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Miroslav Mateev
Jennifer Nightingale *Editors*

Sustainable Development and Social Responsibility —Volume 1

Proceedings of the 2nd American University in the Emirates International Research Conference, AUEIRC'18 – Dubai, UAE 2018

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Editors

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Preface

The 2nd American University in the Emirates International Research Conference (AUEIRC) was held on November 13th–15th, 2018 in Dubai. It has become one of the major events of the year in the field of sustainable development and social responsibility. AUEIRC'18 was organized under the patronage of His Excellency Sheikh Nahayan bin Mabarak Al Nahayan—Cabinet Member and Minister of Tolerance, United Arab Emirates. The conference had served as a platform for academicians, practitioners, scientists, and decision makers from around the globe to engage in a dialogue on some of the most pressing issues in the drive towards sustainable development and social responsibility. The proceedings will be published in the Advances in Science, Technology & Innovation book series of Springer.

AUEIRC'18 highlighted the various aspects of sustainable innovations, smart technology, education and sustainability, human security and legislation, and creative business that can scale for the benefit of communities. The scope of the conference included a broad range of topics in different areas of sustainability that impact contemporary society. The AUEIRC International Scientific Committee comprises over 60 international experts in various fields as per the themes of the conference. The conference keynote speakers were highly profiled experts and researchers, more specifically: H.E. Dr. Rashid Alleem—Chairman of Sharjah Electricity and Water Authority (United Arab Emirates), Prof. Yousef Al-Assaf, President of Rochester Institute of Technology—Dubai (United Arab Emirates), and Dr. Toufic Mezher—Professor of Engineering Systems and Management, Khalifa University (United Arab Emirates).

It has received 164 abstracts and 103 full papers from 33 countries in six different tracks, namely Sustainability and Smart Business, Sustainability and Smart Technology, Sustainability and Creative Industries, Sustainability and Social responsibility, Sustainability and Education, Sustainability, Human Security and Legislation.

The panels were divided based on tracks and all papers were presented in 24 thematic sessions. Each session had a chairperson, while each paper had a discussant. A double-blind peer review process enabled 87 full papers to be accepted for publication (in two edited volumes) by Springer.

On behalf of the AUEIRC 2018 Steering Committee, we would like to thank all the referees, track chairs, discussants, and paper authors. Special thanks to Prof. Muthanna G. Abdul Razzaq (Conference Chairperson), who contributed all resources at his disposal to ensure the high standard of the conference. We also thank the American University in the Emirates (AUE) Provost, Prof. Abhilasha Singh, for her contributions and for attending all the meetings to guarantee that the conference is on track. We likewise extend our gratitude to the Chairman of the AUE Board of Trustees, who was present on campus during the conference, for his valuable support. We also thank the members of the conference steering committee for their hard work, dedication, and continuous support throughout the preparation and implementation of the conference's activities. Moreover, we are grateful to the event management, information technology, auxiliary services, media, security, public relationship, and protocol teams. We likewise extend our thanks to all faculty and staff members from different committees for their support in organizing the conference and ensuring its success.

AUEIRC'18 enabled undergraduate, graduate, and Ph.D. students from different academic institutions to participate in the conference and share their research achievements with an international community of academics and industry experts. Ten papers in total have been presented during the first day as part of the Master/Ph.D. session. Two papers presented by postgraduate students received the Best Paper Award: Ms. Noha Abd El-Rahman from British University in Egypt (BUE), Ph.D. student, for her research paper: "The Assurance of Sustainability Reporting: An Extra Fee or A Guarantee", and Ms. Wafa Aldamegh from Imam Muhammad Ibn Saud Islamic University (Saudi Arabia), Master student, for her research paper: "T-Mix a Threshold Based Cryptography Mixing Service Based on Mixcoin".

Overall, AUEIRC'18 was a high-quality event with remarkable success, although you must judge this matter for yourselves. We are optimistic that you will enjoy reading the collection of papers included in this book.

Dubai, UAE — Prof. Miroslav Mateev
Slippery Rock, PA, USA — Dr. Jennifer Nightingale

About this Book

The book presents high-quality research papers presented at the 2nd International Research Conference, AUEIRC 2018, organized by the American University in the Emirates in Dubai on November 13th–15th, 2018. The book covers all dimensions of sustainable development and social responsibility, and is broadly divided into two sections: Sustainability and Smart Business, and Sustainability and Creative Industries. Sustainability and smart business track covers areas such as risk assessment in agriculture, measurement of financial and assets performance in agriculture firms, corporate social responsibility and the role of intermediaries, the impact of privatizing health insurance, political events and their effect on foreign currency exchange, the effect of sustainable HR practices on financial performance, gender inequality in the MENA economies (panel data model), sustainable marketing in the Era of Industry 4.0, micro-enterprises as a tool to counter unemployment, the impact of financial education and control on financial behavior, a comprehensive strategic approach to sustainability in the UAE, sustainability and project finance, HR analytics (FAD or fashion for organizational sustainability), conceptual framework of sustainable competitive advantages, psychology of organizational sustainability, Blockchain technology and sustainability, institution building (analysis from emotional intelligence perspective), virtue ethics, smart technology, and sustainability. The track for sustainability and creative industries covers sustainable concrete production using Ceramic Waste Powder (CWP), producing green concrete by using bicycled materials from UAE, occupants' behavior and energy usage in Emirati's houses, a design chart to determine the sizing of vertical windows for day-lighting, the effect of shop lighting on the consumer behavior, multimedia applications in digital transformation art, private initiatives versus state intervention in downtown Cairo, experimental sustainable practices in fashion education, technology-assisted student-centered learning for civil engineering, 10-step design process for architectural design studio.

The papers in this book present novel and original research work, findings, and practical development experiences. The papers discuss many real world complex problems that cannot be easily handled with traditional methods. The exact solution of the problems at hand can be achieved with innovative approaches and sustainable business practices.

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A 10-Step Design Process for Architectural Design Studios

Tarek Galal Abdelhamid

Abstract

In most architectural schools, Design Studios Architectural design is usually a process in which there is no clear methodology or scientific step-by-step process that should lead the student to a design acceptable to his instructors. This paper suggests a systematic method that reduces studio design to a clear process that should lead to what can be a better design output in a shorter time. This method is for beginner to intermediate level design studios. We will first describe and analyse the issue, then we will explain the proposed process in detail, then a brief report is given on implementation in five different case studies, ending with recommendations on how to make the best use of the process.

Keywords

Design education • Design process • Design methodology • Architectural design • Design techniques

1 Introduction

Architectural design can be considered a problem-solving activity in which the student is required to generate a solution in the form of a building, which will satisfy a specific program to fit a specific site for specific users to perform specific functions and activities on that site, using a process (a series of steps) to finally communicate his final solution in universally accepted presentation methods. All over the world, the method of this problem-solving activity in almost all architectural schools is the Design Studio, making it the core of Architectural Education (Salama 1995; El Nachar et al. 2008; Bas Leurs 2014). Although mostly unwritten, this method with its undocumented process creates what has been called a "Design Culture" for each Design Studio, with almost all basic knowledge and practice of architectural design being learnt in the studio within that Design Culture. It is the main part of the academic culture and education of the architect in those institutions, a practice that is standard worldwide in all schools of architecture (AIAS 2002, 2008; Salama 1995). Architecture students allocate 39–58% of their time to Design Studios and Architectural Design, making it the "single largest component of the curriculum" (Wallis et al. 2009: 2; Salama and Amir 2005) and the major subject of their education (AIAS 2002).

Most Architectural Design Studio cultures are based on the French "Beaux-Arts" method of architectural education, which started the formal education model of architects. This was started in the Ecole des Beaux-Arts in Paris established in the mid-nineteenth century (Mahmoodi 2001; Draper 1977). The studio method has been further modified by the concepts of the early twentieth century Bauhaus (1919–1933) education that was established in Germany then taken by its immigrant instructors and graduates to the US, then by academics returning with their PHDs from their studies in the United States and Europe to all other schools all over the world (Barrada 1986; Salama 1995). The studio design methodology and process, usually unwritten and part of the culture, is quite similar in most architectural schools, with varying degrees of focus on structure, and technology, depending on the school and year. This has become the worldwide standard traditional studio teaching method. There are positives and negatives when considering different design studio approaches when assessing traditional studio teaching as surveyed from the literature (Salama 2005; Wallis et al. 2009). Although the system remains the same, the practices and shortcomings differ with the times, as seen in numerous examples given by Salama (1995). As of 2005, it is a requirement of universities in the US to have their own written "Studio Culture Policy" manual as part of their accreditation, e.g. Cornell (n.d.), however, such a policy is

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not a requirement elsewhere, and is usually very flexible and general to accommodate different methods of teaching.

For the schools of architecture in Egypt (Salama and Amir 2005; Barrada 1986), design studios follow the same worldwide trend, including variations depending on factors such as the design year and professors in charge, with a concentration on the final finished presentation of the project. The old established schools (Cairo, Ain Shams, Fine Arts and Alexandria) have their own clear "studio culture", while some relatively new schools of architecture, whether in the governmental or private sector, may not yet have a consistent and clear "studio culture". Time and continuity will eventually foster a culture similar to that found in the older established governmental universities, giving those architectural schools a clear studio culture of their own.

The aim of this paper is to suggest a systematic method that should take out the mystery from architectural design and reduce it to a process that if followed should lead to what can be a better design output in a shorter time. We must differentiate between what we mean by Design Methodology and the Design Process. There are several definitions for methodology in the literature (e.g. Lidy 2006; Cross 1984); however, we can define Design Methodology as the general method that if followed should lead to an acceptable design solution, while the Design Process is the actual steps taken to implement that methodology. In some design studios, both the methodology and process are clear and can be easily followed; however, we can note that quite often, even if there is a Design Method and culture, the Design Process itself may not be there, can start clearly but then becomes vague, or there is no consensus on how it will continue to final completion. In my quest for a suitable design process for students of architecture, numerous design methodologies were surveyed. It is obvious that there will never be a consensus on one design methodology or process. Consequently, this paper proposes one process that can be used as one step for further development, especially that with the different digital design workflows available, having a clear specific design process is no longer a luxury but a necessity (Agha Khan 1986).

2 Engineering, Studio Culture and Design Process of the Study

In Egypt, just as in some other parts of the world, the School of Architecture is part of the Faculty of Engineering. Usually, first-year students study general subjects of engineering with no concentration, and then they specialize for four years in the branch of engineering of their choice, with variations (von Meiss 2002; Agha Khan 1986). However, for students in their first year of specialization in Architectural Engineering, Architectural Design in that studio format is markedly different from other subjects studied. When Architectural Design as a discipline is taught as part of engineering, this suggests a "scientific" paradigm; however, we find that it is not addressed in the same way as other topics being taught in engineering, or as what was taught in high school, with mathematics and physics concentrations.

Especially for the first three years of design studios, there is usually no clear methodology that if followed will lead to a solution to the design problems offered. The scientific paradigm and scientific methods that are the hallmark of engineering education are suddenly missing. Instead, there is a "studio culture", implicitly including a methodology. With variations, most are based on a "site analysis/zoning/schematic plan" design method. The exact process is usually general and sketchy. For the final and fourth design studio year, the student usually has gained enough design and studio experience to be able to handle the design task.

In the traditional Design Studio, architecture is taught and learnt by doing and learning in a master/apprentice relationship, creating a dialogue from which both learn. Trial and error is of paramount importance, with numerous iterations till an acceptable solution is reached. The process is also collaborative, relying also on peer to peer learning, cooperation, criticism, sharing and competition. Students learn by trial and error, by criticism, by doing "and instructors function more as coaches than as teachers. In the early stages of the practicum, confusion and mystery reign that is mediated by a distinctive dialogue of student and coach in which description of practice is interwoven with performance" (Hill 2007). In the Design Studio, the basic tool between professor and student is the "critique", where the student brings his work and the professor critiques it, usually in a group, but provides one-on-one interaction (Smith and Boyer 2015; Goldshmidt et al. 2010). One categorization of design approaches identified two basic methods for Design Studios: the rationalist approach (systematic and functional) versus the expressionist approach (intuitive or artistic or creative skill) (Bashier 2014).

New Architectural Engineering students whose focus of study since high school was based on a concentration of mathematics and physics, experience frustration and loss due to lack of understanding of the scientific steps that should be followed to reach a design "acceptable" by their teachers in the Design Studio. The problem of lack of a non-specific "scientific method" or a "design process" that can be applied to architectural design becomes only too evident when the student is "stuck" with no solution to his architectural design problems (Sachs 1999). He can't find nor is he given a clear and standard process that if followed would lead him out of his problems. There are no "theorems" or "formulas" or laws to help him. The "methodology" taught does not help him. The number of variables, variations, styles and correct solutions is overwhelming to the student, with no clear

process to reach a solution, and a "mystification" of the design process ensues. There is always the frustration of the lack of logical steps that if followed would eventually lead to one if not several solutions. The problem is compounded by the rigid hierarchy of professors and jurors who behave as if they are the sole judges of knowledge of what is "architectural design", adding to the mystification of the process.

A specific "design process" is not yet part of the "design culture" of most schools of architecture in Egypt and elsewhere, in-spite of the existence of "design methods". Except for rare examples, absence or existence of a clear process for architectural design has not been considered as a factor in the education of the architectural engineer, or in the points of action that have been suggested to address problems of architectural education. The dominance of the traditional "design studio culture" and the "myths" prevailing in every design studio has been an accepted part of architectural education worldwide. This traditional lack of a clear problem-solving "design process" for Architectural Design as taught to students in Architectural Design studios was not addressed until the 1960s. Until now, there is simply no clear consensus on the "design process" for the architectural studio. Few instructors teach their design students a method with clear steps and guidelines that remove the mystery out of architectural design. Even the written "Studio Culture Manual" of US schools of architecture is too sketchy and flexible to be put to practical use as a design "process". With the boom in architectural schools in private sector universities and institutes in Egypt, addressing this issue is now becoming a necessity.

3 The Proposed Design Process

3.1 Theoretical Framework

The process being proposed is based on some of the ideas surveyed above, and is limited to the design phase, and will not continue to the design-build cycle. The proposed process can be considered a variation on the basic "Analysis, Synthesis, Appraisal then Decision" method.

The proposed process makes use of case studies (architectural history), the use of patterns (Alexander 1964), the use of sketches (Laseau 2001), the use of generating concepts (Lawson 1980; Gero 1997), the use of models (Salama 2005; Asfour 2011), the inclusion of user needs and requirements (Dubberly 2004; Sanoff 2000), lectures, personalization of the design process and presentations by the student and other ideas (see Mcallister 2010; Nabih 2010), plus my own experience.

Sketching and drawing are an integral part of this process, since it is considered an integral part of architectural design thinking. Sketching is a "problem-solving heuristic procedure" (Goldschmidt 1992) that is employed to enhance visual feedback, with information being read and design reasons are derived from the sketch image (Brawne 2003). Sketching and drawing are of paramount importance in our proposed design process. Drawings are "the designer's principal means of thinking" (Herbert 1993). A sketch is a type of "shorthand reference" which can be elaborated upon when developed and combined with other elements (Graves 1997). The sketching of a designer explores an analogy thus restating the design problem for further design development (Oxman 1995). Different drawing types and sketching techniques have been shown to influence the making of architecture (Herbert 1993; Fraser and Henmi 1994; Robbins 1994), thus sketching and drawing are both an integral part of this process.

Using digital techniques as a complement to this manual method is part of a "mixed media" approach, with the sketching as a basis for further development using computer-aided drafting (CAD) systems. Integrating available digital resources in the use of CAD in the production of drawings, sketches and visualization together with traditional methods like scale models and hand-rendered sketches is encouraged in this process, especially in the formative steps of concept generation and modelling. This "mixed media" approach has been shown to give better results in perception of spatial qualities and understanding the design problems (Nassar et al. 2010; Shih et al. 2015). The use of digital techniques has been shown to have a positive effect on both the creativity and productivity of students (Farghaly 2006). The investigation of the correct mix of traditional manual methods with digital techniques ("mixed media") (Shih et al. 2015) warrants more research, and with the current rapid pace of change in the technology there are ever-increasing options available. Whether freehand, by a 2D or 3D CAD program, or "mixed media", sketching the ideas during the design process is an integral part of our proposed "10-step design process".

It has been noted that some problems associated with design are a result of architects not studying the user requirements enough and not generating a design that will cater for those requirements, with lack of investigation of the design problems and program, giving theoretical solutions to real-world problems. As has been observed, "formal abstraction in design only distances students from their physiological understanding and engagement with the real world" (Salingaros and Masden 2010). Research of the site, program and user requirements are a core part of the proposed process, in addition to the reliance on case studies of similar projects or similar details or subcomponents of the project. Thus, an integral part of the process is studying the site, program and user requirements. Reliance on theoretical forms and projects to solve real-world problems for real people with specific requirements is counterproductive, since

it will lead to theoretical solutions and architecture that people can't use nor relate to.

Acknowledging Darke's "primary generator" (Lawson 1980), an integral part of the design process is the sketching and documenting of a Conceptual Statement of the design idea (see Duerk 1993). The verbal description of the concept of the project is of paramount importance, since that basic verbal statement is the main method of communication with future clients. The student must be able to vocalize the concept behind his project, the driving force of his design. Once he can do that, all his other skills and efforts can be focused on achieving that concept and vision. A compact summary of the process must be written down in a clear and compact statement. A sketch explaining the concept is essential for a clear explanation of the idea. This written statement, sketch and schematics become the driving force behind the design, the main generating concept, an integral part that forces the student to clarify his project and add detail. A simple sketch outlining the idea with the main components of the design and how they will fit together should suffice, together with the verbal statement. Building on the conceptual statement, the use of study models to explain the design concept (physical or digitally generated 3D CAD models) becomes an integral part of the proposed process. Simple physical models of cardboard, Styrofoam, clay, modelling clay, or other materials are usable, with the suitable medium used for the suitable form or style (Mills 2005). 3D CAD software that can be used for rapid generation of 3D masses is now standard, with packages like Sketchup, 3DMax, Autocad and many others available and with a relatively short training time can be used for generation of study models. Proficiency in the use of such software is now a basic skill that most students are forced to master.

Based on studies of patterns and precedents from the history of architecture, the proposed process relies heavily on the study of precedents of similar projects, or of precedents of details for the design and style. Since we can consider architectural design as inventing form in response to function and context, collecting and providing good design and patterns can stimulate good design solutions (Alexander 1964). The use of patterns and pattern types through the collection of style of architecture in projects and in details is a core requirement of this proposed design process. This can only be achieved by looking at similar precedents from the history of architecture and similar examples of whole buildings, segments of buildings or different architectural details. Building on precedents and patterns, the integration of case studies like the problem being designed is an integral part of the process. History of Architecture is filled with ideas and parallels of similar designs or design ideas that can be used or from which inspiration can be drawn to help solve the design problem or copy old solutions to new problems. Rather than reinvent the wheel, case studies of similar designs and design solutions are a prime generator of new design solutions and form an integral part of the process. Many students do not acknowledge this and attempt to consistently reinvent the wheel with usually pathetic results. The simple and logical fact is that rather than reinvent the wheel repeatedly, students can learn from architectural history and develop new forms or get inspiration from the creative work other architects have built. This is a practice that both History of Architecture instructors and Architecture Design instructors should clarify to their students. The importance of the History of Architecture and accumulating a suitable vocabulary that can be used in architectural design is of paramount importance and should be conveyed to the students. Architectural Design and Architectural History are quite interrelated and complement one another, a fact that most architectural students tend to ignore.

For the final stages of the process, the conceptual model is converted into a detailed zoning diagram to ascertain that all functions work together, then inserted to scale in the layout then converted to a single line diagram (plan with single lines) which is then converted into a regular plan with proper wall thickness and other graphic requirements. The use of a 3D digital CAD model should be the outcome of this suggested process. Currently and with the resources available to the architectural student, it is no longer acceptable not to generate an accurate 3D virtual digital model of the design. As a further development of the design, the creation of a BIM model should be encouraged. BIM packages are now becoming standard, and from the BIM model all required documentation can be produced. Once an architect has created a 3D BIM model, then he has a buildable design.

Although the process is offered as clear steps that appear linear, yet the process is cyclical, with steps possibly skipped then revisited. However, whenever parts of the problem are not solved, going back to the linear process and retracing the steps to discover what was missing offers a sure way to set the student back on track in finding a solution to the parts of the problem.

3.2 Description of the Process

The 10-step process suggested is as follows:

1. Program Overview, with case studies and design standards.
2. Site Analysis and User/Social Aspects Analysis.
3. Program Development and Areas Checklist.
4. Functional Diagram.

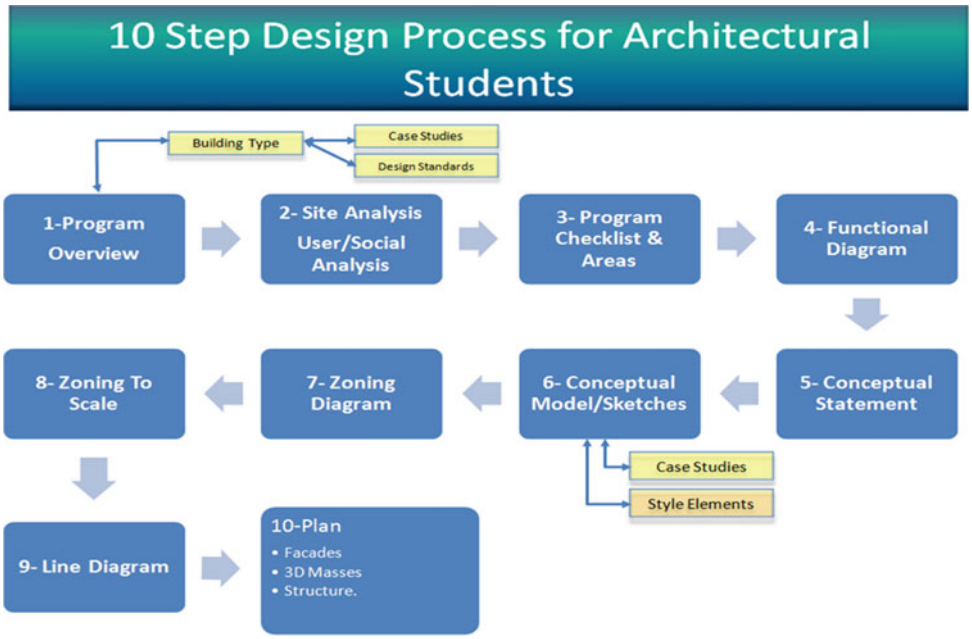

Fig. 1 Flowchart for the 10-step design process

5. Conceptual Statement with a conceptual diagram.
6. Conceptual Model/Sketches with case studies of similar concepts.
7. Zoning Diagram.
8. Zoning Diagram to Scale.
9. Generation of a Line Diagram.
10. Generation of a Plan as a basis for a 3D model (Fig. 1).

Several intermediate functions are required in addition to the main steps. Although the process relies on a 3D conceptual model for the initial design, yet the final product is generated from a plan as the basis for a 3D model for the design. The plan has always been a fundamental tool for design, which continues to be so in this proposed process, and a generator of the final design (Brawne 2003). The process may require numerous iterations or may require going back one or several steps to complement missing issues. It must be noted that "jumping" from one step to the other undermines the value of the process and should be discouraged. However, jumping back is always possible to retrace the process.

The following describes each procedure in detail.

4 The Process in Detail

4.1 Program Overview

In this stage the design studio faculty suggests a program with specific requirements for a specific site as the studio project. Designing the program is of paramount importance, so should be the choice of the site. Ambiguous or unclear requirements should be avoided. Careful reading of the program is required, and from that the following research and outputs should be collected:

- Case studies of similar building types.
- Architectural standards for the different functions of the programs for that specific building type.

4.2 Site Analysis and User/Social Aspects Analysis

Site Analysis: sun/wind/topography/views/vegetation/context/access/traffic/site constraints/building envelope/building regulations/sustainability analysis/environmental impact/lines of sight…etc. and other aspects of the analysis of the site.
User/Social Analysis: Types of users, category of users, median income, targeted users, users demographics and age, user expectations of building activities and use, function and performance of the building, impact of the building on the environment, environmental performance of the building, other social aspects of the intended function of the building.

4.3 Program and Areas Checklist

Based on the preceding steps, a checklist of all the spaces required in the building that are to satisfy the user/site/program is to be prepared with approximate areas to reach an

approximate total project area and determine the number of floors and how the building will fit within the site and the building envelope, within the constraints of building regulations and law.

4.4 Functional Diagram

This diagram determines the functional relationships between the different elements of the building, determining the strongest and weakest relationships between the functions and its spaces. It is usually done using blocks to indicate the different spaces with solid lines connecting the main and direct relationships between the spaces, and dotted lines to indicate secondary relationships.

4.5 Conceptual Statement

A 3–5 line statement should be written explaining the concept or main idea behind the design that is to be proposed. This is of paramount importance and will be the driving force behind the design. Failure to summarize the idea indicates that a solution to the architectural problem offered has not been reached yet in the perception of the student. The statement can be as general as "courtyard house in an Islamic style, introverted with a clearly Islamic character" or "a modern style rectangular house with a double height living area opening onto terraces and the swimming pool and garden" or "replicating an organic form in the shape of the building" or any other statement that will summarize the basic idea behind the design. Part of that verbal statement, sketches or schematics may be added to clarify the concept, with additional sketches to outline the relationship between the physical form and concept with the main components of the design.

4.6 Conceptual Model/Sketches

To explain the conceptual statement mentioned above. A scale model of the proposed masses should be created by the student. The introduction of the third dimension in this stage is important as a test if the concept will work within the building envelope. Form is also determined within which the functions will be later fitted, determining the entrances/exits, overall building size and components. 3D sketches can be used or other sketches that will clearly demonstrate the concept, however, it is found that a scale model is much more effective, since the students gets a feel of the scale of the project and the dimensions of his building and its relationship to the site. The style of the building is also determined in this stage and should impact the conceptual model and masses. Two further studies must be added:

- Case studies of similar concepts.
- Style elements. The different elements that constitute the chosen style are to be collected.

4.7 Zoning Diagram

This diagram determines the zoning relationships between the different functions of the building based on the preceding steps. The proximity relationships between the zones are to be graphically illustrated as if drawing an actual plan, but not to scale. Usually free forms are drawn to indicate the different spaces with no restrictions to the scale or site dimensions.

4.8 Zoning Diagram to Scale

Fit the zoning diagram above into the site and form to scale.

4.9 Line Diagram

Convert the free drawn forms, drawn to scale in the preceding step into straight/curved single lines with no doors or windows, just simply a line diagram of the plan as reached in the scaled zoning diagram. With this stage, a list of questions must be answered by the student as a checklist, prior to submitting his line diagram, to determine if his design has the elements that will contribute to a working and acceptable design. The checklist should cover the fulfilment of the program elements, the building code and envelope, the existence and clarity of concept, form, functional requirements, correct zoning, orientation, entrances/exits, lines of sight, views, circulation, image, style and structural system.

4.10 Plan

Convert the line diagram into an actual architectural plan, using actual wall thicknesses, doors, windows, stairs, etc. from which 3D masses can be generated, the facades studied and the structure imposed for the design.

This concludes the preliminary process. Further steps for refinement of this preliminary design will be needed, but the basic problems should have been solved. From my experience, such a process was useful to students in reaching a plan with a clear project concept that can be further developed. The checklist for fulfilment of good design practice can be used to cover the basic elements of a good architectural design like and clarity of the most important elements like: concept, form, zoning and functional relationships, fulfilment

of Orientation/ventilation/illumination requirements, clear entrances and exits, clear lines of site to and from the project, clear horizontal and vertical circulation, a clear project image (Edges/Zones/Paths/Nodes/Landmarks), clear style and a valid structural system.

The process is iterative, with return to previous steps as often as needed whenever a change or lack of study of an element requires a revision to retrace the steps then follow the path again.

5 Case Studies: The Process in Practice

The process has been tested in five different design studios in two separate private sector universities in Egypt in Spring and Fall semesters of 2016 and 2017 for second- and third-year architectural design students. In both universities, class sizes averaged 30–45 students, with one or two professors and 2–4 teaching assistants. Also, in both universities, the students were taught in previous design courses using the following methodology: site analysis, standards, zoning, then the first sketch plan, with a weekly session where student submissions are critiqued with a professor or a teaching assistant. A final jury, usually with the participation of external jurors finally evaluates the projects at the end of the semester. This roughly summarizes the "studio culture" of both universities. The studio topics varied: elementary school, mixed-use complex (5-star hotel, mall and office building) and three variations on an Islamic centre (central mosque plus different facilities). For those studios, the proposed "10-step process" was explained, then enforced with each week the students being graded on the work submitted according to the process steps, which the students were required to pass through in weekly stages, reaching a line diagram by week 5 of the semester, with weeks 5–9 for design development, week 10 for the final sketch and final jury was to be in week 11 (Figs. 2, 3, 4 and 5).

From the above five case studies using the process, the following was noted:

- The process is cumulative with each step building on that before it. It is recommended not to skip steps, and if any steps are skipped then they should be retraced.
- The process must be clearly explained to the students and they must be reminded several times of what the steps are and that if they are missing any steps then they should go back to complete them.
- The students must also understand the importance of each step and be attempted to see how each of the steps serves as input towards the overall design.
- All instructors in the design studio must clearly understand the process and should be asked to enforce each step. If the instructors are not convinced with the process or offer contradicting instructions that do not follow the sequence, then there will be little or no benefit from this process.
- Instructors must strictly follow each step and enforce that each student is not submitting work just for grades, but that the work submitted is used in each subsequent step by continuously asking how each step was affected by the step before it.
- The integration into the design of the lessons learnt from the case studies chosen by the students when they are studying similar projects is a tool should be focused upon and used as a source of correction of their designs.
- For most students, the use of physical models proved to be a great aid in giving better visualization and understanding of the site, scale, mass, form and concept than digital 3D models, especially in the early stages of the design during concept formation.

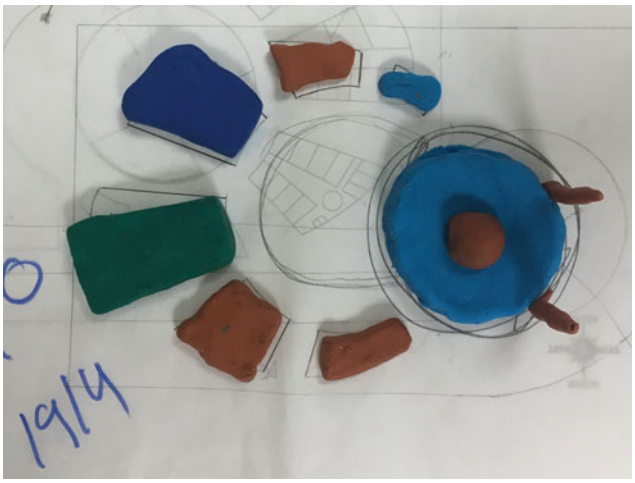

Fig. 2 Conceptual model created by a student in the studio based on the critique

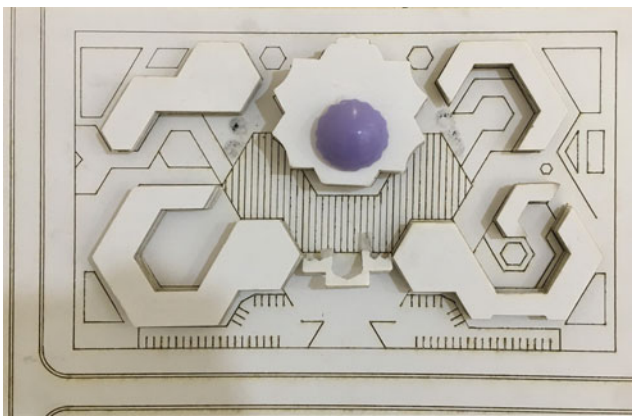

Fig. 3 Cardboard study model of another project in its final stages

Fig. 4 Final 3D rendering of the same project

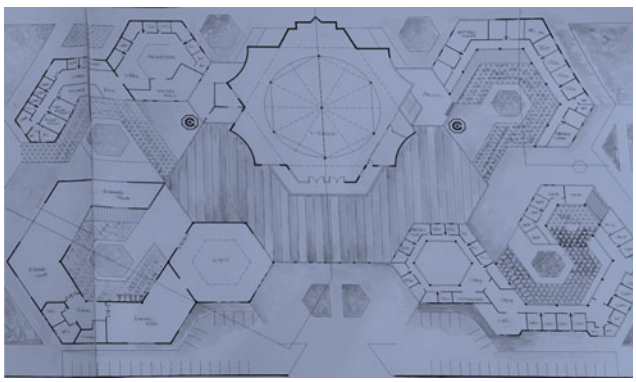

Fig. 5 Final plan of the same project, CAD drawn but manually rendered

- Mixed media techniques were shown to give great benefit for reaching a design solution and for final presentation.
- History of Architecture and examples of similar buildings, details of buildings, facades, etc. are an integral part of the process and the students should be reminded of similar buildings they can draw inspiration from.
- Depending on the type of project, different steps in the process can be more critical than others. Each step of the process builds on the one before it and contributes incrementally to the final design.
- Different steps in the process will vary in importance and become the "critical step" without which one can't continue to design successfully. Sometimes relationships of masses and forms can be the determining factor for the success of the project, especially for projects with separate functions. For complex projects in which functionality and relationship between the different components of the project is important, design standards and functional relationships become a critical step that if not correctly studied will adversely impact the design leading to a non-functional building. However, for most students, the bottleneck in the design process for most projects is the conceptual statement with its explanatory sketches and/or 3D models. It is a "critical point" or "watershed task" that must be crossed successfully before any design can be reached.
- The checklist of design clarity and quality with the submission of the line diagram is of paramount importance, and every student should be trained to go through it prior to submitting his design for a critique.
- It must be noted that regardless of the design methodology being used, the instructor experience, student responsiveness and capabilities and the overall atmosphere and chemistry between the students and instructors are major factors that can't be factored into any design process.

6 Conclusion

This 10-step process forces the student to approach the design problem in a systematic way, with clear steps that if followed correctly should lead to an initial preliminary design that correctly addresses the design problem. The process suggested here is limited to the Preliminary Design phase for use in an architectural studio in an academic environment. The process forces the student to better understand the user requirements and fulfil the program or adapt it to fit the user requirements based on the sociocultural needs of the user. Forcing the student to do the necessary background research for the design problem offered will give the student a better understanding of the problem and the constraints of the solution. Inherent in the process is the consideration of case studies and patterns of solutions that can inspire and direct him to solve the problem offered. Drawing from History of Architecture courses and examples of important buildings as inspiration for design solutions or details or forms is an important part of the process. The wording of a conceptual statement for the design coupled with a schematic conceptual model explaining the idea with the different project components and their general overall relationships is of paramount importance in the process, without which the student should not be allowed to proceed. Zoning diagrams that are converted to a simple single-line plan that is developed further is the next step in the process, giving the basis for a final 3D digital model. Depending on the project, it was found that some steps may be more critical than others, creating a bottleneck or hurdle that must be successfully crossed or else the student cannot generate a valid design. The

massing/schematic step (step 5) and the zoning to scale step (step 8) are perhaps the most critical; however, they cannot be skipped to without following the other preceding steps, even in a truncated and concise manner. The design checklist was very helpful and important. Even if the process was not followed to the letter, or some steps truncated or merged, it was found that the existence of a checklist with the process forces the student to organize his thinking and leads to design solutions at a faster rate than having no methodology at all or relying on a trial and error process or expecting divine inspiration for his design. Instructor experience and commitment to the process is a major part of the process, while student responsiveness and capabilities are major factors for the success of any methodology, with individual differences taken into consideration.

It is my hope that with more focus on defining a clear "Design Methodology" with a clear step-by-step "Design Process" into the "studio culture", the quality of designs generated from the design studio would be better, dissipating the "mystification" of architectural design. This will provide a better learning experience for the soon to be architect, allowing him to learn an orderly and systematic way to approach architectural problems and eventually create better architecture that addresses the socio-economic and aesthetic needs of his clients and environment, while still satisfying the best practices of his chosen profession.

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A Design Chart to Determine the Sizing of Vertical Windows for Daylighting

Shady Shawky Saifelnasr

Abstract

The main objective of this paper is to introduce a simple quick tool for architects represented by a design chart that determines the sizing of vertical windows for providing minimum or average amount of daylight as a function of the properties of the window, the room, and the surrounding environment. One of the most important purposes for introducing windows to a building envelope is providing adequate daylight suitable for the different uses within the different functional spaces. And daylighting might be one of the main reasons for the sizing of those windows. Different calculation methods could be used for daylight calculation and analysis; formula methods, graphical methods, scale models, and computer programs. Although formula methods are not the most accurate daylighting calculation method, they could be used as a rule of thumb especially within the preliminary stages of design. The proposed design charts are derived from formula methods to be used by architects as a simple quick tool that could be used for both design and analysis. They could be used within the design process by finding the sizing of vertical windows. Moreover, they could be used in the analysis of an existing case by finding the available daylight factor. The design charts are a combination of more than one graph to include most of the specifications of the window, the room, and the surrounding environment, to find the sizing of vertical windows, that would ensure the minimum or average amount of daylight for any city all over the world, within the low, middle, or high latitudes.

Keywords

Design charts • Sizing windows • Daylighting

1 Introduction

As a valuable building asset, a window can provide several functional aspects such as daylighting, natural ventilation, and/or views (Friedman 2012). And the window sizing could be a result of one or more of those aspects. But conflicts with other building systems should be considered while sizing a window, e.g., oversizing a window can increase unwanted heat transfer, i.e., increase heat gain during summer and increase heat loss during winter (Lechner 2008).

In this paper, the author tries to represent a quick tool for finding the window area that can provide a minimum amount of daylighting needed for most basic applications.

1.1 Nomenclature

DF	Design Daylight Factor[1] (Pohl 2011) %
τ	Transmittance of Glazing[2] (Phillips 2004) %
R	Average Internal Surface Reflectance %
θ	Sky Exposure Angle °
W	Window Area m^2
A	Floor Area m^2
ΣA	Total Area of Internal Surfaces m^2

1.2 Background and Previous Studies

Previous studies proposed methods of sizing for daylight apertures in the form of tables or graphs. Those tables or graphs were either designed for a specific location, i.e., city, or they were for studying the effect of certain specific

[1]The daylight factor (DF) expresses the daylight available as a percentage of the daylight concurrently available out of doors.

[2]Glazing is a transparent material used for windows for the admission of light, e.g., glass. There are basically three types of glazing, namely, clear glazing, tinted glass, and miscellaneous glazing, e.g., patterned glass, wired glass, laminated glass, glass blocks, and high-tech glazing.

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variables that might affect the sizing of such daylight apertures, e.g., the effect of the reflected component in clear sky climates (DeKay and Brown 2014).

In this paper, the author tries to represent a quick tool to determine the sizing of vertical windows for daylighting. Unlike other studies, the proposed method of sizing vertical windows could be characterized by being simple and more generic.

The simplicity lies in describing the sizing of vertical windows as a percentage of a single variable which is the surface area of the room; floor area or total area of internal surfaces, while being more generic because it is in the form of a design chart, which in turn makes it applicable for any location, i.e., city, within the low, middle, or high latitudes.

1.3 Main Objective and Hypothesis

The main objective of this paper is to introduce a simple quick tool for architects, represented by two design charts[3] used to determine the sizing of vertical windows needed for providing an adequate amount of daylight as a function of the properties of the window, the room, and the surrounding environment.

The main hypothesis of this paper is to investigate the possibility of using a quick rule of thumb to find the surface area of a vertical window for daylighting as a percentage of the floor area or the total area of internal surfaces. This could be done using the proposed design charts that use graphs signifying most of the different variables that affect the amount of daylight entering a given room. Those design charts could be used for both design and analysis; design by finding the surface area of the window needed to provide an adequate amount of daylight, while analysis by calculating the amount of daylight in a room resulting from the existence of a window or more with given surface areas.

2 Methodology

In this paper, in order to carry out the aimed design charts, a number of calculation methods were used associated with some simplifications and assumptions as follows.

2.1 Used Calculation Methods

Different calculation methods could be used for daylight calculation and analysis; formula methods, graphical methods, scale models, and computer programs. Although formula methods are not the most accurate daylighting calculation method, they could be used as a rule of thumb especially within the preliminary stages of design. The proposed design charts; the first and the second are derived from the following formula methods one and two, respectively (Reid 1988).

$$\text{Formula 1: W} = \frac{4 \times \text{A} \times \text{DF}\%}{\tau \times \theta}$$

$$\text{Formula 2: W} = \frac{2 \times \Sigma\text{A} \times (1 - R) \times \text{DF}\%}{\tau \times \theta}$$

Those proposed design charts could be used by architects as a simple quick tool for both design and analysis. They could be used within the design process by finding the window area (W) needed to provide adequate amount of daylight as a percentage of the floor area of the room (A), i.e., as a ratio (W/A), as in the first design chart, or as a percentage of the total area of the internal surfaces of the room (ΣA), i.e., as a ratio (W/ΣA), as in the second design chart. Moreover, both design charts could be used in the analysis of an existing case by finding the available daylight factor (DF).

2.2 Simplifications and Assumptions

Some simplifications and assumptions are considered in the first and second design charts concerning the effect of the different variables and their applicability.

According to Corrodi and Spechtenhauser (2008), the quantity of light provided by a window depends on different variables. These variables involve the properties of the window, the room, and the surrounding environment. Window properties include size, position, and shape. Room properties include size and geometry, i.e., proportions of length, width, and height. While surrounding environment includes sky cover, amount of illumination, external obstructions, and external reflectance (Kittler et al. 2012).

Effect of window position and shape. Both position and shape of the window affect not only the distribution of light along the depth of the room, i.e., the quality of daylight, but also affects the quantity of daylight. But, since the design charts are derived from formulas, those influences concerning the position and shape of window are neglected.

Effect of the geometry of the room. Both design charts deal with surface areas, either the floor area (A) in the first design chart or the total area of the internal surfaces (ΣA) in the second chart. But none of them considered the effect of the geometry of the room represented in its proportions and ratios between length, width, and height that could be described by a room index.

Effect of external obstructions. In both design charts the effect of external obstructions is included within the chart

[3] A chart is a graphical representation of data.

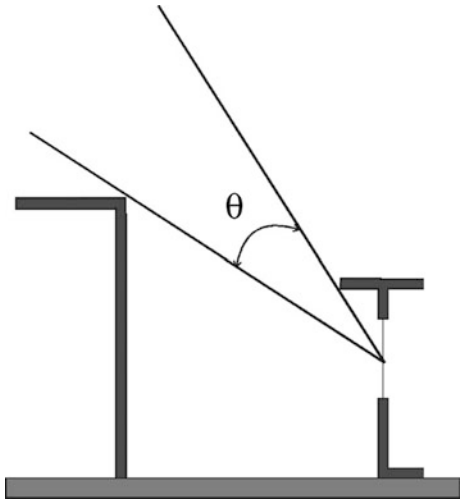

Fig. 1 The sky exposure angle (θ) (The sky exposure angle (θ) is the portion of the sky visible from the center of the window, measured in degrees. It indicates the height and position of external obstructions) (*Source* Saifelnasr 2003)

represented by the sky exposure angle (θ) (see Fig. 1) (Saifelnasr 2003). But the influence of the shadows that might be casted by such external obstructions is neglected.

Effect of reflectance of the external surfaces. The amount of external reflected component (ERC) is a function of the reflectance of the external surfaces that in turn can increase or decrease the total amount of daylight factor (DF) inside a room. The change of that surface reflectance might be a result of changing the materials used in the landscape or the change in the surface reflectance of the external obstructions themselves. That effect is neglected for both design charts because it is not involved in the used formulas.

Effect of reflectance of the internal surfaces. The main difference between the first and second design charts that the average surface reflectance of the internal surfaces (R) is addressed in the second design chart which makes it more accurate than the first design chart that neglects such influence.

Applicability of the design chart. It is applicable for locations with overcast skies. It could be also used for locations with clear skies based on the assumption that the direct sunlight is totally blocked by any means of shading, e.g., using shading devices.

3 Results

Figures 2 and 5 show the two proposed design charts developed by the author using two different formulas. Both design charts consist of a number of graphs[4] combined together, representing the different included variables that affect the quantity of daylight permitted through a window inside a room.

The main difference between them that the formula used in the second design chart acquires an extra variable which makes it more accurate than the first in case of the existence of that variable, which is the average internal surface reflectance (R). Both design charts could be used for design as well as analysis as will be shown in their description.

3.1 Description of the First Design Chart

The first design chart shown in Fig. 2 is a combination of two graphs; the first graph on the right and the second graph on the left.

Depending on the sequence of use of these two graphs, the first design chart could be used for both design and analysis. If it is used in an anticlockwise direction, i.e., the first graph and then the second graph, it is used for design by finding the window area (W) as a percentage of the floor area (A) of the room, i.e., finding the ratio (W/A). While, if it is used in a clockwise direction, i.e., the second graph and then the first graph, it is used for analysis by finding the daylight factor (DF) resulting from the existence of a window or more with given surface areas (see Fig. 3).

The first graph (on the right) determines the ratio (W/A) between the required unobstructed window area (W) and the floor area (A) of the room. The obtained ratio (W/A) is a function of the design daylight factor (DF) and the transmittance of glazing (τ), while maintaining the sky exposure angle (θ) = 90°, and it is drawn using the formula:

$$\frac{W}{A} = \frac{4 \times DF\%}{\tau \times \theta} = \frac{4 \times DF\%}{\tau \times 90}$$

It consists of two axes and a number of diagonal lines; the horizontal axis represents the design daylight factor (DF) needed for most basic applications ranging from (DF) = 1% (for lower latitudes) to (DF) = 6% (for higher latitudes), while the vertical axis represents the ratio (W/A) between the required unobstructed window area (W) and the floor area (A) of the room. That ratio (W/A) on the vertical axis is obtained after intersecting several diagonal lines that represent the transmittance of glazing (τ) ranging from (τ) = 10% (low transmittance) to (τ) = 90% (high transmittance).

The second graph (on the left) determines the ratio (W/A) between the required obstructed window area (W) and the floor area (A) of the room. The obtained ratio (W/A) is a function of the design daylight factor (DF), the transmittance of glazing (τ) and the sky exposure angle (θ), and it is drawn using the formula:

[4]A graph is a diagram representing a mathematical function or formula.

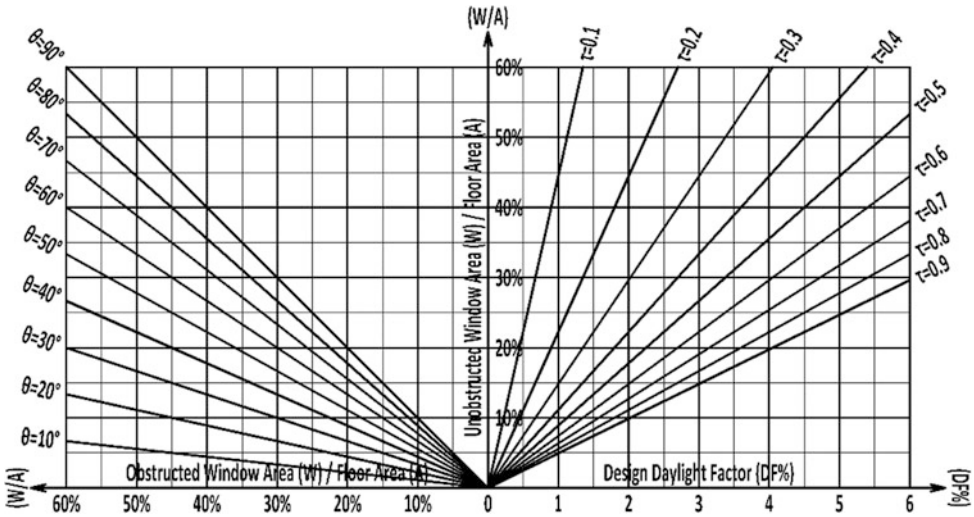

Fig. 2 The first design chart to determine the sizing of vertical windows for daylighting (*Source* The author)

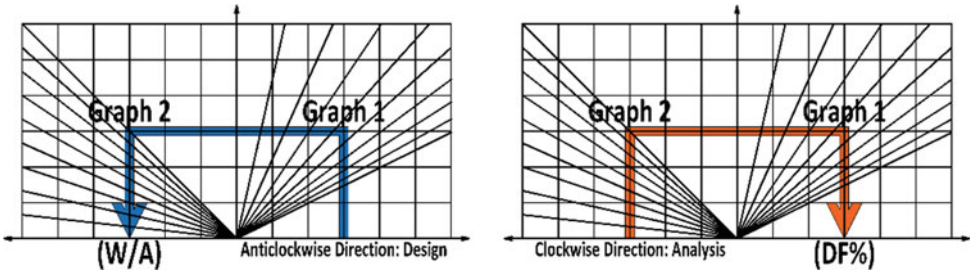

Fig. 3 The first design chart could be used for both design and analysis (*Source* The author)

$$\frac{\mathrm{W}}{\mathrm{A}} = \left(\frac{\mathrm{W}}{\mathrm{A}}\right)_{\text{first graph}} \times \frac{(90)}{(\theta)}$$

It consists of two axes and a number of diagonal lines; the vertical axis represents the ratio (W/A) obtained from the first graph (on the right), while the horizontal axis represents the ratio (W/A) between the required obstructed window area (W) and the floor area (A) of the room. That ratio (W/A) on the horizontal axis is obtained after intersecting a number of diagonal lines that represent the sky exposure angle (θ) ranging from (θ) = 10° (highly obstructed) to (θ) = 90° (unobstructed).

Using the First Design Chart. To find the ratio (W/A). All the graphs of the first design chart are used as follows.

Enter the first graph (at the right) by specifying the design daylight factor (DF) on the horizontal axis. Draw a vertical construction line until it intersects the diagonal lines representing the transmittance of glazing (τ). From the point of intersection, draw a horizontal construction line until the ratio $(\mathrm{W/A})_{\text{first graph}}$ is found on the vertical axis.

Enter the second graph (at the left) with the obtained ratio $(\mathrm{W/A})_{\text{first graph}}$ on the vertical axis. Extend a horizontal construction line until it intersects one of the diagonal lines representing the sky exposure angle (θ). From the point of intersection, draw a vertical construction line downward until the ratio $(\mathrm{W/A})_{\text{second graph}}$ is found on the horizontal axis.

To calculate the window area (W), multiply the obtained ratio $(\mathrm{W/A})_{\text{second graph}}$ by the floor area (A).

$$\mathrm{W} = \left(\frac{\mathrm{W}}{\mathrm{A}}\right)_{\text{second graph}} \times \mathrm{A}$$

To find the (DF). All the previous steps are made in reverse, i.e., entering the second graph at first by specifying the ratio (W/A) on the horizontal axis and then intersecting the different diagonal lines in a clockwise direction (see Fig. 3).

Example Using the first design chart, it is required to design the window sizing for daylighting, i.e., find the window area (W), in the city of Prague, Czech Republic ((LAT) = 50° N), needed to provide daylight factor (DF) = 5%, given that the transmittance of glazing (τ) = 50%, the sky exposure angle (θ) = 80° and the floor area (A) of the room = 20 m^2.

Solution. Enter the first graph (at the right) by specifying the (DF) = 5% on the horizontal axis. Draw a vertical construction line until it intersects the diagonal line representing (τ) = 50%. From the point of intersection, draw a horizontal construction line until it intersects the diagonal line

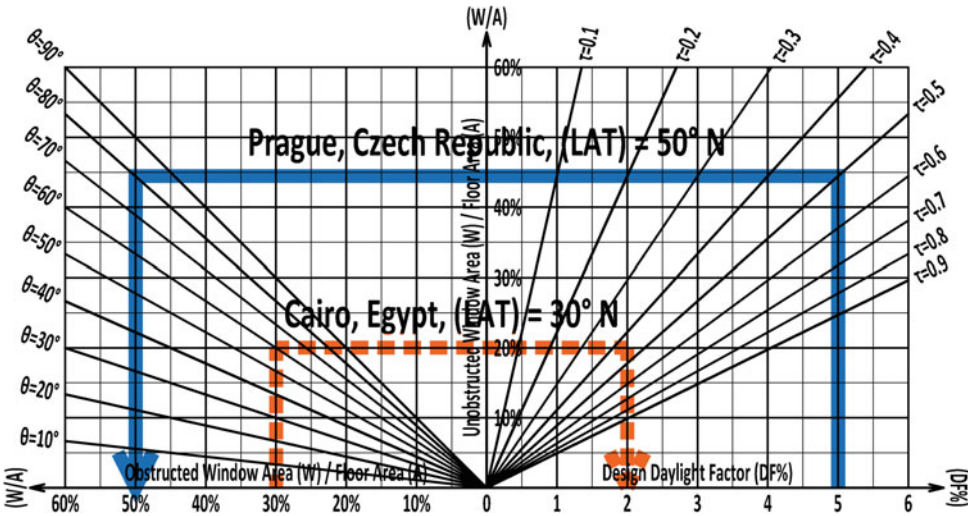

Fig. 4 Examples for using the first design chart in design and analysis (*Source* The author)

representing (θ) = 80%. From the point of intersection, draw a vertical construction line downward until the ratio $(W/A)_{\text{second graph}} \approx 50\%$ is found on the horizontal axis. (see Fig. 4).

To calculate the window area (W) for the city of Prague, Czech Republic:

$$W = \left(\frac{W}{A}\right)_{\text{second graph}} \times A = 0.50 \times 20 = 10\,m^2$$

Example Using the first design chart, it is required to analyze the daylighting, i.e., find the daylight factor (DF), in the city of Cairo, Egypt ((LAT) = 30° N), given that the transmittance of glazing (τ) = 45%, the sky exposure angle (θ) = 60°, the window area (W) = 6 m^2 and the floor area (A) of the room = 20 m^2.

Solution. To find the (DF), in the city of Cairo, Egypt, all the previous steps are made in reverse as follows. Enter the second graph (at the left) at first by specifying the ratio $(W/A)_{\text{second graph}} = 6/20 = 30\%$ on the horizontal axis. Draw a vertical construction line until it intersects the diagonal line representing (θ) = 60%. From the point of intersection, draw a horizontal construction line until it intersects the diagonal line representing (τ) = 45%. From the point of intersection, draw a vertical construction line downward until the (DF) 2% is found on the horizontal axis (see Fig. 4).

3.2 Description of the Second Design Chart

The second design chart shown in Fig. 5 is a combination of three graphs; the first graph at the top right, the second graph at the top left, and the third graph at the bottom left.

Depending on the sequence of use of these three graphs, the second design chart could be used for both design and analysis. If it is used in an anticlockwise direction, i.e., the first graph, then the second graph and then the third graph, it is used for design by finding the window area (W) as a percentage of the total area of internal surfaces (ΣA) of the room, i.e., finding the ratio (W/ΣA). While, if it used in a clockwise direction, i.e., the third graph, then the second graph and then the first graph, it is used for analysis by finding the daylight factor (DF) resulting from the existence of a window or more with given surface areas (see Fig. 6).

The first graph (at the top right) determines the ratio (W/ΣA) between the required unobstructed window area (W) and the total area of internal surfaces (ΣA) of the room. The obtained ratio (W/ΣA) is a function of the design daylight factor (DF) and the transmittance of glazing (τ), while maintaining the average internal surface reflectance (R) = 50% and the sky exposure angle (θ) = 90°, and it is drawn using the formula:

$$\frac{W}{\Sigma A} = \frac{2 \times (1 - R) \times DF\%}{\tau \times \theta} = \frac{2 \times (1 - 0.50) \times DF\%}{\tau \times 90} = \frac{DF\%}{\tau \times 90}$$

It consists of two axes and a number of diagonal lines; the horizontal axis represents the design daylight factor (DF) needed for most basic applications ranging from (DF) = 1% (for lower latitudes) to (DF) = 6% (for higher latitudes), while the vertical axis represents the ratio (W/ΣA) between the required unobstructed window area (W) and the total area of internal surfaces (ΣA) of the room. That ratio (W/ΣA) on the vertical axis is obtained after intersecting a number of diagonal lines that represent the transmittance of

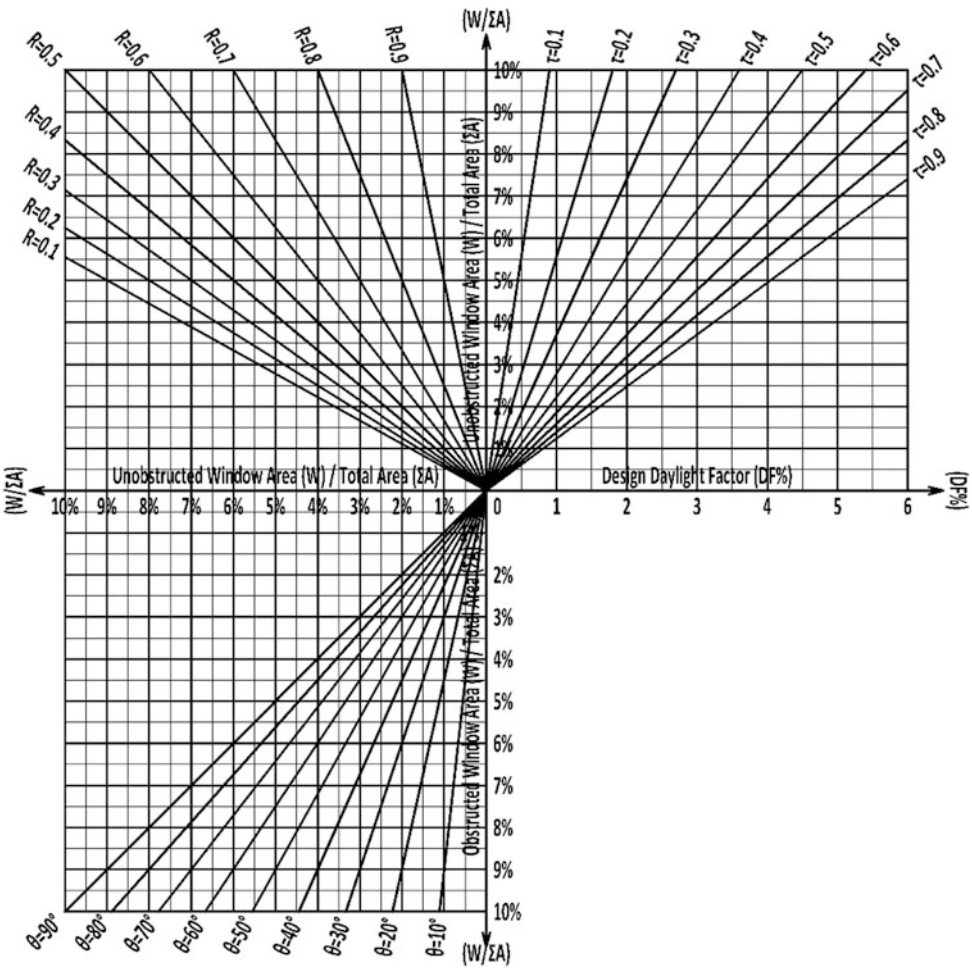

Fig. 5 The second design chart to determine the sizing of vertical windows for daylighting (*Source* The author)

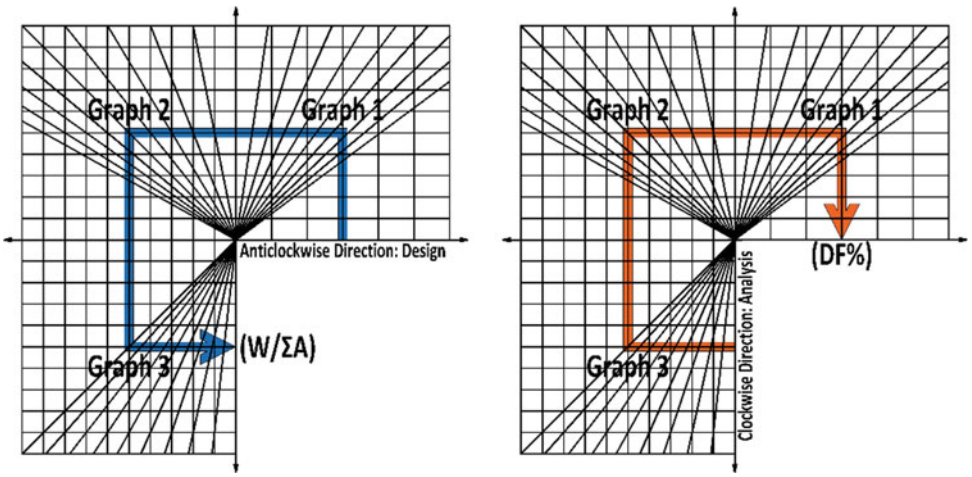

Fig. 6 The second design chart could be used for both design and analysis (*Source* The author)

glazing (τ) ranging from (τ) = 10% (low transmittance) to (τ) = 90% (high transmittance).

The second graph (at the top left) determines the ratio (W/ΣA) between the required unobstructed window area (W) and the total area of internal surfaces (ΣA) of the room. The obtained ratio (W/ΣA) is a function of the design daylight factor (DF), the transmittance of glazing (τ) and the average internal surface reflectance (R), while maintaining the sky exposure angle (θ) = 90°, and it is drawn using the formula:

$$\frac{W}{\Sigma A} = \left(\frac{W}{\Sigma A}\right)_{\text{first graph}} \times \frac{(1-R)}{(1-0.5)}$$

It consists of two axes and a number of diagonal lines; the vertical axis represents the ratio (W/ΣA) obtained from the first graph (at the top right), while the horizontal axis represents the ratio (W/ΣA) between the required unobstructed window area (W) and the total area of internal surfaces (ΣA) of the room. That ratio (W/ΣA) on the horizontal axis is obtained after intersecting a number of diagonal lines that represent the average internal surface reflectance (R) ranging from (R) = 10% (low reflectance) to (R) = 90% (high reflectance).

The third graph (at the bottom left) determines the ratio (W/ΣA) between the required obstructed window area (W) and the total area of internal surfaces (ΣA) of the room. The obtained ratio (W/ΣA) is a function of the design daylight factor (DF), the transmittance of glazing (τ), the average internal surface reflectance (R) and the sky exposure angle (θ), and it is drawn using the formula:

$$\frac{W}{\Sigma A} = \left(\frac{W}{\Sigma A}\right)_{\text{second graph}} \times \frac{(90)}{(\theta)}$$

It consists of two axes and a number of diagonal lines; the horizontal axis represents the ratio (W/ΣA) obtained from the second graph (at the top left), while the vertical axis represents the ratio (W/ΣA) between the required obstructed window area (W) and the total area of internal surfaces (ΣA) of the room. That ratio (W/ΣA) on the vertical axis is obtained after intersecting a number of diagonal lines that represent the sky exposure angle (θ), ranging from (θ) = 10% (highly obstructed) to (θ) = 90% (nonobstructed).

Using the Second Design Chart. To find the ratio (W/ΣA). All the graphs of the second design chart are used as follows.

Enter the first graph (at the top right) by specifying the design daylight factor (DF) on the horizontal axis. Draw a vertical construction line until it intersects the diagonal lines representing the transmittance of glazing (τ). From the point of intersection, draw a horizontal construction line until the ratio $(W/\Sigma A)_{\text{first graph}}$ is found on the vertical axis.

Enter the second graph (at the top left) with the obtained ratio $(W/\Sigma A)_{\text{first graph}}$ on the vertical axis. Extend a horizontal construction line until it intersects one of the diagonal lines representing the average internal surface reflectance (R). From the point of intersection, draw a vertical construction line downward until the ratio $(W/\Sigma A)_{\text{second graph}}$ is found on the horizontal axis.

Enter the third graph (at the bottom left) with the obtained ratio $(W/\Sigma A)_{\text{second graph}}$ on the horizontal axis. Extend a vertical construction line until it intersects one of the diagonal lines representing the sky exposure angle (θ). From the point of intersection, draw a horizontal construction line downward until the ratio $(W/\Sigma A)_{\text{third graph}}$ is found on the vertical axis.

To calculate the window area (W), multiply the obtained ratio $(W/\Sigma A)_{\text{third graph}}$ by the total area of internal surfaces (ΣA).

$$W = \left(\frac{W}{\Sigma A}\right)_{\text{third graph}} \times \Sigma A$$

To find the (DF). All the previous steps are made in reverse, i.e., entering the third graph at first by specifying the ratio (W/ΣA) on the vertical axis and then intersecting the different diagonal lines in a clockwise direction (see Fig. 6).

Example Using the second design chart, it is required to design the window sizing for daylighting, i.e., find the window area (W), in the city of Brussels, Belgium ((LAT) = 50° N), needed to provide daylight factor (DF) = 5%, given that the transmittance of glazing (τ) = 70%, the average internal surface reflectance (R) = 50%, the sky exposure angle (θ) = 80°, and the total area of internal surfaces (ΣA) = 94 m^2.

Solution. Enter the first graph (at the top right) by specifying the (DF) = 5% on the horizontal axis. Draw a vertical construction line until it intersects the diagonal line representing (τ) = 70%. From the point of intersection, draw a horizontal construction line until it intersects the diagonal line representing (R) = 50%. From the point of intersection, draw a vertical construction line until it intersects the diagonal line representing (θ) = 80%. From the point of intersection, draw a horizontal construction line to the right until the ratio $(W/\Sigma A)_{\text{third graph}} \approx 9\%$ is found on the vertical axis (see Fig. 7).

To calculate the window area (W) for the city of Brussels, Belgium:

$$W = \left(\frac{W}{\Sigma A}\right)_{\text{third graph}} \times \Sigma A = 0.09 \times 94 = 8.46 m^2$$

Example Using the second design chart, it is required to analyze the daylighting, i.e., find the daylight factor (DF), in the city of Dubai, United Arab Emirates ((LAT) = 25° N), given that the transmittance of glazing (τ) = 55%, the average internal surface reflectance (R) = 50%, the sky exposure angle (θ) = 80°, and the ratio (W/ΣA) = 5%.

Solution. To find the (DF), in the city of Dubai, United Arab Emirates, all the previous steps are made in reverse as follows. Enter the third graph (at the bottom left) at first by specifying the ratio $(W/\Sigma A)_{\text{third graph}} = 5\%$ on the vertical axis. Draw a horizontal construction line until it intersects the diagonal line representing (θ) = 80%. From the point of intersection, draw a vertical construction line until it

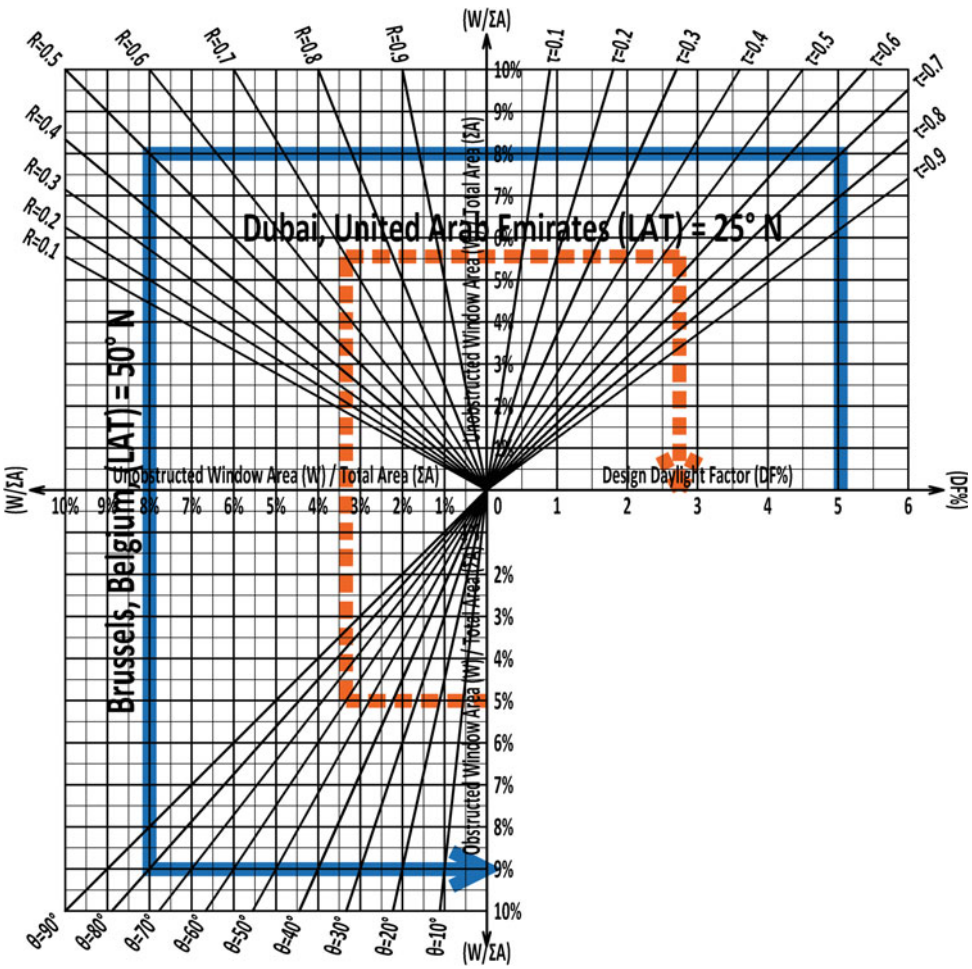

Fig. 7 Examples for using the second design chart in design and analysis (*Source* The author)

intersects the diagonal line representing (R) = 50%. From the point of intersection, draw a horizontal construction line until it intersects the diagonal line representing (τ) = 55%. From the point of intersection, draw a vertical construction line downward until the (DF) ≈ 2.7% is found on the horizontal axis (see Fig. 7).

3.3 Notes on the Design Charts

Average Internal Surface Reflectance (R). When the internal surfaces have different colors or materials, i.e., different reflectance (ρ) for each surface of area (a), (R) could be calculated as the area-weighted average internal surface reflectance as follows.

$$R = \frac{(a_1 \times \rho_1) + (a_2 \times \rho_2) + (a_3 \times \rho_3) + (\ldots \times \ldots) + (\ldots \times \ldots) + (a_n \times \rho_n)}{(a_1 + a_2 + a_3 + \ldots + \ldots + a_n)}$$

The average internal surface reflectance (R) is a very important aspect, especially for interior designers who might select the colors of the interior from an aesthetical point of view only that might lead to an insufficient amount of daylight inside the room. (R) could be obtained from the second design chart as follows. Enter the first graph (at the top right) by specifying the design daylight factor (DF) on the horizontal axis. Draw a vertical construction line until it intersects the diagonal lines representing (τ). From the point of intersection, draw an extended horizontal construction line. Enter the third graph (at the bottom left) with the given ratio (W/ΣA) on the vertical axis. Draw a horizontal construction line until it intersects the diagonal lines representing (θ). From the point of intersection, draw an extended vertical construction line until it intersects the previous extended horizontal construction line at a point indicating (R). The obtained (R) is the minimum amount that the interior designer could reach (see Fig. 8).

Significant Effect of (τ), (R), and (θ) on the Window Sizing for Daylighting. It is obvious from the proposed design charts that the change of a single variable; (τ), (R), or (θ), while maintaining the others, would make an extensive change in the window area. That is why designers should draw more attention toward the specifications and properties of the window, e.g., (τ), the room, e.g., (R), and the surrounding environment, e.g., (θ).

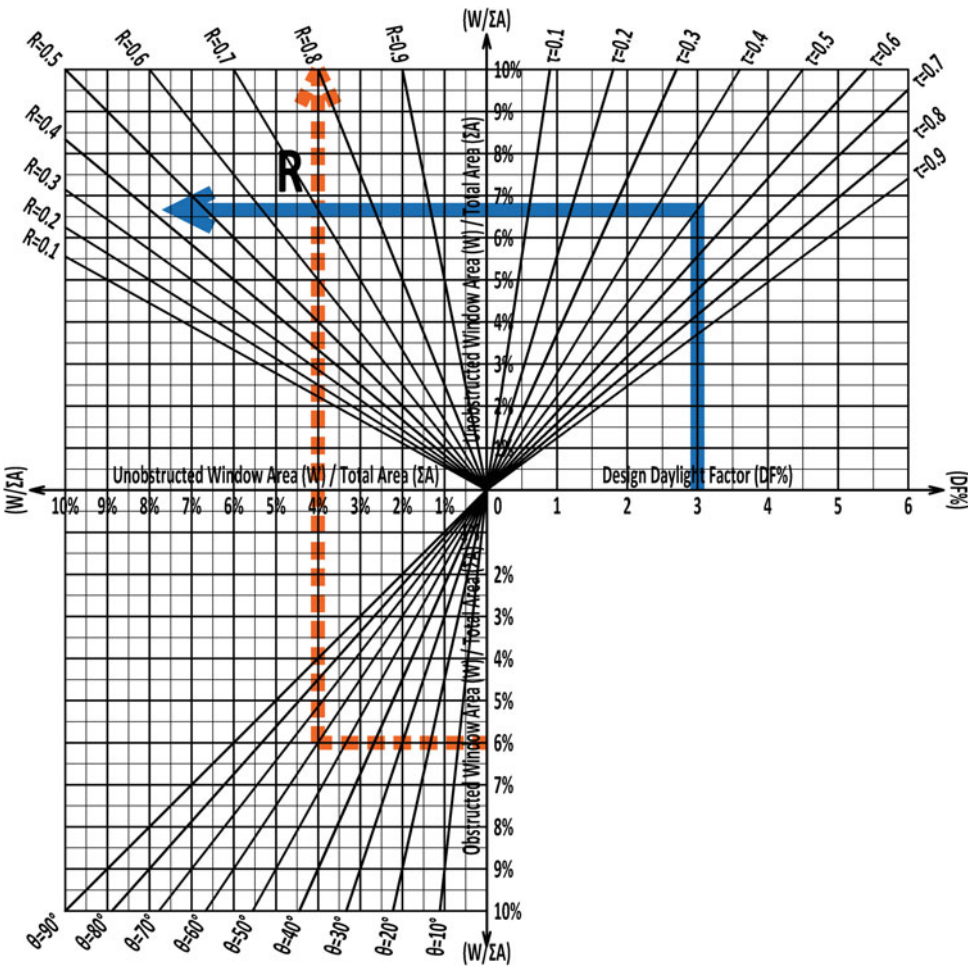

Fig. 8 The average internal surface reflectance (R) could be obtained from the second design chart (*Source* The author)

Avoidance of Oversimplifications. From the proposed design charts, it is obvious that it is not appropriate to oversimplify the process of sizing the windows for daylighting by mentioning that window area should equal approximately 20% of a room's floor area, to provide enough light, even during overcast days (Keeler and Vaidya 2016). This is not a very precise method to be used as a rule of thumb due to the fluctuating variables that affect the area of glazing required for providing an adequate amount of daylight, e.g., (τ), (R), and (θ). Additionally, if it is required to simplify the process of sizing the windows for daylighting, the use of the proposed design charts might be the answer.

4 Discussion and Conclusions

It is possible to use the proposed design charts as a rule of thumb to determine the sizing of vertical windows needed for providing adequate amount of daylight needed for most basic applications. The amount of daylight entering a given room is a function of a number of variables concerning the properties of the window, the room, and the surrounding environment. And the proposed design charts use graphs signifying most of those different variables, which in turn make it possible to be used as a quick tool, especially within the preliminary stages of design. Those design charts could not only be used for design by finding the window area (W), but also could be used for analysis by finding the daylight factor (DF) caused by an existing window.

In future researches, those design charts could be upgraded to include more variables such as orientation, sky conditions, external reflected component (ERC), etc. The same methodology could be used for finding the dimensions of other daylight media such as skylights, etc., or other architectural elements such as self-shading masses, climatic envelopes, etc. (Saifelnasr 2003). Other researches might involve studying the integration between daylighting and other building systems, e.g., solar heat gain (Szokolay 2008), ventilation, etc., that might affect the sizing of such windows that are used for more than one function. In addition, future researches might involve studying the cost-effectiveness, efficiency, or energy savings that might result from the use of such windows in the different climates.

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An Analysis of Corporate Social Responsibility and Role of Intermediaries for Value-Added Services

Jeffrey Darville and Alessio Faccia

Abstract

Consumers represent the largest market segment by total population and frequency of transactions across the global economy. However, many potential customers of products are unable to purchase goods due to their low income. The root causes of poverty are explored in terms of consumer products, the role of intermediaries, and the social responsibility of corporations. Consumer purchases often travel through intermediaries that extract profits from the value chain because of market structures and industry customs. This study reveals the hidden costs to consumers in the prices of common fungible consumer products, namely disposable batteries. This study examines the members of the value-added chain, and their contributions relative to the producers of the product. It will propose a model for transactional reallocation with respect to the marginal utility of intermediaries and the final price to end users. It is further proposed that the creation of a national market to reduce intermediary costs will more readily link final users with producers. Based on this analysis it was determined that opportunities exist to create greater profit margins for manufacturers who could then increase capital expenditures, reinvest in research and development while providing greater wages to unskilled labor.

Keywords

Corporate social responsibility • Value-added • Distribution chain • Intermediary • Market allocation • Supply chain • Stakeholder theory • Consumer pricing

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1 Introduction

Corporate Social Responsibility (CSR) advocates should take into consideration new methods of developing Value-Added Statements (VAS). These new methods to display value-added activities can be used to explain the relative profit that is being claimed by each entity involved in the production and distribution of products (Rathi 2017). Profit should no longer be considered the primary metric to judge organizational excellence. Instead, the role of each entity in the creation and distribution of products could be considered in the broad social context. Corporate actions affect many aspects of individual consumer's individual well-being, including purchasing power through prices and increased income through employment.

Battery companies provide a good test case to illustrate how the Responsible Value-Added Analysis (RVAA) indicates who has been remunerated, based on the capital invested. Portable power sources are used across the globe and are needed by consumers in both developed and developing countries. Each ring that makes up the supply chain remunerates the same five types of capital: (a) labor capital, (b) structural capital, (c) credit capital, (d) social capital (infrastructural capital), and (e) risk capital. By analyzing each ring individually and by breaking down all the remunerated capital sources and recomposing the RVAA by capital type to show the whole chain, it is possible to observe the incidence of the payment of each capital source for the entire chain in each company and for each industry.

When focusing only on one company (as a single link in the chain) it would not be possible to check whether the whole industry (especially for production-related industries) adheres to socially responsible behaviors, for example creating jobs. However, by expanding the level of analysis to the industry and viewing it as interconnected parts of the same whole a clearer picture of common trends emerges.

Incentives determine the likely response of each of the three blocks in the RVAA. The motivations are different for

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each segment. If a retailer or wholesaler wants to improve their return on capital employed, they typically focus on the reduction of costs and liabilities concerning taxable income. These cause-and-effect relationships show that minimal changes in areas such as skills or work in process can have a significant impact on profitability (Nielsen and Nielsen 2008). However, the producer always pays the most in taxes because tangible capital is taxed at the highest rates and because it is difficult to relocate the production.

Retailers and wholesalers pay less taxes because they can move money earned in nontaxable forms into low tax jurisdictions. This represents a significant advantage over producers because production is fixed to a country and certain geography. Taxing and regulations in the US encourage businesses to offshore and outsource to avoid direct taxes on tangible capital expenditures. Many other corporations around the world have adopted variations on these profit maximization strategies.

Applying the VAS equation to each corporation's 10-K quarterly statement is the first step in the process of evaluating the capital components in corporations' financial statements. The next step takes the process of analyzing added value in a new direction by linking the supply chain to the value-added equation. Rulers, presidents, ministers, administrators, policy-makers, and managers have many interests that intersect the accurate display of these economic and financial activities. Leaders need to make wise decisions based on valid data and interpretations of these transactions. Policy-makers, regulation, agents, and ministers need to be able to track, tax, and act upon the legitimate actions and operations of businesses within their jurisdiction. Additionally, managers especially need to consider the consequences of their decisions to create and implement strategy accordingly. This RVAA has many implications for corporations considering Direct Foreign Investment (DFI), spinoffs, vertical integration, mergers, and acquisitions.

This model could be used by policy-makers to understand the trend of the industries, considering the whole supply chain, and to foresee a taxation inversely related to the creation of work in the complex in order to reduce unemployment. A study like this could be replicated in any industry to help managers, knowing the profitability of the entire value chain, decide whether it is convenient to proceed with vertical integration (considering the maximization of profit for shareholders). The following literature review provides the background and reasoning for the social responsibility basis for the proposed empirical method of accounting for value-added.

2 Literature Review

"Added value" happens at each step in the transformation of raw materials into a product and its delivery to the eventual end user. Value-added statements provide useful information to identify, record, and note who created each stage of value in a supply chain. This process is often used to identify the role of intermediaries at each step in the distribution of tangible products. Value-Added (VA) was originally used by economists to explain how a service offered will gain value for the user when it is improved as compared with basic products or services of the same kind.

At the core of Corporate Social Responsibility (CSR) efforts are social imperatives that consider the consequences of business success where "clearly articulated and communicated policies and practices of corporations that reflect business responsibility for some of the wider societal good." (Matten and Moon 2008). The added value that individual business entities provide is linked to the value-added statement below.

Individual consumers make frequent purchases, often buying goods and services for their household, and this group is are the largest customer segment in the world (Coviello and Brodie 2001). They respond predictably and positively to Corporate Social Responsibility activities by companies when making purchasing decisions regarding their products (Fagerstrøm et al. 2015). Most consumers at the bottom of the pyramid (BOP), those that earn less than $2000 per year, spend up to 80% of their income on necessities including food, clothing, and fuel alone (Gangopadhyay and Wadhwa 2004). Therefore, the decisions made by corporations in each industry, especially those that address consumer needs, will have a significant impact on the quality of life of individuals, particularly in the developing world.

For many BOP consumers, electronic devices affect their entertainment, mobility, and education. All of these are related to productivity and self-esteem. Disposable batteries or primary batteries which consist of alkaline, lithium, silver oxide, zinc-air, zinc-carbon, and zinc-chloride are not rechargeable. These portable sources of energy power many devices from appliances and cameras to phones and video game controllers. As of 2009, 70% of all primary batteries are purchased by consumers and the world demand for primary and secondary batteries is forecasted to grow by 7.7% annually, amounting to US$120 billion in 2019 (Tran et al. 2018).

Many costs are hidden by retailers and passed onto consumers in the final prices of goods. Because the value-added is equivalent to the cost paid by the retailer plus any markup it represents the total wealth created in a nation's economy (Riahi-Belkaoui 1992, 1996, 1999). Common fungible consumer products that are related to energy storage such as disposable batteries are a good test case for the tacit costs incurred by consumers.

Members of the value-added chain, and their contributions relative to the producers of the product, have not been analyzed in many product categories. In many cases, there is a gap between "real" and "pseudo" value-added activities. The VAS is often used as a broad measure to determine corporate performance buy-in. It has gained recognition as a more useful tool when compared to conventional measures based on the traditional accounting system.

Value-added accounting provides a bridge between the macro and micro levels of accounting as it uses a well-established term since value-added was used in 1970 in the first US Census of Production (Fort et al. 2017). Between 1950 and 2000, over 100 articles have been published related to value-added reporting (Riahi-Belkaoui 1996, 1999; Haller et al. 2016) have recommendation the broad adoption of value-added reporting in the United States to conform with international standards of reporting. The claim that "value added information has greater predictive and explanatory power than earnings" is not empirically supported because "value added is not calculated consistently" (Van Staden 1999).

Supply Chain Management (SCM) as a body of knowledge suffers from a lack of novel ideas (Burgess et al. 2006). Instead, most researchers base their work on multiple existing theories coopted from other areas and combine existing research methods to generate data to extend existing theories. Because corporations vary greatly the way they structure supply and distributional channels SCM analysis should consider the advantages and disadvantages of each based on the transaction undertaken (Ellram 1991). From an accounting standpoint, supply chain reporting has greater consistency in terms of the reduction of information impactedness and the use of a common framework when compared to value-added statements alone.

Many views of value-added statements and stakeholder theory give rise to a view of CSR that contains competing, contradictory, and incompatible objectives (Charkham 2011). For CSR to be translated into operational decision-making it must be communicated with clarity and understood by all levels of an organization and those outside of the organization who regulate and tax it. Mitchell et al. (1997) propose little modification to enhance the utility of stakeholder theory with respect to value-added services. It has become apparent that this area is harmed more by a broad definition that loses operational effect than a narrow definition that sacrifices managerial salience. Additionally, the use of value-added accounting has often been stretched beyond its effectiveness because of competing definitions. Business leaders' and policymakers' attention is devoted to growing and sustaining operations. An unexamined broad definition of value-added and stakeholder theory encourages corporations to set aside CSR as a public relations foil.

Research that recommends modifications to value-added theory in order to better understand CSR has far-reaching ramifications for economic, societal, legal, ethical, and philanthropic development. Framing this topic is the key to resolution between various interests. This conflict of ideas strikes at the very foundations of the study of organizations including how we determine the legality of various groups. Stakeholder theory lacks specificity and cannot be operationalized in a way that allows scientific inspection and therefore offers no decision-making criteria. However, value-added accounting does provide measurable and testable data for use by academics, administrators, and practitioners alike.

Value-added accounting, corporate social responsibility, and stakeholder theory all have the same object of analysis: businesses. All organizations have stakeholders, yet for-profit multinational corporations (MNC) are the primary object of stakeholder theory for two reasons (Camilleri 2017; Markley and Davis 2007). First, these firms represent powerful interests that are not bound by international treaties and whose actions have global consequences. Second, other nongovernmental organizations of substantial size and financial wherewithal do not have direct ownership but instead are controlled by a board that views corporations as competitors for the control of scarce financial resources. This sets up a game.

As the debate is often focused on publicly traded firms this discussion is limited to the application of stakeholder theory to MNCs. Based on relationships between executives, the board of directors and shareholders, managers of these companies are given various levels of autonomy to make good and bad decisions. Without this independence, exemplified by the more autocratic capitalism in some developed countries, corporations become the arm of another entity, presumably the state. Each corporation can make the commitment to improve community well-being in order to maintain its independence through discretionary business practices and the choice to contribute corporate resources to social initiatives (Lee and Kotler 2011; Seretny and Seretny 2012). Instead of asking should a firm care about the triple bottom line of planet, people, or profits, research should explore how every corporation is obligated to all these interests by defining the boundaries of stakeholder theory. The following research methodology will identify and isolate real-value-added when compared to pseudo-value-added.

3 Analysis: Data Base and Analytical Procedures

Specific analyzes were carried out on the income statement of the top three US companies. Data were obtained from the respective 10-K forms, financial statements published by law. The selected companies represent only a non-exhaustive sample, but only an example of the application of the new approach suggested by this research paper (see Tables 1, 2, 3 and 4).

The value chain is represented in Table 1. The data analysis was conducted to conform with this Responsible Value-Added Analysis framework creating consistent points of comparison across firms in each industry. Without attempting to determine any amount of financial capital remuneration as unfair, this process will analyze if: (a) there is a balance in the chain and (b) which part of the chain offers greater compensation for work.

Therefore, certain activities create more value and greater equity and wealth can be created for people who contribute in these ways. This would occur through the creation of jobs, increase in gross national product, and a reduction in unemployment.

Many classifications of the VAS were developed by the researchers (Mandal and Goswami 2008). The one referred to in this research paper is represented in Fig. 1.

In this RVAA analysis, the first margin, value-added, represents the gross production side. These are considered as a set of inanimate inputs and outputs.

The subsequent margin allows researchers to highlight the participation of all stakeholders in contributing to the added value. The composition can therefore be observed and in what proportion the added value has been distributed among all the direct stakeholders as shown in Fig. 2.

Considering the distribution of added value not only for a single company, but for the whole industry, through the supply chain, we obtain a combined configuration of tools that are useful to add vertical and horizontal returns (Mandal and Goswami 2008; Hannan et al. 2017; Afzal Hossain 2017; Haller and Van Staden 2014; Cox 1979; Moreley 1979; Mondol and Goswami 2008; Rao 2000; The Future of Company Report 1977). The added value, as already mentioned above, from the production side, can be considered as the difference between inanimate inputs and outputs. Analyzing in detail the added value on the distribution side, in this paper the focus is not on a single company. Instead this framework provides a broad view of the whole industry and enhances the ability of decision-makers to understand the value chain throughout the supply chain.

The new approach consists of following the following procedure (see Fig. 3).

This procedure consists of the following steps:

1. Decomposition and analysis of the distribution of added value for each individual company (or business cluster) that make up the supply chain (in this case: lithium producers, wholesalers, and retailers);
2. Re-composition and horizontal sum of the returns of the entire supply chain divided by recipient (specific stakeholder) of the return;
3. Analysis of the distribution of added value of the supply chain when considered as a whole.

The combination of these analyzes produced by the supply chain and the VAS leads to the creation of an instrument of extraordinary value and utility. This innovative approach makes it possible to provide valuable information not only for the stakeholders themselves but also for those who indirectly can influence their returns. Government agencies and regulators are one example. Two of the natural targets of the RVAA are to reduce the unemployment rate and increase revenues to business that add real value. If the policy-maker only focuses on a single link in the chain, without considering the upstream and downstream consequences, a policy change could get unintended or unwanted results. The decision to allow a facility zone, licensing, tax abatement, or other advantages to an industry must consider the return of all links in the chain, not just one of them. For example, it could be discovered that a higher level of employment can be achieved in one industry rather than another and thus warrant greater supports (Van Staden 2000; Ianniello 2010; Catturi 1994; Freeman 1984; Maddison 2005; Evraert and Riahi-Belkaoui 1998; Reichmann and Lange 1981; Morley 1978; Jain et al. 2010; Burgess and Singh 2006).

4 Findings: Results and Related Considerations

The analysis of the consumable batteries sector, divided between producers of lithium, wholesalers, and retailers, following the steps indicated in the previous paragraph, has allowed us to provide a good example of the concrete applicability of the new analysis approach. The top three companies were selected for each ring of the supply chain (lithium producers, wholesalers, and retailers), the income statements of each link in the chain were analyzed in an aggregate way and the sum of returns was reported in a final aggregate for the whole industry (see Tables 2, 3, 4, 5 and 6).

The composition of yields in the three different macro-aggregates was very different, but in any case, in line

Table 1 Value-added statement through the supply chain

Production	**Income statement—value-added classification**		Producers
	Revenues		
	– Raw materials		
	– Service expenses		
Distribution	**Value-added**	**Type of remunerated capital**	
	– Wages and salary	Labor capital (employees)	
	EBITDA		
	– Depreciation and amortization	Structural/pluriannual capital (fixed assets)	
	EBIT		
	– Interest expenses	Financial capital (creditors)	
	EBT		
	– Taxes	Infrastructural and social capital (government)	
	Earnings		
	– Dividend	Risk capital (owners)	
	Retained earnings	Reinvestable capital for R&D and growth	
Production	**Income statement—value-added classification**		Wholesalers
	Revenues		
	– Raw materials		
	– Service expenses		
	Value-added	**Type of remunerated capital**	
Distribution	– Wages and salary	Labor capital (employees)	
	EBITDA		
	– Depreciation and amortization	Structural/pluriannual capital (fixed assets)	
	EBIT		
	– Interest expenses	Financial capital (creditors)	
	EBT		
	– Taxes	Infrastructural and social capital (government)	
	Earnings		
	– Dividend	Risk capital (owners)	
	Retained earnings	Reinvestable capital for R&D and growth	
Production	**Income statement—value-added classification**		Retailers
	Revenues		
	– Raw materials		
	– Service expenses		
	Value-added	**Type of remunerated capital**	
Distribution	– Wages and salary	Labor capital (employees)	
	EBITDA		
	– Depreciation and amortization	Structural/pluriannual capital (fixed assets)	
	EBIT		
	– Interest expenses	Financial capital (creditors)	
	EBT		
	– Taxes	Infrastructural and social capital (government)	
	Earnings		
	– Dividend	Risk capital (owners)	
	Retained earnings	Reinvestable capital for R&D and growth	

Table 2 Income statements top 3 US-listed producers

	FMC	SQM	ALB	Aggregate
Revenue	12/31/2017	12/31/2017	12/31/2017	
Total Revenue	2,878,600	2,157,323	3,071,976	8,107,899
Cost of revenue	1,757,100	1,394,822	1,907,601	5,059,523
Gross profit	**1,121,500**	**762,501**	**1,164,375**	3,048,376
Operating expenses				
Research development	141,500	0	78,630	220,130
Selling general and administrative	470,200	101,171	407,601	978,972
Nonrecurring	0	0	0	0
Others	0	34,738	0	34,738
Total operating expenses	2,368,800	1,530,731	2,393,832	6,293,363
Operating income or loss	**509,800**	**626,592**	**678,144**	1,814,536
Income from continuing operations				
Total other income/expenses net	−329,000	−32,002	−146,859	−507,861
Earnings before interest and taxes	509,800	626,592	678,144	1,814,536
Interest expense	−80,000	−48,301	−62,549	−190,850
Income before tax	180,800	594,590	531,285	1,306,675
Income tax expense	264,100	166,173	431,817	862,090
Minority interest	25,300	59,647	143,147	228,094
Net income from continuing ops	**−83,300**	**428,417**	**99,468**	444,585
Nonrecurring events				
Discontinued operations	621,700	0	0	621,700
Extraordinary items	0	0	0	0
Effect of accounting changes	0	0	0	0
Other items	0	0	0	0
Net income				
Net income	**535,800**	**427,697**	**54,850**	1,018,347
Preferred stock and other adjustments	0	0	0	0
Net income applicable to common shares	**535,800**	**427,697**	**54,850**	1,018,347
Dividends paid	88800	373933	140,557	603,290
Depreciation	113,000	238,171	196,928	548,099
N. employees	7000	4921	5400	17,321

with expectations. It should be noted that due to lack of time it was not possible to reclassify the added value in detail, in the tables shown there is therefore no distinction between the cost of goods sold and labor expenses, both included in the purchase expenses. The remuneration of labor in this analysis will therefore not be considered. Further details of those values will be the object of subsequent studies.

The producers mainly remunerate the infrastructural (social) capital. This is assumed to be because production companies cannot easily relocate production in the presence of high tax rates (see Fig. 4).

Infrastructural and structural capital return represent the stakeholders that absorb the main part of added value at the time of its distribution (see Fig. 5) for the wholesalers.

Structural and risk capital return represent the stakeholders that absorb the main part of added value at the time of its distribution (see Fig. 6) for the retailers.

Considering the level of employment (see Fig. 7), it can be seen that producers are the component of the value chain that contribute most to increasing jobs as a percentage of revenue. Wholesalers, but especially retailers, provide the lowest contribution to the level of employment in terms of percentage of revenues. We could therefore affirm that these two links in the supply chain, which represent only intermediaries between production and the consumer, are not very useful socially, from the point of view of the target of reducing unemployment.

Table 3 Income statements top 3 US-listed electronics wholesalers

	DNOW	AXE	DIT	Aggregate
Revenue	12/31/2017	12/29/2017	9/30/2017	
Total revenue	2,648,000	7,927,400	1,274,985	11,850,385
Cost of revenue	2,147,000	6,356,400	1,202,536	9,705,936
Gross profit	**501,000**	**1,571,000**	**72,448**	2,144,448
Operating expenses				0
Research development	0	0	–	0
Selling general and administrative	542,000	1,213,800	64,174	1,819,974
Nonrecurring	0	0	–	0
Others	0	0	–	0
Total operating expenses	2,689,000	7,606,300	899	10,296,199
Operating income or loss	**−41,000**	**321,100**	**6225**	286,325
Income from continuing operations				0
Total other income/expenses net	−11,000	−83,500	(786)	−95,286
Earnings before interest and taxes	−41,000	321,100	6225	286,325
Interest expense	−6,000	−74,700	(826)	−81,526
Income before tax	−52,000	237,600	5439	191,039
Income tax expense	0	128,600	2489	131,089
Minority interest	0	0	–	0
Net income from continuing ops	**−52,000**	**109,000**	**2950**	59,950
Nonrecurring events				
Discontinued operations	–	–	–	0
Extraordinary items	–	–	–	0
Effect of accounting changes	–	–	–	0
Other items	–	–	–	0
Net income				
Net income	**−52,000**	**109,000**	**2,950**	59,950
Preferred stock and other adjustments	–	–	–	
Net income applicable to common shares	**−52,000**	**109,000**	**2,950**	59,950
Dividends paid	0	0	707	707
Depreciation	50,000	58,800	2,049	110,849
N. employees	4600	8900	790	14,290

Wholesalers and retailers make no contribution to product innovation, but only distribute them, from the point of view of physical transformation. But considering the level of employment in absolute and nonpercentage terms, the level of employment is guaranteed by all three links in the chain in an almost homogeneous way (only wholesalers contribute slightly less) (Fig. 8).

Concerning social responsibility and only the parameter of the level of employment, there is a disparity in the appropriation of added value within these three blocks or links in the value-added chain. A difference between the revenue generated at similar quantities of employment takes place to the disadvantage of workers, and the advantage of wholesalers and retailers. These two last links in the chain, generate much higher revenues than producers ensuring the same contribution in terms of employment, but with greater benefits to the other sources of capital, i.e., structural capital, credit capital, social capital (infrastructural capital), and risk capital.

5 Conclusions and Recommendations

The Responsible Value-Added Analysis demonstrates that the value chain is not balanced across the battery industry and between companies. Purchasing power as a component of individual poverty across the world is based on the ability of BOP consumers to afford basic necessities. Global poverty is also directly related to employment and wages.

Table 4 Income statements top 3 US-listed retailers

	WMT	Cost	KR	Aggregate
Revenue	1/31/2018	09-02-18	02-03-18	
Total revenue	500,343,000	141,576,000	122,662,000	764,581,000
Cost of revenue	373,396,000	123,152,000	95,662,000	592,210,000
Gross profit	**126,947,000**	**18,424,000**	**27,000,000**	172,371,000
Research development	0	0	0	0
Selling general and administrative	104,698,000	13,876,000	22,114,000	140,688,000
Nonrecurring	0	0	0	0
Others	0	0	0	0
Total operating expenses	478,094,000	137,096,000	120,212,000	735,402,000
Operating income or loss	**22,249,000**	**4,480,000**	**2,450,000**	29,179,000
Total other income/expenses net	−7,126,000	−38,000	−966,000	−8,130,000
Earnings before interest and taxes	22,249,000	4,480,000	2,450,000	29,179,000
Interest expense	−2,330,000	−159,000	−601,000	−3,090,000
Income before tax	15,123,000	4,442,000	1,484,000	21,049,000
Income tax expense	4,600,000	1,263,000	−405,000	5,458,000
Minority interest	2,953,000	304,000	−26,000	3,231,000
Net income	**9,862,000**	**3,134,000**	**1,907,000**	14,903,000
Dividends paid	6,124,000	804,000	443,000	7,371,000
Depreciation	10,529,000	1,370,000	2,495,000	14,394,000
N. employees	2,300,000	245,000	449,000	2,994,000

	INCOME STATEMENT - VALUE ADDED CLASSIFICATION
PRODUCTION	REVENUES
	- RAW MATERIALS
	- SERVICE EXPENSES
	VALUE ADDED
DISTRIBUTION	- WAGES AND SALARY
	EBITDA
	- DEPRECIATION & AMORTIZATION
	EBIT
	- INTEREST EXPENSES
	EBT
	- TAXES
	EARNINGS
	- DIVIDEND
	RETAINED EARNINGS

Fig. 1 Value-added statement

When intermediary profits are found to be out of proportion with the production block which also employs individuals attempting to rise out of poverty many questions are left unanswered.

In many cases the indirect channel is a vestige of the past. As large retailers continue to squeeze out wholesalers, the question becomes which end of the value chain will win the battle? If retailers control their suppliers, then they will force lower profits for producers and maintain higher profits online or at the store. On the other hand, if producers can create value by retaining earnings and balance the share of capital employed fewer manufacturing jobs will be lost. Moreover, this model will aid governments in shifting the focus and

Fig. 2 Distribution of value-added

VALUE ADDED		TYPE OF REMUNERATED CAPITAL
- WAGES AND SALARY		LABOR CAPITAL (EMPOYEES)
EBITDA		
- DEPRECIATION & AMORTIZATION		STRUCTURAL / PLURIANNUAL CAPITAL (FIXED ASSETS)
EBIT		
- INTEREST EXPENSES		FINANCIAL CAPITAL (CREDITORS)
EBT		
- TAXES		INFRASTRUCTURAL & SOCIAL CAPITAL (GOVERNMENT)
EARNINGS		
- DIVIDEND		RISK CAPITAL (OWNERS)
RETAINED EARNINGS		REINVESTABLE CAPITAL FOR R&D AND GROWTH

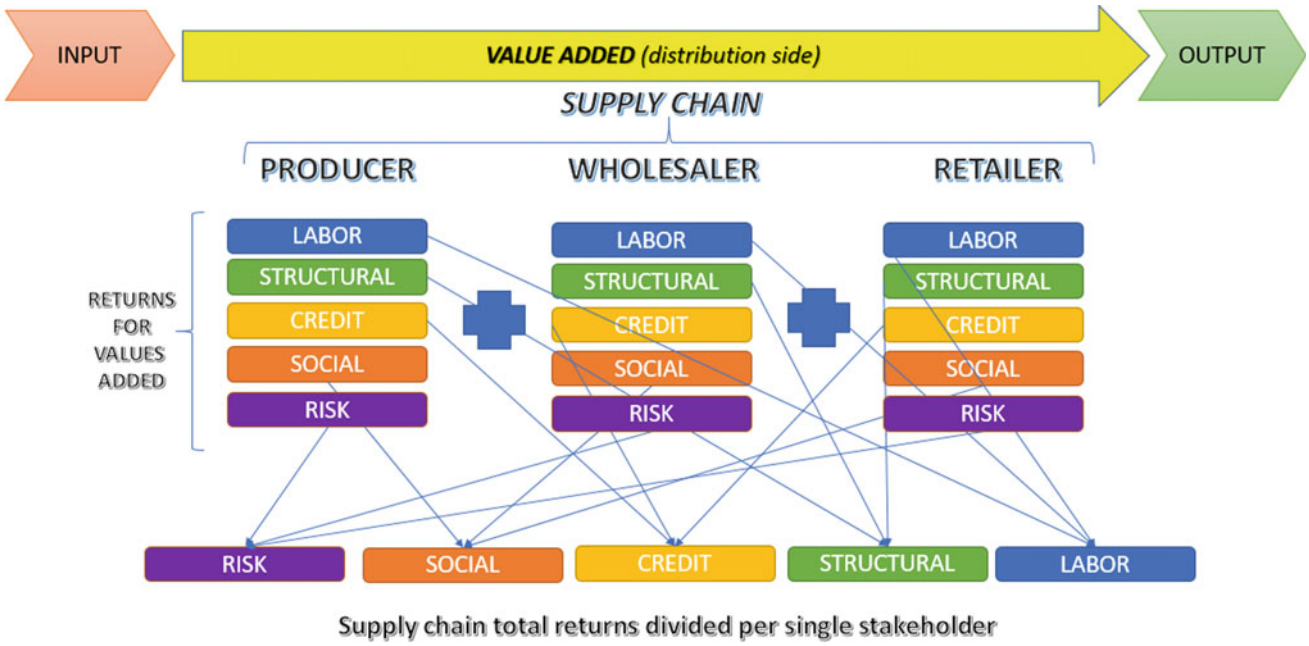

Fig. 3 Distribution of value-added

Table 5 Summarized returns divided by chain

Returns as a % of gross profit	Producers (%)	Wholesalers (%)	Retailers (%)
Tangible capital return	18.0	5.2	8.4
Credit capital return	6.3	3.8	1.8
Infrastructural capital return	28.3	6.1	3.2
Risk capital return	19.8	0.0	4.3
Purchase expenses	27.7	84.9	82.4
	100.0	100.0	100.0

Table 6 Returns divided by chain

	Producers	Wholesalers	Retailers
Revenues	8,107,899	11,850,385	764,581,000
Cost of revenues	5,059,523	9,705,936	592,210,000
Depreciation	548,099	110,849	14,394,000
% of cost of revenues	**10.8330%**	**1.1421%**	**2.4306%**
Gross profit	3,048,376	2,144,448	172,371,000
Other operating expenses	1,233,840	590,263	143,192,000
EBIT	1,814,536	1,554,185	29,179,000
Interest expenses	190,850	81,526	3,090,000
EBT	1,306,675	191,039	21,049,000
% of gross profit	**6.2607%**	**3.8017%**	**1.7926%**
Income taxes	862,090	131,089	5,458,000
Net income	444,585	59,950	14,903,000
% of gross profit	**28.2803%**	**6.1129%**	**3.1664%**
Dividend paid	603,290	707	7,371,000
N. employees	17,321	14,290	17,321
% of revenues	**0.2136%**	**0.1206%**	**0.0023%**
% of gross profit	**0.5682%**	**0.6664%**	**0.0100%**

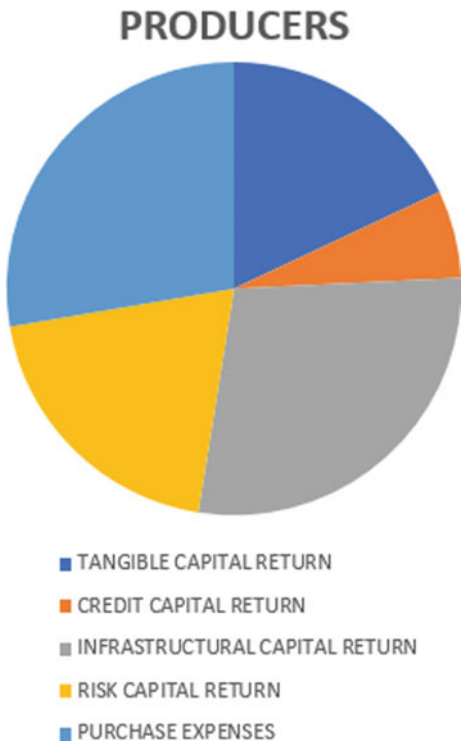

Fig. 4 Stakeholder's returns for top 3 US-listed lithium producers

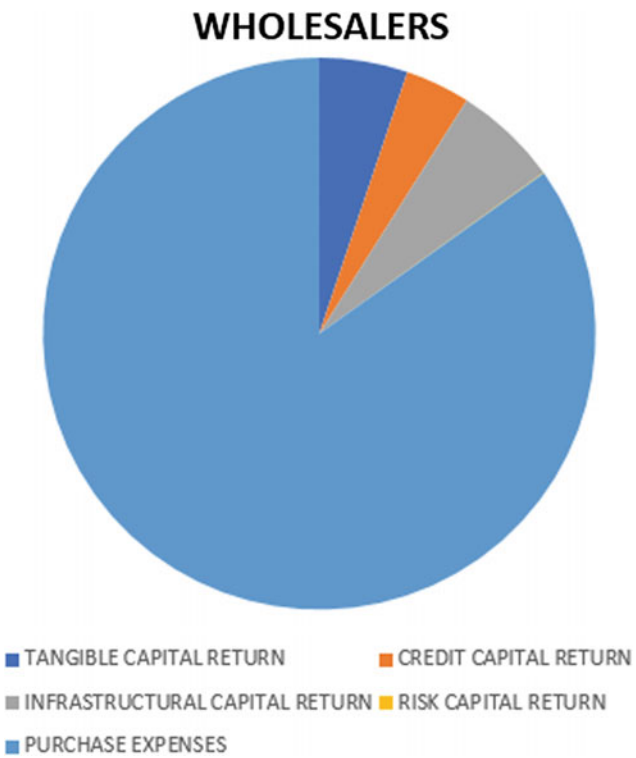

Fig. 5 Stakeholder's returns for top 3 US-listed electronics wholesalers

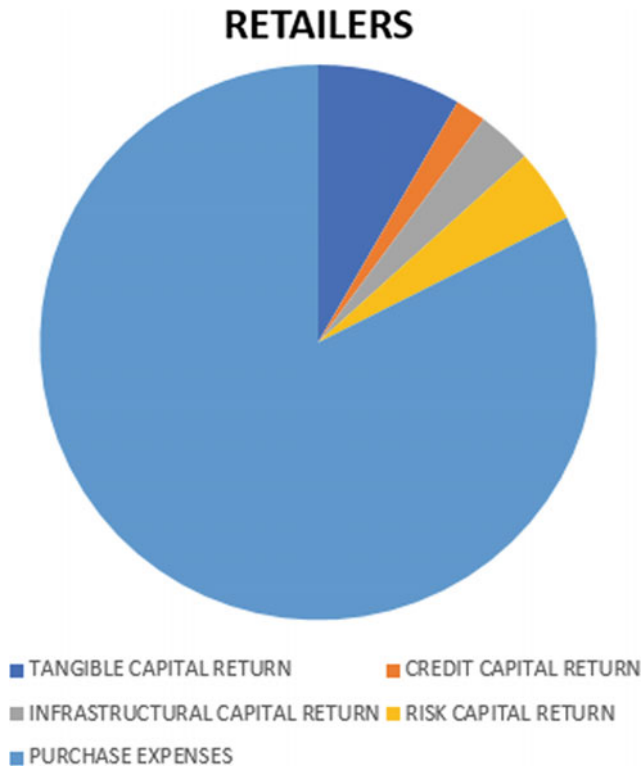

Fig. 6 Stakeholder's returns for top 3 US-listed retailers

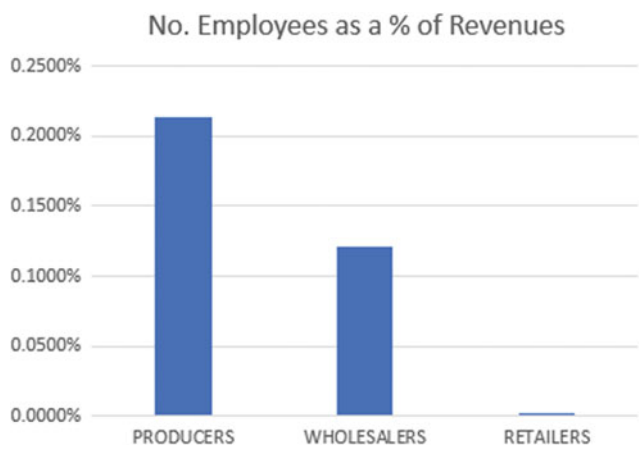

Fig. 7 Number of employees expressed as a percentage of revenues

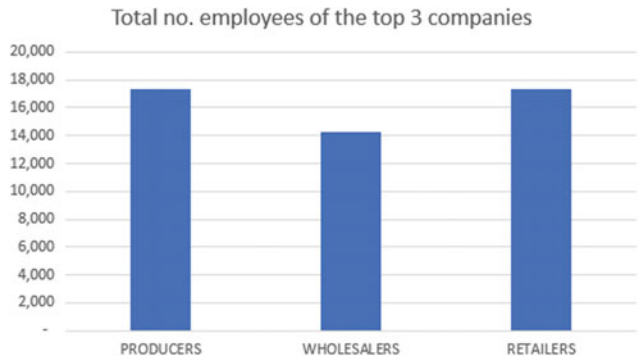

Fig. 8 Total number of employees

incentives from intermediaries to real value-added production, transportation, and sales activities can accompany an express mandate to reduce the final price to end users.

The political and social power of consumers in the United States is well documented, from the Boston Tea Party to Ralph Nader and consumer activism, preference and petition can change government policies (Glickman 2009). It is possible for a shift in consumer demands and behavior to affect an entire industry. As a result, this may push governments to address the price to profit gaps that exist due to intermediation. Over time, this may create the impetus for the creation of a national market to facilitate purchase for consumers at the BOP. This market can be either private or public, managed by trade agencies or ministries of commerce, and in many countries, it could exist through a public–private partnership.

The goal of this marketplace is to reduce intermediary costs that will more readily link final customers with producers. United Nation's Millennium Development Goals set out several objectives, regulations, and policy prescriptions for governments to enhance and encourage environmental sustainability and reduce world poverty (Akhtar and Mekki 2017). To do this, corporations must shift to creating value rather than simply abiding by pseudo-value-added activities. Direct marketing channels to consumers at the BOP will decrease prices and increase purchasing power. Opportunities exist to create greater profit margins for manufacturers who could then increase capital expenditures, reinvest in research and development while providing greater wages to skilled and unskilled labor.

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An Overview of Bahrain's Microenterprises Role in Eliminating Unemployment

Husham Alawsi

Abstract

Unemployment is one of the most significant communal, humanitarian, and economic issues that prevail in almost all the developing and several developed countries across the globe. It's identified as one of the major factors that deter economic growth and development. Microenterprises play a pivotal role in generating employment opportunities, especially in countries with low income per capita. Small-scale enterprises are found to be more efficient in creating employment and generating income. They also provide help in boosting the economy during the economic crisis. In Bahrain, microenterprises also show 99% of all the commercial industry, registered. As a whole, the microenterprises sector contributes approximately 28% in the Gross Domestic Product (GDP) of Bahrain. Despite huge significance of microenterprises in Bahrain, there is not much researched or studied about them. The purpose of the study is to provide a complete overview of the SME sector of Bahrain, including its role in eradicating unemployment, so that economic growth can take place. This paper is quite beneficial for the individuals of Bahrain, for providing guidance, regarding the role of SMEs in reducing unemployment. This paper defines that unemployment is a big problem but microenterprises in Bahrain play a positive role in reducing it. The information for this paper is collected from research papers, articles, and books which describe the role of small enterprises in reducing unemployment. Microenterprises in Bahrain reduce the negative effects of unemployment and also improve the standard of living. This paper also attempts to explore the main aspects of the current debate on the regulation and supervision of microfinance in Bahrain, along with arguments related to regulation and supervision of microfinance. In order to reach its full potential and further grow as a credible development tool in Bahrain, the microfinance industry must eventually be able to enter in the area of licensed, supervised financial intermediation to be able to capture and minimize any financial crises or crimes that may possibly occur. Steps to promote their establishment, especially in low socioeconomic settings are also included.

Keywords

Unemployment • Microenterprises • Bahrain • Small and medium enterprises (SMEs)

1 Introduction

In developing and developed countries, the role of microenterprises as the main source of economic growth and the creation of employment opportunities has been acknowledged by all the economic and social policy researchers and makers. Also, in Bahrain, the idea of economic growth and unemployment are considered to be the most important, when policy makers discuss economic policies. Currently, employment opportunities and increasing the rate of economic growth are considered as important issues. As per the Labor Market Regulatory Body, almost 90% of registered companies have less than 10 employees in Bahrain, and approximately 98% of them employed less than 50 people each. This shows that the economy of Bahrain mainly depends upon its microenterprises sector. Thus, this can play a pivotal role in the success of Bahrain's economy (Oxford Business Group 2018).

Unemployment demonstrates the fraction of people who are capable of and are willing to work, but are unable to find relevant jobs. The major reason for people to be unemployed in Bahrain is the inadequateness of capital and investments. Technological advancement has introduced more sophisticated machinery that requires less handling and manpower for operations, hence depleting job opportunities in the

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process. As per the latest report presented by the Ministry of Labour, the unemployment in Bahrain was 3.7% in 2017, previously it was 4.0% in 2016, which shows the reduction in unemployment rate, which may be due to government policies (Alrayes and Abu Wadi 2018).

While in 2006, Bahrain's government has established Tamkeen, as essential microenterprises development tool. This semi-government body focuses on encouraging the formation of new SMEs and providing support to existing ones, in order to strengthen the SMEs sector. It has spent around BD 51 m ($120 m) in guarantee payments and profits, so the SMEs factor can grow. After the success of Tamkeen, the government initiated the enterprise support program, to offer experience building through foreign placements of employees, to get international exposure (Oxford Business Group 2018).

The purpose of this paper is to provide an overview of the microenterprises sector of Bahrain, along with its role in eliminating unemployment. This paper also contributes to build up nascent research study and literature on Bahraini SMEs.

2 Research Methodology

This paper is mostly based on secondary data; including reviewing literature systematically, organized into three stages including planning, executing, and reporting. Published literature from indexed journals was selected to evaluate concepts, such as unemployment, microenterprises, role of microenterprises in alleviating unemployment, and challenges faced by microenterprises in Bahrain. Ten to 18 papers were reviewed and keeping in view recent published literature. The search was conducted on the renowned scientific paper database including Google Scholar, which is properly cited and referenced.

3 Literature Review

Unemployment is not a severe problem in Bahrain because research data revealed that the unemployment rate in the underlying country in May and June 2012 was 4.5% and 4.8%, respectively, but it has reduced in December 2012 to 3.9% (International Labor Organization 2017).

Unemployment is a technical term to describe. Several times it is simply thought to be lack of job vacancy whereas there are people who have an ability to work and are still not counted as unemployed such as students in secondary and tertiary phases. The International Labor Organization categorizes Unemployed persons aging from 16 to 59 years of age without work, actively seeking employment, and these unemployed persons have taken specific steps to search for paid work (Juwei 2003).

Microenterprises or Small and Medium Enterprises (SMEs) play an important role in most of the economies of the world, particularly in developing economies. As per report issued by World Bank in 2017, SMEs contribute around 60% of total employment and 40% of total national Income (GDP) in most of the emerging economies. The figures are higher, after including the informal SMEs. Also, as per its estimation, almost 600 million jobs will be required to cater the upcoming global workforce, which requires further development of the SME sector (World Bank 2017).

A study was conducted by the Organization for Economic Cooperation and Development (OECD) on the importance of microenterprises' role in alleviating unemployment. It describes that microenterprises are the predominant form of enterprise, which provides main source of employment—almost 70% average—and also are major contributors in value creation (OECD 2017). In emerging economies like Bahrain, SMEs can contribute up to 45% of total employment and 33% of GDP.

A study by the Edinburgh Group, also explored the role of micro or small enterprises in economic growth. According to it, SMEs play a significant role in world economy and contribute a major portion of income, output, and employment. However, some recent global financial crisis created tough climate for SMEs, but it is now improving with time (Edinburgh Group 2018).

According to Cravey et al. micro and small-scale enterprises play an important role in boosting economic growth and generating job opportunities. He discovered that microeconomic setups sustain well in changing economic environment. They are flexible about adjusting to change since it is easier to introduce a reform and manage it in a small setting. Small-scale enterprises also promote regional development and help in the export market expansion (Alia 2014).

The definition of micro and small enterprises varies significantly across different regions of the world. What may be considered a microenterprise in developed countries may actually be classified as a small enterprise in developing countries. This variation is mainly due to the amount of the workforce deployed and the capital invested, plus the level of technological sophistication is diverse in different countries.

The Bolton Committee designed a definition encompassing economic and statistical aspects and it defines micro and small enterprises as an independent company, which has a small fraction of market share and is run by the owner themselves, lacking a proper organizational structure and management. Size, input to GDP, job opportunities, exports, and overall contribution to the economy are all considered,

considering the statistics (Hassan and Kashif 2016). According to SMEsDA, microenterprises include those firms that have less than 10 employees working for them and have a fixed turnover of Rs. 2.5 million.

Small enterprises are exceptionally significant to all economies across the globe, but more so to developing nations. He said that small enterprises not only contribute toward economic output but also endorse the creation of decent job opportunities. He believed that micro and small enterprises are seeds for large-scale industries of the future and directly play a part in boosting economies (Sayre 2016).

In the European Union, microenterprises are defined as independent firms employing fewer than ten employees and the annual turnover for this firm should not exceed two million Euros. In other regions including the U.S., micro to small enterprises includes firms constituting employees fewer than 500.

Similarly, a small enterprise in Japan may be considered as a large one in other developing regions of the world. In Yemen, an enterprise employing fewer than four employees is considered to be small, whereas in Jordan, the number of employees between two and 10 qualify for a small enterprise (Alia 2014). In Africa, small enterprises are further divided into three tiers based upon the capital invested. These levels include firms with capital less than 100 €, capital between 100–700 € and capital between 700–10,000 €.

In Algeria, firms with one to nine employees and an annual turnover of fewer than 20 million dinars are considered to be small enterprises. In Indonesia, firms employing less than 20 employees and in Ghana firms employing one to four employees are classified as microenterprises. Hence, the definition of micro and small enterprises primarily depends upon government policies varying from country to country (World Bank Group 2019).

A study conducted in Mekelle city demonstrated that microenterprises are quite efficient in creating job opportunities for a significant number of individuals. The average number of employees working in small enterprises was seven, and this number showed an increment in the consecutive years (Hassan and Kashif 2016).

Ghazala analyzed microenterprises to find a sound linkage with development in the economy. She discovered that micro firms provide employment to four to five individuals on an average and are more labor-intensive. They not only promote capital generation, but also contribute to the betterment of family welfare by providing Rs. 52–Rs. 59 thousand on a monthly basis.

Levitsky discovered that the microenterprises, even though constituting a single self-employed individual, were the main source of income for more than half of the population in developing nations. He also concluded that with the help of considerable attention given to these micro setups by the government, a huge difference was made in their development.

The aforementioned literature review provides evidence from different regions of the world, regarding the important role, microenterprises play in countering unemployment and boosting economic growth. Apart from this, micro and small-scale enterprises are also crucial to the generation of exports, technological advancement, and improvement of skills and promotion of innovative thinking. To summarize, microenterprises support and strengthen the part played by the private sector in economic growth and contribute significantly to the national economy, especially when it comes to developing countries. They are an effective solution to the problem of unemployment and are capable of providing jobs to a large range of the workforce belonging to different backgrounds, acquiring diverse skill sets. These micro setups inevitably ensure political and social stability and provide create job opportunities for individuals that lack academic or financial support to work or get employed.

4 Main Findings

4.1 Microenterprise Sector of Bahrain

Bahrain is situated in western shores of the Arabian Gulf, covering the total land area of 765.3 km^2. Within the entire Arabian Gulf in 1930, oil was first discovered in Bahrain. It is classified as a "high income economy" with Gross National Income per capita of 42,930 PPP dollars, in 2017 and has a 1.493 million population. It also placed as 62nd in World Bank's 2019, "Ease of doing Business" rankings out of 190 economies of the world (World Bank 2018).

As per an official report of the Ministry of Industry, Commerce and Tourism of Bahrain, SMEs cater to almost 30% of Bahraini economy, with almost 6335 enterprises in the whole country (Asharq Al-Awsat 2018). Also, among all Gulf countries, Bahrain is particularly friendly with the SMEs sector, as almost 99% of all of Bahrain's businesses fall under the SMEs category.

As mentioned in Table 1, microenterprises contain up to 10 employees, with the annual turnover of Bahraini Dinars (BD) 50,000. In the case of small enterprises, six to 50 employees are considered, with the annual turnover of Bahraini Dinars (BD) 50,0001–1 million. On the other hand, medium enterprises contain 51–100 employees and have an annual turnover of Bahraini Dinars (BD) 1,000,002–3 million.

From Table 2, it can be observed that microenterprises hold a major part of SMEs in Bahrain, consisting 92.78%, which shows that it provides employment to millions of people. With further development in this sector, more

Table 1 Definition of SMEs in the Kingdom of Bahrain

Category	Number of employees	Annual turnover (Bahraini Dinars)
Micro	Up to 5	1–50,000
Small	6–50	50,001–1 million
Medium	51–100	1,000,001–3 million

Source Ministry of Industry, Commerce and Tourism (2018)

Table 2 Distribution of different enterprises in Bahrain

Category	Number of enterprises	Portion of enterprises (%)
Microenterprises	85,000	92.78
Small enterprises	5485	5.99
Average enterprises	950	1.04
Large enterprises	176	0.19
Total	91,611	

Source Asharq Al-Awsat (2018)

employment opportunities can be created. Also, Jafar al-Sayegh, member of Bahrain Economists Association, said that the SMEs sector holds 28–30% of Bahraini economy and can play an important role in reducing the unemployment.

4.2 Main Organizations in Bahrain

Over the last few years, the Bahrain government has brought many changes in SMEs sector regulations. Initially, mainly two organizations, Tamkeen and Labor Market Regulatory Authorities (LMRA); was overseeing the SMEs sector. Recently, His Royal Highness Prince Salman Bin Hamad Al-Khalifa introduced an SMEs Development Board to coordinate with the Ministry of Industry, Commerce and Tourism, Tamkeen, Bahrain Development Bank and Bahrain Chamber of Commerce and Industry (BCCI). It aims to foster the economic growth of microenterprises and assist with the creation of more jobs and increase GCP contributions.

The current government has also introduced an Integrated Tasks Plan to develop the SMEs sector over the next five years. This plan will focus on accessing market and finance, streamlining the business environment and fostering skills developments for reducing unemployment.

In 2006, Tamkeen was formed as national reform in Bahrain, mainly for support and development of the private sector, including individuals and enterprises, in order to enhance their growth and productivity. It was classified into two levels; individual support programs and enterprises support programs (ESP). ESP aims to provide support to existing and new businesses through different types of schemes, including Tasweeq (marketing support), Tarweej (support in exhibitions) along with many others (Saad Znad Darwish 2014).

In 2017, a $100 million fund was launched in Bahrain for the SMEs sector. This initiative was taken by Tamkeen with the collaboration of Ibdar Bank and Islamic Corporation for Development (ICD) (Arabian Business 2017).

The CEO of Tamkeen, Dr. Ebrahim Mohammed Janahi said, "Through this partnership, we aim to provide further support to enterprises in the kingdom, to achieve their highest potentials."

A substantial amount of work has been done over the years to prove that micro and small-scale enterprises play a pivotal role in alleviating unemployment. Last year, Industry, Commerce and Tourism Minister of Bahrain, Zyed Bin Rashid al-Zayani introduced a national plan, along with the collaboration of Economic Development Board, Bahrain Development Bank, and Tamkeen, to further develop the microenterprise sector of Bahrain. This plan will focus on all the axes of the sector, including the legislative aspects. He further assures that this new plan will increase the capability of the SMEs sector and thus, there will be more creation of jobs (Economic Development Bank Bahrain 2017).

5 Challenges Identified

One of the major challenges faced by micro and small-scale enterprises in Bahrain include the lack of leadership. Most small-scale firm owners are not properly trained when it comes to exercising leadership skills. Given the challenges of running a business and leading a workforce, it isn't exactly easy to manage all the matters without being skilled to do so. Also, Bahrain micro and small-scale enterprises lack a sound organizational setup. Owners of these firms

should at least define a clear goal and outline work ethics in order to ensure a healthy environment and quality of employment. A simple yet strategic plan should be introduced to ensure the smooth running of operations and management of the business. Following traditional pathways and simple techniques strip the business off of a competitive edge, which is quite essential to thrive in the modern market, dominated by technological advancements. In order to cut down on costs and maximize profit, small-scale enterprises in Bahrain struggle to maintain quality and productivity. Political changes in Bahrain also have a great influence on micro and small-scale setups. Owners of micro and small-scale setups do not have control over the politically driven increase in costs. Since most of these setups are situated in rural areas, it is difficult to promote innovative thinking and ideas, hence setting these enterprises back in terms of modernization and advancement. Having access to funds and credit is essential for the growth of microenterprises in Bahrain and financial intermediaries pose a challenge to these setups when it comes to providing funding and capital in form of loans. Even if loans are provided, the lack of flexibility and underlying assets of the firm being treated as collateral don't really help the enterprise grow (Hayat and Malik 2014).

In Bahrain, SMEs are small, thus, to run them responsibly, it is crucial to meticulously take care of the legal issues. One of the main issues that seem to prevail among these small-scale businesses in Bahrain includes handling and paying taxes. Determining the right amount of taxes to pay is important, otherwise resulting in fines and even legal charges. Apart from that, even though microenterprises employ a small number of workforces, issuing proper employee contracts are still essential to protect the company's as well as the worker's interests. These contracts should include payment, termination clauses, rights and responsibilities, and work ethics and rules. Contracts to deal with unsatisfied customers should also be taken into consideration to protect the business from suffering substantial losses. In Bahrain, small and medium enterprise law is implemented, which provides support in the development of micro and small enterprises. Additionally, there are many organizations like Tamkeen that are working for the development of SMEs in Bahrain.

Poor people in Bahrain have faced financial service needs and it is the duty of the microfinance industry to fulfill those needs. The microfinance industry and SMEs in Bahrain must have specialized licenses to successfully perform its services. The regulatory and legal framework in Bahrain governs microfinance and creates restrictions that all the products and services are according to the regulation. There must be legal relationships between the recipient and the provider of transactions. The microfinance industry has faced several regulations in Bahrain such as microfinance law, the related laws and regulations, implementing administrative regulations and executing administrating agencies properly organized and staffed. The credit and saving associations which are the informal providers of microfinance services do not need to register nor are regulated. The semiformal providers of microfinance services must legally register them because they are supervised or regulated. The microfinance industry is also licensed and regulated with the Ministry of Finance under the Convention Cadre Agreement (Bahrain Economic Development Bank 2018). The microfinance industry must follow the external reporting rules such as Dutch GAAP or US GAAP and IFRS. All of the reporting rules are typical and can be changed with the passage of time. The microfinance institutions, which take interest from individuals in their loan amount, have to pay taxes to the government on the interest amount paid by the people.

6 Discussion

Microenterprises are crucial to counter the increasing rate of unemployment and under the light of the evidence provided by the literature review; essential steps should be taken to exploit the maximum potential of this set up for growth and development of Bahrain's economy. In order to develop and endorse the establishment of microenterprises, the government needs to provide these business owners with funds in form of loans in order to encourage them to expand and grow, creating more job opportunities in the process. With the ever-evolving industry and technological advancements, training employees to upgrade their skills and working methods is more of a necessity than a requirement. It will not only allow them to compete in bigger markets but will also provide them with an edge essential for their long-term sustainability. Bahrain also provides early retirement options which help to create new opportunities after retirement. The government of Bahrain also provides subsidies to the SMEs (Hassan and Kashif 2016). The government should support this by conducting free training workshops for employees working at micro and small-scale enterprises to standardize the setup. Conferences should be conducted to discuss new ideas and innovative techniques that can, in turn, help microenterprises grow and develop. The government should also provide microenterprise owners with incentives to counter high rent and transportation costs. A major reason that contributes toward unemployment is the high rate of illiteracy. To counter this, educational programs should be introduced to allow everyone to have access to at least basic level education. Since most of the microenterprise setups are situated in rural areas, the concept of exploiting traditional skills and promoting goods and products that are pertinent to that particular area will not only promote culture but will

also reduce costs in terms of transportation of resources and raw materials (World Bank 2017). Women are a significant part of microenterprises. Encouraging them to work by educating them will not only promote women empowerment but will also eventually improve the area's GDP per capita with an increase in the number of working class. Besides empowering women, it promotes the betterment of the society as it is. It is also important to reinforce the significance of the nonagricultural sector and people should be encouraged to work in village-based industries rather than just relying on farming. Last but not least, the government should help create awareness about market opportunities, improved technological setup, and skills that would be beneficial to these microenterprises. This could be done by organizing trade fairs and exhibitions, organizing buyer–seller meetings, collaborating with large-scale firms, creating awareness and publicizing (Wagner 2014).

7 Conclusion

Micro and small enterprises are recognized all across the globe for their unique influences on economic growth and their role in countering unemployment. It is safe to say that micro and small enterprises are the backbone of both developed and developing nations around the world and hence particular attention should be given to this sector in order to work on its betterment to fully exploit its potential.

In Bahrain, microenterprises represent more than 93% of the total enterprises. Although, Bahrain government is quite serious regarding the development of the SMEs sector, still, there is lot of room for improvement. Many microenterprises are facing capital issues, which should be resolved by government. Unemployment can also be alleviated only by the development of the SMEs sector.

No doubt, Bahrain has invested in constructing a business support environment for SMEs development. It also was in the forefront to find new and innovative ways to provide support to the SMEs sector in the form of capital and flexible laws. Despite all the measures, the Bahraini government is still facing some issues in development of the SMEs sector, and thus there is also a significant percentage of unemployed people in Bahrain.

As a whole, this research paper clearly outlines the seriousness of the problem that unemployment is and how microenterprises in Bahrain play a significant role in countering it. This also provides extensive evidence through literature review from different regions of the world which demonstrates how microenterprise setups have helped create job opportunities, promote economic growth, promote innovative thinking, and improve economies as a whole.

8 Recommendations

This paper covers unemployment as a problem affecting economy of Bahrain and how microenterprises in the underlying country can act as a major tool to counter it. However, further work needs to be done in order to lay down effective policies to implement the efficient set up of microenterprises, especially in low-income settings. Further research needs to be done regarding the factors that pose a major challenge in the development of these small-scale enterprises and ways to counter them should be discussed. Research work including literature, targeting unemployment, and efficacy of microenterprises in these regions can give more direction to the topic.

The government of Bahrain should provide its focus to increase their capital which will also reduce the country's unemployment. Advancement in technology has also increased which reduces the need of people because technology performs more efficient work as compared to individuals. Microenterprises play an essential role in providing more jobs to people and providing a positive contribution to the economy of Bahrain. The government must reduce barriers from microenterprises so that they can easily start their businesses.

The government should also find more ways to reduce the capital shortage and establish laws and regulations to support the microenterprises. Tamkeen should also increase its pace for development of SMEs. All the institutions should work together for the growth of the SMEs sector, ultimately contributing to the reduction of unemployment. The government can also initiate interest-free loan schemes for the SME sector to encourage them to grow their business.

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Assessing Crop Yield and Risk: A New Method for Calculating Insurance Based on Rainfall

Fabian Capitanio, Azzam Hannoon, Jeffrey Darville, and Alessio Faccia

Abstract

The aim of this paper is to explore a new method for data analysis that could be used for insurance calculations. In many agricultural nations rainfall per year and per annual quarter are good indications of the productive capacity in farmland. Essentially, there is a curvilinear relationship between rain and crop yield. The goldilocks zone varies by region and product, however, every farmer and minister of agriculture fears drought and/or flood. A Copula Quantile Regression (CQR) approach provides a novel approach to estimate the dependence of a function of the yield with respect to climate factors. This is then combined with quantile regression for nonlinear optics. This approach utilizes "Big Data" modeling and analytics to draw upon the wealth of information contained in the RICA databases. This study assesses variables such as the share of land covered by a sprinkler system, altitude, fragmentation of land, production intensity, rain, and temperature. It was found that this method provides a simpler and more flexible approach to analyze complex ecological, geological, economic, and sociological factors that impact business and commerce through risk management, strategic planning, and insurance.

Keywords

Crop yield and risk insurance • Risk management • Strategic planning • Agriculture • Climate factors

1 Introduction

Risk is a component of all business activities, but the agricultural sector has its peculiarities. The risks to which agricultural enterprises are subjected and which can compromise the income of the company are different: (a) risks related to production (agronomic, phytosanitary, health, environmental, climate, etc.), (b) market risks (sales price fluctuation), and (c) risks linked to the price of production factors. In particular, the climatic risks (more and more frequent) for the agricultural productions represent a challenge for the correct definition of (financial) instruments useful for the common agricultural policy and for the Rural Development Policy.

The European Union has included risk management among the priorities of the rural development policy for the 2014–2020 programming period. Since 1 January 2015, the EU Reg. 1308/2013 and the EU Reg. 1305/2013 (Rural Development Policy) has become operational and de facto represent the totality of financial aid for risk management in agriculture. The financial resources available to agricultural enterprises for the next six years are immense. Aid for agricultural risk management is divided into:

- ex-post: financial coverage of part of the damage after the incident occurred (due to adverse weather conditions);
- ex-ante: aid provided for risk prevention.

Ex-post aid is rarely available because compensatory aid for damage due to insurable adversity is no longer available. Within the framework of the ex-ante aid, on which we will concentrate, two types of instruments can be distinguished:

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- active hedging (anti-frost systems, anti-hail nets);
- passive hedging (insurance policies).

The passive preventive hedging tools (insurance) are the focus of this research. An insurance contract is a tool through which the company transfers its risk to third parties (insurance company). The company that underwrites an insurance contract effectively transfers to third parties (insurance company) the business risk or part of it, which in this case is represented exclusively by potential damage due to adverse weather or epizootics. At the same time, the insurance company is obliged, in respect of the insured, to compensate the company if an accident occurs according to the contract conditions. For the transfer of risk the agricultural company must bear a cost (insurance premium), for which it can receive partial financial support from the European Union or the State. The agricultural enterprise, which intends to sign an insurance contract, has two possibilities: adherence to a collective contract or the signing of an individual insurance contract.

Thanks to the application of the Copula Quantile Regression (CQR) approach the authors are able to effectively estimate the dependence of the function with respect to climate factors and the empirical analysis leads to the identification of threshold values, and the computation of the insurance premium can be divided into two phases. In the first phase, the aim is to estimate the relationship between climatic factors (FC: average rainfall, average temperature, maximum and minimum) and yield with an econometric model. Second, the yield of the individual products should be attributed an economic value. In the second stage, the analysis identifies the distribution of FC odds and calculates threshold values and award.

Professor Fabian Capitanio has contributed to this research with his valuable experience for setting and deciding on the model variables and for framing the framework of the European agricultural system in general and Italian. In particular, Dr. Alessio Faccia has contributed to determine the implementation of the statistical mathematical model, test the data using the RICA database and to determine the conclusions. Dr. Azzam Hannoon contributed to the determination of the literature review and to the formulation of the starting hypotheses. Dr. Jeffrey Darville contributed to the definition of the conclusions, the revision of the paper, and the proofreading.

2 Literature Review

2.1 Estimation Methods

So far most studies use correlation coefficients, simple linear regression based on Ordinary Least Squares (OLS), or a generalization of OLS to explain the variation in crop yields by a weather index (Berg and Schmitz 2008; Clover and Nieuwoudt 2003; Lobell and Burke 2010; Piearce 1984; Chowdhury et al. 2016; Birthal et al. 2015). These approaches, which rely on relationships being conditioned on the mean response of the yield to the weather index, suffer from at least three disadvantages that represent structural limitations for the insurance design.

First, responses of crop yield to weather are not constant across all potential states of weather realizations (Schlenker and Roberts 2006). For instance, marginal crop yield responses to (additional) rainfall strongly depend on the level of water already being available to the plant. Second, crop yields are often not normally distributed but are negatively skewed (Zheng et al. 2008; Swinton and King 1991). This is in many cases associated with the frequent occurrence of outliers, i.e., yield realizations that do not follow the pattern described by the majority of yield observations. Deriving mean-based relationships between crop yields and weather indices in these situations cause highly inefficient or even biased estimates (Hubert et al. 2010).

Third, the focus on mean-based measures itself neglects a substantial amount of information, which is highly relevant to generate efficient insurance solutions. This is due to the fact that farmers are more concerned with below-average situations (e.g., exceptionally low crop yield events), and the inclusion of these events in insurance contracts (Antle 1987; Groom and Gray 2008; Kumbhakar and Tveterås 2003). In some cases, these adverse events may even affect the continuation of a farm (Moschini and Hennessy 1999). Although robust regression approaches can reduce the outlier problem (Finger et al. 2013) and nonparametric methods overcome the first two drawbacks of OLS regression outlined above (Vedenov and Barnett 2004), they still conceptually focus on the mean response. Hence, tailoring the insurance design to extreme events is—even though promising—not possible.

These approaches assume, as already mentioned, a linear relationship between the variables. To overcome that limitation, the considered approach is based on Copula functions in a combined method with the quantile regression, which aims to establish the relationship between yield and FC conditioning in nonlinear optics. The model parameters are estimated using the maximum likelihood method.

Several studies have been carried out on the risk insurance in agriculture and the development of the sector, the first research (Valdés et al. 1986) that appears, however, systematic was carried out in America in the mid-80 s, highlighting the same problems that now afflict the sector, even if then the problem of climate change was not so evident. Later, in the 1990s, attention focused mainly on the study of the role that agricultural insurance plays in developing countries (Hazell 1992). Finally, in the 2000s, attention shifted to the study of climate change, in particular

paying attention to climatic indices related to agriculture (especially in the poorest areas) (Barnett and Mahul 2007), on government policies (Mahul and Stutley 2010), national and European standards, and risk assessment models (Glauber 2004; Faccia 2012). The analysis of climate change and the role of information and insurance, however, represent the most current and discussed topic among researchers (Mullins et al. 2018), companies in the sector and governments, interested in sustaining agricultural development (Dalhaus et al. 2018; Arias et al. 2018; Sidibé et al. 2018; Počuča et al. 2018).

However, no study has, so far, used the methodology applied in this research, which instead managed, given the variables used, to provide empirical evidence, based on a valid and internationally recognized database concerning the critical determinants to be analyzed to determine the risk in agriculture. In particular, the risk related to rainfalls is particularly interesting for the determination of the insurance risk. The assessment of this risk is decisive for establishing the right cost of insurance premiums, avoiding market distortions, especially as the sector often benefit from government subsidies, given the importance of supplying food.

3 Analysis: Data Base and Analytical Procedures

3.1 Dataset

For the realization of this study, we can use three databases. The first database is provided by the FADN/ RICA. It is micro-data on an annual basis, related to agricultural enterprises for the period 2008–2014 (7 years). The dataset is longitudinal in the sense that most companies are taken over time. Furthermore, a regular update of the sample is provided in order to preserve the representativity compared to the reference population. The RICA contains information such as yield, irrigation, altitude, production intensity, work unit, etc. The second database contains information on rainfall, average temperature, minimum and maximum daily basis, disaggregated at the sub-provincial level. The third dataset is provided by ISMEA (Institute for Agricultural and Food Market Services) and contains the prices of agricultural products to be broken down to the level of the major markets throughout the country.

The obstacle that occurs is related to different units of observation of three databases (agricultural enterprises, sub-provincial areas, and markets), the removal of which can occur in two different ways. Firstly, we could consider the individual farmer as observed unit. In this case, the values of climate variables of sub-provincial area are attributed to all the farms in the sample localized in such area. The second way consists in taking as the unit of observation the sub-provincial area for which climate data is available. In such cases, all the farms belonging to sub-provincial area are aggregated into a single synthetic farmer which corresponds to a weighted average for the size. The latter approach has the limit of drastically reducing the sample size, limiting the effectiveness inferential analysis.

3.2 Econometric Model

We first consider the following Cobb-Douglas production function slightly modified to take account of the FC:

$$Y_{ijt} = L_{ijt}^{\alpha}(\mathrm{FC}_{ijt}\,\mathrm{HA}_{ijt})^{1-\alpha}, \tag{1}$$

where Y_{ijt} represents yield, L_{ijt} is the equivalent labour unit, and HA_{ijt} are the hectares of the ith farmer for the jth crop in tth year. Following this modelization, HA_{ijt} contribution (or impact) on production is affected by FC_{ijt}.

Dividing both terms by HA_{ijt}, we have:

$$\frac{Y_{ijt}}{\mathrm{HA}_{ijt}} = \left(\frac{L_{ijt}}{\mathrm{HA}_{ijt}}\right)^{\alpha} \mathrm{FC}_{ijt}^{1-\alpha} \tag{2}$$

Transforming the Eq. (2) in terms of growth rate, we obtain:

$$\frac{\dot{Y}_{ijt}}{\mathrm{HA}_{ijt}} = \alpha\frac{\dot{L}_{ijt}}{\mathrm{HA}_{ijt}} + \beta\dot{FC}_{ijt} + \gamma X_{ijt} + u_{ijt} \tag{3}$$

where instead of $(1-\alpha)$ we consider a more generic β by taking into consideration not constant returns to scale; X represents a set of control variable and u is a vector of error term. Alternatively, we could estimate the following log transformation of Eq. (3):

$$\log\left(\frac{Y_{ijt}}{\mathrm{HA}_{ijt}}\right) = \alpha_j\left(\frac{L_{ijt}}{\mathrm{HA}_{ijt}}\right) + \beta_j \log(\mathrm{FC}_{ijt}) + \gamma X_{ijt} + u_{ijt} \tag{4}$$

As well known, the weather events affect differently on agricultural production depending on when they occur with respect to the productive cycle of the crops. Therefore, necessarily we need to distinguish the effect of FC in the different stages. This can be done empirically by inserting in Eqs. (3) and (4)—not already the annual average value of FC, but—as many variables are the phases or the months of the production cycle. Moreover, we can compare different models with a different number of months or stages (e.g., using the Hausman test) to identify the number of stages that makes the model most efficient.

It would be possible to test the overall estimation using appropriate tests for the stability of the parameters estimated at the regional level and by type of agricultural product. In the latter case, it is possible to test the hypothesis that $\beta j = \beta$, or if there exist steadiness in case of a subset of similar crop.

The variable X of the Eqs. (3) and (4) is defined by two groups of variables that influence the agricultural product: the factors that are constant in the medium term, e.g., soil quality and soil, and other factors that generally improve over time as the biodiversity, cultivation practices (rotations, etc.), irrigation tools and structures (Wang et al. 2016). Using the wealth of information contained in the FADN/RICA databases, one may consider the following variables belonging to the two groups described above: the share of land dedicated to the production of the agricultural product covered by a sprinkler system, altitude, fragmentation of land, production intensity as crop share of the total available to the farm.

It would also be possible in this environment to test the hypothesis (very plausible) of nonlinearity in the relationship between yield and FC, adding the quadratic term of the FC in the set of independent variables. Quantile regression (Koenker and Bassett 1978) may be an alternative approach (Finger et al. 2013; Olalekan and Adeyinka 2013; Kapphan et al. 2012) especially in a more general version that uses the copula functions, defined in the literature as "copula quantile regression" (Bouyé and Salmon 2013).

The quantile regression focuses on the estimation of the relationship between yield and FC in quantile (median and quartiles) rather than in the media as is found in the classic one.

Therefore, we establish a relationship between yield (y) and WI (=FC).

$$y = g(\mathrm{WI}) + \varepsilon$$

Quantile regression leads to the following minimization problem:

$$\min_{\beta\varepsilon R^K}\left(\sum_{t\varepsilon \mathrm{T}_p} p|y_t - x_t\beta| + \sum_{t\varepsilon \mathrm{T}_{1-p}} (1-p)|y_t - x_t\beta|\right)$$

with $T_p = \{t : y_t \geq x_t\beta\}$ and T_{1-p} represents his addition referring at pth quantile.

The vector ε is generally characterized by a Gaussian distribution, and this implies the adoption of the same distribution for either the yield or FC or and their joint distribution.

This assumption of normality is not always found in the empirical analysis. For this reason, an analysis that includes generalized nonlinear models has been carried out. The copula quantile regression is a nonlinear quantile regression technique that makes use of copula functions. The main advantage of this method consists in the possibility of separating the estimate of the marginal distributions of the variables taken into consideration (in this case, yield and FC) from that of their joint distribution obtaining, in this way, a simpler and more flexible approach. The choice of the distribution shape for marginal can be separated and arbitrary, and different from the one selected for their joint distribution.

The copula quantile regression employs the concept of copula conditioning (in terms of the partial derivative of the copula compared to the values assumed by the FC variable) to estimate the dependence of function of the yield on climate factors in relation to the desired quantile. Denoting by x and y, two random variables, with CF_{xx}, F_{yy}—the copula function characterized by the parameter δ that binds uniform marginal distribution functions, Fxe Fy, and p—the probability distribution of y conditional on x (usually expressed as a partial derivative of the copula than $Fx(x)$), we get the following minimization problem:

$$\min\delta\left(\sum_{t\varepsilon \mathrm{T}_p} p|y_t - q(x_t,p;\delta)| + \sum_{t\varepsilon \mathrm{T}_{1-p}} (1-p)|y_t - q(x_t,p;\delta)|\right)$$

with $T_p = \{t : y_t \geq q(x_t,p;\delta)\}$ e $q(x,p;\delta) = F_y^{-1}\left(DF_x(x),p;\delta\right)$,

where D is the inverse of the partial derivative of Copula and, finally, $Fy{-}1$ is the pseudo-inverse of Fy.

3.3 The Economic Value of the Yield

Typically, the yield variable is not expressed in the corresponding economic value but in the amount of product produced (e.g., tons/hectares). In this case, it is necessary to associate with the average yield, the price for each year and for each crop considered. Specifically, you could use the average price of the agricultural market nearest the farmers considered. It seems appropriate that compensation is linked to the average price realized on the product before it occurred the adverse climatic event. Indeed, it is likely that the post climatic event price is positively affected by a reduction in supply.

3.4 Timeline of the Compensation

According to some approaches, it might be offered a policy that provides compensation for example if the rain is below or above a given threshold value, but only if such an event occurs at certain times of the year (or months). These periods correspond to the stages of the production cycle for which, according to the econometric analysis, there is a greater correlation between climatic events and yields.

3.5 Originality

The most studies in the literature focus on just one climatic variable: rain and, in some cases, temperature. The use of copula function combined with the quantile regression technique in the multivariate field, considering both rain and temperature, is an interesting methodological advancement aimed to overcome the limitations associated with the linearity and to the excessive rigidity of the models used so far and which allows, in this way, to obtain estimates that are more reliable.

4 Findings: Results and Related Considerations

Phase 2 consists of the following steps:

1. We use available data on FC to calculate the parameters of their probability distribution.
2. Calculate the expected value (pure risk premium or actuarial) as a result of specific climate events.
3. The expected value would be increased by a risk factor and a mark up for administrative and operational costs. The amount resulting would represent the insurance premium.

The following is a breakdown of each step. We identify a probability distribution for FC and we estimate the value of the parameters. Usually, in the literature, the gamma distribution is utilized (Poudel et al. 2018), whose parameters can be estimated using the maximum likelihood method (MLE) whose expression is to maximize the following log-likelihood:

$$L(\alpha,\beta;\mathrm{FC}) = (\alpha-1)\sum_{i=1}^{N}\ln(\mathrm{FC}_i) - \frac{1}{\beta}\sum_{i=1}^{N}(\mathrm{FC}_i) - N\alpha\ln(\beta) - N\ln(\Gamma(\alpha)) \tag{5}$$

where α and β are parameters of shape and scale, respectively; Γ represents the gamma distribution and N represents the sample.

Following the literature, it is assumed a put insurance contract with two thresholds: strike and limit. The strike is the level of FC (e.g. rain) under which you are entitled to compensation (above or up, e.g., see wheat or tomato). The higher the level of rain is set below the strike level, the higher the compensation. After reaching the lower threshold (limit) of the level of rain, the compensation reaches its maximum and becomes constant. Schematically, placing the maximum compensation equal to 1, we have:

$$0\,\text{se FC} > \text{strike}\,\frac{\text{strike}-\text{FC}}{\text{strike}-\text{limit}}\,\text{se limit} < \text{FC} \le \text{strike}\,1\,\text{se FC} \le \text{limit} \tag{6}$$

The expected indemnity value in the case of maximum compensation of 1, with strike and threshold limit values, is, therefore, given by the following integral function:

$$0\,\text{limit}f(\mathrm{FC})d\mathrm{FC} + \int_{\text{limit}}^{\text{strike}}\left(\frac{\text{strike}-\text{FC}}{\text{strike}-\text{limit}}\right)f(\mathrm{FC})d\mathrm{FC}, \tag{7}$$

where f(FC) is the density function.

The maximum indemnity value may be set as the value of the cost (price × decreased yield) that corresponds (on the basis of the econometric model) to a level of precipitation equal to the threshold limit.

Another important question relates to the choice of threshold limit values and strike that has been set at the level that identifies the maximum likelihood of the link among yield and FC. Moreover, we set a coefficient to transfer the gap between observed rain in the year of the contract (expressed in mm) and the strike set in the contract that is a nonlinear identification among yield and strike aimed to transform rain in indemnity (Euro).

The product of the expression (7) and the maximum compensation gives the expected value of the effective compensation, corresponding to the actuarially fair premium or pure. In other words, the fair risk premium identified by this methodology represents the probability that the threshold introduced in the insurance contract can be exceeded at the current time of the contract's functioning.

The risk factor, reloading for administrative and operational costs, can be identified in a proportion to be added to the pure premium. It is believed that the estimated costs for car insurance policies can be taken as a reference. In the American market, the relationship between those costs and the pure premium is on average equal to 40% (Mahul and Stutley 2010).

We found in our empirical analysis for 27 provinces and 6 crops that a higher risk reduction implies a benefit for both, the insured, whose interest lies in an effective risk-hedging instrument and a low basis risk, and the insurer, who is concerned with insurance demand and willingness to pay.

In addition, our findings show that the relative risk reduction of our analysis compared to OLS increases while lowering the strike level. Notably, lowering the strike level means less frequent insurance payout, which leads conceptually to catastrophic index insurance. Index insurance is triggered only by extreme events; however, has a much stronger systemic component, which leads to an increased yield-index correlation and a reduced basis risk. For this reason, index-based insurances designed as a disaster relief instrument, seem to be promising (Khan and Watts 2009;

Alderman and Haque 2007; Barnett et al. 2008), and copula function is in particular powerful to condition the yield-index to these extremes.

We found that our methodology improves the yield-index representation, especially in the lower tails of the distribution and hence increases the risk-reducing properties of index-based insurances.

5 Conclusions and Recommendations

Carrying out the analysis, we set pricing for all crops/province analyzed. Focusing on qualitative analysis of rain distribution, e.g., rain time series since 1975–2015 for Verona province, is interesting to emphasize that is quite evident a decreasing trend throughout the time considered (see Fig. 1); also, focusing on the picture of distribution error is interesting to remark the increase in variance of the latest decades (see Fig. 2).

Coming back at the empirical results from our model, we represent the strike, coefficient, and pricing for all crops and province analyzed in Tables 1, 2, 3, 4, 5, and 6.

Our methodology is a flexible approach to represent the functional relationship between variables, extending the classical mean-conditioned view to the extremes. In this paper, we evaluate the risk-reducing properties of a new weather index-based insurance design which conditions the relationship between crop yield and weather index using Quantile Regression (QR). Carrying out our analysis, we set pricing for 5 crops and 27 provinces analyzed.

Focusing on qualitative analysis of rain distribution, e.g., rain time series from 1975–2015 for each province is interesting to emphasize that a decreasing trend is observed throughout the time considered; focusing on the picture of distribution error its interesting to observe the increase in variance of the latest decades.

The market orientation of the CAP has significantly increased over time and at the same time its exposure to

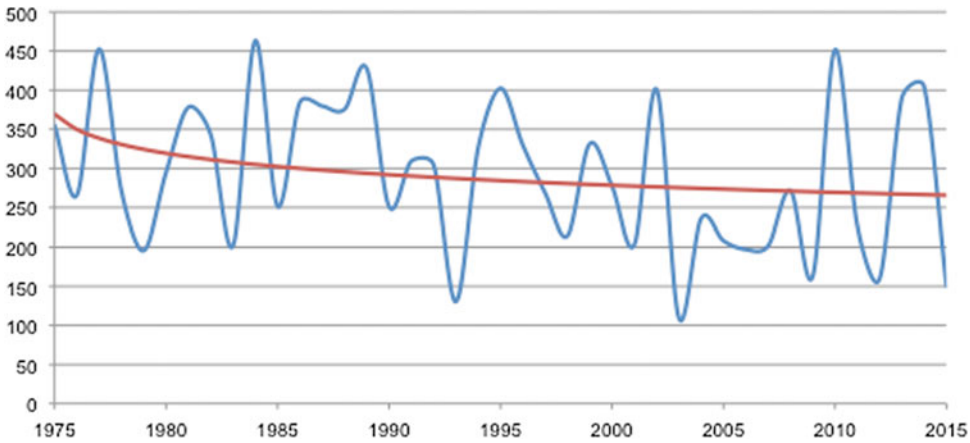

Fig. 1 Pricing of crops in the latest decades

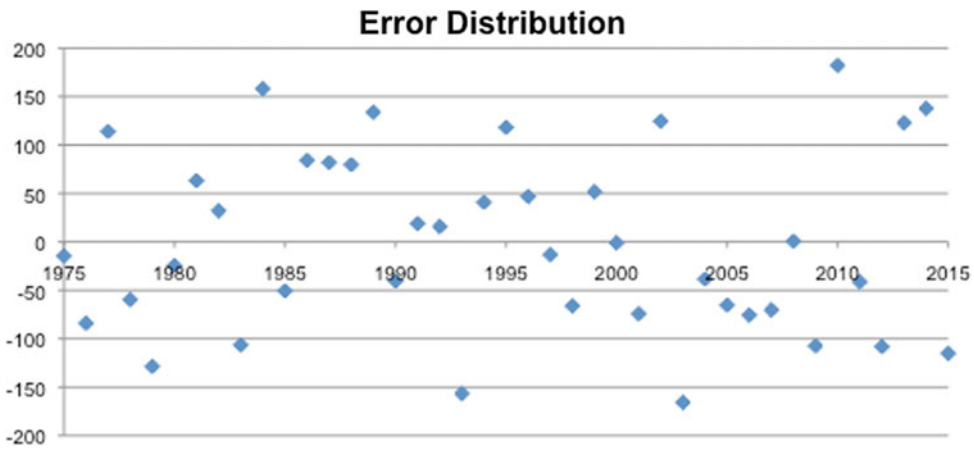

Fig. 2 Distribution error in the latest decades

Table 1 "Erba medica" (alfalfa) results

WS	Province	Yield	DDD (Stike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Alexandria	Alexandria	94.06	493.76	0.1894	3256.52	336.53	285.46	153.55	103.07	3.98	2.67
Castehuovo Scrivia	Alexandria	76.77	493.67	0.1546	3147.76	33667	28,940	125.29	84.11	3.98	2.67
Novi Ligure	41r.sandria	33.06	47,621	0.13671	135.554	333.77	286.09	62.05	36.01	4.58	2.68
Ancona	Ancona	8514	355.98	0.2397	3.61431	249.19	213.59	125.22	88.29	3.46	2.44
Novi Ligure	Ancona	10,374	352.72	0.2247	423.339	246.9	211,763	115.09	83.90	2.71	1.97
Benevento	Benevento	6302	47.52	0.1471	2.78475	313.27	26,451	108.50	52.74	3.89	1.39
Anzola del'Emilia	Bologna	97.00	40,617	0.2608	3977.00	234.74	244,136	28.91	10.72	0.73	0.27
Bologna	Bologna	87.69	40,128	2116	339.444	23476	240.65	26.30	9.08	0.73	0.25
Orzinuovi	Brescia	6642	54,755	0.1174	2.72321	383.50	32,471	5.93	–	0.22	0.00
Campobasso	Campobasso	78.52	79,588	2560	3219.12	207.82	179.13	48.53	21.54	1.51	0.67
Petrella Tifernin	Campobasso	74.59	29,628	2432	325.823	207.82	17,413	46.10	20.47	1.51	0.67
Mondragone	Caserta	20,000	392.77	6929	8200.00	274.4	235.66	226.04	97.28	2.76	1.19
Crema	Cremona	107.05	532.62	0.1946	4329.06	372.3	319.57	17.18	0.60	0.39	0.01
Cremona	Cremona	88.27	484.93	0.1762	3619.02	339.45	29,296	33.29	2.83	0.92	408
Alberone	Fans	11,929	434.64	2670	4915.45	30,425	260.78	137.61	75.95	2.50	1.55
Faun	Latina	102.07	493.59	2448	4.13492	282.51	242.15	128.75	79.69	3.06	1.90
Lana	Latina	70.27	345.71	0.1968	2281.12	242.03	20,743	59.50	34.45	2.07	1.20
Suzzara	Mantova	81.25	366.78	2144	323,125	256,475	220.07	75.96	34.89	2.28	1.05
Mania	Milano	84.35	491.47	1661	3.45852	344.03	294.211	18.27	–	0.53	0
Milano	Milano	104.63	499.66	42,077	42130.99	349.76	29,950	38.20	9.34	0.89	0.22
Modena	Modena	11,120	414.12	22,613	4583.64	MSS	24,447	33.00	13.33	0.72	0.29
Cittadella	Padova	101.90	527.51	41,370	4177.32	36,926	31,650	34.73	10.10	0.13	0.24
Parma	Parma	103.05	484.93	2157	4.43024	339.45	29,496	40.75	3.47	0.92	8
Mondolfo	Pesaro Urbino	70.10	356.30	0.1935	227,425	249.41	213.78	99.12	69.62	3.45	2.42
Pesaro	Pesaro Urbino	72.34	382.53	21,231	2366.14	267.77	229.52	47.29	5.17	1.55	0.17
Fionenzoula d'Arda	Piacenza	8648	494.29	41,694	454,430	346.03	296.57	44.62	11.03	1.26	0.31
Volterra	Pisa	90.57	446.61	41,963	3.71325	312.63	26,707	51.19	73.47	1.38	0.63
Merano	Ravenna	94.51	376.55	2430	3275.11	26343	225.93	77.46	15.87	1.87	0.41
Cervia	Ravenna	6221	368.65	5649	2575.13	253.06	221.19	43.69	3.68	1.70	0.14
Brescello	Reggio Emilia	102.14	457.40	0.3582	413,736	341.18	292.44	26.99	–	0.64	0.00

(continued)

Table 1 (continued)

WS	Province	Yield	DDD (Stike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Rovigo	Rovigo	160.23	434.64	0.3582	6.59417	304.75	26,478	184.60	101.88	2.80	1.55
Trecenta	Rovigo	108.09	403.92	22,593	4.43161	282.75	242.35	136.67	84.54	3.05	1.91
Altavilla	Salerno	85.65	397.80	2084	3311.66	278.46	23,908	87.23	36.20	2.48	1.33
Battipaglia	Salerno	76.79	404.97	0.1224	127,911	283.44	242.95	81.02	33.77	2.59	1.08
Chiusdino	Soma	60.03	409.97	0.1417	2461.03	286.93	245.98	54.98	27.67	2.23	1.12
Seinna	Soma	63.04	442.66	0.1379	235,420	30,986	765.59	34.94	15.86	1.35	0.61
Verona	Verona	112.01	501.08	2.10E+05	439,222	330.76	30,055	42.41	457	0.92	0.01
Taquinia	Viterba	28.49	322.52	46,865	1.1672	223.76	19,321	30.54	5.46	2.61	0.47
Tuscania	Viterba	53.51	379.29	0.13E6	2.19403	26,550	22,757	62.33	34.66	2.84	1.53
Viterba	Viterba	65.16	382.62	41,648	2.67127	26,723	22,927	84.56	48.51	3.17	1.81

Table 2 Overall results for durum wheat

Alessandria	Alessandria	47.39	290.62	0.1588	1943.01	203.44	116.25	111.60	5.74%	3.43%
Castelnuovo Scrivia	Alessandria	53.33	290.15	0.1790	2186.44	203.11	116.06	125.17	5.72%	3.42%
Ancona	Ancona	46.57	231.08	0.1963	1909.30	161.76	92.43	62.11	3.25%	1.88%
Filottrano	Ancona	47.01	231.71	0.1976	1927.35	162.20	92.68	58.36	3.03%	1.88%
Benevento	Benevento	42.68	367.10	0.1132	1749.86	256.97	146.84	46.28	2.64%	1.60%
Bologna	Bologna	65.68	271.28	0.2358	2693.04	189.89	108.51	38.42	1.43%	0.27%
Campobasso	Campobasso	29.95	233.41	0.1250	1228.06	163.39	93.36	24.15	1.97%	0.90%
Petrella Tifernina	Campobasso	41.04	233.41	0.1713	1682.77	163.39	93.36	33.10	1.97%	0.90%
Alberone	Ferrara	58.18	277.71	0.2041	2385.43	194.40	111.08	78.83	3.30%	2.01%
Ferrara	Ferrara	55.19	253.40	0.2121	2262.60	177.38	101.36	60.17	2.66%	1.45%
Mesola	Ferrara	48.69	278.70	0.1702	1996.44	195.09	111.48	43.09	2.16%	1.01%
Foggia	Foggia	37.35	163.42	0.2226	1531.24	114.39	65.37	42.11	2.75%	1.76%
Lesina	Foggia	39.71	151.81	0.2548	1628.26	106.26	60.72	68.34	4.20%	2.54%
Lucera	Foggia	37.83	163.46	0.2254	1550.97	114.42	65.38	42.58	2.75%	1.75%
Rignano Garganico	Foggia	39.88	163.42	0.2377	1635.06	114.39	65.37	44.97	2.75%	1.76%
San Severo	Foggia	40.53	163.53	0.2414	1661.77	114.47	65.41	45.07	2.71%	1.72%
Latina	Latina	46.05	254.19	0.1765	1888.16	177.93	101.68	85.27	4.52%	2.82%
Sezze	Latina	29.50	283.57	0.1013	1209.50	198.50	113.43	41.80	3.46%	1.94%
Lecce	Lecce	14.98	215.03	0.0679	614.25	150.52	86.01	21.79	3.55%	1.94%
Nardò	Lecce	21.60	213.80	0.0984	885.48	149.66	85.52	30.78	3.48%	1.88%
Aliano	Matera	23.49	188.12	0.1216	963.25	131.69	75.25	80.53	8.36%	5.41%
Matera	Matera	28.88	210.52	0.1336	1183.97	147.37	84.21	51.12	4.32%	2.68%
Modena	Modena	55.54	268.33	0.2016	2277.24	187.83	107.33	32.07	1.41%	0.23%
Monselice	Padova	60.53	302.20	0.1951	2481.62	211.54	120.88	49.97	2.01%	0.75%
Padova	Padova	59.52	293.88	0.1973	2440.12	205.72	117.55	58.45	2.40%	0.88%
Monreale	Palermo	30.67	258.70	0.1155	1257.48	181.09	103.48	39.60	3.15%	1.19%
Partinico	Palermo	33.33	258.96	0.1254	1366.67	181.27	103.58	43.20	3.16%	1.20%
Parma	Parma	57.39	309.48	0.1806	2353.16	216.64	123.79	55.32	2.35%	0.86%
Mondolfo	Pesaro Urbino	47.26	231.27	0.1990	1937.70	161.89	92.51	64.64	3.34%	1.96%
Pesaro	Pesaro Urbino	46.01	238.00	0.1883	1886.44	166.60	95.20	45.28	2.40%	0.92%
Tavullia	Pesaro Urbino	49.38	237.98	0.2021	2024.47	166.58	95.19	48.56	2.40%	0.92%
Volterra	Pisa	33.84	286.56	0.1150	1387.56	200.59	114.63	23.64	1.70%	0.63%
Alfonsine	Ravenna	51.83	241.21	0.2093	2124.98	168.85	96.48	46.90	2.21%	0.77%
Cervia	Ravenna	55.79	235.78	0.2305	2287.46	165.05	94.31	34.01	1.49%	0.48%
Altavilla Silentina	Salerno	28.24	311.43	0.0883	1157.65	218.00	124.57	40.02	3.46%	1.66%
Chiusdino	Siena	29.62	267.09	0.1080	1214.23	186.96	106.83	15.52	1.28%	0.13%
Siena	Siena	36.22	294.09	0.1200	1485.11	205.86	117.63	7.39	0.50%	0.08%
Chivasso	Torino	50.85	387.95	0.1277	2084.75	271.57	155.18	128.54	6.17%	4.06%
Alcamo	Trapani	29.90	246.13	0.1183	1225.72	172.29	98.45	29.19	2.38%	0.90%
Cavarzere	Venezia	59.12	294.76	0.1954	2424.03	206.33	117.90	58.36	2.41%	0.78%
Lonigo	Vicenza	92.52	312.49	0.2884	3793.20	218.75	125.00	60.60	1.60%	0.53%
Tarquinia	Viterbo	38.63	236.76	0.1589	1583.71	165.73	94.71	55.20	3.49%	2.05%
Tuscania	Viterbo	38.99	270.22	0.1406	1598.73	189.15	108.09	33.32	2.08%	0.40%
Viterbo	Viterbo	40.26	262.03	0.1496	1650.52	183.42	104.81	52.15	3.16%	1.59%

Table 3 Overall results for soft wheat

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Alessandria	Alessandria	58.59	290.62	0.1988	2402.22	203.44	174.37	137.97	82.39	5.74	3.43
Castelnuovo Scrivia	Alessandria	62.88	290.15	0.2137	2578.26	203.11	174.09	147.61	88.08	5.72	3.42
Novi Ligure	Alessandria	50.22	318.18	0.1556	2058.94	222.73	190.91	68.40	48.32	3.32	2.35
Ancona	Ancona	38.18	231.08	0.1629	1565.22	161.76	138.65	50.92	29.36	3.25	1.88
Filottrano	Ancona	56.08	231.71	0.2386	2299.12	162.20	139.03	69.62	43.18	3.03	1.88
Benevento	Benevento	56.83	367.10	0.1526	2330.16	256.97	220.26	61.62	37.21	2.64	1.60
Montesarchio	Benevento	42.55	296.62	0.1415	1744.68	207.63	177.97	70.35	38.96	4.03	2.23
Bologna	Bologna	63.27	271.28	0.2300	2594.26	189.89	162.77	37.01	6.97	1.43	0.27
Cremona	Cremona	58.21	309.48	0.1854	2386.55	216.64	185.69	56.11	20.55	2.35	0.86
Pizzighettone	Cremona	61.90	328.05	0.1860	2537.88	229.63	196.83	31.02	5.65	1.22	0.22
Alberone	Ferrara	67.82	277.71	0.2408	2780.69	194.40	166.63	91.89	55.76	3.30	2.01
Ferrara	Ferrara	55.72	253.40	0.2168	2284.47	177.38	152.04	60.75	33.19	2.66	1.45
Foggia	Foggia	35.00	163.42	0.2112	1435.00	114.39	98.05	39.46	25.25	2.75	1.76
Latina	Latina	50.98	254.19	0.1977	2089.99	177.93	152.52	94.39	58.93	4.52	2.82
Sabaudia	Latina	37.86	260.21	0.1435	1552.43	182.15	156.12	45.93	22.67	2.96	1.46
Sezze	Latina	58.05	283.57	0.2018	2379.89	198.50	170.14	82.25	46.08	3.46	1.94
Nardò	Lecce	18.18	213.80	0.0839	745.45	149.66	128.28	25.91	14.05	3.48	1.88
Casalpusterlengo	Lodi	64.46	298.99	0.2126	2642.67	209.29	179.39	91.19	38.43	3.45	1.45
Suzzara	Mantova	71.01	302.40	0.2315	2911.40	211.68	181.44	54.68	19.96	1.88	0.69
Matera	Matera	30.00	210.52	0.1405	1230.00	147.37	126.31	53.11	32.93	4.32	2.68
Milano	Milano	62.65	298.39	0.2070	2568.84	208.87	179.03	85.04	34.00	3.31	1.32
Modena	Modena	55.89	268.33	0.2054	2291.50	187.83	161.00	32.27	5.37	1.41	0.23
Casale di Scodosia	Padova	59.88	286.03	0.2064	2455.12	200.22	171.62	74.05	47.24	3.02	1.92
Cittadella	Padova	71.93	339.73	0.2088	2949.12	237.81	203.84	48.50	22.21	1.64	0.75
Monselice	Padova	62.42	302.20	0.2036	2559.10	211.54	181.32	51.53	19.28	2.01	0.75
Padova	Padova	54.41	293.88	0.1826	2230.82	205.72	176.33	53.44	19.68	2.40	0.88
Parma	Parma	59.62	309.48	0.1900	2444.57	216.64	185.69	57.47	21.05	2.35	0.86
Mondolfo	Pesaro Urbino	44.72	231.27	0.1907	1833.61	161.89	138.76	61.16	35.85	3.34	1.96
Pesaro	Pesaro Urbino	44.17	238.00	0.1830	1811.12	166.60	142.80	43.47	16.72	2.40	0.92
Tavullia	Pesaro Urbino	47.87	237.98	0.1983	1962.77	166.58	142.79	47.08	18.12	2.40	0.92

(continued)

Table 3 (continued)

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Fiorenzuola d'Arda	Piacenza	54.85	331.76	0.1630	2248.71	232.23	199.06	19.47	5.29	0.87	0.24
Volterra	Pisa	34.84	286.56	0.1199	1428.31	200.59	171.94	24.33	8.96	1.70	0.63
Alfonsine	Ravenna	63.98	241.21	0.2615	2623.23	168.85	144.72	57.89	20.23	2.21	0.77
Cervia	Ravenna	67.15	235.78	0.2808	2753.17	165.05	141.47	40.94	13.08	1.49	0.48
Brescello	Reggio Emilia	57.80	310.83	0.1833	2369.77	217.58	186.50	48.97	18.95	2.07	0.80
Rovigo	Rovigo	66.30	277.71	0.2354	2718.34	194.40	166.63	89.83	54.51	3.30	2.01
Trecenta	Rovigo	70.32	253.26	0.2738	2882.96	177.28	151.96	76.54	41.83	2.66	1.45
Siena	Siena	35.50	294.09	0.1190	1455.50	205.86	176.45	7.24	1.10	0.50	0.08
Chivasso	Torino	46.24	387.95	0.1175	1896.01	271.57	232.77	116.90	76.93	6.17	4.06
Moncalieri	Torino	55.29	391.29	0.1393	2266.75	273.91	234.78	80.95	38.35	3.57	1.69
Torino	Torino	55.96	399.82	0.1380	2294.33	279.88	239.89	85.60	41.46	3.73	1.81
Cavarzere	Venezia	64.70	294.76	0.2164	2652.58	206.33	176.86	63.86	20.68	2.41	0.78
Verona	Verona	65.12	308.87	0.2079	2669.96	216.21	185.32	55.78	20.49	2.09	0.77
Lonigo	Vicenza	62.14	312.49	0.1961	2547.92	218.75	187.50	40.70	13.42	1.60	0.53
Tarquinia	Viterbo	42.81	236.76	0.1783	1755.12	165.73	142.06	61.18	36.00	3.49	2.05
Tuscania	Viterbo	36.48	270.22	0.1331	1495.53	189.15	162.13	31.17	6.04	2.08	0.40
Viterbo	Viterbo	39.04	262.03	0.1469	1600.81	183.42	157.22	50.58	25.52	3.16	1.59

Table 4 Overall results for maize

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Alessandria	Alessandria	88.66	267.68	0.3173	3635.06	160.61	133.84	130.35	73.16	3.59	2.01
Castelnuovo Scrivia	Alessandria	101.45	267.58	0.3632	4159.45	160.55	133.79	149.01	83.66	3.58	2.01
Novi Ligure	Alessandria	95.71	233.30	0.3930	3924.10	139.98	116.65	154.93	100.49	3.95	2.56
Ancona	Ancona	59.12	186.46	0.3038	2423.95	111.87	93.23	124.96	70.32	5.16	2.90
Filottrano	Ancona	45.16	187.05	0.2313	1851.41	112.23	93.52	91.72	51.14	4.95	2.76
Montesarchio	Benevento	42.97	127.57	0.3227	1761.67	76.54	63.79	94.53	50.59	5.37	2.87
Bologna	Bologna	95.06	218.62	0.4166	3897.49	131.17	109.31	101.04	42.24	2.59	1.08
Orzinuovi	Brescia	100.42	307.20	0.3132	4117.20	184.32	153.60	39.35	14.02	0.96	0.34
Campobasso	Campobasso	47.40	153.27	0.2963	1943.42	91.96	76.64	15.99	4.14	0.82	0.21
Crema	Cremona	136.16	290.71	0.4487	5582.63	174.43	145.35	69.27	33.63	1.24	0.60
Cremona	Cremona	109.07	275.17	0.3797	4471.74	165.10	137.58	68.61	25.51	1.53	0.57
Pizzighettone	Cremona	126.75	290.71	0.4177	5196.71	174.43	145.35	64.49	31.31	1.24	0.60
Alberone	Ferrara	100.82	250.41	0.3857	4133.60	150.25	125.20	163.97	87.46	3.97	2.12
Ferrara	Ferrara	94.78	228.80	0.3968	3885.82	137.28	114.40	134.21	67.10	3.45	1.73
Mesola	Ferrara	88.03	249.93	0.3374	3609.32	149.96	124.97	72.16	28.57	2.00	0.79
Rignano Garganico	Foggia	47.98	113.35	0.4055	1967.09	68.01	56.68	98.97	45.74	5.03	2.33
Latina	Latina	118.05	131.22	0.8618	4839.96	78.73	65.61	410.08	265.41	8.47	5.48
Sabaudia	Latina	123.55	130.12	0.9096	5065.48	78.07	65.06	383.53	229.56	7.57	4.53
Sezze	Latina	81.35	138.87	0.5612	3335.52	83.32	69.44	251.83	164.46	7.55	4.93
Casalpusterlengo	Lodi	90.16	278.33	0.3103	3696.53	167.00	139.16	67.92	22.36	1.84	0.60
Suzzara	Mantova	117.46	277.28	0.4058	4815.77	166.37	138.64	93.90	46.92	1.95	0.97
Milano	Milano	104.14	279.83	0.3565	4269.58	167.90	139.91	79.86	26.25	1.87	0.61
Modena	Modena	87.54	228.96	0.3663	3589.16	137.38	114.48	77.08	15.30	2.15	0.43
Casale di Scodosia	Padova	99.59	266.06	0.3586	4083.22	159.63	133.03	175.27	84.56	4.29	2.07
Cittadella	Padova	107.16	315.82	0.3250	4393.40	189.49	157.91	45.93	9.10	1.05	0.21
Monselice	Padova	105.22	275.79	0.3655	4313.88	165.47	137.89	78.71	21.20	1.82	0.49
Padova	Padova	100.97	273.19	0.3541	4139.95	163.91	136.60	63.66	17.15	1.54	0.41
Parma	Parma	102.58	275.17	0.3571	4205.94	165.10	137.58	64.53	23.99	1.53	0.57

(continued)

Table 4 (continued)

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Pesaro	Pesaro Urbino	69.29	206.63	0.3212	2840.71	123.98	103.32	74.74	22.22	2.63	0.78
Tavullia	Pesaro Urbino	55.53	206.60	0.2575	2276.56	123.96	103.30	60.62	17.79	2.66	0.78
Fiorenzuola d'Arda	Piacenza	97.02	240.74	0.3861	3978.00	144.45	120.37	75.98	33.50	1.91	0.84
Alfonsine	Ravenna	80.56	201.23	0.3835	3303.04	120.74	100.62	76.99	22.21	2.33	0.67
Cervia	Ravenna	102.79	196.39	0.5014	4214.30	117.83	98.19	114.55	53.95	2.72	1.28
Brescello	Reggio Emilia	109.90	276.75	0.3804	4505.83	166.05	138.38	65.37	26.50	1.45	0.59
Rovigo	Rovigo	103.47	250.41	0.3959	4242.44	150.25	125.20	168.29	89.76	3.97	2.12
Trecenta	Rovigo	103.63	229.47	0.4327	4248.99	137.68	114.74	149.95	73.77	3.53	1.74
Altavilla Silentina	Salerno	28.00	132.56	0.2024	1148.00	79.54	66.28	60.68	33.14	5.29	2.89
Chiusdino	Siena	32.50	185.41	0.1679	1332.50	111.25	92.71	35.93	16.24	2.70	1.22
Chivasso	Torino	92.99	338.51	0.2632	3812.76	203.11	169.26	177.81	107.41	4.66	2.82
Moncalieri	Torino	92.78	350.72	0.2534	3804.11	210.43	175.36	118.09	72.66	3.10	1.91
Torino	Torino	111.70	361.33	0.2961	4579.56	216.80	180.66	81.51	33.04	1.78	0.72
Cavarzere	Venezia	103.06	278.33	0.3547	4225.61	167.00	139.16	74.97	19.08	1.77	0.45
Verona	Verona	107.29	291.68	0.3524	4398.74	175.01	145.84	59.57	18.94	1.35	0.43
Lonigo	Vicenza	109.36	288.10	0.3637	4483.81	172.86	144.05	117.19	44.54	2.61	0.99
Tarquinia	Viterbo	147.93	115.59	1.2261	6065.09	69.35	57.79	506.96	337.92	8.36	5.57
Tuscania	Viterbo	80.16	166.73	0.4606	3286.58	100.04	83.36	139.90	69.14	4.26	2.10
Viterbo	Viterbo	69.48	175.98	0.3782	2848.52	105.59	87.99	133.01	81.07	4.67	2.85

Table 5 Overall results for olive oil

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Ancona	Ancona	35.73	493.71	0.0733	1464.96	641.83	691.20	16.00	3.62	1.09	0.25
Filottrano	Ancona	57.81	492.79	0.1188	2370.02	640.63	689.91	26.63	6.07	1.12	0.26
Benevento	Benevento	43.76	695.96	0.0637	1794.28	904.75	974.35	34.77	11.81	1.94	0.66
Montesarchio	Benevento	54.17	581.69	0.0943	2220.83	756.19	814.36	78.78	42.85	3.55	1.93
San Pietro Vernotico	Brindisi	35.67	400.10	0.0903	1462.41	520.13	560.14	24.03	11.00	1.64	0.75
Campobasso	Campobasso	45.55	426.11	0.1083	1867.38	553.94	596.55	31.52	20.23	1.69	1.08
Petrella Tifernina	Campobasso	30.52	426.11	0.0726	1251.50	553.94	596.55	21.12	13.56	1.69	1.08
Foggia	Foggia	32.51	318.70	0.1033	1332.92	414.31	446.18	27.20	11.67	2.04	0.88
Lesina	Foggia	37.57	311.39	0.1222	1540.19	404.81	435.95	30.73	13.14	2.00	0.85
Lucera	Foggia	35.10	317.67	0.1119	1439.06	412.97	444.74	30.35	13.11	2.11	0.91
Rignano Garganico	Foggia	29.09	318.70	0.0925	1192.62	414.31	446.18	24.34	10.44	2.04	0.88
San Severo	Foggia	45.80	317.63	0.1461	1877.96	412.92	444.68	39.65	17.14	2.11	0.91
Latina	Latina	69.19	515.44	0.1360	2836.87	670.07	721.62	46.14	17.94	1.63	0.63
Sabaudia	Latina	25.87	520.46	0.0504	1060.70	676.60	728.65	11.78	4.49	1.11	0.42
Sezze	Latina	34.75	555.62	0.0634	1424.86	722.30	777.86	18.71	4.31	1.31	0.30
Lecce	Lecce	29.37	408.79	0.0728	1204.20	531.43	572.31	20.58	11.01	1.71	0.91
Nardò	Lecce	17.91	409.16	0.0443	734.38	531.90	572.82	13.89	8.08	1.89	1.10
Aliano	Matera	21.05	350.06	0.0609	863.06	455.08	490.09	39.58	23.53	4.59	2.73
Matera	Matera	22.08	399.66	0.0560	905.33	519.56	559.53	10.45	2.53	1.15	0.28
Monreale	Palermo	34.50	429.01	0.0815	1414.35	557.72	600.62	14.22	2.78	1.01	0.20
Partinico	Palermo	46.36	432.02	0.1087	1900.85	561.62	604.83	27.52	9.97	1.45	0.52
Mondolfo	Pesaro Urbino	50.71	494.09	0.1040	2079.29	642.31	691.72	22.44	5.08	1.08	0.24
Pesaro	Pesaro Urbino	53.97	517.71	0.1056	2212.95	673.03	724.80	2.93	–	0.13	0.00
Tavullia	Pesaro Urbino	64.08	518.02	0.1253	2627.31	673.43	725.23	3.38	–	0.13	0.00
Volterra	Pisa	32.25	653.07	0.0500	1322.17	848.99	914.29	25.13	15.92	1.90	1.20
Altavilla Silentina	Salerno	36.15	622.43	0.0588	1482.28	809.16	871.41	41.98	26.42	2.83	1.78
Battipaglia	Salerno	22.22	633.49	0.0355	911.11	823.54	886.89	22.45	14.32	2.46	1.57
Chiusdino	Siena	12.00	581.35	0.0209	492.00	755.76	813.89	2.01	0.32	0.41	0.06
Siena	Siena	14.86	626.35	0.0240	609.28	814.25	876.89	1.01	–	0.17	0.00
Alcamo	Trapani	23.48	416.26	0.0571	962.55	541.14	582.77	11.72	4.68	1.22	0.49

(continued)

Table 5 (continued)

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Verona	Verona	21.00	663.39	0.0321	860.93	862.40	928.74	3.93	0.78	0.46	0.09
Tarquinia	Viterbo	21.63	487.45	0.0450	886.97	633.69	682.43	17.71	8.57	2.00	0.97
Tuscania	Viterbo	42.31	551.30	0.0777	1734.81	716.68	771.81	15.47	4.85	0.89	0.28
Viterbo	Viterbo	40.76	553.61	0.0746	1671.04	719.69	775.05	21.54	7.46	1.29	0.45

Table 6 Overall results for tomato

WS	Provincia	Yield	DDD (strike)	Coeff	Tot_yield	Strike_30%	Strike_40%	Tot_pay_out_1	Tot_pay_out_2	Rate_1 (%)	Rate_2 (%)
Alessandria	Alessandria	556.71	450.11	1.1663	22,825.09	585.15	630.16	380.59	186.99	1.67	0.82
Castelnuovo Scrivia	Alessandria	663.46	450.00	1.3903	27,201.71	585.00	630.00	454.52	223.35	1.67	0.82
Benevento	Benevento	166.667	390.48	0.4025	6833.33	507.62	546.67	226.59	130.62	3.32	1.91
Cremona	Cremona	598.80	460.89	1.2252	24,550.90	599.16	645.25	328.07	249.12	1.34	1.01
Mesola	Ferrara	802.88	420.16	1.8020	32,918.13	546.21	588.23	675.41	411.88	2.05	1.25
Foggia	Foggia	962.24	210.62	4.3083	39,451.95	273.80	294.86	1568.81	1087.69	3.98	2.76
Lesina	Foggia	1104.75	200.77	5.1890	45,294.86	261.00	281.08	1277.72	871.45	2.82	1.92
Lucera	Foggia	864.24	210.71	3.8678	35,433.77	273.92	294.99	1405.98	973.86	3.97	2.75
Rignano Garganico	Foggia	1006.76	210.62	4.5076	41,277.00	273.80	294.86	1641.38	1138.00	3.98	2.76
San Severo	Foggia	1052.85	210.69	4.7123	43,167.04	273.90	294.97	1713.49	1187.06	3.97	2.75
Latina	Latina	701.25	285.87	2.3132	28,751.25	371.63	400.21	957.67	677.17	3.33	2.36
Sezze	Latina	670.30	304.43	2.0763	27,482.21	395.76	426.21	1303.92	901.74	4.74	3.28
Aliano	Matera	400.00	201.90	1.8682	16,400.00	262.47	282.67	1581.55	1277.06	9.64	7.79
Matera	Matera	802.78	243.51	3.1088	32,913.89	316.56	340.91	1473.24	1006.31	4.48	3.06
Parma	Parma	672.95	460.89	1.3769	27,590.89	599.16	645.25	368.69	279.97	1.34	1.01
Fiorenzuola d'Arda	Piacenza	746.27	443.95	1.5852	30,597.01	577.13	621.53	310.66	165.70	1.02	0.54
Alfonsine	Ravenna	698.49	352.54	1.8684	28,638.24	458.30	493.55	731.93	382.68	2.56	1.34
Altavilla Silentina	Salerno	921.05	334.05	2.6001	37,763.16	434.26	467.67	1922.96	1370.33	5.09	3.63
Battipaglia	Salerno	618.35	342.77	1.7012	25,352.46	445.60	479.88	1135.05	771.39	4.48	3.04
Alcamo	Trapani	117.652	207.30	0.5352	4823.53	269.50	290.23	122.82	75.76	2.55	1.57
Cavarzere	Venezia	560.79	465.46	1.1361	22,992.36	605.10	651.64	1129.30	750.78	4.91	3.27
Tarquinia	Viterbo	942.49	257.96	3.4453	38,641.98	335.35	361.15	976.74	622.76	2.53	1.61
Tuscania	Viterbo	838.49	328.32	2.4083	34,378.05	426.81	459.64	1150.62	653.53	3.35	1.90

world markets. In the context of climate change and higher occurrence of extreme events, farmers' exposure to yield, price, and income variability will increase. In this scenario, Italy is one of the EU countries whit higher public intervention in the field of risk management in agriculture.

Nowadays, public support, however, has been characterized by a substantial failure if we consider that less of 20% of the overall production in Italy is insured. We showed that QR improves the yield-index representation, especially in the lower tails of the distribution and hence increases the risk-reducing properties of index-based insurances. This finding contributes to an improved contract design, which is essential as imperfect hedging seriously challenges the acceptance, implementation, and up-scaling of index-based insurance tool.

In this view, paying attention to new tools to manage farmer revenue risk would represent a fundamental task for Italian Agriculture Ministry; index-based contract would catch a large share of agricultural production considering lower costs of the insurance premium and his simple mechanism. Moreover, would identify a solution of asymmetric information problem that notoriously plagued crop insurance viability.

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Banking System in the MENA Region: A Comparative Analysis Between Conventional and Islamic Banking in the UAE

Fiona Mrad and Miroslav Mateev

Abstract

This paper investigates the banking systems in the MENA region and compares the performance of conventional and Islamic banks in the UAE, using descriptive, correlation, and multiple regression analyses to analyze their efficiency and profitability. The analysis uses a sample of 352 observations from 32 banks, for 11 years (2005–2015). We find a significant difference in cost efficiency between conventional and Islamic banks in the UAE. The impact of bank-level characteristics and capital adequacy measures on a bank's cost efficiency is strong in both types of banks. Risk-taking has a strong influence on the cost efficiency of conventional banks, but this effect is insignificant for Islamic banks. We find that profitability is not significantly different between conventional and Islamic banks. The effect of capital adequacy measures on a bank's profitability is strongly significant only in the group of conventional banks. However, Islamic banks' profitability is more responsive to risk-taking. We are suggesting that since Islamic and conventional banks are governed by different rules and principles, then setting up and implementation of regulations should be different for each type of bank to improve their financial performance, compliance standing, and risk assessment. We also recommend that banking systems in the MENA region should increase their ability to adapt applicable reforms and share the Islamic banking principles and instruments as they are more efficient toward the social responsibility and the risk effects.

Keywords

MENA region • Conventional banking • Islamic banking • Cost efficiency • Profitability • Financial crisis

1 Introduction

The Middle East and North Africa (MENA) region has faced several key challenges and conflicts over the last decade and is still recovering from interacting crises ensued from political issues, civil wars, terrorism, economic crisis, oil prices, and revenues decline (Ghenimi et al. 2017). As a result, the increase in volatility of commodity prices and inflation have caused monetary policy to be less accommodative which in turn led to increasing the potential risk and policy uncertainty over the long run, especially in the oil trading markets; reforms were essential to boost and rebound potential outputs in the economic growth over the long term (Lassoueda et al. 2017). The MENA countries are enduring challenges and setting economic agendas, reforming policies, and government effectiveness to reach political stability, economic growth, and sustainability (Ghenimi et al. 2015), but because of the uncertainty, it is very challenging for these countries to adequately tackle the issues with risk and corruption (Shaukat et al. 2017).

Over the last decade, the Islamic banking and finance in the MENA region recorded a rapid growth of 10–12% on an annual basis, and increased coverage of Shari'ah compliance by financial institutions, banks, capital markets, and insurance companies (The World Bank 2015). Islamic finance is based on Shari'ah principles with emphasis on equity, ethicality, sustainability, economic and social responsibility, avoidance of oppression, and risk sharing (Addawe 2012). The impact of the financial crisis in 2008–2009 caused panic in the region's banking system and highlighted the banking system's behavior toward risk. The financial crisis impact

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was found to be higher in countries that are oil exporters than oil importers. The oil price decline impacted the GCC countries which are oil exporters, and to stabilize their economic growth, they have to set measures to cut oil production, generate other sources of revenues, and implement the Value Added Tax (VAT) in 2018. The commercial banks in the region came under financial distress as the foreign investments declined, so prices fell, and the construction developers had to sell-off in regional markets that increased mortgage defaults along with the drop in oil prices that resulted in sharp decline in the stock market. IMF recommended that the MENA countries' governments offer the commercial banks deposit guarantees and reform the monetary policy to strengthen the banking systems (Habibi 2009).

The implications of the central banks' monetary policy in the MENA region contribute to a fiscal policy that aims to increase the national GDP growth. Developments of the banking sector and the financial liberalization helped to improve capital efficiency and to sustain the growth rates of investments and savings, trade and population; all these have positive and significant contribution to the economic growth, inflation, government size, and help overcome banking crisis impact on the economic growth of countries in the MENA region (Rachdi et al. 2015). The implementation of Basel III rules will affect all the countries in the MENA region, as the scope of Basel III guidelines and the implementation processes are on a fully consolidated basis for banks acting internationally. Adopting the Basel III rules is promoted by the Bank of International Settlements (BIS) as it is beneficial to the MENA region countries in terms of future crisis and risk avoidance, but at the same time is critical because it implies transitional costs which can be challenging to adopt (Gray et al. 2013).

The previous studies have investigated the performance of the two banking systems—conventional banking (CB) and Islamic banking (IB) in the MENA region—the risk related to their assets, and the effect of financing modes on the equity composition. Using a sample of 92 banks in the Gulf Cooperation Council (GCC) region, during the period 2006–2009, Amba and Almukharreq (2013) investigated the effect of the financial crisis on the profitability of the IBs versus CBs. No evidence was found to support the common view that Islamic banking has better weathered the recent financial crisis. In another study, Olson and Zoubi (2016) argue that the previous studies differentiate between the two banking systems (CBs and IBs) based on the concept of how the risk is linked to their assets and the effect of financing modes on the equity composition. They find the banking systems' principles and the operational modes to be dissimilar, and so are their performance; they examine whether the Global Financial Crisis (GFC) has led to a convergence in performance between CBs and IBs in the MENA region. Their study confirms that IBs were more profitable and more financially stable than CBs prior to the GFC.

The main objective of this paper is to analyze the difference in the performance of CBs and IBs in the MENA region, and more specifically, in the UAE, over the period from 2005 to 2015, which covers precrisis, crisis, and postcrisis periods, including the recovery and the regulatory requirement reforms that impact on the UAE banking system's performance (in terms of cost efficiency and profitability). The cost efficiency of the UAE banks was found to be significantly different between CBs and IBs. Moreover, the evidence shows that the impact of bank-level characteristics and capital adequacy measures on a bank's cost efficiency is strong in both types of banks. In contrast, the analysis finds that profitability is not significantly different between CBs and IBs, and the crisis seems to have a limited impact on bank profitability in both types of banks.

2 Literature Review

This study draws on the findings of previous research papers that investigated the performance of the two banking systems (IB and CB) and compare the performance of the two banking systems in different geographical regions and countries, including the MENA region, and more specifically, the United Arab Emirates (UAE) country, in terms of profitability and cost efficiency. They investigate the impact of specific bank-level characteristics, capital adequacy, risk measures, ownership structure, or crisis on the banking system's performance.

Alharbi (2015) observed that the number of Islamic banks has boosted over the years around the world, and some CBs either have fully converted to Islamic banking or established Islamic windows. Numerous regulatory bodies of Islamic finance industry have been established; such examples are the Accounting and Auditing Organization for Islamic Financial Institutions (AAOIFI) established in 1990 to audit and govern financial institutions and ensure their compliance to the Islamic Shari'ah standards, and the Islamic Financial Services Board (IFSB) in 2002 to set Islamic financial guidance and ensure stability.

The Shari'ah key principles of Islamic Banking transactions in business and trading are as follows (Alharbi 2015):

- Prohibition of interest on all payment and receipt transactions (Riba).
- Prohibition of financing immoral businesses or illicit sectors (Haram).[1]
- Prohibition of financing gambling activities and projects (Maisar).
- Focuses on tangibility and real assets financing (materiality).
- Prohibition of speculation (Gharar).
- Poor receive alms paid from the rich on their owned assets (Zakat).
- Profit and loss sharing principle (Musharakah).
- Investment income sharing (Mudarabah).
- Returns and risks are lined (Sukuk).

Ibrahim (2015) compared the financial ratios of two UAE banks throughout 5 years, 2002–2006, which is the precrisis period. The study shows that the CB has better liquidity, profitability, management capacity, and capital structure; however, the IB is more stable in the market performance indicators (market value, price earnings ratio, market value to book value, and earnings per share).

Tabash et al. 2017 examine the profitability and the main determinants of banks performance of 14 CBs and five IBs based in the UAE in the precrisis and the crisis periods (2006–2009) using Return on Assets (ROA) as a profitability measure. The analysis shows that there is no significant difference between the two types of banks in terms of profitability, while there is a significant difference between IBs and CBs in terms of liquidity, operating efficiency, capital adequacy, and financial risk. More specifically, the results reveal that IBs have higher operating efficiency, bank size, and more liquidity than CBs, but have lower capital adequacy and higher financial risk. A study of Tlemsani and Suwaidi (2016) based on a cross-sectional analysis of 43 CBs and 8 IBs in the UAE for the period of 2007–2008 argue that during the crisis period, there was no significant difference between CBs and IBs in terms of profitability (as measured by ROA); IBs market share and total assets were higher than the CBs, and they had better liquidity compared to CBs. Ibrahim (2016) investigated the performance of the two types of banks by examining the financial ratios on CAMEL framework using observations for three CBs and three IBs from 2009 to 2013. The findings show that IBs perform better than CBs in terms of profitability, liquidity, and efficiency but both are similar in credit risk. Faizulaye (2011) discusses the similarities and the main differences between conventional and Islamic banking as summarized in Table 1.

El Massah and Al Sayed (2015) conducted an analysis comparing the differences between five IBs and 11 CBs in the UAE during and after the crisis (2008–2014) using financial performance measures in four categories: profitability (Return on Assets, ROA and Return on Equity, ROE), liquidity (Loan/Deposit, Total Loans/Total Assets, and Cash and Portfolio Investment/Deposits), solvency (Debt/Equity, Debt/Total Assets, and Equity Multiplier) and credit risk (Common Equity/Total Assets, and Equity/Net Loans). They concluded that IBs are less profitable, less solvent, and riskier than CBs. Gebba and Aboelmaged (2016) conducted explanatory research on 12 CBs and seven IBs for two years (2014–2015). The study explains how CBs and IBs are similar in terms of corporate governance and concluded that both types of banks are characterized by high ownership concentration. Ul-Islam and Ashrafuzzaman (2015) analyzed the two banking systems (CBs and IBs) in the GCC countries and found that there is no significant difference in capital adequacy, management capability, and earnings; a significant difference between CBs and IBs is found in their asset quality. Furthermore, Haque and Brown (2016) argue that ownership concentration and government ownership have a positive influence on cost efficiency.

In conclusion, there is a limited number of previous researches in the MENA region comparing between CBs and IBs in terms of profitability and cost efficiency before, during, and after the global financial crisis. However, for getting more accurate results the period should be extended to include also the performance of banking systems after the recovery or stability period, where the impact of the financial crisis is still ongoing, and central banks and regulators are imposing reforms and adjusting their policies in response to the financial crisis, with the aim to strengthen the banking system's capital adequacy and liquidity in order to minimize risks. The available comparative analysis between CBs and IBs in the UAE is very limited; the previous studies have compared the performance of CBs and IBs from different perspectives using different performance indicators and different financial measurements. These studies analyze and compare the performance of the two banking systems in terms of profitability and cost efficiency while controlling the specific bank-level characteristics, capital adequacy, and risk measures, ownership structure, or crisis effects; therefore, the results are indifferent and conflicting. Moreover, the previous studies of banking systems in the UAE lack a comparative analysis based on more extended periods, the size of the samples was relatively small and there was no clear evidence on the difference in the banking systems'

[1]Discouragement of the production of goods and services which contradict with the Islam values, e.g., alcoholic beverages, non-halal poultry, and pork. Halal: adhere to Shari'ah principles. Haram: contradictory to Shari'ah principles.

Table 1 Comparison between conventional and Islamic banking

#	Comparison items	Conventional banking	Islamic banking
1	Base and principle	Based on man-made rules and regulations	Based on Islamic religious law (Shari'ah Compliant)
2	Objective and limitation	Profit maximization	Profit maximization subject to Shari'ah restrictions
3	Social responsibility	Does not deal with any charity or welfare	Providing collection centers for the rich people where they pay out alms (Zakat) and passes it to the poor
4	Client relationship	Creditor or debtor	Partner, trader, investor, seller or buyer
5	Deposit guarantee	Profit on the deposited funds	Repayment of their funds deposit accounts only (Wadiah)
6	Loan, borrowing, and mortgages	Transactions offered by commercial banks are interest-based	Based on Shari'ah approval for underlying transactions
7	Financing	Based on the client's credit-worthiness	Based on the project's viability
8	Equity investments	Profitable or losable	Equity participation (Musharakah)
9	Investments and developing project assessment	Less assessment and evaluation because it is based on fixed-income by the applicant	More assessment and evaluation because it is based on profit and loss sharing
10	Late payments and defaulters	Imposing compounded interests and penalties	A small amount only of compensations and to be given to charity

performance and the factors that determine these differences in terms of profitability, cost efficiency, and risk effects.

The contribution of this study lies in the fact that it adds a comprehensive comparative analysis of the performance of CBs and IBs in the MENA region, and more specifically in the UAE, using cost efficiency and profitability as measures of bank performance. By investigating the impact of bank-specific characteristics, risk-taking and ownership structure on bank profitability, this study also contributes to the analysis of the financial crisis impact on the UAE banking systems (both CBs and IBs) as well as their performance over an extended period of 11 years (2005–2015). The main research question addressed in this study is related to the difference in bank performance between CBs and IBs in the UAE. More specifically, we address the following two questions: (i) Are there significant differences in the performance of CBs and IBs in the UAE based on their efficiency and profitability? and (ii) Do the bank-level characteristics, capital adequacy and risk measures, and/or ownership structure explain these differences? To answer to these questions, we formulate a number of research hypothesis to test the difference in the performance of the conventional and Islamic banking system, as well as the influence of different factors such as bank-level characteristics, capital adequacy, risk measures, and ownership structure which are expected to be significant determinants of a bank's profitability and efficiency. More specifically, the following null and alternative hypotheses are tested:

H01: There is no significant difference between conventional and Islamic banking systems in cost efficiency.

HA1: There is a significant difference between conventional and Islamic banking systems in cost efficiency.

H02: There is no significant difference between conventional and Islamic banking systems in profitability.

HA2: There is a significant difference between conventional and Islamic banking systems in profitability.

H03: There is no significantly different effect of capital adequacy on banks' cost efficiency between the conventional and Islamic banking systems.

HA3: There is a significantly different effect of capital adequacy on banks' cost efficiency between the conventional and Islamic banking systems.

H04: There is no significantly different effect of capital adequacy on banks' profitability between the conventional and Islamic banking systems.

HA4: There is a significantly different effect of capital adequacy on banks' profitability between the conventional and Islamic banking systems.

H05: There is no significantly different effect of risk-taking on banks' cost efficiency between the conventional and Islamic banking systems.

HA5: There is a significantly different effect of risk-taking on banks' cost efficiency between the conventional and Islamic banking systems.

H06: There is no significantly different effect of risk-taking on banks' profitability between the conventional and Islamic banking systems.

HA6: There is a significantly different effect of risk-taking on banks' profitability between the conventional and Islamic banking systems.

H07: There is no significantly different effect of ownership structure on banks' cost efficiency between the conventional and Islamic banking systems.

HA7: There is a significantly different effect of ownership structure on banks' cost efficiency between the conventional and Islamic banking systems.

H08: There is no significantly different effect of ownership structure on banks' profitability between the conventional and Islamic banking systems.

HA8: There is a significantly different effect of ownership structure on banks' profitability between the conventional and Islamic banking systems.

3 Methodology

3.1 Data Collection and Sampling

This study uses a dataset of 32 CBs and IBs operating in the UAE, from 2005 to 2015. The financial data are collected for each bank from the database of Orbis Bank Focus—Bureau Van Dijk (A Moody's Analytics Company). Financial statements and annual reports of the banks in the sample are downloaded from their official website and the Central Bank of UAE in case of missing data for some banks. For banks and banking institutions to be included in the sample they have to meet the following conditions:

1. The banks are located in the country UAE, the branch's origin or the regional head office should be in the UAE;
2. The bank's status is active;
3. Financial activity is banking;
4. The accounting standards used by the banks are the International Financial Reporting Standards (IFRS);
5. The Basel Accord II is implemented on the financial reporting and the financial statements;
6. The consolidated financial statements are either audited or restated;
7. The total assets are more than five million of the local currency AED, or the net income is more than AED 50 million.

The data set covers 352 observations from 32 banks and banking institutions all based in the UAE, for 11 years (2005–2015). The sample is composed of 27 banks that are listed (regulated and supervised by the Central Bank of UAE) and five unlisted banks (a percentage of 84.38% and 15.63%, respectively). The bank ownership's structure includes 25 National banks (78.13%) and seven Foreign banks (21.88%). The data set comprises 22 CBs and 10 IBs, which represent 68.75% and 32.25%, respectively. The sample of CBs includes 242 observations, and the sample of IBs consists of 110 observations which sum up to a total of 352 observations. Table 2 displays the list of banks included in the sample and the total number of banks in the sample categorized by their listing status (listed vs. unlisted), ownership (national vs. foreign), and type (conventional vs. Islamic) as well as the total and the percentage of each category. Table 2 also represents the average number of years of observations per bank which is calculated by the total number of observations for 11 years (2005 –2015) divided by the total number of variables (20).

3.2 Data Analysis

The data set is cleaned by tabulating the values and frequencies, setting up and unifying the value types, and dropping the variables with a high frequency of missing values or embedded blanks. The cleaned data set contains text string (bank, type, and specification), numeric yearly date (int) for the years 2005–2015, numeric (double) for the ratios and numeric (byte) for the dummy variables. The data is analyzed by using the statistical package software STATA IC 15.0. Highlighting the differences in the governing principles and rules between CBs and IBs discussed in the literature review results in some differences in their financial ratios and performance measures. The difference in the financial instruments used by each type of banking system is reflected in their financial statements; therefore, the calculations of the Islamic financials are different from the conventional ones as follows: (1) Net income (EBIT) is calculated as net income before taxes and before Zakat; (2) Deposits are the customers' payments for investing purposes which includes saving and current accounts, Murabaha, Mubadala, and MT Wakala; (3). Loans as Islamic financing instruments are Murabaha, Musharakah, Mudarabah, Ijarah, Istisna, Salam, and Wakalt; and (4) Interest income is the income from the Islamic financing instruments fees, and interest expenses are profit distributions to customers (Miah and Uddin 2017). As the previous empirical studies conflict in their results, the main purpose of this study is to investigate the performance of UAE banks in terms of cost efficiency and profitability, and to compare between CBs and IBs from a more comprehensive perspective by measuring the impact of specific bank-level characteristics, capital adequacy, risk, and ownership structure on their performance.

To measure the banks' performance, we select the following indicators as dependent variables: cost efficiency and profitability that can be measured by observable variables (Tahir and Haron 2010); therefore, based on the available financial data we use Cost to Income Ratio (CIR) and Net

Table 2 Composition of the UAE banks (2005–2015)

Banks	Listing		Bank ownership		Bank type		Average number of observations
	Listed	Unlisted	National	Foreign	CB	IB	
Abu Dhabi Commercial Bank	1	0	1	0	1	0	10.8
Abu Dhabi Islamic Bank	1	0	1	0	0	1	5.7
Abu Dhabi Islamic Bank—Public	0	1	1	0	0	1	10.75
Ajman Bank	1	0	1	0	0	1	4.35
Al Hilal Bank PJSC	1	0	1	0	0	1	7.1
Al Khaliji France SA	1	0	0	1	1	0	3.1
Amlak Finance PJSC	1	0	1	0	0	1	8.55
Arab Bank for Investment and Foreign Trade (Al Masraf)	1	0	1	0	1	0	9.9
Bank of China Middle East (Dubai)	0	1	0	1	1	0	1.55
Bank of Sharjah	1	0	1	0	1	0	9.55
Banque Nationale de Paris International	0	1	0	1	1	0	0.3
Citibank NA	1	0	0	1	1	0	1.55
Commercial Bank International	1	0	1	0	1	0	10.55
Commercial Bank of Dubai PSC	1	0	1	0	1	0	10
Dubai Islamic Bank PJSC	1	0	1	0	0	1	10.55
Emirates Islamic Bank PJSC	1	0	1	0	0	1	9.7
Emirates NBD PJSC	1	0	1	0	1	0	9.35
First Gulf Bank	1	0	1	0	1	0	10.2
HSBC Bank Middle East	0	1	0	1	1	0	2.35
HSBC Bank Middle East Limited	1	0	0	1	1	0	2.3
International Banking Corporation	0	1	0	1	1	0	3.3
Invest Bank PSC	1	0	1	0	1	0	8.9
Mashreq Bank PSC	1	0	1	0	1	0	9.85
National Bank of Abu Dhabi	1	0	1	0	1	0	8.8
National Bank of Fujairah PJSC	1	0	1	0	1	0	10.5
National Bank of Ras-Al Khaimah	1	0	1	0	1	0	7.45
National Bank of Um-Al Qaiwain	1	0	1	0	1	0	10.6
Noor Bank	1	0	1	0	0	1	6.6
Sharjah Islamic Bank	1	0	1	0	0	1	10.9
Tamweel PJSC	1	0	1	0	0	1	9.9
Union National Bank	1	0	1	0	1	0	10.85
United Arab Bank PJSC	1	0	1	0	1	0	5.85
Total	27	5	25	7	22	10	241.7
Percentage (%)	84.38	15.63	78.13	21.88	68.75	31.25	68.66

Sources Orbis Bank Focus (Bankscope), the banks' official websites, and the Central Bank of UAE

Interest Margin (NIM) as proxies for cost efficiency, while Earning Assets to Total Assets (EARTA) ratio and Earning Assets to Gross Loans (EARGL) ratio are used to measure bank profitability (Bahrini 2017). The independent variables used in our analysis are (1) specific bank-level characteristics such as Deposits/Assets, Loans/Assets, ROA, Other Earning Assets, Income Diversity, Non-Interest Income and Log (Size); (2) capital adequacy ratios: Tier 1 ratio, Tangible Equity, Liquid Assets, and Funding Fragility; (3) risk measures: Equity Volatility and Log(Z); and (4) ownership structure measures: Ownership concentration, Government ownership, and Foreign ownership (Noor and Ahmad 2012). A description of the variables used in the analysis is available in Table 3.

Table 3 Description of the financial variables

Variable		Explanation
Dependent variables		
Cost efficiency measures	Cost to Income Ratio (CIR)	[Operating costs/Operating income] × 100%
	Net Interest Margin (NIM)	[(Interest income − Interest expenses)/Earning assets] × 100%
Profitability measures	Earning Assets on Total Assets (EARTA)	[(Interest income − Interest expenses)/Total assets] × 100%
	Earning Assets on Gross Loans (EARGL)	[(Interest income − Interest expenses)/Gross loans] × 100%
Explanatory variables		
Bank characteristics	Deposits/Assets	[Deposits/Total assets] × 100%
	Loans/Assets	[Loans/Total assets] × 100%
	Return on Assets (ROA)	[Net income/Total assets] × 100%
	Other Earning Assets	[(Derivatives + Other securities + Other remaining assets)/(Loans + Other Earning Assets)] × 100%
	Income Diversity	1 − [(Net interest income Other operating income)/Total operating income × 100%]
	Non-Interest Income	[Non-Interest Income/Total operating income (EBIT)] × 100%
	Log(Size)	Log(Total assets)
Capital adequacy	Tier 1 ratio	[Tier 1 capital/Risk weighted assets] × 100%
	Tangible Equity	[Equity/Total assets] × 100%
	Liquid Assets	[(Liquid Assets: Cash + Marketable securities + Accounts receivable)/Total assets] × 100%
	Funding Fragility	[(Deposits from other bank + other deposits + short term borrowing)/(Total deposits + Money market Short term funding)] × 100%
Risk measures	Equity Volatility	[$\sum$ SQRT (σ(Annual Equity Return))] × 100%
	Log(Z)	Z (ROA) = Log[((ROA + capital)/assets)/σ(ROA)]
Ownership structure	Ownership concentration	The level of ultimate ownership held by the largest shareholder
	Government ownership	The proportion of equity held by the government
	Foreign ownership	The proportion of equity held by foreign investors

Source Orbis Bank Focus (Bankscope)

We use descriptive analysis and *t*-test of mean difference to examine the difference between the sample of CBs and IBs. In addition, correlation and covariance analysis,[2] as well as multivariate regressions, are used to test the relationship among the variables. The significance of the relationship is tested for both the full sample and the subsamples (IBs and CBs) using different measures of cost efficiency and profitability. In brief, we use the following types of analysis (techniques):

1. **Descriptive analysis**: The descriptive analysis is performed for 11 years of observation (2005–2015) and 23 variables. The descriptive statistics are the mean, maximum & minimum, and standard deviation. The sample includes 352 observations for 32 UAE banks, respectively; the number of observations is 242 for CBs and 110 for IBs. The descriptive statistics for both types of banks are presented in Table 4.
2. **The *t*-test for the mean difference analysis**: The *t*-test is used to test the mean difference between the two banking samples (two independent samples), using the following equation:

$$t = \sqrt{\frac{SD_1^2}{N_1} + \frac{SD_2^2}{N_2}} \quad (1)$$

where SD—standard deviation, SE—standard error, significance level = 5%, confidence level = 95%, *Z*—value for 95% confidence level is 1.965, and critical *t*-value at 10%, 5%, and 1% significance level is 1.65, 1.97, and 2.60, respectively. The *t*-value and the *p*-value for the mean difference tests are presented in Table 4.

[2]The full-size correlation and covariance matrices are available upon request.

Table 4 Sample statistics by bank type (2005–2015) and *t*-test for mean difference (CB vs. IB)

Variable	Conventional banks					Islamic banks					Mean Test			
	Obs	Mean	SD	Min	Max	Obs	Mean	SD	Min	Max	df	|t| value	*p*-value	
Cost efficiency measures														
CIR (%)	168	32.78%	12.66%	1.04%	96.40%	86	43.70%	12.85%	10.61%	75.16%	252	6.4381	0.0000	***
NIM (%)	169	4.28%	7.24%	1.27%	95.70%	86	3.80%	6.62%	1.20%	63.80%	253	0.5286	0.5977	
Profitability measures														
EARTA (%)	169	2.40%	30.91%	−98.12%	96.43%	86	3.95%	33.78%	−98.11%	87.76%	253	0.3566	0.7219	
EARGL (%)	169	0.21%	30.16%	−99.69%	99.09%	86	1.31%	21.24%	73.46%	86.81%	253	0.3348	0.7381	
Bank characteristics														
Deposits/Assets (%)	169	73.04%	6.61%	51.08%	89.60%	89	74.21%	14.14%	20.97%	93.83%	256	0.7366	0.4629	
Loans/Assets (%)	169	62.08%	10.97%	23.05%	82.01%	89	64.23%	12.80%	31.42%	92.74%	256	1.3449	0.1806	
ROA (%)	169	2.33%	2.13%	−3.25%	20.56%	89	1.22%	3.22%	−6.59%	26.11%	256	2.9355	0.0039	***
Other Earning Assets (%)	168	16.76%	12.97%	1.06%	75.37%	89	22.64%	19.24%	0.08%	95.88%	255	2.5883	0.0107	**
Income Diversity (%)	169	38.68%	16.34%	−15.88%	96.01%	89	39.89%	21.04%	1.02%	96.86%	256	0.4740	0.6362	
Non-Interest Income (%)	169	33.52%	14.61%	−20.96%	96.01%	89	30.44%	15.49%	1.00%	87.42%	256	1.5468	0.1238	
Log(Size)	169	10.62	1.77	7.27	17.28	89	9.99	0.97	7.37	11.92	256	3.6801	0.0003	***
Capital adequacy														
Tier 1 ratio (%)	132	18.48%	5.56%	9.38%	37.21%	51	17.43%	7.50%	6.74%	35.14%	181	0.9145	0.3634	
Tangible Equity (%)	169	21.51%	10.99%	5.36%	81.49%	89	19.74%	14.67%	1.26%	84.05%	256	0.9990	0.3195	
Liquid Assets (%)	169	21.11%	10.87%	0.69%	55.60%	89	15.95%	10.18%	1.87%	53.24%	256	3.7787	0.0002	***
Funding Fragility (%)	168	11.94%	15.63%	0.01%	95.40%	84	16.63%	25.53%	0.01%	100.00%	250	1.5463	0.1248	
Risk measures														
Equity Volatility (%)	116	24.65%	22.36%	1.00%	97.09%	52	23.88%	21.34%	1.00%	78.01%	166	0.2122	0.8324	
Log(Z)	184	2.86	0.94	−1.18	3.96	83	2.58	0.89	−0.48	3.56	265	2.3426	0.0203	**
Ownership structure														
Ownership concentration (%)	122	34.13%	20.85%	0.00%	100.00%	89	47.70%	32.57%	0.00%	100.00%	209	3.4479	0.0007	***
Government ownership (%)	121	11.61%	22.93%	0.00%	64.84%	89	5.20%	13.82%	0.00%	100.00%	208	2.5154	0.0127	**
Foreign ownership (%)	114	12.80%	21.66%	0.00%	100.00%	89	9.74%	18.32%	0.00%	58.00%	201	1.0897	0.2772	
Dummy														
LISTED_D	242	0.82	0.39	0	1	110	0.90	0.30	0	1	350	2.1539	0.0321	**
ISLAMIC_D	242	0.00	0.00	0	0	110	1.00	0.00	1	1	350	n/a	n/a	
Crisis_D	242	0.18	0.39	0	1	110	0.18	0.39	0	1	350	0.0000	1.0000	

*Significance Level (*t*-value): $|t|^{***} \geq 2.60$, $|t|^{**} \geq 1.97$, $|t|^{*} \geq 1.65$, *Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. The descriptive statistics show the number of observations per variable, the mean, the standard deviation, and min & max values. The *t*-test presents the significance of the mean difference for all the variables between the samples of Islamic banks and conventional banks

3. **Regression analysis**: This type of analysis is to test the significance of the relationship between a bank's performance in terms of cost efficiency and profitability and the variables that are expected to have a strong influence on different types of banks. As mentioned above, we use two cost efficiency measures: Cost to Income (CIR) ratio and Net Interest Margin (NIM), and two profitability measures: Earning Assets to Total Assets (EARTA) ratio and Earning Assets on Gross Loans (EARGL) ratio, and analyze the differences in the effects of bank-specific characteristics, capital adequacy, risk measures, and ownership structure on the performance of CBs and IBs. Based on the power and the sample size, we perform OLS Linear Multilevel (Multivariate) Regression analysis. The basic model of the regression analysis is

$$f(Y_{it}) = \beta_0 + \beta_1 . X_{it} + \beta_2 . Z_{it} + D_{variables} + \varepsilon_{it} \qquad (2)$$

where Y is the dependent variable (CIR and NIM as measures of cost efficiency, and EARTA and EARGL as measures of profitability) for bank i at time t, β_0 is the intercept, β_1 is the regression coefficient of the explanatory variables X for bank i at time t, β_2 is the regression coefficient of the control variables Z for bank i at time t, and D variables are the dummy indicators for: (1) listing status, with the value of 1 if the bank is a listed bank and 0 otherwise, (2) bank type, with the value of 1 if the bank is Islamic and 0 otherwise, and (3) crisis effect, with the value of 1 for crisis period (2008–2009) and 0 otherwise. Finally, ε which is the residual term assuming a normal distribution.

To test the power and the significance of the variables, a multilevel regression analysis is conducted to examine the relationship of a bank's profitability (as measured by cost efficiency and profitability ratios) with specific bank-level characteristics while we control for capital adequacy, risk, and ownership structure. We run the analysis for the whole sample as well as for the subsamples of CBs and IBs separately. We add the control variables one at a time to differentiate between the effects of different profitability and efficiency determinants. The results of the regression analysis for each dependent variable are presented, respectively, in Tables 5, 6, 7, and 8.

4 Results and Discussion

Based on the results of the t-test of the mean difference (see Table 4) between IBs and CBs, we find that the two types of banking systems in the UAE are significantly different in the level of their cost (in) efficiency (the t-value for the cost efficiency measure (CIR) is 6.4381, greater than the critical value of 2.60); it indicates that there is a significant difference between IBs and CBs in their cost efficiency.

Additionally, the results show that the cost efficiency ratio (operating costs to operating income) of CBs is smaller than IBs, which means that CBs are more cost-efficient than IBs. Moreover, the outputs of the regression analysis in Table 5 show that for CBs, CIR is significantly positively associated with Deposits/Assets ratio but negatively correlated with both ROA and the "Listed" dummy variable (see Model 5), this means the banks with more deposits are less efficient; however, banks that have a higher return on assets and those who are listed on a national or international stock exchange can achieve higher efficiency. The results for IBs show a positive and statistically significant relationship between CIR and Loans/Assets ratio but a negative association with the "Crisis" dummy variable (see Model 9 and 10), which indicates that banks with higher loan to assets ratio are less efficient; for these banks cost efficiency is higher during the crisis period. The effect of risk measures is significant only for the sample of CBs. In conclusion, we observe a significant difference in the effect of bank-level characteristics and risk-taking on the cost efficiency of the two types of banks, whereas the capital adequacy impact is similar across the two samples.

The t-test of the mean difference in Table 4 shows that NIM ratio is insignificantly different between the samples of CBs and IBs (the t-value is 0.5286, which is less than the critical value of 1.65). Further, Table 6 shows the effect of bank-level characteristics on cost efficiency as measured by NIM, for each type of banks. We find that bank-level characteristics (except Deposits/Assets ratio) have a strong influence on NIM for conventional type of banks; however, this effect is relatively weak for IBs. More specifically, Log (Size) and Loans/Assets variables are negatively correlated with NIM for both types of banking systems. The ROA effect on NIM is positive and statistically significant for CBs but negative for IBs. The impact of Other Earning Assets is negative and significant for both types of banks. In conclusion, we find strong evidence for a significant difference between CBs and IBs in terms of efficiency when NIM is measured; even more, the bank characteristics effect seems to be more pronounced in the sample of CBs than the IBs. Thus, hypothesis HA1 is confirmed.

HA1: There is a significant difference between the conventional and Islamic banking systems in cost efficiency.

The results reported in Table 4 show that the t-value for both profitability measures (EARTA and EARGL) is insignificant, that is, less than 1.65. Based on the t-test results, we can conclude that there is no significant difference in the profitability of CBs and IBs. The outputs of the regression analysis for profitability (as measured by EARTA) are reported in Table 7. We can witness that both CBs and IBs

Table 5 Panel regressions of bank efficiency as measured by CIR (2005–2015)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Constant	0.1623 0.148	0.2097 0.499	1.5833 0.000***	1.6900 0.000***	0.3444 0.011**	1.5147 0.000***	2.0549 0.000***	2.2622 0.000***	0.0057 0.983	−0.7688 0.311	1.8897 0.092*	2.9361 0.066*
Deposits/Assets	0.1357 0.117	−0.0381 0.828	0.1084 0.537	−0.0961 0.601	0.2839 0.042**	−0.0218 0.909	0.0812 0.675	0.1284 0.555	0.2172 0.113	0.3122 0.428	−0.1960 0.621	−0.1550 0.678
Loans/Assets	0.1455 0.082*	0.2452 0.200	−0.7566 0.027**	−1.2127 0.001***	−0.0762 0.452	−0.8908 0.002***	−1.1659 0.004***	−1.7226 0.000***	0.3782 0.023**	0.8206 0.002***	−0.7799 0.201	−0.9185 0.137
ROA	−1.4154 0.000***	−3.2222 0.000***	−4.1264 0.000***	−1.3890 0.244	−3.0684 0.000***	−1.3816 0.161	−1.6485 0.236	0.0002 1.000	−0.1586 0.771	−2.7701 0.262	0.1049 0.961	1.9097 0.380
Other Earning Assets	0.0658 0.286	−0.0472 0.683	−0.3050 0.184	−0.9328 0.000***	0.0479 0.566	−0.0766 0.561	−0.3236 0.190	−0.7851 0.012**	0.1040 0.293	−0.2136 0.273	0.0616 0.868	0.7350 0.115
Income Diversity	0.0962 0.198	0.0832 0.379	−0.3157 0.007***	−0.3524 0.003***	0.0215 0.908	0.3623 0.119	−0.3467 0.189	0.1315 0.702	0.0131 0.889	0.0000 1.000	−0.5267 0.000***	−0.6034 0.001***
Non-Interest Income	−0.1228 0.181	−0.0134 0.916	0.3741 0.019**	0.4203 0.015**	−0.0356 0.875	−0.4153 0.144	0.3303 0.289	−0.1441 0.732	−0.1929 0.125	−0.0082 0.958	0.5066 0.005***	0.8006 0.004***
Log(Size)	0.0029 0.571	0.0030 0.764	−0.0359 0.002***	−0.0177 0.345	0.0014 0.791	−0.0236 0.026**	−0.0250 0.058*	−0.0260 0.258	0.0034 0.847	0.0318 0.346	−0.0638 0.204	−0.1618 0.142
Tier 1 Ratio		−0.0988 0.736	0.5573 0.093*	0.2032 0.610		−0.3788 0.318	−0.3676 0.460	−0.3497 0.538		−0.6575 0.495	0.7304 0.392	0.3788 0.617
Tangible Equity		0.0530 0.855	−0.5406 0.083*	−0.2862 0.440		−0.3890 0.195	−0.4054 0.242	−0.1909 0.675		1.0739 0.236	−0.5211 0.466	0.0977 0.897
Liquid Assets		0.0547 0.757	−0.7325 0.005***	−1.2551 0.000***		−0.7277 0.003***	−0.9143 0.002***	−1.6240 0.000***		0.6060 0.015**	−0.7304 0.088*	-0.8284 0.098*
Funding Fragility		−0.1151 0.326	0.2625 0.101	0.1985 0.325		−0.1186 0.344	0.0463 0.809	0.1970 0.426		−0.4144 0.097*	0.1628 0.572	−0.1957 0.596
Equity Volatility			−0.1195 0.006***	−0.0665 0.132			−0.1165 0.018**	−0.0691 0.185			0.0098 0.841	0.0696 0.180
Log(Z)			−0.0472 0.004***	0.0068 0.720			−0.0997 0.000***	−0.0395 0.276			0.0138 0.410	0.0374 0.106
Ownership Concentration				0.0234 0.659				0.0185 0.756				0.0871 0.461
Government Ownership				−0.0320 0.601				0.0059 0.929				−1.6442 0.446
Foreign Ownership				0.0374 0.744				−0.1600 0.263				−2.8104 0.353
LISTED_D	−0.0293 0.376	0.0244 0.606	−0.0217 0.668	0.0603 0.278	−0.1321 0.013**	Omitted			0.0438 0.374	0.1184 0.027**	−0.0920 0.286	0.1060 0.788
ISLAMIC_D	0.0835 0.000***	0.1062 0.000***	0.0693 0.046**	0.1561 0.000***	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a

(continued)

Table 5 (continued)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
CRISIS_D	−0.0185 0.364	−0.0458 0.033**	0.0276 0.231	0.0655 0.035**	0.0067 0.770	−0.0045 0.854	0.0504 0.073*	0.1034 0.015**	−0.0652 0.081*	−0.1135 0.004***	0.0068 0.813	0.0096 0.717
Number of Observations	253	180	117	90	167	131	91	66	86	49	26	24
Number of Parameters	11	15	17	20	10	13	15	18	10	14	16	19
F	9.22	6.13	8.19	5.78	8.90	3.94	7.04	3.75	1.58	4.25	8.53	11.18
Prob > *F*	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0002***	0.1360	0.0003***	0.0008***	0.0071***
R-squared	0.2759	0.3421	0.5672	0.6106	0.3379	0.2863	0.5648	0.5704	0.1578	0.6123	0.9275	0.9758
Adj R-squared	0.2459	0.2863	0.4979	0.5049	0.3000	0.2137	0.4846	0.4182	0.0580	0.4683	0.8188	0.8885
Root MSE	0.1165	0.1052	0.7993	0.0700	0.1010	0.0975	0.8191	0.0715	0.1247	0.0837	0.2629	0.0211
Breusch–Pagan test of independence: chi2(6)	82.21	57.65	60.64	61.38	105.43	86.33	53.79	47.43	32.89	35.40	23.45	45.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of cost efficiency, we use Cost to Income Ratio (CIR). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks

Table 6 Panel regressions of bank efficiency as measured by NIM (2005–2015)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Constant	0.1200 0.001***	0.0718 0.541	0.2248 0.000***	0.2392 0.000***	0.0273 0.083*	0.1286 0.003***	0.2287 0.000***	0.2986 0.000***	0.5684 0.000***	−0.2211 0.619	0.1268 0.220	0.1444 0.172
Deposits/Assets	0.0219 0.436	0.1383 0.038**	−0.0083 0.669	−0.0180 0.469	0.0230 0.181	−0.0117 0.590	−0.0104 0.639	0.0005 0.986	−0.0080 0.899	0.3931 0.096*	−0.0491 0.211	−0.0010 0.971
Loans/Assets	−0.0925 0.001***	−0.0938 0.195	−0.1268 0.001***	−0.1329 0.005***	0.0216 0.095*	−0.0658 0.047**	−0.1356 0.004***	−0.1688 0.003***	−0.3350 0.000***	−0.1568 0.291	−0.0649 0.261	−0.0284 0.484
ROA	0.1113 0.366	−0.2767 0.384	1.0385 0.000***	1.0044 0.000***	0.3319 0.000***	0.6170 0.000***	1.1472 0.000***	1.0354 0.000***	0.1137 0.653	−3.6393 0.016**	−0.0790 0.702	0.0010 0.995
Other Earning Assets	−0.0277 0.165	−0.0089 0.838	−0.0543 0.034**	−0.0761 0.028**	0.0158 0.127	−0.0335 0.027**	−0.0544 0.056*	−0.0433 0.288	−0.1442 0.002***	0.1731 0.135	−0.0765 0.052*	−0.0393 0.219
Income Diversity	−0.0356 0.152	−0.0469 0.191	−0.0246 0.056*	−0.0224 0.150	0.0189 0.423	0.0595 0.026**	−0.0269 0.372	0.0203 0.661	−0.0458 0.294	−0.0212 0.736	0.0052 0.518	0.0121 0.110
Non-Interest Income	−0.0316 0.301	−0.0483 0.314	−0.0142 0.417	−0.0206 0.368	−0.0727 0.012**	−0.0923 0.005***	−0.0136 0.701	−0.0670 0.239	−0.0703 0.226	−0.0748 0.415	−0.0355 0.025**	−0.0237 0.088*
Log(Size)	−0.0032 0.059*	−0.0077 0.041**	−0.0042 0.001***	−0.0038 0.138	−0.0019 0.006***	−0.0025 0.038**	−0.0034 0.023**	−0.0042 0.177	−0.0257 0.002***	0.0006 0.976	0.0036 0.438	−0.0077 0.304
Tier 1 Ratio		0.4726 0.000***	0.1078 0.004***	0.1268 0.021**		0.1634 0.000***	0.0842 0.141	0.1025 0.182		1.0243 0.077*	−0.0256 0.750	−0.0271 0.621
Tangible Equity		−0.3564 0.001***	−0.1292 0.000***	−0.1593 0.002***		−0.1133 0.001***	−0.1278 0.002***	−0.1681 0.008***		−0.6702 0.210	−0.0004 0.995	0.0745 0.209
Liquid Assets		0.1315 0.050**	−0.1278 0.000***	−0.1514 0.000***		−0.0941 0.001***	−0.1306 0.000***	−0.1755 0.000***		0.2327 0.105	−0.0824 0.050**	−0.0429 0.207
Funding Fragility		−0.1862 0.000***	−0.0025 0.889	0.0222 0.414		−0.0204 0.155	−0.0113 0.604	0.0215 0.518		−0.3648 0.015**	−0.0189 0.493	0.0265 0.337
Equity Volatility			−0.0118 0.014**	−0.0093 0.121			−0.0126 0.025**	−0.0108 0.125			0.0000 0.994	0.0018 0.604
Log(Z)			−0.0028 0.113	−0.0030 0.241			−0.0067 0.013**	−0.0168 0.001***			−0.0022 0.185	0.0000 0.991
Ownership Concentration				0.0026 0.715				−0.0018 0.823				0.0103 0.250
Government Ownership				−0.0159 0.057*				−0.0104 0.248				0.1220 0.436
Foreign Ownership				−0.0258 0.099*				−0.0537 0.007***				0.0336 0.872
LISTED_D	0.0170 0.108	0.0206 0.251	−0.0107 0.057*	−0.0052 0.486	0.0075 0.223	Omitted			0.0140 0.538	0.0010 0.973	−0.0022 0.786	−0.0267 0.370

(continued)

Table 6 (continued)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
ISLAMIC_D	0.0049 0.416	−0.0157 0.116	−0.0060 0.118	−0.0044 0.414	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CRISIS_D	0.0164 0.016**	0.0280 0.001***	0.0043 0.091*	0.0059 0.154	−0.0029 0.313	−0.0010 0.708	0.0052 0.104	0.0067 0.231	0.0500 0.005***	0.0115 0.603	−0.0016 0.574	−0.0042 0.068*
Number of Observations	254	180	117	90	168	131	91	66	86	49	26	24
Number of Parameters	11	15	17	20	10	13	15	18	10	14	16	19
F	3.09	6.11	17.10	12.29	8.24	13.25	16.94	13.28	3.94	8.68	11.14	24.15
Prob > *F*	0.0010***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***	0.0004***	0.0000***	0.0003***	0.0011***
R-squared	0.1128	0.3414	0.7323	0.7694	0.3195	0.5741	0.7573	0.8246	0.3179	0.7633	0.9435	0.9886
Adj R-squared	0.0763	0.2855	0.6895	0.7068	0.2807	0.5308	0.7126	0.7625	0.2371	0.6754	0.8588	0.9477
Root MSE	0.0387	0.0398	0.0088	0.0095	0.0130	0.0111	0.0094	0.0096	0.0578	0.0493	0.0025	0.0015
Breusch–Pagan test of independence: chi2(6)	82.21	57.65	60.64	61.38	105.43	86.33	53.79	47.43	32.89	35.40	23.45	45.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of cost efficiency, we use the Net Interest Margin (NIM). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks

Table 7 Panel regressions of bank profitability as measured by EARTA (2005–2015)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Constant	0.5418 0.064*	0.0928 0.770	0.0608 0.968	0.5872 0.730	0.7936 0.036**	1.8931 0.111	1.3617 0.417	3.5525 0.050**	−0.1353 0.848	−0.0035 0.999	9.2690 0.315	0.2768 0.988
Deposits/Assets	−0.2117 0.357	−0.1546 0.921	−0.0064 0.993	0.3547 0.642	−0.4931 0.231	−0.0412 0.946	0.0335 0.965	0.5903 0.437	−0.0376 0.917	−0.7022 0.656	−2.1824 0.526	−2.6184 0.628
Loans/Assets	−0.4325 0.058*	−0.5298 0.357	−0.3327 0.808	−0.8550 0.543	−0.2251 0.465	−2.0669 0.026**	−1.6039 0.308	−2.6729 0.066*	−0.3756 0.386	−0.0917 0.927	−2.8309 0.579	−1.0564 0.893
ROA	1.2811 0.204	0.6569 0.795	−5.3267 0.200	−6.7306 0.175	0.7775 0.627	4.5056 0.150	0.6352 0.908	−0.3533 0.946	1.6498 0.254	−6.6157 0.503	−2.9852 0.873	−4.8633 0.872
Other Earning Assets	−0.1584 0.330	−0.1812 0.603	−0.3039 0.744	−0.8366 0.426	0.1287 0.602	−0.3026 0.471	−0.7265 0.457	−0.4968 0.637	−0.4197 0.109	−0.8263 0.291	6.1090 0.080*	5.6944 0.353
Income Diversity	−0.4249 0.037**	−0.3624 0.204	−0.0694 0.882	−0.0308 0.948	−0.3154 0.576	−0.7895 0.285	0.3118 0.765	1.3342 0.269	−0.4186 0.094*	−0.1001 0.815	−0.8108 0.279	−0.7527 0.572
Non-Interest Income	0.0710 0.776	0.2789 0.465	0.1804 0.779	0.1328 0.850	−0.0098 0.989	0.5382 0.551	−0.7015 0.570	−1.7983 0.224	−0.0120 0.971	0.3739 0.549	3.8890 0.010***	3.4504 0.182
Log(Size)	−0.0065 0.633	0.0227 0.448	0.0208 0.658	0.0073 0.925	−0.0202 0.218	0.0034 0.918	0.0321 0.537	−0.0487 0.542	0.0418 0.371	0.0556 0.680	−0.5650 0.195	0.1905 0.892
Tier 1 Ratio		−0.4484 0.611	−0.7183 0.593	−0.9483 0.567		−2.0687 0.088*	−2.2198 0.262	−2.4191 0.224		−4.3885 0.259	−20.5756 0.016**	−18.5715 0.130
Tangible Equity		1.2257 0.160	1.6186 0.201	1.1558 0.453		1.1917 0.212	1.4340 0.297	0.1041 0.948		4.9886 0.172	21.7045 0.004***	18.9862 0.125
Liquid Assets		−0.7432 0.163	−1.7139 0.100*	−1.6509 0.137		−1.8201 0.020**	−2.2743 0.051*	−2.4210 0.034**		0.0720 0.940	−1.0617 0.757	1.0590 0.864
Funding Fragility		−0.0587 0.868	−0.0546 0.933	0.2235 0.789		−0.1110 0.781	−0.2504 0.742	−0.1943 0.821		0.6493 0.510	−2.8044 0.271	−3.6588 0.496
Equity Volatility			0.1195 0.492	−0.0892 0.624			0.0672 0.726	−0.1163 0.519			0.0061 0.988	0.0246 0.971
Log(Z)			−0.0172 0.790	−0.1117 0.159			0.0100 0.913	−0.2076 0.103			−0.0048 0.973	−0.0753 0.795
Ownership Concentration				0.2328 0.292				0.1952 0.349				−0.9730 0.563
Government Ownership				−0.1928 0.449				0.0139 0.952				0.3155 0.992
Foreign Ownership				−0.4026 0.399				−0.9301 0.065*				6.2195 0.881
LISTED_D	0.1023 0.235	0.1497 0.294	0.1803 0.382	0.4207 0.071*	0.0279 0.850	Omitted			0.2791 0.034**	0.2362 0.258	−1.7934 0.029**	−1.8836 0.741

(continued)

Table 7 (continued)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
ISLAMIC_D	0.0663 0.174	0.2326 0.004***	0.3479 0.015**	0.4362 0.010***	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CRISIS_D	0.0829 0.135	0.0711 0.269	−0.0156 0.868	0.0502 0.692	0.0123 0.860	0.0189 0.808	−0.0994 0.369	−0.1842 0.203	0.2072 0.036**	0.2348 0.125	0.1167 0.642	0.1278 0.739
Number of Observations	254	180	117	90	168	131	91	66	86	49	26	24
Number of Parameters	11	15	17	20	10	13	15	18	10	14	16	19
F	1.32	1.75	1.88	1.79	0.95	1.35	1.02	1.67	1.51	0.95	3.38	1.54
Prob > *F*	0.2175	0.0499**	0.0308**	0.0420**	0.4861	0.1984	0.4459	0.0837*	0.1600	0.5129	0.0287**	0.3343
R-squared	0.0517	0.1294	0.2314	0.3265	0.0512	0.1210	0.1578	0.3712	0.1516	0.2614	0.8353	0.8472
Adj R-squared	0.0127	0.0556	0.1084	0.1437	−0.0029	0.0316	0.0027	0.1486	0.0512	−0.0129	0.5882	0.2971
Root MSE	0.3169	0.3166	0.3258	0.2908	0.3102	0.3103	0.3254	0.2492	0.3290	0.3361	0.2274	0.3040
Breusch–Pagan test of independence: chi2(6)	82.21	57.65	60.64	61.38	105.43	86.33	53.79	47.43	32.89	35.40	23.45	45.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of profitability, we use Earning Assets to Total Assets Ratio (EARTA). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks

Table 8 Panel regressions of bank profitability as measured by EARGL (2005–2015)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
Constant	0.2280 0.370	0.7812 0.294	0.9886 0.375	0.4315 0.695	0.4276 0.242	2.9531 0.003***	2.2324 0.079*	2.3838 0.048**	−0.1780 0.695	1.291 0504	0.3965 0.554	−0.0732 0.934
Deposits/Assets	0.0167 0.933	0.2627 0.533	0.3517 0.501	0.7820 0.117	−0.1444 0.717	0.2824 0.566	0.9112 0.117	1.4623 0.005***	0.2602 0.263	0.2605 0.767	−0.0812 0.748	0.1719 0.503
Loans/Assets	−0.3608 0.068*	−1.2474 0.007***	−1.9065 0.060*	−1.4519 0.113	−0.4172 0.165	−3.3520 0.000***	−3.7419 0.002***	−3.4617 0.001***	−0.2520 0.367	−0.5816 0.302	−0.4471 0.248	−0.1763 0.637
ROA	1.3433 0.126	0.3328 0.869	1.7011 0.574	−2.2308 0.485	1.9281 0.216	5.7312 0.026**	9.5473 0.023**	4.5654 0.191	1.5708 0.094*	1.6712 0.761	0.1991 0.885	0.6952 0.626
Other Earning Assets	−0.0687 0.627	−0.3222 0.247	−0.8844 0.195	−1.3890 0.044**	0.1398 0.560	−0.4287 0.210	−1.1440 0.121	−1.2943 0.069*	−0.1885 0.263	−0.5821 0.184	−0.7577 0.008***	−0.5654 0.083*
Income Diversity	−0.1424 0.419	0.0196 0.931	0.6744 0.052*	0.7524 0.016**	0.8410 0.126	0.7674 0.202	1.3324 0.092*	1.7403 0.033**	−0.2018 0.208	−0.1357 0.571	0.0882 0.123	0.0912 0.179
Non-Interest Income	−0.1071 0.621	−0.4993 0.102	−1.2034 0.012**	−1.4454 0.002***	−1.3664 0.043**	−1.6620 0.025**	−2.5644 0.007***	−2.9795 0.004***	0.1273 0.548	−0.0515 0.882	−0.0190 0.837	0.0151 0.891
Log(Size)	−0.0044 0.714	0.0069 0.771	0.0356 0.300	0.0660 0.192	−0.0128 0.420	−0.0085 0.755	0.0519 0.184	0.0510 0.339	0.0096 0.750	−0.0792 0.295	0.0261 0.405	0.0175 0.791
Tier 1 ratio		−0.7096 0.313	−0.7915 0.421	−1.1583 0.282		−2.2427 0.024**	−3.5006 0.020**	−3.3276 0.014**		−3.1473 0.149	0.2256 0.675	0.3401 0.511
Tangible Equity		0.4331 0.532	0.4548 0.622	0.9374 0.348		0.5846 0.451	1.0005 0.332	1.1722 0.269		2.1258 0.293	−0.3808 0.407	−0.2397 0.641
Liquid Assets		−0.6074 0.152	−1.5476 0.043**	−1.5746 0.030**		−2.3634 0.000***	−2.4210 0.006***	−3.0361 0.000***		1.1185 0.042**	−0.3430 0.195	0.0049 0.987
Funding Fragility		−0.0747 0.790	−0.1524 0.747	−0.2381 0.660		0.1616 0.618	−0.4196 0.462	−0.3851 0.502		−0.6500 0.240	−0.2921 0.132	−0.0703 0.776
Equity Volatility			−0.1269 0.319	−0.0093 0.937			−0.1318 0.361	0.0463 0.699			−0.0498 0.135	−0.0357 0.290
Log(Z)			0.0285 0.547	−0.0737 0.152			0.0589 0.395	−0.1073 0.203			−0.0368 0.005***	−0.0345 0.044**
Ownership Concentration				−0.0500 0.726				−0.1981 0.156				0.0124 0.873
Government Ownership				−0.2192 0.186				−0.1048 0.498				0.3355 0.813
Foreign Ownership				−0.1142 0.711				−0.5056 0.129				0.2454 0.900
LISTED_D	0.1055	0.1018	0.1019	0.2236	0.1441	Omitted			0.1511	0.1692	0.0701	−0.0137

(continued)

Table 8 (continued)

Variable	All banks				Conventional banks				Islamic banks			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10	Model 11	Model 12
	0.159	0.370	0.499	0.137	0.314				0.074*	0.148	0.209	0.458
ISLAMIC_D	0.0455 0.283	0.0667 0.290	0.0672 0.513	0.1994 0.068*	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
CRISIS_D	0.0020 0.967	−0.0321 0.530	−0.0408 0.552	−0.3297 0.000***	−0.0073 0.914	−0.0343 0.589	−0.0344 0.678	−0.5108 0.000***	−0.0066 0.916	−0.0540 0.521	−0.0064 0.729	0.0041 0.988
Number of Observations	254	180	117	90	168	131	91	66	86	49	26	24
Number of Parameters	11	15	17	20	10	13	15	18	10	14	16	19
F	0.70	1.41	1.43	3.45	0.92	2.93	2.78	7.18	1.03	1.19	7.61	8.57
Prob > *F*	0.725	0.154	0.144	0.0001***	0.509	0.0014***	0.0022***	0.0000***	0.4228	0.3256	0.0013***	0.0130**
R-squared	0.0280	0.1068	0.1861	0.4836	0.0498	0.2297	0.3389	0.7176	0.1089	0.3067	0.9194	0.9686
Adj R-squared	−0.0120	0.0310	0.0558	0.3434	−0.0043	0.1514	0.2171	0.6176	0.0034	0.0492	0.7985	0.8556
Root MSE	0.2755	0.2522	0.2381	0.1884	0.3016	0.2526	0.2442	0.1658	0.2120	0.1873	0.0168	0.0143
Breusch–Pagan test of independence: chi2 (6)	82.21	57.65	60.64	61.38	105.43	86.33	53.79	47.43	32.89	35.40	23.45	45.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of profitability, we use Earning Assets to Gross Loans Ratio (EARGL). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks

in the total sample and each subsample of banks have a significant effect on bank profitability only for a limited number of bank characteristics. More specifically, Income Diversity is significantly and negatively correlated with EARTA in the total sample and the sample of IBs but insignificant for the sample of CBs. Additionally, we observe that EARTA is positively correlated with "Listed" and "Crisis" dummy variables only in the sample of IBs. Other significant variables are Loans/Assets (in the sample of CBs) and Income Diversity (in the sample of IBs).

Table 8 presents the outcomes of the regression analysis for EARGL as another measure of bank profitability. We find that bank characteristics effect on EARTA is negative and significant for Loans/Assets in the whole sample and the sample of CBs but not for IBs; the only significant variable in this group of banks is Other Earning Assets. As in all previous models, ownership structure has no impact on bank profitability on either type of banks while risk-taking (as measured by distance to default, Log(Z)) is an important determinant of IBs profitability. In conclusion, the effect of bank characteristics on EARGL is strongly significant only in the group of CBs, which is not in line with the results reported in Table 7. Based on the results of both the mean *t*-test, we may conclude that there is no evidence of a significant difference in bank profitability (as measured by EARTA and EARGL) between the two types of banking systems. Hypothesis HA2 is thus rejected, and H02 is accepted. However, the effect of bank characteristics on profitability is more pronounced in the group of CBs than in the group of IBs.

H02: There is no significant difference between the conventional and Islamic banking systems in profitability.

The effect of capital adequacy measures (control variable) on cost efficiency (CIR) is presented in Table 5. The influence of a bank's capital adequacy on cost efficiency is significant and negative for Tangible Equity and Liquid Assets (see Model 3), and marginally significant for Tier 1 ratio. If we consider CBs and IBs separately, we will find that only Liquid Assets have a strongly negative effect on cost efficiency, which is more pronounced in the sample of CBs. We may conclude that there is a significant effect of a bank's capital adequacy on cost efficiency for both types of banks, but this effect is limited only to Liquid Assets (banks with more liquid assets are more efficient). Hypothesis HA3 is thus partially confirmed.

HA3: There is a significantly different effect of capital adequacy on the banks' cost efficiency between the conventional and Islamic banking systems.

The capital adequacy effect on cost efficiency as measured by NIM is presented in Table 6. The effect of a bank's capital adequacy on its cost efficiency is strongly significant in the whole sample (all the estimated coefficients are statistically significant). We observe similar (significant) relationship in the sample of CBs except for Funding fragility. However, this effect is relatively weak in the sample of IBs where Tier 1 ratio and Liquid Assets are marginally significant while Funding fragility is statistically significant at the 5% level of significance. In conclusion, the effect of capital adequacy on a bank's cost efficiency is found to be strong and significant in the sample of CBs but relatively weak for IBs. The capital adequacy effect on bank profitability as measured by EARTA is reported in Table 7. We observe that the effect of a bank's capital adequacy on bank profitability is insignificant in the whole sample as well as in the sample of IBs. For the sample of CBs, we find that Liquid Assets have a strongly negative influence on bank profitability; that is, banks with less Liquid Assets can achieve higher profitability. Hypothesis HA4 is thus partially confirmed.

HA4: There is a significantly different effect of capital adequacy on the banks' profitability between the conventional and Islamic banking systems.

The alternative tests for capital adequacy effect on the bank performance (using EARGL as another measure of bank profitability) are reported in Table 8. The capital adequacy's influence on EARGL is significant yet negative only for Liquid Assets (see Model 3 and 4 for the whole sample of UAE banks). Again, we observe a significant difference in the capital adequacy effect between CBs and IBs. While in the group of CBs both Tier 1 ratio and Liquid Assets have a strong influence on bank profitability, no significant effect is observed in the group of IBs (except for Liquid Assets in Model 10).

The effect of risk-taking on cost efficiency as measured by CIR is presented in Table 5. We find that the influence of bank risk on CIR is strongly significant both in the whole sample of UAE banks and in the sample of CBs; however, it is insignificant for IBs. Moreover, this effect is significant only when bank-level characteristics and capital adequacy measures are added to the model together with the risk measures (Equity Volatility and Log(Z)). The results for Log (Z) show that the banks with high distance to default (low risk) are more cost-efficient. However, the evidence indicates that risk-taking does not influence the cost efficiency of IBs in the UAE.

Similarly, the risk effect on cost efficiency when measured by NIM is presented in Table 6. The bank risk influence on NIM is significant and negative for the whole

sample of UAE banks as well as for the sample of CBs but insignificant in the group of IBs. Again, we find strong evidence that the effect of bank risk-taking on cost efficiency is significantly different between the two groups of banks. Hypothesis HA5 is thus confirmed. CBs strive to improve their cost efficiency by reducing the risk more than IBs.

HA5: There is a significantly different effect of risk-taking on the UAE banks' cost efficiency between the conventional and Islamic banking systems.

The risk effect on bank profitability as measured by EARTA is presented in Table 7. We do not observe a significant influence of bank risk-taking on profitability in both samples (CBs and IBs). It means that risk-taking activities do not improve bank profitability of either type of banks. Table 8 shows the risk effect on bank profitability as measured by EARGL. We find no significant influence of bank risk on profitability in the group of CBs but a significant negative relationship between Log(Z) and IBs' profitability (see Model 11 and 12); this provides partial evidence in support of the hypothesis (HA6) that risk-taking has a different impact on bank profitability of the two banking systems in the UAE.

HA6: There is a significantly different effect of risk-taking in the UAE banks' profitability between the conventional and Islamic banking systems.

The effect of a bank's ownership on cost efficiency as measured by CIR is presented in Table 5. We do not find evidence for a significant effect of ownership type on cost efficiency. All the measures of ownership structure (Ownership concentration, Government ownership, and Foreign ownership) are statistically insignificant for both CBs and IBs. Thus, we are unable to confirm our hypothesis that the effect of ownership structure is different between the two types of banking systems. However, the results reported in Table 6 show that both Government ownership and Foreign ownership have a strong influence on a bank's cost efficiency (both coefficient estimates are negative and significant).

Furthermore, Foreign ownership effect is strongly significant in the sample of CBs but insignificant for IBs. This result is in line with our findings reported in Table 4 that shows a significant difference in ownership structure between CBs and IBs. It seems that IBs have a higher percentage of ownership concentration (47.70% vs. 34.13%), whereas the share of Government ownership is larger in CBs (11.61% vs. 5.20%). Hypothesis HA7 is thus confirmed.

HA7: There is a significantly different effect of ownership structure on the UAE banks' cost efficiency between the conventional and Islamic banking systems.

The effect of a bank's ownership structure on bank profitability as measured by EARTA is reported in Table 7. Similar to the results in Table 5 for cost efficiency effect, we do not observe a significant influence of ownership structure on bank profitability; all the measures of ownership structure are statistically insignificant for CBs. There is a marginally significant effect of Foreign ownership on bank profitability only in the sample of CBs (see Model 8). The results for ownership structure effect on bank profitability as measured by EARGL are presented in Table 8. Once again, no significant relationship between different types of ownership and bank profitability is observed. As a result, we may conclude that the type of ownership structure does not affect the bank profitability of either type of banks. Thus, hypothesis HA8 is rejected.

H08: There is no significantly different effect of ownership structure on the UAE banks' profitability between the conventional and Islamic banking systems.

5 Robustness Checks

In addition to the previous tests where we use alternative measures of cost efficiency and profitability, we check the robustness of our results by running the regression analysis separately for three different periods: the full sample period (2005–2015), the precrisis and crisis period (2005–2009), and the postcrisis period (2010–2015). The results are reported, respectively, in Tables 9, 10, 11, and 12. The effect on a bank's cost efficiency as measured by CIR before, during, and after the crisis is presented in Table 9. We find evidence that banks with a higher return on assists (ROA) were able to achieve better efficiency in the precrisis period, including the crisis years, and in the full sample period; however, this effect is insignificant in the postcrisis period. In opposite, the effect of Income Diversity seems to be more pronounced in the postcrisis period. Bank size also appears to be a relevant determinant of efficiency performance during the precrisis and crisis periods.

The capital adequacy measures are all significant in the postcrisis period and the full sample period; however, they do not affect a bank's cost efficiency during the precrisis and crisis period, this is a result of enhancing the capital requirements after the crisis period (2008–2009). Islamic bank's dummy variable is significant in all models (except for precrisis and crisis period), which shows that the efficiency effects are more pronounced in the sample of IBs than in the sample of CBs. Similarly, the effect on a bank's cost efficiency as measured by NIM is presented in Table 10. The

Table 9 Panel regressions of bank efficiency (CIR) by periods (full sample, precrisis and crisis, and postcrisis)

Variable	Full sample period (2005–2015)			Pre-crisis and during crisis period (2005–2009)			Post-crisis period (2010–2015)		
	Model 1	Model 2	Model 3	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Constant	0.1623 0.148	0.2097 0.499	1.5833 0.000***	0.2735 0.131	0.7279 0.260	1.1459 0.181	0.0417 0.762	−0.0851 0.783	1.7622 0.000***
Deposits/Assets	0.1357 0.117	−0.0381 0.828	0.1084 0.537	0.2686 0.112	0.2083 0.501	0.7263 0.004***	0.1887 0.047**	0.1816 0.369	0.1844 0.374
Loans/Assets	0.1455 0.082*	0.2452 0.200	−0.7566 0.027**	0.2143 0.122	0.0853 0.852	−0.3803 0.662	0.1987 0.064*	0.3097 0.103	−1.5839 0.000***
ROA	−1.4154 0.000***	−3.2222 0.000***	−4.1264 0.000***	−1.2229 0.034**	−4.8534 0.010***	−12.4012 0.000***	0.0949 0.889	−1.8117 0.060*	−0.6537 0.537
Other Earning Assets	0.0658 0.286	−0.0472 0.683	−0.3050 0.184	0.0963 0.350	0.0649 0.752	0.1199 0.791	0.0933 0.212	0.1897 0.189	−0.6666 0.002***
Income Diversity	0.0962 0.198	0.0832 0.379	−0.3157 0.007***	0.1087 0.429	0.5143 0.077*	−0.1114 0.576	0.2037 0.020**	0.1010 0.245	−0.4302 0.001***
Non-Interest Income	−0.1228 0.181	−0.0134 0.916	0.3741 0.019**	−0.1837 0.204	−0.4938 0.200	0.2591 0.335	0.1061 0.381	0.2101 0.088*	0.6993 0.000***
Log(Size)	0.0029 0.571	0.0030 0.764	−0.0359 0.002***	−0.0273 0.038**	−0.0383 0.104	−0.0597 0.007***	0.0020 0.712	−0.0034 0.752	−0.0260 0.027**
Tier 1 Ratio		−0.0988 0.736	0.5573 0.093*		−0.6118 0.294	0.2316 0.642		0.8585 0.022**	1.3350 0.001***
Tangible Equity		0.0530 0.855	−0.5406 0.083*		0.3967 0.507	0.1872 0.701		−0.6171 0.070*	−1.1600 0.001***
Liquid Assets		0.0547 0.757	−0.7325 0.005***		−0.0437 0.914	−0.7465 0.315		0.2006 0.288	−1.0025 0.000***
Funding Fragility		−0.1151 0.326	0.2625 0.101		−0.0527 0.772	0.3425 0.052*		−0.3913 0.014**	0.1607 0.544
Equity Volatility			−0.1195 0.006***			−0.0856 0.098*			−0.0424 0.415
Log(Z)			−0.0472 0.004***			−0.0261 0.245			−0.0009 0.973
LISTED_D	−0.0293 0.376	0.0244 0.606	−0.0217 0.668	0.0101 0.840	−0.0941 0.365	−0.0524 0.523	−0.1060 0.013**	−0.0009 0.984	−0.0252 0.594
ISLAMIC_D	0.0835 0.000***	0.1062 0.000***	0.0693 0.046**	0.0393 0.223	−0.0839 0.245	−0.0210 0.725	0.1090 0.000***	0.1206 0.000***	0.0635 0.053*
CRISIS_D	−0.0185 0.364	−0.0458 0.033**	0.0276 0.231	–	–	–	–	–	–
Number of Observations	253	180	117	99	66	37	154	114	80
Number of Parameters	11	15	17	11	15	17	10	15	16
F	9.22	6.13	8.19	3.88	2.36	14.14	8.93	9.03	8.00
Prob > *F*	0.0000***	0.0000***	0.0000***	0.0000***	0.0130**	0.0000***	0.0000***	0.0000***	0.0000***
R-squared	0.2759	0.3421	0.5672	0.3059	0.3934	0.9188	0.3582	0.5400	0.6522
Adj R-squared	0.2459	0.2863	0.4979	0.2270	0.2269	0.8538	0.3181	0.4802	0.5707
Root MSE	0.1165	0.1052	0.7993	0.1265	0.1161	0.0572	0.1000	0.0829	0.0604
Breusch–Pagan test of independence: chi2(6)	82.21	57.65	60.64	37.38	36.90	32.63	35.92	36.90	24.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of cost efficiency, we use Cost to Income Ratio (CIR). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks. We run the analysis separately for the full sample period (2005–2015), precrisis and crisis period (2005–2009), and the postcrisis period (2010–2015)

Table 10 Panel regressions of bank efficiency (NIM) by periods (full sample, precrisis and crisis, and postcrisis)

Variable	Full sample period (2005–2015)			Precrisis and during crisis period (2005–2009)			Postcrisis period (2010–2015)		
	Model 1	Model 2	Model 3	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Constant	0.1200 0.001***	0.0718 0.541	0.2248 0.000***	0.2012 0.010***	−0.4725 0.129	0.0813 0.212	0.0477 0.003***	0.1035 0.009***	0.2391 0.000***
Deposits/Assets	0.0219 0.436	0.1383 0.038**	−0.0083 0.669	0.0524 0.475	0.2555 0.089*	0.0133 0.449	0.0254 0.022**	0.0111 0.664	0.0354 0.196
Loans/Assets	−0.0925 0.001***	−0.0938 0.195	−0.1268 0.001***	−0.1972 0.002***	0.1994 0.363	−0.0354 0.594	−0.0060 0.629	−0.0565 0.019**	−0.1895 0.000***
ROA	0.1113 0.366	−0.2767 0.384	1.0385 0.000***	−0.1444 0.566	−2.1589 0.017**	0.3402 0.017**	0.6497 0.000***	0.8153 0.000***	1.1122 0.000***
Other Earning Assets	−0.0277 0.165	−0.0089 0.838	−0.0543 0.034**	−0.0617 0.160	−0.0649 0.510	−0.0223 0.521	0.0074 0.398	−0.0326 0.075*	−0.0576 0.040**
Income Diversity	−0.0356 0.152	−0.0469 0.191	−0.0246 0.056*	−0.0322 0.602	−0.1049 0.446	−0.0188 0.224	−0.0090 0.374	−0.0063 0.564	−0.0123 0.433
Non-Interest Income	−0.0316 0.301	−0.0483 0.314	−0.0142 0.417	−0.0171 0.792	0.1030 0.574	0.0048 0.812	−0.0257 0.070**	0.0072 0.642	0.0148 0.461
Log(Size)	−0.0032 0.059*	−0.0077 0.041**	−0.0042 0.001***	−0.0093 0.115	−0.0014 0.903	−0.0016 0.305	−0.0019 0.003***	−0.0022 0.111	−0.0037 0.017**
Tier 1 Ratio		0.4726 0.000***	0.1078 0.004***		−0.1034 0.710	−0.0810 0.043**		0.2033 0.000***	0.2336 0.000***
Tangible Equity		−0.3564 0.001***	−0.1292 0.000***		0.2004 0.484	0.0991 0.014**		−0.1609 0.000***	−0.2315 0.000***
Liquid Assets		0.1315 0.050**	−0.1278 0.000***		0.6092 0.003***	−0.0259 0.644		−0.0649 0.007***	−0.1474 0.000***
Funding Fragility		−0.1862 0.000***	−0.0025 0.889		−0.2265 0.012**	−0.0131 0.312		−0.0442 0.027**	−0.0879 0.014**
Equity Volatility			−0.0118 0.014**			−0.0034 0.376			−0.0064 0.349
Log(Z)			−0.0028 0.113			−0.0014 0.402			−0.0073 0.048**
LISTED_D	0.0170 0.108	0.0206 0.251	−0.0107 0.057*	0.0387 0.072*	0.1284 0.012**	−0.0100 0.121	−0.0047 0.338	−0.0126 0.035**	−0.0153 0.016**
ISLAMIC_D	0.0049 0.416	−0.0157 0.116	−0.0060 0.118	0.0274 0.055*	0.0549 0.115	−0.0020 0.658	−0.0038 0.129	−0.0077 0.020**	−0.0109 0.012**
CRISIS_D	0.0164 0.016**	0.0280 0.001***	0.0043 0.091*	–	–	–	–	–	–
Number of Observations	254	180	117	100	66	37	154	114	80
Number of Parameters	11	15	17	11	15	17	10	15	16
F	3.09	6.11	17.10	2.57	4.81	6.93	14.32	12.92	22.25
Prob > *F*	0.0010***	0.0000***	0.0000***	0.0088***	0.0000***	0.0000***	0.0000***	0.0000***	0.0000***
R-squared	0.1128	0.3414	0.7323	0.2243	0.5691	0.8472	0.4723	0.6267	0.8391
Adj R-squared	0.0763	0.2855	0.6895	0.1372	0.4508	0.7250	0.4393	0.5782	0.8014
Root MSE	0.0387	0.0398	0.0088	0.0571	0.0556	0.0044	0.1169	0.0105	0.0079
Breusch–Pagan test of independence: chi2(6)	82.21	57.65	60.64	37.38	36.90	32.63	35.92	36.90	24.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of cost efficiency, we use the Net Interest Margin (NIM). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks. We run the analysis separately for the full sample period (2005–2015), precrisis and crisis period (2005–2009), and the postcrisis period (2010–2015)

Table 11 Panel regressions of bank profitability (EARTA) by periods (full sample, precrisis and crisis, and postcrisis)

Variable	Full sample period (2005–2015)			Precrisis and during crisis period (2005–2009)			Postcrisis period (2010–2015)		
	Model 1	Model 2	Model 3	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Constant	0.5418 0.064*	0.0928 0.770	0.0608 0.968	0.7735 0.177	–0.2949 0.899	5.2611 0.383	0.1616 0.564	1.1159 0.137	0.1011 0.928
Deposits/Assets	−0.2117 0.357	−0.1546 0.921	−0.0064 0.993	0.2094 0.702	0.2254 0.840	0.6215 0.703	−0.1884 0.326	−1.0134 0.039**	−1.6782 0.016**
Loans/Assets	−0.4325 0.058*	−0.5298 0.357	–0.3327 0.808	–0.3759 0.419	0.3341 0.839	–7.1228 0.258	–0.2041 0.348	0.1941 0.670	1.6645 0.157
ROA	1.2811 0.204	0.6569 0.795	–5.3267 0.200	2.6972 0.154	11.5979 0.084*	1.8390 0.882	0.6094 0.658	–0.3675 0.873	–2.4543 0.483
Other Earning Assets	−0.1584 0.330	−0.1812 0.603	–0.3039 0.744	0.0595 0.855	0.5337 0.472	–3.0194 0.355	–0.2538 0.095*	0.3091 0.375	0.6645 0.339
Income Diversity	−0.4249 0.037**	−0.3624 0.204	–0.0694 0.882	–0.3107 0.501	–0.1184 0.909	0.5737 0.686	–0.3589 0.042**	–0.2868 0.172	–0.6401 0.106
Non-Interest Income	0.0710 0.776	0.2789 0.465	0.1804 0.779	–0.1341 0.782	–0.5014 0.716	–1.5861 0.407	0.5839 0.019**	0.5488 0.065*	1.6302 0.002***
Log(Size)	−0.0065 0.633	0.0227 0.448	0.0208 0.658	–0.0773 0.080*	–0.0548 0.514	0.0458 0.748	0.0025 0.823	–0.0431 0.099*	0.0127 0.739
Tier 1 Ratio		−0.4484 0.611	–0.7183 0.593		1.9812 0.345	0.1294 0.971		0.0697 0.938	0.1865 0.879
Tangible Equity		1.2257 0.160	1.6186 0.201		–0.2424 0.910	1.8279 0.600		–0.8854 0.278	–0.4112 0.716
Liquid Assets		−0.7432 0.163	–1.7139 0.100*		–0.7910 0.588	–8.7059 0.108		0.2290 0.615	0.9397 0.263
Funding Fragility		−0.0587 0.868	–0.0546 0.933		0.3771 0.565	1.0684 0.377		0.0144 0.970	–0.1794 0.838
Equity Volatility			0.1195 0.492			0.5413 0.139			–0.2599 0.134
Log(Z)			–0.0172 0.790			0.0925 0.558			–0.1080 0.236
LISTED_D	0.1023 0.235	0.1497 0.294	0.1803 0.382	0.0789 0.621	–0.0375 0.920	–0.0490 0.933	0.1154 0.180	0.0639 0.571	–0.0259 0.868
ISLAMIC_D	0.0663 0.174	0.2326 0.004***	0.3479 0.015**	0.0086 0.935	0.2304 0.374	0.3548 0.409	0.0726 0.097*	0.0830 0.185	0.1389 0.197
CRISIS_D	0.0829 0.135	0.0711 0.269	–0.0156 0.868	–	–	–	–	–	–
Number of Observations	254	180	117	100	66	37	154	114	80
Number of Parameters	11	15	17	11	15	17	10	15	16
F	1.32	1.75	1.88	1.50	1.93	2.33	1.31	1.34	2.05
Prob > *F*	0.2175	0.0499**	0.0308**	0.1538	0.0450**	0.0375**	0.2377	0.2030	0.0250**
R-squared	0.0517	0.1294	0.2314	0.1440	0.3462	0.6511	0.0756	0.1483	0.3242
Adj R-squared	0.0127	0.0556	0.1084	0.0478	0.1667	0.3720	0.0178	0.0376	0.1658
Root MSE	0.3169	0.3166	0.3258	0.4268	0.4185	0.4085	0.2033	0.2002	0.1995
Breusch–Pagan test of independence: chi2 (6)	82.21	57.65	60.64	37.38	36.90	32.63	35.92	36.90	24.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of profitability, we use Earning Assets to Total Assets Ratio (EARTA). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks. We run the analysis separately for the full sample period (2005–2015), precrisis and crisis period (2005–2009), and the postcrisis period (2010–2015)

Table 12 Panel regressions of bank profitability (EARGL) by periods (full sample, precrisis and crisis, and postcrisis)

Variable	Full sample period (2005–2015)			Precrisis and during crisis period (2005–2009)			Postcrisis period (2010–2015)		
	Model 1	Model 2	Model 3	Model 13	Model 14	Model 15	Model 16	Model 17	Model 18
Constant	0.2280 0.370	0.7812 0.294	0.9886 0.375	0.6058 0.259	4.0416 0.046**	6.5743 0.257	−0.0112 0.953	−0.1693 0.703	−0.1175 0.804
Deposits/Assets	0.0167 0.933	0.2627 0.533	0.3517 0.501	0.0132 0.979	−0.8262 0.388	0.1223 0.937	0.0545 0.676	0.5884 0.044**	0.1744 0.547
Loans/Assets	−0.3608 0.068*	−1.2474 0.007***	−1.9065 0.060*	−0.5300 0.225	−3.0907 0.032**	−9.1360 0.134	−0.1494 0.313	−0.3113 0.253	−0.0979 0.843
ROA	1.3433 0.126	0.3328 0.869	1.7011 0.574	0.8952 0.612	9.8698 0.086*	10.1148 0.398	2.0593 0.029**	0.4209 0.759	−0.1880 0.899
Other Earning Assets	−0.0687 0.627	−0.3222 0.247	−0.8844 0.195	−0.1031 0.736	−0.1986 0.754	−4.7828 0.132	−0.0502 0.627	−0.1042 0.615	0.1109 0.705
Income Diversity	−0.1424 0.419	0.0196 0.931	0.6744 0.052*	0.2553 0.555	1.9156 0.034**	3.5031 0.016**	−0.2531 0.036**	−0.1420 0.255	0.0535 0.747
Non-Interest Income	−0.1071 0.621	−0.4993 0.102	−1.2034 0.012**	−0.2668 0.558	−3.1214 0.011**	−4.9730 0.012**	0.2981 0.077*	0.0728 0.679	0.0056 0.979
Log(Size)	−0.0044 0.714	0.0069 0.771	0.0356 0.300	−0.0483 0.240	−0.0810 0.262	0.0820 0.548	−0.0050 0.513	−0.0077 0.617	0.0263 0.107
Tier 1 Ratio		−0.7096 0.313	−0.7915 0.421		−0.6797 0.705	−3.1827 0.352		0.2598 0.626	0.2425 0.641
Tangible Equity		0.4331 0.532	0.4548 0.622		−1.6128 0.383	1.1955 0.719		−0.4427 0.362	−0.1450 0.762
Liquid Assets		−0.6074 0.152	−1.5476 0.043**		−1.2250 0.329	−6.5685 0.198		0.4802 0.079*	0.3841 0.280
Funding Fragility		−0.0747 0.790	−0.1524 0.747		0.0736 0.896	0.4538 0.692		−0.4748 0.037**	−0.3856 0.300
Equity Volatility			−0.1269 0.319			0.0409 0.904			−0.1020 0.164
Log(Z)			0.0285 0.547			0.1427 0.348			−0.0689 0.076*
LISTED_D	0.1055 0.159	0.1018 0.370	0.1019 0.499	0.0498 0.739	−0.0221 0.945	0.2296 0.681	0.1346 0.023**	0.1029 0.127	−0.0201 0.761
ISLAMIC_D	0.0455 0.283	0.0667 0.290	0.0672 0.513	0.0338 0.733	−0.1355 0.541	0.0302 0.941	0.0437 0.142	−0.0035 0.924	−0.0558 0.220
CRISIS_D	0.0020 0.967	−0.0321 0.530	−0.0408 0.552	–	–	–	–	–	–
Number of Observations	254	180	117	100	66	37	154	114	80
Number of Parameters	11	15	17	11	15	17	10	15	16
F	0.70	1.41	1.43	0.69	1.35	0.95	1.69	1.32	1.07
Prob > *F*	0.7252	0.1539	0.1437	0.7352	0.2143	0.5315	0.0973*	0.2154	0.4037
R-squared	0.0280	0.1068	0.1861	0.0715	0.2699	0.4330	0.0953	0.1462	0.2000
Adj R-squared	−0.0120	0.0310	0.0558	−0.0328	0.0695	−0.0206	0.0388	0.0353	0.0125
Root MSE	0.2755	0.2522	0.2381	0.3999	0.3586	0.3902	0.1386	0.1192	0.8447
Breusch–Pagan test of independence: chi2(6)	82.21	57.65	60.64	37.38	36.90	32.63	35.92	36.90	24.58

*Significance Level (*p*-value): $p^{***} \leq 0.01$, $p^{**} \leq 0.05$, $p^{*} \leq 0.10$

Note The sample includes 352 observations of 32 banks in the UAE over 11 years. The sample of conventional banks includes 242 observations, and the sample of Islamic banks includes 110 observations. As the dependent variable to measure the bank's level of profitability, we use Earning Assets to Gross Loans Ratio (EARGL). The independent variables used in this analysis are bank-level characteristics, capital adequacy ratios, risk and ownership structure measures. The regressions analysis tests the significance of the relationships between the dependent and explanatory variables, the control variables, and the dummy variables for the whole sample, as well as for the samples of Islamic banks and conventional banks. We run the analysis separately for the full sample period (2005–2015), precrisis and crisis period (2005–2009), and the postcrisis period (2010–2015)

effect of ROA is strongly significant and positive in the postcrisis period but negative in the precrisis and crisis period. Similar to Table 9, the effect of capital adequacy measures on cost efficiency is found to be strongly significant and positive in the postcrisis period and the full sample period but less pronounced in the precrisis and crisis period.

The effect on a bank's profitability as measured by EARTA before, during, and after the crisis is reported in Table 11. The effect of bank-level characteristics, risk-taking, and ownership structure seems to be weak during the precrisis period and the full sample period. However, we find more evidence for a significant effect on profitability during the postcrisis period (Deposit/Assets, Income Diversity, and Non-Interest Income are all strongly significant). Finally, the effect on a bank's profitability as measured by EARGL is presented in Table 12. Bank specific characteristics such as Loan/Assets ratio, Income Diversity, and Non-Interest Income are the only bank characteristics that strongly influence bank profitability during the precrisis and crisis period. Capital adequacy ratios and risk measures seem to have no effect on bank profitability in all analyzed periods.

In conclusion, we find that bank level and other effects are more pronounced in the postcrisis period, suggesting some improvements after the global financial crisis, which also saw the implementation of the Basel II framework. These improvements indicate that the positive effect of Basel II implementation and other developments is more significant on bank cost efficiency than bank profitability.

6 Conclusion and Recommendations

Banking systems in the MENA region are vital and significantly contribute to the economy as a monetary strategy instrument for governments to facilitate the development plans and economic growth in these countries. On the other hand, banking systems can be affected by the global economic crises and the political, economic, and social development of the countries in the region. The consequences of the recent financial crises are still ongoing, and the banking systems are not fully recovered. This study analyzes the difference in the performance of CBs and IBs in the UAE, throughout 2005–2015. We find that the profitability of the UAE banks is not significantly different between CBs and IBs; however, IBs profitability is more responsive to the risk-taking as measured by distance to default Log(Z). Bank specific characteristics have a strong impact on a bank's profitability only in the group of CBs. We observe a significant influence of capital adequacy measures on the profitability of CBs, but this effect is insignificant for IBs. The crisis seems to have a limited impact on bank profitability of both types of banks.

Additionally, we find that the effect of bank-level characteristics and capital adequacy measures on a bank's cost efficiency is significant in both groups of banks; yet, this effect seems to be more pronounced in the sample of CBs. However, we observe a significant difference in the effect of risk-taking on cost efficiency between CBs and IBs; whereas the lower risk is associated with an improvement in cost efficiency in the group of CBs; this effect is insignificant for IBs. The effect of the crisis on cost efficiency, when measured by CIR, is found to be significant in both samples of UAE banks, but insignificant for CBs when measured by NIM. Finally, we provide evidence that the effect of ownership structure is not significantly different between the two banking systems. We find limited evidence that Foreign ownership has a significant effect on both cost efficiency and profitability of CBs but is insignificant for IBs.

As a result of our analysis, we may recommend that the banking system in the MENA region should increase its ability to adopt applicable reforms aligned with the regulatory rules. Since IBs and CBs are governed by different rules and principles and can be affected differently by global financial crises, then setting up and implementation of regulations should be different for each type of banking systems to improve their financial performance, compliance standing, and risk assessment. The banking practices and products that comply with Shari'ah principles give an outlook on bank transparency and benefits, even though the CBs are more cost-efficient than the IBs, but the Islamic banking principles and instruments are more efficient toward the social responsibility and the risk effects. As the effect of Liquid Assets was found negative and strongly significant for CBs, we may conclude that liquidity is an essential tool to improve their performance and reduce potential losses. For individual banks and financial companies, risk assessment policies should be considered and tailored with the bank's business models, size, products, and services. For individual clients and small businesses, this study offers an outlook of the banking products and an in-depth comparative analysis of CBs and IBs performance based on their bank-specific characteristics, capital adequacy, and risk-taking; it also depends on clients' expectations of the short- or long-term investments, financing, or profit-making a well as the option to avoid risk.

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Blockchain Technology, Sustainability and Business: A Literature Review and the Case of Dubai and UAE

Pythagoras N. Petratos, Nikolina Ljepava, and Asma Salman

Abstract

The importance of innovation across all sectors is emphasized by the UAE leadership (United Arab Emirates, UAE Vision 2021). The UAE National Innovation Strategy (NIS) aims to take innovation to new heights by creating an innovation enabling environment, innovation champions and priority sectors (United Arab Emirates, 2015). Among these priorities is technology and sustainability. UAE has encouraged numerous technology activities, mainly The Smart Government and The Smart City initiatives. Within this broader innovation and smart city framework, the Dubai Blockchain Strategy was recently launched. The purpose of this paper is to elaborate on the UAE framework and identify business areas that blockchain can have significant impact. UAE, and Dubai in particular, has been a global markets and finance hub. In this paper, we examine the potential applications of blockchain technology in UAE finance industry, exchanges and marketing. We also discuss the role of blockchain technologies for sustainability. Blockchain is identified as one of the most important emerging technologies (Mulligan et al. in World economic forum: Blockchain beyond the hype—A practical framework for business leaders, 2018). We conclude that UAE and Dubai has rightly identified and promoted blockchain technologies and more strategic investment would be beneficial.

Keywords

Blockchain • Finance • Marketing • UAE • Innovation • Sustainability

1 Introduction

Blockchain is a type of Distributed Ledger Technology (DLT). Blockchain became renown globally with the introduction of Bitcoin. Bitcoin popularity, users and value increased over the years. Today there have been more than 1500 cryptocurrencies expanding on the initial concept of Bitcoin. In addition, there are many more current and anticipated applications of Blockchain in various industries. In that sense the Blockchain, and broader the DLT, can have a profound and massive impact on organizations and business. Therefore, it can be considered a foundational innovation and technology.

This paper elaborate on some business applications of Blockchain Technology. We focus mainly on financial applications and marketing applications. Blockchain can be assumed to be an asset but also an exchange, that serves financial and market operations. Although we do recognize that there are many more businesses uses, we limit our analysis to finance and marketing, which are vital for UAE. The paper focus is on UAE, since there is a lack of research in this area. The analysis starts by shortly describing Blockchain without expanding on DLT, and discussing related UAE policies. Next, we briefly discuss some general applications of Blockchain and we then turn to financial and marketing applications in the context of UAE. We examine the current state-of-art of blockchain and investigate financial and marketing applications for UAE. Technologies like Blockchain are critical for UAE government policy and innovation. Blockchain can strengthen sustainability and in particular, sustainable economic growth and consequently enhancing UAE's global competitiveness position.

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2 Significance of the Study

Blockchain is a foundational technology that would transform industries. UAE is a global financial, trading and marketing hub, and aspires to be a global leader. In that sense, UAE should adopt this emerging foundational technology, invest in it and accordingly develop financial, marketing and other business and social applications. These applications could create significant value and sustainable economic growth. This study contributes to the existing literature by identifying and discussing some important blockchain applications for UAE. We also recommend how these applications can benefit business, citizens and the UAE government.

3 What Is Blockchain?

Blockchain technology is often mistakenly considered as synonymous to Bitcoin. While Blockchain was firstly used when Bitcoin was introduced (Yli-Huumo et al. 2016), it is a technology with a much broader range of applications than only cryptocurrencies. Many predict a plethora of applications, from government to healthcare and financial industries. Nevertheless, while expectations are high, the real world impact of Blockchain is unclear, probably due to inflated expectations (Seebacher and Schüritz 2017). In that sense there is significant uncertainty surrounding the technology itself and the realization of its applications. Due to the continuous development of the Blockchain technology and its applications there are different approaches to define it. Therefore, a generally accepted definition does not exist (Seebacher and Schüritz 2017).

The definition of Blockchain is usually based on its characteristics and considerably varies across different studies. Seebacher and Schüritz (Seebacher and Schüritz 2017) in a literature review identify 11 distinct characteristics of Blockchain Technology and some authors associate it with only one (Lewenberg et al. 2015), while others with ten (Beck et al. 2016). This example illustrates the variability of characteristics and consequently the definitions of Blockchain. Many studies on Blockchain are concerned with technical aspects. Accordingly, these studies focus on the technical aspects of the Blockchain technology. There is no doubt that the technical features of Blockchain are crucial to its characterization and definition. Nevertheless, our research regards its application to the business environment. Thus, we would concentrate on the characteristics for the Blockchain technology applications.

A useful characterization of Blockchain in respect to organizations and business applications, is that it is *distributed* and *encrypted* (Tapscott and Tapscott 2017).[1] The term distributed features technical characteristics, but at the same time it can denote business characteristics, as decentralization in organizations, peer to peer exchange, and the lack of intermediaries. Encrypted is another crucial characteristic and largely, enables distributed systems. Encryption provides the security level for peer to peer exchange, without the need for a trusted third party (intermediary). It therefore enables peer to peer exchange and decentralization by providing trust through security for distributed systems. Encrypted can respectively denote trust and peer verification.[2] Encryption is especially critical when there is exchange of significant value. Personal information as well as business contracts and currency are some examples of Blockchain applications, where a high level of trust can be secured by cryptography.

4 General Applications of Blockchain Technology

While the literature on Blockchain is increasingly expanding, most of the studies have not considered a comprehensive discussion of blockchain applications (Tama et al. 2017). The lack of comprehensive studies can be mainly due to the limits of realizing in practice of blockchain technology. There is overwhelming amount of hype expectations regarding blockchain technology over the past years, and a high number of 'evangelists', people who believe that blockchain applications can solve everything (Mulligan et al. 2018). It is important to emphasize that many of the Blockchain applications are theorical rather than applied in practice. However due to its potential, Blockchain develops very fast and can be therefore considered an important emerging technology.

In addition, the investment in this technology seems to exponentially increase, enabling Blockchain applications to have the necessary funding and accordingly to grow quicker. According to data by Pitchbook, in the three quarters of 2018, blockchain and crypto companies have raised nearly $3.9 Billion in traditional Venture Capital, which in just three quarters is around 280% more than 2017 (Diar 2018).[3] The number of deals also nearly doubled from last year and

[1] Tapscott and Tapscott (2017) identify a third advantage (characteristic), *public*; that anyone can view blockchain because they reside in the network. Although this is true for Bitcoin and other applications, Blockchain can be also private. Thus, we prefer to adopt a more general approach in our analysis and overlook this characteristic, although we recognize its importance.

[2] This are two important characteristics identified by (Seebacher and Schüritz 2017).

[3] https://diar.co/volume-2-issue-39/.

these deals are becoming larger, with median deal size of blockchain investments increasing by approximately 65% from 2017 to 2018.[4] These data demonstrate substantially more activity in blockchain applications in just one year.[5] Despite the investment and entrepreneurial activity in Blockchain technologies, it would take years to observe which companies and applications would survive and potentially thrive.

Our analysis would be grounded on the existing literature, which to a large extent predicts, rather than explains Blockchain applications. A common distinction in the current literature is between financial and non-financial sectors (Crosby et al. 2016). This is reasonable, since the first blockchain application, Bitcoin, concerns the financial industry. More than 1500 cryptocurrency applications have been created (Amro 2016). This is an additional justification for the importance of Blockchain technology in the financial sector and our focus is on it. However there many more applications. Non-financial applications are also important, especially in the context of UAE. The government has a leading role not only in increasing its efficiency and performance but also it significantly promotes business and innovation.

The literature covers many Blockchain business applications which are directly or indirectly associated with the UAE government. Besides the financial sectors in UAE and notably Abu Dhabi and Dubai as financial and trading centers globally, Blockchain technology have a wide range of applications in payment systems and other types of exchanges, markets and services. Some of the most important applications are documentation, smart contracts (Tapscott and Tapscott 2017), healthcare (Tama et al. 2017), service systems (Seebacher and Schüritz 2017), sales, and marketing (Tapscott and Tapscott 2017). Sales and marketing can be very important for improving the efficiency and performance of the UAE government, satisfy and make citizens happy by offering them new products and services and enabling them to use advanced technologies.

The potential of Blockchain is tremendous and the impact is visible in the financial world. Another notable application according to prominent analysts is the "sharing" economy. The sharing economy is expected to grow from $15 billion in 2015 to $335 billion by the year 2025, according to a report by PricewaterhouseCoopers as noted by leading Financial Analyst (Amro 2016). The rapid growth of the sharing economy is reflected in companies like Uber and Airbnb. Literature review (Hawlitschel et al. 2018) suggests that blockchain technology can promise to revolutionize interactions, have many applications and to some degree replace trust in sharing economies. Blockchain can be used to create decentralized, shared economy applications and improve citizen's security and wealth (Huckle et al. 2016). However, sharing does not only refer to economy and business, but also to government information sharing applications. Blockchain will lead to innovation and transformation of governmental processes and has a wide range of potential benefits, from technical to economic and strategic (Ølnes et al. 2017). Accordingly, the UAE government has established strategies for innovation and notably blockchain, to realize its benefits.

5 Blockchain and UAE

'Blockchain is a foundational emerging technology of the Fourth Industrial Revolution, much like the internet was for the previous (or third) industrial revolution' (Hawlitschel et al. 2018). The fundamental status of Blockchain technology is evident. It can transform how people transact and redefine how businesses, governments, and societies operate (Hawlitschel et al. 2018). Moreover, substantial innovation activity can be attributed to Blockchain technology. While it can be considered a nascent technology, significant innovative applications as cryptocurrencies and smart contracts have been developed. As Blockchain technology matures, an increasing number of innovations are likely to arise. There is also enthusiasm about blockchain's potential to drive and support sustainable environment and resilient growth.

UAE's vision for sustainable environment and infrastructure as well as a competitive knowledge economy is directly related to Blockchain technologies. Promoting the entrepreneurial culture and innovation are key priorities for UAE. They coincide with the accelerating entrepreneurship opportunities and tremendous capacity for innovation that Blockchain technology offers. In accordance to Vision 2021 UAE government has launched the UAE National Innovation Strategy. Technology is among the six priority sectors of this Innovation Strategy. Smart Government and Smart Cities are some of the related initiatives (United Arab Emirates 2015). Blockchain can have a major impact on how the government conducts its operations as well as transformative applications in businesses and smart cities. Illustrative examples are smart contracts and secured payment systems. The UAE has also launched the Fourth Industrial Revolution Strategy (4 IR) aiming to strengthen the UAE's position as a global hub and to increase the contribution to the national economy by advancing innovation and future technologies. The 4 IR identifies among its strategic areas, economic security, that Blockchain can facilitate because of enhanced security features. The Blockchain technology is a fundamental pillar of the fourth industrial revolution. In that sense, it should constitute a large part in UAE's efforts.

[4]Ibid.
[5]These trends are also confirmed by previous year's historical data.

Keeping up with these challenges and emerging technologies, the UAE Government created the Emirates Blockchain Strategy 2021 (Huckle et al. 2016). The purpose is to benefit from the blockchain technology and transform half of government transactions into the blockchain by 2021. This is a major commitment and challenge. The transformation of half of government transactions, and correspondingly a large proportion of the exchanges with the private sector, is an unprecedented initiative. It is another display of the UAE global leadership. In this case, it globally leads in Fourth Industrial revolution, and Blockchain in particular.

6 Financial Applications of Blockchain Technology

The Blockchain technology has numerous financial applications. However, most of its applications are anticipated for the future. Bitcoin is the first impactful applications. The decentralized cryptocurrency, Bitcoin, relies on blockchain technology to record its transactions in a public ledger; a technology originally conceived for Bitcoin in 2008 and first implemented in 2009. The blockchain is a distributed database that maintains a continuously growing list of records called blocks secured from tampering and revision. Each block contains a timestamp and a link to a previous block. It serves as the public ledger for all transactions. Every compatible client can connect to the network, send new transactions to it, verify them, and take part in the competition to create new blocks. The competition of creating new blocks is known as mining. The Bitcoin design has been the inspiration for other cryptocurrencies as well as for other applications. However, it should be emphasized that different cryptocurrencies and applications can feature very diverse organizational architectural and technical elements (i.e. Hyperledger).

Similar applications occur for the other cryptocurrencies. Blockchain technology can revolutionize financial alternatives and consequently monetary systems. It could change the structure, administration and policy of monetary systems. From centralized government assets, currencies could become private and decentralized (Ølnes et al. 2017). More competition could be introduced in the monetary system. Consequently, the efficiency of the global and national monetary and financial systems could increase. This is particularly important for countries with inflation, macroeconomic and financial instability. The use of currencies based on blockchain technology, could provide to governments and citizens the choice to adopt more stable, and in general better, monetary alternatives. Moreover, citizens and businesses would have a wider range of options. This can be particularly valuable for UAE. Abu Dhabi and Dubai are global financial center in Middle East and new currencies could better facilitate and boost financial activity. Innovative Blockchain based currencies in UAE could also augment its leadership role in monetary affairs in the Middle East and globally.

A useful distinction is between the currencies per se and the exchange mechanism (Mulligan et al. 2018). This is usually hard to distinguish since the operations are often compactly joint. The exchange mechanism, or digital platform, is a more inclusive concept. It can encompass different types of exchanges, ranging from financial markets, to clearing houses, insurance contracts and in general, every exchange, financial or not. It can be applied to the government transactions with citizens, incorporating payment systems and exchanges. The range of innovative financial exchange mechanisms and their applications is enormous. It can range from simple accounting and financial information to more complicated transactions being better and more securely accessed and managed. There can be additional dimensions that Blockchain technology can add, as a sequence, the opportunity to search companies and attractions full records of value (Tapscott and Tapscott 2017). There can also be more advanced applications as the back-office handling of transactions, which can be speed up, more effectively reported, increase the transparency and dissemination of data, better comply with regulation, and of course reduce transaction costs (United Arab Emirates 2018).

NASDAQ, one of the largest and most developed markets, 'believes there is a great potential across the financial services industry to leverage blockchain', and it has created (Nasdaq) Blockchain Strategy (Hayek 1990). This is a crucial initiative, since it displays the interest of important financial institutions in Blockchain technology. More specifically, Nasdaq Blockchain Strategy observes applications in several services, like tracking and transfer of assets, managing payments and cash, facilitating collateral arrangements and securities lending (Bank of International Settlements 2017). Analogies between Nasdaq (USA) and Nasdaq Dubai can be drawn since they share common features and they are both leading in innovation. Blockchain ecosystems, as 3R, have been established to foster industry wide collaboration with the participation of a range of organizations including central banks, international banks, large accounting and consultancy firms and technology companies.

The sharing economy presents another major field for blockchain applications, related to finance. Huckle et al. (2016) suggest that blockchain has the opportunity to create a myriad of sharing applications, for example, automated payment mechanisms, foreign exchange platforms, electronic sales and smart contract exchanges. Blockchain, to some extent, can replace trust in sharing economy interactions and respectively replace central infrastructures as well

as intermediaries, and most notably payment services, in sharing economy ecosystems (Hawlitschel et al. 2018). The government can use blockchain technology in any sharing information activity, transaction or information exchange in which the government is involved, including payment and other services for citizens (Ølnes et al. 2017).

7 Application of Blockchain Technology in Marketing

The potential application of blockchain technologies is wide, spanning numerous industries and business disciplines. However, the full potential of these technologies in business disciplines other than finance and area of digital currencies is yet to be seen. Marketing practices increasingly shift toward digital marketing, and respectively sharing economy applications, and related exchange and payment systems. Blockchain technology is expected to be one of the disruptive innovations that will influence marketing practices in the years to come (Fanning and Centers 2016).

So far, not many studies have explored the potential application of blockchain technology in marketing. Harvey et al. (2018) argued that blockchain technologies could potentially be a significant disruption factor in digital marketing, providing the higher level of control and privacy, ending marketing fraud and spam, enabling more secured transactions in digital businesses and more precise targeting in advertising campaigns. The highest impact of blockchain technologies in marketing practices is expected in online advertising, with the potential to completely change the paradigm of online advertising by microtargeting, remonetizing media consumption, and elimination of intermediaries such as Facebook and Google in online advertising campaigns (Nasdaq 2016; Fanning and Centers 2016; Kecskés 2018).

Kumar and Pathkak (2018) conducted a comprehensive overview of the current and potential applications of blockchain technology in marketing. They also found the area of online advertising as one of the potentially most promising areas when it comes to the application of blockchain technologies in marketing. They argued that blockchain could enable consumers to preserve control over their data and be able to choose if and how they want to interact with the specific advertiser. Moreover, companies can get better leads by ensuring that they are showing only relevant ads to consumers and by eliminating intermediaries.

Currently, in digital advertising, advertisers are paying to intermediaries when consumers click on add or view it; the advertisements are shown according to consumer behavioral and demographic segmentation recorded and provided by intermediaries. This approach raises numerous privacy issues related to utilization of the consumer data to create targeted campaigns in online marketing without their explicit permission. The use of blockchain technology can enable users to avoid unwanted advertisements across digital platforms and preserve their privacy, while in the same time it can permit companies to do narrow targeting, ensuring that ads are shown only to the target group with the high level of interest for their product or service.

Additionally, application of blockchain is found to have potential to completely change the paradigm of online advertising by introducing direct payment to consumers for viewing advertisements using blockchain technologies (Nasdaq 2018; Harvey et al. 2018). Although their data is collected and traded, users do not receive any compensation for this. By creating platforms where users will own their data, the entire model of digital advertising can change in a way that instead of platform owners such as Google and the Facebook, user can receive micropayments for watching provided advertising content.

Although the current body of research indicates that blockchain technologies can have a future application in online advertising having in mind that none of these solutions have been tested so far, more research is needed to support the current expectations from the blockchain technology. Parsinen et al. (2018) argued that although blockchain has potential in addressing some of the critical issues in online advertising such as privacy and narrow targeting, it is not currently ready to be applied in online advertising and it should be carefully tested before wider implementation in the advertising marketplace.

8 Conclusions and Recommendations

Blockchain is still a nascent technology. It just celebrated its ten-year anniversary, since the creation of Bitcoin. Despite its promises and the hype surrounding the Blockchain technology, not many applications have been yet realized. There is no a generally accepted definition of Blockchain technology (Seebacher and Schüritz 2017). Nevertheless, the Blockchain technology market is rapidly developing and expanding at exponential rates, as Venture Capital and other type of investment (i.e. ICO) activity indicate. At the same time, Blockchain applications are respectively developing and growing. However, there are not many widely adopted Blockchain technology innovations. Nevertheless, some important applications have been already identified. Financial and marketing are among the most significant applications, especially in the context of UAE.

Blockchain constitutes a foundational emerging technology for the Fourth Industrial Revolution and it has the potential to drive and support sustainable environment and resilient growth (Hawlitschel et al. 2018). UAE has established strategies for Innovation, the Fourth Industrial

Revolution and recently for Blockchain. In this context, Blockchain is a fundamental part of UAE government policy. The UAE government and Dubai in particular, have properly identified and promoted blockchain technologies. First and most, as an emerging technology, Blockchain is having and it would have a big impact on innovation. UAE can significantly benefit and fulfill its strategy. At the same time, it could boost economic growth and employment. This research makes a contribution to the literature and UAE government policy by identifying and discussing some important financial and marketing applications. These applications could create value, employment and sustainable economic growth.

Abu Dhabi and Dubai are global financial markets. Blockchain technology can have a wide range of benefits for them. First and most, starting from digital currencies, UAE could also augment its leadership role in monetary and financial affairs in the MENA region and globally. The competitiveness and growth of financial markets in Abu Dhabi and Dubai and UAE as a whole, can be improved because it can offer innovative financial services. Digital payment platforms, clearing systems and many other innovative financial applications can increase efficiency and create value. Blockchain can offer due to encryption and distributed nature a better security, more resilience and sustainability. These concepts are at the core of UAE policy. Sustainability is strongly connected to security and resilience. Sustainability in this context, can be understood as the ability to maintain and perform successfully financial operations. Encryption increases security and the avoidance of adverse cyber events. Resilience through distributed systems guarantees less damage and quicker recovery. Blockchain applications can contribute to the advancement of financial markets, like NASDQ Dubai and generate valuable institutional and industry partnerships.

Similarly, UAE is a global hub for markets and trade. Blockchain technology is expected to be one of the disruptive innovations in marketing (Fanning and Centers 2016). With the launch of emcash, digital currencies can be a reference point in the use of blockchain technology in the UAE (Parssinen et al. 2018). More effective digital marketing, enabling more secured transactions in digital businesses, can be useful in almost every aspect of trade. Through the Blockchain marketing applications businesses and citizens could have better security and control of information. The UAE government can use some of these innovative applications and achieve its target to transform half of government transactions into the blockchain by 2021. Blockchain marketing and service applications can have a massive impact on how the government informs, transacts and satisfies citizens. They can increase security, efficiency and flexibility for citizens and businesses. Blockchain exchange systems can further facilitate this process. All these benefits could be larger if UAE gains a first mover advantage in the MENA region and globally, to retain and further strengthen its leadership position. As noted by Salman and Abdul Razzaq (2018) the future of digital currencies and Blockchain in the UAE is evident from the establishment of a Global Block Chain Council under Dubai Government. In order to be a global leader in Blockchain technology, it is recommended that UAE enhance the financing and entrepreneurial ecosystem to develop innovative Blockchain technology applications.

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Experimental Sustainable Practices in Fashion Education

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Abstract

Sustainability is expanding and transforming the context and practice of fashion education these days. The current industrial fashion education paradigm is reaching its end, and new patterns are emerging to address the socio-economic, human and environmental concerns related to the fashion industry. Valued at approximately 3000 billion (3 trillion) dollars by fashionunited.com, the global fashion industry has seen exponential growth over the last few years (https://fashionunited.com/global-fashion-industry-statistics. Retrieved 30th July 2018). The next generation of designers, therefore, need to be trained and prepared to face fashion industry challenges and opportunities in the technologically advanced but resource-constrained future. This paper explores the application of garment construction sustainability concepts of zero-waste, upcycling and reconstruction in a viable experimental project based on sustainable design practices. The project involves the designing and execution of a collection by undergraduate fashion design students at the College of Design at American University in the Emirates in Dubai. The works are analyzed based on design concept, material, process, and professional sustainable practices. The research outcomes will be used to shape and enhance future fashion design projects/assignments based on best sustainable practices and current fashion trends to promote sustainable design.

Keywords

Fashion education • Fashion design • Sustainability

1 Sustainability and the Fashion Industry

Fashion is a vibrant industry valued at USD 1.3 trillion, employing hundreds of millions, and touching almost every human life (https://www.ellenmacarthurfoundation.org/news/industry-leaders-join-forces-to-make-fashion-circular). In the past few decades, clothing has been made to seem "disposable" in a way it never used to be. This "fast fashion" phenomenon combined with the higher disposable income of the rising middle class has led to doubling of production from 2000 to 2014, and the number of garments produced exceeding 100 billion by 2014. According to a Greenpeace report, compared to 15 years ago, an average person buys 60% more items of clothing every year and keeps them for about only half as long, producing immense volumes of textile waste thrown out with household waste that ends up in landfills or incinerators, causing massive negative environmental impact (Greenpeace Germany research. Timeout for fast fashion. 6c356f9a-fact-sheet-timeout-for-fast-fashion. Retrieved 16th August 2018). As cited by Crabb and mentioned in the Living Planet report by WWF (2014), we require about 1.5 earths to sustain the current global consumption levels.

The entire fashion system has thus been readily accepted as "unsustainable" and a heavy burden on the environment (Fletcher and Grose 2012). For this study, an examination of the meaning of sustainability is, therefore, necessary. As cited by Evans and defined by Gro Harlem Brundtland in the 1987 report of the World Commission on Environment and Development, "sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Brundtland 1987; Evans 2011). Based on the same report, Muthu elaborates on the definition of a sustainable textile product as one "that is created, produced, transported, used, and disposed of with the due consideration to environmental impacts, social aspects, and economic implications, thereby satisfying all three pillars of sustainability" (Muthu 2014).

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A sustainable textile product is, therefore, expected to have minimum environmental and social impact during its life cycle.

Since university education shoulders the responsibility of nurturing and equipping students for the future while enabling them to fit in and contribute positively to the present, integrating sustainability in design practice is the emerging solution. The cradle-to-cradle concept of McDonough and Braungart reframes design as a positive, regenerative force that has the power to bring about change and eliminate the concept of waste with enduring benefits for society (McDonough and Braungart 2002). The circular economy model proposed by the Ellen McArthur Foundation has been interpreted into "make fashion circular" to replace the take-make-dispose model (https://www.ellenmacarthurfoundation.org/news/industry-leaders-join-forces-to-make-fashion-circular). This paradigm shift from those previously acquired by (fashion) practitioners is being explored in this paper through the application of sustainable fashion concepts of zero-waste, upcycling, and reconstruction, that focus on the reduction of textile waste generated. The paper discusses the innovation and possibilities in fashion education practice to enable student designers to recognize their place in the future fashion system.

According to the United States Environment Protection Agency (EPA), between 70 and 80% of a product's environmental impact is locked-in during the design and development stage (http://www.business.vic.gov.au/marketing-and-sales/business-sustainability/checklist-designing-sustainable-products). The fashion industry is a mix of complicated processes and activities; therefore, the designer has the responsibility of not just designing an outfit but managing the whole production pipeline to be able to minimize or eliminate waste at every step (https://www.cetonline.org/fast-fashion-textile-waste/; Domina and Koch 1997). Education offers an opportunity to foster new ideas with a deep concern for the ethical that would lead to ecologically literate fashion graduates who would shape the contribution of the various stakeholders in the fashion supply chain. Change-oriented sustainable fashion practices reinforce the concept of environmental responsibility among design students and prepare them for the future direction of the fashion industry.

The two major challenges facing sustainability are the increase in population as well as an increase in the use of limited resources. According to McKeown (http://unesdoc.unesco.org/images/0015/001524/152453eo.pdf), education for sustainable development (ESD) is where education is used as a tool to attain sustainability. ESD needs to be applied and relevant locally and culturally to have a bubble effect and find application on a larger scale. It is a holistic approach to education that has been defined by UNESCO (http://unesdoc.unesco.org/images/0013/001393/139369e.pdf) as "education that allows learners to acquire the skills, capacities, values, and knowledge required to ensure sustainable development", leading to viable employment. Bhamra and Lofthouse (2008) stressed that designers need to understand the full context of sustainability to propagate the fact that sustainability is more than recycling and using recycled materials—it must be applied to design at the concept stage and maintained through the production to the ultimate use by the consumer. The development of new courses and curricula, as well as case studies, play important pedagogical roles in expanding the context and application of sustainability in fashion education (Parker and Dickson 2009). Through transformative learning and teaching practice, students are encouraged to critically reflect upon and work towards a progressive future for fashion (Sala 2016).

2 Sustainable Concepts in Fashion Design Practice

Studies have revealed that the fashion design production process gives little or no consideration towards the life cycle of a garment and the textile waste generated during pattern cutting, manufacture and use of the garment (Eskandarypur et al. 2009). Textile waste has, therefore, become a serious environmental threat—if current practices continue, it is estimated that by 2030, fashion's annual waste from production and consumer disposal will increase by 60% to 148 million tons globally (Pulse-of-the-Fashion-Industry_Executive-summary_2). Broadly categorized as pre- and post-consumer textile waste, it is either landfilled or incinerated. While post-consumer waste consists of second-hand textiles and clothing, pre-consumer waste includes the waste generated before the textile even reaches the consumer and generally includes end-of-rolls, damaged textiles, sampling yardage and the textile scraps generated during garment manufacture at the cutting table (https://www.redressdesignaward.com/learn/zero-waste/). It is, therefore, imperative that the designer integrates sustainable design practices during the fashion design process, and consequently brings about change in the way that garments are produced, used, and discarded.

2.1 Zero-Waste

"Zero-waste" is a design technique that focusses on eliminating the pre-consumer textile waste at the design stage by cutting patterns in a way that all the fabric is used up in the garment without leaving any cut-off pieces (Gwilt and Rissanen 2012). This saves approximately 15% of the fabric that is wasted in conventional design approaches, as mentioned by "zero-waste" pioneer Risannen in his thesis (Rissanen 2013). The designer needs to carefully plan the

cutting of the pattern pieces of the outfit from the fabric, with prior knowledge of the fabric dimensions to execute the intended plan successfully. The zero-waste technique reduces not just the textile waste generated, but also the use of resources in generating those textiles. Though this concept is not new and has been used traditionally in many cultures (such as Japanese and Indian draped garments), the recent over-production, as well as easy and affordable accessibility of textiles, has given priority to the speed of manufacture without the justifiable use of materials.

2.2 Upcycling and Reconstruction

WRAP compliance has found that an estimated £140 million worth (350,000 tons) of used clothing goes to landfill in the UK every year (WRAP 2012). Extending or prolonging the life of a garment can, therefore, go a long way in saving the costs of resources used in clothing supply, laundry, and disposal. Upcycling transforms used textiles into products of equal or greater value, which prolongs their life, avoids textile waste and reduces the need for new materials. It is estimated that an extra nine months in the life of a clothing item through active use by such methods would reduce the carbon, waste, and water footprints by around 4–10% each (WRAP 2017). Upcycling can be used as a vibrant method for innovative creation, challenging the designers and giving new life and value to materials destined for the landfill (Han et al. 2017). It is a sustainable technique that leads to "chic" and unique designs that appeal to socially conscious customers, and its application should be explored in fashion design education through practical projects (DeLong et al. 2017).

A reconstruction is a form of upcycling post-consumer waste that involves deconstructing existing designs and reconstructing them into new desirable outfits with excellent finishing. Through patterns or draping, the designers can experiment without boundaries and contribute to prolonging the life of clothes, even those that are damaged or out of fashion (Brown 2013). Consumer behavior also plays a major role in the proliferation of these sustainable practices as an upcycled/recycled garment must be able to replace the purchase of a new garment.

3 Integration of Sustainability Concepts in Fashion Design Education

This practice-led study was conducted to explore the integration of sustainability concepts in a fashion design undergraduate program to produce contemporary, market-ready, and viable products. The hands-on involvement of the students in the process from research to production is believed to be more valuable and effective than teaching the same concepts theoretically in class.

The project was undertaken with third-year undergraduate students of Fashion Design at the College of Design at American University in the Emirates in Dubai, United Arab Emirates. The Fashion Design program at the college comprises 126 credit hours including general, core, elective, and specialization courses. The specialization courses cover fashion subjects such as patternmaking, draping, history of costume, textiles, CAD, merchandising, etc. The students undertake various studio and field projects during the courses to gain practical experience in addition to theoretical knowledge. The involvement of the students in external design competitions (local and international) and the resulting effect on their learning was explored earlier by the researcher in a previous study (Agarwal 2017).

The current study aims to create awareness, build knowledge, enhance creativity, and hone the construction skills of students to create designers of the future who are well-equipped to enter the industry and promote sustainable behavior in their local and global community. This ESD model of education will help create graduates who will lead the transformation by pursuing sustainability not just as an ideology, but with practical application.

The students were briefed about the above-mentioned three techniques used by fashion designers to reduce textile waste. They conducted research on sustainability in the fashion industry in addition to identifying sources of textiles that could be used for upcycling and reconstruction.

3.1 Project 1

The collection titled "Farfalla" (Italian name for butterfly) follows the theme of the butterfly. Each of the three outfits represents a stage in the life cycle from the cocoon to the metamorphosis of the adult butterfly. The designs were created using pre-owned textiles/garments that were deconstructed and recreated into fashionable garments with high-quality finish.

Analysis of sustainable practice and design: The concept was aptly represented through this textured and layered garment with varied color patterns. In line with the sustainable concepts of upcycling and reconstruction, each used garment was disassembled by opening the seams, and the component parts were used as fresh textiles for the design. In this way, all the sustainable practices were strictly adhered to and the value enhancement was done through the application of Swarovski crystals and beads on the pants (Table 1).

Table 1 Details of design #1

Designer	Aliya Alfaour
Project	"Farfalla"
Year of production	2018
Design concept	A colorful outfit inspired by the butterfly coming out of the cocoon (beginning of the life cycle)
Material used	The material used is predominantly denim/all fabrics from preexisting used garments, Swarovski crystals
Sustainable techniques used	Upcycling and reconstruction

Table 2 Details of design #2

Designer	Aliya Alfaour
Project	"Farfalla"
Year of production	2018
Design concept	The design is inspired by the butterfly taking shape in the cocoon
Material used	The materials used are denim from an old discarded pair of jeans, end-of-roll fabric, Swarovski beads
Sustainable techniques used	Zero-waste and upcycling

Analysis of sustainable practice and design: The concept was appropriately presented through this layered garment with detailing and unique combination of fabrics. Zero-waste pattern cutting was implemented in the blouse through meticulous planning and patternmaking to avoid any wastage. The pants were made from denim that was upcycled from a discarded pair of jeans, and the hemline was achieved with labels from used clothing. The sustainable practices were, therefore, strictly adhered to and the design element was enhanced through the application of Swarovski beads (Table 2).

Analysis of sustainable practice and design: The concept was suitably characterized through this textured and layered outfit consisting of a jumpsuit and long vest. Zero-waste pattern cutting was used again and the texture was added at the hemline of the vest through lines of flowers made of denim and enhanced through the use of Swarovski crystals (also used on the collar). The sustainable practices of zero-waste and upcycling were used well to complete the construction of the outfit (Table 3).

3.2 Project 2

The collection with an architectural theme was designed with the used school uniforms of passing-out students of grade XII of a school in Dubai. After finishing school, the girls donated their check pattern uniforms, which were combined with laser-cut fabric leftover from a previous collection made by the fashion student. The students drew inspiration from the works of Vivienne Westwood and the fashion brand Jacquemus and styled the outfits using varied construction techniques to have an interesting interplay of fabrics. During the making of the garments, zero-waste technique was applied, resulting in upcycled and reconstructed designs.

Analysis of sustainable practice and design: The design justifies the inspiration from Vivienne Westwood as well as the deconstructed and twisted design philosophy of French designer Jacquemus. The plaid texture of the material sourced from the uniforms of graduating high schoolgirls has been explored well in the linear design. The laser-cut

Table 3 Details of design #3

Designer	Aliya Alfaour
Project	"Farfalla"
Year of production	2018
Design concept	The design captures the shape of the butterfly in this jumpsuit with a long flowing vest
Material used	The materials used are from pre-owned garments, end-of-roll fabric, 3d flowers created with surplus fabric, Swarovski beads
Sustainable techniques used	Zero-waste and upcycling

Table 4 Details of design #4

Designer	Samreen Kazi
Project	"Architectural Plaid"
Year of production	2018
Design concept	The design is inspired by architectural shapes and cuts as well as the funky/edgy style of designers Vivienne Westwood and Jacquemus; trendy fitted pants with a fringed hemline and tube top with draped panel
Material used	The materials used are plaid uniform trousers, laser-cut leftover textile, blue school blazer
Sustainable techniques used	Zero-waste and upcycling

material lends uniqueness to the design. The plaid trousers and navy blue blazers were deconstructed and then reconstructed, with careful pattern cutting to avoid waste (Table 4).

Analysis of sustainable practice and design: The design uses the panels of plaid fabric and end-of-roll tulle in a novel way with a play of lines to create an interesting effect. The zero-waste pattern cutting technique off sustainable design has been followed well to eliminate waste, and the uniform clothes have been deconstructed and then upcycled into the trendy outfit (Table 5).

Analysis of sustainable practice and design: The design uses lacing on the skirt and top to create a unique effect, with a combination of all the deconstructed fabrics available from the school uniform skirt, blazer, and trouser. The fabrics were blends that were combined with laser-cut fabric leftover from a previous collection made by the student. Owing to the limited size of the deconstructed textiles, the patternmaking, and layout for cutting were challenging tasks, achieved without leaving any waste (Table 6).

4 Analysis

Sustainability education emphasizes knowledge that is practical, applicable, and inclusive, aimed at achieving sustainable communities. Incorporating sustainable practices in fashion design reinforces the concept of environmental responsibility.

The study was conducted to address the central question for educators about what to teach and how to engage students in sustainability-oriented design practice. As a design discipline, it is imperative to link theory with practice and industry application, and this study provided the intellectual thrust to the students to take this subject seriously and develop the required skillset for undertaking future

Table 5 Details of design #5

Designer	Samreen Kazi
Project	"Architectural Plaid"
Year of production	2018
Design concept	The design presents crisp fabrics in sculptural shapes through asymmetric top and skirt
Material used	The materials used are plaid uniform trousers, laser-cut leftover textile, blue school blazer, end-of-roll tulle
Sustainable techniques used	Zero-waste and upcycling

Table 6 Details of design #6

Designer	Samreen Kazi
Project	"Architectural Plaid"
Year of production	2018
Design concept	The design presents a modern silhouette with an emphasis on cut and angles to utilize the available materials in a chic design.
Material used	The materials used are plaid uniform trousers, laser-cut leftover textile, blue school blazer, end-of-roll tulle
Sustainable techniques used	Zero-waste and upcycling

challenges. The project takes a holistic approach, unifying research, education, and practice to stimulate students to identify solutions based on market trends and sustainability.

The conventional steps of fashion design practice were challenged and reinvented during this project. The usual flow starting with trend and concept research, and going on to concept/theme selection, color selection, designing of outfits/technical drawings, fabric research and sourcing, patternmaking/draping, sewing and finishing, was followed in a different order, as the students started with trend research along with identifying and sourcing used and/or end-of-roll fabrics. This was the most critical step as the fabric would serve as inspiration for the designs, thereby deploying "new ways" of designing to meet creativity as well as sustainability goals. Further research was then conducted to create designs that would align with the sustainable principles of zero-waste, upcycling and reconstruction.

After participating in the project, the students reported learnings that were multidimensional. There was a substantial increase in their knowledge and skills, and they felt enabled, empowered, and inspired to implement sustainable design strategies. They also experienced improvement in critical thinking skills and problem-solving due to the complexities arising because of limited fabric resources. Due to the social and community nature of the project, feelings of empathy and social responsibility were heightened (Grose 2017). The teachers took on the role of facilitators during the student-centered project (Welsh and Murray 2003). As cited by Agarwal and proposed by Jeffrey and Craft, this "learner

inclusive" approach leads to ownership of the project and control of the outcome by the students, leading to greater learning (Agarwal 2018).

Though the students had previously been exposed to the knowledge and information about sustainability in the fashion industry, it was found that working hands-on during this project provided them experience about the zero-waste layout for patterns and construction techniques to achieve good finishing and new look from pre-used garments/textiles. Zero-waste fashion design involves creative pattern cutting which is both aesthetic and functional (Carrico and Kim 2014). The students thus reported increased ability in pattern making and cutting that can be applied to new design areas. Upcycling and reconstruction encouraged them to reuse garments and textiles, giving them a new life as fashionable outfits. The combination of the three sustainable techniques led them to previously untapped areas of creativity and adaptability as well as additional skills (Townsend and Mills 2013). Design educators, therefore, need to align design research, practice, and education to be situated at the center of sustainability and vice versa to redefine the role of design and fashion designers. The transformation process of the fashion industry into one that is more sustainable is a long-term commitment that will take time and widespread change at all levels (Fletcher 2008).

Since the fundamental aim of the project was to find the suitability and ways to embed education for sustainability into the wider curriculum, the practical experience of this study will be used as a building block for future courses in the program.

5 Future Perspective

The research studied experimental practices in sustainability in fashion that could be applied to a fashion design curriculum in the United Arab Emirates to prepare future designers for working with the challenge of limited resources. The role and influence a designer can have in the manufacturing process of fashion cannot be underestimated, and the study builds on this premise to develop their potential as sustainable designers to slow the flow of materials through the fashion system. The importance of such practices was highlighted, and it was found that students respond better and imbibe more during hands-on creative work compared to the knowledge imparted theoretically. The students were able to experience and witness multiple approaches with a focus on sourcing, pattern making, garment construction, and finishing to present their work as modern and saleable designs. They developed new skills and built upon their existing knowledge in fashion design to find ways of living within nature's limits.

Since the study was restricted to the undergraduate Fashion Design program at American University in the Emirates, further research may be carried out after the inclusion of such practices in the curriculum, and their impact could be studied on students' designing methodology as well as behavior as a fashion consumer.

According to Fletcher (2008), not just sustainable practices, but an interconnected approach calling for user involvement through a new way of consuming fashion and a long-term commitment can bring about gradual change. Studies may, therefore, be conducted to identify ways of transforming consumers to be more sensitive to bring down the impact generated by them at the individual level (Gardetti and Torres 2017).

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HR Analytics, Fad or Fashion for Organizational Sustainability

Tahir Masood Qureshi

Abstract

HR analytics is becoming more and more important over the years. Understanding how to work with the data is paramount to the success of an organization working in the competitive business world. The largest expense of many companies is on human resources, starting from sourcing, recruiting, training, retaining till end of service. Therefore, it is essential to know how HR decisions impact business performance by linking HR practices to business outcomes and using meaningful information instead of gut feelings. For this purpose, HR analytics can help companies know what they need to improve the work process performance. It can help them to form a high-performance team and maintain good working environment and predict exactly which candidates are likely to exceed. However, the major challenge for the companies is to find out the right person who can work with HR data and perform analytics in a right and meaningful way. Few companies using HR data analytics are not taking it seriously because they think that it is just another product added in the company's soft assets, but few are using it properly to make data-driven decisions. Using five-point Likert scale questionnaire, 273 responses from HR professionals working in GCC automobile industry were collected and analyzed using SPSS. Analysis revealed that HR analytics used properly to generate reports that help organizational executives to run routine operations and HR-related strategic matters is contributing significantly toward organizational sustainability. Furthermore, organizations' readiness to use HR analytics and human capital mediates relationship between HR analytics and organizational sustainability, which creates learning.

Keywords

HR analytics • Organizational sustainability • Human capital • HRM

1 Introduction

Organizations are struggling to shift from operational reporting to analytics despite having huge interest in human resource (HR) analytics and vast data availability. However, few organizations appreciating such growth have struggled to move toward HR analytics through development of people models and statistical analysis for actionable solutions based on facts (Bersin 2015). Therefore, many organizations have yet to grow their analytical capabilities. There are many business intelligence (BI) software that help companies to gain insight on their overall growth. BI products available in the market enable organizations to capture, categorize, and analyze corporate data and extract best practices for improved decision-making. Like other business functions for human resource field, HR analytics—referred to as people analytics or talent analytics based on different models of statistics and mathematics—is used to develop talent management related policies and strategies for improving sustainable organizational performance. HR analytics is a process of HR data recording, mining, analysis, visualization, and planning for better performance.

Many researchers and practitioners are lamenting the lack of analytical skills among HR professionals and organizations' readiness to use the human resource analytics (ORHRA). HR professionals are responsible for developing and implementing HR planning for the current and future matters related with human resource management, while HR data analysis is essential activity of HR data scientists and has a high demand in the world. These professionals are responsible to develop a logical story based on HR data analysis but based on certain logic. The simplest way is calculating correlation among different HR functions to

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identify how they are linked with each other and organizational sustainability. Converting analytical insights into legitimate business actions begins with effective storytelling using analyzed data related with people, operations, and finance. To do this, the main requirement is that HR analytics and analysts address core strategic issues, enabling organizational leaders to develop and implement the vision-aligned strategies in order to achieve better employee performance and organizational sustainability.

2 Literature Review

2.1 HR Analytics and Organizational Sustainability

Twenty-first century organizations are rapidly adopting technology and analytics to run business matters. Therefore, there is a need to explore the empirical relationship between organization experts' readiness to use HR analytics with reference to organizational sustainability (Van den Heuvel and Bondarouk 2017). The focal objective of this empirical investigation is to contribute in the taxonomy of HR analytics by investigating how HR analytics significantly contribute toward organizational sustainability. HR analytics refers to the use of analysis, data, and systematic reasoning to make decisions (Davenport et al. 2010). HR analytics is perceived as a tool aiming to enhance organizational insights regarding future innovation and its sustainable growth (Smeyers and Delmotte 2013). In addition, HR analytics refers to the organization's ability to recognize and quantify the firm's human centric performance and sustainability aiming to formulate better future decisions. However, it is the focal responsibility of the firm's HR department to quantify and identify the human driven performance outcomes. It has been suggested that HR analytics must be perceived as a cognitive process in relation to the statistical and logical framework (Van den Heuvel and Bondarouk 2017). In the absence of a well-articulated research problem, any developmental insights resulting from the data analysis generate insignificant results about HR analytics, which consequently, mitigate organizational future sustainability. It is difficult to forecast how human resource management practices will change in the future. HR analytics are used by most of the known organizations like Google and others. Past studies shown that a firm's adaptation of HR matrices is to analyze HR data, these HR matrices enable organizations to conceptualize data through the lens of holistic perspective using tabulations, charts, dashboards, and different other formats that enable organizations to conceptualize important findings in an understandable and meaningful way. It has been observed from the past literature that in the absence of clear comprehension regarding predictors of performance management, organizations are unable to develop their HR matrices based on HR practices (Huselid 2015). Matrices are unable to provide holistic view about the organizational outcomes resulting from the various factors associated with the organizational future growth and sustainability (Kramar 2014). HR analytics is comprised upon various essential hallmarks in relation to the organization outcomes, HR practices, and policies. Organizations are still endeavored to develop their HR analytics despite various HR practitioners' forecasts about its future role and importance (Van den Heuvel and Bondarouk 2017). It is evident that the organizations are still unable to adapt HR analytics due to their failure to develop employees to use analytics and prepare guidelines in this regard (Wolfe et al. 2006), which consequently affect the organizational sustainable development and growth. According to Ability-Motivation Opportunity (AMO) theory, HR systems significantly manipulate employee productivity based on the organizational ability to attract and develop high performance employees, that enable organizations to sustain their growth in competitive business environment (Guerci et al. 2015). It has been evident from the AMO perspective that an organization's performance management capabilities and contingent rewards system are significantly associated with the employee motivation, positive workplace attitudes, and organization citizenship behavior (OCB). Moreover, organizations' HR systems and AMO theory are considered to be the most critical factors in relation to the organizations' financial performance and employee turnover rate (Subramony 2009).

2.2 Organizations' Readiness, HR Analytics and Org. Sustainability

Organizations' readiness to use HR analytics is matter of concern (Bassi 2011). Based on recent studies on the individual adaptation of HR analytics as innovation and change in the organization, the decision to adopt innovation in the organization happens when all the stakeholders consistently follow the processes resulting from the choice whether to adopt or refuse innovation in the organization (Vargas et al. 2018). "Adoption is a decision to make full use of an innovation as the best course of action available" (Rogers 2003) despite individual positive behavior and attitude toward innovation adaptation in the origination. There is still an uncertainty in relation to organizational innovation process, that mitigate the employees' ability to engage with such a process, and this in turn decrease the organization ability toward organizational sustainable goals pursuit (Vargas et al. 2018). It has been evident that organization's ability to use HR analytics as an innovation driver is based on the five steps that includes (a) knowledge, (b) persuasion, (c) decision, (d) implementation, and (e) confirmation. HR

analytics should be conceptualizing on the bases of early adaptation stage, which consequently, enable the organizations to identify and formulate their predictors of competitive advantage. However, various factors related to intuitional isomorphism manipulate the organizational early adaptation ability in relation to their HR analytics, which mitigate the firm's ability to sustain a competitive advantage.

2.3 HR Analytics, Human Capital, and Organizational Sustainability

In a contemporary business environment, organizations are required to spend on their human capital aiming to develop and sustain their core competencies. Adaptation of HR analytics by the organization significantly contributes toward organizational long-term sustainability. Implication of HR analytics in business organizations is conceptualized as one-time effort by the organizational management, which is significantly associated with organizational sustainability and growth (Minbaeva 2018). It is the main responsibility of the firm's HR practitioners to adopt analytical methodologies (Boon et al. 2018) for better decision making related with human resource management functions. Analytics must be conceptualized based on context in order to generate consequential inferences. It is essential for the HR practitioners to recognize the quality of the data before the data entry process. Inferential and descriptive statistical models coupled with structure equation modelling, correlation matrices, and regression models should enhance the firm's capacity to recognize how organizational human capital significantly contribute toward firm's sustainability and growth (Angrave et al. 2016). HR analytics can be perceived as a strategic tool used to optimize the organizational insights on how to gain a competitive advantage in today's contemporary business environment. Organizations that invest in human capital and consider employees to be a valuable asset are more enabled to gain competitive advantage as compared to others. In addition, it has been recommended in past studies that organizational management and HR practitioners should formulate a mental liaison in terms of how organizational human capital significantly associated with organizational sustainability and future growth by using HR analytics. It has been evident that due to the growing adaptation of Human Resource Information System (HRIS) organizations have the ability to store its data in one place; this, in turn, enhance organization's ability to retrieve desired information effectively (Fitz-Enz and John Mattox 2014).

Based on gap identification and a comprehensive literature review, the following theoretical model and propositions are developed to study the effect and value of each variable (Fig. 1).

Proposition 1 *Human resource analytics (HRA) is significantly contributing toward organizational sustainability.*

Proposition 2 *Organizations' readiness to use HRA to mediate relationship between HR analytics and organizational sustainability.*

Proposition 3 *Trained human capital mediates relationship between HRA and organizational sustainability.*

3 Research Methodology

Based on literature review one dependent variable (Organizational Sustainability), one independent variable (Human Resource Analytics), two mediators (Organizations' Readiness to use HRA and Human Capital). To collect primary data, a five-point Likert scale questionnaire was used. The questionnaire was distributed to 600 human resource professionals working in the automobile sector operating in GCC, and 271 responded. In the cross-sectional study, primary data was collected using stratified random sampling.

4 Analysis and Findings

Collected data was coded in SPSS-22. Overall Cronbach's alpha value ($\alpha = 0.865$) ensured reliability of instrument and permits further analysis (Table 1).

Furthermore, reliability values for each variable, i.e., organizational sustainability ($\alpha = 0.971$, human capital ($\alpha = 0.826$), and organizations' readiness to use HR analytics ($\alpha = 0.782$) ensured the adequacy of questionnaire as recommend by Nunnally (1978). To test the propositions, correlation and regression analysis were performed (Table 2).

Correlation between human resource analytics and organizational sustainability ($r = 0.765$, $p < 0.05$), human capital and organizational sustainability ($r = 0.871$, $p < 0.05$), and organizations' readiness to use HR analytics ($r = 0.709$, $p < 0.05$) are evidencing significant relationship among the tested variables (Table 3).

Regression values for each independent variable; human resource analytics ($\beta = 0.322$, $p = 0.009$), human capital ($\beta = 0.426$, $p = 0.004$), and organizations' readiness to use HR analytics ($\beta = 0.337$, $p = 0.011$) ensured significant contribution of independent variables to organizational sustainability. In addition to acceptance of first proposition, these values permit mediation test for proposed model and given proposition (Table 4).

To test the second proposition, human capital is used mediator in step one and in second step HR analytics is used as independent. ($\beta = 0.526$, $p = 0.002$), is changed to

Fig. 1 Theoretical framework

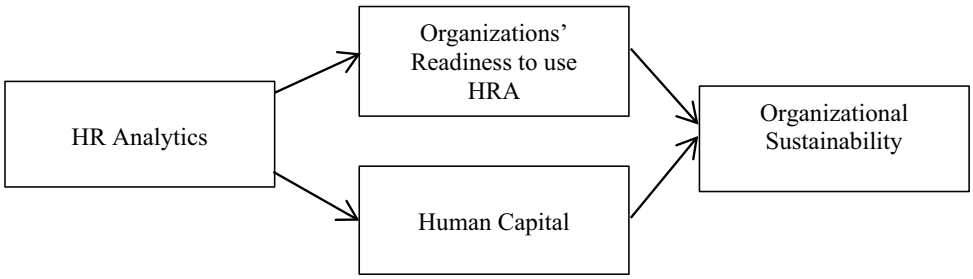

Table 1 Cronbach's alpha value

OS	HRA	HC	ORHRA	Overall reliability
0.971	0.879	0.826	0.782	0.865

Table 2 Correlation matrix

	OS	HRA	HC	ORHRA
	1			
Human resource analytics (HRA)	0.765[a]	1		
Human capital (HC)	0.871[a]	0.921[a]	1	
Organizations' readiness to use HR analytics (PRHRA)	0.709[a]	0.896[a]	0.683	1

[a]Correlation is significant at 0.05 level (1 tailed)

Table 3 Regression analysis

	β	R^2	ΔR^2	Sig.
HRA	0.322	0.529	0.069	0.009
HC	0.426	0.624	0.107	0.004
ORHRA	0.337	0.561	0.071	0.011

Table 4 Mediation analysis: human capital as mediator

		β	R^2	ΔR^2	Sig.
Step I	HC	0.526	0.103	0.021	0.002
Step II	HRA	0.511	0.135	0.006	0.061

Table 5 Mediation analysis: professionals readiness to use HR analytics as mediator

		β	R^2	ΔR^2	Sig.
Step I	ORHRA	0.527	0.111	0.050	0.025
Step II	HRA	0.511	0.096	0.033	0.607

($\beta = 0.511$, $p = 0.061$) this change ensure the mediation of the tested variable (Table 5).

To test the third proposition, organizations' readiness to implement HR analytics is used as mediator and in second step, HR analytics is used as independent variable. Results produced were changed from ($\beta = 0.527$, $p = 0.025$) to ($\beta = 0.511, p = 0.607$). This value ensures the acceptance of proposition three related with mediation.

5 Conclusion and Recommendations

Analysis revealed that the all three prepositions (Proposition 1: Human resource analytics is significantly contributing toward organizational sustainability, Proposition 2: Organizations readiness to use HRA mediate relationship between HR analytics and organizational sustainability, and

Proposition 3: Trained human capital mediates relationship between HR analytics and organizational sustainability) are accepted. Therefore, it is recommended for the organization to focus more on implementing HR analytics and train employees how to use this tool in order to attain the short- and long-term organizational sustainability.

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Measurement of Financial and Asset Performance of Agricultural Farms: Operational Proposal for a New Rating Model for Agricultural Companies for a Sustainable Development of the Industry

Fabian Capitanio, Felice Adinolfi, Rania Itani, and Alessio Faccia

Abstract

The aim of this research paper is to suggest an operational rating model that can be immediately used to improve the finance scheme of agricultural companies. Currently, banks are employing a rating model provided by Moody's that uses various weighted indicators and linking the probability of default mainly to general and non-specific factors. The sampling carried out by Moody's to obtain the probability of default was based on a small sample of agricultural companies. In this study, the authors propose the use of a new model based on the Altman EM score, using the Italian RICA database (Agricultural Accounting Information Network) and other variables derived from reclassified financial statements. This approach facilitates to emphasize how the national distribution of companies by rating classes is unbalanced toward the vulnerability area, central to the classification system used, by drawing a normal Gaussian distribution with a slight negative asymmetry. Therefore, the authors find out that for the evaluation of the creditworthiness of the farms, it is recommended to include in the calculation of the rating "historical" and economic-financial quantitative data (such as financial statements, income tax return), trend data (such as Internal of the credit institutions and Central Risks Database), qualitative, and others. The above proposed rating model has been tested on many companies and applied immediately.

Keywords

Financial performance • Asset performance • Rating model • Agriculture • Sustainable development

JEL Classifications

G21 • G22 • G23 • M41 • Q14

1 Introduction

Agricultural systems have evolved a lot in recent years. Academics and policy makers showed a lot of interested in the subject of access to risk capital (Ullah et al. 2016). The intensification of competitive pressure increases the farmer's exposure to the risk associated with business activity. In this perspective, the use of credit is not only a tool to support the on-going concern and the growth of the company, but also an important resource for risk management (Eidman 1990). In fact, where the potential harm of undesirable events is limited to farmers, the risk can be usefully assessed with ex-post measurements. The most common of these tools is based on the use of credit and/or savings, to avoid reductions in the level of consumption and guarantee an adequate level of contribution capital. Accordingly, the consequences of a harmful event can be distributed over time, and its correspondent cost is represented by the opportunity cost of the financial reserves that must be moved to mitigate the effects. Nowadays, access to loan capital and the availability of adequate financial products are therefore an essential factor

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for the growth of the agricultural business. Hence, assumption of the relationship between banks and the agricultural enterprise is relevant. In addition to claiming remuneration through the application of interests and since credit is a limited resource, lenders try to assess the riskiness of loan transactions through selecting companies that offer adequate guarantees of repayment of capital.

Therefore, in the economic system, the profitability and solidity analysis of a company is a very important topic because both are directly connected to the assessment of the creditworthiness and to which approval of loans is subordinated.

The inefficiency resulting from a bad credit distribution is relevant to both lenders (for whom the risk of losing invested capital shares increases), and producers (because it increases the cost of access to loan capital and a part of the production chain is penalized in the implementation of less risky investment projects than those chosen by the credit system). This clarifies the growing attention over the years by both the credit system and the public sector to the issue of risk assessment.

As far as the national agricultural system is concerned, the novelties of the last few years have defined a completely new scenario. In fact, in the past, the credit in agriculture has been regulated by "special schemes" (Italian Decree Law 24 January 2012) which, by promoting better conditions of access for farmers, have become real instruments of agricultural policy. Meanwhile, today with the new Consolidated Law (Italian Legislative Decree no. 141/2010) in banking and credit matters and the introduction of the Basel III rules (Basel Committee on Banking Supervision, 2010; Basel Committee on Banking Supervision 2004; Core and Magagnoli 2008; Crivellaro 2008), the condition of an agricultural entrepreneur ceases to benefit of most of the special regulations that facilitate for the farmer the role of guarantees in relations with the credit system is scarcely relevant. Due to the absence of audited accounts for most national agricultural enterprises and the standardized charges of the cadastral income indexes that is considered to be the main source of revenue generated from agricultural activity, this change is even more important.

The structure of this research paper includes a part dedicated to the presentation of the state of the art on the methods for assessing the creditworthiness of farms, in which the points considered critical for their use will be explained. Subsequently, a new approach to risk assessment in agriculture is presented, accompanied by an empirical analysis carried out by testing the model on the sample of the RICA (Rete Informazione Contabile Agricola) database. The final Sect. 6 is dedicated to the final considerations.

2 Literature Review

The regulation for the credit system provided to the agricultural industry in Italy has led to a recent development of analyses and proposals for the assessment of the creditworthiness of farms. The implementation of rating models as synthetic indicators for the assessment of creditworthiness in the agricultural sector, has also been subject to many difficulties due to the simplified accounting system, which is common among operators in the sector. Moody's has developed on behalf of ISMEA (Istituto di Servizi per il Mercato Agricolo Alimentare) the "Small and medium enterprises model", while some empirical tests have involved the application of the Altman EM Score (Adinolfi and Capitanio 2009a, b, c; Altman 2005; Altman et al. 1998; Altman and Haldeman 1995).

In details, the "Small and medium enterprises model" created by Moody's specialized agency for ISMEA (Moody's KMV 2009; Moody's KMV 2004; Moody's 2005a, b; Cupo and Di Domenico 2008) in 2007 provides for the use of several weighted indicators and identified five sections, which have been assigned different weights; each of which corresponds to a specific weight:

- Section 1—Economy: 4%;
- Section 2—Market/Industry: 6%;
- Section 3—Management: 25%;
- Section 4—Business: 40%;
- Section 5—Financial: 25%.

Each section is in turn composed of weighted indices that are shown below:

- Section 1—Economy: level of confidence in the food industry; level of trust in agriculture.
- Section 2—Market/Industry: attractiveness of the sector; regional specificity; specificity altimetry; parks or protected areas; access to communication routes.
- Section 3—Management: Experience; specific training; technical assistance and updating; accounting management and control; risk management—insurance contracts; development of alternative commercial channels; access to foreign markets; extra-agricultural incomes; voluntary certifications; recognized brand.
- Section 4—Business: membership of cooperatives, consortia and others, relations with suppliers; customer relations; relationships with large retailers; customer payment times; future design and development, net profit; dependence on capital.

- Section 5—Financial: average duration of loans: indebtedness index, degree of coverage; liquidity index; gross operating margin on sales; change in revenues; changes in inventories; average duration of debts; degree of net coverage; Infinity amortization rate.

The main limitation of Moody's model is the prevailing weight that the Sects. 3, 4 and 5 assume with respect to the synthetic judgment of value on the creditworthiness of the companies. The possibility that the solvency of a farm should necessarily depend on the management's structure, business and finance is a critical estimation, especially because of the entrepreneurial structure of Italian agriculture (Adinolfi and Capitanio 2009a, b, c):

In addition, there are other critical points of Moody's methodology can be found out in the small number of the monitored sample, along with obvious problems in the representation of the sample with respect to the farms' universe and ex-post statistical verification of the implemented model. Moreover, there are severe penalization rating opinions in the event of absence of replies from the farmer, within the subjected questionnaire, with the result of finding companies with a very robust economic/financial structure in scales of reargued rating for this reason.

In summary, the rating scale resulting from the application of the model, to which the relative probabilities of default (PD) are associated, is illustrated Tables 1 and 2.

On the other hand, the usage of Altman's EM-Score, makes it possible to generally assess the state of reliability of the observed companies using values derived from the financial statements. Based on this rating indicator, Adinolfi and Capitanio (Capitanio and Adinolfi 2009) defined, using the RICA database, a reference framework representative of the creditworthiness expressed by the national agricultural reality. The variables used were derived from the reorganization of the accounting data recorded in the RICA statistical sample, within a reclassification of the financial statement format. The result of the EM Score weighted quotient is the sum of the following indices and weights (Crivellaro 2008; Adinolfi and Capitanio 2009a, b, c):

$$EMScore - 3.25 + 6.56\,(C/K) + 3.26\,(U/K) + 6.72\,(RO/K) + 1.05\,(PN/PT)$$

where:
C = working capital
K = invested capital
U = retained earnings
RO = operating result
PN = equity
PT = total liabilities.

The application of the Altman EM Score results a final value between 0 and 30 which, by inserting it into a reference classification, allows the rating of the company examined to be assigned. The classification taken as reference uses the classic matrix adopted by Standard & Poor's (20 classes of reference with a vote expressed in letters) and has been further aggregated into three areas of reliability (Security, Vulnerability, Risk). Table 1 links the rating assigned in relation to the probability of default (De Luca 1998).

This approach highlighted on how the national distribution of companies by rating classes is unbalanced toward the vulnerability area, central to the classification system used, by drawing a normal Gaussian distribution with a slight

Table 1 Rating scale/Moody's model

Rating scale ISMEA	Implicit rating MKMV	Related "cuttoffs" min (%)	Related "cuttoffs" max (%)
1	Aaa	0,00	0,02
2	Aa1	0,02	0,03
3	Aa2	0,03	0,05
4	Aa3	0,05	0,09
5	A1	0,09	0,14
6	A2	0,14	0,18
7	A3	0,18	0,22
8	Baa1	0,22	0,28
9	Baa2	0,28	0,43
10	Baa3	0,43	0,66
11	Ba1	0,66	1,10
12	Ba2	1,10	1,65
13	Ba3	1,65	2,48
14	B1	2,48	3,71
15	B2	3,71	5,57
16	B3	5,57	8,35
17	Caa/C	8,35	

Table 2 Altman's EM score

Altman's EM score	Rating	Default probability (%)	Reliability level
EM > 8.15	AAA	0–0.25	Safe
8.14 < EM < 7.60	AA+	0.25–0.37	
7.59 < EM < 7.30	AA	0.37–0.43	
7.26 < EM < 7.00	AA−	0.43–0.50	
6.99 < EM < 6.85	A+	0.50–0.62	
6.84 < EM < 6.65	A	0.62–0.79	
6.64 < EM < 6.40	A−	0.79–1.00	
6.39 < EM < 6.25	BBB+	1.00–1.19	
6.24 < EM < 5.85	BBB	1.19–1.73	
5.84 < EM < 5.65	BBB−	1.73–2.00	
5.64 < EM < 5.25	BB+	2.00–2.90	Vulnerable
5.24 < EM < 4.95	BB	2.90–3.56	
4.94 < EM < 4.75	BB−	3.56–4.00	
4.74 < EM < 4.50	B+	4.00–5.48	Risky
4.49 < EM < 4.15	B	5.48–7.59	
4.14 < EM < 3.75	B−	759–10.00	
3.74 < EM < 3.20	CCC+	10.00–20.96	
3.19 < EM < 2.50	CCC	20.96–34.97	
2.49 < EM < 1.75	CCC−	34.97–50.00	
EM < 1.74	D	>50.00	

negative asymmetry. Altman's EM Score, like all the traditional methods of assigning creditworthiness, due to the high level of capitalization generally associated with farms, returns a generally high and overestimated score compared to the real conditions of economic and patrimonial equilibrium of companies; therefore, determining a low default risk for most of the business structures. This is an important limit that does not effectively assess companies with investment portfolio; hence, with a high degree of indebtedness, which, however, represent the core of productivity in the primary sector (Mester 1997; Ferri and Lacitignola 2009; Latini 2004).

3 Research Questions

The main research question that reflects the purpose of this article is addressed below:

"What would be the best operating rating model that helps in improving the finance scheme of agricultural companies?"

The answer of the above-said research question will be found in the findings, Sect. 6.

The research question should be clear, concentrated, short, and opens the discussion about a topic that is out of interest to the reader. Moreover, the research question of this article has helped the authors in concentrating on the core research path enabling to reach a final result that is precise, yet defensible https://marcushumanities12.weebly.com/uploads/3/7/9/0/37903231/how_to_write_a_research_question.pdf (2019).

4 Research Methodology and Methods

4.1 Research Philosophy

The research is positioned in the Epistemology stance and conducted based on a positivism situation. Epistemology deals with what is considered adequate information in the studied area (Saunders et al. 2012). Since the studies was built on an evidence-based reality that was mathematically interpreted, positivism best would suit the purpose of this research.

4.2 Research Strategy

This article used the quantitative research strategy because the study is engaged in a quantification process, meaning converting data into a numerical form. Additionally, the authors are employed coding process after having collected the data to identify the weights of the variables.

4.3 Research Approach

This article belongs to the deductive research approach because it incorporates the evolution of a theory, which is later applied to a severe test throughout a list of suggestions (Saunders et al. 2012). More specifically, the study moves from general presentation to specific, proofing the belonging of the research into the deductive approach.

4.4 Research Design and Data Collection

Research design is the "blueprint" for the data collection, measurement and hence the study of the data (Cooper and Schindler 2008). This study is read as an exploratory research. Having set the research design, designing and sampling the data collection is the next step which was done based on a secondary data collection method from the RICA database which is the main reference of all the accounting information of the Italian agricultural companies.

5 Analysis: Data Base and Analytical Procedures

With these assumptions, due to the limits highlighted for the models most frequently used to assess the creditworthiness of farms, the contribution of this work is to propose an innovative methodological approach capable of overcoming some current critical issues (Mester 1997). To efficiently evaluate the creditworthiness of the national agricultural fabric and provide some recommendations for the implementation of a rating operating system based on the RICA database, it was necessary to select only the companies present in the archive for all the years considered in the research.

Accordingly, the companies of the sub-sample generated were then divided into three classes, using as a criterion the total composition of the PLV (Gross Sellable Production) of each company according to the activity carried out:

1. "Companies specialized in various crops", activities attributable for more than 60% to a specific crop;
2. "Companies specialized in breeding", activities attributable for more than 60% to breeding;
3. "Non-specialized companies", diversified companies, that did not show any prevailing activity (60% higher than the total of the PLV).

The analysis showed that some companies, over time, have changed the type of activity carried out (e.g., companies specialized in breeding in 2004, which have become nonspecialized in 2005). This condition has therefore determined, with the same number of companies included in the sample, a variation in the time of distribution of the same in the three different classes.

Aware of the description of the individual variables contained in the RICA dataset, the authors proceeded to select the variables that are considered to be less "alterable" in the preparation of the financial statements; for instance the cash item, which very often becomes the financial container to which imputation of activities of a different nature from a financial point of view. Consequently, this choice must be associated with the need to obtain results that are not very sensitive to "strategic" accounting behavior.

Resulting from the above explained setting, the variables selected and used for the current study are the following:

- Sup_TOT, total area available for the company;
- Cap_FOND_TOT, total land capital;
- Inv_FOND_NEW, new land investments;
- Cap_ESE_PROP, working capital in ownership.

With these variables, indicators were constructed, instrumental to the proposed formalization for the assessment of creditworthiness.

The variable A and the indicator designated by B, C, and D have been identified as follows:

A: Sup_TOT. This variable, expressed in ha, highly reflects the level company's equity, since the farms that have more surfaces available, should ensure greater strength.

- Assigned score 1 for values between 0 and 10;
- assigned score 2 for values between 10.01 and 30;
- assigned score 3 for values greater than 30.

The increasing score assigned is proportional to the area available to farms to carry out their business, an implicit guarantee of company soundness.

B: Cap_FOND_TOT/Sup_TOT. Ratio between land and land available, expressed in thousands of euros: companies that have made structural investments over time.

- Assigned score 1 for values between 0 and 15,000;
- assigned score 2 for values between 15.001 and 30.000;
- assigned score 3 for values greater than 30,000.

The usefulness of this index must be identified in the fact that the structural investment capacity appears directly related to the financial solidity of the company where it can rely on the investment of the resources generated by self-financing operations and by the belief of the entrepreneurs in equipping the company with its own assets.

C: Inv_FOND_NEW/Cap_FOND_TOT. Relationship between investments and landed capital: companies that

have/have not made investments in the year and to what extent. This index presumes to highlight the real development of a farm and the connected potential for potential development.

- Assigned score 0 for a value of 0% (no investments have been made);
- assigned score 1 for values between 0.01% and 50%;
- assigned score 2 for values between 50.01% and 100%;
- assigned score 3 for values greater than 100%.

It assigns a growing merit in proportion to the ability and willingness of investment demonstrated over time by the entrepreneurs, an index of determination, by the latter, in taking care of the interests and business development.

D: Cap_ESE_PROP/Sup_TOT. Ratio between working capital and total area (Euro/ha). This index highlights the exploitation of the available area of the company; therefore, with this indicator, it is presumed to be able to highlight the productivity of the company.

- Assigned score 1 for values between 0 and 1,500;
- assigned score 2 for values between 1,501 and 3,000;
- assigned score 3 for values greater than 3,000.

This indicator aims to highlight the intensity of use of the Utilized Agricultural Area (UAA), under the assumption that the UA matches with the Total Agricultural Area (SAT).

The construction of a weighted quotient of performance indicators for the creditworthiness of individual farms, is as follows:

$$Q = (15\% * A) + (30\% B) + (25\% * C) + (30\% * D)$$

As illustrated above, the quotient can vary between a minimum of 0.75 and a maximum of 3. The scoring scale adopted corresponds to the following ranges of values:

A (5): for companies that have reported a weighted quotient equal to 3.00 (maximum value);

B (4): for companies that have reported a weighted quotient between 2.26 and 2.99;

C (3): for companies that have reported a weighted quotient between 1.51 and 2.25;

D (2): for companies that have reported a weighted quotient between 1.01 and 1.50;

E (1): for companies that have reported a weighted quotient between 0.75 and 1.00;

The PDs associated with the different rating classes are shown in Table 3.

In accordance with this scale, the results reported in the various years considered for three classifications performed are those shown below. The percentages indicated represent the ratio between the number of companies falling within each rating class compared to the total of companies included in the specific classification in each year of reference. In detail, the authors continued to calculate the rating scale for the years between 2004 and 2007, for nonspecialized companies, for the specialized in breeding and for those specialized in crop/horticultural/fruit production, as identified by the RICA. The results, as described above, are identified in Table 4.

This research paper highlighted how the distribution of companies by rating classes is unbalanced toward classes 4 and 3 (ratings B and C), central to the classification system used, by drawing a normal Gaussian distribution with a marked positive asymmetry. It is interesting to underline how in the period considered, for the companies specialized in breeding there has been an increase in the concentration of the same, in the highest rating classes (5 and 4). Reverse trend instead for the specialized in various crops. This result, even if stopped at 2007 due to the availability of data; therefore, out of the period of severe crisis in livestock due to the crisis in commodity prices on international markets, seems to reward the greater propensity to invest in this type of company and its greater size in terms of working capital and land.

In this regard, it seems opportune to recall how the normal distribution (Latini 2004) is the distribution of continuous probability mostly used in statistical analysis because it has so far managed to provide an apparently correct description of most natural and economic-industrial phenomena.

The rating agencies are required to make available to the public the ex-post analyses of the ratings issued in previous years by relating each category with the cumulative default rates to verify ex post the predictive power of the rating. The accuracy of the assignment of each rating class to the issuers is carried out through the ex-post evaluation of the issuer's performance with the calculation of the cumulative default rates (Lucarelli 2006; Szego 1999). Since the present study

Table 3 Default Probability using the new methodology

Numbers	Letters	PD ranges (%)
5	A	0,00–0,05
4	B	0,05–0,50
3	C	0,50–2,00
2	D	2,00–5,00
1	E	>5,00

Table 4 Rating tables results

2007 non-specialized			2007 specialized breeding			2007 specialized crops		
Rating scale			Rating scale			Rating scale		
Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)
5	A	0,79	5	A	0,42	5	A	0,57
4	B	33,47	4	B	41,67	4	B	37,25
3	C	55,77	3	C	50,53	3	C	52,53
2	D	9,67	2	D	7,07	2	D	9,18
1	E	0,30	1	E	0,32	1	E	0,51
2006 non-specialized			2006 specialized breeding			2006 specialized crops		
Rating scale			Rating scale			Rating scale		
Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)
5	A	0,59	5	A	0,92	5	A	0,66
4	B	30,99	4	B	39,57	4	B	39,22
3	C	57,48	3	C	48,83	3	C	51,55
2	D	10,53	2	D	10,27	2	D	8,19
1	E	0,41	1	E	0,41	1	E	0,38
2005 non-specialized			2005 specialized breeding			2005 specialized crops		
Rating scale			Rating scale			Rating scale		
Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)
5	A	0,85	5	A	0,82	5	A	0,51
4	B	31,28	4	B	37,01	4	B	40,01
3	C	57,19	3	C	51,65	3	C	51,09
2	D	10,33	2	D	9,90	2	D	8,02
1	E	0,36	1	E	0,62	1	E	0,37
2004 non-specialized			2004 specialized breeding			2004 specialized crops		
Rating scale			Rating scale			Rating scale		
Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)	Numbers	Letters	PD ranges (%)
5	A	0,76	5	A	0,71	5	A	0,70
4	B	33,69	4	B	40,05	4	B	42,45
3	C	56,70	3	C	48,17	3	C	48,73
2	D	8,53	2	D	10,60	2	D	7,81
1	E	0,32	1	E	0,47	1	E	0,31

introduces for the first time an innovative methodological approach, thus not having historical data of any default of the companies examined, for this purpose (identification of PD), we tried to integrate the information contained in the RICA dataset extracting from archive "AIDA" (Bureau Van Dijk/Moody's Analytics Company database) the financial statement data of the farms. This attempt, with the aim of looking for the "factual counterpart" of the PDs found in the analysis, did not have a positive outcome because of the impossibility to directly observe the companies that had actually failed because the research parameter provided only for companies "ceased", which included companies that could have been liquidated for reasons other than defaulting bankruptcy, such as the owner's will or death. Furthermore, the balance sheet data of the AIDA archive do not correspond to those present in the RICA archive, since they were

recorded differently, therefore they would not have been comparable.

Similarly to the practice used in rating agencies, the determination of the weights associated with the variables used, since this is a job defined for the first time for the sector, and with a different approach to those applied up to now, has been configured on the basis of subjective considerations a priori; however, based on technical and rational expectations, which will nevertheless be subject to refinement over time with the observation of the results produced.

The number of calculable indices, in the presence of the variables made available by the RICA archive, can be very high, especially where there is a certified balance sheet, and the counterparty is present in the Central Risk. A priori is difficult to state that indices belonging to a specific area (liquidity, profitability, etc.) are indicative of credit risk, depending on the results of the sample on which they were determined.

The possible combinations of adoptable variables depend in synthesis of:

- presence of different information sources;
- number and depth of the data set available: for example, the availability of only one or a few years of economic and financial data does not allow to calculate the variation indices;
- possibility to calculate transformed variables (logarithmic, etc.).

In the model under study, we are in the presence of an information source, deliberately chosen as unique for simplicity of use and reliability of the data contained therein, one characterized by a significant depth both temporal and spatial.

The variables used in the calculations of the rating algorithm proposed in the present report, as introduced, show some substantial differences with respect to the two previously mentioned methods; Moody's for ISMEA and EM Score by Altman.

These rating assignment methods are mainly based on the historical "fundamental' analysis and on the collateral presented by the business owner. This modus operandi is based on the implicit and intuitive postulate for which past performances have the same probability of replicating in the future.

This approach appears not to be relevant to the management reality of farms. The past, while retaining valuable insights into the evolution of the company's financial and equity performance, cannot be considered the predominant factor for future profitability and creditworthiness and, therefore, for future prospective analysis.

From the moment in which the payment of a credit line occurs, the past economic conditions "weigh" little (obviously after appropriate assessment of any excessive previous debit charges). What can most affect the possibility of not repaying debts on time and, in the most serious cases, falling into default, are the entrepreneurial and innovation skills compared to the uncertainty of the market, elements that are difficult to predict but which can be assessed in the light of business projects—consistent and functional.

Some authors believe that the application utility of the rating methodology is greater for large industrial companies, where a potential lender cannot have direct access to management. According to this thesis, in the case of SMEs it would therefore be preferable to visit the productive reality rather than to trust a synthetic judgment such as that offered by the ratings. The application of the New Prudential Supervisory Agreement on minimum capital requirements, better known as "Basel II", and in the future of the even more stringent one of "Basel III", has however made it necessary for credit institutions to assign a rating for any type of use of funds, including SMEs.

The ambitious claim of ratings to provide a very brief analysis of PD, through the simple indication of letters followed by numbers or positive/negative indications, has often clashed with empirical evidence that, in price changes also associated with changes in the attribution of rating by specialized agencies, have followed the power laws rather than the distributions of the "Gaussian" bell curve.

Rather than continuing to focus mainly on the potential risks that could lead to insolvency, without ignoring the indication of a synthetic creditworthiness judgment, this work aims to create a calculation system led by positive terms, that is, based on the development opportunities, on the intrinsic potentials of the company system, and therefore based on the resources actually available in the company, which are more easily identifiable and assessable in an endogenous way and indicative of the company "forces" in the strict sense. In confirmation of this statement it is commonly found that even in the case of SWOT analysis, internal analysis (strengths and weaknesses) is (ex post) almost always the most coherent and complete, while the external one, concerning exogenous elements such as opportunities and threats, most of the time it underestimates risks (some of which are not actually even conceivable ex ante) or overvalues opportunities not directly influenced by the company itself, but subject to the occurrence of "random", fortuitous, unpredictable or contingent elements.

The assessment of the creation of development opportunities and of the intrinsic potential of the corporate system, the main object of the study's survey, constituting a clear reduction of insolvency risks, allows a mainly indirect association of the PD ranges to each rating class.

Unlike the Moody's model, which considers many qualitative variables exposed to subjective evaluations, uses only quantitative variables, objectively determinable. Moreover, for the purposes of a more immediate and concise evaluation, only variables present in the RICA archive were used, which have thus been able to guarantee a comparability over time of the values.

Compared to the Altman EM Score, on the other hand, as previously indicated, the variables most sensitive to the fiscal policies implemented by the owners of the companies (i.e., working capital, operating result, and profits) were excluded, to reach a result the as objective as possible.

Finally, in contrast to both previous models, the existence of new investments and their incidence with respect to land capital was considered, consistently with the underlying indication that the growth of the potential of a company reduces the insolvency risks (Tagliavini 1998; Venceslai 2008).

Justification of the variables included in the models and their weights

All the variables chosen from those available in the RICA archive are the ones that most summarize (combined) the ability of the assets to be exploited. They are, however, the only ones that can be used both with reference to agricultural farming activities and livestock breeding activities.

- Total area available for the company: this variable highlights the availability (expressed as an absolute value) of the total land available for the companies and directly influences the size of investments and the available land factor. The greater this variable, the greater the production capacity.
- Total land capital: this variable highlights the extent of available land (excluding the part of the available area where there are buildings), thus allowing highlighting (combined with the previous variable) the part available for the company's core business activities.
- New land investments: this variable allows to highlight the investment capacity for the expansion of the territory available for the activities and is an excellent indicator of vitality of the companies that reduces the risk of default.
- Working capital in ownership: It represents the value of current assets held for the company's business. This variable, combined with the capital identified by the land, represents the set of assets available to businesses and which can provide a guarantee for creditors.

The weights have been defined ex post, that is, algorithmically reiterating all the combinations of the variables until obtaining a bell shape (normal trend). The weights assigned to the variables are therefore statistically significant by absolute definition, such as the statistical and economic literature review.

Justification of the focus on Italian companies

Complete archives relating to agricultural enterprises, which are often small, are really rare. The widespread analysis imposed by the European Union to the member countries has resulted in the creation of the RICA Italian archive, which the authors have had the precious opportunity to have the availability.

The RICA archive complies with the directives indicated by the European Union and respects all the scientific criteria of detection and composition, so it seemed perfect to the authors to base their research.

If it were possible to find similar archives from other European Union countries it would be possible to extend and further verify the assumptions. Nor is it possible to replicate at government level the request to implement the same type of archive even in any country in the world.

6 Findings: Results and Related Considerations

Transition matrices calculate the ex-post probability that the creditworthiness assigned to an issuer at the beginning of a different period (following a downgrading or upgrading), e.g., remains in the same rating class at the end of the period considered. For each specific degree of accuracy of the rating, the lower the rate of migration from one rating class to another, the more the rating is reliable (and stable). Therefore, one of the objectives of the agencies is to minimize the transitions from one rating class to another. This eventuality represents an objective reliability test of the implemented rating methodology.

More generally, attention should be given to any downgrading, as the worsening of the opinion expressed on the credit risk of a company could, in turn, trigger a self-fulfilling spiral of the forecast, making the synthetic judgment of the model unreliable. In this regard, on a global level, it has been observed, in fact, that agencies can increase systemic risk through significant and not early downgrading; sudden downgrading can cause large market losses due to sudden sales of downgraded securities, liquidity problems and obvious systemic domino effects on market participants through regulation, supervisory policies, contractual clauses, and customary practices. Investment (Ferri et al. 2009).

The methodological application carried out on the RICA archive for the companies considered, showed that as many as 71.41% (3,976 companies) of the total number of companies surveyed (5,568) maintained the same rating over the

Table 5 Transitions

Transitions			
Total number of companies	2004/05	2005/06	2006/07
5568	667	580	854
	11,98%	10,42%	15,34%
Of which			
Upgrading	256	280	430
Over total transitions	38,38%	48,28%	50,35%
Over total number of companies	4,60%	5,03%	7,72%
Downgrading	411	300	424
Over total transitions (%)	61,62	51,72	49,65
Over total number of companies (%)	7,38	5,39	7,61

4 years (from 2004 to 2007) examined. The results in the transition matrices were highlighted in detail in Table 5. The empirical evidence has shown that, except for the year 2005, the number of downgrades in relation to upgrading is substantially equivalent.

Therefore, based on the initial assumptions, it is reasonably plausible to state that the presence of an extremely limited number of observed transitions (less than 30%) is indicative of a good degree of reliability of the algorithm used to determine the ratings in the new model.

The assumptions described above are reflected in the studies of Altman and Rijken (Edward 2004; Cantor and Falkenstein 2001), which found that, in issuing ratings, the stability of the opinions expressed, is considered by the rating agencies a benchmark of reference, almost a goal, to be counterbalanced with timely needs only if the indicators show a long-term credit risk.

7 Conclusions and Recommendations

Capitalization and profitability are the key elements for accessing credit and containing the cost. This imply for the company the need to ensure detailed and transparent information flows, based on strict accounting principles, a condition not guaranteed today by a significant number of companies.

The analysis implemented in this research paper emphasizes the need to continue with the experiences already started, aimed at the implementation of evaluation systems calibrated on the real characterizations of the primary sector. The traditional methods of assigning creditworthiness, due to the high level of capitalization generally associated with agricultural holdings, return generally high and overestimated scores compared to the real economic and equity equilibrium conditions of the companies themselves, thus causing a low risk default for most of the business structures.

The greater exposure to market risk and the new rules that have modified the conditions for access to credit for farmers, however, make this option less easy than in the past and the same data, resulting from the analysis, related to the poor recourse to indebtedness on the part of farms highlights the need, in many structures, to reorganize the structure and management functions.

The guidelines emerging from the methodological approach proposed in this paper indicate that in the evaluation of the creditworthiness of agricultural holdings it is appropriate to include and incorporate in the calculation of the rating "historical" economic-financial quantitative data (budget, income tax return), trend data, qualitative, and other, not included in the other categories.

In the particular case of farms, mainly SMEs in Italy, whose legal configuration does not require the preparation of the financial statements, or allows the preparation only in simplified form, the presence of homogeneous and comparable data of the RICA archive used for the model under study they represent an important support in this direction and, possibly, to be implemented and improved in the quality of the data.

For each profile (qualitative, quantitative, etc.) a score is normally associated, which, opportunely weighted together with the others, allows to attribute the overall score.

The rating model highlighted in this study is, however, distinguished by the exclusive use of quantitative variables as they are the only ones that incorporate measurement objectivity, the presence in the RICA archive, and the solidity, opportunities for development and intrinsic potential of the system. company. The simplicity of the application, the empirical feedback and the objectivity of the variables used can therefore be considered the strengths of the model. However, the authors cannot exclude the integration with other important exogenous evaluation elements, such as the calculation of the risk of yield and quality (for example, through the identification of an indicator of climate change), the institutional risk (variation of EU and national agricultural policies) or the risk of demand (linked to the use of GMOs or to possible contamination).

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Multimedia Applications in Digital Transformation Art

Smilen Antonov Savov, Rumiana Antonova, Kamen Spassov, and Thomas Muschalik

Abstract

The aim of this paper is to focus on some of the multimedia applications used in the art process. This paper offers several definitions of multimedia, identifies a sample of the most popular multimedia technologies, the most important tools, and provides a discussion of their content and sources for further information. In addition, this paper presents an overview of the most important aspects of art software development. The paper investigates how the artists use multimedia in theater, art exhibits, opera, presentations shows, and 3D mapping for concerts. The paper investigates the pros and cons of multimedia art technologies, using some traditional, new, and experimental techniques. In the various stages of the application of multimedia in art, your importance is described in the visualization of industry 4.0 and in the software tools of digital transformation.

Keywords

Multimedia • Signs • Video • Theater • Shows • Opera • Text • Sound • Animation • Graphics design • Digital transformation • 3D mapping • Art innovations • Creative industries • Film and TV production

1 Introduction/Reflections

Multimedia has a powerful potential. Its applications are not limited only to the IT and Internet worlds. Recently we encountered many new improvements in various spheres in life, especially in arts and sciences. Science being an art or art being a science is not disputable. The thin line between the two important parts of life is smeared. We see, hear, touch, and use multimedia with our senses constantly (smartphones as an example).

Before starting, I just want to mention that this paper is a collection of various multimedia applications' examples, solutions, endeavors, creations, and efforts of many artists and scientists, and give an extensive picture of various multimedia used in arts. The author also adds his own personal multimedia knowledge and experiences used for many TV productions, film, and theater performances.

The following multimedia applications are used in various creative projects such as TV/film production, theater/opera performances, and TV studios. The most popular is called *WATCHOUT of Dataton company* (DATATON *WATCHOUT* 3D Mapping). It is used for project mapping in theme parks, art galleries, marketing shows (Corporate & Marketing Events Multimedia Shows), broadcast, corporate live events (Corporate & Marketing Events Multimedia Shows), and museums. In Bulgaria's *NOVA TV Broadcasting* studio production (NOVA TV Broadcasting), I used it as a multimedia tool in TV production, creating, executing, and controlling video files, graphics (collages), animations, LIVE feeds, projected on the multimedia plasma screens backgrounds, and creating the TV studios production set and decorations of all studio work.

The recent improvement of the software includes live 3D animations mapping of characters imagery, meteorological events, architecture structures, and visualizations/reconstructions of happenings/accidents/crashes in the NEWS broadcast studio. For example, when the meteorologist explains the raining/snowing conditions in the city, in the studio, rain or snow falls, and when the anchors mention a famous person (politician or other), the mentioned individual appears in the studio near the hosts as like a "hologram projected image".

For theater production and dance shows of the *New Bulgarian University and Smilen Savov are* used for our interactive multimedia project "*Left Finger*" (Smilen Savov

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& New Bulgarian University), an architecture based mapping hardware/software called *TOUCHDESIGNER 099* (Smilen Savov & New Bulgarian University) for motion tracking and visualizations. The laser beam scanned the dancing performer and projected a "holographic type image" on the screen behind the live performer. The final result was an interesting symbiosis between the live dancer and the projected image. The "multimedia dance" is also a type of "dancing with light" or the dancer is like painting a picture on the backscreen with her/his body (Smilen Savov & New Bulgarian University).

The work of the Chinese multimedia artist Cao Fei, *Whose Utopia*? (Cao 2006) is located where she uses the environmental work factory settings for staging her live art model installations. In the case of this artist, she utilizes the backgrounds, live modeling, makeup, video and photography art, and creative lighting designs to set up her imagery. The main artistic goal for her is to show the connection between the materialistic world/industrial revolution and the poor contemporary educational system.

The stated that multimedia art installation was discussed by many scientists, artists, and educators, and especially on *TED presentation* of *BBC show of Sir Ken Robinson* (TED of BBC; TED of BBC, animated version), called "Do Schools Kill Creativity?" The discussion is important about the art of teaching, since multimedia is now widely used in schools and the author is concerned with the children's lack of creativity and stamina in the modern school environment, playing lots of computer games, talking to a screen, using their iphones/tablets, virtual reality world and learning through multimedia testing software instead of reading books and writing with pens.

Artistic works Robots, as multimedia toys, are the next discussed topic. Robots of the future, described by *Isaac Asimov* (Isaac Asimov, robots of the future) in many of his novels are human helpers but also are threatening the people. The author's warning is to be aware of robots' great multimedia potential, but to use them cautiously. Elon Musk (Artistic Work Robots—Basic Income), a space rockets pioneer and investor in space technologies, is also very interested in multimedia arts/sciences and he is recalling the robots as the most important for the future of the humanity. He as a brilliant mind supports the vision of the future for the *Universal Basic Income*, one of the most popular ideas of our time, finding solution for the upcoming seizure of robotized machines of more trivial activities of men, such as providing/sustaining the livelihood food consumption of many people all over the world. "Jobs are for machines, life is for people!" he states.

Performing arts are using multimedia as of today not only to create props and set designs as well as 3D mapping solutions but also for the interaction with the artist (Corporate & Marketing Events Multimedia Shows). Some of the multimedia art software is used for body motion tracking device and partner for the performer. The following examples are clear examples of human/machine interaction, creating powerful multimedia performances. The artists often use the language "digital art interventions and input," when using the multimedia tools in their performances.

In *HAKANAI* (Digital Art Interventions), the show is staged in a digital cube where body motion laser sensors dance with the moving performer.

Projection Mapping of the *BOX* (Digital Art Interventions) on moving surfaces, shows the relationship between real and digital space on a real stage with a live performer.

In *PORSCHE MACAN 3D Mapping Show* (Digital Art Interventions), we see how successfully 3D mapping can be used for creating astonishing art multimedia performances.

In *Real-Time Tracking and Projection Mapping* multimedia performance is also executed by the advanced Panasonic video 3-chip DLP™ SOLID SHINE laser projectors (Digital Art Interventions).

"*Baisser in Mary Boone, in Glassish & Waxish Glitch*" (Digital Art Interventions) is a 3D visualization show and installation in live art gallery video, where two digitized live performers are projected as 3D objects and seen making a dance of love.

Wander through the Crystal Universe (Digital Art Interventions) is a 3D environment where laser projections of objects interact with the performers on stage. The performers also can control the color and the patterns of the lights projections.

Digital Art (exhibited in contemporary art galleries) is present since 1950s (Digital Art Interventions). Many art galleries are trying to show it recently because it is associated with modern men and its day-to-day technology usage and is also interactive and entertaining.

Very interesting are the so-called *VIDEO SCULPTURES* (VIDEO SCULPTURES), where the swiss artist Marck (project 'gegenstrom') is using multimedia (video, animations, graphics, architecture settings) and creative performances to film his subjects from a bird's eye view and create a vivid video compositions called "sculptures".

Digital art nowadays uses smartphones to control and manipulate the art. In this video, an art gallery video installation of two people *Blowing a Chewing Gum Bubbles* (Digital Interactive Art: Smart Phones controlled Art) is seen being "helped" by a smartphone. The visitor is blowing over the smartphone applet which simultaneously fills the bubbles on the screen with air. This interactive multimedia digital art installation is using a manipulation multimedia software connected to the video projection on the wall.

Deep Web (Digital Art Interventions) is an audiovisual kinetic laser/lightning show, where live lights and lasers paint a picture of a remarkable moving bright, many colored, and 3D spacial compositions.

Kat Von D Live Face Projection Mapping (Digital Art Interventions) is a digital face makeup, where 3D rendered images are projected on a live video of the performer's face, which also executed real-time physical movements.

In *Human and Robot Dance Duet* (Digital Art Interventions), two performers execute a love duet dance (Pas-De-Deux), but the only detail is that one of the performers is an industrial robot.

Video with Drones controlled by Algorithms (Digital Art Interventions), an art project by Faena Studio Drift, is an amazing 3D video environment shot by 300 drones that were controlled by mathematical algorithms and formulas.

There is also art/sciences multimedia exhibit called *HUMAN+* (ARTSCIENCE MUSEUM HUMAN+), where multimedia artists from all over the world are exhibiting their new multimedia art installations and endeavors. They are concerned only about the future of arts and "The future of our Species". One of the most interesting projects of HUMAN + is the one created by Daniel Gonzalez "BeAnotherLab," creating a *Virtual Reality BeAnother World* set up (ARTSCIENCE MUSEUM HUMAN+), where two people enter each other's "Virtual Reality Identity" or entering the body of someone else (possibility to swap bodies with someone else). The creator combined neuroscience (neuropsychology) technological protocols received from the VR reality hardware and system and the live performance art. The final result is called "The Machine to Be Another".

Very interesting is to mention that the *Hollywood motion picture* "*Her*" (Her, motion picture) is an artistic point of view that describes the possible future and the existential drama of a man who falls in love with his computer operating system, acted by Scarlett Johansson.

Artificial Intelligence (AI) (ARTIFICIAL INTELLIGENCE) is an important exploration universe, where multimedia arts and sciences merge to create solutions to help people in their various lives.

GOOGLE Assistant (ARTIFICIAL INTELLIGENCE) helps people in the Google Internet browser fulfill various tasks.

The next *five Coolest ROBOTS* (ARTIFICIAL INTELLIGENCE) can also assist and help people and are not so expensive.

Following are *Five Humanoid A.I. Robots* with emotions and "brains" (ARTIFICIAL INTELLIGENCE).

It is amazing how SOPHIA, a humanoid robot, became a citizen of Saudi Arabia (ARTIFICIAL INTELLIGENCE).

The multimedia technology, robotics, neuroscience, and arts are so advanced today that it is possible to create *Mind-Controlled Bionic Limbs* (Mind-controlled Bionic Arm). The following examples show various arm prostheses that can help humans control bionic arms via their brains and to be able to use the artificial limbs as their "real" arms.

All TV professionals, having a small studio estate, are relying on a flexible, quick, Internet-based, and portable solution for their broadcasts, and the following virtual TV studio and limitless TV production system over IP offers this. It is called *TriCaster* (TriCaster, Virtual TV Studio Production system) and it provides live video streaming solution for all virtual TV sets. It could be set in a private house room with a green screen virtual TV studio, and a reliable Internet connection. The backgrounds for the TV studio are many virtual sets and are mapped on the top of the green screens, replacing the green. The airing is a live broadcast with fast live streaming. All you need is an IP address and a fast Internet connection!

World famous *video artist Bill Viola* (Bill Viola, video artist), uses multimedia and especially video monumental vertical screens in art galleries as installations, to stage his conceptual ideas and metaphors of birth, life, death, happiness, and love of humans. He manipulates video using various colors, water, sound effects, nudity, slow motion, and creative light design to achieve his dramatic imagery and impact upon the viewers.

And finally, all technologies are impressive and helpful, *BUT BEWARE of the CELL PHONES* (Smart Phones Threat), those multimedia devices that are cute and always with us. The scientists on this site are warning us that the smartphone usage can alter the chemical balance of the brain and impair some functions, and cause premature wearing of eyeglasses in children, and extensive phone usage could be addictive!!!!

WATCH OUT!

What is the biochemical evolution dynamics of modern men? The BBC documentary *Are we still evolving?* (BBC: Are we still evolving?) is concerned about the impact of the technologies and multimedia on humans. The film is worth watching as an educational and warning device against the overwhelming usage of multimedia nowadays!!!

2 Conclusion

Multimedia is widely used at the present. Multimedia is a unique merge of arts and sciences. The aim of this paper is to focus on some of the multimedia applications used in art/sciences creative processes. This paper offers several definitions of multimedia, identifies a sample of the most popular art performance and AI multimedia technologies, as most important contemporary tools and provides a discussion of their content and sources for further information. In addition, this paper presents an overview of the most important aspects of art software developments and is a warning against an extensive usage of the multimedia technologies.

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Occupants' Behavior and Energy Usage in Emirati's Individual Houses in Al Ain: Exploratory Investigation

Amna Al Ameri and Kheira Tabet Aoul

Abstract

Existing buildings in the United Arab Emirates (UAE) account for over 65% of the total energy consumption, with the residential sector leading the way with around 40%. Further, the energy demand trend is expected to keep rising, confirming its threefold increase from 2000 to 2012. Factors such as population growth, economic development, the physical building characteristics, climate differentials, and occupants' behavior have resulted in high-electricity demand, ranking the UAE as one of the highest energy consumptions per capita in the world. As a result, the UAE government has taken far-reaching actions to curb energy consumption. As such, building regulations and codes emerged as well as energy-saving media campaigns. While actions and studies are flourishing in terms of building energy efficiency, very little is known about occupants' behavior and energy usage in their home, despite the vast body of literature acknowledging that occupants' behavior is a driving factor in determining building energy consumption. Particularly in the UAE, there is evidence that the local Emirati population carries higher home energy usage than the expatriates. This paper reports on an exploratory qualitative study aimed to investigate first, nationals' behavioral patterns and second, its consequent impact on energy consumption in their detached houses (villas) in the city of Al Ain (Abu Dhabi Emirate). The methodology is based on semi-structured interviews, addressing occupants' daily energy usage patterns, cultural aspects and their awareness level of energy consumption in their homes. Housing data and electricity bills have also been considered. An exploratory pilot study with a small number of units was carried out in the month of June. This paper presents preliminary results of this investigation, expected to contribute to a better understanding of Emirati energy consumption patterns in relation to their culture, way of life, and potentially established appropriate venues to address energy use reduction in the residential sector of the UAE.

Keywords

Occupants' behavior • Household energy usage • Villa • United Arab Emirates

1 Introduction

Since the discovery of oil and gas in the mid-twentieth Century, the United Arab Emirates (UAE) experienced rapid economic development and massive urbanization, resulting in an excessive consumption of natural resources. It resulted in overall better quality of life, making the UAE a popular migrant destination, leading to an extraordinary population increase, ranging from an estimated half a million in 1975 to more than 9 million inhabitants in 2018 (United Arab Emirates Population 2018). These factors have resulted in high-energy consumption per capita, ranking the country as one of the highest per capita ecological footprints in the world (https://www.foxnews.com/story/report-united-arab-emirates-has-highest-per-capita-ecological-footprint). In 2010, the UAE ranked sixth in the world in terms of carbon dioxide emissions and seventh in electricity consumption per capita (KWh/person) (https://www.indexmundi.com/map/?v=81000). In fact, the electricity demand has increased 6-fold from 2001 to 2018 to reach around 110 billion KWh (https://www.indexmundi.com/g/g.aspx?v=81&c=tc&l=en) (Fig. 1). The UAE residents consume a larger amount of energy than commercial and residential sectors, with almost 225% more than the energy consumed by European counterparts (Khawaja 2012).

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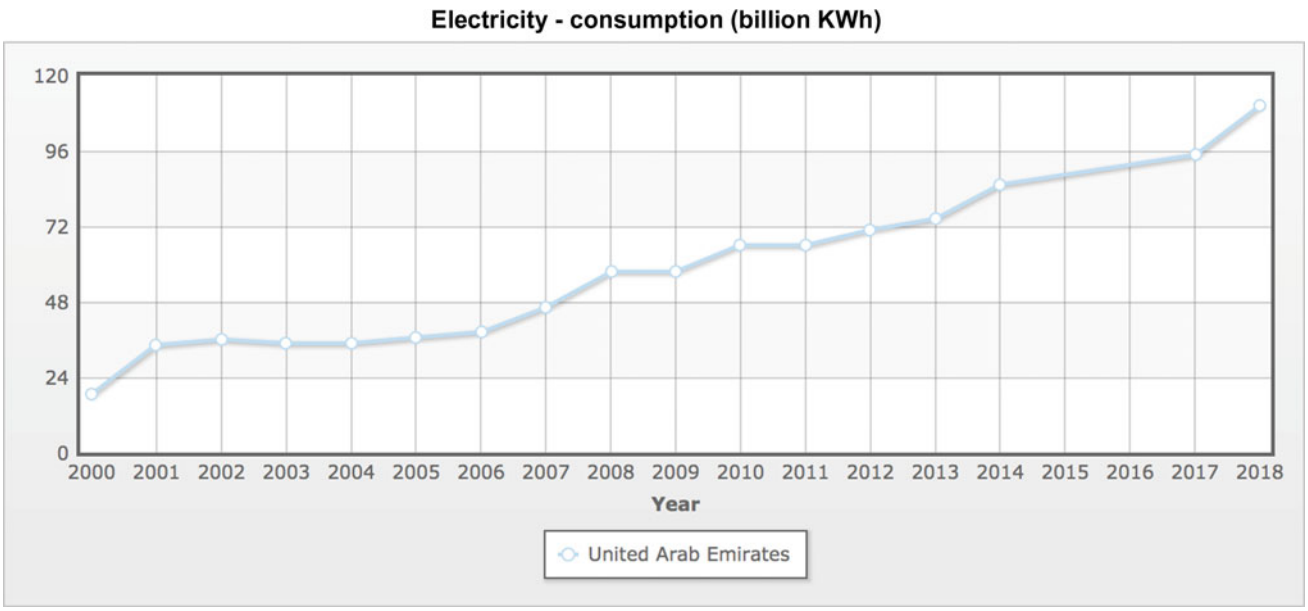

Fig. 1 UAE's electricity consumption from 2000–2018

In light of these findings, the UAE government has taken actions towards curbing and managing excessive energy consumption. However, if different solutions and regulations have been established to cut down the energy consumption, understanding, and addressing occupants' behavior remains a challenging key factor that has not been taken fully into consideration despite its important impact. It has been further reported that Energy usage of Emiratis in their homes stands at three folds of their expatriate counterparts (Fig. 2). Hence, the objective of this study is to explore and understand Emirati occupants' behavior patterns and attitude vis-à-vis of their home energy usage, aiming to explore, detect, and unveil high energy loaded behavioral attitudes and usage patterns. This research aims to fill the gap in the area of local energy consumption and occupants' behavior in order to draw adequate comprehensive contextual solutions for energy conservation.

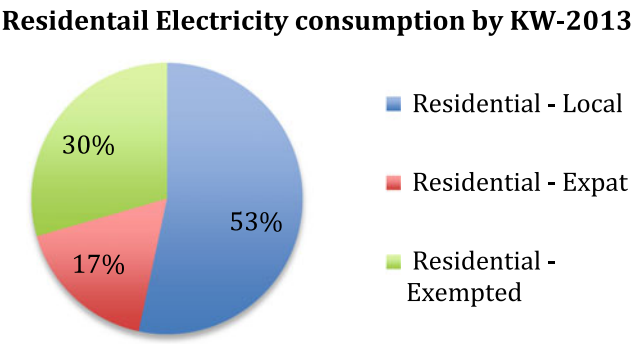

Fig. 2 Al Ain city residential electricity consumption national versus expatriate—2013 (AADC)

1.1 Energy Consumption in the UAE Housing Sector

The residential sector forms the largest part of the infrastructure and is the biggest consumer of energy in the UAE (https://www.export.gov/article?id=United-Arab-Emirates-Construction). In fact, this sector contributed up to 40% of the total electricity consumption in the city of Al Ain, while the commercial sector stands at around 18% (Fig. 3). What raises the question is that statistics indicated that nationals or "local" residents consumed more than half of residential electricity in Al Ain city according to the Abu Dhabi Distribution Company (AADC) Fig. 2. This finding highlights the urgency of a thorough investigation of the reasons behind such high-energy consumption.

2 Background Literature

2.1 Factors Influencing Energy Consumption

According to the International Energy Agency (IEA), worldwide Building sector contributes up to 40% of the primary energy consumption. Many reasons explain the high demand of electricity in this sector, numerous studies indicate that domestic energy consumption is strongly related to climate and socio-demographic factors such as income, household design, size, and household construction materials (Brandon and Lewis 1999; Gardner and Stern 1996; Moll et al. 2005; Lopes et al. 2005). Unit size, for example, has a positive correlation with energy consumption. Larger

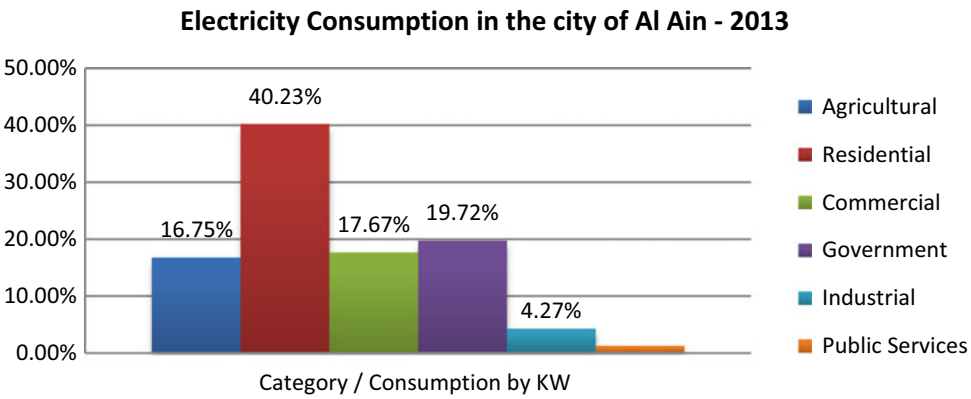

Fig. 3 Electricity consumption in the city of Al Ain 2013 Abu Dhabi Distribution Company (AADC)

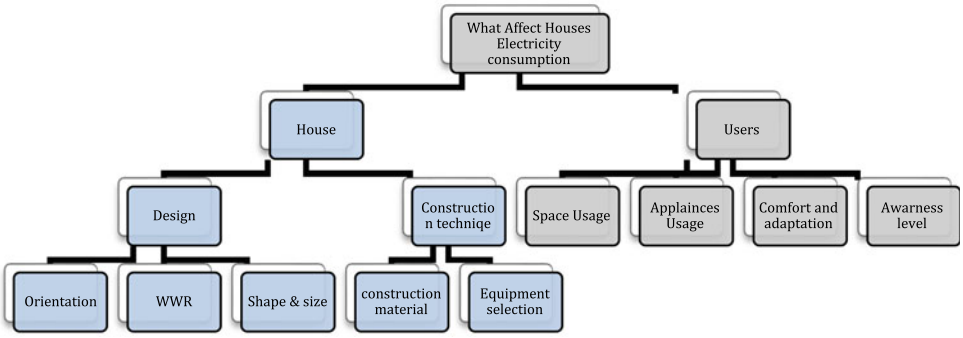

Fig. 4 Summery of factors influence domestic electricity consumption

dwellings consume more energy than smaller ones, thus the owners of large dwelling are willing to invest in energy-efficient retrofit to reduce energy consumption (Santin et al. 2009). Energy consumption is also linked to psychological factors as occupants' behavior (Fig. 4) highlights the main factors influencing household electricity consumption.

2.2 Occupants' Behavior and Energy Consumption

Extensive literature links occupants' behavior to the wide variation in electricity consumption in residential units with the same number of occupants (Seryak and Kissock 2003; Yohanis 2012; Rafsanjani et al. 2015). The impact of occupants' behavior limited the ability of energy simulations models to predict the actual building energy performance, exhibiting a gap of up to a 150% between the actual and the predicted energy performance for what is believed to be a direct result of occupants' behavior (Clevenger and Haymaker 2006). Further, other studies proved that the technological solutions are insufficient without the occupants' cooperation (https://www.researchgate.net/publication/233108103_Energy-efficiency_interventions_in_housing_Learning_from_the_inhabitants). Findings indicated also that issues such as personal lifestyle had also an effect on occupants' behavior towards energy (Anker-Nilssen 2003).

Incidentally, a strong relationship was found between the educational level and energy efficiency retrofit investment (Trotta 2018). This assertion reinforces the idea that new policies towards better building construction techniques and the usage of energy-efficient technologies and appliances are insufficient without the change in occupants' behavior. Age, gender, and other demographic factors have also been found as influential in energy-saving behavior (Trotta 2018; Barr et al. 2005; Steg and Vlek 2009).

2.3 Behavioral Change Towards Energy Conservation

The impact of a rapid change in lifestyle and its implication on energy usage consumption in the residential sector are well researched (Steg and Vlek 2009) Parallel studies agree that changing occupants' behavior towards energy usage is relative to the information they may have on energy-efficient appliances, rating systems, and energy retrofitting. Significant energy saving could be achieved by providing appropriate information (Yohanis 2012; https://www.researchgate.net/publication/233108103_Energy-efficiency_interventions_in_housing_Learning_from_the_inhabitants;

Trotta 2018). Thus, changing occupants' behavior by providing energy-saving education can reduce more than 10% of electricity consumption (Ouyang and Hokao 2009).

2.4 Studies on Nationals' Behavior Towards Energy Consumption

In addition to establishing Estidama & Pearl Rating System (PRS), which are the local sustainability framework, codes, and building energy efficiency standards. There is a clear indication that understanding occupants' high-energy usage has been recognized as needed information. The target of this study is to explain the reason behind the high-energy usage of national's occupants while they only represent only 11.4% of the total population of the UAE.

The Regulation and Supervision Bureau of Abu Dhabi have addressed occupants' behavior towards energy consumption in a recent study (Alaileh et al. 2013). It is an independent regulatory department aiming to increase the understanding and awareness of critical issues on energy usage in the Emirate of Abu Dhabi. The undertaken study explored the potential of electricity consumption saving programs involving householders, while the aspect of provision of information and examine the use of technology seems to increase awareness through installing Customer Display Units (CDU) in the pilot study volunteer's villas and the results shows that 16.3% reduction in demand response due to education and information, and 16.8% reduction due to conservation practices.

3 Research Method and Data Collection

This exploratory qualitative study aims to detect and highlight the UAE nationals' energy behavior and understand their way of life related to energy usage in their individual villas (villa) in the city of Al Ain (Abu Dhabi Emirate). The main objective is to conceptualize the problem variables and define the main dimensions and indicators influencing occupants' energy behavior in their daily life ahead of a wider study. The methodology used is based on semi-structured; open-ended in-depth interviews addressing the main investigation questions. Four main themes were explored including space usage, quest for comfort, energy practices, and awareness of energy usage.

The pilot study was conducted during the summer of 2016. Four representative villas occupied by Emiratis families were the targets of this pilot study (Fig. 5).

Further, data collection included the household and general demographic and villa characteristics, such as the house area, number of occupants, and average annual electricity consumption (Table 1). The second is to develop the villas' energy performance indexes (consumption per area and consumption per capita).

The review of related literature indicates a strong positive correlation between house sizes and energy consumption. Larger dwellings consume more energy than smaller ones (Santin et al. 2009). The number of occupants has also a relation with Electricity consumption, as the number of occupants increases, space occupation and appliances usage increases thus electricity consumption increases as well. Energy performance indexes (consumption per area and consumption per capita) reveal the same tendency in the considered sample as shown in Fig. 6.

Next, interviews were carried out with the aim to identify compliance with the identified themes in the literature while highlighting specific contextual factors. The sub-themes explored relate to 1. Energy usage practices, and the use of appliances during the occupation. 2. Quest for comfort and adaptation; questions about how to achieve comfort during "overheated periods" summer and winter seasons were investigated 3. Space usage and relation between space function and energy consumption were explored and 4. Awareness of energy usage, and house electricity consumption information.

4 Study Results and Discussion

Interviews were carried with wife/mother, in their houses starting with general demographic questions such as the number of occupants, age, occupant's level of education, and professional activities of the family heads. The interview took an average of one hour and thirty-minute. A brief introduction was given while ethical consent forms were signed. The main outcomes as related to the themes explored can be summarized as follows:

(1) Occupants space usage: In all four cases, the occupants' categorized their homes based on their daily usage and function. Questions such as, where they gather on a regular basis as well as on occasional ones (such as Fridays and celebrations), what spaces are usually occupied and which spatial quality impact their personal comfort constricted the core of this theme. All considered the living room as the most important space in the house. It is the place where all family members gather all day long. The main characteristics of using the living room effectively are the location of the living room and the provisions. Absence or undefined living room makes family members use most of the spaces like a living room as it was observed in H1 and H4.
(2) House design satisfaction: House design should always meet the family's needs in terms of function and size. In terms of villa size and number of rooms, a weak

Fig. 5 Views of some of the selected villas of this study

Table 1 General demographics, housing, and energy information of the considered sample

	H1	H2	H3	H4
Unit habitable surface area (sqm)	646.9	666	838	1121
Number of occupants	11	9	9	15
Annual electricity consumption (kwh)	120,680.50	86,390	135,722.50	230,926
Ratio (kwh/sqm)	186.55	129.71	161.96	206
Ratio (kwh/person)	10,970.95	9,598.90	15,080.28	15,395.10
Ratio (sqm/person)	58.8	74	93.1	74.7

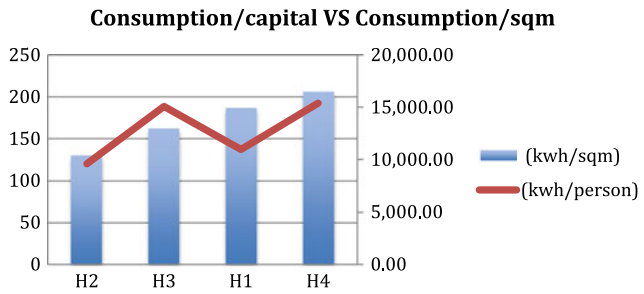

Fig. 6 Correlation between consumption/capital and consumption/sqm

relationship was found between the number of occupants, age, and the house size, especially if they are a single small family. The villa is often designed for future needs of the expanded family, compared to the current family size. Hence, this indicates the need for alternate design solutions that may consider flexibility in design to expand as per family later growing needs. A larger investigation coupled with a bigger home sample range, where the concept of expandable villa design may be validated through measuring occupants' satisfaction in terms of their villa design, its size and if their current villa design fulfill their needs today only or they are using the concept of long-term villa design to avoid future changes. It was also noted that for example an absence of important functions such as study room, led occupants to use alternate spaces such as Al Majlis to fulfill their needs. The Majlis, a gathering designed space, may often be double or three times bigger than a regular study room size, such as in H1, H2, and H4 and will, therefore, be an energy-intensive space for the given activity.

(3) Quest for comfort: During the high-temperature seasons, occupants agreed that, in order to achieve thermal comfort in any space in the house, air conditioning units should be all turned on as one of mothers said "we can't stand the heat, AC is always ON". Being able to control/adjust the thermal conditions of space and the equipment being quiet are the criteria of the most comfortable spaces. In all four houses the mothers and the two daughters agreed that the most comfortable place in their house is the bedroom, and that can be explained on the basis of availability of individual controls. Although all four houses are alternatively switching the AC units on in the spaces that are not daily occupied during summer for different reasons; first they need the house to be cooled during summer, to keep the furniture and décor safe from heat "cracks" and to keep the house ventilated by circulating air. Another finding lies in the total absence of the concept of natural ventilation for thermal comfort, except marginally in the cooler season (winter). Fans were not used even when they could alleviate heat in certain seasonal times. What remains to be explored further is the reason not to use fans in their houses, despite its recognized benefits and lower energy load.

(4) Awareness: Awareness in the interview was addressed from two perspectives. First, to find out if about the householder's electricity consumption and who pays the bills; second about the impact of government energy conservation campaigns. Three of the four houses reported that the father usually pays the electricity bills, while family members were not aware of how much they consumed or how do they pay for it, in H1, H2, and H4 respondents expressed "Honestly I don't know about the consumption, the father receive the bill and he

pays". On other hand, because of the absence of the father in H4—studying abroad—the mother was responsible for the household expenses. All mothers in four houses were not aware of the new tariff system and the new bill format—the new bill format shows if your consumption is within the average. Two out of four knew about the government subsidies, but how much the government pays was a chock. Regarding the campaigns, they agreed that they rarely watch television, and sometimes the campaign messages are not stimulating and efficient enough to have any impact.

5 Conclusion

The study presented in this paper aimed to explore the energy behavior of UAE nationals in their homes (large single detached villas). A small sample of Emiratis residing in villas was the focus of the study. Housing characteristics, energy bills, and demographics were first collected. Semi-structured interviews were carried out in June 2016. The results indicate a strong link between occupants' behavior and energy usage reflected through functional space usage patterns linked to lifestyle, cultural factors and expected social norms and perhaps, more importantly, a lack of awareness. Often enough, the women with whom the interviews were carried were not aware of energy bills as not involved in the households' expenditures management. These exploratory results need to be validated with a larger sample. Further, the fully subsidized energy for nationals at the time of the interview may need to be revisited in light of the introduction of fee-based on usage as this may carry an impact.

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Private Initiatives versus State Interventions in Downtown Cairo: An On-Going Debate Questioning the Sustainability of Newly Pedestrianized Streets. The Cases of Kodak and Al-Alfi Passageways

S. Ashour and B. Braker

Abstract

A walk through Downtown Cairo is a unique experience any urban planner and architect would appreciate. It is a district from the 19th century that was dramatically transformed from an elite neighbourhood into a chaotic district overrun by street vendors and busy traffic within its streets. A decayed condition which left the area with many forgotten urban pockets that caught the attention of the Egyptian government and some private developers in the 1990s. Their agenda focused on bringing in new blood of different activities at the expense of expelling many residents and small-scale stakeholders. Along this sprawling gentrification, many private initiatives worked tirelessly on reclaiming some forgotten pockets and marginal passages as potential seeds for new urban ideas and social bonds to re-establish as opposed to gentrifying the area. This paper focuses on two pilot projects in Downtown, one is the ongoing experimentation of 'Kodak', a narrow service alleyway that was transformed into a 'public hub' by private entrepreneurs named 'CLUSTER'. They emphasized a societal method that would bring in new types of users and promote for a more engaged interaction with the residents of the area. The other project is called 'Al-Alfi' Street, a project directed by the governorate in coordination with "Alfi Street Occupant's Union". The street went through many top-down strategical planning since the 1990s, mainly focusing on refurbishing the pavement, face-lifting the shop windows, and controlling vendors' trespassing. This paper discusses the successes/failures of the collaboration between urban planners and users in the streets of Downtown through exploring whereas the two different strategies of both cases which are still under evaluation. The paper questions how can we 'as planners' make sure that such transformations would not gentrify the streets as we know them? What sort of policies would ensure our social responsibilities toward our societies?

Keywords

Streets • Public spaces • Downtown Cairo • Entrepreneurs • Kodak passage • Al-Alfi street • Sustainability • Gentrification

1 Introduction

A walk through Downtown Cairo is a unique experience any urban planner or architect would appreciate. It is a district from the nineteenth century that has transformed from an elite neighbourhood once known as the 'Paris of the Nile' into a chaotic district overrun by busy traffic in the main streets and street vendors in the marginal passageways, Fig. 1.

Such decayed conditions left the area with potential urban cracks and forgotten pockets that caught the attention of the Egyptian government as well as the private developers in the 1990s, Fig. 2. Their agenda was based on bringing in new blood of different types of activities at the expense of expelling original residents and small-scale stakeholders out of the areas they had occupied. Along the process, downtown went through a major gentrification wave in some of its vital zones, and this rapid change in the area led some private initiatives and entrepreneurs to act against this sprawling gentrification. They started reclaiming some forgotten pockets and marginal passages in Downtown as potential seeds for new urban ideas to develop and new social bonds to establish.

This paper, therefore, focuses on two pilot projects in Downtown: one of the projects is an ongoing experimentation of a passage called Kodak, a narrow service alleyway that was transformed into a 'public hub' by an entrepreneur

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Fig. 1 The bustling streets of Downtown Cairo nowadays. Source (Momahed El Shahed/AFP 2017)

Fig. 2 Futuristic visions of Downtown Cairo as an open public space for all. Source (SWA n.d.)

called CLUSTER. Their approach of transforming the street emphasized a more welcoming, diverse and sustainable experience that included shops, cafes and galleries. A method that would bring in new types of users and would promote a more engaged interaction with the residents of the area.

The other project is called Al-Alfi Street, a project directed by the governorate in coordination with 'Al-Alfi Street Tenants Association'. In the 1920s, the street served as an old hub for nightlife, frequented by European visitors and expatriates seeking entertainment. With the turn into the 1930s, commercial activities were introduced to the wide street among others which helped in transforming Downtown into a mixed-use district. As a potential for a homogenous public use, this street went through many top-down strategical planning sessions over the years since the 1990s, which mainly focused on refurbishing pavements, face-lifting shop windows and cafes, controlling vendors' trespassing and most of all, turning it into a pedestrian zone.

This paper will discuss the successes/failures of the collaboration between urban planners, state intervention and input of users in downtown streets through exploring both strategies, the bottom-up intervention of Kodak passage and the top-down planning of Al-Alfi Street. Two different strategies of two different projects that are still under evaluation.

The main question focuses on how we can 'as planners and entrepreneurs' make sure that such transformations would not gentrify the streets as how we know them, rather create a sustainable redefinition of existing public spaces that are accessible for all. What sort of policies would ensure our social responsibilities towards our societies, and how can we best manifest all efforts into sustaining a healthy interaction between different classes within one space?

2 Literature, On Streets as Public Spaces

Many researchers and urban planners stressed the definition of a sustainable public space as a space that would encourage people to safely spend more time interacting within the society with no segregations between lower and higher incomes among their communities.

In 1957, Tönnies talked about the non-negotiable physical spaces in the past, where the individual was part of the group sharing the same public space and activities whether it was a square or a street. Reality, however, shows that the term community is now manifested in these small informal clusters of spaces emerging whenever it is possible within the street's domain (Tönnies 1957). Lefebvre also confirms that every society produces its own space; this production of the urban space with its settings and structure requires a background of culture and identity to sustain its existence. In other words, it reflects the effect of physical boundaries, the external limitation of expansion, areas and volumes, the internal activities versus the external and the performed functions (Hemeid and Kamel 2013; in Lefebvre and Nicholson-Smith 2009)

Some public spaces can also be forgotten pockets, spaces that Trancik refers to as 'lost spaces'; he argued in his writings that several fundamental principles of the structure of traditional urban space have been lost or ignored in most modern cities, resulting in what he identified as 'anti-space'. He suggested accordingly ways for the designers to restore traditional values and reclaim meaning to the urban open space (Trancik 1986).

Going along with this line of thought, Jan Gehl has been always interested in the way people move between buildings and how they communicate with the form between those buildings. In his writings, he calls for an understanding of the subtle, almost indefinable qualities, which have always related to the interaction of people in public spaces. Gehl states that in recent years, residents of many cities have become very active in crying out for people-oriented city planning (Gehl 2010).

In 2012, a collaborative report produced by Project for Public Spaces—under the auspices of the UN-HABITAT—worked on the importance of redefining existing public spaces and how to efficiently transform them into healthy

accessible public spaces for all; in other words, sustainable public spaces. The report provided an excellent documentation of several successful cities that managed to create successful public space for all. The president of the Project for Public Spaces stated in their report that 'You have to turn everything upside down to get it right-side up', a strategy that considers the public space as a vital ingredient of successful cities. The cases mentioned in the report clearly explained how they helped in building a sense of community, civic identity and culture. They also helped facilitate social capital, economic development and community revitalization (PPS 2015)

The urban planner Bill Hillier discussed in his recent book 'Space Is A Machine' the failure of modernism as it was mainly focused on form and function and the integral interrelation between them more than the understanding of the relation between form and meaning which was due to architecture; several peculiar social pressures had become more concerned and preoccupied with social engineering through architecture rather than with architecture itself. Hillier argues that there are many versions of this belief, and some assume that the direct relationship between building and behaviour should take the form of 'fitting' activities to spaces. Others stress the intervening role of cognition where the built environment acts as a series of behavioural clues (Hillier 2015).

Such social activities should reinsure a sustainable use/reuse of the public space in general, an idea that Steven Cohen profoundly talked about in his book 'The Sustainable City'. He asserted the fact that sustainable cities must provide clean water, toxin-free air, renewable energy, mass transit, environmentally sound solid waste management and public space. He looked at examples of existing parks and open space plazas in the United States and Brazil. What those examples had in common was the fact that they were transformed and repurposed from a non-functional, abandoned site or 'lost spaces' into widely popular open spaces that everyone can freely and safely utilize. He urged to develop a deeper understanding of human technologies and the impact of those technologies on the living systems of vivid places. The key to a sustainable and renewable (resource-based) economy is the sustainable city itself (Cohen 2017).

Relying on this theoretical discussion followed by exploring some successful cases of transforming forgotten/abandoned pockets into sustainable urban spaces outside of Egypt, this research should get a clearer view on how to identify a sustainable approach in redefining street spaces as interactive public places for all. A process of thinking that can improve the usability, aesthetics and the liveability of some of the hidden or misused streets in Cairo and converting them into sustainably inviting public spaces.

3 Public Spaces as Tools for Social Sustainability, Experimental Urban Interventions

> Urbanization is the defining trend of the 21st century; by 2030, 75 percent of the world's 9 billion people will be living in cities. And urbanization is occurring most rapidly in places with the greatest lack of planning for urbanization. UN-*HABITAT Executive Director Joan Clos I Matheu.* (Streets are Public Spaces 2015)

Accessible areas play an important role in boosting the social and economic life of their communities. New typologies of public places and street spaces are now being created internationally in several towns and cities, which can be an important source of inspiration for other cities from a socio-economical point of view.

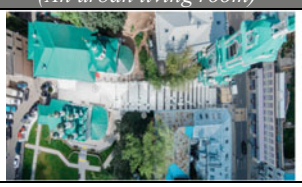
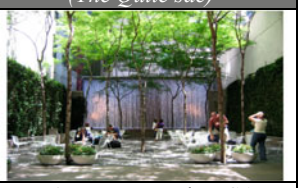
A selection of 18 international cases proposed good examples on how to create an accessible public space that fulfils the needs of its users through an 'open-minded' collaboration between policymakers, designers and users. They are chosen for their diversity in location, the proposed strategies and their functional similarities to the chosen two pilot projects in Cairo, which are the focus of this research. While the diversity of the cases makes 1:1 comparison difficult, it allows for an evaluation of how use and perception are similar or different despite socio-economic and geographic circumstances, as well as variations in the background of the space itself and its financial management. It also helped come up with a list of indicators that would assist in evaluating the success/failure of our cases from a sustainable viewpoint, Table 1.

4 The Prototypes, from a Decaying Street to a Vibrant Public Space

> Think of a city and what comes to mind? Its streets. If a city's streets look interesting, the city looks interesting; if they look dull, the city looks dull. (Jacobs 2016)

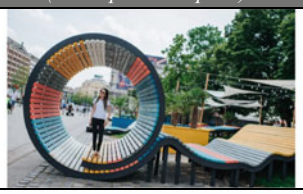
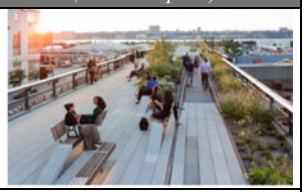
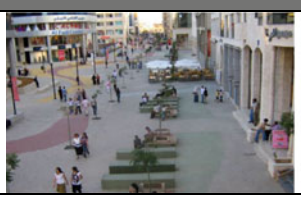
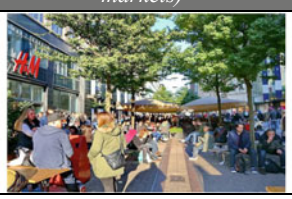
In 1872, Ismail Pasha, the Khedive of Egypt, sought to change the nature and typology of Cairo as a medieval city, famous for its compact structure with short walking distances, squares and marketplaces. He commissioned Haussmann to replicate his Parisian model in an unoccupied zone northwest of old Cairo and directly east of the Nile banks. The Haussmannization process, as it was called, is one of many westernization movements to modernize the urban fabric and increase the global competitiveness of cities at that time, Fig. 3. The idea goes back to the late nineteenth century when countries such as France began to demonstrate the rationality of their government through space and urban planning. Policing the city became increasingly important at this point. It is perhaps where the rationale of Haussmann's

Table 1 A selection of 18 international cases proposed as good examples on how to create an accessible public space. *Source* Authors, 2018 based on the following refernces Altrock (2006), Basat (2018), Coisson(2016), Gehl (2011), Hopkins (2016), Jaber (2013), Kang'ethe (n.d.), Peach (n.d.)

	Annie Street Plaza *(An Alleyway)*	**Swissnex Parklet** *(The event machine)*	**New Road** *(Cars on people's terms)*
CHARACTER			
FACTS	**Location: Annie Alley at Mission Street, San Francisco** **Installed:** 2014 to 2016 **Designed by:** CMG Landscape Architecture **Sponsored by:** Yerba Buena Community Benefit District **Status:** Inactive	**Location:** Montgomery street in front of Swissnex, USA **Installed:** June 2015-December 2015 **Designed by**: Gehl Architects with ETH Zurich Urban Think Tank and UC Berkeley **Sponsored by:** Swissnex **Status:** Inactive	**Location: New Road, Brighton, UK** **Installed**: 2007 - 2010 **Designed by:** Landscape Projects, Jan Gehl and Martin Stockley Associates **Sponsored by:** Brighton & Hove City Council **Status:** Active
IDEA	Creating a two-year operative public space as a pedestrian-only zone	Using parking spaces for other activities Reclaiming the streets	Creating a sustainable inviting hub for all, where users can move freely
FEATURES	▪ Variety of uses ▪ Sitting and relaxing ▪ Movable and fixed seating ▪ Hanging plants ▪ Lighting & chalk boards for community messages ▪ Safer space ▪ Bordered by high buildings	▪ Three meters high' modular unit ▪ Colourful boxes for storage & seating ▪ Low budget installations ▪ Memorable experience ▪ Societal participation ▪ Physically restrained by the size of a parking lot	▪ Rigid features were eliminated ▪ Artistic installation ▪ Friendly wooden benches facing the street ▪ Lighting fixtures for night activities providing safety ▪ New friendly tiling
	Chernigovsky Lane *(An urban living room)*	**Souq Waqif** *(Vintage market)*	**Paley Park** *(The Quite sac)*
CHARACTER			
FACTS	**Location:** Moscow, Russia **Installed:** 2015 **Designed by:** Megabudka Architectural Bureau **Sponsored by**: The city of Moscow ***Status:*** Active	**Location:** Doha, Qatar **Installed:** 2004-2007 **Designed by:** Mohamad Ali Abdallah **Sponsored by:** Amiri Diwan ***Status:*** Active	**Location:** New York, USA **Installed:** 1967 **Designed by:** William Paley and Landscape architects Zion & Breene Associates **Sponsored by:**William Paley **Status:** Active
IDEA	Create a quiet side street adjacent to the noisy main street and emphasize the contrast between them.	Rejuvenate the memory of the old Souq (translated market in English)	A privately-owned public space. Its details were crafted in order to mitigate city noise and create a peaceful space.
FEATURES	▪ Quiet zone signage. ▪ Area for the screening of silent old films. ▪ Spots for Book-Crossing ▪ Benches/planters ▪ The existing asphalt surface was painted. ▪ White is the dominating colour scheme.	▪ Metal roofs replaced with traditional wooden roofs. ▪ Street lighting system. ▪ Removal of random alterations ▪ Shaded areas created cool walkways. ▪ Removable furniture.	▪ Elevated from street level to create a privacy barrier. ▪ Trees as sound barrier. ▪ Waterfall feature on the back wall produces white noise to overcome the noise from the city. ▪ Light and movable mesh chairs provided comfort and flexibility for the users.

(continued)

Table 1 (continued)

	Ströget Street *(No more wheels)*	**Pop up Park** *(Solar powered park)*	**The High line** *(Elevated park)*
CHARACTER			
FACTS	**Location: Copenhagen, Denmark** **Installed:** since 1962 **Designed by:** ---- **Sponsored by:**Copenhagen city, Stadsarkitektens Direktorat, Bjørn Nørgård **Status:** Active	**Location:** Budapest, Hungary **Installed:** 2018 **Designed by**: Hungarian design studio Hello Wood **Sponsored by:** Municipality of Budapest City **Status:** Temporary	**Location:** New York, USA **Installed:** 2008 **Designed by:** James Corner Field Operations with Diller Scofidio + Renfro **Sponsored by:** City of New York **Status**: Active
IDEA	Encourage people to spend time in the city's forgotten alleyways.	Revive a forgotten public space through creating a temporary solar power park.	Creating a strategy of "*agri-tecture"* to allow people to freely experience the park.
FEATURES	▪ Using progressively better-quality materials ▪ The dimensions of the street allowed for public entertainments ▪ limiting the number of parking spaces ▪ The "Stork Fountain" as a focal point	▪ A unique space promoting a sense of democracy. ▪ Welcoming colourful wavy wooden structures. ▪ Palms and olive trees. ▪ Sail shades providing additional shading. ▪ Solar panels to power charging stations.	▪ A dozen access points to the elevated park. ▪ Sundeck and water feature ▪ Open lawn and seating steps ▪ Paving system that encourages natural growth which creates a 'pathless' landscape
	Salim al- Qudah Street *(First pedestrian street)*	**Spitalerstraße Street** *(Shopping Centre & seasonal markets)*	**Kibebe Tsehay Playground** *(Do It Yourself- DIY)*
CHARACTER			
FACTS	**Location:**Amman, Jourdan **Installed:** 2007 **Designed by:**TURATH Consultants **Sponsored by:** Greater Amman Municipality GAM **Status:** Active	**Location:**Hamburg, Germany **Installed:** 1968 **Designed by:** ---- **Sponsored by:** The city of Hamburg **Status:** Active	**Location**:Addis Ababa, Ethiopia **Installed**: 2012 **Designed:** Basurama office **Sponsored by:** University of Addis Ababa, Spanish Aid Workers. **Status:** Active
IDEA	Prioritizing pedestrians and cyclers and promote the "Anti Mall Space".	Transform a car street into a pedestrianized shopping street.	Motivate poor communities to create shared public spaces for young inhabitants.
FEATURES	▪ A recreational promenade. ▪ Policemen were present for security. ▪ Regulating parking along the street free-of-charge. ▪ Seating is only provided on the main pedestrian spine. ▪ Providing built-in pedestrian scale lighting.	▪ Multiuse along both sides. ▪ Trees in the middle. ▪ Flexibility of furniture. ▪ Space for many artists play music or paint for the public. ▪ Connects the main train station to the city centre.	▪ Light structures of local recycled materials. ▪ Colourful flooring ▪ Affordable costs. ▪ Materials included abandoned objects and donated wooden pallets and canvas.

(continued)

Table 1 (continued)

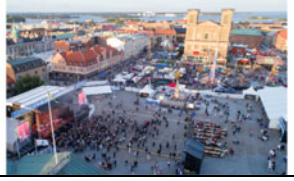
	Slavic Village *(Tactical Urbanism)*	**Stortorget square** *(Open Plaza)*	**Cheonggyecheon River** *(Sunken Stone Garden)*
CHARACTER			
FACTS	**Location***:* Cleveland, USA **Installed:** 2017 **Designed by:** Better Block **Sponsored by:** The Cleveland Foundation, Slavic Village Development **Status:** Active	**Location:** Karlskrona, Sweden. **Installed:** 1999- 2003 **Designed by:**Caruso St. John Architects and Eva Löfdahl **Sponsored by:** Swedish Arts Council ***Status:*** Active	**Location:** Seoul,South Korea **Installed:** 2005 **Designed by:** Kee Yeon Hwang and The Seoul Metropolitan Government **Sponsored by:** L.M. Bak **Status**: Active
IDEA	Empowering people to reclaim their streets through creating a gathering node.	Transform the old square into a pedestrianized plaza and maintain the old cobblestones	Creating a green urban corridor and eliminate the environmental pollution.
FEATURES	▪ Served as a kick-off for "Rooms to Let "use them as art installations ▪ Stage for music ▪ Customised long tables and benches. ▪ Greenery and cafe seating to improve the streetscape	▪ Removal of roads and pavements. ▪ New lighting masts. ▪ Temporary play areas for children. ▪ A stage ▪ Weekly markets. ▪ Benches.	▪ Temporary stalls. ▪ Concrete steps for sitting. ▪ Colourful night lighting. ▪ Stepping-stones. ▪ Waterfalls and fountain. ▪ Easily accessible from the street level. ▪ People can cool their feet in the water in hot days.
	OberHafen *(The new cultural hub)*	**Cat Street** *(A hipster pocket)*	**Acland Street** *(Distinguish by physical fixtures)*
CHARACTER			
FACTS	**Location:** Hamburg, Germany **Installed:** 2011 **Designed by:** Users &tenants **Sponsored/funded fully by**: HafenCity Hamburg GmbH **Status**: ongoing	**Location***:* Tokyo, Japan **Installed:** since Tokyo Olympics 1964 **Designed by**: ----- **Sponsored/funded fully by:** The Japanese government **Status:** Active	**Location***:* Melbourne, Australia **Installed:** 2016 **Designed:**BKK Architects **Sponsored by:** City of Port Phillip and McGregor Coxall ***Current Status:*** *Active*
IDEA	Developing intensified uses for existing buildings through transformational process.	An intermediate hidden gem, linking vibrant areas	Enhance the local character by offering opportunities for events and festivals
FEATURES	▪ Variety of creative cultural uses. ▪ Photographic studio, relaxed location for jazz and classical music. ▪ Long warehouse buildings for cultural activities ▪ Vacant spaces to host children playgrounds.	▪ Flanked by design shops and artists' studios. ▪ It links two most interesting vibrant areas and allowing people to avoid battling the traffic. ▪ It has a bohemian feel with local colours. ▪ A playground for children.	▪ New design language that blurs the boundaries between the street and infrastructure ▪ accommodate the new tram terminus ▪ Flexible plaza space and public furniture.

Fig. 3 The Haussmannization of Downtown Cairo in the nineteenth century. Source (Cairo and Giza: Then and now 2015)

straight line comes into play. The visibility and span of the extending boulevards of Paris helped in facilitating control over the city, something that could not be achieved through the old narrow streets (Attia et al. 2012).

However, the idea behind Downtown Cairo was totally different and derived from an aesthetics perspective,which was achieved through a very expensive effort to persuade the world that Egypt was one of those modernized countries. A new center was created as a platform for a special 'boulevard culture' that sprouted promenades and café life along the new city's wide streets. Over the past 50 years, Downtown Cairo has fallen into decay after the government embarked on a nationalization program in the 1950s. As Cairo expanded in the 60, 70 and 80 s, it experienced spatial, social and symbolic shifts within its fabric leading to a major transformation of Downtown. It has changed from a place for the elite of society into a middle-class district and then to a lower-middle-class district. All this affected the type of activities within new definitions of the public spaces and the street spaces as a natural result of the diverse demands and needs of each class (Braker 2016).

Downtown Cairo, like many other city centers, is deeply fragmented and dominated by heterogeneity with an inoperative public realm. Lack of money and funding is being used as an excuse by policymakers for not proposing substantial improvements. It was clear from the previous examples that inexpensive, short-term actions can give people the ability and confidence to create spaces that would respond to their needs. Many streets in Downtown Cairo fell into decay and became a no man's land, which inspired many private initiatives especially after the uprising in 2011 to rediscover those hidden pockets and work on transforming them into liveable mini public parks that would attract the users and boost the economy of the area. This research will focus on two cases: one is a forgotten narrow street that is rediscovered, and the other is a wide traffic street that is pedestrianized.

4.1 Kodak Passage, *Private Initiative*

Location: Kodak Alleyway off Adly street, downtown Cairo.
Installed: April 2014–ongoing.
Designed by: CLUSTER (Cairo Laboratory for Urban Studies, Training and Environmental Research), CKU (Center for Culture and Development), DEDI (the Danish Egyptian Dialogue Institute).
Sponsored and funded by: Al-Ismaelia for Real Estate Investments and some shop owners.
Area: 636 m^2 (Width: 9.5 m, Length: 80 m).
Current status: Active (Fig. 4).

Over the history of civilization, streets were always considered as one of the main public domains of the city. In some cases, they function as connectors between public spaces and the urban form of the city, whilst in other cases they are the main public space itself. Within them, as platforms of public interaction, people get to engage in a diverse array of socio-economic and recreational activities (Braker 2016). Without spaces for active and passive socialization and with no opportunity for casual and formal interactions, our streets would be no more than agglomerations of privatized spaces within buildings, devoid of the opportunity for the individual to reclaim the right of the physical space (Mehta 2013).

Kodak passage is one of the underutilized in-between streets in Downtown that has been neglected for a long period of time. Originally, the passage contained a Kodak store, a garage, labs and a warehouse on the west side of the street. On the east, there was an old Brazilian coffee store. It

Fig. 4 Kodak Passage, Downtown Cairo. Source (Abaza 2017)

was a service alleyway surrounded by two high buildings and faced with one of the oldest Jewish synagogues in Cairo. The fact that the passage was facing the synagogue made it difficult for the space to accommodate any kind of activities due to the sensitive nature of the building and the possibility for terrorist attacks, which enforces security personnel all the time in the passage to control the area. However, after the uprising in 2011, the state was very weak and there was a very empowered sense of community, and people were trying to reclaim the streets and change their settings. This general atmosphere encouraged many private initiatives to start discussing how to take advantage of the current situation of control suspension. CLUSTER (Cairo Laboratory for Urban Studies, Training and Environmental Research) was one of the initiatives that started looking at the passage and invested time and efforts on redefining the unique features of the passage and how they can pave the way for the people to reclaim it in the most sustainable manner.

> As you walk you have to negotiate your right to the street, from a gender perspective, from a class perspective, from a culture perspective. There are different frames of references for what you can and cannot do, it is not necessarily what the law says. There are multiple layers of order that govern Nagati, Co-founder of CLUSTER (Matroos 2017)

4.1.1 The Initiative

Passageways in downtown are spaces between buildings that connect the main streets that located off the main channels of traffic and operate as hubs for competing interests and claims to space. Viewed together, they offer an opportunity to re-envision downtown as a network of 100 to 150 pathways housing commerce and entertainment. They also offer a counterpoint to the traffic and street grid and may serve as a stage for periodic artistic and cultural programs, such as book fairs, children's festivals, flea markets and even bike ways and greenways (Nagati and Stryker Eds. 2016).

In 2011, a team of academics consisted of Omar Nagati, Jan Braker and Bedour Braker started a design course at MSA University focusing on the 'In-Between' spaces of downtown Cairo. The team led a group of 30 students to explore the inner spaces and forgotten alleys of the area and came up with an extensive array of solutions that would enhance the condition of those passages and lead to more integral interaction between the users.

The outstanding outcome encouraged Nagati, three years later in 2014 to work more intensively with his CLUSTER team to realize some of those proposals. They chose two forgotten passages and one of them was Kodak Alleyway (Matroos 2017).

4.1.2 The Intent

In 2014, CLUSTER was supported by two Danish organizations—Danish Egyptian Dialogue Institute (DEDI) and the Center for Culture and Development (CKU)—to establish a workshop including Egyptian and Danish teams of artists and architects. Their objective was to engage stakeholders and residents in a series of discussions and decision-making to reach the best approach for revitalizing the dead street. The result was a design theme that promotes a safer and accessible space through redefining the public spaces of Downtown as catalysts for more diverse and inclusive interaction between people from different backgrounds. The outcome for Kodak was selected by a juried review and it was referred to as the 'Green Oasis', Fig. 5.

'The design is fairly simple', explains Nagati. We are using the passageways concept to bring nature back into Downtown. So, we added a little bit of a green oasis or an urban garden. The idea is to try to mediate the public and private sphere. As you can see in Cairo, there is not only a lot of spill over from shops onto the street but also street vendors and informal traffic organization. So, the public and private domain are not very clearly demarcated, unlike in Northern Europe for example, (Matroos 2017).

4.1.3 The Path

CLUSTER undertook the design development and implementation of the concept, further adapting it to the needs of the local community and various stakeholders. The implementation was completed and the newly designed passage was inaugurated in January 2015. They have faced a number of challenges concerning the strategy to manage and acknowledge the needs of the stakeholders through negotiations without compromising design integrity (Nagati and Stryker Eds. 2016).

The team then spent an entire summer acquiring the necessary permits by seven relevant local and municipal authorities. It was a challenge to convince different authorities with some of the design ideas like installing benches and lighting due to security reasons since the street was facing the Jewish Synagogue.

In their report, CLUSTER explained how difficult it was to proceed with the construction flow on-site. They mentioned that some of the design details were not accepted by different parties, for instance, the floor tiling and the benches. The objection was the possibility of soliciting certain undesirable actions within the street, a necessity to reach a common ground to persuade the different local stakeholders was clear to the team in order to smoothly proceed with the implementation of the project. Some stakeholders also expressed their concerns regarding making the street open and uncontrolled, which will eventually lead to unpredictable encounters. Contrary to those conventional assumptions, and according to many writings by Jane Jacobs in the 1960s, a welcoming public space frequented by as many people and users as possible can make the space the safest.

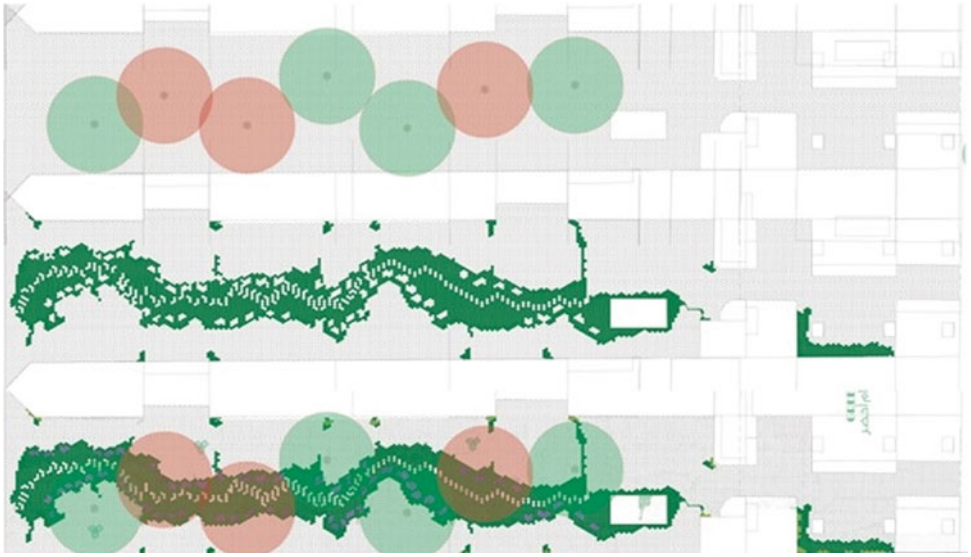


Fig. 5 Schematic Design of Kodak Passage, Downtown Cairo by CLUSTER. Source (MA urban design studio 16/17, n.d)

4.1.4 The Effect

This project exemplified the emphasis of two main aspects: the integral process and the spatial aesthetics. The way in which decisions were made held greater importance than the design outcome itself. The participatory approach that was adopted in this pilot project focused on engaging different parties and considering their requirements and desires and incorporate their recommendation in a simple generic scheme.

Accordingly, the passage was transformed at the end into a cultural microcosm in the middle of Downtown. It became an inviting park equipped with fixed concrete benches, trees for shading, soft lighting and the facades along both its sides were renovated. Its activities vary according to the time of day and day of the week, this new public space can be considered a cultural park hosting different intellectual events and accommodating several art exhibits, screenings, book fairs and performances, and for every season the street changes its decorations to embrace the occasion.

As a hybrid equilibrium of urban design and art manifestation in the northern part of Downtown Cairo, it highlights the existing and emerging initiatives in a way that would help activate other underutilized public spaces in the area.

4.2 Al-Alfi Street, *State Intervention*

Location: Al-Alfi Street off Emad ElDin, downtown Cairo.
Installed: Mid 1990s–ongoing.
Designed by: Cairo Governorate, General Organization for Physical Planning GOPP then National organization of urban harmony NOUH.

Fig. 6 Al-Alfi Street, Downtown Cairo. Photo credits Braker 2018

Sponsored and funded by: Cairo Governorate, union of many banks, and Al-Alfi Street Tenants Association.
Area: 2868 m^2 (Width: 19.5 m, Length: 147.05 m).
Current status: Active (Fig. 6).

> There are now 60 million new cars being added to the planet every year, and with those vehicles come more smoke, toxic emissions and dependency on rapidly depleting resources. As we embrace the car, our cultures become more sedentary and rates of obesity and heart disease increase. Cars not only make our cities unhealthy, they also make our cities dangerous: 270,000 pedestrians are killed by cars every year. (Walker 2013)

Consequently, pedestrianizing the hearts of the cities is one of the solutions that can minimize similar dangers. Well-planned strategies between the state and city inhabitants are crucial in controlling a sustainable process of

transforming streets from polluted spaces to safe parks for all.

In the 1930s, Downtown Cairo became not just a chic residential district, rather it was also introduced to several commercial activities which helped in changing it into a mixed-use district. It became a popular hangout area for commercial and entertainment services with many casinos, cinemas, street cafés and restaurants. One of its main dominant streets was Al-Alfi Street, a wide long street that runs from Orabi Square to Al Gomhuria Street and divided twice with two streets Zakaria Ahmed then Emad ElDin. Since the 1920s, the street—in general—was an entertainment hub with many cinemas and theatres on both sides, not to mention its role as a hub for nightlife and casinos frequented by European expats seeking entertainment. Many famous restaurants, cafes and dessert shops were also established then and still running today.

4.2.1 The Initiative

In the mid-1990s, the western zone of the street—ending with Emad ElDin Street—was officially pedestrianized. This process of pedestrianization and refurbishment was envisioned as a pilot project carried out by Cairo Governorate for a future pedestrian friendly city center. Accordingly, traffic was banned creating a safer space for people with day and night entertainment activities of fast food, restaurants, cafés and cabarets to match with the new nature of the street. However, there was no real social upgrading introduced, just paving, installing basic street furniture and cleaning up building frontages.

The approach back then was more experimental than a well-studied tactic due to the lack of a clear strategy concerning traffic, urban design, activities. Stakeholders were not involved in the decision-making (Attia et al. 2017; Shahine 2018; El Khorazaty 1998).

4.2.2 The Intent

With the turn of the new millennium, the government promoted more trails for beautifying and pedestrianizing Downtown. In 2009, an international competition was launched to revitalize Downtown Cairo and the Al-Alfi passageway was already considered to be a ready model to admire.

The proposed regeneration plan of the street at that time focused on new flooring material (concrete and tiling for pavements), back-to-back seats and adding few bushes. The outdoor spaces were used as extensions for the cafés and restaurants without any boundaries or specific order. The street users stated the negatives in the insufficient number of seats, poor lighting, less security subsequent to street fights started by teenagers, jobless youth and mixed social standards. They suggested maintaining building façades, lighting the street, introducing seating and greenery plus increasing security and allowing regulated traffic for longer durations by daytime (Abdelhadi et al. 2009).

After the uprising of 2011, a state of chaos and behavioural disorder started overwhelming the whole area; wooden chairs in some pedestrian streets were either dismantled or removed and vehicles started storming those streets. Street vendors occupied sidewalks, squares and wide portions of the main streets in downtown Cairo. An invasion led to a consistent pace of deterioration of many streets.

In 2014, a group of researchers conducted a field survey to detect the current negatives in Al-Alfi Street. Locals, mainly, complained about the absence of security, the lack of cleanliness and scarcity of maintenance. They also brought attention to the fact that wooden benches were attracting homeless people and encouraging delinquent attitudes of young lovers, and most importantly not including the residents and shop owners in the decision-making process. That is why the café owners 'deliberately destroyed the public benches for their own benefit to place their own seats and rent them to passers-by', leaving no space for pedestrian activity. Moreover, the governorate reserves the right to rent spots in front of each café or store to anyone ready to pay even if he does not have a shop on Al-Alfi Street (Attia et al. 2017). In the same year, a governmental initiative called 'The state of Downtown' was launched, with the focus of clearing the streets and squares from all street vendors and an overall regeneration of the whole area. Several meetings were held weekly organized by Cairo Governorate, headed by the Governor and attended by representatives from the Governorate, local authorities and experts from different organizations and institutions.

Sahar Attia (a former Co-chair General Assembly of Partners at UN-Habitat World Urban Campaign) describes how the regeneration started this time and the role of different stakeholders:

> …The regeneration project was initiated by Cairo Governorate, the owner of Al-Alfi Street, while mobilizing different stakeholders to participate in the project each with a specific role. Cairo Governorate, GOPP and NOUH represented the governmental institutions involved in the project; who were responsible for issuing legislations and making all decisions regarding design aspects of the regeneration project. Other stakeholders funded the project namely Ismailia Company upgrading its owned property. Misr Real Estate assets part of Misr Insurance holding Company sponsored the painting of buildings' façades based on the approved design. Private owners of businesses and shop owners had to adjust their shop frontages based on the agreed upon design. Other involved stakeholders included the consultant, the review committee and the governorate advisors of academicians and professionals, and the contractor. Researchers and postgraduate students were involved in conducting before and after surveys. Finally, Social Media Companies were responsible to bring the project to the local community awareness… (Attia et al. 2017)

NOUH (National Organization for Urban Harmony) proposed to the Cairo Heritage development committee two alternatives to the development plan for Al-Alfi passageway. Both proposals included kiosks, seating area with built-in seats, billboards and streetlights as well as infrastructure. The difference between them is the location of the outdoor seating area and the allocated pedestrian pathway. The first proposal is similar to the existing condition, where the outdoor seating area is aligned on both sides of the walkways directly connected to each café, while the central part dedicated to pedestrians. In the second alternative, the central part of the walkway is dedicated to the seating area, while the sideways are evacuated for pedestrians (Alshenawy 2017a, b), Fig. 7. The committee should have discussed both proposals with the stakeholders before choosing one. The governorate and the local authorities had the dominant control over the regeneration process of the street. First, 'by issuing legislations to the act of trespassing; presently citizens can trespass after taking the permission of the authorities and after paying the price of occupying the public space to the government' (Attia et al. 2017) Second, the planning and funding process.

Mantiqti (a monthly newspaper focusing on Downtown Cairo news) conducted a pilot survey enquiring about the preferable alternative amongst the users of the space and the majority agreed on the first alternative. Some mentioned that the second alternative lacks safety especially with the absence of a clear entry for ambulance and fire engine.

4.2.3 The Path

The first phase of regeneration ran from November 2014 until May 2015. The process involved the removal of illegal occupations, infrastructure and piping were implemented, rainwater drainage networks were installed, the entire street pavement was upgraded and new lighting system was introduced to the area. All the informal additions on the historic façades were removed and the original ornaments were recreated and the façades were painted. Each building along the street was recognized with a plate that includes the building registration number, name, address and the original architect's name. Moreover, the existing kiosks were replaced by smaller ones 2×2 m^2 (Alshenawy 2017a, b; Attia et al. 2017; Nagati and Stryker Eds. 2016).

The second phase lasted from April 2017 till July 2017 and involved the participation of the Tenants Association of Al-Alfi Street and the implementation of the Egyptian International Company for Contracting. Al-Alfi Street Tenants Association was formed of occupants of cafés, shops and residents by the decision of Governor of Cairo in February 2016. The approach was to tackle the street violations by café owners, as they have occupied the spaces in front of their shops with seats and tables.

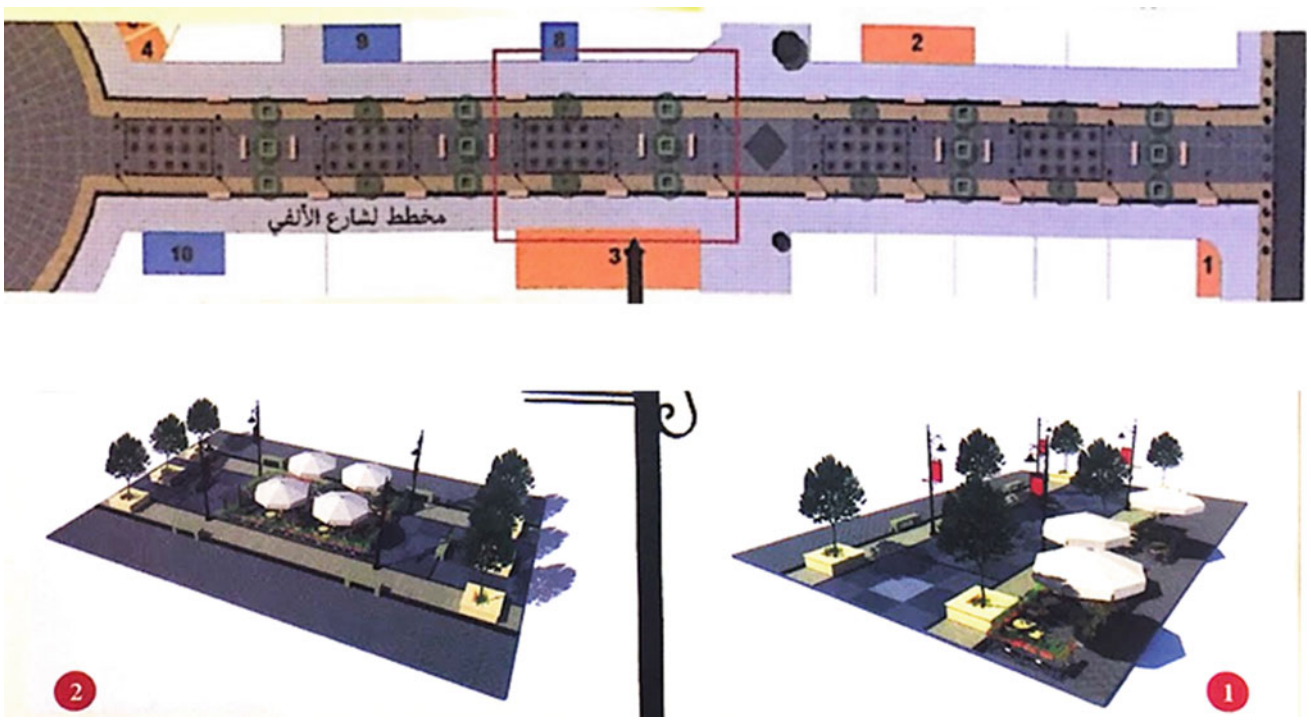


Fig. 7 Schematic Design of Al-Alfi street, Downtown Cairo. Source NOUH (National Organization for Urban Harmony) development proposal for the passageway (Alshenawy 2017a, b)

To sustain the ongoing maintenance of the street, funds were raised from the governorate and unions of many banks. During the recent development, the street was defined with carefully zoned cafés, and boundaries were set by flower metal boxes carrying the café/restaurant name. The marble seats were replaced with 24 wooden seats. To keep an avid eye on the street, three security cameras were installed, in addition to two security kiosks plus hiring security officers belonging to the Tenants Association. All kiosks were removed just keeping existing licensed kiosks and cafés.

Users and residents of the street started to feel some sense of belonging to the space and started an initiative called 'Put a book…Take a book' aiming to spread the reading habit by providing small libraries to benefit passers-by with free books to read and return or to replace the book with another. This initiative started in Al-Alfi passageway and targeted 25 other places in Downtown Cairo. It was funded by Bavaria Fire Fighting Solutions; however, it did not succeed as expected since some took the books and never returned them (Alshenawy 2017a, b, 2018a, b).

Haidi Shalabi (from the National Organisation for Urban Harmony) describes the street now as "…newly rehabilitated with the participation of the local community. Al-Alfi is now a buzzing recreational center, with the zoning of cafés taking place under the scrutiny of security cameras. We have created a Tenants Association and fund for the street and have hired a company in charge of rubbish-collection and security." (Shahine 2018).

4.2.4 The Effect

Authorities dealt with this passageway as an experimental prototype for street interventions in Downtown that can be reimplemented in other streets. This made the most regeneration efforts along many years of incomplete intervention trials that focused superficially on physical aspects like paving roads, painting façade and installing fixed benches without anticipating the real economic implications, not to mention how to sustain the revitalization process. Pedestrianization strategy was not appreciated as pedestrian area shrunk in favour of side cafés. Simultaneously, those cafes encouraged different types of users to frequent the street and turn it into a kinetic hub once again. Some street events and dancing performances even took place in recent years engaging many locals and visitors of the street to perceive the street from a different perspective. El Kadi sums up this continuous process of revitalization in a few words 'The province has accelerated the implementation of Al-Alfi development in a short period of time, thus some errors in implementation have emerged and re-development of the street took place once again' (Alshenawy 2018a, b).

The following photo-mapping explains the conditions of both streets before and after interventions Fig. 8.

5 Post Occupancy Evaluation from a Sustainable Viewpoint (POE), Successes or Failures

> …The power of architecture is believed to support social ideals, human needs, physical health, and spiritual aspirations. With the aim to fulfil the various dimensions of human needs that are linked to architecture, different environment-behaviour methods have been applied to the profession, e.g. Evidence-based design and Post Occupational Evaluations… (Eberhard 2009)

Sustainability has a social dimension based on fair distribution, and a material dimension based on efficiency, savings and sufficiency. It can be achieved by accelerating the refurbishment and regeneration of the constructed city, as well as maximizing the performance of the city machinery (Citizen Commitment to Sustainability 2012–2022).

Consequently, the quality of a sustainable public space automatically leads to place attachment, simply because when a space is being successfully sociable, freely accessible, and supported by different types of uses and a variety of activities, this can automatically boost the economic force within that space and accordingly in the area surrounding it as well. In his writings, Jan Gehl highlighted six issues that need to be addressed in order to evaluate a space:

1. Are reclaimed streets providing more equitable distribution of open space?
2. Do new spaces promote greater diversity of users and choices of outdoor activity?
3. Are public places facilitating greater transit and social connectivity?
4. Can improved access to public space promote greater neighbourhood health and wellness?
5. Can these spaces deepen a sense of community participation, belonging and ownership by residents, businesses and stakeholders?
6. Do the new spaces inspire creativity and improve beauty in the neighbourhood?

The United Nations World Commission on Environment and Development in 1987 (Brundtland report 1987) restricted the sustainable development to meet the needs of the present without compromising the ability of future generations to meet their own needs. Many guidelines for measuring the sustainability of cities already exist. Four main methods are as follows:

1. The Circles of Sustainability model developed by the Global Compact Cities initiatives
2. The Green City Index
3. The Improvement and Efficiency Social Enterprise (IESE) Cities in Motion Index

Fig. 8 Comparative photo/pictorial showing the stages of regeneration/indicators. Source Authors, photo credits: (Ashour 2018; Attia et al. 2017; Braker 2018; CLUSTER, n.d.)

4. The Gross National Happiness GNH Index developed by the Happiness Alliance.

These methods are sometimes referred to as common guidelines because they can be applied to many cities, generating comparisons and knowledge sharing, although they have not been used often and widely enough to be considered standard sector approaches (KPMG International, n.d.).

For this research, three main concerns are needed to be addressed in order to reach a reliable list of indicators:

- Can an improved public space perform economically to support the social needs of its community?
- Who benefits from those improvements?
- How can we sustain the revitalization of those spaces?

Relying on the above and through the examination of the 18 international cases, a list of indicators and sub-indicators was concluded to test the sustainability of both streets.

This list is based on five main indicators and sub-indicators as clarified in Fig. 9:

1. Accessibility: to what extent is the space welcoming its visitors?
2. Activity: what, when and where are the users occupying the space?
3. Leisure: can we call it a comfort zone?
4. Finance: what are the costs, who is funding the revitalization and its infrastructure?
5. Sociability: does it provide gender equality, safety and social valency?

The POE process was primarily based on personal interviews with stakeholders and users of the streets, site visits and observational survey on different time intervals throughout different occasions in addition to intensive desktop data gathering. Accordingly, both chosen streets in Downtown Cairo were inspected according to those indicators as shown in the following Table 2

6 Conclusion

In general, urban public spaces and streets represent the customs of its communities, societal values and political order. A healthy sustainable public space can be an indicator on how balanced the individual and the collective interests

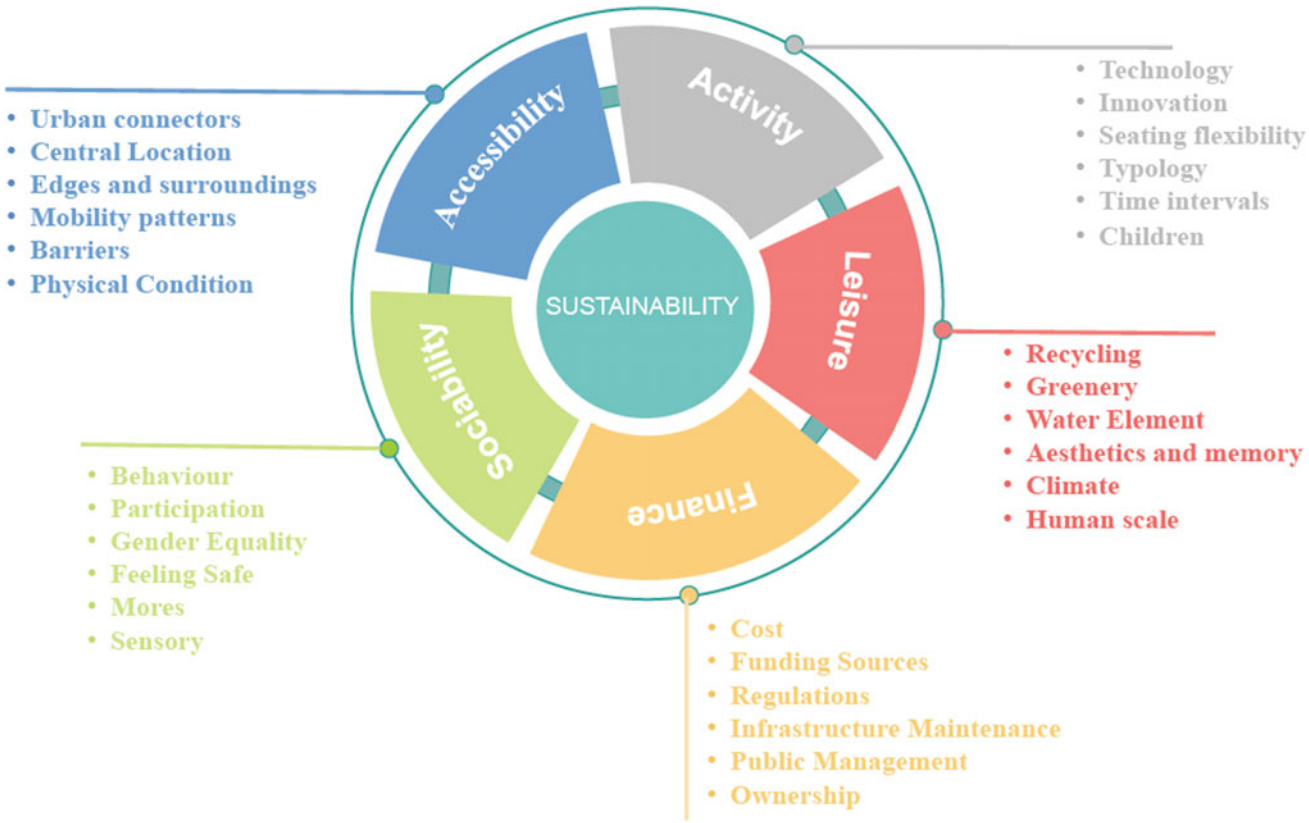


Fig. 9 Spatial indicators. *Source* Authors, 2018

denote the ability of the community to act and perform in a civil manner despite social and cultural diversities.

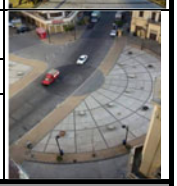
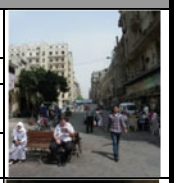
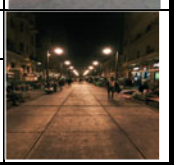
'By recognizing and developing the positive potential of their public spaces, cities can enhance safety and security, create economic opportunity, improve public health, create diverse public environments, and build democracy' (PPS 2015). It is the role of urban planners, architects and artists to help the public re-acknowledge their needs through a process of space reclamation and participatory decision-making. They should also act as mediators between local governments and private investors to help get the voices of people being listened to.

Egypt lacks the mechanism of locals' representatives in the parliament or local government departments where they can perform as a lobby group that can stress the needs of the people and push for societal changes when needed. 'Downtown Cairo has been experiencing an urban transformation guided in part by neo-liberal globalisation, capitalist investment interests, and the emergence of an independent culture-arts scene' (Awatta 2015). Both Kodak and Al-Alfi Streets in Cairo serve as living models on how the people were striving to find a space to meet and interact. It was also clear that the urban planners and designers of Kodak passage (CLUSTER) played an important role as intercessors to deliver the list of needs and interests of the civil society to the government and to the private investors through a process of negotiations. They successfully shed the light on how the success of the street development can bring new businesses to the area and help boost the economy in later stages.

Al-Alfi Street on the other hand (after pedestrianization and renovation processes) required the presence of some sort of confrontation and collision between different interest groups in order to push the mechanism of reclaiming the street. However, such confrontation did not exist due to an agreement between the authorities and the locals on the way the space of the street was being used and by whom. The revitalization of both streets can be, however, a hidden code for unsolicited gentrification, 'and it is the role of the civil society to establish an alternative before classic gentrification led by private entrepreneurs takes hold' (Matroos 2017).

Accordingly, there is an urgent need to learn how to raise the public awareness of the importance of sustainable public spaces that would foster the exchange of ideas between different genders, different classes, and different policy-makers. There is also a need to educate new generations of researchers, urban planners, community activists, and other civic representatives about the benefits of the Placemaking methodology that would help getting different voices together on a common ground in order to create the most efficient

Table 2 Assessment of indicators in Kodak and Al-Alfi passages. Source Authors, photo credits: (Ashour 2018; Attia et al. 2017; Braker 2018; CLUSTER, n.d., D-CAF, n.d.)

Kodak Passage		INDICATORS	Al-Alfi Passage	
Accessibility				
	4 points connected	**Urban connectors**	Several points	
	Downtown Cairo	**Central Location**	Downtown Cairo	
	Two sides high walls, two sides streets	**Edges and surroundings**	Two sides short walls, one side street and one side square	
	Longitudinal motion between two ends	**Mobility patterns**	Longitudinal motion between two ends	
	No barriers	**Barriers**	Fixed concrete stoppings	
	Recently renovated, good condition	**Physical Condition**	Recently renovated, bumpy pavements	
Activity				
	Seasonal hanging decorations	**Technology**	None	
	Wall for movie projection	**Innovation**	None	
	Fixed benches	**Seating flexibility**	Fixed benches and movable chairs	
	Cultural realm	**Typology**	Commercial realm	
	Active mostly at day, and night in times of events	**Time intervals**	Active day and night	
	Rare engagement	**Children**	Rare engagement	
Leisure				
	Colour coded bins	**Recycling**	None	
	Spread shading trees	**Greenery**	Palm trees	
	None	**Water Element**	None	
	Well-designed concrete benches, seasonal decorations, quiet zone	**Aesthetics and memory**	Night lights, food smells, shisha smells, noise of vehicles	
	Relaxing shaded Oasis with breeze	**Climate**	Sunny and breezy	
	Narrow, relatively short passage	**Human scale**	Wide, relatively long passage	
Finance				
Medium costs on one phase		**Cost**	High costs on several phases	
Private		**Funding Sources**	State, Banks, Tenants Association	
Fixed		**Regulations**	Changed along regeneration phases	
Maintained		**Infrastructure Maintenance**	Maintained	
Involved, mainly private sector		**Public Management**	Involved, Tenants Association	
Ismailia Real-estate company		**Ownership**	Government	
Sociability				
	Passers-by in the day for rest and Cultural event at night	**Behaviour**	Youngsters in the day, Families and friends at night	
	Specific social class	**Participation**	Mixed	
	Women not considered in design	**Gender Equality**	Women not considered in design	
	Dim lights, Quiet	**Feeling Safe**	Well lit, live space	
	Cultural	**Mores**	Commercial	
	Sounds and light.	**Sensory**	Smells, sounds and light.	

strategies of reclaiming the public space. The assessment of 'Post Occupancy Evaluation-POE' is another necessity that needs to be acknowledged by training state staff on how to assess the impact of the implemented designs and physical interventions on targeted spaces as well as documenting how people are experiencing the improved quality of the new spaces. 'It is the process of enhancement of the citizenship in a sustainable environment. It stems from integrated vision that includes economic, physical, social and environmental aspects and improves the quality of life. It is the best way to revive the city center and an essential precondition for the locality and acts as a catalyst for the city as a whole' (Attia et al. 2017).

Decisions regarding sustainability are increasingly affecting how we redefine our public spaces, and the success of a specific street as a public space does not only lay in the hands of the urban planner or the architect. It also greatly depends on how the people are using, embracing and sustainably managing the street itself after reclaiming it as a street for all.

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Producing Green Concrete by Using Recycled Materials in UAE

Syed Talha Muhammad Ali and Mustafa Batikha

Abstract

Concrete is one of the most widely used construction materials. The materials used in the preparation of concrete mix have harmful effects on the earth's environment. For instance, each ton of cement produces 709 kg of CO_2 in the middle east. UAE produced 40.7 million tons of cement in 2014. On the other hand, the high demand for aggregate in concrete (48.3 billion tons in 2015) due to the increase in buildings causes a reduction in natural resources. Moreover, the growth of the demolition landfills is a serious problem that needs a solution as well. Therefore, the main aim of this research is to check the efficiency of using the demolition waste within the concrete mix and produce environmentally friendly concrete which has a cost efficiency as well. In this study, replacement of cement and the natural aggregates used in concrete by Recycled Coarse Aggregate (RCA) and Ceramic Waste Powder (CWP) took a place. It is worth mentioning that these recycled materials are produced daily in UAE. An experimental test was conducted to produce a new concrete product of 100% RCA as replacement of coarse aggregate, 20% CWP as replacement of cement and 20% CWP as replacement of fine aggregate. Then, the mechanical properties together with the cost of the new product were estimated. It was confirmed by this research that the demolition waste generated in the UAE can be efficiently used to obtain high strength, low cost, and green concrete.

Keywords

Concrete mix • Recycled Coarse Aggregate • Ceramic Waste Powder • Sustainability • Mechanical properties • Cost

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1 Introduction

Since its invention, concrete is one of the widely used man-made materials in the world. According to a recent study, approximately three tons of it is used annually per person (De Brito and Saikia 2013). Concrete comprises three major constituents: aggregate, binder, and water. About 75% of the total volume of concrete is aggregates. Therefore, aggregates play a vital role in the overall properties of concrete mix and it is very important to select proper aggregates with suitable size distribution to develop a special type of concrete mix (De Brito and Saikia 2013).

The increase in the world population, as well as increased urbanization and the economic conditions of the rapidly developing countries, have increased the rate of construction in those countries. As a result, old buildings are being demolished making way for new buildings. Due to the huge amount of demolitions, a lot of construction waste is being produced all over the world. This is a serious issue for the environment as it cannot be disposed of properly. It is reported that about 850 million tons of CDW is generated in Europe per annum, which is 31% of the total CDW generated in the whole world (Fisher and Werge 2009). In the UAE, it is recorded that the waste produced by the construction and demolition amounted 2,580,913 tons in Abu Dhabi during 2016 (Statistics Center 2016). Another problem which is the Ceramic Waste (CW) has been raised because ceramic industries result in much crushed CW which keeps scattered on a large land field bringing aesthetic destruction to the surrounding areas. Moreover, the fine powder produced by the polishing process of ceramic is a useless material that can go with the air, soil, and water causing serious pollution. Therefore, the main aim of this research is to use both RA and CW in concrete and validate this usage on the mechanical properties and the cost of the new concrete.

Many studies have been conducted on the use of CWD as Recycled Aggregate (RA) in concrete. Although using RA

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may guide many benefits such as reducing the demolition landfills and the use of the natural resources, it may affect the quality of the concrete. Additionally, many studies have been conducted on the use of CWD as Recycled Aggregate (RA) in concrete. Although using RA may guide many benefits such as reducing the demolition landfills and the use of natural resources, it may affect the quality of the concrete. For example, it has been demonstrated that 100% usage of RA may only cause a reduction of 10, 17, and 21% to the compressive strength, the tensile strength and the elastic modulus of concrete, respectively (Agrela et al. 2013). However, the resource of the used RA has been shown to have an important role in evaluating the recycled concrete properties. In this study, the RA produced in the UAE will be utilized.

On the other hand, CW has been applied partially in the concrete as coarse aggregate, fine aggregate, and cement. For example, Kannan et al. (2017) show that 40% partial replacement of cement by Ceramic Waste Powder (CWP) can obtain concrete of superior durability, low chloride ion permeability, and high electrical resistivity although 15% decrease in the compressive strength was observed. Another example by Siddique et al. (2018) displays that 40% replacement of Natural Fine Aggregate (NFA) by CW can increase the compressive strength and the split tensile strength of concrete by 16% and 7%, respectively.

However, it is rare to find that there is a research in which RA and CW are combined in the same concrete mix. Moreover, none of the previous research uses 100% of the RA together with CW. This shows the originality of this study which utilizes 100% RA and 20% of CW in the concrete mix to check the effect of this utilization on the mechanical properties and the cost of the new mixes.

2 Experimental Procedure

2.1 Materials

Figure 1 explores the materials used in the mixes. The properties of these materials are given below:

Cement. The cement used to prepare all the mixes is Type I Ordinary Portland Cement. The cement is produced in the United Arab Emirates by UltraTech Cement Factory. The cement conforms the BS EN 197-1:2011 standard with class 42.5 N. The letter N represents that the cement has a normal setting rate.

Natural Coarse Aggregate (**NCA**). Two types of coarse aggregates are used in this research: 10 and 20 mm with a combined ratio of 1:4. Using ASTM standards (Kett 2010), the properties of the aggregates are determined by performing various tests including, sieve analysis, specific gravity, Rodded Unit Weight, and moisture content. Table 1 demonstrates these properties.

Natural Fine Aggregate (**NFA**). Black sand is used as NFA in the concrete mix. All the required data including, sieve analysis, specific gravity, fineness modulus, and moisture content are obtained by performing standard tests (Kett 2010) as seen in Table 1. It is important to note that the fineness modulus is 3.27, which is more than 3 as a result of coarse sand.

Recycled Coarse Aggregate (**RCA**). The RCA used in this research is obtained from Bee'ah recycling plant located in Sharjah, UAE. The maximum diameter size of the recycled aggregates is 14 mm. Table 1 shows the properties of the RCA where it can be seen that the moisture content and the water absorption for the RCA are higher than the NCA due to the fully or partially mortar layer still attached to the RCA.

Recycled Ceramic Waste. The ceramic waste to partially replace fine aggregates is obtained by crushing the waste tiles. The tiles are crushed using the Los Angeles Abrasion Machine in the Geoscience Testing Laboratory, Jebel Ali, Dubai. The crushed material is further sieved to obtain the required size from 5 to 0.15 mm as Ceramic Fine Aggregate (CFA). Table 1 shows that CFA has lower specific gravity and fineness modulus, but much higher in terms of the water absorption and the moisture content. For partial replacement of cement, Ceramic Waste Powder (CWP) from the polishing of the ceramic tiles was utilized.

Superplasticizer. The superplasticizer used in the mix is PC 400. It is based on polycarboxylate (PC) ether. PC 400 has many advantages including, increases the early strength development, reduces permeability, helps to resist frost and carbonation, increases the workability, reduces drying shrinkage (PAC Technologies LLC 2018). PC 400 is added to the mixture during the mixing process after 80% of the water has been added. The dosage of the PC 400 is 0.8–1.5% of cement. The amount of superplasticizer used in this study is 1.25% to the weight of cement.

2.2 Mix Proportioning

The concrete mixes were designed using ASTM standard (Kett 2010) for M40 concrete grade in which the characteristic cylindrical compressive strength (f_{ck}) is 40 MPa with mean cylindrical strength (f_{cr}) of 49.6 MPa (Kett 2010). Mix codes together with a description of each mix are shown in Table 2. Also, Table 3 demonstrates the materials' quantity per m^3 of concrete.

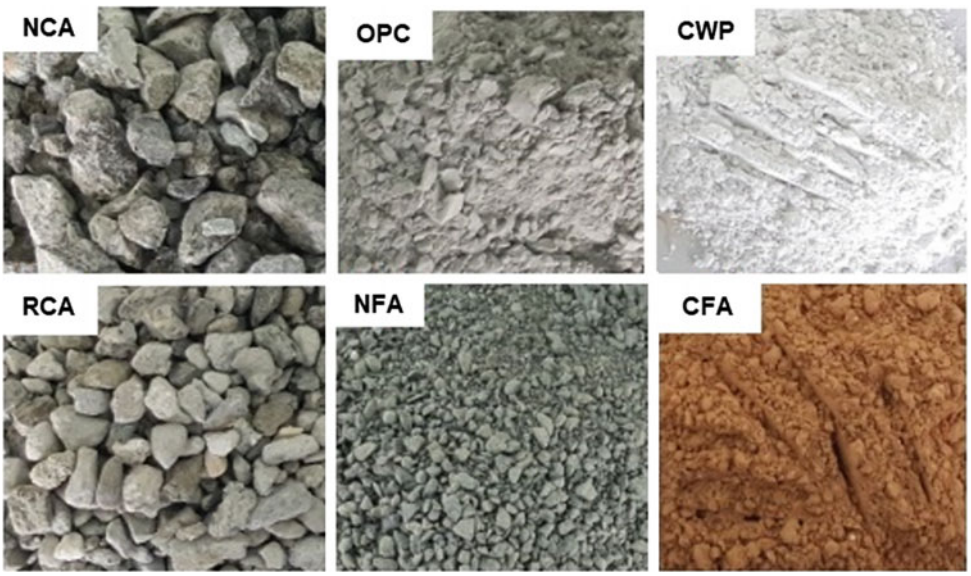

Fig. 1 The materials used in the concrete mixes

Table 1 Properties of the aggregates used in the concrete mixes

Properties	NCA (20–5 mm)	NFA (5–0.15 mm)	RCA (14–5 mm)	CFA (5–0.15 mm)
Specific gravity	2.61	2.67	2.76	1.89
Fineness modulus	–	3.27	–	2.66
Abrasion value %	31	–	20	–
Water absorption %	2.8	4.17	4.1	6.56
Moisture content %	0.9	1.3	1.3	2.6
Compacted bulk density t/m^3	1.41	–	1.47	–

Table 2 Mix code and their descriptions

Mix-code	Mix description
M0	100% OPC-100% NFA-100% NCA-Water-Plasticizer
MRA100	100% OPC-100% NFA-100% RCA-Water-Plasticizer
MRA100-CFA20	100% OPC-80% NFA-20% CFA-100% RCA-Water-Plasticizer
MRA100-CFA20-CWP20	80% OPC-20% CWP-80% NFA-20% CFA-100% RCA-Water-Plasticizer

Table 3 Mix proportions

Mix-code	Materials (kg or L/m^3)								
	OPC	CWP	NCA 20 mm	NCA 10 mm	RCA 14 mm	NFA	CFA	Water	Plasticizer
M0	400	–	740	250	–	840	–	132	5
MRA100	400	–	–	–	827	995	–	132	5
MRA100-CFA20	400	–	–	–	827	796	199	132	5
MRA100-CFA20-CWP20	320	80	–	–	827	796	199	132	5

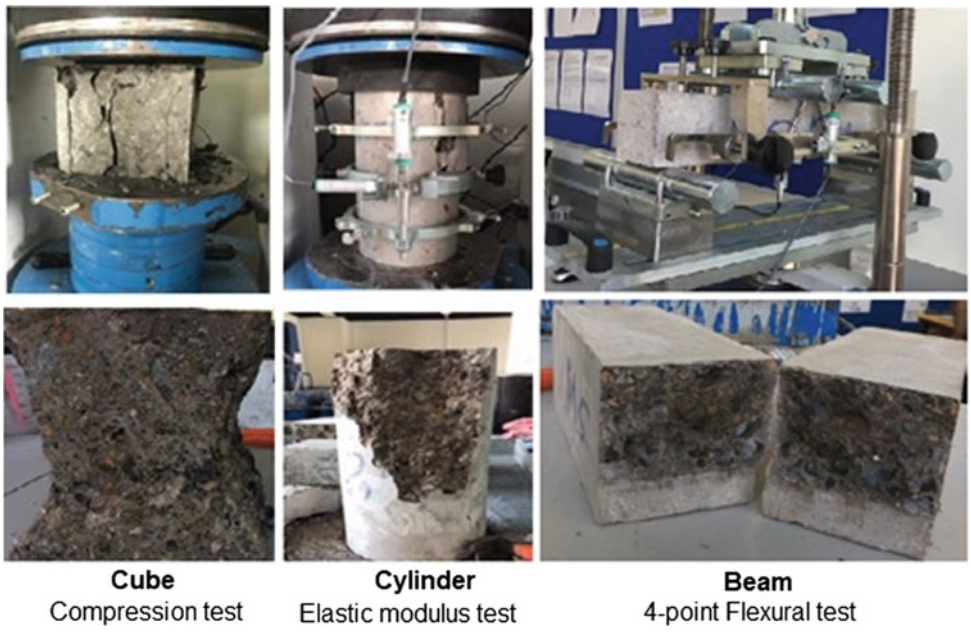

Fig. 2 Examples of tested samples

2.3 Tests on Hardened Concrete

Compression test, elastic modulus test, and 4-point flexural test were conducted using cubes of 150 × 150 × 150 mm, cylinders of 150 × 300 mm and beams of 100 × 100 × 500 mm, respectively. Figure 2 shows the tests done for these samples. The tests were done at 56 days because it is expected that a delay in concrete strength may occur by ceramic contribution.

3 Results and Discussion

Table 4 summarizes the results from the 56-day tests where f_{cu}, f_c, E, and f_{ct} are the cube compressive strength, cylindrical compressive strength, elastic modulus, and the flexural tensile strength, respectively.

3.1 Compressive Strength

Figure 3 shows the relative percentages between the control mix (M0) and other mixes regarding the cylindrical compressive strength (f_c). The relative differences were obtained from the test results in Table 4. From Fig. 3, it can be observed that the compressive strength of MRA100 is 6% lower as compared to that of the control, whereas, it increases by 15% for MRA100-CFA20. The mix MRA100-CFA20-CWP20 observed a decrease in compressive strength by 2%.

3.2 Elastic Modulus Test

Figure 4 represents the elastic modulus results (Table 4) in terms of relative references to the control mix (M0). It can be seen that the elastic modulus of MRA100 and MRA100-CFA20 is 12% less as compared to that of the control mix, while, the mix MRA100-CFA20-CWP20 observed modulus of elasticity 16% less. Although low elastic modulus causes increasing the deflection of the structural elements, it should be noted that less cement content decreases the shrinkage and creep of concrete (ACI 209.2R-08 2008). This reduction in long-term effects will help in decreasing the deflection and make the effect of the low elastic modulus negligible.

3.3 Flexural Tensile Test

The flexural test results in Table 4 rearranged as relative differences in comparison with the control mix (M0) as shown in Fig. 5. It can be observed that the flexural tensile strength of MRA100 is 5% higher than the control mix. For MRA100-CFA20, the flexural tensile strength is equal to

Table 4 Tests on the hardened concrete at 56 days

Mix-code	f_{cu} (Mpa)	f_c (Mpa)	E (Gpa)	f_{ct} (Mpa)
M0	55	47	32	4.1
MRA100	46	44	28	4.3
MRA100-CFA20	57	54	28	4.1
MRA100-CFA20-CWP20	50	46	27	4.6

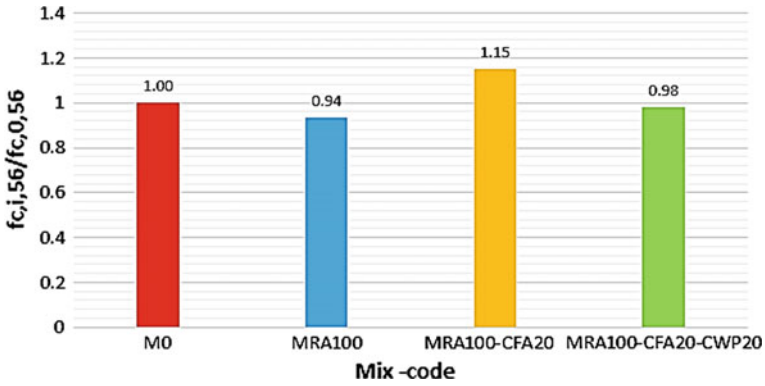

Fig. 3 The relative percentages between each mix (Mi) and the control mix (M0) regarding the cylindrical compressive strength

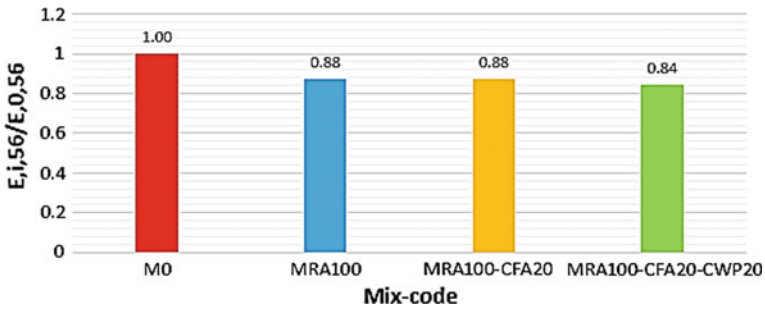

Fig. 4 The relative percentages between each mix (Mi) and the control mix (M0) regarding the elastic modulus

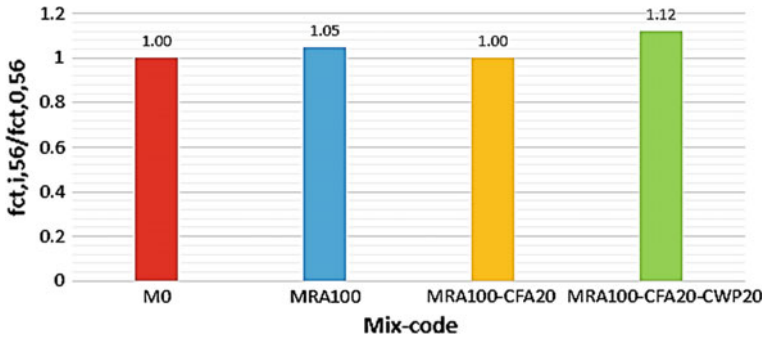

Fig. 5 The relative percentages between each mix (Mi) and the control mix (M0) regarding the flexural tensile strength

that of the control mix, whereas the flexural strength of the mix MRA100-CFA20-CC20 is 12% higher.

4 Cost Analysis

Cost analysis was done for all mixes in Tables 2 and 3. According to the market prices in Dubai (Dubai Statistics Center 2018), the unit cost of each material was applied as shown in Table 5. Because the readily damaged ceramic is not recycled in the UAE, it was estimated to cost 10% of the cost of RCA since a secondary crushing is only required.

Using Table 5, the total cost of each mix can be found in Fig. 6, where the conventional concrete (M0) costs the highest (204 DHS/m^3). The mixes MRA100, MRA100-CFA20, and MRA100-CFA20-CWP20, cost 187, 185, and 160 DHS/m^3, respectively. As a result, the mix MRA100-CFA20-CC20 costs to lowest by 22% from the

Table 5 The unit price of the concrete ingredients

Material	Cement	Ceramic	NCA 20 mm	NCA 10 mm	RCA 14 mm	NFA	Water	Plasticizer
Cost (DHS/kg or L)	0.283	0.0018	0.036	0.038	0.018	0.028	0.007	6

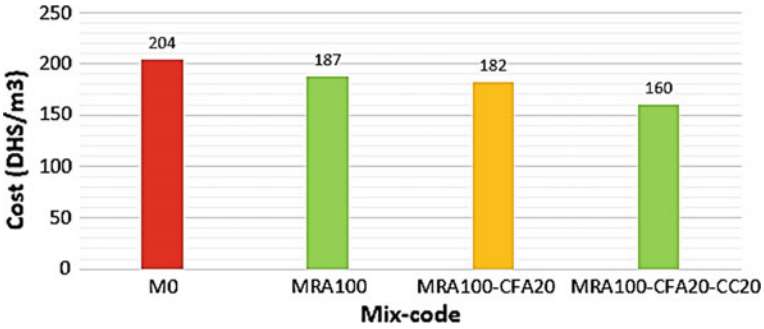

Fig. 6 The cost of the mixes in Table 2

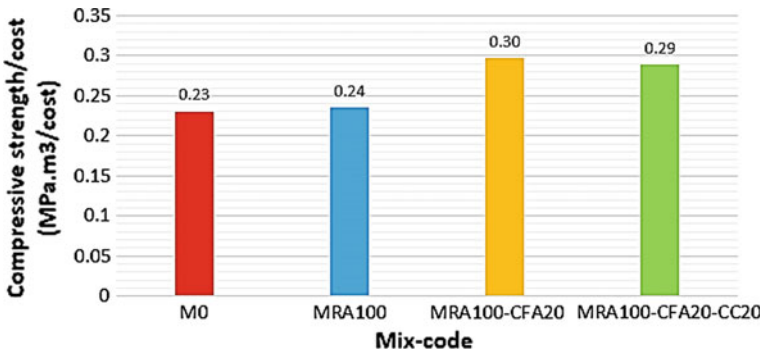

Fig. 7 Value index: ratio of the cylindrical compressive strength to the mix cost

control mix. On the other hand, using 100% RCA instead of NCA help in reducing the cost by 8%.

To assess the profitability of each mix, the compressive strength of each mix was linked with its cost in Fig. 7. The compressive strength was selected from the mechanical properties because it mainly characterizes the strength of concrete. In Fig. 7, a value index was assumed as a ratio of the cylindrical compressive strength to the cost of the same mix. High index value refers that the mix can sustain a high strength at low cost.

From Fig. 7, all mixes with replacement provide a higher value index than the mix without any replacement (M0). Moreover, MRA100-CFA20 and MRA100-CFA20-CWP20 give a high-value index by 30% and 26%, respectively. However, MRA100-CFA20-CWP20 could be the best choice although it has a slightly less value index than MRA100-CFA20. It is because replacement the cement is much effective in reducing the CO_2 emission.

5 Conclusions

In this research, an experimental study has been conducted to evaluate using the recycled materials produced into concrete in the UAE. The use of 100% Recycled Coarse Aggregate (RCA) as a replacement of Natural Coarse Aggregate (NCA), 20% Ceramic Waste Powder (CWP) as replacement of the cement and 20% of Ceramic Fine Aggregate (CFA) as replacement of Natural Fine Aggregate (NFA) were applied in this work. The mechanical properties and the cost of the mixes prepared using these replacements were obtained. The conclusions of this study can be summarized as follows:

1. Using the RCA produced in UAE doesn't affect that much the mechanical properties of the new recycled concrete. It was found that using 100% of RCA reduces

the compressive strength by 6% only, while, it increases the tensile strength by 5%.
2. If 20% of CFA is combined with 100% RCA in concrete, the compressive strength can be enhanced by 15%.
3. A combination of 100% RCA, 20% CFA, and 20% CWP reduces the compressive strength by only 2%, whereas, the tensile strength increases by 12%.
4. A 22% reduction in cost was registered for using 100% RCA, 20% CFA, and 20% CWP. This high reduction in cost comes from the 20% replacement of cement, which is the costliest material, by ceramic. On the other hand, decreasing the CO_2 emission by minimizing the cement in this mix make this mix is the best choice for a sustainable, cost-effective, and green concrete.

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Psychology of Organizational Sustainability

Deepika Gaur

Abstract

The ever-developing area of human behavior invites a new sphere of actions and activities. Study in the area of human psychology also helps the management in selection, training, and recruitment of the right candidates for job positions. In today's managerial world, this study has relevance around the study of emotions, which considers not only the organizational role before hiring the employees but also taking into consideration the positive mental growth of employees during the tenure of their work life, which in turn builds sustainable organization. The article focuses on sustainable behavior a field of Conservation Psychology from the perspective of organizational well-being. It aims at enhancing the socio-physical environment to facilitate better life for employees in an organization. The primary prevention goal of the psychology of sustainability can create positive behavior at every level of an organization. It emphasizes sustainability not only in terms of the ecological, economic, and social environment but also in relation to psychological well-being of people in an organization. Through the intense review of previous literature developed over a period giving rise to the model of gainful employment and concept of subjective well-being, a conceptual paper has been developed to establish the role of variables of positive psychology on the extrinsic and intrinsic motivation components which creates positive environment in an organization. This paper is aimed to develop an explanatory model of sustainable behavior instigated by situational and dispositional positive antecedents and maintained by positive psychological consequences. In conclusion, this paper discusses the effect of positive psychology of sustainability and its impact on other social sciences dealing with sustainability issues.

Keywords

Sustainable development • Positive psychology • Organizational well-being • Psychology of sustainability

1 Introduction

According to Sigmund Freud, a healthy life can be described as where a person has the ability to love and work. After the statement given by Freud, psychology literature reinforced the significance of positive interpersonal relationships and employment. This was given a term as gainful employment (Synder, Lopez, & Pedrotti, 2011). However, the twenty-first century on a whole can be defined as complex, hastening, changing speedily and so the workforce is insecure, economically unstable, and in ongoing turbulence. This situation is leading to a challenging and risky environment for the well-being of individuals and organizations. As many people get up only to dread getting up and going to work it creates the opportunity for a new research area and intervention, specifically the psychology of sustainability. This gives support to the sustainable development for well-being in organizations (Tetrick & Peiro, 2012; Di Fabio, 2016a, 2017; Peiro, 2017).

The 17 sustainable development goals of the United Nations focused on: no poverty, no hunger, good health and well-being, quality education, gender equality, clean water and sanitation, clean and affordable energy, decent work and economic growth, industry, innovation and infrastructure growth, reduction in inequality, sustainable cities and communities, responsible consumption and production, climate action, life below water, life on land, peace, justice and strong institutions, and partnerships to achieve the goals. In these, goal eight is focused on decent work and economic growth; this also emphasizes the point of promoting safe and secure working environments for employees. The aim of decent work and economic growth is to enhance the

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opportunities for employees to ensure sustainable development and global growth. The progress of communities can be determined by providing safe and secure working environment which can lead to the well-being of an organization. Hence, from an organization's point of view, it becomes important to ensure social, mental, and physical well-being of employees to support the goal of decent work and economic growth.

The goals of an organization to maintain well-being and sustainable development can be achieved by introducing positive psychology concepts in the work environment. The aim of positive psychology is to lead to positive behavior by correcting the worst things in life (Seligman & Csikszentmihalyi, 2000). The field of positive psychology deals with subjective experiences of well-being, which improves positive individual traits such as interpersonal skills, aesthetic sensibility, future mindedness, and high talent. Gable and Haidt (2005, p. 104) comprehended that positive psychology as "the study of the conditions and processes that contribute to the flourishing or optimal functioning of people, groups and institutions". In a group context, the social values make the individual a better citizen, responsible, and a person of work ethics (Seligman & Csikszentmihalyi, 2000). Seligman and his colleagues have proposed that happiness is a central focus to psychology which can be broken down into three components: the pleasant life, the engaged life, and the meaningful life. Positive psychology through the focus of gainful employment highlights nine benefits (Synder et al., 2011, p. 418):

1. Variety in duties performed
2. A safe working environment
3. Income for the family and oneself
4. A purpose derived from providing a product or service
5. Happiness and satisfaction
6. Positive engagement and involvement
7. A sense of performing well and meeting goals
8. The companionship of and loyalty to coworkers, bosses, and companies.

These benefits motivate the employers to implement the concept of positive psychology and well-being to the work, and to accomplish the goal of sustainable development in organizations and society.

In this paper, we are going to analyze the results of studies about the psychology of organizational sustainability. Moreover, we are going to develop an explanatory model of sustainable behavior instigated by situational and dispositional positive antecedents and maintained by positive psychological consequences. Therefore, the objectives of the study are the following:

1. To study the current literature on the effect of positive psychology on positive behavior in an organization.
2. To study the current literature on the impact of positive behavior in creating positive environment in an organization.
3. To create the model of the impact of positive psychology on the well-being and sustainability of an organization.

2 Variables of Positive Psychology for Positive Behavior in Organization

The factors of positive psychology which can lay emphasis on positive behavior of employees in an organization could be positive emotions, humanity, psychological strength and virtues, fairness, positive environment, and psychological well-being. The mentioned factors could be clubbed into sustainable positive leadership and subjective well-being (Diener, 2000), with respect to employees.

2.1 Positive Emotions

As per Fredrickson, negative emotions narrow down the thought process resulting into a limited set of possible actions that might be taken during any emotion-provoking situation. As when anger or fear engulfs a person, he becomes self-focused and absorbed into his own selfish thoughts. This does not give way to think of all the possible options. This thinking may lead to negative consequences for self and organization as it will lead to tunnel vision where the focus gets limited and creative thinking gets hampered and this limited vision does not give way to come out of the problem with a positive alternative solution.

On the contrary, positive emotion opens people's thinking to a variety or array of possible actions. Fredrickson and her colleagues asked research participants to watch emotionally charged film clips (Fredrickson, 2001a) consisting of four emotions: joy, contentment, anger, and fear. After watching the clip, they were asked to imagine a situation creating similar feelings. After the feelings created by the imagined situation, they were asked to list the things they would like to perform correctly. People who were in the joy and contentment condition listed more things they would like to do right than those who were in the anger and fear condition. This supported his concept of broaden-and-build theory. "Certain discrete positive emotions—including joy, interest, contentment, pride, and love—although phenomenologically distinct, all share the ability to broaden people's momentary thought-action repertoires and build

their enduring personal resources, ranging from physical and intellectual resources to social and psychological resources" (Fredrickson, 2001b). Positive emotion enhances resilience, giving a person ability to bounce back from a stressful situation and give a sense of well-being. Myers (1992) also noted that negative emotions and unhappiness cause a person to be self-absorbed, self-centered, and focused on his own preoccupations, where happiness leads to more expansive view of the world. So, creating positive emotions in organizations enriches the environment of the organization and give it a complementary effect.

2.2 Positive and Sustainable Leadership

The psychology of sustainability to initiate organizational well-being requires the emphasis on positive and sustainable leadership along with positive emotions and subjective well-being. The supervisors providing clear job definitions and duties and support to employees foster job satisfaction and production. The managerial styles and leadership giving recognition and respect to relationships in organizations and well-being of workers are in demand from the psychology of sustainability and sustainable development (Di Fabio, 2017a, 2017b). Managers and leaders focusing on employee's strength can clearly communicate companies' goals and concisely give feedback as improvement areas leading to positive experiences for employees. Concerned and authentic supervisors encourage trust and positive emotions in the employees along with high engagement and motivation to reach shared goals. The authentic boss (Synder et al., 2011, p. 433) gives high standards and depicts integrity and honesty to employees. Modeling the behavior from the leader motivates the employees for positive teamwork and brings a variety of positive outcomes in the workplace. The positive outcomes in an organization depend a lot on the leadership being practiced within the organization. The feeling of being valued in the workplace by employers gives employees a sense of satisfaction and happiness at work. The sense of engagement, productivity, and satisfaction all seem to go together in a positive workplace. As per several works, the supervisor providing positive and sustainable leadership plays a crucial role in making positive outcomes happen.

2.3 Subjective Well-Being

Diener (2000) is a prominent researcher who studied subjective well-being (SWB). SWB states a person's level of happiness and life satisfaction. The researchers who studied SWB assessed the good life of people with the component of how much do they like their life. These measures focused on a person's cognitive and affective judgement of the satisfaction of the events around them. Studies done on happiness (Diener, 2000) clarified that material success does not impact happiness to a greater extent. Even after winning a multimillion-dollar lottery, lottery winners return to their pre-lottery level of happiness (Baumgardner & Crothers, 2015; Diener, 2000). The focus from an organization's point of view, out of many traits considered in positive psychology of SWB, one of the traits is work situation which accounts for the happiness of employees in the workplace. Hence, positive psychology is dealing with the positive experiences involved in subjective well-being as these experiences give rewarding life (Diener, Lucas, & Oishi, 2002).

3 The Benefits of Positive Variables of Positive Psychology

People behave the way they do largely because they associate positive consequences with their actions. Sustainable behaviors produce significant psychological benefits to individuals who practice it (Verdugo, 2012). The positive factors mentioned in the previous section instigate positive behavior in employees as it reinforces positive consequences. These positive behaviors give rise to two positive consequences, namely, extrinsic and intrinsic benefits.

3.1 Extrinsic and Intrinsic Consequences

Extrinsic benefits are characterized as material resources gained due to the result of some desirable action performed. External benefits, in turn, reinforce positive behavior and create a positive environment at the time it is attained.

Intrinsic consequences are the factors that instigate inner satisfaction and motivation. This has a long-lasting effect as it gives inherent gratification rather than some consequences which is subjective to end after a period. From a positive psychology of sustainability point of view, intrinsic gratification is more important, which arose from the environment of positive emotions, sustainable leadership, and subjective well-being. This is not dependent on external factors and prevents sustainable behavior from disappearing.

3.2 Job Satisfaction

It is important to consider job satisfaction and job design for sustainable organization. Job satisfaction is a consequence of positive emotional state arising due to employees' job experience, in reference to their relationship with supervisors and fellow colleagues and quality of working condition. Job satisfaction is arising due to intrinsic and extrinsic consequences of positive psychology factors.

3.3 Happiness

Happiness can be defined as a positive consequence of positive factors. People who enjoy frequent positive emotions experience few negative emotions, along with a judgement that their life is satisfying, are considered happy. If a person is happy at work, chances are that his or her overall satisfaction with life will be higher. Happiness and satisfaction factors may influence each other to produce a sense of gainful employment. For example, performing well at work accelerates the sense of satisfaction and sense of satisfaction contributes to an employees' better performance in workplace.

3.4 Engagement and Involvement

Employees' complete involvement within their work is defined as engagement whereas satisfaction is employee enthusiasm at work. Engagement occurs when employees find that their needs are being met. Engagement reflects the circumstances in which employees know what is expected of them, "know what they need to do get their work done, have opportunities to feel something significant with coworkers whom they trust, and have chances to improve and develop". The concept of engagement and satisfaction is related to commitment at work. Herrbach found that individuals experiencing a more positive effect at work were more likely to experience a higher level of effective commitment.

3.5 Safe Work Environments

Happiness at work is shared by a safe and healthy physical work environment which proves that management cares about the welfare of workers. Harter et al. (2002) perceived that safety of the workplace was one of the most robust predictors of employee satisfaction. Keeping workers physically safe and injury free leads to better physical health elsewhere.

4 A Model for Studying the Relation of Positive Psychology Factors to Sustainable Positive Behavior

The positive consequences of positive factors expressed in the previous section lead to positive environment in the organization. In a positive organization, sensibility is required to regulate and ensure sustainable development in today's uncertain and rapidly changing environment. A managerial approach of sustainable leadership that understands the importance of relationships and positive organizational contexts is the key to promote sustainable development and well-being of people in the organizations. The relation of positive behaviors to the positive consequences is attempted to be established through the model depicted in Fig. 1.

Positive psychology is an approach of explaining human functioning rather than explaining why the behavior occurs. Through this model an attempt is made to draw a relation of positive psychological factors in the instigating positive behavior for organization. This in turn can create organization well-being and a role toward sustainable development.

Positive psychology explains the positive aspects of people's personality and relates positive experiences to positive behavior. The gap of relating sustainable behavior and actions of humans to the positive stimulus in the workplace requires a conceptual framework. Several models are required to support this relation of positive psychology, so that future studies can study these sustainable behavior factors and the workplace can utilize these factors to enhance well-being of employees.

As per the introductory nature of this paper, a sketch of the model is presented in Fig. 1 to understand the relationship of positive psychology as compared to positive behavior. The positive psychology behaviors of positive emotions, sustainable leadership, and subjective well-being support the positive behavior consequences of happiness, job engagement, safe working environment, and psychological well-being in the workplace. This paper emphasizes the need for positive reinforcement to create positive environment in the workplace by creating positive emotions and emphasizing on sustainable leadership and subjective well-being in the organization. The sustainable factors produce positive consequences of intrinsic (satisfaction, self-esteem, belongingness) and extrinsic (material gains, social reinforcement) motivation which leads to inner satisfaction of employees and psychological well-being. The psychological benefits influence pro-environmental factors, like extrinsic consequences of social recognition and monetary rewards stimulate sustainable practices, feelings of happiness, well-being, and intrinsic consequences emerging from sustainable behavior enhances the inner strength and virtue toward pro-social and pro-environmental behaviors. This is a "positive model" that depicts a simple relation without emphasizing the interrelation of each factor. If covariance of sequence flow is to be analyzed, both the positive and negative factors affecting sustainable behavior will have to be emphasized. For further study, the relations could be drawn by keeping sub-factors as a part of study.

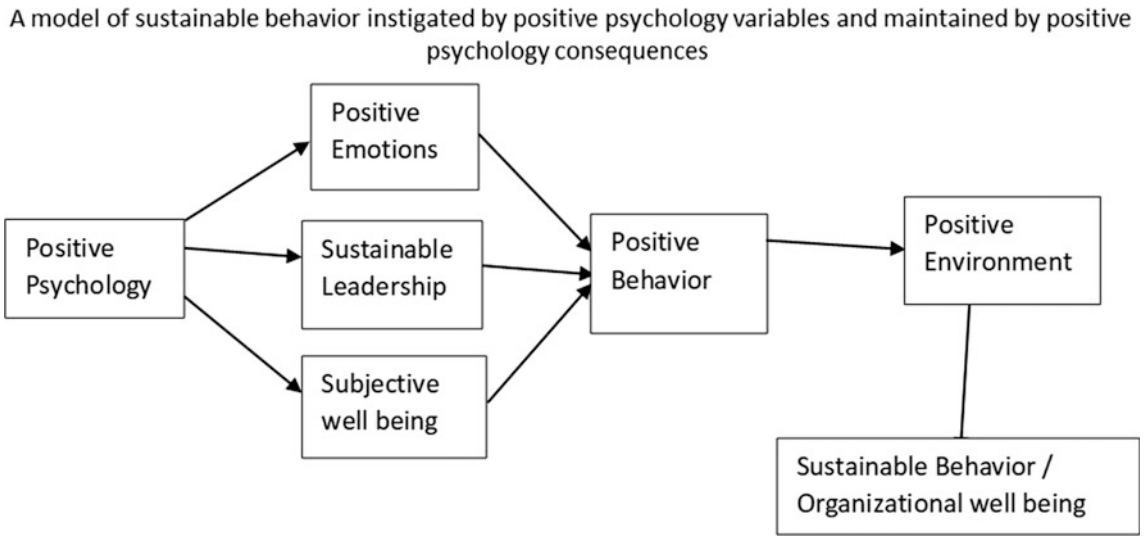

Fig. 1 Proposed model workflow

5 Conclusion

Although several studies are quoted on researching positive aspects of sustainable behavior, it is still possible to find the correlation of positive variables to positive behavior. The psychology of sustainability and sustainable development brings awareness to the concept of organizational well-being from a unique perspective. This involves promoting organizational development and well-being from the direction of enhancing constructive relationship and positive environment in everyday workplace life.

Positive psychology is a new branch studying human behavior and experience. It contributes to the understanding of what instigates the behavior we act and shows a direction toward inspiring human well-being and the growth of human potential needed for healthy atmosphere. It aims at improving the quality of life of people and the environment. Through the concept of gainful employment of positive psychology, Henry (2004) cited by Snyder, Lopez, and Pedrotti (2011, p. 424), described, "The centrality of work to well-being is not surprising when you think of the number of benefits it offers, notably: an identity, opportunities for social interaction and support, purpose, time filling, engaging challenges, and possibilities for status apart from the provision of income". The positive consequences of intrinsic and extrinsic motivation have been derived from this concept of the benefits of positive psychology. The model described in this paper is supported by the thoughts of several psychologists, the relationship of happy worker and effective and efficient work performance is given by Herzberg (1966), cited by Snyder, Lopez, and Pedrotti (2011) similarly, career self-efficacy, which is defined as the personal confidence in one's capacity to handle career development and work-related goal activities has been related to both success and satisfaction in the workplace. Workers from the very highest organizational status to the lowest can perceive their work as a calling, which gives them passion and commitment (Wrzesniewski, Cauley, Rozin, & Schwartz, 1997). The focus of this research is fulfilled by introducing a positive model to enhance sustainable organizational culture through positive psychology. New researches and interventions are needed to better explore and understand these relations in depth. Furthermore, future directions can also consider analyzing the factors through factor analysis and correlation method and can help to prove the relation between the independent variable of positive psychology and consequences producing positive and sustainable environment. Hence, in the future I will be conducting research to analyze the probability of the model to function in a manner stated in this paper.

The positive psychology of organizational sustainability is an adaptive response to develop well-being in organizations that need to cope with the challenges of complex, hastening and rapidly changing work environments of the twenty-first century. Instead of focusing on extremely negative emotions from a conservationist attitude, the need is to move toward the optimistic aspect of positive psychology and gainful employment.

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Sustainability and Financing Project: The UAE Paradigm

Pythagoras Petratos

Achieving equality, sustainability and growth together is possible but needs proactive far-sighted leadership
—World Economic Forum, Global Competitiveness Report 2018.

Abstract

The importance of project finance as a method to invest in infrastructure and industrial assets has grown dramatically in the recent years and has become increasingly important not only to public bodies, but primarily to the private sector (Eisenbach et al. in Business Strategy and the Environment 23:375–394, 2014). These trends are expected to continue to grow and one of the major issues within the project finance industry are environmental and social risks (Esty and Sesia in An overview of project finance and infrastructure finance-2009 update. Harvard Business School Publishing, 2010). Project finance industry is increasingly concerned with the volume and awareness of sustainable development (Eisenbach et al. in Business Strategy and the Environment 23:375–394, 2014). Sustainability is becoming a key issue because of its ethical dimensions as well as risk management, firm value and performance. United Arab Emirates (UAE) can be considered a global leader in sustainability. In has actively displayed its commitment by placing sustainable environment and infrastructure as one of its top national priorities in UAE Vision 2021. The purpose of this paper is to mainly present the policies and initiatives that created this unique UAE paradigm. Moreover, the paper examines how sustainability was successfully implemented in UAE's financed infrastructure at various industries (i.e., smart cities, tourism, sports, etc.) and the added value it produces.

Keywords

Alternative finance • Project finance • Sustainability • Infrastructure • Risks • Leadership • UAE

1 Introduction

UAE's history and nation building has been forged by infrastructure investment and development. UAE's is home to some of the most distinguishable and impressive infrastructures in the world. Infrastructure is an important pillar of competitiveness, environmental sustainability and sustainable economic growth. It is transformed by global trends and the Fourth Industrial Revolution (4IR). The development of smart cities, an important part of UAE's policy, is a demonstration of this integration and emerging trends. The integration of new technologies with infrastructure creates new opportunities and challenges. We examine some of these opportunities and challenges.

The purpose of this paper is to answer the research question if the UAE is a global unique paradigm. We assess it mainly in the context of sustainability, both environmentally and economically. The UAE has displayed significant global leadership and vision regarding infrastructure. First, we briefly present global infrastructure trends and the importance of infrastructure. Then we also shortly discuss the significance of UAE policies in infrastructure development. The main discussion concerns a description of different types of infrastructure, transportation, tourist and sport, real estate and free zones and general public infrastructure. We highlight their unique characteristics and find evidence that the UAE is a unique global paradigm regarding infrastructure.

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The uniqueness of the UAE project financing and infrastructure paradigm lies on the diversity of infrastructures, supporting a sustainable economy, innovation, important environmental standards and initiatives, as well as a range of specialized free economic zones. There is vertical and horizontal integration across infrastructure projects, creating value, enhancing a diversified economy and sustainability. Some of the infrastructure is top ranked globally. The UAE also displays a remarkable vision and leadership in policy making and supporting infrastructure development and sustainability. All these reinforce the hypothesis that UAE is a unique paradigm.

This paper serves a dual purpose. It fills the research gap in the literature on infrastructure in the UAE. It can be also used as an initial case study on the UAE's infrastructure development. The methodology that we follow is focusing on the UAE and its distinctiveness. This is because there are not any appropriate comparisons. Other countries do not match the size and characteristics of the UAE. Countries like Singapore and Hong Kong that might have been considered comparable, have not based their development on oil, their economic and geopolitical narrative is different, and most importantly, concerning infrastructure they do not have the range of specialized economic zones as the UAE.

2 Significance of the Study

Infrastructure investment and development occupies a large part of UAE's history. Surprisingly the related literature can be considered quite limited, especially regarding financing. We contribute to the literature by providing an overview of major types of infrastructure in the UAE. Unique features of infrastructure are presented and analyzed. This paper can be used for research purposes and facilitate future research in relation to the UAE. At the same time, it emphasizes important policies, as Specialized Free Economic Zones and their significance to the economy and sustainability. It also highlights opportunities and challenges, as the development of smart cities and the impact of global and technological trends on infrastructure.

3 Global Infrastructure Trends

The World Economic Forum Global Competitiveness Report has introduced a new version of its Global Competitiveness Index, 4.0. The new index comes partly as a response to the Fourth Industrial Revolution (4IR). It emphasizes, based on worldwide consensus, the need for a holistic approach that combines and integrates well-established aspects with new and emerging factors of competitiveness (Schwab 2018). Infrastructure is a well-established, fundamental pillar of the enabling environment and driver of productivity. At the same time, infrastructure can be combined with numerous other pillars. Almost all the other 12 pillars are in a manner enabled by infrastructure.

Infrastructure is also transformed by the Fourth Industrial Revolution. Modern infrastructure is not only brick and mortar. Infrastructure is increasingly integrating innovative technologies. While the infrastructure and urban development industry (IU) has not kept up with digital technologies, there are future scenarios anticipating the effect on global megatrends on transformation of the industry, including the adoption of advanced technologies at scale, and the use of data and digital models (Schwab 2018). Smart infrastructure and smart cities are the most illustrative example. Smart infrastructure is about transforming cities to smart cities through digital technologies. "A smart city uses information and communications technology (ICT) to enhance its livability, workability and sustainability" (Berst and Logsdon 2016). "Smart cities put data and digital technology to work with the goal of improving the quality of life…In particular, smart technologies change the nature and economics of infrastructure" (McKinsey Global Institute 2018). There is no universally agreed smart city definition and it can mean different things to different people and it varies across countries (Government of India 2018). However, it can be widely accepted that it involves the applications of new technologies belonging to the Fourth Industrial Revolution.

In that sense, infrastructure is closely related to another important pillar, innovation capability. Without innovation capability, the infrastructure is going to remain backward looking and eventually become obsolete. Similarly, additional pillar, notably macroeconomic stability and the financial system, is essential in order to support and promote change and sustainable development. Financial innovation is also essential in order to find pioneering ways to both finance infrastructure and sustain it. Many international organizations have highlighted the infrastructure and infrastructure investment gaps (OECD 2018). The influence of the Fourth Industrial Revolution is likely to accelerate and widen this gap. More investment would be necessary to keep up with the pace of technological transformation and impact on infrastructure. In addition, climate change and the scenario of low carbon future could further increase these gaps (Mirabile et al. 2017). The world is entering a new phase and emerging challenges arise. An important challenge is financing sustainable and smart infrastructure.

4 UAE Policy and Infrastructure

The UAE has a vision to support and encourage infrastructure and sustainability. Vision 2021 promotes "sustainable development and infrastructure" and "highlights the

importance of infrastructure and aims for the UAE to be among the best in the world in the quality of airports, ports, road infrastructure, and electricity. And leading telecommunications infrastructure will allow the UAE to become a forerunner in the provision of Smart services" (UAE Vision 2021 2018). A Smart and Sustainable City is a key theme in Dubai's 2021 Strategy Plan. It focuses on developing "fully connected and integrated infrastructure", promoting sustainability in managing and consumption (His Highness Sheikh Hamdan bin Mohammed bin Rashid Al Maktoum 2018). It is related to the Dubai Strategic Plan 2015 (DSP 2015), which drove major investments in infrastructure (Government of Dubai 2018). Abu Dhabi Economic Vision 2030 focuses on four key priorities areas. Infrastructure development and environmental sustainability is a priority area and "Develop a Sufficient and Resilient Infrastructure Capable of Supporting Anticipated Economic Growth" is an ongoing policy focus (Goverment of Abu Dhadi 2008). To sum up, the UAE is actively pursuing infrastructure development with emphasis on sustainability, quality, and economic growth.

5 Infrastructure in UAE

5.1 History

The UAE has a long and distinguished leadership and tradition in infrastructure. Its history and evolution have been defined, to a large extent, by infrastructure. It can be argued that Dubai has defined its global prominence based on building an enabling business environment through infrastructure. The discovery of oil was not only producing revenues to finance infrastructure projects. Oil exploration and energy infrastructure was accompanied by the development of commercial and transportation infrastructure. Most importantly, investment in infrastructure might be an effective method to obtain significant returns in diverse industries, diversify risk and increase resilience. The UAE has significantly diversified its economy by investing in different types of infrastructure. At the same time, it has strengthened other competitiveness pillars as macroeconomic stability and business dynamism. Economic development and infrastructure seem to have a symbiotic relationship in UAE.

5.2 Port and Airport Infrastructure

Port Rashid and Jebel Ali ports are often quoted as examples of vision and leadership. The latter was developed in a period of uncertainty and it displayed a remarkable degree of proactive far sightedness. The recent mega project of Khalifa port displays the continuing commitment of the UAE in port infrastructure investment. Ports have been a business enabler for the UAE to become an important trading hub. In addition, it enabled UAE corporations to expand worldwide. Notably DP World became one of the biggest global port operators. In a similar manner, the project financing of airport infrastructure has demonstrated significant growth.

The Dubai International Airport (DXB) did reach the first position in passengers in 2014 and since then it has remained among the top airports in the world. From approximately 9 million passengers in 1997 it has reached around 90 million in 2017 (Airports Council International 2018). This tenfold increase in 20 years was supported by substantial infrastructure investment. The development of infrastructure has provided the opportunity to The Emirates Group to rapidly expand globally. Emirates Airlines and Emirates Skycargo are some of the companies of the group and among the largest airlines and cargo airlines, respectively. The Abu Dhabi International Airport and Etihad are also expanding fast. Another airport, the Al Maktoum International Airport was recently developed, once again demonstrating the government's intentions to invest in large-scale projects.

What is important in both port and airport infrastructure is that they enhance access and economic activity. It has been found that airport infrastructure does not only diversify the economy, but it also contributes significantly to manufacturing, wholesale and retail, construction, hotels and restaurants and other social and personal services (Oxford Economics 2014). The three biggest Emirates, Abu Dhabi, Dubai, and Sharjah had more than 21 million tourists in 2016 and this number follow increasing trends. Without airport and associated development of airlines, this would have been very difficult to achieve. Travel and tourism combined contribute approximately 12% of GDP (UAE Government 2018a).

5.3 Tourism and Cultural Infrastructure

Tourism is a key economic driver of UAE economy. It is enabled by sustainable and top-quality infrastructure, which attracts tourists with high purchasing power. Dubai tops the list of the global destination cities with average spending by day of $537 (Mastercard 2018). Paris is in the second position with $301. Abu Dhabi is the fastest growing tourist city in the Middle East and Africa, with an annual growth rate of 18.21% between 2009 and 2017 in visitor arrivals, making it among the top 10 cities in international arrivals growth (Haine 2018). The quality and value-added of infrastructure and tourism in the UAE attracts this spending. The UAE is home to one of the best tourism infrastructures in the word. Burj al Arab is one if not the most luxurious hotel in the world. Additionally, Dubai has the highest number of tallest hotel buildings in the world—seven out of

10 (Abbas 2018a). Emirates Palace was one of the most expensive hotels to construct.

The Department of Culture and Tourism supports the sustainable tourism development of the country. The government has launched and is implementing the "green" tourism and hotel initiatives as well as environment-related exhibitions and conferences. "Through our licensing procedures, we are able enforce the highest international standards toward the classification of organizations that contribute to our growing tourism industry, improving infrastructure and promoting competitiveness" (Department of Culture and Tourism 2018). The tourism industry and related government policies further reinforce standards for infrastructure quality and sustainability. An exemplary cultural infrastructure adds value to tourism and other infrastructure. The Sheikh Zayed Grand Mosque is a unique contribution to Islamic art one of the largest and most impressive Mosques in the world. Abu Dhabi has museums on Saadiyat Island, including Louvre Abu Dhabi, Zayed National Museum and Guggenheim Abu Dhabi, also present unique architectural features and quality. The Etihad Museum, the Frame in Dubai, the Sharjah Museum of Islamic Art and Al Noor Mosque the Sheikh Zayed Palace Museum in Al Ain and the Ajman Museum are landmarks that add value to tourism and infrastructure.

5.4 Sport Infrastructure

The UAE has some of the most valuable real estate projects in the world. Except tourism and cultural projects, the UAE has financed many sport projects. The Yas Marina Circuit is considered one of the most technological advanced circuits in the world and the most expensive to build and sold to the Abu Dhabi government for $1.32 billion (Connoly 2018). The Yas Marina Circuit is very interesting from various perspectives. First, it is one of the most sophisticated construction projects. A large part of its sophistication lies on the sustainable development. It was a major challenge to preserve wildlife safe, like gazelles and ostriches, while building the track and surrounding facilities. There was additional sustainable development in the form of flora. Notably, a two square kilometers forest was built to preserve the natural environment on the western shores of Yas Island (Lewis 2009). Another valuable feature of the Yas Marina Circuit is that it is a broader project. It adds value by developing community engagement in health and fitness. This is an expansion on the sport activity dimension. On another dimension, Yas Marina Circuit operates the Yas Conference Center for business events, Yas Central, a hub for retail offerings and consumer experiences (Yas Marina Circuit 2018). Sports infrastructure in this occasion has become a central hub for other sports and numerous other business activities.

The UAE hosts several major international tournaments and accordingly it has invested in state-of-the-art faculties. It provides the best facilities in cricket, football stadiums, equestrian clubs, tennis courts, racetracks and circuits (UAE Government 2018b). Some of the sports infrastructure includes in equestrian sports, the Abu Dhabi Equestrian Club, the Dubai Polo & Equestrian Club, Sharjah Equestrian & Racing Club; in Marine sports the Abu Dhabi Sailing & Yacht Club, the Dubai Marina Yacht Club; in Golf, the Dubai Creek Golf and Yacht Club, the Emirates Golf Club, Jumeirah Golf Estates. These facilities are of top quality with international reputation. Godolphin stables and the Meydan racecourse are also examples of excellence and leadership.

"The [Meydan] project is the culmination of his [His Highness Sheikh Mohammed Bin Rashid Al Maktoum] vision to create not just a venue for horseracing, but an integrated city that is sustainable, environmentally responsible and one that positions Dubai at the centre of the competitive global business stage… link the world with the Emirate of Dubai through international horseracing and equestrian events, a range of commercial developments, hospitality, sports, entertainment and amusement services, a series of state-of-the-art business parks, residential villa communities, schools, hospitals, business towers with luxury waterfront developments and shopping destinations. The centrally located Meydan Free Zone offers a prime location and ease of incorporation…The portfolio consists of The Meydan Hotel, Bab Al Shams Desert Resort & Spa, The Track Meydan Golf, QUBE Sports Lounge, Meydan Tennis Academy, Dubai Equestrian Club, Emirates Equestrian Centre, Dubai Racing Club and the iconic architectural marvel, Meydan Racecourse, home of the world's richest horse race—the Dubai World Cup… remarkable amenities and facilities including the 711 m tall Dubai One Tower, Meydan One Mall, a five-star hotel, a civic plaza with dancing water fountains, an indoor sports facility, a 4 km canal and a marina" (Meydan 2018).

Meydan racecourse shares similarities with the Yas Marina Circuit. Both were developed as part of bigger projects. The Yas Marina Circuit is part of a complex leisure destination project with an estimated cost of $36 billion, including the Ferrari World, Warner Bros theme parks, the Yas Mall, Yas Waterworld, Yas Beach, Yas Marina, du Arena and Forum and many hotels, restaurants and planned residential and commercial projects (Connoly 2018). The broader project supported sustainability. It also created new standards for sustainable development. More specifically, the Yas Mall project was to gain a Two Pearl score from energy rating system, Estidama ("sustainability" in Arabic), the Abu Dhabi Urban Planning Council's (UPC) version of

the USA's LEED (Leadership in Energy and Environmental Design) sustainability ratings (Raven 2014).

5.5 Real Estate Infrastructure

The UAE is a prime global real estate market. It has the landmark Burj Khalifa, by far the tallest building in the world. The artificial islands of the Palms and World are unique. The construction and financing of such megaprojects displays the technical sophistication, as well as sustainability in financing and business. These projects include numerous project options. Burj Khalifa is next to the Dubai Mall, one of the biggest shopping malls in the world, with various luxury shops and restaurants. The area around Burj Khalifa is constantly developed with high quality commercial and residential projects. Luxurious hotels, shops and restaurants and residential property has been and is still developing in the Palms.

The other, many other mega infrastructure projects whereas the Expo 2020 is the main driving force. Construction will continue to be robust in the next two-and-a-half years with a total value of major Expo-related construction projects reaching Dh 156 billion ($42.5 billion) by the end of March 31, 2018, with Dh 63.8 billion spent on infrastructure and transport, Dh 48.4 billion on commercial and residential projects and Dh 40.37 billion on leisure and hospitality impacting both public and private sectors (Abbas 2018b). Again, we observe a nexus of projects being developed simultaneously, with the real estate commercial and residential sectors playing a key role in investments. Expo 2020 is a development driver, but real estate activity would likely to continue with Al Maktoum International Airport, a center-piece of Dubai South and in general Dubai, as another example of an integrated and sustainable city (Abbas 2018b).[1] Most importantly, private investors are interested in real estate and tourism projects based on the long-term potential, which might not be directly linked to Expo 2020, but expands the vision beyond this project and date (Abbas 2018b).[2] The reputation of Dubai and the UAE as a long-term real estate prime markets support investment and future activity.

The UAE features some of the largest and most sophisticated construction and development companies. Aldar properties, Emaar properties, Damac properties, and Nakheel are some of the most important property developers responsible for some of most valuable projects in the UAE. The real estate infrastructure and development is responsible for more jobs and related business activity. The UAE is a global leader and remains first in GCC for construction (Issac 2018). Construction and building accounted for 10.3% and real estate activities 6.9% of GDP of UAE in 2016 (United Arab Emirates 2017a). Real estate development in total contributed 17.2% surpassing even than extractive industries (including Crude Oil and Natural Gas) at 16.7%. Real estate development is the biggest contributor to the UAE economy and the leading indicator that the UAE is achieving its endeavor for a post-oil diversified economy.

Sustainability and innovation are at the heart of real estate development. Masdar City in Abu Dhabi is an effort to develop the world's most sustainable eco-city. With smart investments, Masdar City is successfully pioneering a "greenprint", how cities can achieve rapid urbanization and at the same time dramatically reduce energy, water and waste (Masdar City 2018). A 10-megawatt solar photovoltaic plant and building-mounted solar panels substantially reduce the need for fossil fuels energy. At the same time, Masdar is another case of an integrated sustainable city with a mix of educational and recreational, housing, retail, manufacturing and office spaces (Masdar City 2018). Masdar city is also a free zone.

5.6 Free Zones

The UAE is a pioneer and leader in free economic zones. The free economic zones are not only examples of infrastructure development, but most importantly commercial activity. A valuable distinct characteristic of UAE's free zones is that they are rather specialized, and they can function as effective business clusters. Free economic zones can have multiple benefits. They can attract FDI and consequently generate significant returns. Jebel Ali Free Zone can be viewed as an extension of the port infrastructure. It is an addition enabled by previous infrastructure. It adds to the value chain of trade and economic activity in the UAE. The Abu Dhabi Global Markets and the Dubai International Financial Center (DIFC) and associated infrastructure have assisted the UAE and the respective cities to become highly ranked global financial centers. The example of Meydan Free zone was also mentioned as part of a broader integrated sustainable project. Although the model of free zones is not exclusive to the UAE, no taxes (exception of VAT) and a broad infrastructure investment makes them exceptional.

5.7 General Public Infrastructure

These projects were complemented by essential infrastructure as energy, water/sanitation and roads. In the 2018 Global Competitiveness report UAE ranks 1st in electrification rate, 7th in the efficiency of air transport services, 9th

[1]Quotes by Avin Gidwani, CEO, BNC Network.
[2]See footnote 1.

in the quality of roads and in general 15th in infrastructure globally (Schwab 2018). Concerning energy, the UAE develops sustainable infrastructure for renewable energy and is undergoing a transformation for the diversification of its energy mix (UAE Government 2018c). It is the first Gulf country with a new energy strategy, involving the nuclear power and solar energy, except natural gas (UAE Government 2018d). Regarding transportation and roads, the UAE "continues to construct and maintain roads in accordance with international standards, using the best technology that fits the country's environmental conditions. The roads projects aim to improve efficiency of traffic and connect parts of the country with a modern road network" (UAE Government 2018c).

The UAE has established the Ministry of Infrastructure Development, dedicated to infrastructure projects. Its vision is "A sustainable and integrated infrastructure that supports the country's global competitiveness" and it is strategically aligned to Emirates Vision 2021 and 2071 (United Arab Emirates 2017b). The Ministry of Infrastructure Development's Strategic Plan 2017–2021 has identified sustainability as a key priority. This is reflected in strategic goals 2 and 3, "Manage Federal infrastructure projects in order to achieve balanced and sustainable development in accordance with the best international standards" and "Enhance the efficiency and effectiveness of federal infrastructure assets to maintain sustainability" while one fifth of its strategic objectives and effort concerns "Sustainability & assets management" (United Arab Emirates 2017b). All these activities display a solid commitment to project financing and infrastructure development.

The Ministry of Climate Change and the Environment, with the vision of "Environmental Pioneering for Sustainable Development" work with partners and further strengthen sustainability (United Arab Emirates 2018). Other government agencies Ministry of Energy & Industry (MoEI), General Civil Aviation Authority (GCAA) Federal Transport Authority—Land & Maritime (FTA), Federal Electricity & Water Authority (FEWA), Telecommunications Regulatory Authority (TRA), Sheikh Zayed Housing Programme (SZHP), Emirates Post Group, Federal Competitiveness and Statistics Authority and local municipalities are also involved and support sustainable infrastructure development.

6 Conclusions: The UAE Unique Paradigm

The UAE's infrastructure and real estate market presents some unique characteristics. A key characteristic is the UAE leadership. Its Vison 2021 and beyond, as well as numerous associated initiatives to create Smart and Sustainable Cities and Communities, display the strong commitment of the government to sustainable infrastructure development. These initiatives are soundly supported by significant government investment. In addition, the UAE government has established an institutional framework, another pillar of competitiveness, to support and strengthen the development of sustainable infrastructure. In that sense the government has created a consistent sustainability policy and institutional framework to invest in infrastructure.

The result is that the UAE ranks highly on the infrastructure pillar of the WEF Global Competitiveness Report occupying the 15th place globally. It ranks 7th in efficiency of air transport services and 1st in electrification rate and is ranks very high on related categories. This is predominantly public infrastructure. The UAE ranks 1st in mobile-broadband subscriptions (Schwab 2018). This reveals also an expensive and resilient participation of the private sector in the development of infrastructure, namely telecommunication corporations. Telecommunications infrastructure is crucial for the development of Smart and Sustainable Cites and Communities. In that sense the government policies and projects are also financed and augmented by the corporate sector. The government institutional framework is complemented and leveraged by corporations, creating a unique nexus.

Another concept that makes the UAE paradigm unique is integrated cities. Integrated cities can be viewed as urban agglomeration of diverse infrastructure projects and business clusters that synergistically create value. Illustrative examples are the Jebel Ali port with DP World and Jebel Ali Free zone with thousands of companies, and the Dubai International Airport with Emirates group, Duty Free and other companies. Yas Island with Yas Marina Circuit, hotels shops and other projects also highlights synergies. Masdar is a unique case of an integrated city based on the principles of sustainability. These mega projects encompass diverse projects with significant value. Diversification can make them resilient and sustainable. This can be considered like horizontal integration and related synergies.

Although free economic zones are not only a UAE phenomenon, their number and specialization are rather unique. Free economic zones in the UAE are quite specialized in diverse activities establishing important clusters of economic activities. Moreover, these business clusters are integrated in the cities and communities generating many synergies. Free economic zones are a main driver of Foreign Direct Investment. Financing is channeled not only to business activities per se, but to a broader range of projects like real estate and developing further infrastructure. This symbiotic relationship promotes growth. The benefits of business clusters are many. Rosenfeld (1997) emphasizes the importance of business cluster for economic development.

Clusters can be a factor for service-based tourism and regional economic development (Jackson and Murphy 2006) and improve competitiveness (Lagos and Courtis 2008). Moreover, they can encourage entrepreneurship and economic development (Rocha 2004) as well as innovation (Piperopoulos 2012). Special economic zones have been a powerful tool for attracting foreign investment, promote growth and generate employment, upgrading, encouraging regional integration, enhancing innovation, being sustainable, and protecting the environment (Farole and Akinci 2011). The UAE has successfully created free economic zones that contribute to all these challenges and more importantly actively advancing sustainability and protecting the environment.

The uniqueness of the UAE financing of projects and infrastructure paradigm lies also on the fast that there is not only vertical integration at the municipality and small city level but there exists horizontal integration among diverse municipalities at the city and metropolitan area. This creates a very diversified infrastructure and business ecosystem. The UAE is moving to the post-oil era and diversification is an important strategy to achieve that. Most importantly, infrastructure as represented by construction and building, and real estate activities has surpassed the contribution of natural resources to GDP.

Abu Dhabi and Dubai are home to some of the most expensive, top quality and technologically advanced projects. These projects are environmentally sustainable and, in addition, support business and economic sustainability. The UAE has therefore successfully diversified its economy by financing projects in infrastructure. At the same time, the UAE reduced sustainable development, environmental and social risks (Eisenbach et al. 2014; Esty and Sesia 2010. Moreover, the high policy stability that characterizes the UAE, further reduces investment risks (James and Vaaler 2018). The UAE is also continuously innovating by investing in smart cities and modern technologies. All these policies and characteristics make the UAE a unique global paradigm in infrastructure and prepare it well to face the transformations and challenges of the Fourth Industrial Revolution. The UAE is a leader in financing and infrastructure development and innovative policies can further enhance its regional and global leadership in infrastructure, digital transformation and sustainable development goals (Petratos and Petratos 2019).

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Sustainable Concrete Production Using Ceramic Waste Powder (CWP)

Ali Rostami, Meirzhan Kurtayev, and Mustafa Batikha

Abstract

It is well known that concrete material in building construction is in high demand due to its many advantages which therefore makes concrete the most essential material in construction. However, the materials used in the concrete mix have harmful effects on the earth. For instance, cement industries are the primary producer of CO_2. Likewise, the high usage of aggregate in concrete reduces the natural resources. Therefore, a replacement for the concrete ingredients starts taking a place where Ceramic Waste Powder (CWP) is one of the substitutions. In this research, CWP was used as partial replacement of cement and fine aggregate. Two percentages of replacement were considered in this study: 20 and 30%. Subsequently, an experimental work has been conducted to check the effect of this partial replacement on the mechanical properties and the cost of the new concrete products. At the end of this work, it can be observed that using CWP in concrete produces a high strength concrete with a lower cost which makes the new product green and sustainable for the future trend of sustainable cities.

Keywords

Concrete mix • Ceramic waste powder • Replacement • Sustainability • Mechanical properties • Cost

1 Introduction

Concrete material can be considered as a construction material most spread worldwide for many advantages that this material has such as high durability, less maintenance required, low-skill labor needed, and high fire resistance. Besides these characteristics, concrete has high harmful effects to the earth environment through its ingredients where cement industries are the primary producer of CO_2. Moreover, the aggregates used in the concrete bring a much yearly reduction of our natural resources. Therefore, researchers have initiated in a full or partial substitution of the concrete components with recycled materials (e.g., glass, plastic, demolition waste) in which the aim is to produce a green sustainable concrete and decrease the landfill areas. Using ceramic waste has been one of the interests of researchers where ceramic industries produce much waste regardless of the enhancements the enterprises have been introducing in the manufacturing process. It is recorded that ceramic sectors generate about 15–30% of the residues (Raval et al. 2013). It should be noted that, for example, 10,000 tons/year is an average of ceramic waste from one company in the United Arab Emirates (UAE) (Kanaan and EL-Dieb 2016). Many construction companies rule out the crushed waste from ceramic industries and deem them unfit for sale due to their mechanical and dimensional defects. Finally, the ceramic disposals remain scattered on a large land field causing an aesthetic ruin to the surrounding space. Similarly, when polishing ceramic tiles, Ceramic Waste Powder (CWP) is produced and dumped into the landfills which can result in air, soil, and ground-water pollution (Kanaan and EL-Dieb 2016). All these problems caused by CWP encourage researchers to utilize it into concrete. As an example, Kannan et al. (2017) explored the partial replacement up to 40% of cement by CWP in producing high performance concrete. Although the reduction in compressive strength was about 15% by 40% cement substitution, superior durability has been observed by very low chloride ion permeability and considerably high electrical resistivity (Kannan et al. 2017). Another case, Rashid et al. (2017) replaced partially the coarse aggregate with Ceramic Waste Aggregate (CWA) up to 30% replacement. It was an evidence that 30% CWA replacement causes an 17% increase in the compressive strength. The Fine Ceramic Aggregate (FCA) has been also utilized instead of Natural Fine Aggregate (NFA) in concrete. Siddique et al. (2018) show

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that FCA can be used up to 40% in structural concrete. For this replacement percentage, an increase of 16% and 7% was registered for the compressive strength and split tensile strength respectively. However, none of the previous studies have worked on a comparison between the fine aggregate replacement and cement replacement by ceramic waste for the same mix grade. On the other hand, other researches have mainly focused on the compressive strength regardless of other important mechanical properties such as the flexural tensile strength and the elastic modulus. Moreover, this study produces a cost value for this replacement which is so important for the market. Therefore, the current study is trying to add more emphasis toward using CWP into concrete.

2 Methodology of This Research

In this study, an experimental test has been conducted on utilizing 20 and 30% of CWP in concrete as a partial replacement of cement and fine aggregate. The high percentages of 20 and 30% were selected as most previous studies have concluded that those percentages can be used without much reduction. On the other hand, using a high percentage of cement replacement can help in decreasing the cost of the concrete mix.

The mechanical properties of the new concrete have been obtained together with the cost to check the economic behind using this substitution.

3 Experimental Procedure

3.1 Materials

Figure 1 shows all the materials used in the mixes as follows:

3.1.1 Cement

Ordinary Portland Cement (OPC) was used in this experimental research. The used Portland Cement is a product of UltraTech Cement based in UAE. This cement is Type I of Class 42.5 N.

3.1.2 Natural Coarse Aggregate (NCA)

10 and 20 mm Natural Coarse Aggregates (NCAs) are used in mixes of this experimental research. Various tests such as sieve analysis, rodded unit weight, moisture content, water absorption, abrasion value test and specific gravity were conducted using ASTM standards (Kett 2010). Results of these tests are shown in Table 1. Furthermore, the combination ratio of 10 and 20 mm coarse aggregate used in this experimental research is 1:4.

3.1.3 Natural Fine Aggregate (NFA)

Black sand fine aggregate is used in the mixes produced in this research. Tests such as sieve analysis, specific gravity, fineness modulus, moisture content, and water absorption were found according to ASTM standards (Kett 2010). Table 1 shows the properties of the used black sand. The fineness modulus is 3.27 which is more than 3. This indicates that this sand is a coarse type.

3.1.4 Recycled Ceramic Waste

The ceramic wastes used are from factory wastage based in UAE. This wastage was collected and crushed in particle sizes ranging from 4.75 mm to 0.015 mm to be applied as a partial replacement of the fine aggregate. Table 1 demonstrates the properties of the Ceramic Fine Aggregate (CFA). The CFA has less specific gravity than the Natural Fine Aggregate (NFA). Also, it is finer since the fineness modulus is much lower (2.66). On the other hand, the water absorption and the moisture content for the CFA are much higher than the NFA.

Besides CFA, Ceramic Waste Powder (CWP) from the polishing process of the ceramic tiles was used partially instead of the cement.

3.1.5 Superplasticizer

A superplasticizer was used with all mixes to confirm a high workability with the low water to cement ratio applied. The type of the superplasticizer is PC 400 by PAC Technologies based on Poly-Carboxylate Ether (PCE) polymers (PAC Technologies LLC 2018). After the 80% addition of the total water, 1.25% of the cement weight was poured during the mixing.

3.2 Mix Proportions

The concrete mix design was done using ASTM standard (Kett 2010) to comply with M40 concrete grade. M40 grade is to obtain a characteristic cylindrical compressive strength (f_{ck}) of 40 MPa and mean cylindrical strength (f_{cr}) of 49.6 MPa (Kett 2010). The mix code and the description of each mix can be found in Table 2. Also, Table 3 displays the mix proportions.

3.3 Tests on Hardened Concrete

Samples from each concrete mix described in Tables 2 and 3 were prepared and cured in water until the date of the test. Figure 2 shows the samples where cubes of 150 × 150 150 mm and cylinders of 150 mm diameter and 300 mm height were made to obtain the axial compressive strength and elastic modulus. Moreover, beam samples of

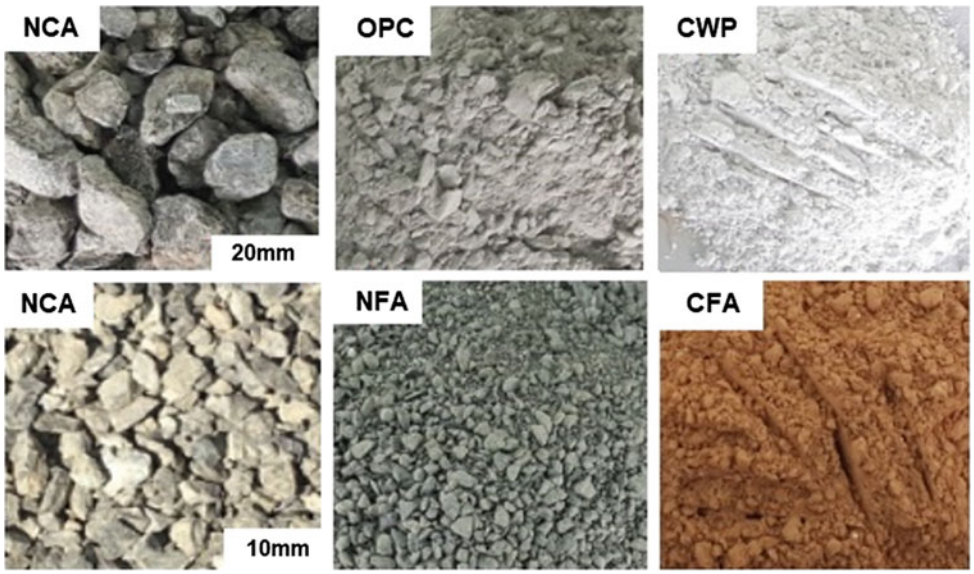

Fig. 1 The materials used in the concrete mixes (Current study)

Table 1 Properties of the aggregates used in the concrete mixes

Properties	Natural Coarse Aggregate (NCA) (20–5 mm)	Natural Fine Aggregate (NFA) (5–0.15 mm)	Ceramic Fine Aggregate (CFA) (5–0.15 mm)
Specific gravity	2.61	2.67	1.89
Fineness modulus	–	3.27	2.66
Abrasion value %	31	–	–
Water absorption %	2.8	4.17	6.56
Moisture content %	0.9	1.3	2.6
Compacted bulk density t/m^3	1.41	–	–

Table 2 Mix code and their descriptions

Mix-code	Mix description
M0	100% OPC-100% NFA-100% NCA-Water-Plasticizer
Mcc20	80% OPC-20% CWP-100% NFA-100% NCA-Water-Plasticizer
Mcc30	70% OPC-30% CWP-100% NFA-100% NCA-Water-Plasticizer
Mcfa20	100% OPC-80% NFA-20% CFA- 100% NCA-Water-Plasticizer
Mcfa30	100% OPC -70% NFA-30% CFA-100% NCA-Water-Plasticizer

Table 3 Mix proportions

Mix-code	Materials (kg or Liter/m3)							
	OPC	CWP	NCA 20 mm	NCA 10 mm	NFA	CFA	Water	Plasticizer
M0	400	–	740	250	840	–	132	5
Mcc20	320	80	740	250	840	–	132	5
Mcc30	280	120	740	250	840	–	132	5
Mcfa20	400	–	740	250	672	168	132	5
Mcfa30	400	–	740	250	588	252	132	5

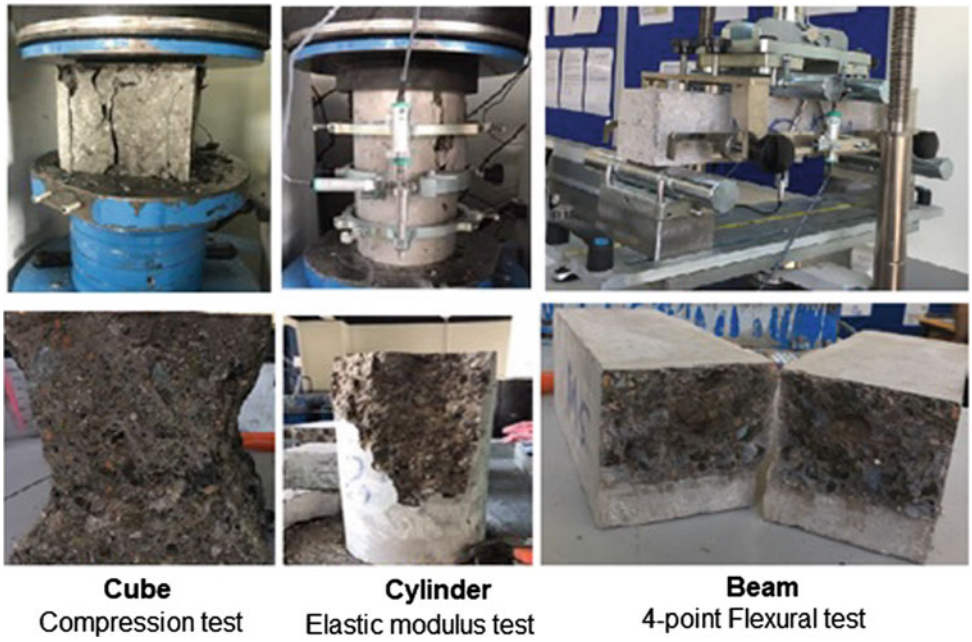

Fig. 2 Examples of tested samples (Current study)

100 × 100 mm section dimensions and 500 mm length were produced to conduct a 4-point flexural tensile test. The tests have been conducted on day 56 to avoid the delay in strength that the ceramic may cause. Figure 2 explores the samples at the time of test and the failure shape after the test done.

4 Results and Discussion

Table 4 shows a summary of the results obtained from the tests conducted on day 56 on the hardened concrete samples, where f_{cu}, f_c, E, and f_{ct} are the cube compressive strength, cylindrical compressive strength, elastic modulus, and the flexural tensile strength, respectively.

4.1 Compressive Strength

The cylindrical compressive strength (f_c) in Table 4 can be discussed via Fig. 3 where the relative percentages between the control mix (M0) and other mixes are shown. From Fig. 3, a reduction in the compressive strength was observed in a ranging from 6 to 19%. The lowest compressive strength was registered when 30% of the cement was replaced by ceramic (Mcc30), whereas the maximum compressive strength is for 20% cement replacement (Mcc20). Also, it can be shown that more CFA usage instead of the NFA provides higher strength (Mcfa30).

4.2 Elastic Modulus Test

Figure 4 illustrates the comparison between the elastic modulus of the concrete mixes (Table 4) in terms of relative percentages, where M0 is the control mix and considered as 100%. As it has come with the compressive strength, Mcc30, again, recorded the lowest elastic modulus. 20% cement replacement in Mcc20 brings 6% higher elastic modulus than Mcc30. Low elastic modulus can cause more deflection to the structural elements. However, it is worth mentioning that less cement content reduces the long-term

Table 4 Tests on the hardened concrete at 56 days

Mix-code	f_{cu} (Mpa)	f_c (Mpa)	E (Gpa)	f_{ct} (Mpa)
M0	55	47	32	4.1
Mcc20	48	44	27	3
Mcc30	45	38	25	2.9
Mcfa20	47	40	30	3.75
Mcfa30	52	42	26	3.1

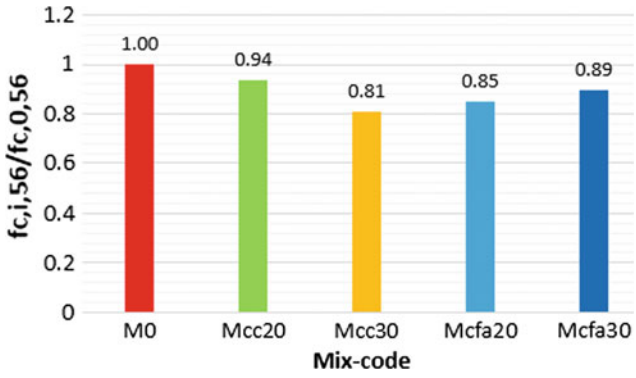

Fig. 3 The relative percentages between each mix (Mi) and the control mix (M0) regarding the cylindrical compressive strength

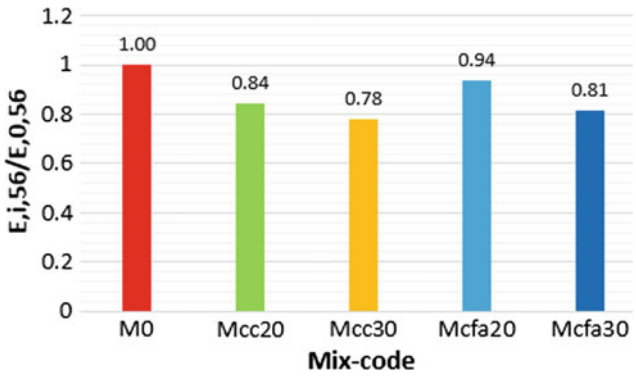

Fig. 4 The relative percentages between each mix (Mi) and the control mix (M0) regarding the Elastic Modulus

effects of concrete such as shrinkage and creep (ACI 209.2R-08 2008). This will help in reducing the deflection and make the effect of the observed reduction in the elastic modulus negligible. On the other hand, Fig. 4 demonstrates that 20% NFA replaced by CFA (Mcfa20) decreases the elastic modulus by 6% only from the one obtained by the control mix (M0). More NFA replacement leads to a lower elastic modulus (Mcfa30).

4.3 Flexural Tensile Test

From the flexural test results in Table 4, the relative differences between the control mix and other mixes were derived and displayed in Fig. 5. It is observed that the replacement of cement affects considerably the tensile strength: 27% drop by 20% cement replacement (Mcc20) and 29% reduction by 30% cement replacement (Mcc30). The lowest fall (9%) is when the 20% NFA was substituted by CFA (Mcfa20). As soon as the substitution of NFA increased, the drop is much more (Ncfa30).

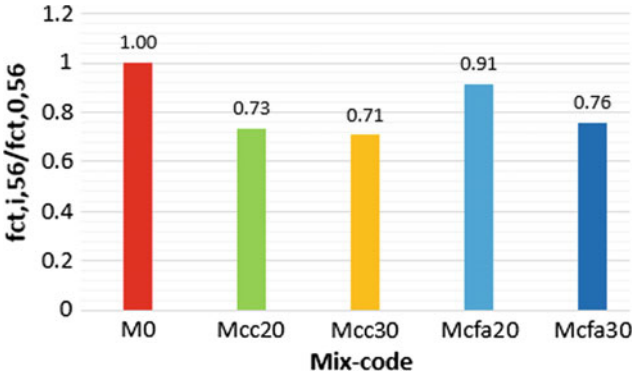

Fig. 5 The relative percentages between each mix (Mi) and the control mix (M0) regarding the flexural tensile strength

5 Cost Analysis

A cost analysis was conducted to produce all the concrete mixes in Tables 2 and 3. The unit cost of each material used to produce concrete was obtained according to the market prices in Dubai (Dubai Statistics center 2018) as shown in Table 5. Since the ceramic is not recycled in Dubai, it was assumed that its recycling costs 10% of recycling concrete demolished waste because ceramic waste is a ready-crushed material which needs only a secondary crushing and sizing. Using Table 5, the total cost of each mix can be seen in Fig. 6, where the replacement of cement plays an important role in bringing the price down. For example, the price decreases by 11% for 20% cement replacement (Mcc20), whereas the drop is 17% by 30% cement replacement (Mcc30). No noticeable decrease can be shown by substitution of the NFA (Mcfa20 and Mcfa30). Therefore, CWP being a substitute for cement is considered the most cost-efficient alternative material, thus, replacing the sand (F.A) by CWP does not give any economic benefits.

To value the benefit of each mix, the compressive strength of each mix was linked with its cost through Fig. 7. The compressive strength was chosen because it is the one that more characterizes the concrete material. For example, the tensile strength of concrete can be enhanced by installing steel reinforcement to concrete. In Fig. 7, a value index was estimated as a ratio of the cylindrical compressive strength to the mix cost. High index value indicates that the mix has high compressive strength with low cost.

Table 5 The unit price of the concrete ingredients

Material	Cement	Ceramic	NCA 20 mm	NCA 10 mm	NFA	Water	Plasticizer
Cost (DHS/kg or liter)	0.283	0.0018	0.036	0.038	0.028	0.007	6

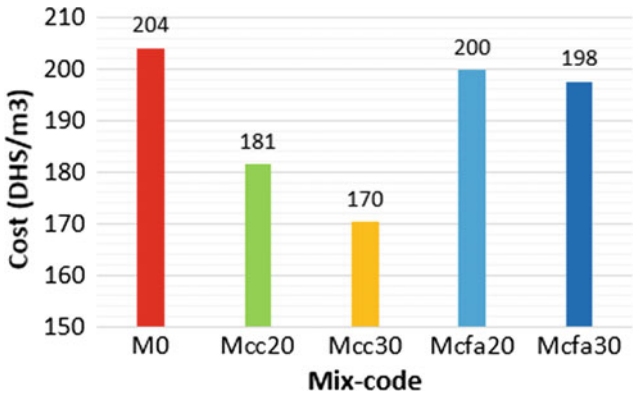

Fig. 6 The cost of the mixes in Table 2

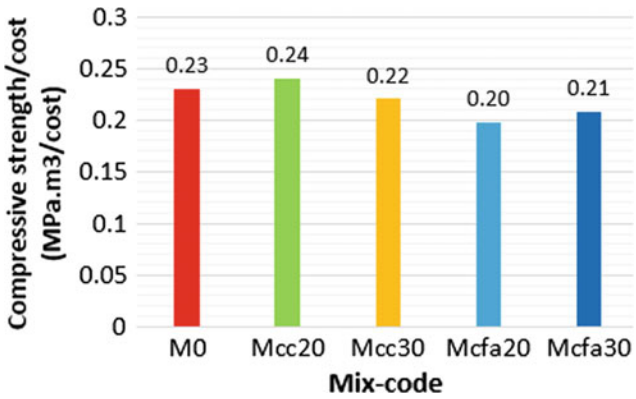

Fig. 7 Value index: ratio of the cylindrical compressive strength to the mix cost

The maximum value index (0.24) was recorded for Mcc20 as an evidence that 20% cement substitution by CWP produces a good compressive strength together with low cost. Any other choice can affect either the strength of the concrete or the cost.

6 Conclusions

Experimental tests have been conducted in this research to estimate the benefits of using ceramic waste as a replacement for both the cement and the natural fine aggregate in concrete. Two replacement percentages were utilized in this work: 20 and 30%. Then, the mechanical properties together with the cost of each mix were obtained. The results of this study can be summarized as follows:

1. The maximum replacement of cement should not be more than 20%. A further replacement can lead to low mechanical properties for the concrete mix.
2. The maximum replacement of natural fine aggregate should not be more than 20%. More replacement provides a considerable reduction in both the elastic modulus and the tensile strength. Regarding the compressive strength, a negligible enhancement was registered in using 30% of CFA.
3. The cost analysis shows that replacement the cement reduces the price of concrete. Replacement of NFA causes no noticeable reduction in price.
4. A value index was set in this study to link between the mechanical properties and the cost. Via this index, it was shown that 20% of cement replacement is the best choice to guarantee a high-quality mix with low price.

7 Future Work

This paper presents only the effect of the replacement on the mechanical properties of the concrete mix. The effect of the replacement on the long-term behavior of the concrete should be addressed in future work. Also, the CO2 emission for the new mixes with CWP should be explored.

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Technology-Assisted Student-Centered Learning for Civil Engineering Students

Chiranjeevi Rahul Rollakanti, Vikas Rao Naidu, Ram Kishore Manchiryal, and Kiran Kumar Poloju

Abstract

Advancements in technology have progressed social life as well as educational scenario over the period. Every year this scenario undergoes a significant shift, due to demand of market and increment in various challenges as per the requirement of different sets of students. Consequently, revisiting the implementation of educational technology in the teaching and learning process is extremely important. This paper highlights the impact of technology to enhance students' performance in civil engineering module, in which student-centric approach was followed. The study was conducted on civil engineering students at a private college in Muscat, Oman wherein a flipped teaching approach along with free online interactive tools is employed on most of the topics in a basic civil engineering module. A mixed method of three approaches was utilized in collecting data through various means such as questionnaires on the educational technology implemented during module delivery, records of three controlled groups based on their performance and participation in student-centric classroom activities, data and feedback analysis on students' coursework and end-of-semester assessments. Findings revealed a significant and positive impact on students' learning experience and their digital competency. The main thrust of the paper is anchored on how technology can be beneficial in providing ample learning avenues for students to improve their performance in class.

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Keywords

Educational technology • Flipped teaching • Online interactive tools • Student-centric approach • Teaching and learning

1 Introduction

Over the past few years, there has been an escalation in adapting innovative teaching methodologies in higher education sector. Recent advancements in technology, phenomenal increase in the availability of Internet, and usage of smart devices unlocked various opportunities for educators to implement student-centered teaching and learning strategies. This student-centered learning has shifted the responsibility of learning from educators to students (Babak and Hamideh 2016). Various researches in the educational field suggest that flipped teaching approach along with technology-assisted learning plays an important role in maximizing the student learning experience. Flipped teaching primarily focuses on engaging students in acquiring knowledge of new course materials outside the class usually through free online interactive tools and lecture videos. In addition, class time is best utilized in applying knowledge through group-based problem-solving activities or discussions.

To study the effectiveness of technology-assisted student-centered learning approach and to assess how technology can enhance student learning experience, authors have selected a basic civil engineering module—Introduction to Civil Engineering. This module consists of basic concepts of civil engineering and scientific principles of construction materials and their properties. The session comprises of 24 students attending college on full-time basis. Students were from different socio-economic backgrounds. Module was taught for 15 weeks (one semester) by the same instructor. Civil engineering students should not only gain professional basic knowledge but also they must

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develop innovative consciousness, logical thinking abilities toward the developments and trends in civil engineering field. Therefore, it is well needed to adopt appropriate teaching and learning methods by educators to develop student's understanding and learning capabilities. Consequently, the selected module was delivered through flipped teaching methodology along with free online interactive tools. This approach includes various types of pre-class, in-class and post-class activities.

Required lecture materials were made available to students well in advance to acquire sufficient knowledge outside the classroom. Students were instructed to attempt quizzes related to lecture resources helped the educator to assess students' understanding of the course content for the respective class. In addition to this pre-classroom activity, various interactive platforms were used to engage students with online lecture videos. These e-tools allowed educator to ask cognitive questions during the video which promoted students' interest to watch lecture videos completely. Various in-class activities were organized to enhance students' learning experience like Think, Pair, and Share which encouraged students to share their understanding of the course content in their personal voice and developed communication among students. Furthermore, brainstorming interactive activities on a certain topic were conducted in group sessions to promote teamwork and developed learning from other students. At the end of the classroom session, Kahoot and Socrative were used to assess student's wisdom on the content delivered through various pre-class and in-class activities. Periodically post-class activities like quizzes and problem-solving were given to students and especially student qualitative feedback was collected through Padlet and SurveyMonkey to evaluate the effectiveness of the practices.

To assure the validity of the data and to enhance the credibility of the current study, triangulation was implemented through a mixed method of three approaches to analyze the impact of technology on students' learning experience (see Fig. 1). The first approach included the accumulation of students' feedback through questionnaires on flipped classroom activities and technology-assisted learning. The qualitative data was recorded through online tools such as Padlet where students have given anonymous feedback. The second one was students' performance data from interactive online activities and third was students' grades from both in-semester and end-of-semester assessments. Based on students' engagement and performance in interactive flipped classroom activities, students were divided into three controlled groups. The group of students whose performance was more than 80% on an average in all online activities were considered as Group 1. Accordingly, students' performance between 50–80% as Group 2 and performance less than 50% were kept under Group 3.

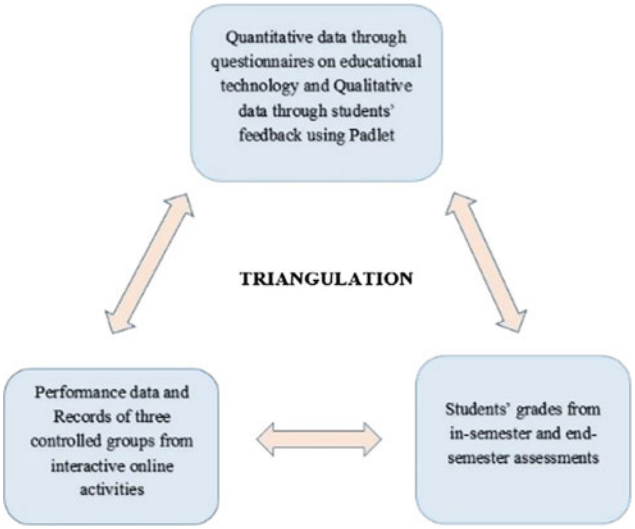

Fig. 1 Triangulation of mixed method of three approaches

2 Methodology and Implementation

Flipped teaching methodology allows to place students at the center of the learning experience (Bergmann and Sams 2013). Moreover, usage of educational technology in the teaching and learning process enhances students' understanding and learning capabilities (Chen and Denotelles 2013). Considering these researches and also in line with the institutional strategy toward teaching and learning, flipped teaching methodology was implemented with the support of in-house developed lecture videos and other resource materials. Various types of flipped classroom and problem-based group activities were organized during the class time to assess students' learning and understanding of the module content.

Apart from in-class activities, online interactive videos enhance students' learning experience and also makes learning more interactive (Marco 2010). Therefore, online interactive lecture videos have been developed through Vizia, Playposit, and TedEd. These online interactive videos supported authors to assess students' engagement with pre-classroom activities. Other free online tools like Socrative, Kahoot, Padlet, and SurveyMonkey were employed for in-class and post-class activities. Additionally, Video Pad editing tool and Screen cast-o-matic were also utilized in the teaching and learning process.

2.1 Socrative

This tool was used for some of the formative exercises during the session. It works in two modes: teacher and student modes. This provides a very effective fun-based

active session in which the teacher can organize activities such as quiz, surveys, etc. This online tool assigns a room number to the session which is displayed on the top of screen. The students are required to sign in through a student login to gain access to the session and need to enter the room number which is shared by the teacher. During the session, the teacher's screen with final output (statistics and results) was displayed on the projector screen, while students participated in these activities from their mobile devices. Instant display of student results that were dynamic made the session livelier. These results were also saved for later referral (Dakka 2015). This online tool comes in a free version as well as a pro version. In this study, to appraise students' knowledge, only the free version was used since it adequately served the purpose.

2.2 Kahoot

This is another interesting and very interactive tool. It is simple to use, yet it's very effective for basic quiz-based exercises during class sessions. In some of the sessions, Kahoot was used for brainstorming (Carolyn and Julia 2017). Again, there are two modes of operation in Kahoot, similar to Socrative. In this study, the educator has created a quiz with some revision questions about the previous class. And before starting the present class, the revision exercise was completed. Students had installed Kahoot on their mobile devices, since it is a free tool available for all platforms. This tool is very light and does not need a lot of memory. Like Socrative, the teacher's screen was displayed on the projector and the moment students joined the session (with the session code), their names started displaying on the projector screen. Once all students joined the session, the faculty initiated the quiz, and after each question they were able to see the result, as well as whether they answered it correctly. The results of the quiz can be saved for later referral. The quiz designed here did not contain many questions and the teacher made sure that this exercise ends within the first 10–15 min of the session. The only issue with this tool is that any student can join the session anonymously as they can login to the session by typing any name of their choice.

2.3 SurveyMonkey

SurveyMonkey is one of the most famous online tools, which is generally used for conducting surveys. It comes in a paid version as well as a free version. The paid version is being used by many organizations for various purposes (Retta and Donna 2009). This online tool is used for the revision exercise apart from collecting feedback at the end of a few sessions. The best part of this tool is that the outcome can be obtained in a visual format, in terms of graphs and charts, which makes the final assessment process very easy to analyze. In the current study, SurveyMonkey was used to collect students' feedback on instructional resources, flipped classroom activities, and online interactive tools.

2.4 Vizia

This is one of the most creative online tools which have put an end to the passive viewing of videos. The video-based lecture materials which are initially uploaded online and the reference materials from YouTube can be fetched through Vizia. Here the video can be stopped at any interval and a small cognitive quiz component can be inserted just to ensure that understanding of the topic has been taken place (University of Sussex 2018). Some of the videos were also shared through Vizia. Students were required to access these videos through Vizia website directly by the link shared by the educator. While viewing these videos, they were prompted for a couple of quiz-based questions every few minutes. They were not able to move further unless they attempted those questions. This online tool smartly tracks the record of the view history of students, means, how much video they have watched and how many questions they have answered correctly. Later, the entire dataset can be viewed in summary format and accordingly the educator can plan for the next activity in the class. In some cases, most of the students had failed to provide a correct answer to certain questions. In such situations, educators' intervention was required in terms of explanation of that topic again in the class through some other means, such as demonstrations and examples. Students found this way of active viewing of videos much more effective compared to conventional way of passive viewing of videos through a Learning Management System (LMS) and YouTube.

2.5 PlayPosit

PlayPosit is another tool quite similar to Vizia but with some additional options. When it comes to collaborative learning activities, this tool is really effective. This tool can be used especially for students in specified groups and is very good at tracking their progress in the learning process (Seyed Abdollah 2018). Apart from this, assessment in such collaborative activities becomes easier. In the current practice, PlayPosit was used to create a specific classroom for separate sessions allowed educators to monitor individual sessions' performance. Tracking of particular students belonging to respective sessions was helpful to monitor student engagement with pre-class activities.

2.6 Padlet

Padlet was also used in the current study as one of the revision tools. This works on the similar concept of Google Docs, where a shared page was generated online and the link was shared with students during class hours. It was especially used at the end of class, so that students can write their classroom reflections, in terms of topics they understood or feedback on the flipped classroom practices being implemented (Sangeetha 2016). Unlike Google Docs, this provides a very colorful user-interface that can be customized. The usage of Padlet was very interesting and fun as the feeds were displayed timely on the projector screen. The only issue with this tool was that students were able to type into the feeds anonymously. Hence, in certain cases, it was difficult to identify who has posted a particular feed. However, the overall experience with this tool was really affable.

2.7 *Screencast-O-Matic*

This is a screen-recorder tool which was used for recording self-lectures (Cecile and Gladson 2014). It has options to record screen actions along with video and audio through built-in camera and microphone, respectively. In the present study, it was used for recording many video-based instructional videos. Students found it helpful since they were able to connect to the educator more easily due to the spoken language and easy to understand accent. It was noticed from students' oral feedback that videos recorded through screencast-o-matic were so effective and easily understandable rather than random online videos or YouTube videos.

2.8 Videopad Video Editor

This free tool was used to edit videos, which improved the final quality of the self-recorded lecture videos (NCH Software Homepage 2019). The videos were later added with titles and credits to make it more interesting. Finally, these videos were converted to WMV format since it was required to upload these videos on the streaming server of the college. Students were able to access these videos through Moodle and found them very useful. This tool also supports subtitling and some video-based demos were added with subtitles for better understanding. Some students were also involved to provide demonstrations in Arabic, and hence making the overall experience of learning very fruitful.

3 Outcomes of the Practice

This study includes both quantitative and qualitative analysis to compare the performance of students in three controlled groups through their engagement with interactive online activities and assessment results. Data from online tools like Playposit, TedEd, Socrative, students' feedback from SurveyMonkey, and both in-semester and end-of-semester grades were analyzed to divide students into three controlled groups. Out of 24 students in the session, seven students were in Group 1 as they were pro-active and highly engaged with educational technology and flipped classroom activities. Eight students who were moderately active in this teaching and learning process were identified as Group 2. The remaining nine students in the session who fall under Group 3 were observed to be reactive and have shown minimal engagement in the technology-assisted learning process.

A comparative study has been conducted among the groups by reviewing their performance and engagement with technology-assisted student-centered learning (see Fig. 2). It demonstrates the average engagement of members in Group 1 is highly appreciable in contrast with the performance of the other two groups. The analysis clearly indicates each controlled group's engagement and performance with educational technology.

Subsequently, examining each controlled group's average engagement with in-house developed lecture videos, the following analysis has been made (see Fig. 3). Participation of the first group has been noticed as pro-active among others as 94% of the videos have been followed by students in this group. Group 2 was moderately active as only 66% of

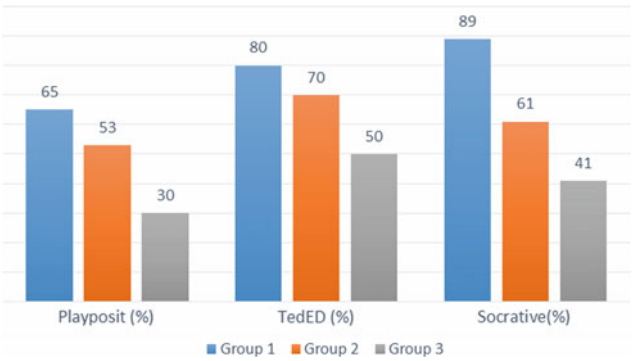

Fig. 2 Performance and engagement of three controlled groups in relation to percentage of students who followed technology-assisted learning

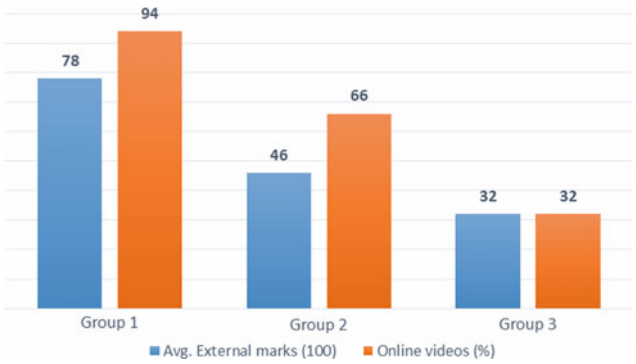

Fig. 3 Performance and engagement of three controlled groups in relation to percentage of students who followed in-house developed lecture videos and end-of-semester assessment marks

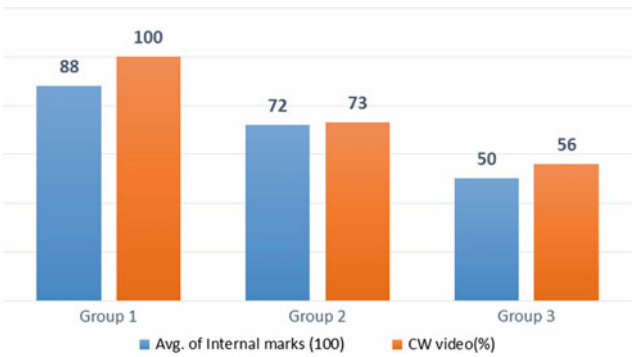

Fig. 4 Performance and engagement of three controlled groups in relation to percentage of students who followed in-semester assessment tutorial videos and course work assessment marks scored

the content has been covered by the group. Unfortunately, members in the Group 3 were able to follow only up to 32% of the videos, reflecting inactive engagement with online lecture videos. From students' feedback, it has been proved that understanding of the course content has been enhanced through online lecture videos as they had the chance to watch videos at their own pace during module delivery and preparation for end-of-semester assessment. Consequently, it is evident that students' engagement with in-house developed interactive lecture videos amplified the students' performance in end-of-semester assessment.

It was noticed from the previous semester students' feedback that the threshold to score good marks in in-semester assessments was the clear understanding of the course work tasks. However, the educator explains the assessment tasks clearly in the class but most of the students were not able to retain it further. Considering students' feedback in the present study, educators have developed self-recorded tutorial videos with detailed explanation of in-semester assessments. These tutorial videos have assisted students during their planning, preparation, and submission of their in-semester assessments.

Furthermore, students' engagement with in-semester assessment tutorial videos and its impact on students' performance in internal course work marks were scrutinized (see Fig. 4). It was perceived that Group 1 engagement was 100% with the tutorial videos and their performance in assessments was competent with an average of 88 marks out of 100. Considering Group 2 engagement with tutorial videos, it was 73% and marks are relatively less when compared with Group 1. Unsatisfactorily, Group 3 engagement with these course work tutorial videos was disappointing as it was just 56% and their performance was deficient with only 50% of internal marks.

The effectiveness of the current practice in terms of implementation of technology-assisted student-centered teaching and learning process during module delivery and the impact of technology to enhance students' performance and learning experience have been analyzed through the quantitative data (see Fig. 5). The data and results exhibit that 80.95% of the students' group agreed that various online e-tools utilized to deliver the module content has increased their learning and understanding capabilities. However, it is also evident that 90.47% of the students among all three controlled groups agreed that technology-based interactive tools amplified their learning experience.

Padlet was used to collect qualitative data on the practice, which enables students to share their true opinions anonymously (see Fig. 6). It has been identified that most of the students' response on the current study was positive. It has been noticed from the students' feedback that "The use of interactive and self-recorded videos to deliver the module content is very helpful". In addition to this, from students' oral feedback it was observed that "Usage of free online tools during pre-class, in-class, and post-class activities have developed their interest toward learning and enhanced their performance in both in and end-of-semester assessments".

4 Challenges and Limitations

According to the feedback and reflections from educators implementing these practices in their sessions, it was observed that educators should require some digital competency skills to develop self-recorded lecture videos. Furthermore, it was identified that the educator should possess self-learning skills to explore technologies available online to identify the suitable source relevant to their teaching strategies. However, the educator may find online learning resources and tutorial videos to develop resource content. From the experiences of the educators involved in the current study, the success of the technology-assisted student-centered learning may depend on various factors like module content or syllabi, demographics, and

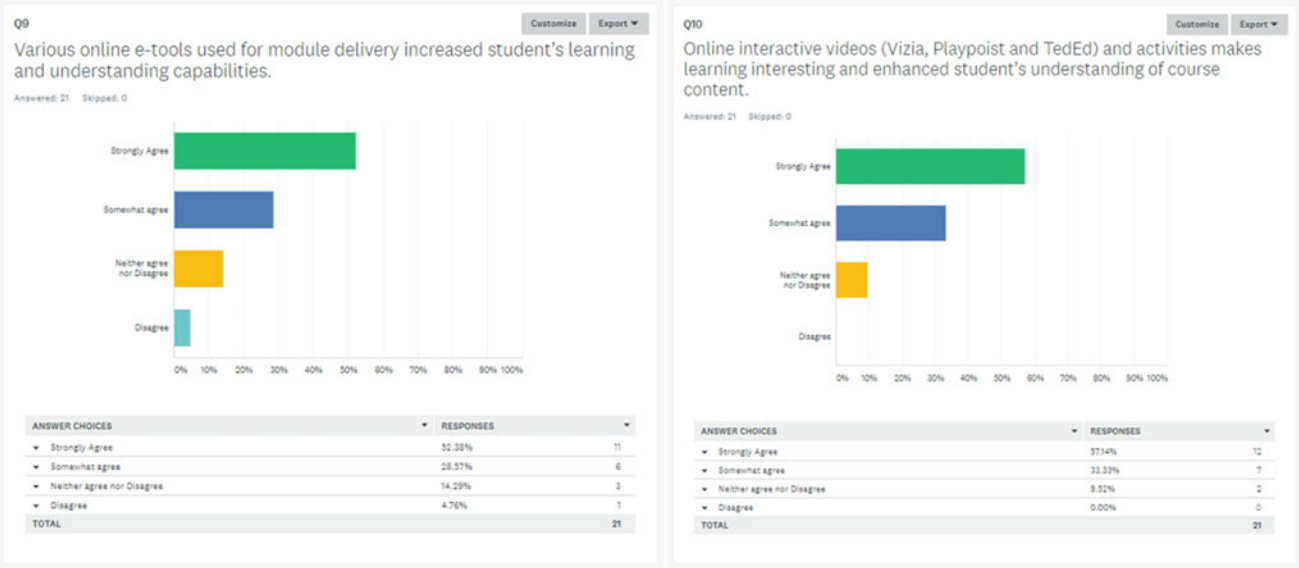

Fig. 5 Quantitative analysis of student feedback on effectiveness of technology-assisted student-centered learning

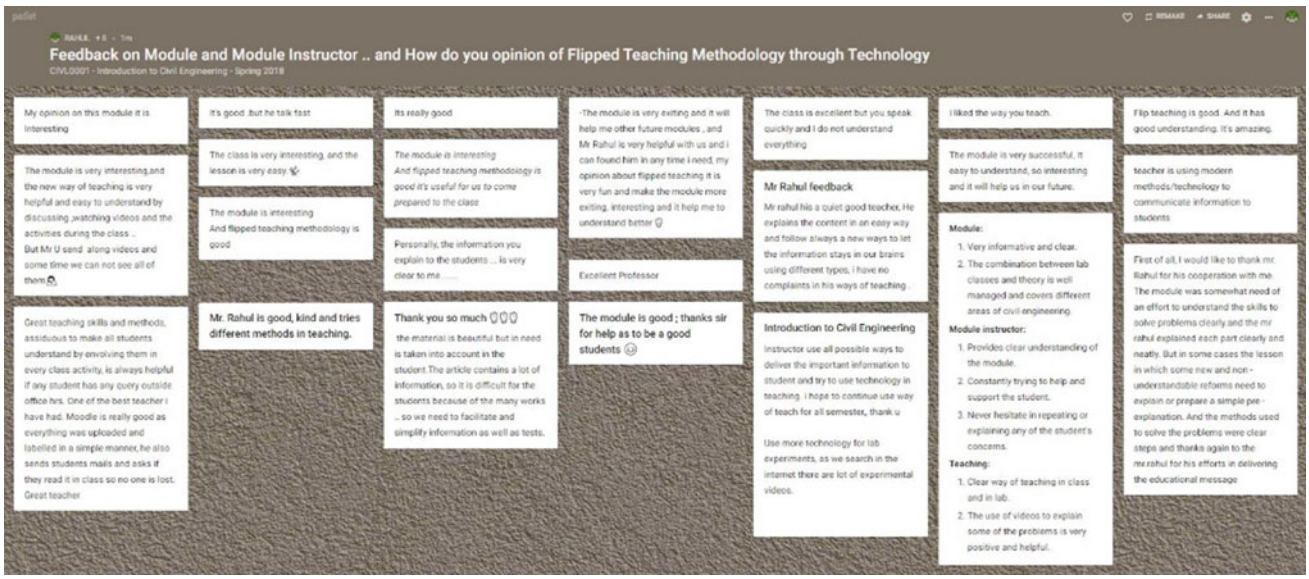

Fig. 6 Qualitative data through student feedback on implementation of flipped teaching methodology assisted by the educational technology

perceptions of students, institutional limitations and mostly based on the response from the group of students. Pertaining to three controlled groups considered for this study, the percentage of students coming prepared to flipped classroom and how educator reacts to these situations is crucial. Referring to various concerns mentioned in this study, educator should be self-motivated and required to encourage students toward student-centric activities.

5 Conclusion

The three controlled groups considered for the practice were having a lot of differences in their perceptions toward teaching and learning process. Despite these differences, students' marks and qualitative date through students' feedback revealed that the student-centered approach makes

their learning interesting and improved their understanding capabilities of the course content. These types of approaches lead to increase in number of active student participants day by day. However, according to the quantitative analysis, Group 1 has shown more interest toward technology-assisted learning and yielded good results in both in-semester and end-of-semester examinations. Other groups have reported less interest and poor efforts, respectively, toward educational technology, and consequently their performance in assessments was also disappointing.

The current practice exhibits the positive impact of the flipped teaching approach along with free access of online interactive tools. Hence, usage of educational technology in the teaching and learning process can amplify students' learning skills as well as their performance in formative and summative assessments. This research concludes that technology-assisted student-centered learning may be considered and implemented to enhance student learning experience and digital competency skills. However, before implementing it, the faculty must ensure the learning outcomes and implication of these tools to meet the requirements. Technology should be used for assistance and as a facilitator, but by the end, it is the duty of the faculty to ensure that learning outcomes are met. If the particular tool is not able to facilitate student learning, then faculty intervention must be to enhance the understanding of the subject among the students.

Acknowledgements Researchers would like to convey their sincere thanks to the management of Middle East College, Oman for the motivation and support provided toward research in innovative teaching pedagogies. Authors are thankful to Dr. Van Louis Lo and Dr. Anupam Srivastava for extending their esteemed guidance and support at various stages of implementing these practices and for their encouragement to pursue this research work.

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The Assurance of Sustainability Reporting: An Extra Fee or a Guarantee

Noha Abd El-Rahman

Abstract

Despite the significant importance of sustainability reporting as an objective measurement of sustainable performance, nowadays there is a consensus on the poor quality of sustainability reporting among academics and practitioners. This research aims at evaluating the impact of the assurance of the sustainability report on its quality level and that could be the reason behind a poor-quality level. Based on the relevant literature, the research applied Ordinal, Logistic Regression analysis to test the impact of the external assurance of the report on the quality of sustainability reporting. This relationship has been tested on a sample of 500 sustainability reports that represent the Global Fortune 100 (G100) companies for a period of 2011–2015. The empirical study concluded that there is an extremely significant, positive relationship between the assurances of the sustainability report on the quality of sustainability reporting.

Keywords

Corporate governance (CG) • Quality of sustainability reporting (QSR) • Assurance of report (ASR) • Global reporting initiative (GRI)

JEL Classification

M410 • O16 • M14 • M42

1 Introduction

In the last few years, companies are increasingly seeking to provide social and environmental disclosures to their stakeholders, driving by Corporate Governance Practices/ theory, who became demanding the corporate performance in regards to these sustainability aspects, upon which they take their decisions. And since stakeholders are at the core of the corporate strategy, their demands must be satisfied. Consequently, social and environmental aspects became important indicators for the corporate performance, together with the economic factor, that all should be disclosed. This increased interest in sustainable development has led them to the adoption of sustainability reporting on its three dimensions, instead of mere "social and/or environmental" reporting. Thus, a robust report should be a reflection of the corporate performance in regard to those three market factors. More specifically, these requirements of corporate reporting should be disclosed to stakeholders in the form of performance indicators. The performance indicators should be readily understandable and measurable so that they support the decision-making process. This format of corporate reporting denotes the so-called "*Sustainability Reporting*" (Junior et al. 2017; Farneti and Guthrie 2009).

Sustainability Reporting (SR) requires that an entity reports meaningfully on its economic, environmental, and social performance to its internal and external stakeholders, regardless of their impact on its economic position. SR is a way to hold an organization accountable for its activities and improve its sustainable development performance. In other words, it could be said that SR helps the organization in strategically managing the three components of sustainability (Comyns et al. 2013; Baumgartner and Rauter 2017). That is why sustainability disclosures are usually provided voluntarily by corporate managers, who justified this behavior with its considerable role in increasing the attention and the positive attitude toward the company. These benefits

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are achieved through enhancing the transparency and accountability of the corporate operations toward its potential stakeholders (Junior et al. 2017; Arnold 2017; Nobanee and Ellili 2016). It is this reporting that forms the contextual background for the intended research. SR is used by organizations as a tool to gain legitimacy and acceptance by the society and to respond to the concerns of the different stakeholders. For example, the sustainability disclosure by the oil companies increased after the case of Exxon Valdes oil spill and chemical companies increased after the case of Bhopal leak. Moreover, reporting on the three dimensions of sustainability determines the extent of the sustainability reporting quality as they are the measure for the quality of the corporate sustainability performance (Comyns et al. 2013; Nobanee and Ellili 2016; Latridis 2013; Roca and Searcy 2012; Daub 2007). In addition to assessing the current sustainability performance of the corporation, SR is the method responsible for communicating the information about the corporate sustainability performance and progress to the stakeholders. In addition, it is considered as the basis for planning changes required to improve the sustainability performance of the organization. SR is a competitive advantage for the reporting organization as stakeholders are more likely and more trusting to invest in organizations reporting on business environmental and social issues (Latridis 2013; Fritz et al. 2017; Lozano 2013; Ahmed and Sundaram 2012; Gond et al. 2012; Gray et al. 1993). Although focusing on the environmental and social aspects, sustainability does not overlook the economic aspects and its importance in reaching a sustainable performance. Based on that, sustainability reporting is a crucial economic aspect of sustainability. In which, sustainability reporting should reflect all sustainability-related issues, including the corporate financial benefits, such as financial stability, profitability, and liquidity. It should be stressed here that financial benefits should be the result of applying corporate sustainability activities. It is found that the sustainability reporting disclosed by conventional banks listed in the UAE financial markets, as opposed to Islamic banks, leads to a considerable improvement in the economic, more specifically financial, performance of these banks (Baumgartner and Rauter 2017; Nobanee and Ellili 2016).

2 Research Problem

Although the concept of SR becomes, theoretically, well-known in the last decade, the practice of SR among corporations is still in its infancy and involves some confusing issues. Furthermore, most of the researches, implemented in the area of the SR and its measurement, were qualitative studies while there are only a few empirical studies in this area (Roca and Searcy 2012; Eugenio et al. 2013; Ane 2012; Bebbington 2009). Given the increasing attention directed to sustainability and sustainability performance, research interest has grown in the latest years in these areas among academics and practitioners. However, most of the evolving studies focused on the quantity of the disclosed information with less consideration to its quality (Farneti and Guthrie 2009; Nobanee and Ellili 2016; Roca and Searcy 2012; Bebbington et al. 2008). This may have led to a deterioration in the quality of the reported information, having companies showing adequate detailed information in terms of quantity but still not reflecting the actual sustainability performance. Consequently, there is an insistent need for future research on assessing and improving the quality of SR (Comyns et al. 2013; Nobanee and Ellili 2016; Lamberton 2005). The quality of SR becomes a focus subject for research and benchmarking studies nowadays. There is a consensus on that although the number of sustainability reports is increasing among corporations the quality of these reports is still poor. It is theoretically claimed that the current quality of ***Sustainability Reporting is Unsustainable***, as corporations adopt a lower level of quality for SR than that adopted by quality assessors and academics (Comyns et al. 2013; Latridis 2013; Gray et al. 1993; Hubbard 2011; Rupley et al. 2012).

The United Nations Conference on Trade and Development (UNCTD) reported that the decisions taken by the corporate stakeholders become more sophisticated because of the methods used to report on sustainability issues. It is found that the corporate disclosed by the Islamic banks are inconsistent. A relevant survey reveals that 50% of the surveyed investors in addition to all the study analysts viewed SR as poor. Latridis (2013) found that reports including sustainability disclosures in Malaysia are very poor in which they are general, narrative in nature, and lack quantitative indicators to a large extent. Dawkins and Lewis (2003) found that 54% of the investors and 43% of the analysts believe that the quality of the information disclosed in the corporate sustainability reports is very deficient. The level of SR in the tourism sector is very deficient (Nobanee and Ellili 2016; Raiborn et al. 2011; Rowbottom and Lymer 2009; Wijk and Persoon 2006. Hooks and Staden 2011) found that a considerable number of companies in the Centre for Business and Sustainable Development (CBSD) database are reporting poor quality sustainability disclosures. Ane (2012) found that the quality of the environmental reporting in China is still very lacking, especially in relation to reliance and comparability. The study reveals that out of the 110 tested firms in different sectors of China, only 5% are reporting environmental information in a quantitative form and 17% in both quantitative and qualitative forms. These percentages are very low in terms of quantitative reported information that is more required for a qualified sustainability report as it facilitates understanding and evaluation by

the corporate stakeholders. It is also found that the SR of the Islamic banks is inconsistent (Bebbington et al. 2008).

Briefly, it can be concluded that there is a wide agreement among academics and practitioners on the poor quality of SR. This leads the stakeholders to take improper decisions, which in turn affect negatively on the corporate investment opportunities, profitability, and market value. In accordance with the Pragmatic-Based Approach of the research planning, the research question that evolves is that, "What is the factor(s) affecting the quality of SR?" and that can be the reason behind its poor quality. This question will be answered through investigating that factor(s) and applying proper methods to empirically test the proposed solution.

3 Research Objectives and Contribution

It is a fact that cannot be denied nowadays that the importance of SR is increasing by time. This importance is largely emphasized in the corporate setting, which is extensively claimed to hold most of the responsibility related to achieving the sustainable development goals through being sustainability oriented. Based on the research problem, despite of the emphasized importance of SR, its poor-quality level is dominating all over the world. The research aims to provide an original contribution toward setting objective criteria for evaluating the quality of sustainability reports. Setting such an objective criterion contributes to the scientific knowledge by developing a robust measure (reporting) for the degree of the sustainable development worldwide. The research aims to identify/evaluate the effect of the ***Assurance of Report (ASR)*** that is scientifically proposed in the coming sections, through theory and practice, on the quality of SR. In other words, the research aims at testing the *Causal Relationship* between the assurance of report and the quality of SR. This aim is achieved through the following research objective: Testing, theoretically and empirically, the impact of the Assurance of Report (ASR) on the quality of Sustainability Reporting (SR).

4 Theoretical Basis

The main targeted contribution of the research is to assess the effect of the assurance of the report on the quality of SR, as considering that assurance as a factor that can improve the quality of SR and consequently assists in developing a conceptual framework for a qualified SR. A theoretical framework is developed through the combination of a set of interrelated concepts emerging from one or more theories. Furthermore, relying on a theory allows for a robust evaluation of sustainability practices against predetermined criteria. In which, a theory is a set of constructs or factors that can best describe and/or explains a certain phenomenon and the reasons behind its occurrence (Fernando and Lawrence 2014; Miles 2012; Punch 2014). Proceeding from this, Legitimacy Theory represents the justification for almost all the sustainability disclosure practices implemented by organizations. Consequently, the research objective, referred to in the previous section, will be attempted while considering it through the Socio-Economic theory of "***Legitimacy Theory***". It provides the scientific justification for the corporate behavior of supplying a sustainability report to its stakeholders who highly demand this reporting. Satisfying the needs of the corporate stakeholders lead to gaining social legitimacy and preserving corporate survival. Legitimacy Theory is considered as the most common theoretical basis applied in studies of environmental and social disclosures by organizations (Fernando and Lawrence 2014; de Villiers and van Staden 2006; Tilling 2004). In which, as being a Socio-Economic theory, it considers the social issues related to the organizational activities together with related economic issues, so that serving all corporate stakeholders, as opposed to the purely economic theories focusing only on economic activities, so that targeting only financially oriented corporate stakeholders. Moreover, legitimacy theory is considered as the most comprehensive theory to ground the SR, relative other theories that have been exposed in this area, mainly the institutional theory and the stakeholders' theory. Of which, the institutional theory states that an institution can follow the best practices of SR followed by its institutional peers, despite of overlooking the quality of the provided reporting. The stakeholders' theory states that a firm should not give all the consideration to the shareholders but to all its stakeholders. From one side, legitimacy theory overcomes the main criticism of the institutional theory by focusing the quality of the provided report to maintain corporate legitimacy while keeping an institution being competitive with its peers to preserve its continuity. From the other side, it achieves the main objective of the stakeholders' theory of fulfilling the needs of all the corporate stakeholders rather than the shareholders only by providing a comprehensive sustainability information (Fernandez-Feijoo et al. 2016; Samudhram et al. 2016). Therefore, legitimacy theory provides the most robust theoretical basis for justifying the corporate behavior toward its SR practices.

5 Literature Review and Hypothesis Development

5.1 Assurance of Report

Assurance services could be considered a growing field as more than 200 assurance services were currently found to be provided. Assurance service aims at providing an independent professional opinion on the quality of corporate information to help stakeholders to take appropriate decisions. The main characteristic of assurance is that a third independent party provides it other than the reporting firm, which guarantees the reliability and relevance of the information for the stakeholders. As a growing field, assurance comprises several types of services. These services could be divided into two main categories: attestation services and other assurance services. The attestation services aim at issuing a report on an information or assertion that is offered by another party. This sort of service is the distinguished job implemented by a Certified Public Accountant (CPA) and a popular example is the audit of corporate financial statements. While the other assurance services do not require, but may include, a written report. These services are not restricted to CPAs, but non-CPA providers also implement them. They focus on improving the quality of corporate information used by its stakeholders. The most evolving example of these services is the assurance of sustainability reports, which is the concern of this research. Stakeholders seek transparency in the disclosed information in the sustainability report in addition to the accountability of the reporting company to the probable sustainable impacts resulting from the company's operations (Latridis 2013; Rupley et al. 2012; Arens et al. 2017). In order to verify the disclosed sustainability information, there should be an independent professional third party so that it could be considered as reliable and accurate for the corporate stakeholders who may lack the required knowledge and experience to verify the disclosed information. The existence of a third party responsible for auditing the companies' sustainability reports is an attribute for the quality of the reports, in which the third party verification about the information included in the sustainability report, is considered as a guarantee for the stakeholders about the quality and the reliability of the report upon which they base their decisions. The existence of a third auditing party acts also as a motivator and driver for improving the quality of the reports offered by the companies that will seek to improve the quality of their report in order to avoid negative audit reports (Latridis 2013; Daub 2007; Gray et al. 1993; Ane 2012; Lamberton 2005; Hubbard 2011; Rowbottom and Lymer 2009; Hammond and Miles 2004).

While the research field has been experiencing a gap around sustainability assurance, the practical field provides a good level of performance. Whereas the rate of the assured sustainability reports is increasing by time with a high percentage offered by the big 4 auditing firms (the big 4 are the biggest international companies providing auditing, assurance, and other accounting related services and they are Deloitte, EY, KPMG and PWC). In which, it is found that the number of sustainability reports assured by the big 4 has increased from 35.4% in the period of 2002–2004 to 51.35% in the period of 2006–2007. Furthermore, an increase has remarked in the market share of the big 4 from 60% of the sustainability reports assured in 2005 to 67% of the sustainability assured reports in 2013. However, despite of their increasing role in sustainability assurance, the big 4 firms differ among each other in relation to their participation rate in the assurance of sustainability reports as follows. In the beginning of the current decade, KPMG and PWC showed a greater participation in the sustainability field than Deloitte and EY. The reason is that, Europe—where KMPG and PWC are headquartered—promoted the concept of sustainability before the USA—where Deloitte and EY are headquartered. This promotion was significantly highlighted with the release of the "Europe 2020 strategy" by the European Commission in 2010, which focuses on developing business models based on sustainability concepts and strategies. It is worth mentioning that, KMPG specifically has been playing the most important role in sustainability reporting among the big 4 firms and a significant role in SR research and practice. Since 2008, KMPG is one of the leaders in sustainability auditing and assurance. In which it is following a business strategy that is extensively focusing on the effectiveness of SR and this is obviously reflected in the beneficial surveys that it continuously holds in this field, which is also considered as one of the important references used in SR researches. Most of the companies offering high-quality sustainability disclosures in their reports are audited by one of the big 4 auditors. As being global firms, the big 4 are continuously maintaining a certain quality level of assurance services offered to companies worldwide. It is also found that in Netherlands—headquarters of KPMG—there is a positive relationship between sustainability assurance and corporate accountability for its sustainability activities (Latridis 2013; Fernandez-Feijoo et al. 2016). This emphasizes the importance of a third independent party to audit companies' sustainability reports to ensure the quality of the reports for the companies' stakeholders, especially this type of sustainability-related information that needs a considerable level of knowledge and experience to be verified, i.e., credence information. Based on that, the assurance of the sustainability report is considered as a crucial requirement

for improving and maintaining the quality of the sustainability report.

A main factor that affects the corporate decision to contract with a certain assuror/auditor to assure its sustainability report is the fees that the company must pay to that assuror to complete his job. Producing a high-quality sustainability report is expensive and requires resources consumption of which the company has to incur costs for aggregating, measuring, and verifying the information as well as costs for publishing and printing. Several companies are reluctant to incur high costs and thus affects negatively on the quality of the sustainability report produced. However, eventually incurring high costs for producing and assuring a qualified sustainability report will retain the company's legitimacy for the stakeholders and consequently this legitimacy will positively affect the financial position of the company. In which, customers will be willing to purchase the company products that they trust, investors will be willing to purchase the company stocks and the company will not face any penalties or fines for violating the regulations (Comyns et al. 2013; Latridis 2013; Lozano 2013; Lamberton 2005; Fernandez-Feijoo et al. 2016). Highly qualified disclosures in the corporate reports lead to the improvement of the aggregate social welfare through reducing the costs incurred by the society searching for information about the corporate performance. Furthermore, online reporting is a cost-efficient way for reporting as it is cheaper than the hard copy reporting that requires printing and distribution costs. As the level of information asymmetry between the report reader and the company increases, the cost of preparing the report decreases. There is no need to incur high costs by the companies to improve the report quality to gain the legitimacy of the readers, who receive corporate information through private channels, other than the formal published report. The cost that the organization bears to provide its stakeholders with a comprehensive sustainability report comprises all costs paid for both the preparation and communication of the sustainability report. These costs include all the monetary amounts paid for the preparation process, which in turn includes the costs of collecting, measuring, verifying, and aggregating the information, together with all the monetary amounts paid for the communication process, which in turn includes the costs of printing and publishing the sustainability report (Comyns et al. 2013; Lamberton 2005; Rowbottom and Lymer 2009; Brown and Hillegeist 2007). Therefore, incurring costs for producing, as well as assuring sustainability reports is faced with firm's resistance, which will negatively affect the quality of the report and the corporate legitimacy.

Based on the literature reviewed, it can be concluded that the assurance of report is considered as an essential factor and driver that should be considered for improving and maintaining the quality of SR. Therefore, the audit by a third independent party of the sustainability report can act as a guarantee for reliability and accountability of the corporate report. Thus, the research hypothesis generated for testing is:

H: That Assurance of the Sustainability Report (ASR) has a significant impact on the Quality of the Sustainability Reporting (QSR).

6 Research Design and Methodology

6.1 Methodological Theory

As the research is following the *Pragmatic Approach*, the research chooses the most appropriate techniques that can best answer the research question in the most effective and efficient way. This entails specifying the research structure before pursuing the empirical part of the research. In which, the research question is predetermined while introducing the research problem. Moreover, the research design is accurately preplanned before starting the empirical part that will use mostly well-structured data. The research data are tightly structured using quantitative measures before starting the data collection process. One of the significant benefits of having a well-structured research design in advance of the empirical part is that the more tightly structured the research design and in turn the research data, the more likely there will be a well-developed conceptual framework. The research is following the *Positivism Philosophy*, with essentially a *Deductive Approach*, in which the research aims at verifying an existed theory, i.e., Legitimacy Theory, through testing objective data, in order to finally reach law-like generalizations that develop knowledge. It has been historically observed that the Positivism philosophy has dominated the science. This philosophy studies knowledge using free-value quantitative measures where if used by different researches will give the same results. Based on that, a scientific method is applied that empirically tests hypothesis using a large sample of mostly structured quantitative data. Unlike other research philosophies, i.e., realism, interpretivism and pragmatism, the research will not be affected by any subjective issues so that the researcher's values or other surrounding viewpoints will not influence the research procedures held (Punch 2014; Hinton and McMurray 2017; Saunders and Tosey 2013). Since the research question is "What is the Factor(s) affecting…?" which is a quantitative question, therefore the research applies a *Mono Quantitative Design* that is best convenient to answer this question. Documentation is used to extract the required data that is tested longitudinally over subsequent periods. Documentation is characterized by the accuracy, reliability and verifiability of the extracted data, in which it is less likely to involve bias and subjective values or

viewpoints. Thus, it is an objective resource for data collection that is leading to objective results and findings (Saunders et al. 2009; Sekaran 2000, 2003).

6.2 Research Methods

The research employs explanatory research techniques that use empirical/experimental techniques for testing causal relationships between different variables under controlled conditions. These techniques use quantitative data to show the strength of relationships between different variables to make inferences about tested variables. This explanatory quantitative research has to test the effect of the assurance of report discussed in the literature review section, through making precise predictions about the change in a certain dependent factor/variable (i.e., Quality of SR) because of the change in the independent factor/variable (i.e., Assurance of Report). These predictions can best determine accurate cause-and-effect relationships among the different variables, which are required by the research. Accordingly, the best statistical analysis to fulfill these tasks is the *Regression Analysis*, which is employed by the research (Hinton and McMurray 2017; Sekaran 2000, 2003; Fawcett and Downs 1986; Dougherty 2002; Mason et al. 1999). There are several types of regression analyses that are applied in the social sciences, the most well-known and applied among these types are the Linear Regression and the Logistic Regression. More specifically, to the most knowledge of the researcher, the quantitative empirical studies that evaluated the corporate SR used either an Ordinary Least Squares Linear Regression or Logistic Regression (Nobanee and Ellili 2016; Latridis 2013; Lanis and Richardson 2013; Rupley et al. 2012; Fernandez-Feijoo et al. 2016; Brown and Hillegeist 2007). Linear Regression is used in case that the dependent variable of the research relationship is represented in Ratio values, i.e., normal numbers. However, Logistic Regression is used in case that the dependent variable is represented in Category values (Categorical), i.e., values representing different categories. Since the research dependent variable that is the Quality of SR is divided into categories of quality levels as will be explained in the next section, then the *Logistic Regression (LR)* is the most convenient type of regression to be applied in this research. More specifically, the ***Ordinal Logistic Regression (OLR)*** type of LR is the most appropriate statistical technique that can test a proposed relationship for which the categories of the dependent variable (QSR) have a natural order of more than two categories while taking into consideration the rank ordering of the outcomes (Fernandez-Feijoo et al. 2016; Koletsia and Pandis 2018; Montañés et al. 2014; Kleinbaum and Klein 2010).

6.3 Research Variables and Estimating Equation

Dependent Variable:

Quality of Sustainability Reporting (QSR) This variable is defined as the quality assessment of the corporate sustainability report in terms of each company's level of adherence to the GRI performance indicators. From which a GRI-based grade has been agreed to act as a measurement for the quality of corporate SR. This grade aims to enable companies to provide standardized and qualified sustainability information within, or in addition to, its annual audited financial statements (Latridis 2013; Daub 2007; Lozano 2013; Rupley et al. 2012). Consequently, based on the previously mentioned inspiring researches, the level of adherence to the GRI indicators is used as a measurement for the quality of SR.

According to the guidelines of the GRI organization, there are 79 performance indicators required to be disclosed in the corporate sustainability report, in relation to the economic, social, and environmental aspects of the organization. The level of adherence to these indicators is determined by a grade, which reflects the number of indicators that are included and fulfilled within the corporate report, out of the total 79 performance indicators. There are 6 grades that are used to measure the level of adherence to the GRI, as follows: A, B, C, D, E, and F. These 6 grades represent ordered levels of adherence, respectively. An A grade means that most indicators of the GRI guidelines are addressed in the corporate sustainability report. F means zero indicators have been shown to be addressed in the corporate sustainability report. Accordingly, this variable is considered as a Discrete, Categorical variable, as it is measured in six categories of A, B, C, D, E and F and the difference between these categories does not represent an equal measurement scale. In addition, this variable can also be called an Ordinal, Categorical variable as it consists of categories that are ranked by certain order (Hubbard 2011; https://www.globalreporting.org/standards/getting-started-with-the-gri-standards/).

Independent Variable:

Assurance of the Sustainability Report (ASR) This variable is defined as whether the corporate sustainability report is assured by an independent, third party. The Assurance of the Sustainability Report has been extensively applied by researches that studied the assessment of corporate SR as an indicator for the quality of sustainability report (Latridis 2013; Ane 2012; Lamberton 2005; Rowbottom and Lymer 2009; de Villiers and van Staden 2006; Fernandez-Feijoo et al. 2016; Samudhram et al. 2016; Hammond and Miles

2004; Hooks and Staden 2011). Based on the previously mentioned inspiring researches, this variable is measured as a value of 1 is to be assigned in case the corporate sustainability report is assured by a third party, and a value of 0 is to be assigned when no assurance is implemented. Consequently, this variable is a Discrete Categorical variable as it is measured in two integers of 0 and 1 and the difference between these integers does not represent an equal measurement scale. This variable is also called a Dichotomous (Binary) variable as it is reported as a choice between only two options.

Control Variables:

Company Size (TOA) This variable is defined as the company size in terms of the company owned "Total Assets" at the end of each relevant year so that it is a *Continuous* variable. Company Size has been employed as a control variable by several researches that studied the assessment of the corporate SR (Nobanee and Ellili 2016; Latridis 2013; Lanis and Richardson 2013; Brown and Hillegeist 2007).

Net Profitability (ROA) This variable is defined as the ratio (percentage) between "Net Profit" for each relevant year and the appropriate "Total Assets" at that year-end. With that, it is a Continuous, Scale variable; as it is measured in a percentage that can be accurately measured with any monetary value and the difference between any of these values represent an equal measurement scale (Latridis 2013; Lanis and Richardson 2013).

The following Multiple, OLR Model is used to estimate/predict the variation in the QSR because of the ASR:

$$QSR = a + \beta 1ASR + \beta 2TOA + \beta 3ROA$$

where,

QSR is the Quality of Sustainability Reporting that represents the Dependent variable.
ASR is the Assurance of the Report that represents the Independent variable
TOA is the Total Assets that represents the first Control Variable.
ROA is the Return On Assets that represents the second Control Variable.

Data Sources and Acquisition:
Based on the previous explanation, it is concluded that the research is primarily quantitative. The research extracted its data from five main sources. First, the companies chosen to represent the research sample are determined based on the "Fortune.com" database. According to "Fortune.com," the database ranks the top companies and executives worldwide each year. Out of the "*Global 500*" companies, the research chose the first 100 companies, "***Global 100 (G100),"*** to be its operational sample. The G100 are currently employing 67 million people across 33 countries worldwide. There are two reasons for choosing the G100 companies to represent the research sample, as follows. The first reason is that these G100 fit the research objective as 95% of them provide sustainability disclosures. The second reason is that they spread worldwide, which gives applicability for the results in various environments and economic situations. In addition, a significant number of companies (39%) has Egyptian branches or at least having operations in Egypt, my origin country, for which research benefits should be assured (Comyns et al. 2013). Second, the Global Reporting Initiatives (GRI) database "globalreporting.org" is used as the reference for getting the data for the guidelines and regulations of the corporate SR. The GRI database comprises the most globally accepted and used SR guidelines in addition to comprising companies' sustainability reports (Farneti and Guthrie 2009; Latridis 2013; Roca and Searcy 2012; Lozano 2013; Hubbard 2011; Wijk and Persoon 2006; Fernandez-Feijoo et al. 2016; Hooks and Staden 2011; http://www.globalreporting.org). Third, the Corporate Register database "CorporateRegister.com" is considered as the largest repository for sustainability reports worldwide. Thus, data about the sustainability reports of the G100 companies is collected from this database. The Corporate Register is an independent international organization that profiles the largest number of Corporate Responsibility (CR) reports for organizations worldwide. The database includes more than 78,661 reports, which are increasing by time, of organizations working in all sectors, from across 13,488 countries (http://www.corporateregister.com/). Fourth, the individual companies' websites, which are accessed as needed to get sustainability reports of the G100 companies. The companies' websites also include information about each organization, especially the organization's profile and its strategic plans and objectives as in Roca and Searcy (2012). Fifth, and most significantly, is the Bloomberg database. Bloomberg is an international database that provides financial professional services, including financial information, analyses, and news. As working in the economy for more than 30 years, the terminal has around 2800 financial ratios and data items that covers international and US companies. Moreover, for the data to be included in the terminal, it goes through a systemized verification process so that ensuring its accuracy and integrity, thus financial screening and analyses could be done based on dependable data inputs. The financial analyses process is implemented using a wide range of analytical tools, in addition to the availability of more than 15,000 indexes (http://www.bloomberg.com/). Quantitative data extracted from these five sources are collected for five years, from 2011 to 2015

(inclusive), for the 100 companies, so that research data are collected and tested for 500 reports. Consequently, it is envisaged that no data will be collected from private sources; therefore, no ethical issues should arise in terms of data collection and analysis.

7 Empirical Results and Discussion

The Statistical Package for the Social Sciences (SPSS) is employed to implement the statistical analysis for the collected data. SPSS is considered as the most popular and user-friendly statistical analysis software package. It can run descriptive statistics as well as sophisticated inferential statistics (Punch 2014; Sekaran 2003; Adams et al. 2007). Then, the statistical results are divided into the two categories of Descriptive results and Inferential results, as follows.

Discussion of Descriptive Results:
The first step in presenting and reporting the results of the statistical analysis process is to describe and summarize the results, which are called the *Descriptive Results*. Since the research variables are divided into two categories, Categorical and Continuous variables (as explained in the previous section), the descriptive results for the variables are divided into two categories as well (Comyns et al. 2013; Nobanee and Ellili 2016; Latridis 2013; Gray et al. 1993; Hubbard 2011; Hinton and McMurray 2017; Hooks and Staden 2011; Joseph 2012). Tables 1 and 2 present the descriptive statistics for the categorical variables and Table 3 presents the descriptive statistics for the continuous variables. As shown in Table 1, only 98 out of the 500 reports, which represent 19.6%, are ranked in the highest quality level of SR (A), with the remaining 80.4% of the reports vary in their quality level of SR. This indication is reinforced by the finding that most of the reports representing 60.8% falls in the lowest quality level of SR (F). Hence, this finding is compatible with the literature reviewed that claims the poor quality level of the corporate SR. Table 2 shows that about 37 companies only out of the G100 companies implement external assurance for their sustainability reports as opposed to around 63% of the reports being not externally assured. The finding of Table 2 can be related to that of Table 1, which indicates that around 60% of reports hold the poorest quality level of SR. A preliminary conclusion can be reached that the non-assured reports have a poor quality of SR, which is in line with the literature reviewed. This preliminary finding will be settled while interpreting the inferential results in the next section. Table 3 presents the descriptive results for the continuous variables, in which the mean value for the Total Assets (TOA) and the Return on Assets (ROA) of the G100 companies are 1394181.253 and 3.88 million dollars, respectively.

Categorical Variables

Table 1 Descriptive statistics of quality of sustainability reporting (QSR)

QSR	Count	%
A	98	19.6
B	52	10.4
C	14	2.8
D	12	2.4
E	20	4
F	304	60.8
Total	500	100

Continuous Variables

Table 2 Descriptive statistics of assurance of sustainability reporting (ASR)

ASR	Count	%
YES	184	36.8
NO	316	63.2
Total	500	100

Discussion of Inferential Results:
After discussing the preliminary inferences deducted from the descriptive results, the inferential results of the statistical analysis process are discussed, so that being able to decide on the proposed research hypothesis and consequently draw final inferences and conclusions regarding the proposed research relationship. As explained in the previous section, the research applied an *Ordinal Logistic Regression* to statistically analyze the research data using an *Enter Method* that enters all the variables into the regression model at the same time. The research builds two Ordinal Regression models to be tested as follows. Model 1 includes the

Table 3 Descriptive statistics of total assets (TOA) and return on assets (ROA) variables

Variable	*N*	Minimum	Maximum	Mean	Std. deviation
TOA	500.00	4621.30	22209780.00	1394181.25	3438233.03
ROA (%)	500.00	−36.50	28.54	3.88	5.00

Table 4 Accuracy indices of the research models

Model	Sig. (*P*-value)	Deviance (*P*-value)	Pseudo R square	
			Cox and snell R square	Nagelkerke R square
1	0.000***	1	0.147	0.156
2	0.000***	1	0.152	0.166

* Significant at 10% significance level
** Significant at 5% significance level
*** Significant at 1% significance level
No stars means no significance

Dependent variable (QSR) and the Independent variables, (ASR), without including the Control variables. Model 2 includes the same Dependent variable and Independent variables of Model 1, in addition to the Control variables, (TOA) and (ROA), to test the impact of the control variables on the model, if any.

Model 1:

$$\text{Logit QSR} = \alpha + \beta\text{ASR}$$

Model 2:

$$\text{Logit QSR} = \alpha + \beta 1\text{ASR} + \beta 2\text{TOA} + \beta 3\text{ROA}$$

Table 4 presents the inferential statistics of the two models as a whole, in which the three statistical measures of the Significance, the Deviance and the Pseudo R-Square, which is represented in Cox and Snell R-Square and Nagelkerke R-Square, are used to build inferential conclusions about the applied regression models. These measures can provide the statistical assurance about the overall significance and quality of the regression model in addition to the degree of the association between the model's independent variable(s) and the dependent variable (Saunders et al. 2009; Sekaran 2003, 2000; Fawcett and Downs 1986; Dougherty 2002; Mason et al. 1999; Adams et al. 2007; Denham 2017) that will be explained in detail as follows.

The first measure is the Significance, which measures the level of the model significance in relation to explaining the change in the dependent variable. The criterion used to judge the goodness of the Significance measure is its P-value. The P-value has three levels of significance, which are at 10, 5 and 1% (Saunders et al. 2009; Sekaran 2003, 2000; Dougherty 2002; Mason et al. 1999: Adams et al. 2007). As shown in Table 4, Model 1 has a *P*-value of Significance by 0.000 that is less than 0.01 so it is extremely significant, which means that it is an extremely good model for explaining the variability in the Quality of Sustainability Reporting (QSR). Similarly, Model 2, that includes the control variables, has a *P*-value of Significance by 0.000 that is extremely significant as well. This means that it is also an extremely good model for explaining the variability in the Quality of Sustainability Reporting (QSR). Therefore, both models are significant. As shown in Table 4, Model 1 has a *P*-value of Deviance by 1.000 that is significant. This means that the Independent variable (ASR) is well-fitted in the ordinal regression model. Model 2 has a *P*-value of Deviance by 1.000 that is significant. This means that the Independent variable (ASR) is well-fitted in the ordinal regression model, after adding the Control variables (TOA and ROA) as Independent variables as well. Therefore, both models are statistically well-fitted. The R-Square value is ranging from 0 to 1, in which 0 means no strength and 1 means the highest strength (Denham 2017). As shown in Table 4, Model 1 has a Cox and Snell R-Square and the Nagelkerke R-Square values of 0.147 and 0.156, respectively. This means that, the Independent variable (ASR) can explain from 14.7 to 15.6% of the variability/change in the dependent variable (QSR). Model 2 has a Cox and Snell R-Square and the Nagelkerke R-Square values of 0.152 and 0.166, respectively. This means that the Independent variables —including the control variables (ASR, TOA and ROA)—can explain from 15.2 to 16.6% of the variability/change in the dependent variable (QSR). Although both models can explain a significant part of the change in the research dependent variable, it should be mentioned that a slight improvement in the values of R-Square has occurred after including the control variables in Model 2. Thus, it was a valid decision to include the control variables in the research model.

Based on the previous discussion, the robustness of the two research models has been assured through measuring their goodness of fit and level of strength in relation to their

Table 5 Inferential statistics for the research variable(s) for model 1 and 2

Models	Variable	Estimate	Exponential	Sig. (*P*-Value)
1	ASR	2.083	8.028518	0
2	ASR	2.138	8.482456	0
	TOA	−1.22E−07	1	0.001
	ROA	0.002	**1.002002**	**0.898**

*Highlighted figures represent insignificant variables

ability to statistically represent and measure the proposed relationship between the research dependent and independent variable. Then, the next step is to present and discuss more specific inferential results about the variables composing each model, as presented in Table 5, that will be discussed as follows.

Table 5 presents the statistical analysis for the independent variable in relation to the dependent variable through the coefficient of each variable. The first measure employed to test the relationship of an independent variable to the dependent variable is its Significance. After measuring the significance of the relationship between the independent and dependent variables, the second and more sophisticated level of measurement for that relationship is to measure the direction and magnitude of the relationship. For this purpose, the second measure used is the Estimates for the coefficients of the independent variables. The Estimate determines the direction of the relationship between the independent and dependent variables, of being either a Positive relationship or a Negative relationship. Moreover, the second important role for the Estimate is that it provides prediction values for the probability of the change in the outcome of the dependent variable as a result of the change in the value of the Estimate-related independent variable. However, the Estimates values cannot be directly used to refer to the amount of the change in the dependent variable, because of the change in a certain independent variable. The reason behind this is that, the values of the Estimates coefficients are computed based on the Log of the values for the variables data, as previously shown in the two research models and not the normal values, so they result in Log values of Estimates as well. From the statistical viewpoint, the Log, for the values of the variables data, are used to run the ordinal regression analysis because of the nature of the dependent variable of being a categorical variable (Kleinbaum and Klein 2010; Denham 2017). In which, as explained in the previous section, the categorical variable is represented in values of categories that are not real numbers and the distance between each category is not specifically determined. Then, the resulting Log values of Estimates coefficients have to be reversed back to a normal value in order to be used to build inferences about the expected change in the variables. Reversing a Log value to a normal value is implemented by computing its *Exponential* (*Exp*) value, it is also called *Odd Ratio*. As the inverse function of the Log is the Exponential, in which it inverses the power raised values back to their original values. If the Exponential value is greater than 1, this means that if the independent variable increases by 1 unit, it is more likely to be in a higher level of the dependent variable by the Exponential value. On the other hand, if the Exponential value equals or less than 1, this means that if the independent variable increases by 1 unit, it is less likely to be in a higher level of the dependent variable by the Exponential value (Dougherty 2002; Hosmer et al. 2013; Denham 2017). That is why the Exponential value is computed for all the resulting Estimate coefficients of variables, as shown in table. Therefore, the direction of a significant relationship will be determined based on the Estimate coefficient value of the variable, while the magnitude of the significant relationship will be determined based on the Exponential value of the Estimate coefficient of the variable.

It is worth mentioning that there are two levels of measurement for each of the independent variables in relation to the dependent variable, which have to be interpreted by order. As a first level of judgment, the independent variable has to be first interpreted for the existence of a significant relationship with or without the dependent variable. Then, after fulfilling this first level of measurement, it has to be interpreted for the direction and magnitude of that significant relationship, if any, as a second advanced level of measurement for the relationship. Accordingly, if the result of the first level of measurement is that there is an insignificant relationship between a certain independent variable and the dependent variable, then the second level of measurement that is the direction and magnitude of the relationship will be meaningless and then the values of both the independent variable Estimate and its Exponential should be ignored. As reaching an inference about the existence of an insignificant relationship is sufficient for the research purposes to conclude that a certain independent variable has no considerable impact on the dependent variable of interest, regardless of the direction and the magnitude of that relationship, if any. As previously explained in the statistical measurement of the models, the two research models are extremely significant, with all the constituting variables are well-fitted in the models, based on their *P*-values of Significance and Deviance. However, Model 2, that includes the control

variables, is found to be better in explaining more percentage in the variability/change that happens to the dependent variable. Then, the Model 2 is used to interpret and discuss the inferential results for the research variables, which is presented in Table 5.

The independent variable that is the Assurance of Report (ASR) has a *P*-value of its coefficient by 0.000 that is less than 0.01. This means that there is extremely significant evidence, with a probability of 99%, that there is a *Significant* relationship between ASR and the dependent variable of interest that is the Quality of Sustainability Reporting (QSR). Moreover, that *P*-value means that, the coefficient value of the ASR is extremely significant and can be depended on. After fulfilling the first level of measurement for the ASR, through verifying the existence of a significant relationship with the QSR, the second level of measurement is to interpret the direction and magnitude of that relationship through the Estimate and Exponential of the coefficient. The statistical analysis resulted in an Estimate value of 2.138 and an Exponential value of 8.482456 for the ASR. Concerning the direction of the relationship, since the Estimate value is positive, then there is a *Positive* relationship between the ASR and QSR, in which as the ASR increases, the QSR increases. Concerning the magnitude of the relationship, the Exponential value of 8.482456 means that, if the ASR increases by one unit, it is more likely to be in a higher level of the QSR by 8.482456 units.

Therefore, the research hypothesis is *Accepted*, stating:

H: That Assurance of the Sustainability Report (ASR) has a significant impact on the Quality of the Sustainability Reporting (QSR).

The second independent variable, which is used as a Control variable that is the Total Assets (TOA) has a *P*-value of its coefficient by 0.001 that is less than 0.01. This means that there is extremely significant evidence, with a probability of 99%, that there is a *Significant* relationship between TOA and the dependent variable of interest that is the Quality of Sustainability Reporting (QSR). Moreover, that *P*-value means that, the coefficient value of the TOA is extremely significant and can be depended on. After fulfilling the first level of measurement for the TOA, through verifying the existence of a significant relationship with the QSR, the second level of measurement is to interpret the direction and magnitude of that relationship through the Estimate and Exponential of the coefficient. The statistical analysis resulted in an Estimate value of −1.224E-7 and an Exponential value of 1 for the TOA. Concerning the direction of the relationship, since the Estimate value is negative, then there is a *Negative* relationship between the TOA and QSR, in which as TOA increases, the QSR decreases. Concerning the magnitude of the relationship, the Exponential value of 1 means that, if the TOA increases by one unit, it is less likely to be in a higher level of the QSR by 1 unit.

The third and last independent variable, which is used as a Control variable that is the Return on Assets (ROA) has a *P*-value of its coefficient by 0.898 that is greater than any of the three significance levels of 0.01, 0.05, and 0.1. This means that there is *Insignificant* relationship between ROA and the dependent variable of interest that is the Quality of Sustainability Reporting (QSR). Moreover, that *P*-value means that, the coefficient value of the ROA is insignificant, and on which cannot be depended. After failing to fulfill the first level of measurement for the ROA, through verifying the existence of an insignificant relationship with the QSR, there is no need for the second level of measurement in relation to the direction and magnitude of an insignificant relationship. Thus, interpreting the Estimate and Exponential values of the variable are ignored.

8 Summary and Conclusions

It cannot be denied that the social injustice and the environmental damage have become two of the enormous problems that are vastly increasing by time and threatening our planet in recent decades. This in turn provides the reason behind the growing awareness of the sustainability concept worldwide, both on the organizational level and individual level. On the organizational level specifically, integrating and applying sustainability concepts has turned from being an improving value-added into a requirement for the continuity of the corporate life. Of which, sustainability is considered as the corporate tool to gain and maintain social legitimacy from the corporate stakeholders who are currently depending on sustainability as one of the important criteria for their decisions toward an organization. Communicating corporate sustainability performance to the stakeholders is achieved through ***Sustainability Reporting*** (***SR***). Sustainability Reporting is the *objective measure* for the sustainable performance. Despite the critical importance of sustainability reporting, there is a general consent among academics and practitioners on the poor-quality level of sustainability reporting. As a result, there is an agreement that *sustainability reporting is unsustainable*. Consequently, a considerable work has to be done to leverage this poor level of sustainability reporting to at least a moderate level in a way that can achieve its main aims, which are previously mentioned. Based on this fact, this research is considered as an attempt to solve this problem and participate in leveraging the poor-quality level of sustainability reporting through testing the assurance of report factor for its proposed impact on improving that quality level.

This factor has been tested on the Global Fortune 100 companies (G100) for the period of 2011–2015; representing a sample of 500 reports while applying Quantitative methodological techniques. Having an ordered, categorical dependent variable of the research made the logistic regression the best quantitative choice for the analysis process. Thus, an *Ordinal*, *Logistic Regression Analysis* is chosen to statistically analyze the collected data, using SPSS statistical software package. As a result of the empirical findings, it is concluded that the Assurance of the Sustainability Report (ASR) can explain 15.2–16.6% of the variability occurring in the Quality of Sustainability Reporting (QSR), which is a significant percentage. Of which, the inferential results concluded that there is an *Extremely Significant* relationship between the Assurance of the Sustainability Report and the Quality of Sustainability Reporting. This significant relationship is found to be a *Positive* relationship, in which the statistical results reach that as the assurance of report increases by one unit, it is more likely to be in a higher level of the quality of sustainability reporting by 8.482456 units. Based on that, a conclusive decision is taken regarding the research hypothesis that is the hypothesis is *Accepted* stating that ***Assurance of the Sustainability Report (ASR) has a significant impact on the Quality of the Sustainability Reporting (QSR).***

9 Research Limitations and Future Research

As it is the usual case in any research of social sciences, some limitations have been evolved from the insights provided in this research. There are two main research limitations derived from the empirical results. The first limitation to be highlighted is deducted from the value of Pseudo R-Square of 15.2–16.6%. This means that the Assurance of the Sustainability Report (ASR) can explain only from 15.2 to 16.6% of the change in the Quality of Sustainability Reporting (QSR). Although this is considered as a significant percent; however there is still a more significant percent, which is 83.4 to 84.8%, of the variability/change in the quality of sustainability reporting that needs to be scientifically explained. Based on that, it is recommended for future research to fill in this gap through testing other factors that are affecting around 80% of unexplained change in the quality level of sustainability reporting. The second limitation in relation to one of the controlling variables is that of the company size (measured by the Total Assets (TOA)). Because of this, the empirical results show that it has a negative significant relationship with the quality of sustainability reporting. Although it is not the main research independent variable, its result is contradicting with a considerable literature arguing a positive relationship between these variables. It is recommended for future research to retest the relationship between those variables, perhaps using different measurement technique that may lead to different results.

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Databases

Bloomberg Database: https://www.bloomberg.com.

Corporate Register Database: https://www.corporateregister.com.

Fortune Database: https://www.Fortune.com.

Global Reporting Initiatives (GRI) Database: https://www.globalreporting.org.

The Business Going Concern: Financial Return and Social Expectations

Francesco Manni and Alessio Faccia

Abstract

The present work aims to analyze the corporate social responsibility from a new perspective, observing the link between a progression of business and the distribution of risks between different expectations. The study of the relationships between uncertainty, risk and corporate persistence represents an opportunity to think about the rising concern of the companies, considering both the need for financial returns and human–environmental expectations. Starting from the study of economic–business culture, this paper deals with uncertainty and risk as distinct concepts, analyzing the meaning of "common risk". Subsequently, the cornerstones of the economic order of the company are pointedly displayed, while also highlighting the relation to the request for sustainable human and environmental development. These areas of analysis are intertwined with the issues that arise from the practice of corporate social responsibility (CSR) and the search for coherent structured tools for fair disclosure. Social balance can be viewed as one of the principal mechanisms designed to improve the structured external information system. This is a formalized tool that is principally designed to focus our attention on the analysis concerning the production/distribution of value. These surveys allow finding the value system based on the ongoing progression of the company and, consequently, the distribution of risks between different expectations. The research was conducted by using an unstructured approach, classified as qualitative. The authors find out that the continued development of a business is undermined by the economic–financial sustainability of the human and environmental framework that characterize the production. The shortcomings of a big company turn into a crisis of a community and this calls into question the role that the Government intends to play in the human and environmental fields, also considering the constraints deriving from supranational agreements.

Keywords

Financial return • Social expectations • Risk and uncertainty • Corporate social responsibility • Going concern

1 Introduction

This research is conducted under the guidance of an economic–business perspective that, as is well known, considers the conditions of existence and the living manifestations of the companies (Zappa 1926) essential for the analysis.

This research paper, therefore, has its roots in Italian doctrine, which contributes to the deepening of the study of the economic administration of companies of all kinds, operating in any economic order (Onida 1970).

The stimulus to the present work has been given by the interest in the study of risk, an expression which commonly indicates the likelihood of not realistically achieving what was desired, despite the accuracy of human actions in the setting and carrying out phase. More specifically, the insights that will follow the relationship between uncertainty and risk represent the opportunity to think over the development of the company. This aspect is linked both to the need for economic functionality and the humanistic–environmental expectations.

The distinction between the notions of uncertainty and risk will serve to formulate some considerations on the ongoing progression of the company. This distinction may be viewed as a "tool" (Ferrero 1968) that can be

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extensionally customized in order to realize the purposes assigned to it by those who have promoted the production (Capaldo 2013) (and the multiple and sometimes competing partisan expectations, as well as the short-term definable objectives of general interest). These aims can be concretely pursued by the governance, through its actions that will be regarded as a deciding factor in demonstrating the constraint of economic equilibrium that is valid over time. This balance represents a central unit, a propulsive drive. This central unit influences the real behavior of companies and the responsibility of managers (Zanda 1974) in the environment in which production is implemented and widespread (or determines its influence).

The remarkable scientific relevance of this topic is unquestioned, with immediate effects on the entrepreneurial aspects. This research limits the analysis only to the economic–business context, however, only at the general level and without claiming absolute completeness. Business risk is analyzed directly or indirectly in all institutional studies, those of strategy, or those that affect different functional areas, typically finance (Damodaran 2001). Business risk is also dealt with in the study of the financial statement and of economic capital (Zanda 2013). The topic, therefore, involves the examination of the net result (Capaldo 1998) and the relations with the themes of corporate social responsibility as well as the social balance (Manni 2011a).

The management decision to initiate and/or maintain a production is related to the risk assessment and, especially in cases of corporate default must seek concrete and socially sustainable solutions, both from an economic point of view, both in the humanistic and environmental profiles, which are based on different distributions of benefits/sacrifices.

The analysis is conducted according to a deductive logic and, therefore, does not make use of the quantitative data as a further element of analytical speculation and validation of the statements which are, therefore, conjectures.

It may also be considered as thought-provoking consideration on the subject, without any quantitative analysis, according to the methodological approach of some important business administration scholars.

The paper initially focuses on the business environment that has fueled the study, then focuses on uncertainty and risk as separate topics, subsequently, the cornerstones of the company's structure are investigated, also related to the request for sustainable development from the human and environmental point of view.

2 Literature Review

The aim of this paper is not only the analysis of the difference between risk and uncertainty, which has been widely discussed in international literature, but also the investigation of all those aspects which link the financial return and the social expectations, focusing on the Italian literature. The idea underlying the whole paper is to demonstrate a double-way relationship between financial returns and the well-being of the community in which the company operates. The business studies concerning uncertainty and risk in Italy began during the early decades of the twentieth century, and nowadays represent scientific fields that claim the interest of researchers in every field.

The Italian doctrine has investigated the topic in relation to the management functions that can be usefully studied (Corsani 1939). The company is considered a system of risks, understood in general as a "generic risk" represented by a mix of specific risks. The factors that influence the risks and the management policies being enforced are examined throughout this text (Bertini 1969). In this framework, the analyses concerning the relationship between risk (also studied in relation to the different phases of the life of the company) and entrepreneurial behaviors are contextualized (Fazzi 1957).

The general policy of the company is strongly influenced by choices that concern risk management (Bertini 1969). Management behavior is the result of decisions regarding the governance of the risk system since every management challenge cannot exclude the factor of risk (Dezzani 1971).

The factor of risk in companies can be encountered when combining the tendential rigidity of the structures with the dynamic evolution of the context (Capaldo 1965). Consequently, the topic under consideration can be placed within two conceptual levels of analysis:

- mitigation of the overall risk intensity by acting on the internal and environmental variability as well as on the rigidity of the organizational and operational structures (strategic vision);
- management of the negative effects of risk by transferring them in space and time (Cavalieri 2008).

The factors that influence risk are attributable to all those significant circumstances (in the specific case) that produce variability (and add rigidity) to the environment. Internal

variability is, therefore, linked to the rigidity of the organizational and production structures. Any list of factors that influence risk can hardly be exhaustive of the numerous phenomena that prevent the virtuous adaptation of administrative behavior to change. Management adopts complex management strategies and policies aimed at facing the ever-dynamic business/environment relationship.

The "conscience of risk" (Giannessi 1960) contributes to the creation of programmed management. This is an indispensable prerequisite of a management action that responsibly addresses management challenges. The importance of the information system to support decision-making processes is, therefore, well understood.

The final choice could sometimes prefer intuition, in contradiction with what would suggest evidence of the data concerning the identification and classification/assessment of risks (for example, through the probability of the event, the extent of the damage and of the cost of prevention). This is not surprising, as intuition is the creative dimension of decisions. Intuition is the capacity for imagination—supported by the rational component (study and experience)—together with the profile (and expectations) of the decision-maker. This is the most important factor when choosing how to manage risk.

From the examination of the literature review, several significant observations emerge:

- risk is considered as a state of uncertainty (in other words, the concept of risk is used to signal perspectives regarding random events that can be set in a static–mathematical way);
- risk analysis is conducted considering the factors that generate it in its complex entirety as well as aiming to strengthen its economic function, in favor of all stakeholders (Dello Strologo 2006);
- the risk assessment is usually referred to the company (private and capitalistic)—the reference to the other organizational models of production (Capaldo 2013) is considered rare—in addition to the associated general economic risk that summarizes the complex of risks;
- the numerous classifications—not necessarily opposed but consequent to the development of a perspective and purpose of the analysis of the risk system—place the accent (depending on the cases) on the factors of influence, the functions, the processes (Beretta 2014), the consequences, on the effects (negative and/or positive) and, in this regard, distinguished itself between pure and speculative risks;
- the prospective investigation and the search for integration between risk management and strategic control are considered as risk mitigation tools (Caramiello 1965; Forestieri 1996);
- there is a tendency—with some exceptions (Adamo 2002)—to consider business risk in relation to equity risk.

Considering all the premises made so far, in order to provide a contribution to the study of the economic function of companies, it is possible to distinguish the topics of uncertainty and risk. More precisely, the uncertainty will be referred to the business going concern, while the risk (more specifically the distribution of risk) will concern all the people who oversee the production. Consequently, this research focuses on the distribution of risk among the participants in the production function. It is possible to establish and/or guarantee the survival of companies since a level of uncertainty (going concern) is reached becoming compatible with the claiming of production factors (especially for the financially sensitive part). The management of risk distribution means affecting the humanistic and environmental profiles of production. This framework introduces an ethical dilemma and, therefore, a normative problem that does not have an easy solution regarding the forms of production (or the satisfaction of human needs and aspirations). The authors, with this paper, intend to deepen and more closely and systematically link the studies on risk/uncertainty and those concerning the economic sustainability of the company by analyzing the link between business and community. The study, therefore, focuses on the theoretical–empirical verification of these links.

3 Methodology

The present work paper is categorized as exploratory research, based on investigative techniques. It is a fundamental and qualitative research which aims to demonstrate the growing strong connection between the companies and the communities in which they operate. Starting from the analysis of all the configurations that risks can take in relation to strategic and operational choices, as they are linked to an unpredictable future with respect to many aspects. It is also shown, in theory, but also as empirical evidence, how sometimes some companies survive despite the absence of financial return because they guarantee a social welfare of the community that is considered more important to private profit. It, therefore, occurs that the existence of companies is linked not only to profitability but to sustainability and its integration with the needs and benefits of the community in which it operates. The method followed in the analysis is the use of deductive logical reasoning. A logical reasoning is a form of reasoning that allows to reach a conclusion (conclusion proposition) starting from a set of premises (logical propositions), following a logical–rational path. Considered

valid the wide and coherent literature that determines the logical propositions, through the innovative reasoning we reach a coherent conclusion, founded and useful for the analysis of the survival of the enterprises, therefore to demonstrate some conditions of going concern that apparently would not be instead justifiable in the absence of financial return.

4 Analysis: From General Theories to Analytical Procedures

The topics (and reports) of our focus are the following:

- company;
- uncertainty;
- risk.

The (scientific) notion of a company defined by business scholars. The researchers identify (conventionally/instrumentally) the requirements to define the object of analysis and with respect to this, the paradigm assumes extensive boundaries.

The system of economic events is always the irradiating factor of the topic, although scholars have defined the meaning of the word "company" (Zappa 1957). This word is the expression of the historical moment and of the development of studies, of the means of research and, of the scholar's ability of imagination (Giannessi 1960).

The variances found on this topic are often only expressive and not substantial. Scholars agree on the fundamental area of the investigation (the systematic production of goods and services), even if the specific topic "company", and on its conceptual boundaries. They are punctually delineated with the identification of specific elements that tend to expand or reduce the object of study. The core of scientific observation is always production (Onida 1986).

The meaning of a company (Amaduzzi 1978), therefore, is based on that of "production", that is defined as the systematic production of goods and services and how they are conducted. The production is put in place to achieve the goals (of the promoters of the company or of the entities to which the company belongs), and (simultaneously) the expectations of the people that gravitate around the production entity (Masini 1979; Capaldo 2013).

There is a substantial difference between the (institutional) goals and expectations. If the goals are not satisfied (or if they cannot be met in the future), they can compromise the existence of the company. Failure to achieve the expected objectives does not usually entail the termination of production until the company maintains a force of claiming resources (not necessarily the same). However, the aims and expectations can be persistently pursued (not the same for the purposes) only in the presence of conditions of persistence. These conditions can be obtained consistently with the goals and expectations of achieving the goals of those who, with their specific expectations together, achieve production (Bertini 2006).

However, it may happen that the conditions of production management may not be shared by some who instead wish to terminate the production center. It can also happen that the going concern is obtained without having adequately satisfied the aims of the institute (because they are supported little or nothing at all), or if we want to satisfy other goals, transforming certain (legitimate) expectations into goals.

The company is imagined by its creator(s). The latter assigns the purposes to the company—and the company cannot start, since the conditions of economic functionality are not met from the planning stage. In other cases, the uncertainty of the going concern can be considered acceptable and, in this regard, the methods of participation and claiming of the players to production are obviously not indifferent.

Economic persistence is the principal depersonalized condition of (autonomous) existence of the entity, and, when it ceases, production ceases. It should be added, however, that economic functionality can be obtained in different ways, albeit always uncertain, since it is linked to the claiming of the carriers of those factors that generate production, including users of the outputs. In fact, there is no doubt that production is always a collective technical–economic process, even when there are inevitable conflicting behaviors.

The sharing of production choices (in the absence of defined borders) is clearly considered as an economic fact which, however, has the practical need to be regulated by the authority. This regulation is preferable to be established by public power that responds to the need to define the legal boundaries of the responsibilities, duties, and rights that characterize the business practice of the market, starting from the decision-making process. This requires the presence of instruments of governance that allow to compose the forces that generate production. In other words, to define the propulsive decision-making center and, therefore, the organizational apparatus represents a challenge to be faced.

The fluidity of the development of production can be high and concerns about the ability to define ideas, decisions, and actions are projected into the future (Bertini 1995). The fundamental premise is the sharing of the distribution of sacrifices, of the benefits and risks that characterize them, besides the uncertainty of going concern. So, more than anything else, the initial production conditions design the company in an original way (making its going concern uncertain). The company can durably serve to satisfy aims, expectations, and finality (human well-being), placing as its only constraint the economic functionality, which will

obviously depend precisely on the planned conditions and developments. In other words, the methodological approach to the construction of the company would start by examining the ends for which production takes place and the conditions that make it possible and convenient. It then identifies which organizational structures can contribute to its realization, gratifying at the same time goals and expectations, in respect of an economic system that is projected with reasonable possibilities to last in the future.

Uncertainty is a connotation of the economic function (and, therefore, of the going concern) of the factors of production. Usually, uncertainty is considered a threat, but in some cases, uncertainty is a strength, the basic elements of production.

Uncertainty as a characteristic of the future (due to inevitable change) is a factor in the persistence of production factors. All players expect and trust in the possibility that the future is different from the present (without neglecting the fact that many productions are based on the uncertainty connected to the manifestation of future events). In short, uncertainty (even for a production player) is simultaneously a disturbing factor, but also a fundamental element of the going concern.

The uncertainty management, in order to ensure the going concern of the factors of production, is the essence of governance action. Governance choices are linked—in different situations—to the attitude toward the future. Two different approaches are observed: fatalistic (intuitive) attitude, and rational behavior.

Human decisions are based on the rational component of the analysis of past events—already known—and on the reasoned prefiguration of future scenarios.

The level of knowledge distinguishes the human attitude with respect to a past context object of analysis. The past, as it has already occurred, is not uncertain but only known in depth. Otherwise, the future scenario (as it will still have to happen) is uncertain in the forms it will assume, but it is also partially orientable because current decisions will help to shape it. Therefore, when making decisions, people consider a well-known past and formulate simulations about the future which, as a whole, will be the result of acts (deliberately and/or involuntarily put in place by people) and natural events.

The intuitive component, if considered as the sensitivity to interpret the phenomena and their evolutions, goes beyond formal analysis, and sometimes completely disregards the data ("rationally" obtained) privileging intuitions. Past experiences and technical analyzes determine the intuitions.

The decision-makers in their rational dimension—judged as such based on information from the past, appropriately projected into the future—operate in such a way as to create the conditions for conducting the events most suited to them. Naturally, things can evolve in such a way as to define totally or partially unexpected results, due to circumstances not captured by decision-makers.

The change (in which the root of uncertainty must be identified) may be due to human behave—voluntarily or accidentally—and/or caused by natural events. The increase in knowledge regarding the ability to interpret the current situation and its future developments and the agreement among decision-makers in defining future scenarios tends to mitigate the uncertainty of the future. In other words, if the state of uncertainty regards phenomena attributable to human decisions, it will always be possible to reduce the uncertainty by increasing the knowledge with reference to the decisions taken. Otherwise, for the events caused by humans behave in an unintentional way the state of uncertainty cannot diminish by increasing knowledge, but it can be reduced by thinking over the historical experience and examining the probability with which accidental facts can be manifested on a case-by-case basis. For many natural events —not attributable to human behavior—this is exactly what happens: where it is possible to reduce uncertainty with the help of the tools offered by scientific progress regarding the occurrence/nonoccurrence of an event. Of course, formulating perspectives on the future is different from solving the consequent damage or—more rarely—deriving an advantage from the random event. The ability to manage uncertainty is a fundamental quality to ensure the company's persistence (even if sometimes it may not be enough) and, consequently, reduce the riskiness to which the goals and expectations of those operating to realize the production are exposed.

The risk is connected to a deliberate act that regards an expectation projected into the future (uncertain) and that, therefore, can (what is expected) does not manifest itself in the desired terms. In essence, the decision is taken by the actor with the hope of changing the personal sphere (assets and/or affective), with effects that he considers convenient for himself (otherwise the choice would not have a rational sense) but which may occur in unfavorable way for the combined effect of other people's acts (deliberated or not) and natural events. Thus, the concept of risk is revealed by simultaneously considering three issues: the uncertainty of the future; the deliberate action that requires a sacrifice that is borne in expectation of a utility; the eventuality that the expected outcomes do not occur to the extent necessary to repay as desired for the effort endured. These are interrelated issues and, therefore, the risk is the conceptual platform that connects them.

Uncertainty is not enough to bring out the "risk" and, therefore, these are distinct concepts.

The risk, in the first place, is a bridge that links the uncertainty of the future with the rationally formulated expectation that triggered the decision. In other words, uncertainty for some takes on value as it is linked to specific

expectations, while for others it is insignificant, considering the expectations at stake and, therefore, for the latter there is no risk, although also for them the future scenario appears uncertain.

First, the risk is a bridge that links the uncertainty of the future with the rationally formulated expectation that triggered the decision. In other words, uncertainty, for some researchers, has a value as it is linked to specific expectations, while for others it is insignificant, considering the expectations at stake and, therefore, for the latter there is no risk, although also for they the future scenario presents itself uncertain.

A future scenario can be considered simply possible or probable according to whether we can forecast future events in a rational and credible way. Otherwise, it happens for the risk—in the meaning just mentioned—an analysis of possibilities or probabilities is not appropriate, but an analysis of intensity. The risk qualifies, in fact, in addition to the probable future event, also due to the type of waiting and damage commensurate with the personal (and patrimonial) characteristics to which the decision-maker is exposed. Therefore, the risk always has a subjective connotation as it qualifies for its intensity of perception. Therefore, the entity and quality of the sacrifice (considering the patrimonial solidity of the person making it, the feasible alternatives and its psychological-affective characteristics) to which is connected the uncertainty of the potential damage that is expressed in the impossibility to achieve the expectations (of any kind, not only in economic return), qualify the risk that always has a well-identified subjective connotation. This means that if the sacrifice (considering the position of the investor) is insignificant, the risk to which the actor is exposed is equally insignificant. Moreover, to the extent that the investment is recoverable in alternative ways compared to the bet, the risk is mitigated, since the damage on equal terms other conditions tends to be lower.

The risk is subjective as it depends on the expectations, which obviously are personal, and the investment made, while the uncertainty has a general connotation because it relates to the future and represents the depersonalized dimension of the conceptual platform on which the risk is based.

The distinction between uncertainty and risk makes it possible to grasp some characteristics of management, particularly those of the capitalist company.

The attention of researchers in the business environment has focused on the capitalist model. This model has a well-defined institutional purpose that must be pursued simultaneously satisfying the expectations and under the constraint of lasting economic equilibrium. This is an extremely complex and indefinite goal. The complexity is due to the difficulty of arriving at a synthesis between aim, expectations, and economic constraint; the second characteristic is connected to the uncertainty of the future, a context in which the complex synthesis must be sought. This goal is a connotation of existence that is continually repeated and, therefore, can never be judged to be definitively achieved.

A utility function can summarize this notion. In this utility function, subjective expectations with different natures (psychological, affective, competitive and financial) are combined that refer to all those involved and who make their existence possible. In other words, the setup and survival of the company are not motivated (necessarily) by financial reasons, which paradoxically can also be missing or have a marginal role in the desire to start (or continue) the business. This happens especially when the player is not pressed by inferior needs, so he can be considered satisfied by the achievement of relationships. However, the production players, to satisfy the utility function (i.e., the system of expectations—expressed or not, with legal relevance or not—to which the components that together allow production are linked to each other), must work in compliance with a lasting economic order, consistent with the target assigned by the person or those who caused the startup and with the expectations of those who allow management.

The constancy of the conditions that ensure the economic order—a founding profile of the company going concern—in line with the institutional purpose (and with the expectations of the various stakeholders) is not easy to obtain and this is not due to technical and operational difficulties. However, it happens for the certainty of changing future situations (compared to current). These changes continuously require the search for new economic combinations (technologies/products/markets). Therefore, the uncertainty of the evolving future of the environment/business relationships results in the uncertainty of obtaining the conditions proper to the economic order which are a guarantee of going concern. Those conditions however—it must be specified—are closely connected with the distribution of the sacrifices/benefits that belong to those who make the survival of the production player possible. It refers to both the characteristics that distinguish the claiming of resources and the modalities of their economic reintegration. By managing the distribution of sacrifices and benefits (and therefore the composition of the risk of the various expectations), it is possible to influence the degree of uncertainty of the economic order and, consequently, the going concern.

The future scenarios will obviously have different chances to happen and different effects on the expectations of those who wish to continue the company over time. In other words, the possibility that the company ceases to exist as an independent production center is connected to the circumstance of operating in an inconsistent economic order. This economic order must be compatible with the expectations of

the benefit of those who allow corporate survival thanks to their sacrifices.

When the conditions with which the players managing the production are changed, the overall scenario changes. The economic morphology and all that makes the going concern probable are also modified, in the interest of all the players (assuming the risk of the company) with different expectations in the project of activities to be conducted.

The company is a unique and continuous production project that spreads in time and space, although it consists of various parts that make it autonomously. A multiplicity of resources/expectations converges on it, putting a common expectation in going concern. In the absence of going concern, all expectations would be compromised. Every expectation has its own peculiar riskiness, and all together are subject to the uncertainty of the going concern of the economic order of the company.

The "common risk" is a conceptual bridge between the uncertainty of the future scenario (in which the production project will be implemented) and the desired common expectation of a virtuous economic order, expression of a common interest in maintaining the going concern (also if the particular interests are of different importance for the respective "owners" and not necessarily all the subjects that gravitate in the production orbit wish the going concern of the production in progress).

The various actors differently feel a common risk, it is different from the risks' specific assumptions taken individually by those who make the production, even if it remains connected to the latter. Even with the same intensity, many alternatives can be imagined in the distribution of specific risks. The specific risks characterize the uncertainty of the going concern and, consequently, the intensity of the common risk.

The common risk—conceptual synthesis of specific risks for the remunerative-monetary component only—is linked to the possibility of lack of going concern (eventuality that when it manifests transforms the specific risks into negative contingencies with different weights according to the subjects affected, but for some subjects we can also imagine positive consequences deriving from the cessation of specific production).

To mitigate the intensity of the common risk, it is necessary to devise the organizational models of production in line with the company's survival conditions. In other words, some initiatives according to certain production models can be judged to be of low common risk, while they would be impracticable according to other models due to the uncertainty that would characterize their going concern. The choice of the institutional profile is fundamental so that the production center can perform its functions durably and consistently with the function for which it was created. It is evident that there will be legal problems to be resolved (both legislative and contractual) but this does not constitute a serious obstacle to the creation of freely imagined production initiatives (there has already been an empirical finding) (Zamagni 2013).

Therefore, let us highlight the theme of going concern and the common risk governance and the need to define the institutional model of reference (and, therefore, governance). It also analyzes the organizational efficiency understood, which acts as a link for the identification of the most convenient business program and the related financial coverage. Naturally, these three elements

- institutional formula;
- suitable business size;
- efficiency;

influence each other in determining the going concern, which must be considered a common objective of the "forces" that are favorable to making the company last.

5 Findings: Results and Related Considerations

5.1 The Cornerstones of Economic Functionality

The overall functionality of the company (its ability to create value, i.e., its ability to realize shared utilities) is an indispensable condition for the going concern of production, at least in terms of rational decisions that affect the prolonged survival of the company. However, it should be added that this functionality—in a market economy largely based on monetary exchanges—must first and foremost be confirmed by a lasting economic equilibrium. This extremely complicated balance to be defined, its boundaries are narrower than those that define simple economic survival, this is, in fact, the condition of autonomous existence of the company—understood as a center of production with an indefinite duration. The constraint is represented by the enduring gratification of the institutional purpose and expectations of all kinds, defining its contingent humanistic–environmental synthesis in the distribution of benefits, sacrifices, and, therefore, of "risk."

Economic equilibrium (monetarily weighted by the "market" and durable) is based on a social contract. The production program and the efficiency with which production is carried out, strictly depend on the underlying humanistic and environmental profiles.

By preferring the expository clarity, the aforementioned questions will be considered in sequence, although empirically the problems to be addressed are not linear. The setup of the company that you intend to start to achieve the desired goals and expectations requires continuous adjustments to

the strategy that lead to reconsidering the choices already made.

There is a close link between the lasting economic equilibrium (monetarily weighed by the "market") and the distribution of sacrifices and benefits for those who are the players of production in the most diverse forms. Players can participate with capital, work, or in other ways. In general, anyone can participate by supporting sacrifices or considering that they can enjoy direct and/or indirect benefits (even if they have not participated in the creation of the company). If we change the type of involvement of the players and the forms of the fruition of the results, the conditions of the balance are also changed. An enterprise may end (or managers may be replaced) not only because the durable economic balance has ceased to exist, but also because it no longer satisfies the purposes (and expectations) for which it was established (even if it fulfills the requirement weighed by the "market").

Let us focus on these aspects.

The production process—much wider than the borders of markets—is always a corporate process. In practice, the company examined in the production process appears to be a phenomenon without clear boundaries which, however, naturally exist in its formal management. The crucial point, therefore, concerns how to achieve the unanimity of production decisions oriented toward the creation of value (not only considered as financial value).

The principles of the social contract must be contextualized. In this context productions are carried out and, therefore, alternative forms of governance can be imagined according to the way of mixing sacrifices and benefits.

The governance—that is the realization of the social contract—determines the formal and real involvement of some players in defining the choices of the company which, however, also depends on the behavior of other players formally excluded from the decision-making processes. The excluded players are only formally and not even in substance. On the contrary, it may happen that they are also officially involved—this will depend on the context—due to higher standards than those concerning governance.

Practical solutions to the problem of the social contract can be very numerous, although there are currently a limited number of governance models, some of which clearly prevail over others. The difficulty lies in identifying and weighing the principles on which to base the "effective contracts" for the startup of new productions.

Many guiding principles can be imagined determining governance. Among the most common principles (which can also coexist also with different weight) on which the governance models of the organizations are based are the following: properties; democratic (at different levels of extension); realization idea; critical resource; risk tolerance; prevailing sacrifice; honesty and competence. We can certainly imagine other principles, each of which can be applied according to different criteria, also made operational by imagining various parameters.

The empirical problem of the substantial representativeness of governance arises. The sharing of choices of governance must be assessed in relation to the need for timely decision-making. The freedom to manage the production process determines some practical problems of considerable humanistic–environmental importance that must also be dealt with in legal terms.

Given the constraints that the past choices make to future decisions (which basically concern the modification of the structural scenarios of the territories) and the consequences that the latter will produce on future social equilibriums, the production models embody the humanistic–environmental connotations of the communities.

The going concern is based on the ability to conceive and implement a production program that ensures—bearing sacrifices—the expected monetary rewards, an essential condition for all formal players to remain (even if they can be replaced) voluntarily and durably present as a unit (even if they are many) in the production process.

The elaboration of the most appropriate activity program is always relevant, although the issue has often been addressed by focusing on the producers. Economic processes are fueled by revenues (usually monetary) provided freely by customers who use production output.

A reasonable level of investment (in terms of quantity, quality, prices, places, and times) depends on the expectation of a balanced satisfaction of the formal players in production.

Investments must be included in the program of activities to be carried out, carefully detailed in the overall scenario (in terms of time, place, price, quantity and quality of production outcomes) and in the methods of covering the capital requirements generated by them. The going concern is assured by the virtuous balance also of informal factors.

Considering the main elements of the problem of the size of the company, overall scenarios can be observed in which the uncertainty of the going concern may vary according to the choices made. The most important choices relate particularly to the ability to claim capital and customers, as well as decisions that give flexibility to the business program. Flexibility can be achieved through the sharing of resources with other producers, to reduce the sacrifice (which must then be remunerated in some way) through collaborations (of various kinds) that can help reduce the financial needs associated with the autonomous acquisition of resources.

In short, the size of the company relates to the rational conception of the overall scenario among the many possible ones. Each scenario is characterized by uncertainty and risk

factors linked to different expectations. Expectations related to the benefits obtainable are distinguished in terms of quantity, quality, distribution, and timing.

The expectations of all the players are different and uncertain, but they constitute a strong element of cohesion and push towards improvement. However, this is not enough to avoid the opportunistic behavior of groups and/or individuals, particularly when we are going through critical moments that test the going concern. Production players may be exposed to risk with different intensity. The need to use other instruments of internal cohesion that reinforces the conditions for the good functioning of the company is evident. This finding brings us back to governance problems and introduces us to the next topic that concerns the concrete functioning of the company over time.

The assessment of the going concern of a company focuses on the wideness of the activity program. This program constitutes the link between the possible solutions of the social contract (governance), and the efficiency of the productions realized. The problem of going concern concerns structural choices (distribution of sacrifices and benefits, as well as the wideness of the entrepreneurial program is based on efficiency expectations) linked to each other and the efficient performance of operations. The foundation of the durability of production over time is linked to efficiency.

The uncertainty regards the occurrence that the overall scenario (with respect to which the programmed results are calculated) is expressed in a different way from what is expected. There are, therefore, results that are different from those desired which compromise the (economic) order of the manufacturer, endangering its survival.

Two cases must be distinguished:

- the deviation due to an optimistic assessment of the future, formulated in good faith, or due to opportunism;
- the deviation due to the action that determines the outcome.

In this last case, it is necessary to be able to recognize the malfunctions—even deliberate—of unexpected events that, of course, can compromise the going concern of the company.

The malfunction occurs when the production combinations are made differently from the production program. This happens because of organizational choices concerning the efficient performance of the productions.

An unwanted scenario could be neutralized in all (or largely) by acting on organizational processes. This involves the sustaining of costs. Alternatively, the company would expose itself to a possible future negative event. In one case, organizational choices face uncertainty, while in the other, exposure to uncertainty is a "friction" to which it is consciously subjected to choices of convenience or lack of alternatives. Uncertainty can be faced by focusing on the basic structure of the company, that is, on the wideness and on the social contract. Alternatively, if the basic scenario is not changed, economic–financial strengthening policies can be implemented. The two choices are not alternatives.

5.2 Going Concern, Risk, and Social Responsibility: The Spread of Information

The hinges of the going concern (governance, wideness, and efficient functioning of the production process) were presented sequentially. In substance, they represent the entire corporate challenge, inseparably linked to the humanistic and environmental profiles that characterize the production. In other words, the company operates (systematically) in the environment through choices of economic functionality that are significant from the point of view of the humanistic–environmental profile (and, therefore, of risk distribution) that defines the specific identity.

The (rational) choice of ethical values in the reference environment implies a particularly complex evaluation. This choice must reconcile the institutional purpose, the production/distribution processes and the conditions of economic functionality. These elements are closely related to the issue of going concern and the distribution of risks and, therefore, with the problems of corporate social responsibility (CSR) in general.

Two questions can be formulated. What meaning can be assigned to the CSR expression from the point of view of economic–business analysis? How is social responsibility linked to the issues of uncertainty and risk? The following reasoning tries to answer these questions.

All production players have an impact on the community. However, the institutional goals for which production is implemented are different. Consequently, their economic morphology is different, as it is affected by the realization of the institutional objectives, in line with the gratification of the multiple expectations of those who participate in various ways in the production.

The assessment of the social responsibility of a company can be rationally set by systematically analyzing the going concern, the production process, the efficiency, the adequacy of the performance, the institutional effectiveness, and the social impact. The going concern is an essential condition for expressing a judgment of social responsibility on the behavior of a production players (Manni 2011b; Salman and Abdul Razzaq 2018; Azzam Hannon, & Hayek, A. F 2016).

Social responsibility represents the foresight of governance. The assessment of social responsibility does not end with considering single—even if praiseworthy—patronizing

initiatives that bear witness to their social commitment, but it cannot even relate to individual aspects. Every action must be related to a context (or to a concept, for example, sustainability). The boundaries within which to report the judgment of the context must be defined (sometimes in a very difficult way).

The social responsibility assessment concerns the choice of market positioning, the behavior and the results of the production players. The judgment is sometimes formulated even by those who have specific interests (this is reflected in the reputation of the company). Stakeholders rarely show themselves willing to assess their expectations within the overall framework of expectations to be met, based on relationships directly held with the production and information player they can access. The importance of communication (or simply information) is, therefore, evident to support the going concern of the producer (and the transparency and awareness of the distribution of risks). Every news influences reputation. Reputation has consequences on the economic function of governance.

It is evident that the quality of the social commitment of the companies contributes to forming a judgment of responsibility.

Social engagement is a discretionary act and therefore rationally justifiable only from the point of view of positive selfishness. This social commitment can be achieved in many ways, but in any case, it aims to increase the value of reputation. This factor reduces the uncertainty of going concern, also through appropriate forms of communication (Socialis 2014).

The production agents spread the news—mostly by free choice—continuously, in many ways (sometimes even with conflicting messages) and with particular and/or general contents and often obtained with complex methodologies that require specialized knowledge to be understood. Particularly important is the spread of information using tools that are consistent with different analytical approaches of the company. From the accounting point of view, equipped with many structured means of information, the main instrument is the financial statement.

The main objective of the financial statement is the valuation from the perspective of ownership and the prevailing reference to prices expressed by the market. From the financial statements, however, it is possible to obtain news concerning other subjective perspectives or make evaluations or provide nonfinancial information (Direttiva approvata dal Parlamento europeo 2014).

The financial statement technically summarizes the choices made in terms of uncertainty (going concern), distribution, and hedging of risks in a specific and general manner (Di Lazzaro 1990). The accounting doctrine agrees in attributing to them—regardless of how they are implemented—the function of strengthening the whole enterprise in order to protect the overall expectations.

The substance of the financial statements consists of the valuation agreements aimed at balancing the contractual expectations with the allocation of benefits to the factors of production (or rather to those who have made them available for the exercise of the business) placed in a condition residual (Besta 1932).

It should be noted that the financial statements are an instrument aimed at measuring the distribution of earnings. Therefore, the main issue to be addressed (in the hope of improving information geared to allow assessments on going concern, distribution of risks, and, therefore, measurement of social responsibility) is the development of an information system released from the function of identifying earnings with "remunerative" functions. It is also necessary to give up the idea that the automatisms to be entrusted with the task of illuminating the going concern can be elaborated since it is a creative (original) activity. Except in cases where this judgment concerns cases of companies in obvious default. In short, it is necessary to continue the efforts to identify a more efficient external information system that can express an information platform (in this sense, the new information technologies can make a considerable contribution) from which to evaluate the ability of the company to survive in time. This should facilitate the efficient allocation of resources both at the micro-level and at the macroeconomic level.

Among the tools designed to improve the structured external information system (of production players) is the social balance. This expression indicates a formalized instrument that, among the many characterizations that we give for notes, takes as the result the economic result of the financial statements. This tool is free in form, but dependent on the associated valuation conventions, in the analyses concerning the production and distribution of earnings, it is, therefore, a very important tool for judging the value system on which the going concern is based and the distribution of risks between many expectations.

Generally, all players to production (shareholders, workers, customers, suppliers, institutions) are interested (albeit in a different way) in going concern, but, of course, for this purpose, the methods of acting are not indifferent. These methods are based on the values that guide behavior.

The social report (understood in the fullest sense of the expression, that is, as an information tool having a content in which multidimensional and multi-subjective evaluation perspectives are present) should provide the possibility of judging the foresight of governance to achieve an integral development (Sorci 2006).

This tool, therefore, helps to evaluate the going concern, as it focuses on the factors that determine the economic

function, inseparably linked to the humanistic–environmental profiles and, therefore, to the distribution of risks concerning the different expectations that collectively converge on production.

The evaluation of going concern implies the ability to project the present into the future. The judgment on going concern cannot be separated from the time factor. The evaluation must necessarily consider the context in which the production player operates. The strengths (and weaknesses) make sense with respect to this player, as they are able to seize the opportunities and/or face the threats that emerge from the economic context.

The analysis of the context in which the company operates and its future developments represents the starting point for any judgment that focuses ongoing concern. We must then carry out a careful examination of the company, to evaluate its harmony with the developments of the future context, according to different points of view. The identity, the mission–vision–strategies–programs sequence must, therefore, be analyzed; the current and future economic and financial strength in the short, medium, and long term; the relationships with the interlocutors appropriately segmented, in particular with regard to the sustainability of the production/distribution process of earnings, on which the well-being of the communities is based and on which the production players are called to participate in a socially responsible manner.

In the drafting of the social report, the crucial problem is that concerning the diffusion of private information, that is, of those news concerning aspects of management considered critical, as they could jeopardize the going concern. In fact, the influence that the critical information has on the company's reputation (which—as is well known—is the cornerstone on which the going concern rests) is not negligible. In particular, care must be taken to ensure that information is disclosed in the financial statements or if not considered for the purpose of calculating income for the period. In other words, it is necessary to reason whether and how information can be disseminated about the negativity of the company, which however did not participate in the (quantitative-monetary) formation of the total operating income identified by law.

The topic is complex, as it is necessary to reach a synthesis between:

- conduct evaluations for the assignment of the surplus to those entitled;
- provide quality information on going concern, intimately connected to the issue of risk distribution among production players and, therefore, to the humanistic–environmental aspects that characterize the business management.

In other words, it is necessary to balance the reasonable expectation to remunerate the bearers of the production factors remunerated in a residual way with the quality of the prospective information concerning the economic functionality of the production players.

We would like to point out, in this regard, that it is better to avoid considering corporate social responsibility as a homogeneous and specific variable, as it is a way of observing company policy. It is evident that the strategic choices impact (positively or negatively) on the results of the companies. Strategies that tend to modify company policy are pursued in the hope of improving results, but unfortunately, they do not always have the desired result, whether one observes it financially or considers it from a humanistic–environmental point of view.

Consequently, the outcomes of the empirical investigations conducted to analyze the relationship between CSR and certain aspects of the economic function of enterprises are inconsistent only in appearance (in the sense that they reach divergent conclusions about the effects of CSR on the financial results of the company).

To explain the reasons for our opinion, it is useful to go back to distinguishing between CSR and going concern and between CSR and the risk to which specific expectations are subject. Greater or less preference (which sometimes depends on the cost of claiming) of specific resources. It is evident that in the first case a forward-looking (i.e., virtuous) governance increases the probability of the duration of the enterprise. The same governance can be considered riskier with reference to individual expectations (always a priori and with respect to alternative choices). The value depreciation of the expectations involved is determined. In other words, discretionary choices in the humanistic–environmental field are taken in the hope of an improvement in the conditions of going concern, or they should not be implemented.

This is a difficult judgment in that it concerns the allocation of shared resources and then it may happen that, in retrospect, similar initiatives of social relevance, in some cases, have the expected "synthesis" effects. In other cases, they are not separate, but should always be put into place in the hope of strengthening the conditions of going concern. If it were possible to try a different expectation, then it would be a distraction of resources from the pursuit of institutional goals. The institutional aims are not exclusively financial, but can also be psychological (of power, affective, or solidarity). These other purposes are not acceptable as they would tend to benefit the direct recipients of the socially relevant action to the detriment of all the others, who derive from the expectation of going concern the fundamental premise for the satisfaction of their financial and nonfinancial expectations (Fig. 1).

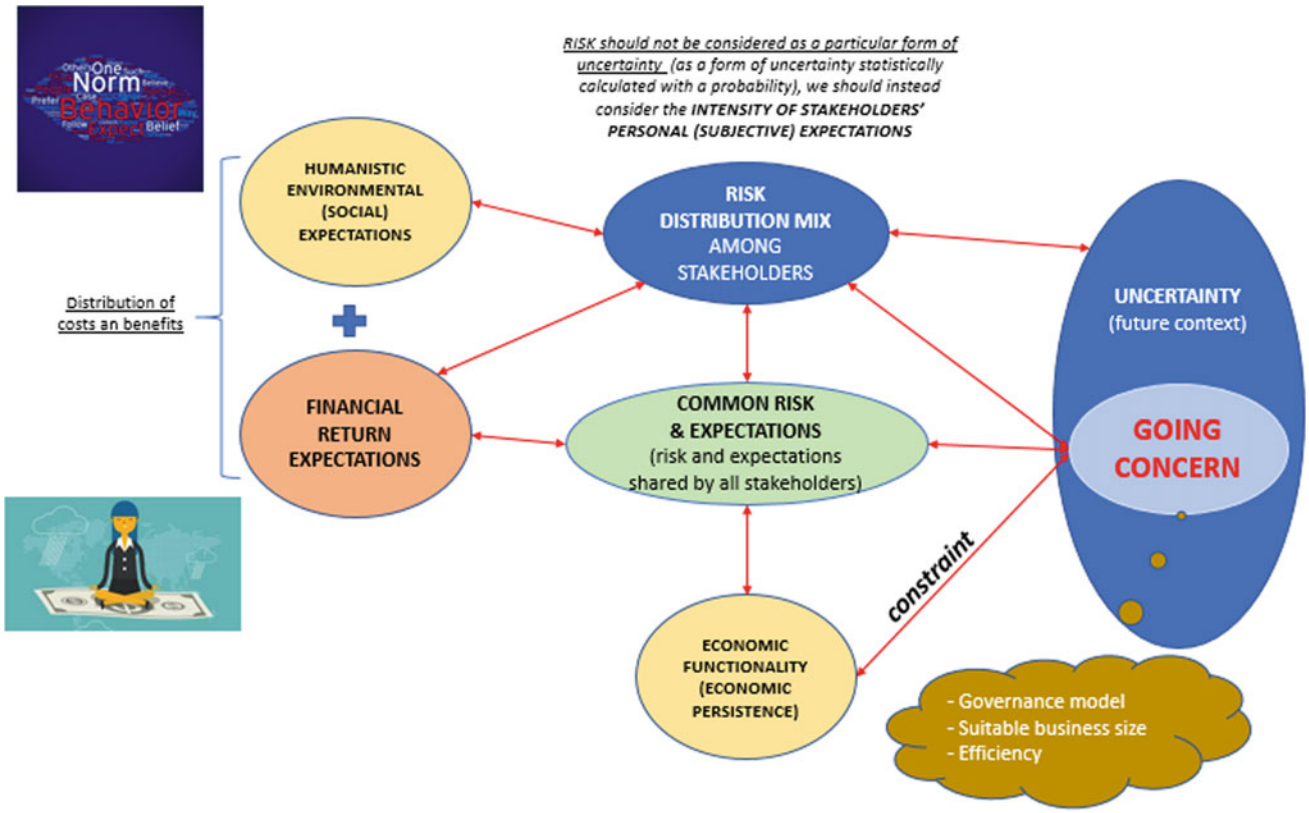

Fig. 1 Link between social expectations and economic functionality

6 Conclusions and Recommendations

What we want to point out, at the conclusion of the research paper, is the ethical–social dilemma concerning the organizational models of production. To what extent is it possible to leverage the humanistic–environmental conditions to ensure the conditions of company survival and, therefore, the going concern of the productions?

In the default situations, the humanistic–environmental issues of production emerge with particular importance, urging the search for solutions to the social problem that the exclusion of a company brings with it.

It is possible to identify solutions compatible with the claiming of the productive factors and, therefore, to maintain the productions in place by modifying the intensity of the common risk. Changing the distribution of common risk means considering the humanistic–environmental aspects of production. This is above all an ethical dilemma and, then, also a normative problem that is difficult to solve that regards the production methods (or ways of satisfying human needs or aspirations), especially in the case of companies that directly or indirectly constitute a "centre of work" for thousands of people. The default of a large enterprise becomes the crisis of a community, even the Government of the State must, therefore, deal with human and environmental aspects, even considering the constraints deriving from supranational agreements.

It should be added that any attempt to reorganize companies in default implies "impoverishment" for all the stakeholders, but it is also an opportunity to think about new organizational models that envisage great innovations in the distribution of sacrifices, benefits, risks, and power. decision-making, thus conferring economic functionality to production. In short, the going concern is subordinated to the economic–financial sustainability of the humanistic–environmental connotations that characterize the production.

In conclusion, considering that the centrality of the financial return due to the persistence of the company is not obvious, in an uncertain future context it is evident that the complex system of relations that guarantees the survival of the company is also linked (sometimes mainly) to social expectations. The main contribution of this research can be traced, not only in the in-depth and complete analysis of Italian literature of the past century, but also and above all in the unprecedented systematic analysis of all these aspects and in the identification of the relations that bind them. By becoming aware of these relationships, it is possible not only to logically justify the persistence in the economic system of some unprofitable companies, but also to provide business

managers with a complete point of view to analyze the economic survival conditions of the company. It is not possible in fact to neglect apparently external and exogenous elements (such as social expectations) but which instead sometimes prevail and guarantee the survival of the company itself.

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The Effect of Shop Lighting on Customer Behavior (Dressing Room)

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Abstract

It is believed that lighting in fitting rooms can influence customer behavior and intention. It can particularly affect their decision as to whether or not to buy the clothing they are trying. Therefore, it is important to know which types of lighting solutions are preferable and which will make customers feel comfortable and relaxed. This study is conducted to test the effect of light on customer behavior and emotion. To come up with a result a visit has been made to the Mall of Sahara Center as a sample area, where three different fitting rooms in three different stores (Zara, Matalan, and Mango) were selected. Assorted measurements of luminous light were taken to find the average illuminance in lux (lx). Also, customers were interviewed throughout the field of experiments and were asked if they were satisfied or not with the light in each fitting room. An online survey of total 80 participants from different ages has been conducted. Then using the collected data, a simulation was conducted by using Revit software to ascertain the ideal scenario for ideal fitting room lighting that would satisfy customers and provide a comfortable environment during the shopping process. Results showed that most customers preferred the lighting in Mango because it did not affect the way they see clothes and it made them feel more comfortable under its shade. Furthermore, customers preferred frontal lights more than overhead lights as the light will not be reflected on the internal mirror and make the customer feels uncomfortable.

Keywords

Light • Customer comfort • Dressing room • Lux

1 Introduction

1.1 Research Background

It is commonly believed that clothing store dressing rooms influence shoppers when making decisions about their purchases, influencing the process either negatively or positively resulting in enormous effects on sales rates. Most retailers spend more money on their store's atmosphere and design to attract customers' attention which would invite them to their stores. Unfortunately, it has been noticed that many of these retailers neglect caring for the dressing room environment and design, which in turn creates a negative effect on sales.

Some interior designers agree that retailers overlook the dressing rooms despite the knowledge that these spaces can influence consumer behavior, while some believe that this is done on purpose to distract customers from the flaws, mistakes, or colors of some items. It is also known that consumer behavior is affected by the atmosphere of the store environment. It puts customers off and causes them to leave the store or to stay away if the environment is negative. In contrast, a pleasant atmosphere improves the customer's mood and potentially increases a store's profit.

Lighting designers point out that a store's illumination solutions can change how people perceive and experience the space. Retailers also use light as an element to create positive store experience.

In retail lighting studies, researchers found that lighting used as an environmental stimulus affects product evaluation, and can greatly enhance or hinder the store's atmospherics and the consumer's shopping experience.

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1.2 Literature Review

Environmental psychology is a knowledge base that focuses on the interaction between individuals and their surroundings. This section defines the term environment broadly including social settings, natural environments, learning environments, built environments, and informational environments.

Dressing rooms are essential to customers' decision-making when purchasing clothing. Poorly illuminated dressing rooms give distorted impressions of the clothing and oneself in those clothes and result in poor shopping experiences (Baumstarck 2008; Baumstarck and Park 2010).

According to the IESNA lighting handbook, there are several recommendations for the dressing room, one of which is concerned with lighting. In most dressing rooms, lighting emanates from overhead fluorescent fixtures, and light should also provide good color rendering to best present true color and texture. Lighting is therefore an essential element in the fitting room, which can create a good experience for customers, which in turn provides comfort and reassurance while choosing their clothes.

One study at Florida University examined women's behavior in fitting rooms, concluding that the overhead lighting created unwanted shadows across the face and form while the frontal lighting was preferred by most women because it created a sense of larger space accentuated by the surrounding mirrors. Conversely, overhead lighting closed the sense of space making customers feel cramped (Fitting Room Lighting Enhances Consumer Purchasing Power 2013).

Another article stated that overhead lighting is the worst for fitting rooms, as it creates unfavorable shadows on the face and body which will result in unwanted appearance for the customer. Fluorescent light creates unflattering green color on the customer's face. On the other hand, linear LED fixtures mounted to either side of the mirror will fill in any unfavorable shadows and offer even lighting, creating a great appearance for customers, resulting in a successful and satisfying shopping experience (Seo 2013).

2 Research Objectives

The purpose of this study is to analyze customer behavior and psychological response to an object under a specific light as well as how this light affects an object's color in stores and dressing rooms by comparing two different outlets. Surveying people's responses to determine the most suitable type of light for dressing rooms is the main objective in this study.

3 Research Methodology

3.1 Study Field Area

In this study, the Sahara Center has been chosen as a sample area since it is one of the leading shopping destinations in the UAE. It exists in Al Nahda St. near Ramada Sharjah, Sharjah city in the UAE, and is strategically located on Dubai–Sharjah highway. This shopping center has an area of 1.853.683 ft^2 with a total number of 350 stores. Each store has its own function and use. For the study, three clothing stores on three different levels have been selected with different light conditions but with approximately the same area. The stores—Zara, Matalan, and Mango—were chosen to study the impact of shop lighting on customer behavior. Figure 1 shows the two shops (Zara and Matalan) and the relationship between them. Figure 2 shows the third shop (Mango). Figures 3 and 4 clarify the entrances of each shop, noting that all the shops are accessible from the main corridor. Usually dressing rooms are in the back of the stores; these rooms are the targets of this study.

Fig. 1 Zara and Matalan shops

Fig. 2 Mango shop

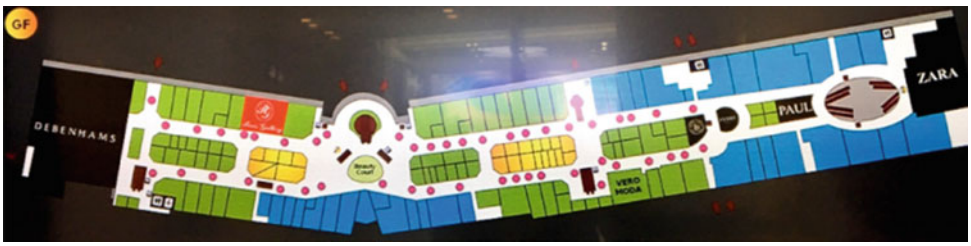


Fig. 3 Ground floor

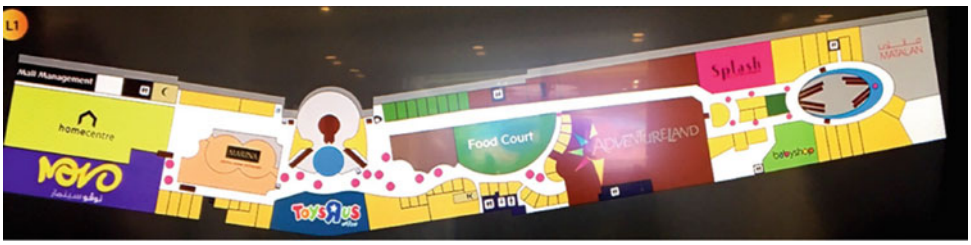


Fig. 4 First floor

3.2 Light Direction

To create a positive and attractive atmosphere, lighting is a key factor for shops (Baumstarck 2008). Lighting is an essential and important element in the whole store environment. Bitner (1992) stated that lighting has a pattern, color intensity, and direction. These elements give customers a sensation of comfort or discomfort. Baumstarck and Park (2010) suggested that retailers and shops use frontal lighting as an alternative to overhead lighting in dressing rooms, but if you want to build a wide range of acceptable lighting conditions and experiences, one must put into consideration the use of both frontal and overhead lighting. Accordingly, depending on earlier discussion, the followings hypotheses are created such as (1) Pleasure will be significantly higher (lower) when using frontal and overhead (frontal) lighting in dressing rooms, (2) Enthusiasm is significantly lower (higher) when using frontal and overhead (frontal) lighting in dressing rooms, and (3) Dominance will be significantly higher (lower) when using frontal and overhead (frontal) lighting in dressing rooms (Baumstarck and Park 2010).

3.3 Light Type and Color

The fluorescent lights that are usually used for overhead lighting are purchased without proper color rendering, as well as other features such as low CRI and warm color temperature that will affect the clothes color which makes it look faded and washed out (Kinetics 2015). It even makes

the fitting room look incommodious and narrow. Some fluorescent lights do not improve the color, which cause customer moods to change from excitement to disinterest when trying on clothes (Verywell Mind 2018). Bad overhead lighting could cause customers to lose their focus on their clothes because of the lighting physique; on the other hand, strait overhead lighting and frontal lighting does not allow facial shadows on the customer. Frontal lighting also reduces the appearance of bags and circles under the eyes and makes the skin appear clearer (Kinetics 2015). During the study by Baumstarck and Park (2010) on investigating the effect of dressing room lighting direction on customer perception of self and environment, she found that customers who try on clothes in fitting rooms with an overhead lighting tend to have a negative experience, while those who try clothes in fitting rooms with frontal lighting tend to have a positive experience. Frontal lights are normally placed on the sides of the fitting room, mounted by wall cones, for example, (track mounted fixtures and strip fixtures), while overhead lights are normally placed in the ceiling. However, combining both the frontal and the overhead lights will create the best fitting room experience that allows the customer to have a more complete overview of the clothes and their appearance. Another type of lighting can be used is the LED light. They have a good CRI, which improves color and saves energy. Warm lighting is used in fitting rooms which gives the impression of skin with a healthy brown tone that will make the customer look better and increase the sales rate because customers need to see what they are buying (Robinson 2016).

Fig. 5 Lunis® SL recessed downlight (directional spotlight), medium distribution *Source* https://www.siteco.com/fileadmin/downloads/application_brochures/1403_Application_Retail_en.pdf

4 Lighting Requirements and Research Experiment

Different types of light can be used in shops depending on the function of use, see Figs. 5, 6, 7, and 8 (Light promotes sales Lighting for the retail sector 2018)

4.1 Data Collection

A luminance meter (light meter) was used in the study to measure the light levels in three different dressing rooms. By using this instrument, three measurements for lights in each dressing room were taken from a height of one meter above the floor, then working out the average of those readings for use in simulation. A laser meter was also used to measure the dimensions of the dressing rooms, which will help us to draw the correct size of the rooms and accordingly achieve a proper simulation for the study. The readings helped in arranging three case scenarios; "best," "worst," and "average," in order to reach the best and most comfortable condition for the customer. Table 1 shows the measurements and average of each store's dressing room.

4.2 Direct and Indirect Variables

Two variables in this research have been set: the independent value, which is the luminous values (lux), and the dependent variables, which is the emotion and behavior of the customer, i.e., check whether or not they feel satisfied and comfortable in the fitting room.

4.3 Data Analysis

Based on the data collected from the three stores and the survey conducted of the customers visiting the stores, the average illuminance in the three cases are described as: Matalan is a case with a high average of illuminance, Mango is a case with a medium average of illuminance, while Zara

Fig. 6 Lunis® SL wallwasher, pan-and-tiltable, asymmetric narrow facetted distribution

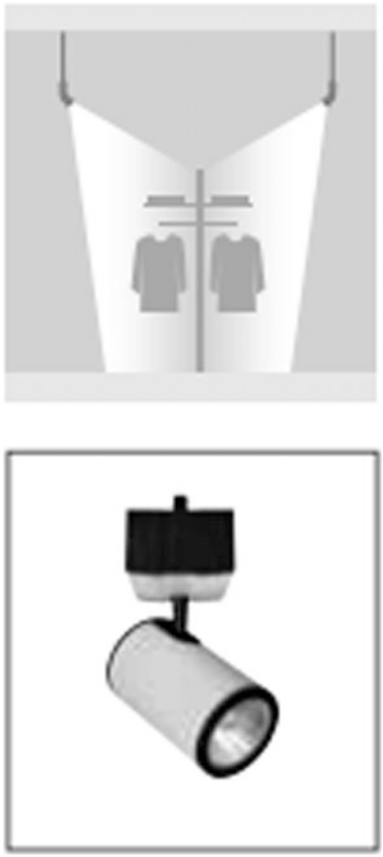


Fig. 7 Lunis® SL-T or Modario® IP20 spot insert, narrow or medium distribution, LED 2700/4500 lm

is a case with the lowest average of illuminance. The measurements were conducted in advance to help the simulation, using Revit software, to find the best-case.

1. Mango Case Study

The average luminous level for the fitting rooms seen in Figs. 9 and 10 is approximated to 1414.3 (lux). A distance of 1.5 m is found between 14 overhead lights. The height of the fitting room is approximated at 2.8 m. One yellow color spotlight and one mirror on the side from the floor to the ceiling are found in the room to comfort the customers and to create the sensation of a large space. Based on the conducted survey, it was found that most women preferred this type of room and intensity of light. Accordingly, Revit software was used to draw the plan in order to create the simulation.

2. Zara Case Study

The average luminous level for the fitting rooms shown in Fig. 11 is approximated to 466.3 (lux). A distance of 1.16 m is found between 20 overhead lights. The height of the fitting room is approximated to 3 m. It is noticed that this store has one spotlight in each room that is yellow in color (warm color). Customers preferred the lighting in Mango more than the case of Zara. After spending enough time in Zara, people tended to feel the need to leave because the light made them feel depressed and gloomy. However, the fitting room has also two mirrors on both sides from the floor to the ceiling so that the customers would feel the sensation of a large space. Similarly, Revit software was used to draw the plan in order to create the simulation (Figs. 12, 13).

3. Matalan Case Study

The average luminous level for the fitting rooms shown in Fig. 14 is approximated to 1441.67 (lux). A distance of 1.6 m is found between 10 overhead lights. The height of the fitting room is approximated to 3.5 m. It is noticed that this store has one white spotlight in each room, (cool color). Customers preferred the light in Mango over the light used in Matalan because the light in Matalan is intense and very high. In a way this can be good because it renders the clothes' actual color and details, but on the other hand, the intensity of light causes headaches as well this light will be

Fig. 8 Traxon Cove Light AC HO linear LED luminaire for cove lighting or backlighting, with high efficiency with various color temperatures

reflected on the mirror to the customers' eyes which will interrupt their visual view making them more likely to leave. Revit software was used to draw the plan and the simulation (Figs. 15, 16).

4. Questioner Analysis

For the study, an online survey has been conducted as a data collection tool. The respondents of the questionnaire were approximately 80 people in different age groups to cover different interests; the survey was applied only to women since they were the target of study. There were three types of questions conducted in the survey, the first type was asking about customer satisfaction with the lighting in the three studied stores. The second type of questions was about the preferable light color (white or yellow) for customers while the third type reflects customers' experience about changing of the color of an object under a specific shade of light Fig. 17.

Based on the survey conducted, most customers unanimously agreed on the following:

1. Lighting in Zara's fitting room was between normal and dissatisfied.
2. Lighting in Mango was normal to satisfying.
3. Lighting in Matalan was satisfying.
4. White was also the choice of color for wall paint.
5. Light with frontal and overhead lights was preferred along with side mirror.
6. For the color changing, most customers expressed that color of clothes changes under different lightings of each fitting room's light.

5 Analysis and Discussion

According to this research and some relevant studies, design guidelines on how to reach the best scenario of a dressing room are explained hereafter.

(1) The Average Maintained Illumination should be "Ambient: 300 lx (30 FC) at 2′–6″ AFF".
2. Uniformity ratio (max/min): Ambient: 3:1.
3. Color temperature (CCT): fluorescent: 3500°, LED: 3500°, Compact Fluorescent: 3500°.
4. Color rendering (CRI): fluorescent: minimum of 80, LED: minimum of 80, compact Fluorescent: minimum of 80. This matches the results of this research where CRI value should be between 80 and 100. The higher CRI of light is better to render colors.
5. White painted wall gives a uniform brightness and good reflected material for coves and smaller room; also, it reduces energy cost and reduces shadows from racks and stacked goods.

Table 1 Readings of illuminance in the fitting rooms

Readings in stores' fitting rooms	(Matalan) Lux	(Mango) Lux	(Zara) Lux
Reading 1	1454	1338	445
Reading 2	1442	1352	475
Reading 3	1429	1553	479
Average	1441.67	1414.3	466.3

Fig. 9 Mango fitting room plan and color of wall Source: Authors

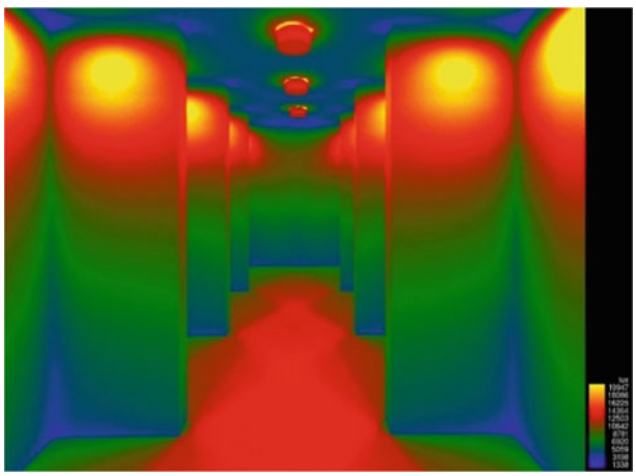


Fig. 10 Revit simulation of Mango fitting room

6 Conclusion

In this study, the impact of lighting on the customer's emotional state and behavior was conducted using an online survey. Three cases (Matalan, Mango, and Zara) were compared. Based on the survey conducted, most customers preferred the lighting in Mango because it did not affect the way they saw the clothes and it made them feel more comfortable under its shade. Revit software was used to create the required simulation and show the results between the best and the worst scenarios. Furthermore, customers preferred frontal lights more than overhead lights as the light will not be reflected on the internal mirror and make the customer feels uncomfortable.

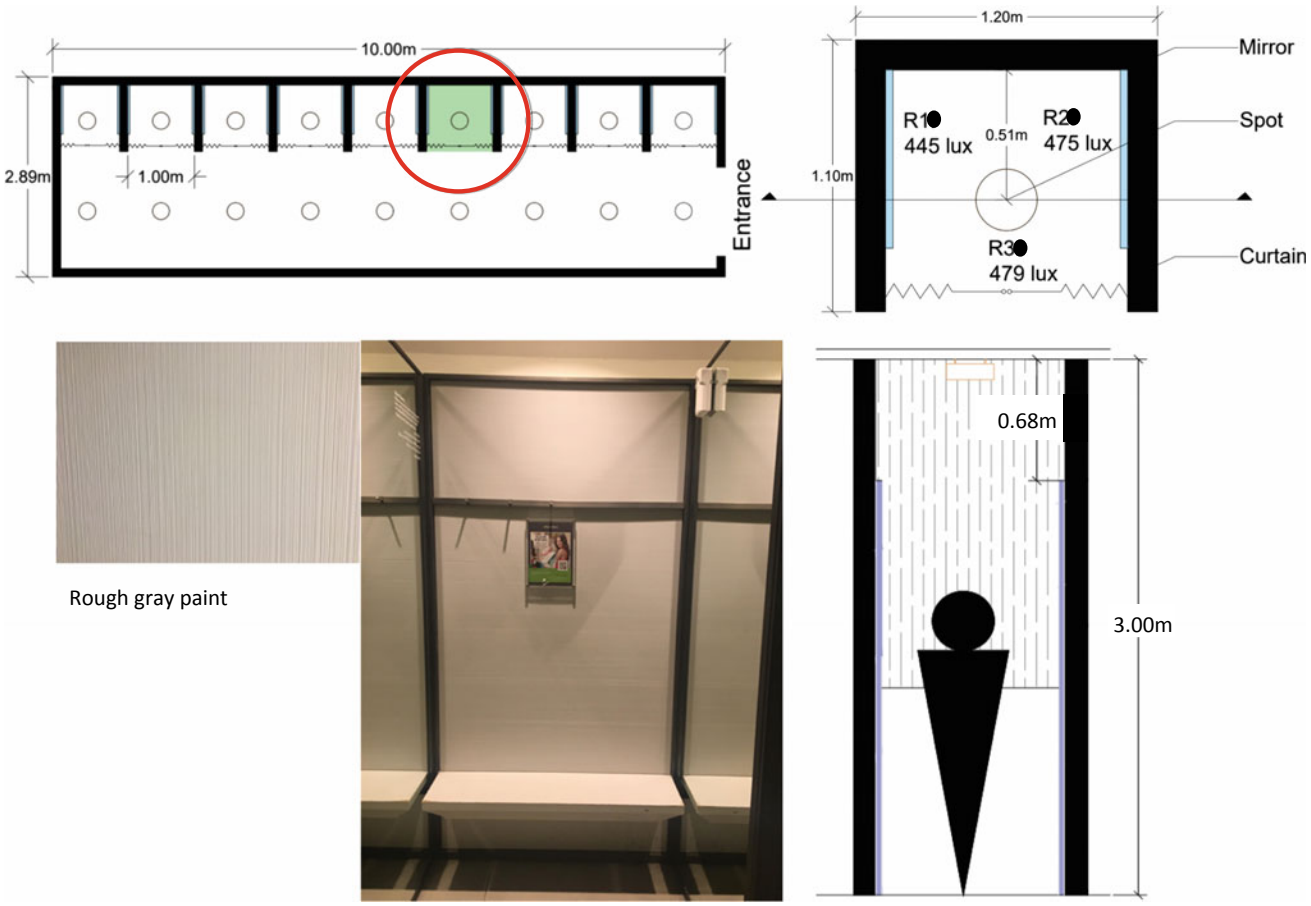


Fig. 11 Zara fitting room plan and color of wall

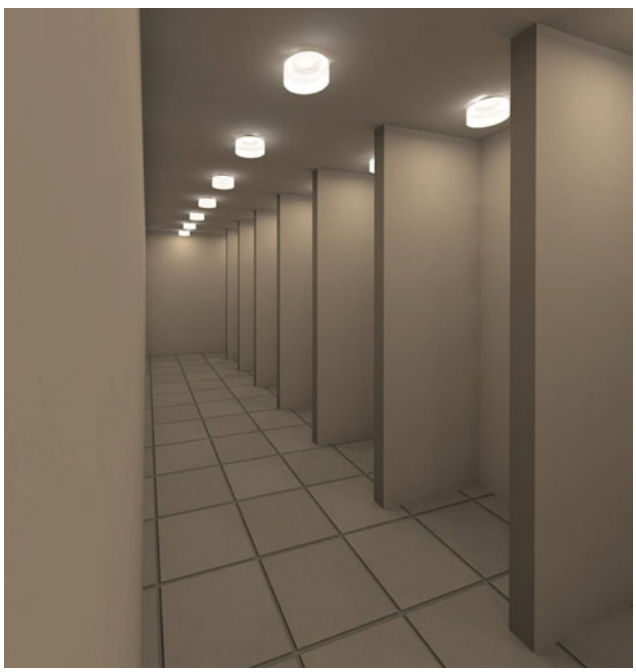


Fig. 12 Revit model for Zara fitting room

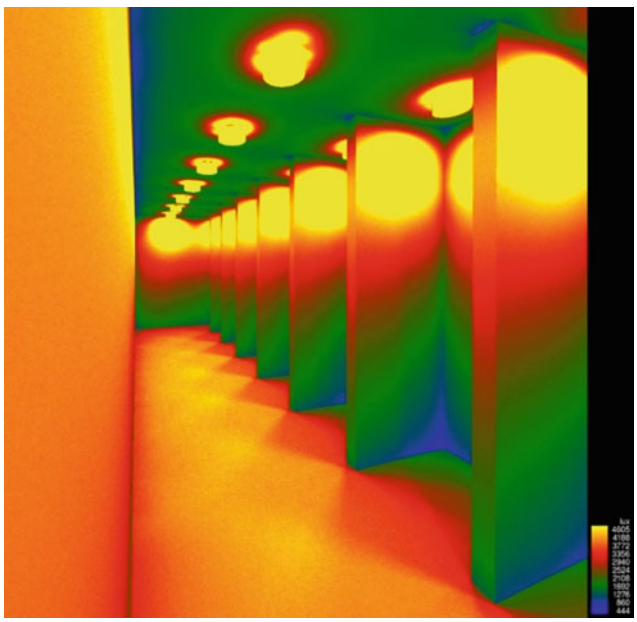


Fig. 13 Revit simulation of Zara fitting room Source: Authors

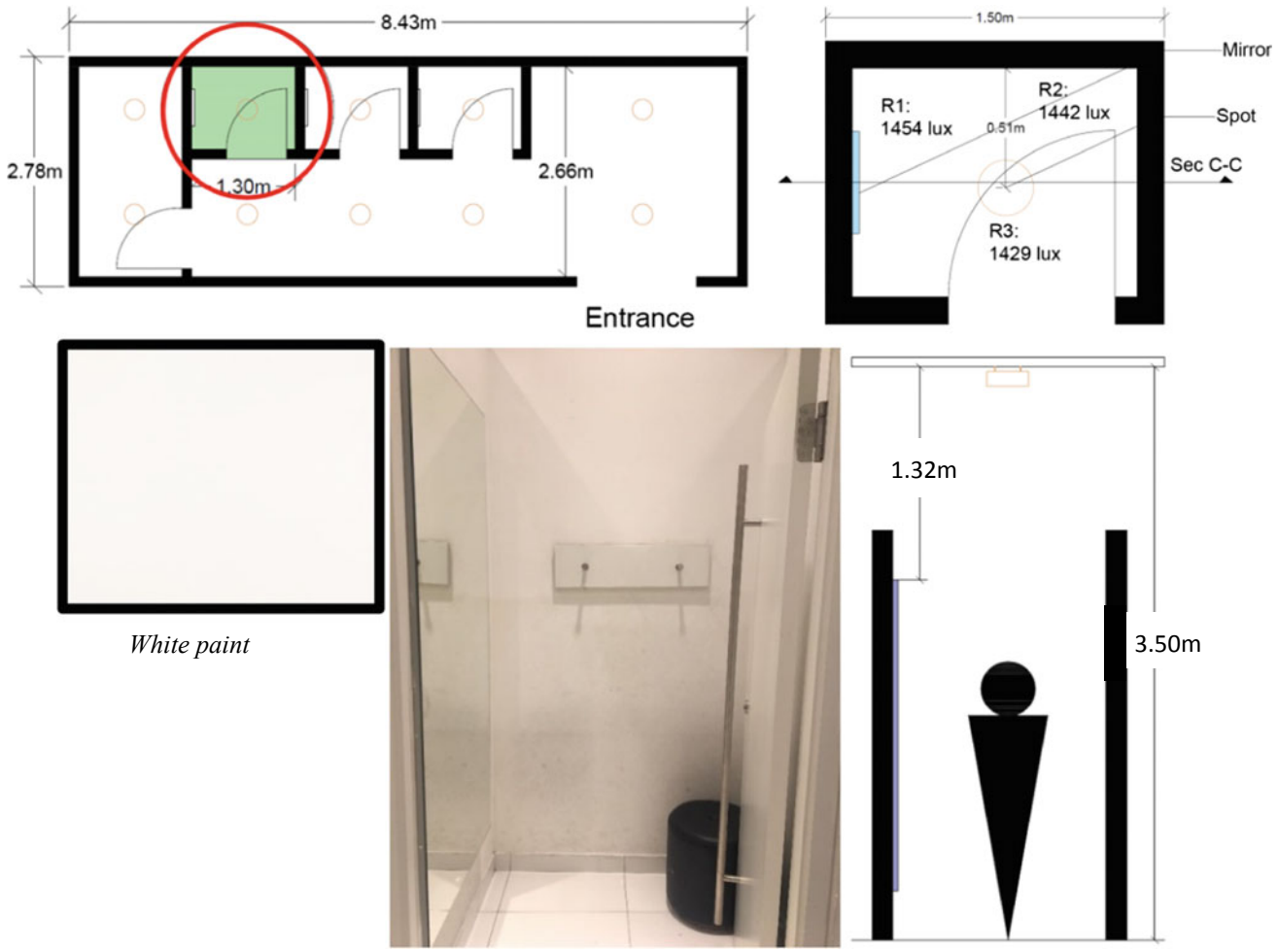


Fig. 14 Matalan fitting room plan and color of wall

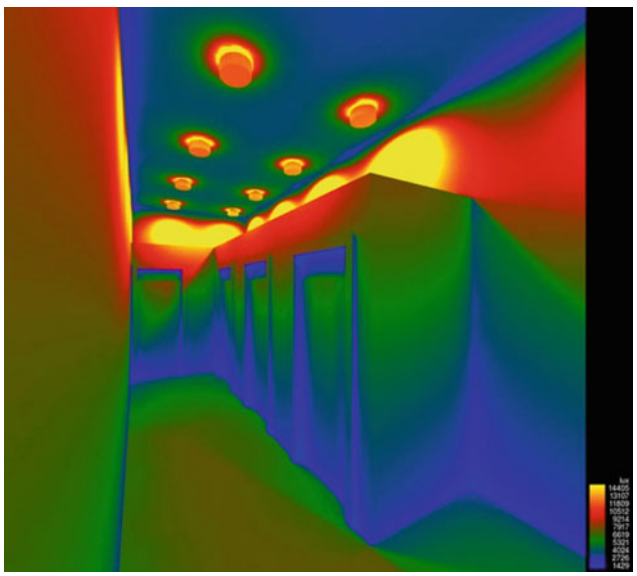
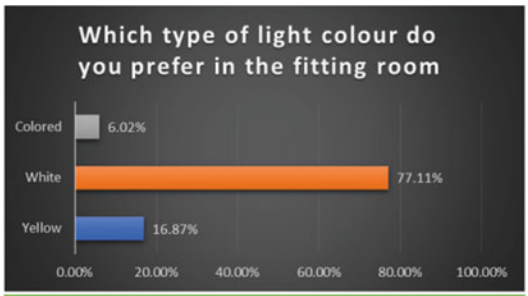
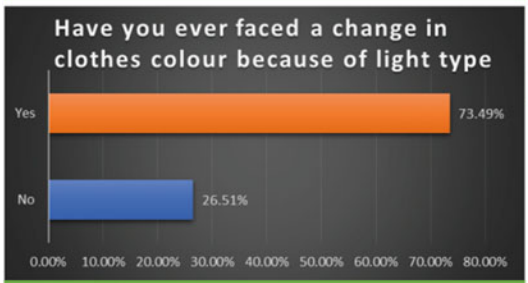


Fig. 15 Revit simulation of Matalan fitting room

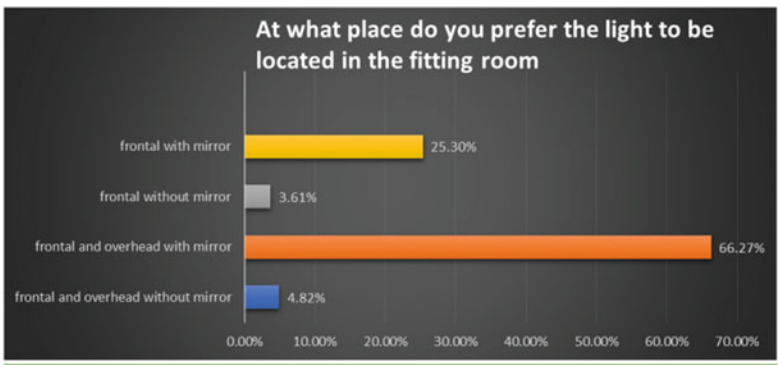
Fig. 16 Revit model for Matalan fitting room Source: Authors



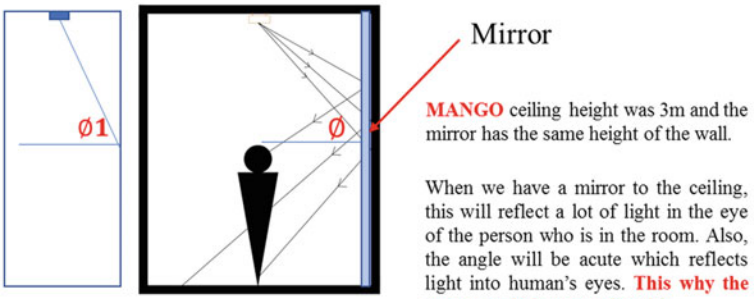
Answer choices	Responses	
Coloured	6.02	14
White	77.11	64
yellow	16.87	5
total		83



Answer choices	responses	
Yes	73.49%	61
No	62.51%	22
Total		83

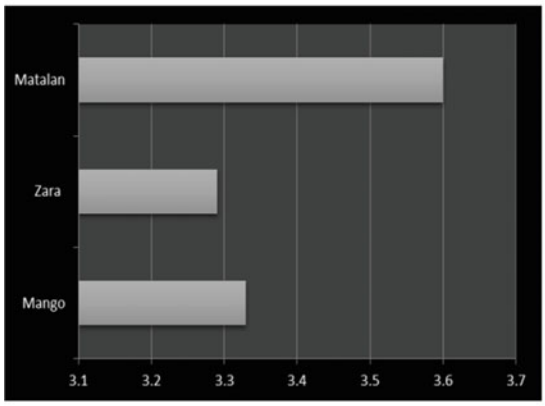


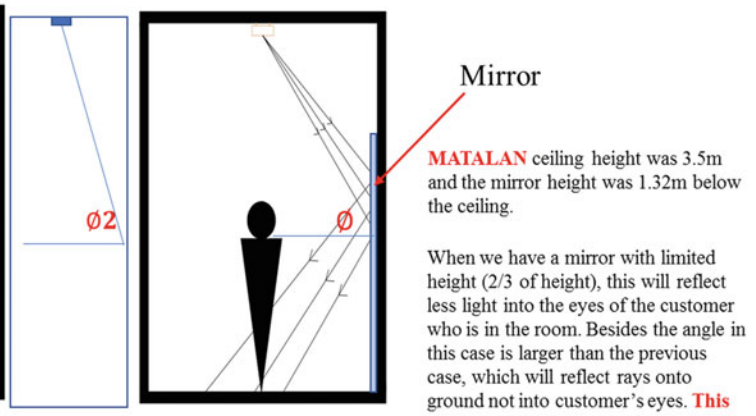
Answer choices		Responses
Frontal with mirror	25.30%	21
Frontal without mirror	3.61%	3
Frontal and overhead with mirror	66.27%	55
Frontal and overhead without mirror	4.82%	4
Total		83



MANGO ceiling height was 3m and the mirror has the same height of the wall.

When we have a mirror to the ceiling, this will reflect a lot of light in the eye of the person who is in the room. Also, the angle will be acute which reflects light into human's eyes. **This why the customer feels uncomfortable**





MATALAN ceiling height was 3.5m and the mirror height was 1.32m below the ceiling.

When we have a mirror with limited height (2/3 of height), this will reflect less light into the eyes of the customer who is in the room. Besides the angle in this case is larger than the previous case, which will reflect rays onto ground not into customer's eyes. **This why people feel comfortable**

Ø2 > Ø1

Fig. 17 Respondents of the conducted questionnaire and explanation of people satisfaction on Matalan fitting room

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The Effect of the EU Referendum on the GBP: Evidence From Brexit

Jelena Janjusevic and William Chegeni

Abstract

The UK not being part of the EU has major implications on the nation's economy, which ultimately affected the GBP's exchange rate. In 2016, the GBP hit a 31-year low against the dollar following the steady plummet in the wake of the Brexit. As the Brexit was an isolated event, which has substantial implications on the country's currency exchange, through an event-study, the extent to which the currency exchange experienced volatility due to this event can be determined. This research will focus on an isolated event, which will be used to determine the extent to which the GBP's exchange rate was affected by Brexit. Using the event study methodology and two different models: the market model and the mean average return model, this research estimates the abnormal returns for the EU referendum event. Coupled with macroeconomic factors, which are implied by the referendum, the research investigates the potential causes for currency market uncertainty within the UK. As there are not many studies which cover the effects of political announcements in developed economies, this study provides some insight on how a developed nation's currency can be affected by unexpected political announcements and news, with a specific focus on the Brexit vote outcome.

1 Introduction

The foreign exchange market is the largest and most frequently traded financial market globally. Approximately USD 4 trillion is traded globally each day. Due to the interconnectedness of the global forex market, events occurring at any one point in time across the globe can have an instantaneous effect on exchange rates and inherently on currency values. Elections and political events are common in most nations and have proven to have an effect on a nation's currency.

The European Union referendum of June 2016 (also known as Brexit), resulted in the UK voting to leave the European Union. The vote result shocked the world, since polls indicated that the 'remain' side had the majority votes. The UK not being part of the EU has major implications on the nation's economy, which ultimately affected the GBP's exchange rate. In 2016, the GBP hit a 31-year low against the dollar following the steady plummet in the wake of Brexit. As Brexit was an isolated event, which has substantial implications on the country's currency exchange, through an event study, the extent to which the currency exchange experienced volatility due to this event can be determined. This research will focus on an isolated event, which will be used to determine the extent to which the GBP's exchange rate was affected by Brexit.

As there are not many studies which cover the effects of political announcements in developed economies, this study will provide some insight on how a developed nation's currency can be affected by unexpected political announcements and news, with a specific focus on the Brexit vote outcome. The GBP is one of the strongest currencies globally and is extremely stable; hence, its continued decline was a cause for concern. This study intends to solidify the idea that uncertainty may have implications that have a significant and direct effect on an economy's exchange rate.

The main aim for this paper is to determine the extent to which the Brexit outcome explains the unanticipated variation in the value of the GBP's exchange rate, in an attempt to demonstrate that even developed economies are prone to significant currency exchange rate volatility following a significant political event outcome and the uncertainty that may arise because of them. The goal of the event study is to successfully measure the abnormal returns of the GBP

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exchange rate during the event window period. The research employs different methodologies for a better assessment of the results and for comparison, both models are revisited in the literature review. Additionally, the results are compared for the two models for which they will both undergo a robustness test. Moreover, this research will highlight any limitations with the research and assess the validity of the model that is being applied.

Even though numerous event studies have been carried out on developed nations, there has not been an extensive amount of research done on political outcomes and their effect on foreign exchange rates in developed economies, as there are other factors that also have substantial and proven effects on a country's exchange rate other than political event outcomes. Though political events have been referred to in the past to explain day to day movements in currencies, they are often circumstantial, and no real assessment has been carried out to determine the extent to which the events can explain for the results.

'Markets like good news. Markets dislike bad news, but markets hate uncertainty', (Willis Sparks, 2016, Middle East Investment Conference). Currency volatility can be brought on by uncertainty, which in turn leads to economic consequences on trade and other macroeconomic factors. This paper does not aim to unearth or prove the macroeconomic issues that may be brought on by a depreciating currency but will shed some light on why a currency may rapidly depreciate following news that leaves a cloud of doubt and uncertainty as to what the future may hold for an economy. It is also expected that developing or emerging nations are most likely to suffer from currency exchange volatility; however, this research hopes to show that even developed nations are prone to variations in exchange rates due to political changes or instability.

The Brexit vote was a political event; however, political events generally come hand in hand with macroeconomic implications. This research's main objective is not to analyze the long-lasting effects of the referendum but will comment on the macroeconomic factors which are the cause of uncertainty. This study will primarily focus on the event itself rather than the implications that the results of the event pose on the nation as a whole. It is important to note that this research tries to explain the variation in the UK's currency value during a specified time. The study intends to contribute to the literature on determining exchange rates and to mark or signify the importance of political announcement or outcomes on the GBP's currency exchange rate.

2 Literature Review

Research by Garfinkel, Glazer and Lee (Frenkel 1981) show that events or announcements have a significant impact on exchange rates. In their research, (Frenkel 1981) they set out to find whether unexpected election results could shed some light on the unexpected variation in foreign exchange rates. They observed the magnitude of forecast errors on currency futures near election times via the use of event studies. They uncovered that some, yet not all elections, can be an important element, which leads to exchange rate volatility. According to their research, exchange rate markets are not indifferent to the candidates or parties for which the elections are held. This can be explained by the different economic policies the opposing sides may adopt after the win. Moreover, currency market volatility was low when the markets had foreseen the election outcome. This would suggest that the markets had already reacted to the news once it was available and had already prepared for the outcome from the election. This study discusses the element of surprise results; however, will not include it in the model for observing abnormal performance.

Kearns and Manners (Galati and Ho 2003) observed the impact of monetary policy on the exchange rates of four countries. Through using intraday data and a short event window, they found that the impact of the monetary policy changes was reflected on the stocks almost instantaneously. During their research, they also discovered that the monetary policy could only account for 10–20% of the total change in the exchange rates within the window period. This suggests that there are other factors that were not accounted for in their research, which would have caused the currency volatility. Markets react to news. News can account for up to 30% in currency variation. This news can lead to currency movements, but trading can further lead to an increase in volatility. Positive feedback trading can affect currency values leading to higher volatilities; in 2005, Osler provided evidence on how stop-loss orders lead to self-generated movement in prices, when the orders either purchased or shorted currencies depending on whether the market rose or fell. This hedging mechanism, though protecting investors can lead to excess supply or demand for the currency in the market, which in turn further damages or inflates the price of a currency.

In 2006, Kearns and Manners (Galati and Ho 2003) showed that monetary policy decisions are well anticipated by the market, hence their impact should already be

incorporated into the interest and exchange rates. Therefore, only surprise or unanticipated announcements and results will lead to significant volatility in exchange rates. Galati and Ho (Fama 1970), found that unscheduled announcements have a larger impact on exchange rates than scheduled announcements. The rationale is that agents have more time to prepare for an eventuality before it occurs if the announcement is scheduled. Other research by Ederington and Lee (Cosset and De La Rianderie 1985) revealed that the system can take less than 40 seconds to react to news, which signifies a robust semi-strong form efficient market.

A surprise announcement does not allow for such preparation time and hence exchange rates are likely to react to this. It can be assumed that the market will react significantly to unpredicted outcomes, especially seeing as information up to when the event takes place is already factored into the market. The EU referendum of 23 June can be related to such an event, seeing as the polls indicated that the majority intended to vote to remain. This research intends to test the semi-strong form efficiency, where the political event results will portray the announcement. As the GBP is a relatively stable currency and one of the strongest globally, it is expected that it would be less prone to shocks following political events or announcements.

Frankel and Wei (Fair 2003) employ a new technique for obtaining de facto exchange rate regimes for different countries. In their research, they criticize past research on exchange rates, which was hinged on a major currency in which they defined as their currency value of interest. The currency, which has most commonly been used, is the US dollar. As much as this may be applicable for currencies, which are stabilized by the authorities, it is not appropriate to anchor all currencies of interest to the dollar. They further explain that the use of currency anchoring can be used with practicality, such as using the Euro as the base currency for studies conducted in central Europe, or the US dollar for Latin American research. There is also the challenge with anchoring a single currency to emerging economy currencies. A better practice that could be put in place is to estimate endogenously, whether the currency is tied to a single currency or a basket of currencies. This research, though, does not explore the endogenous estimation; it does consider the better approach of using a basket of currencies, rather than relying on a single currency for obtaining the value of the currencies of interest. This is revisited in the methodology.

2.1 New Information on Asset Prices

There have been many studies, which analyze the effect that new information has on various financial assets, though there is still a considerable amount of research which focused on the stock markets rather than the currency markets. An element, which has a major effect on the currencies is foreign trade as it can significantly influence a currency's movement mainly via the economy's balance of payments.

Calin (2015) investigated the reaction of different currencies to foreign trade announcements using an econometric event study methodology, finding that trade news had a significant influence on the currencies, which were observed. Though trade announcements are not necessarily changing in trade amounts or volumes, they generally imply that levels of trade will be affected. This notion will be reviewed in relation to the EU referendum result announcement in the macroeconomic implication section.

Currency movements, as described above are generally dictated by macroeconomic shifts. It is with this notion that a considerable amount of literature has focused on analyzing the effect, which macroeconomic announcements have had on currencies. Daily frequencies have been utilized in research, which aims to quantify currency reactions to economic phenomenon. Other research by Fair (Frankel 2007) used intra-daily data to show the impact that macroeconomic events have on currencies and other markets. In the interest of this research, it should be noted that the British Pound was one of the affected currencies. Research conducted by Anderson et al. (2003) analyzed the effect that macroeconomic announcements have on currency exchange rates. They found that from the currencies they observed, good news influenced the currency changes less than bad news did. This would suggest that the currency market is more susceptible to over-reacting to bad news than it is to good news.

2.2 Literature on the Model

There are two elements of empirical literature on exchange rate reactions to announcements or news that can be applied; (1) the difference between actual and expected values following announcements and (2) the modelling of news or announcements as time-series developments within the observed timeline. This research employs variations of the first element seeing as unanticipated results proved to be a significant determinant of exchange rate volatility (Frenkel 1981). Unlike Fenkel's research, this study uses daily data rather than monthly data, which possibly failed to capture the precise event time and significant effect, leading to weaker results. The decision to use daily data works best with this event as the window is quite narrow. This will allow the models to capture the event moment and from that, more significant results can be obtained. This daily data will then be applied to two models from which we can observe the abnormal returns for the event.

The abnormal returns model is obtained via two different models: the constant mean approach and the market model.

Both models can be broadly categorized as statistical models as opposed to the other classification, that is, economic models. Unlike economic models, statistical ones do not rely on investor behavior or economic arguments but solely depend on statistical assumptions. The main assumption, which is imposed on statistical models, is that the returns of an asset are jointly normal, distributed independently and identically through time. Despite this being a strong assumption, it is empirically reasonable.

The constant mean return model is a relatively simple and perhaps the simplest, yet provides great insight on the statistical behavior of the return of an asset; it is a well-known model, which produces robust results. Warner and Brown (1980) found that the model often produces results which are very similar to more complicated models. It has become the benchmark from which the more complex models are evaluated against. The model acts as a foundation from which more complex econometric models and discussions have been built upon. The mean average model is identical to the measurement error model referred to in statistical literature and states that an asset's return is constant over time; this constant can vary from asset to asset but remains constant for the same asset for a given period. It is also associated with an error term, which has a zero mean. The model's simplicity and robustness make it extremely attractive for researchers who are conducting an event study, as more complex models can be difficult to use especially when there are more variables a researcher must consider. More variables increase the need to screen for robustness at every stage, which can be time-consuming.

The other statistical model is the market model, which relates the return of an asset to market returns. The possible improvement that the market model may have over the constant mean return model is the element, which removes the return that is attributed to the market's return. This reduces the variance in the abnormal return, which allows the model to be more sensitive to the effects on an event. An important element, which needs to be considered with the market model, is the R2 from the regression of the model. The model will perform better at reducing the variance in the abnormal return, which in turn leads to a better detection of the event's effects if the R2 statistic is higher. The major issue with the market model is the fact that the model hinges on the researcher's ability to accurately estimate the relationship, which the asset has with the market. If the beta which has been obtained by a researcher is not significant, chances of the model underperforming are higher.

In this study, the mean average model is used in conjuncture with an event study to estimate the expected returns so that the abnormal returns can be calculated. The model's results are then compared to assess which model was most successful in capturing the data or was the most significant.

The literature suggests that currency markets respond to political events and announcements. Moreover, they are more volatile when the outcome is unforeseen, or the event was not expected. Though there is plenty of literature that analyzes the effects of different factors affecting currency values, there is little literature on how currency markets respond to uncertainty and how this can influence their volatility.

2.3 Robustness Concerns

The robustness of a model should be a key concern when conducting research; especially when quantitative methods are employed. As stated earlier, this research employs the event study methodology. Despite its popularity, the event study method has its limitations, which may hinder the ability to accurately measure the impact an event may have on an asset. It is important that these issues are well identified to assess the risk involved with the study.

The first hurdle that needs to be crossed is successfully defining the event date or the event period. As obvious as the time of the event may seem, it is often not (Andersen et al. 2003). The main problem is not when the event occurred, rather, when the market responded to the news. To identify which dates were most affected the GBP value in relation to a basket of currencies (GBPX) was visually mapped out around the event date for this study. The actual event date was 24 June 2016, which was when the EU referendum result announcement was made. Through visual analysis, the event dates of interest for this study were captured (Fig. 1.1).

The trend in the data seems apparent when visually graphed. There is a clear steep drop on 24 June 2016 and this drop continues on 27 of June (adjusting for non-trading days). Hence, the selected event window was 24 to the 27 June 2016.

Another concern when applying the event study methodology is testing the significance of aggregate results (Cumulative Abnormal Returns, CAR). In the early days of event studies, graphical depictions were the primary method used to interpret the results of an event. The CAR would be graphed by researchers to show how the market reacted to the event. However, graphs are still an important and routine element of representing results from an event study; researchers are required to apply more complicated statistical tests to prove the significance of their results. This research will employ the use of a *t*-test for significance testing of the abnormal returns.

Calculating returns has also been an issue, which has been addressed in event study methodology, though many researchers do not elaborate how they calculate their asset returns. Generally, there are two methods, which can be

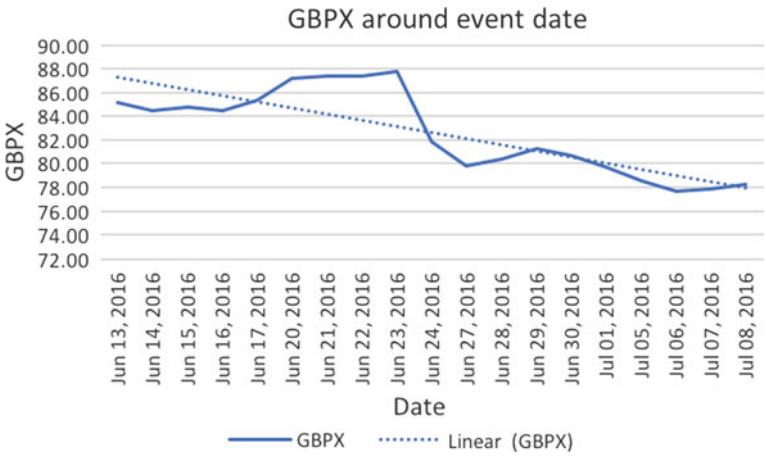

Fig. 1.1 GBPX around event date

applied, simple returns or continuously compounded returns. Though continuously compounded returns are generally regarded to be better suited at satisfying the requirements of normality assumptions when regressing data, this research has opted to use simple returns. A study by Warner and Brown (1980) pointed out the similarity of the two different models. Despite a recommendation from Fama (Fama 1970) for using continuously compounded returns, Warner and Brown (1980) ignored the form of returns in their event studies, which would suggest that the method applied to calculating returns has little bearing on the actual results of an event study.

The other issue when conducting an event study is eliminating the contagion of other events in an event window of interest. Other events may affect the results of the event study but also affect the ability of successfully measuring the abnormal returns obtained from the study. This research has taken this into consideration that a shorter event window has a lower probability of being contaminated by other events. Warner and Brown (1980) confirm that there is a higher chance for a research to control the confusing events in a short window. Another check is scanning the event dates for any news that may have considerable bearing on the event and possibly the results.

As mentioned in the literature review, the researcher should be aware of the lack of significance, if any in their observations, this will allow for better research quality. Other biases that may hinder the research need to be considered, especially when one is conducting an event study. Trading data such as exchange rates can be subject to bias, such as the time in which trading 'closing' prices are recorded. One would assume that this data is evenly spread out, but generally, the closing price is the price at which the last transaction occurred. Moreover, another bias which needs to be addressed is the use of daily data rather than data at shorter intervals. To fully capture the instantaneous results of the market's reaction to an event, shorter intervals would perform better. However, this research fails to eliminate this bias due to the limitations with the data, which is available, thus closing prices will be used to conduct this event study.

Robustness concerns with this research are an important element, which is further addressed in the robustness testing section.

3 Methodology

Initially, two methodological approaches were considered. The first method is based on the fundamental time-series analysis and the second involves engaging an event-study approach. The latter is the favoured approach as it reduces the complexity of the analysis by distinguishing whether the event had a positive or negative effect on the exchange rate. This reduction in dimensionality objectively enhances the ability to measure the effectiveness of an event. Moreover, the event-study method eliminates the 'noise' element that affects the accuracy of time-series estimates.

It is important that the analysis highlights any key events during our event window other than the Brexit referendum that may have affected the exchange rates. To satiate the notion that the Brexit referendum had a long-lasting effect on the exchange rate, it is important that any 'noise' be accounted for in the analysis. The event study methodology will be employed to measure abnormal performance during the event window. This will be achieved through the computation of abnormal and normal returns, which are used to measure the impact of the event on the GBP's exchange rate.

3.1 Defining the Event

The definition and duration of the event window are pivotal to the research. The window selected for this research covers two days (24 and 27 June 2016) which is the day of the referendum vote result announcement and the next trading day following the weekend gap. This window allows for

ample time for the results to be fully captured by the market. This research hinges on the fact that the anticipated results prior to the referendum were that the UK would vote to remain as part of the EU. Normal returns for our model will, therefore, be estimated and will proxy actual results if the event had not occurred. The normal results will be estimated for the estimation period prior to the event window, which will cover 180 days. A post-event window of 180 days will also be examined to see whether the referendum had any long-term effects.

3.2 The Data

The data series used for the event study are exchange rates, obtained from the Reuters electronic trading platform at daily intervals for the period being observed. The exchange rates being observed is the Euro index in comparison to the GBP index.

3.2.1 Measuring the results

This research employs both the market and the constant mean approach to estimate normal returns.

The constant mean approach model is a simple model with a major underlying assumption that asset's returns can differ across companies, yet, they will remain constant for the same company over a given period. This research will mirror the effects, which are expected from stock returns using the GBPX as the asset of interest. The market model concept is that normal returns can be defined as the returns that are expected if the event had not taken place.

As currencies are primarily not listed as indices, obtaining beta values for any given currency at a given point in time can be challenging. Similar to a simple single factor regression model, this study will treat the currency exchange returns as stock returns, which will be observed in relation to other currencies. The GBPX*, is the value of the UK Pound sterling in relation to the value of a basket of four major currencies which significantly trade with the UK. The returns of the GBPX will proxy the returns of an individual stock. The approach seemed to be appropriate following the reasoning provided by Frankel and Wei (1981) that it is difficult to gauge the value of a currency if it is only compared to one or two other currencies. Using a currency index should reduce the specific risk involved with any given currency and prevent events specific to one economy contaminating the results. The weights signify the value of trade the different markets hold with the UK as of June 2016.

The USDX, which is the value of the US dollar in relation to the currency values of the six countries it trades most with, was originally intended to act as the proxy for the market. This idea was discontinued following the preliminary regression analysis, the USD though, is considered as a base currency for most economies and their respective currencies, and has little to do with the GBP. As of June 2016, the USD had a traded weight index of 22.5% in the GBPX, which is significantly lower than the EUR statistic. Following the preliminary regression for beta, the USDX returns failed to be significant at a 90% confidence level. This suggests that the USD has little influence over the GBP and that the estimation of beta would need to be obtained through another currency or factor. Following the advice provided by Frankel and Wei (2008), the research was directed towards a currency which has more influence over the GBP. The Euro as of June 2016 had a trade-weighted index of 67% in the GBP, which would suggest that it has considerable influence over the GBP. To avoid the issue of using a single currency as a base for the Euro as well, the Euro index (hereon, EURX**) will proxy the market data. Another estimation for beta was carried out, this time regressing the daily EURX returns (independent variable) against the GBPX returns (dependent variable) for the estimation period prescribed. The beta significance is revisited in the results section (Fig. 1.2).

Currencies, unlike stocks are measured in relation to other currencies, hence why this research employs the comparison of two indices rather than comparing single currencies. The reason why the EURX was selected as the 'market' index is that the Euro is not only one of the most traded currencies globally but is also the currency that is traded most with the GBP. Using the EURX allows the research to fully capture a fair value of the Euro in comparison to other currencies and reduces the systematic risk that both currencies may be prone to.

The abnormal returns, which can be defined as the ex post return difference between actual returns (observed) and expected returns (normal returns) is calculated as follows:

$$AR_{it} = \varepsilon_{it} = R_{it} - E[R_{it} | Y_t],$$

where $\mathfrak{E}_{it}$ is the abnormal return, R_{it} the actual observed return, $E[R_{it}]$ are the expected returns and Y_t the normal performance conditioning information. Cumulative abnormal

Currency Index	GBPX*	EURX**
Currencies, respective of their weighted geometric means	EUR, USD, JPY, CHF	USD, GBP, JPY, CHF, SEK

Fig. 1.2 The beta significance. *Market returns are risk factor adjustment

returns are also calculated for the exchange rate for the event window and can be denoted by CAR.

$$CAR_i(t_1,\ t_2) = \sum AR_{it},$$

where t_1 and t_2 denote day one and two of the event window, respectively. In this case, the two days of interest are 24 and 27 June 2016. A comparison of the results between the actual returns and expected returns will not be carried out past the event window. The shorter event window should allow the research to accurately capture the abnormal returns when coupled with a long estimation period.

3.3 Windows of Interest

As the anticipated results prior to the referendum were that the UK would vote to remain as part of the EU, normal returns for our model are estimated and proxy the actual results if the event had not occurred. The estimation window was selected as there were no other noticeably significant events that would contaminate the results of the estimation during this period.

3.4 Significance Testing

The *t*-test was employed in this research to assess the statistical significance of the CAR of the exchange rate during the event window. The *t*-test has proven to be the most suitable test for event studies seeing as the inference basis for event studies' test statistics. Moreover, the *t*-test adequately detects the presence or lack of abnormal returns. The estimation window was used to obtain the standard deviation from which the *t*-test will be derived from. The *t*-test was employed to assess both models (the market model and the mean average returns model). Depending on the levels of significance, the models were analyzed in the robustness testing section.

4 Results

4.1 Estimating Beta

The first analysis that was carried out, was the estimation for beta. The beta estimation is perhaps the most critical element when assessing abnormal returns using the market model. An insignificant beta, generally leads to poor abnormal results, which can in turn affect the integrity of the event study. Using OLS regression, the beta regression was estimated and was found to be significant at a 1% significance level for the EURX returns (market proxy), moreover, the beta value was quite influential at the level of −0.3265.

The main aim of event studies is to quantify the abnormal performance of an asset's return throughout the period (event) of interest. This research primarily focusses on successfully assessing and quantifying the abnormal returns of the GBP during and after the referendum. As stated earlier, the research hinges on the fact that until the vote, the polls indicated that the UK would vote to remain in the EU and thus the results were unexpected. The significance of the cumulative abnormal returns is assessed using the *t*-statistics, with the null hypothesis being that the announcement of the EU referendum vote, in which the UK decided to leave the EU, had no effect on the GBP return. This is denoted as

$$H_o : \varepsilon_{it} = 0,$$

where ε_{it} is the abnormal return.

A two-day event window is employed for this study (24 and 27 June 2016). The short-term event window was selected based on the theory by Warner and Brown (1980) that markets can overreact to news and announcements and then stabilizes rather quickly. Hence, to fully capture return anomalies brought on by announcements, a short-term window should be employed. This would suggest that using a long-term window would dilute or contaminate the abnormal returns of the news or event. In this research, a period of 18 days has been used to estimate the *t*-statistic in a test of the significance of the abnormal returns for both models being assessed. A short time frame has been selected so as to limit factors that may contaminate or influence the value.

Figure 1.3 below shows the value of the CAR for both models (Constant Mean Average and Market Model), during the event. After testing for significance (using the t-test), the constant mean approach and the market model CAR are both significant at a 99% confidence level.

The results from Fig. 1.3 indicate that abnormal returns were not only present but also significantly different to zero. Hence, with this notion of the null hypothesis can be rejected, meeting that the abnormal returns during the EU referendum announcement were indeed significant at a 99% confidence level for both models (market model and mean average model). Despite the extremely significant results, both models are screened appropriately to assess the specific integrity of both models in this study.

Figure 1.4 depicts the movement in the abnormal returns for the two methodologies employed for this study around the event date. Both methods display very similar movements in the abnormal returns. However, the mean average approach seems to react slightly less to the event peaking at an abnormal return of -6.81% as opposed to the market

Event Days	CAR on day 0 (MM)	CAR on day 0 (MV)
24 June 2016 & 27 June 2016	-0.0973 (7.6432)*	-0.0924 (3.3842)*

Fig. 1.3 Value of the CAR for both models. *Notes* The figures in brackets represent the *t*-test values, where *, ** and, *** respectively, represent significance at 1, 5 and 10%. MM represents the market model and MV represents the mean average

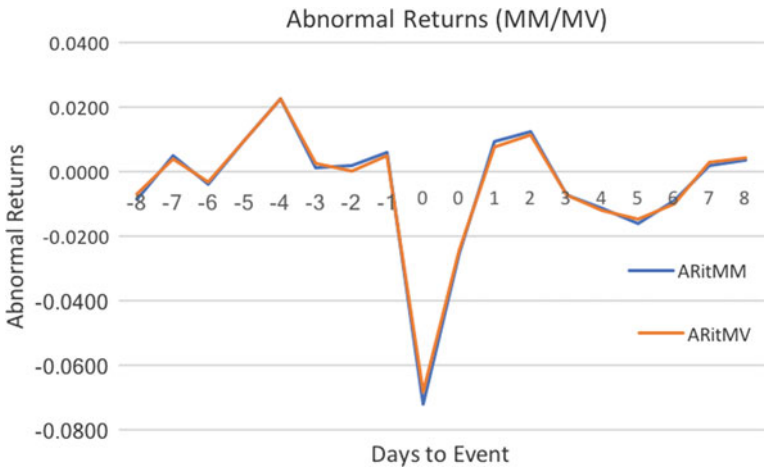

Fig. 1.4 Abnormal returns for both models. *AR_{it} MM represents the abnormal returns from the market model. AR_it MV represents the abnormal returns from the mean average returns model*

models of −7.19%. Despite this difference, both models portray a strong and significant movement in the abnormal returns of the GBP on the event day of interest. There are concerns with the robustness of the market model results, which need to be addressed.

The depiction of the abnormal returns on Fig. 1.4 illustrates that up until the event day, the markets were still relatively positive and bestowed confidence in the GBP. This may be a result which was brought on by the pre-election polls, which on 22 June (day before the election) indicated that the 'remain' side was at 51% and 'leave' side at 49%. Despite the polls differing ever so slightly for each side, the markets would have reacted to this as positive information for the GBP. This could have been the main reason why the abnormal returns began rising at t-2 and plummeted after the announcement on 24 of June. The research was unable to observe the GBP's exchange on 25 and 26 as trading was closed for the weekend; however, the event window was extended to 27, where a continued negative abnormal return prevailed.

Taking Fama's efficient market hypothesis model (Fama 1970) into account, we could conclude that GBP did not decline in value because the information available until the results were announced was in favour of the UK remaining in the EU. If the polls had strongly indicated that the UK would leave the EU, the GBP would have declined in value to reflect the new uncertainty arisen with leaving the EU. This could raise questions with regards to the robustness of polling systems and how the markets react to pre-election polls, which could be an interesting research. However, this research does not aim to prove that the polls potentially misled the markets, yet the fact that the polls indicated that the remain side would prevail and could have caused a negative market shock when the announcement was made. As markets are prone to overreactions and under-reactions, especially when unexpected news is announced, it is possible that the currency market had overreacted to the EU referendum announcement, which resulted in high negative abnormal returns. In the next section, this paper analyzes the macroeconomic factors that could potentially be the reason for the uncertainty surrounding the GBP's exchange rate.

4.2 Robustness Testing

An important part of the research is to assess the robustness of the tests and statistical methods that were employed to assess the integrity of the results. This section aims to challenge the robustness of the results obtained and the methods used in the research to obtain those results.

The first and probably most critical assessment to be made with regards to the robustness of the results is the *t*-test. Despite the clear depiction of the results from Fig. 1.3, which display prominent and quite relevant negative abnormal returns using both models, the *t*-statistic needs to be critically assessed to evaluate the statistical integrity of these results. The *t*-test is the most favoured approach when assessing the statistical significance of data in an event study, yet some academics believe it has been subjected to misinterpretation and has been misused. Some journals have gone as far as claiming that statistical significance based classifications should not be used. Nevertheless, when not

being misconstrued, statistically assessing data using the parametric tests is a robust way to show that the results were not due to chance. In this research, the *t*-test was employed to assess whether the cumulative abnormal returns were significantly different from zero, with the hypotheses being:

Ho: CAR during the event window are not statistically different from zero.

H1: CAR during the event window are statistically different from zero.

The *t*-stat in both models (mean average and market model) were significant at a 1% level of significance, from which the research concluded that the results were indeed significant and the null hypothesis was rejected. This would suggest that the *t*-test has qualified both the mean average and the market model; however, we must consider the fact that one of these models was derived from another element all together, the beta.

A major part of the research hinged on regressing and obtaining beta which was then implemented in the market model to obtain the expected returns, which were then used to calculate the abnormal returns. Though the *t*-statistic validated the significance of the beta obtained, a small degree of positive serial correlation was detected, the Durbin Watson statistic was just below 2 (at 1.924). It is also noteworthy to mention the rather small adjusted R2 value of 0.0454, and this would indicate that the model had a weak performance. The residual normality test would also suggest that the normal distribution does not exist. The Jarque–Bera probability was at 0.07 which is higher than the critical value of 5% from which the null hypothesis of 'normal distribution exists' would be rejected.

Additionally, a fixed effects test was carried out to test for unobserved heterogeneity, for which the *p*-value from the F test was significant at 5%. The null hypothesis of 'observed heterogeneity' must be rejected meaning that there is unobserved heterogeneity.

The robustness testing mentioned above poses a robustness concern, due to the extremely low R2 figure. Foreseeing the challenges that could arise from estimating beta using the market model, this research was conducted on two separate models. The mean average return model provided a benchmark for which the market model could be assessed. As quite a substantial number of academic literature has praised the robustness of the simple average return model, it appears it would be the right model to apply in this situation. The fact that there are some robustness concerns with the estimation of beta, the mean average model managed to map out the expected return and the subsequent abnormal returns. Compared to these returns, the market model performed extremely well, which has been visually represented on Fig. 1.4. The two model's abnormal returns are not only synchronous with one another, but they both managed to significantly assess and measure the abnormal returns during the event in question.

Other concerns with the research include the model that was applied to measure the abnormal returns. As exchange rates are rather complicated to assess, a more suitable model (other than the market model) could have been used. Though multiple factor models could have been applied in the pursuit of more accurate results, past literature suggests that the mean average model is just as effective as more complicated models. Hence, the use of a more complex model was not seen as a necessity in this regard, meaning that the market model (using a single factor element) was employed and alongside it, the mean average returns were utilized to confirm the results at hand.

Moreover, there are other concerns with the estimation period that was used to estimate beta and the standard deviation for the abnormal returns. The date of the EU referendum was announced in February 2016, which also coincides with the estimation period, which was used in this research. As it was expected that the EU referendum date announcement would have had an effect on the GBP's value, this information should have been considered in the analysis. The British Pound had already begun to decline as depicted on Fig. 1.5.

Figure 1.5 shows a clear depreciating GBPX during the estimation period, which leads up to the EU referendum

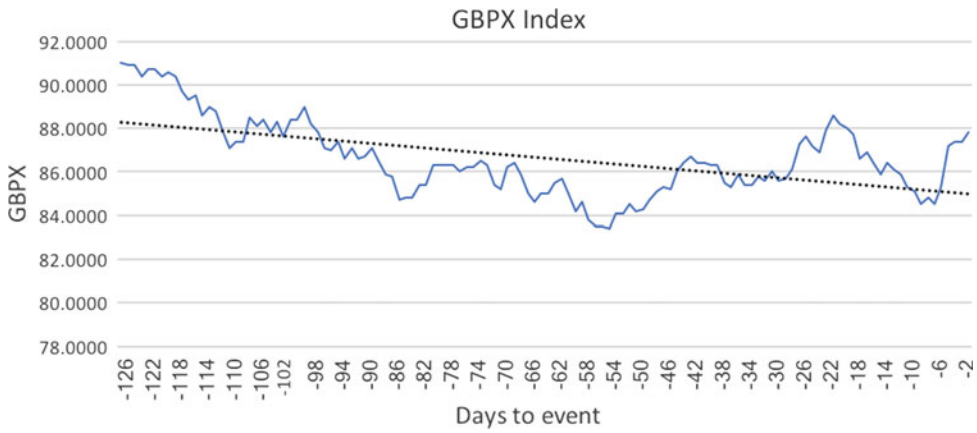

Fig. 1.5 GBPX index during estimating period

event. Additionally, the month in which a significant drop is observed is February 2016. This further corroborates the reason for concern for the data, which was used for the estimation period.

Another element to be noted is the use of the Euro as the basis at which the GBP would be assessed against meaning that the referendum was for leaving the European Union, which is the domestic economy for the Euro. Hence, it is possible that the Euro was also affected during the lead time to the vote and in its anticipation. This element is a limitation to this research, as this was not evaluated in any capacity. Another challenge with conducting event studies on currencies is selecting the appropriate market to regress against the currency of interest to obtain beta. By selecting the major currencies, there is always the risk of intercorrelation of variables. Moreover, the other risk is assessing the value of the currency as was discussed in the literature review. Which currency should be used in assessing the value of the currency of interest, and if so how can it be justified. This research opted to use the Euro but evaluated the currencies in terms of indices, the Euro index against the GBP index due to recommendations from past literature. Though this was not a conventional way to assess currencies, the index approach was more appealing due to specific error reduction.

5 Macroeconomic Implications

The EU referendum did not only affect the GBP but also other effects from this event were witnessed in different asset markets globally. Significant drops in Tokyo, New York and London stock markets were observed, with the Dow Jones industrial average tumbling 611 points, European stocks dropping 8.6% and British stocks falling 3.6%. Investors quickly took refuge in safer investments following this downward trend in many markets. The result from the referendum postured a prospect of continued anxiety in global markets for investors as they failed to accurately infer the implications of what had happened. Investors and economists believed that markets want to know facts and are anxious about the unknown due to underlying potential risks (Financial Times 2016).

Though the GBP has stabilized against the USD and EUR there have been some noteworthy macroeconomic changes that have already come into effect within the UK. Inflation has been on the climb with it rising to 2.5% in 2018 from a 0.5% in 2016, which outpaced average wages, hence squeezing living standards in the UK. Furthermore, growth has been hindered since the referendum with GDP figures slowing down in 2017. A good indicator of growth performance is comparing the UK's growth against the growth of other G7 nations. The UK was comfortably growing at an average rate of 2%, which has dropped to 1.4%, whilst the remaining G7 nations have continued to grow at a faster rate, surpassing that of the UK.

The EU referendum vote was the kick-off for complicated and politically tense negotiations between the UK and the twenty-seven members of the EU. Despite the macroeconomic changes, the referendum triggered a central element to the economy and the negotiations will be the future of the common market as the UK sales to the common market represent almost 50% of its total exports. A major assumption which has been subject to various academic literature is disruption to trade. These studies assumed that the British economy would be subjected to long-lasting damaging effects should it choose to leave the EU. Despite the ominous literature, the leave side managed to campaign against it claiming that they would manage to strike a better deal during the negotiation period. Some EU prominent leaders such as the German Chancellor Angela Merkel, clearly stated that the European Union would not offer a rewarding deal to the UK for leaving as it will encourage other discontented members to pursue the same path. This suggests that the trade element will be one that will definitely be affected, which may further affect the British Pound. This section of the study focusses on the elements which are most likely to be affected by the referendum result and how they are responsible for the level of uncertainty that is currently present in many markets inside and outside of Britain.

It is important to note that the result of the EU referendum vote of 2016 was not the reason for the decline of the GBP yet was more of a trigger. The Brexit result triggered the initial market reaction that would be expected due to the underlying macroeconomic implications that come hand in hand with the UK leaving the EU. This made one thing abundantly clear, to some degree, that the trade between the EU and the UK would be affected. As trade plays a significant part in an economy's prosperity, the currency markets would regard trade in jeopardy following the EU referendum result.

The depreciation of a currency generally signals negative information about the state of a currency's strength. Hence, a large depreciation can lead to lower market confidence, which may further drive down the value of the currency. Prior to the election, some economists and investors had predicted a considerable depreciation in the Pound, should the UK vote to leave the EU. The theory behind this assumption was that leaving the EU would create an environment of uncertainty, which inherently affects the demand of the pound as investors shy away from investments in the UK.

Moreover, this uncertainty would spill over to the trading arena meaning that the extent to which trading conditions would change are not known. This further would discourage investment in the UK, which could lead to a lower economic growth and possibly lower interest rates. Lower interest rates would further reduce the demand for the pound by making

the GBP a less attractive investment. Another concern that could have resulted in a deprecating Pound was the UK current account. The UK has a considerable current account deficit, in which net capital inflows primarily finance. The reduction of these inflows would mean that the GBP would have to decline to offset the imbalance. UK trade has become a subject of much speculation and area for future research, where most economists believe that the UK will still be worse off regardless how the negotiations play out. The UK is currently divided by two opposing concepts: a 'soft' or 'hard' Brexit. A soft Brexit refers to the UK staying closely aligned with the EU by remaining in the EU's single market and customs union. A hard Brexit, on the other hand, rejects the idea of staying aligned with the EU's regulations and tariffs. Trade is likely to be affected depending on which side the negotiations will favour.

Furthermore, the UK was a gateway to the European market, foreign companies could invest in the UK and manage to trade in Europe without facing tariffs or other barriers to trade. Leaving the EU may encourage foreign investment in other EU nations so that they can still have unhindered access to the larger market. Foreign Direct Investments (FDI) are an integral part of the UK economy, following the wake of the Brexit referendum they are expected to reduce significantly. A study conducted by Dhingra, Ottaviano, Sampson and Van Reenen (2016) analyzed the effects of Brexit on FDI in the UK. The researchers estimate that FDI inflows are likely to reduce by approximately 22%. The estimate is considerably high and such a loss could potentially damage the productivity in the UK and reduce real income significantly.

The director of the Center for Economic Performance at the London School of Economics, John Van Reenen commented on the uncertainty and how it will further affect the business environment in the UK. He describes a 'rabbit-in-the-headlights' state, where businesses are reluctant to undertake new investments or make new decisions due to the uncertainty of the future. This will instantaneously lower investment activity, which in turn affects hiring and ultimately slows down the growth of the economy.

The other concern, which investors have had, was that the Pound had already started to weaken in anticipation of the upcoming referendum. This would suggest that the market had already considered the possible decline that the referendum would have caused. Nevertheless, the EU referendum incited a cloud of uncertainty which markets are generally not fond of. Leaving the EU, was the unknown; how trade and investments would be affected were elements which could not be quantified. The markets, therefore, reacted negatively to this uncertainty, which led to a steep plummet in the GBP's value.

The aforementioned factors all contribute to reasons why the GBP fell; however, the consequences of the EU referendum will depend on the terms in which the UK departs the EU and the economic climate during that time. It is quite possible that a further drop in the GBP can be observed at the time of departure; however, there should be less uncertainty in the market once the negotiations regarding Britain's exit are finalized. Some academics believe that the EU referendum vote will have a domino effect on other European states, which poses a risk of another European crisis or further fragmentation from the common market. The question is whether the European integration can survive another crisis or would another event see it fall apart.

As an immediate countermeasure to the trade arena, the UK would need to focus on securing better exit deals with the EU for their strategically imperative sectors to continually support and positively influence investors, businesses and economic growth. With negotiations at hand, the UK may have to make trade-offs and forego the trading agreements for some sectors so as to ensure it supports more important ones.

This section was dedicated to assessing the macroeconomic implications, which indicate a negative environment should the UK exit the EU. This sheds some light on the cause for uncertainty and subsequently the reason why GBP reacted negatively to the EU referendum result.

6 Conclusion

This research aimed to quantify the cumulative abnormal returns using two methodological approaches for a specific event from which significant abnormal returns were obtained. The research managed to quantify the abnormal returns, which were observed following the EU referendum result. This single event does not prove that developed nation's currencies respond to political events (and their underlying factors), yet it does strongly indicate that uncertainty can drastically affect the value of a currency. In this example, the GBP, which is well regarded to be one of the strongest and most stable currencies globally, declined heavily after the announcement that EU referendum vote was in favour of the UK leaving the EU. Currency markets are extremely sensitive, especially with the interconnectedness of today's world; it is important that the economy takes measures to secure the stability of their currency value especially when there are many different variables that can affect them.

The EU referendum hosted an environment of uncertainty, especially about trade, which was undoubtedly been a pivotal factor which led to a depreciated Pound. Other macroeconomic implications are also quite dire, and the markets took this into account. The referendum vote was the initial step, and the currency market reacted to this, yet, it is unknown what agreements for trade and other essentials will

be negotiated. This leaves room for further uncertainty and it is currently unknown what is to be expected from the GBP once the arrangements of the UK leaving the EU are finalized.

Do political events have an effect on currency exchange? From this research, which observed a single event, we can conclude that the political event did have an effect on the currency exchange. However, this statement cannot be generalized based on this research alone. The political event did trigger a currency meltdown, yet the currency market reacted due to the uncertainty brought on by different macroeconomic underlying implications, following the political event. Past research suggests that currencies respond to news about macroeconomic policy changes, and political events proxy these announcements based on the results.

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The Existence of Modified Environmental Kuznets Curve for Gender Inequality in the MENA Economies: Panel Data Model

Hanan Hamed M. Sileem

Abstract

The usual Modified Environmental Kuznets Curve (MEKC) examines the environment–development relationship to reflect the impact of development on environment degradation. However, gender inequality recently appears to have serious impacts on climate mitigation and adaptation measures that require special consideration. After all, sustainable development cannot be fulfilled when the contribution of half the available human resources in the community is underestimated. To reflect the gender dimension, my research examines the existence of MEKC relationship between CO_2 emissions per capita and female participation in 18 Middle East and North Africa (MENA) economies for the period 1990–2015 using panel data estimation. Arguing on the existence of MEKC for gender–climate relationship in the MENA region, the empirical results show that the contribution of women is crucial to reverse the vulnerability of the MENA region to climate change. Thus, gender equality can be an effective factor in adaptation and mitigation measures. In this context, gender-responsive climate policy actions can be an efficient channel to allow sustainable development in the MENA region.

Keywords

Sustainable development • Gender • Climate change adaptation

1 Introduction

The current climate literature reports limited evidence on how mainstreaming gender in climate treaties and policy making can benefit women in mitigation and adaptation measures; however, there is a group of scholars suggesting that low participation of women can have a high cost on economic development (Nabli and Chamlou 2004). According to the World Commission on Environment and Development (WCED) definition, sustainable development is "meeting the needs of the present generation without compromising the ability of future generations to meet their own needs" (Wikipedia Homepage 2016). This definition implies that sustainable development is among human rights. That is to say, the rights to have a sustainable flow of capital across different generations whether it is a physical (man-made), or human, or natural capital; this perspective for sustainable development was originally coined in 1992 by Atkinson and Pearce measurement for sustainability (Pearce and Atkinson 1993).

Focusing on the proper attention to the social aspect of sustainable development that reflects the gender equality as well as recognizing the contribution of half the available human resources can be a vital source in sustaining development. That is why achieving the three dimensions of sustainable development, that is, social, environmental, and economic aspects emphasizes the importance of integrating woman in climate change adaptation policies. This is due to several factors. First, the rights to have a healthy environment can be treated as a critical part of social rights. In this context, environmental rights satisfy part of the sustainable development perquisites. Second, women are among the most vulnerable segments to climate change impacts, where more than 70% of women live below the poverty line (United Nations Development Program 2010). Moreover, women already constitute an essential part of the active formal or informal working force in the developing economies in several critical sectors relevant to climate changes (Arafa et al. 2007). Thus, women could face true climate change challenges due to gender inequalities that limit their access to education, resources, and possible decision-making opportunities to engage in forming effective adaptation and mitigation measures (Delivering on the Paris Promises Homepage 2018).

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Thus, identifying the relationship between woman labor force participation and the environmental degradation can indicate how important is the role that gender equality can play in climate change policies, especially in the most relevant sectors to climate change, that is, water resources management, agriculture, energy, and transportation. There is a limited reference in the climate change literature to this vital issue. Thus, the current study first discusses the main impacts of climate change in some sectors where women participation is often crucial in spite of gender inequality status in the MENA economies. Then, in the following section, the study examines the existence of Modified Environmental Kuznets Curve (MEKC) for gender in MENA economies using fixed panel data model, and presents the empirical results, which indicate the relationship between gender participation and the environmental degradation. Finally, the last section provides recommendations to allow more attention to integrate gender perspective in the climate adaptation policies in vital sectors in MENA economies.

2 Significance of the Study

The lack of comprehensive research on gender interrelationship with climate change consequences and adaptation measures is the reason for conducting the current study. Thus, one of the main objectives of the study is to highlight this neglected gender aspect although it is a perquisite dimension for achieving sustainable development, particularly on certain areas where women are the most vulnerable segment in the community to the climate change. In addition, the paper stresses the significance of integrating gender-sensitive policies to the climate change adaptation measures as women can be efficient agents of change in the MENA region. In this context, allowing more gender participation can be the channel through which more convenient climate policies can be more efficiently implemented to maintain sustainable development targets in the most vulnerable sectors to climate change, such as agriculture, energy, and water management.

3 Gender Versus Climate Challenges and Opportunities in MENA Region

In general, most MENA economies have high population density around its sea shores or at best scenario less than 100 km from sea shores; for instance, more than 60% of the population of Libya, Morocco, and Algeria are located in the coastal areas. Thus, any unexpected sea-level rise can cause major population shifts and adversely affect many relevant economic activities such as tourism, which is a major source of employment and income in many coastal economies such as Egypt, Morocco, and Tunisia (Arafa et al. 2007). Furthermore, land use and the efficiency of energy utilization are issues of great concern for sustainable development in the MENA region. The annual urbanization rate exceeds the rate of population growth. Reliability of transportation systems, water supply and waste-water networks, and energy generation stations will be at risk. Land use and urban planning systems in the MENA region largely ignore basic adaptation requirements to climate change, which place most of the buildings and infrastructure in the region at a direct risk.

For instance, as climate change impacts become more intensive, urban communities in the region face risks from storms, floods, heat waves, and water shortages. These variable climate risks constitute a great challenge if coupled with gender inequality dynamics in the form of more climate change hazards. In specific, at moments of stress, when land and livelihood opportunities are under threat, the most powerful party tends to socially exclude the less powerful people in the communities, that is, women; this is expected because of gender inequality. It is important to identify what gender means before referring to gender inequality. Gender refers to "socially constructed roles, responsibilities and opportunities associated with men and women, as well as hidden power structures that govern the relationships between them" (United Nations Development Program 2010). Inequality between men and women is determined by the learnt unequal treatment socially accorded to women. The MENA region has the highest rate of gender inequality worldwide, which equals to 0.572 (Sustainable Energy for All 2017). In 2012, Egypt has the highest gender inequality rate of the entire North African economies region with a score of (0.575). By 2015, Syria has the highest score with a rate of (0.554), while Libya has the least rate of gender inequality in the region with almost 0.16, whereas the total Arab world has reported a rate of 0.535 (The World Bank Open Data Homepage 2018).

The following subsections present an example for climate challenges for women in MENA economies in some priority sectors, where women are high contributors, yet their efforts are undermined due to several factors that will be explained next.

3.1 Water Management

More than three-quarters of the MENA inhabitants are mainly dependent on rain in their agriculture crops, which are expected to decrease in some economies, with around 50% by 2020 (Arafa et al. 2007). The UN Framework Convention on Climate Change (UNFCCC) Report identifies water as a key priority area for consideration. An increase in water scarcity leads to insufficient domestic water

supplies, having serious implications to maintain equity rights to access adequate fresh water.

Climate change can increase the burden on water by changing rainfall patterns; this means it reduces the available areas that depend on rain instead of usual irrigation methods, thus putting more pressure on water demand. Limited water access for agriculture has called for using treated waste-water for food production, which puts poor people at risk of disease infection (The Global Gender Office of the International Union for Conservation of Nature 2012). Furthermore, the lack of reliable water infrastructure in most of the MENA region can add to the heavy burden on water supply and agriculture. In addition, by 2050, projections on annual river runoff estimate a decrease by around 10–30% in the dry areas in the MENA region, which can cause water insecurity (Arafa et al. 2007). Women are often in charge of household tasks, agriculture, and water collection, and when coupled with the impacts of climate change, the burden on women will widen. Their reliance on livelihoods activities, which depend directly on the natural environment, makes them highly vulnerable to climate change impacts, both in rural and urban areas.

Several economies have begun programs for mainstreaming gender in the climate change policies. Adaptation and risk management practices for the water resources sector have been developed in different areas. The MENA Development Report provides several definitions for adaptation; for instance, Intergovernmental Panel on Climate Change (IPCC) defines adaptation to be "adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm …. beneficial opportunities". The Organization for Economic Co-operation and Development's Development Assistance Committee (OECD-DAC) defines adaptation projects as "those that—reduce the vulnerability of human or natural systems to the impacts of climate change and climate-related risks, by maintaining or increasing adaptive capacity and resilience" (The World Bank 2012). Despite the wide range of adaptation definitions, there is a common basic perquisite for any adaptation policy, which is information. Generating information is crucial, regardless of the method that people will use in responding to implement simple or sophisticated adaptation techniques.

Insufficient information is one of the main lessons that should be considered when integrating gender into adaptation responsive measures. For instance, it is expected that Jordan will witness a rise in temperature, drop in rainfall, a reduction in water availability, and an increase in the frequency of heat waves as well as dust storms. Jordan is one of the economies that are highly vulnerable to the impacts of water scarcity problem, since its annual per capita share is 150 m^3 of water resources, which is lower than the international identified water poverty line (i.e. 1000 m^3). The Jordan River secures 75% of the country's water supply. Climate change and overuse are undermining the river as well as the Dead Sea (The Global Gender Office of the International Union for Conservation of Nature 2012).

That is why the case of women in Jordan explains the important role that women play to manage water scarcity. For instance, they rationalize the use of household water by adapting to new water-saving techniques. Women cope with drought and sustain their home gardens by focusing on hand irrigating short season vegetable crops in winter, and they use different methods, such as plastic sheets, weed residues, wood chops, and fabrics to maintain soil moisture. They also plant seeds deeper in the soil, where moisture is better, and they reuse gray water from cooking to irrigate their gardens. When planting seeds, women learn to reduce the distance between seedlings to protect the bare soil from direct sun exposure and conserve moisture. But women are often excluded from decision making and critical information that would empower their families and communities. Lack of information about the climate change impacts hinders the ability of women farmers who experience hardship to take preventative actions that would protect their water resources.

3.2 Agriculture

Women are the backbone of the agricultural labor force in several developing economies. In particular, statistics indicate that women either worked as paid or unpaid labor, and they constitute in some economies, for example, Egypt and Morocco, over 50% of the total labor in agriculture. In other economies, such as Tunisia, Syria, Lebanon, Iraq, and Sudan, women labor force constitutes at least one-third of the labor of the total agriculture labor (Arafa et al. 2007). The extent to which rural women in MENA are engaged in agricultural production depends on several factors, such as the degree of mechanization used on the farm, farm size, available male workers, and their economic and social status within the household and ecosystem characteristics.

The division of labor in agricultural activities varies between men and women in the region. For example, women in Yemen are involved in all yield production stages particularly rained agriculture in the high altitude areas, whereas in Lebanon, women are engaged in sowing, weeding, harvesting, and processing. In Egypt, men are responsible for land preparation and pest control, whereas women are engaged in all other stages of crop production. Women are also engaged in marketing activities. In Syria, women are involved in sowing and weeding. In Jordan, women work in planting, harvesting, and packing. Yet, as more men migrate to the cities or to the Gulf economies to find jobs, women became mainly responsible for water resource management in both irrigated and rained agriculture. In addition to their

routine activities in agriculture and household, many women have also developed knowledge in water and soil management.

3.3 Energy and Transport

Although the most vulnerable sectors in Egypt according to IPCC involve the development of coastal zone, agriculture, and water resources, energy and transport remains as one of the priority sectors that is influenced by climate change. In the past decade, Egypt has a rapid energy consumption level, which was reflected in terms of more energy subsidies. Petroleum products and natural gas production trigger greenhouse gases (GHGs) emissions in Egypt since they secure most of the country's energy supply. On the one hand, natural gas is slowly replacing crude oil, due to the discovery of natural gas reserves; on the other hand, oil and gas still represent over than 90% of Egypt's energy sources.

In recent years, the Egyptian hoped to produce 20% of total generated electricity from renewable sources by 2020. However, there is a slow impact in practice for using renewable options because of the insufficient information among households of the benefits and methods of renewables. However, energy is not gender neutral. Women depend on energy in both household and income-generating tasks. They can play a central role in ensuring a household's energy security, to assist in developing sustainable and renewable energy lifestyle in the long run. In addition, women are at higher risk of respiratory complaints and premature death due to cooking over indoor fires with poor ventilation (Egyptian Environmental Affairs Agency, Centre for Environment and Development for the Arab Region and Europe and the Global Gender Office of the International Union for Conservation of Nature (IUCN) 2011).

Several developing economies still did not incorporate a gender dimension in their energy management. A good starting point is identifying energy needs where women are mainly involved. Mainstreaming gender into the energy sector requires recognition of the roles that women currently play. This involves promoting the role of women as (i) energy savers by allowing relevant energy information to lower their daily use in households or communities; (ii) key actors in good practice for the methods of renewable energy, particularly in household tasks; (iii) educators to their children about the use of energy (The Global Gender Office of the International Union for Conservation of Nature 2012). Mainstreaming gender perspective in the energy polices will assist in building women's capacities in technical and business skills that will allow them to use and promote clean energy technology.

In spite of the percentage of women labor with underpayment or without payment, their management contributions are significant as evident in the above examples. This represents a strength focal point that would be useful to build a sustainable development that reflects the gender perspective. However, men appear to have predominant control over decision-making. Women access to services such as credit, extension, training, and markets is limited compared to men. This is mainly attributed to weak institutional structures, traditional and cultural practices, as well as women's lack of collateral.

Based on their daily livelihood practices, it appears that women may have more effective roles in implementing to climate change adaption measures. However, many adaptation strategies ignore gender issues, thus reinforce current risk-imbalances as well as undermining the ability of women to contribute efficiently to climate change resolutions. This requires access to financial resources as well as gender-informed approaches on preparing less vulnerable segments (Delivering on the Paris Promises Homepage 2018). This is because permitting gender' priorities will ensure more effective mitigation, adaptation, and relevant programs to all people, by including the social perspective which will serve sustainable development. However, it is worth mentioning that currently the MENA region reports a growing number of programs, businesses, and organizations almost 34% of total initiatives involved in mainstreaming and promoting the gender participation in climate change adaptation measures (Sustainable Energy for All 2017).

4 Econometric Model

Simon Kuznets coined the original idea of EKC (1954) about economic inequality. His main hypothesis assumes that inequality increases in the early stages of development, and then after attaining a certain level of income, inequality starts to decrease in the form of an inverted U-shaped relationship. After few years, climate change literature found the inverted U-shaped hypothesis similar to the income–pollution relationship, which assumes that an economy shows an initial high pollution levels while its main industries develop because of consuming more natural resources, without paying attention to environmental quality or clean technology. However, after reaching a higher level of income, the technology becomes more environment-friendly. At that stage of development, less damage to the natural resources can be attained, and allows more concern for sustainable development. In that context, Olsen reviews a number of empirical literatures that examined the EKC relationship between development and environmental degradation (Olsen 2007).

Most of the income–pollution theoretical and empirical literatures use one of the two approaches: cross-section analysis or panel data (Grossman and Krueger 1995). However, the cross-section assumptions fail to reflect the

variation in the nature of environmental degradation indictors in relation with the development-level across economies. Following the EKC hypothesis, Costantini and Martini modified the variables to reflect development perspective, instead of mere income growth, to examine the sustainability of the development process, in what they called a Modified EKC (MEKC). They used a panel estimation model to analyze the relationship between higher human development levels and the rate of environmental degradation. The findings of their paper identify correlation between human development and sustainable development, following the classic inverted U-shaped EKC hypothesis. Their empirical results showed that human development should be a priority for an effective international climate policy, and an increase in human well-being is necessary to maintain a sustainable development path (Costantini and Martini 2006).

However, the current paper modifies the variables to focus specifically on gender participation perspective instead of variables reflecting human development, and thus, explores whether gender participation has a curvilinear effect on CO_2 emissions in MENA economies (see Appendix A) or not. The current study uses the participation of woman labor force in addition to its square as exogenous variables in the model. These two variables should predict the level of development in gender participation effect on environment degradation in the MENA economies.

4.1 Model Specification

To empirically perform the regression, the current study estimates both the fixed effects and random effects models; however, a Hausman test is performed to examine the inconsistency of the random effects estimation by comparing the fixed effects and random effects slope parameters. A significant difference indicates that inconsistent estimation of the random effects, due to correlation between the exogenous variables and the error term. In case the test found that the random effects model cannot be consistently estimated, only fixed effects estimation is allowed.

To perform the regression, the CO_2 emissions in an economy i at time t is given by the next MEKC function:

$$CO_{2it} = F\,(GPR_{it}, \varepsilon_{it}), \tag{1}$$

where the *fixed effects model* takes the following specification form

$$CO_{2it} = \alpha_i + \beta_1 GPR_{it} + \beta_2 GPR_{it}^2 + \varepsilon_{it}, \tag{2}$$

where $i = 1, 2, \ldots N$, $t = 1, 2, \ldots T$. CO_{2it} is the CO_2 emissions in the log form and is the endogenous variable measuring total CO_2 emissions per capita in economy i at time t, GPR_{it} is the gender participation; ε_{it} is the error term; $\alpha_i = z_i'\alpha$, the term $Z_i\ \alpha$ reflects heterogeneity or individual effects in the fixed effects model.

The first two terms on the RHS in Eq. (2) are intercept parameters that vary across economies i and years t. The assumption is that the level of emissions per capita may differ across economies at different gender participation level. The time-specific intercepts are used to reflect time-omitted variables and stochastic shocks that are similar to all economies. In line with the literature at hand, the CO_2 emissions are expected to reflect the MEKC hypothesis, which suggests the following inverse-U-shape with GRP in the form of a quadratic function. This indicates that GPR coefficient is expected to have positive sign, while the estimated coefficient of the GPR squared is expected to be negative. This means that $\beta_1 > 0$ and $\beta_2 < 0$.

4.2 The Choice of Variables and Data

The majority of EKC literature mainly examined the U-inverse relationship using local air pollution emissions. Although sulfur dioxide (SO_2) pollutant is the most employed indicator in the EKC literature, a distinguished group of the literature argues that CO_2 emissions would be a more valid and reliable indicator in reflecting the inverted-U hypothesis (Olsen 2007). For instance, a study in 2005 estimated that CO_2 and SO_2 are highly correlated with a correlation parameter equals to 0.9536 (Hoffmann et al. 2005). In addition, CO_2 emissions constitute around 77% of the GHG and its concentrations stay in the atmosphere more than 100 years (Banuri and Opschoor 2007).

To examine the MEKC hypothesis, the data collection begins from the year 1990 to 2015 in 18 MENA economies stated in the Appendix. The total number of observations is 468. *CO_2 emissions*: The endogenous variable defining the environmental degradation; CO_2 emissions are measured in ton per capita and this paper used it in the log form.*GPR*: The exogenous variable defining the gender participation rate; it is measured as female labor force as a percentage of total labor force; This study used the GPR variable as well as its square in the log form. The data on both CO_2 and GPR were obtained from the World Bank Open Database, from 1990 to 2015 years (The World Bank Open Data Homepage 2018).

4.3 Empirical Results

Running a Hausman test to examine the consistency of estimating the random effects model, the value of chi-square statistic for testing the differences between all coefficients is equal to 7.889980; this value is higher than the critical value at significant level 0.05. Its corresponding p-value of 0.000

suggests that the null hypothesis of no correlation between the explanatory variables and the random effects should be rejected. This means estimation of random effects specification is inconsistent. Alternatively, the estimation employs fixed coefficients effects (Stern 2004) and the empirical results are reported in Table 1.

The estimated results in subset (1) indicate the existence of a MEKC for the MENA economies; however, testing for heteroskedasticity across panels using the white test, evidence was found for the existence of panel-level heteroskedasticity. The estimated results in Table 1 subset (2) are reported after correcting for heteroskedasticity using the cross-section SUR.

The results in Table 1 reflects the inverted U-shaped relationship expected in both subsets suggested by the estimated signs of the coefficients of GPR and GPR square; where $\beta_1 > 0$ and $\beta_2 < 0$ forming the MEKC shape. All variables were significant at 0.01. This shape indicates that the relation between gender participation at the early stages increases the environment degradation; while after promoting the woman labor force participation and reducing the gender inequality gap the reverse effect begins where more woman involvement reduce the environmental degradation. These results add new empirical evidence to the literature supporting that woman awareness about the rights and efficient practices for all relevant activities whether formal or informal, in productive sectors or home activities can provide a significant role in reducing the environmental degradation, and thus allow a better chance for sustainable development.

This means that when the gender equality of the economy is at a low level, the environment degradation increases, however, when the country reaches a higher level of social development and gender equality, the environment degradation decreases as the environmental awareness and active role of the women population gets higher, and more environment-friendly techniques are implemented and the CO_2 emissions decrease.

5 Conclusion and Recommendations

In light of the empirical results, one can evidently suggest that climate interventions should be gender-sensitive to compensate for gender imbalances, aiming to explicitly promote women's empowerment and achieve gender equality. In this context, gender equality increases the efficiency of climate policies and reduces the climate risks. That is to say gender participation forms a channel through which achieving sustainable development can be maintained. For instance, gender equality and women's empowerment in household livelihoods can allow more self-efficiency, gendered division of labor as well as accessibility to credit.

The efficient use of the resources is imperative to benefit both present and future generations. It has become increasingly clear that to achieve sustainable development, the needs and contributions of half of the world's population, that is women, cannot be marginalized or completely ignored. The adaptation strategies might add to this effect if they are only concerned with the ecological dimension with no regards to a social one. The limited capacity of public institutions to deliver services can add to existing tensions and inequalities. Therefore, it is essential to examine both the impacts of climate change and the respective adaptation strategies in terms of their effect on gender, specifically in the most relevant areas to climate change such as water management, agriculture, and energy use.

These areas also would be a turning point to consider when moving toward a more comprehensive plan to integrate the gender perspective into a successful adaptation plan. They could be areas where the adaptation measures consider the gender opportunities for more contribution and empowerment to act as agents for change. Given the critical link between agriculture, poverty reduction, and the need to use the available water with the highest efficiency possible to secure livelihoods, women's key contribution in water management can effectively enhance agricultural development and eventually allow sustainable environmental practices. However, these benefits can be fulfilled after improving women's equitable access to resources and contribution to the decision-making process. That is why undertaking research and collecting gender data would be an imperative lesson to consider in formulating a sustainable development approach in the region. Policymakers need to be more aware about water rights; the economic and cultural challenges that limit women's effective contribution to secure and use water resources; as well as they should realize the benefits that can accrue by improving women's participation in water management.

Women are known to be creative in maintaining household activities and supplies of water and energy particularly

Table 1 Empirical results for MENA economies before and after correcting for heteroskedasticity

Variables	Subset (1)	Subset (2)
Constant	−8.579796	−9.358436
GPR	8.517682	8.983904
SGPR	−1.701300	−1.768789
No. of observations	468	468

in times of hardships such as droughts. They often rely on local materials that are more adaptable to extended periods of economic hardship, and develop more relevant methods to save water and energy use when early informed. That is why among the most urgent lessons learnt from the weak loops in the MENA region is to (i) ensure an early system of information for women about the expected climate change in their relevant areas, (ii) increase scientific research on gender and climate change, and gender analysis collection; (iii) ensure women's equal participation in all levels of decision-making, through targeted capacity building efforts; (iv) enhance efforts to ensure the availability of climate finance that is gender-responsive, and that it is reaching poor women and the most vulnerable community groups; (v) upgrade mechanisms to promote a balanced participation of indigenous women and grassroots communities.

Finally, a call for more active responsibility of the international community to finance and guide gender integration in the MENA region is inevitable to increase the woman participation in climate change adaptation measures, after all, women are the keepers of the household and their daily practices are most relevant to climate change. Thus, they can act as active agents of change to have a better sustainable development.

Appendix

The sample includes 18 MENA economies: Algeria, Bahrain, Egypt, Jordan, Lebanon, Morocco, Malta, Oman, Qatar, Tunisia, United Arab of Emirates, Syrian Arab Republic, Saudi Arab kingdom, Yemen, Iraq, Djibouti, Libya, and Iran.

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The Impact of Financial Education and Self-Efficacy on Financial Behavior in Croatia: Are We More Similar to Homo Economicus or Homer Simpson?

Irena Palić, Dajana Barbić, and Andrea Lučić

Abstract

This paper tends to reveal whether individuals are more prone to behave like Homo economicus or irrational individuals led by short-run motivation. According to the traditional economic theory, individuals behave perfectly rational and make their financial decisions based on their knowledge. On the other hand, behavioral theory neglects rational behavior assumed by traditional economics. Individuals do not act in their best interest and are prone to make irrational and wrong decisions. In the behavioral economics literature, as opposed to homo economicus, the irrational behavior is represented by the character of Homer Simpson who is often unreasonable, short-run-motivated, responsibility-averse, and does not use the acquired knowledge adequately. The purpose of this paper is to investigate the impact of financial knowledge, as a result of financial education and self-efficacy, on subsequent financial behavior. Therefore, based on the results of the survey conducted among Croatian citizens, this research uses regression modeling to assess how financial knowledge and self-efficacy affect responsible financial behavior among Croatian consumers. Results of the research are valuable for proper educational policy and providing insight into motives behind the efficient financial behavior.

Keywords

Financial behavior • Financial education • Self-efficacy • Survey research • Regression analysis

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1 Introduction

Classical economic theory assumes that informed consumers will demonstrate financially responsible behavior and act as a "Homo economicus" or "rational economic man" (Franz, 2004). The main hypothesis of the classical theory states that individuals will behave perfectly rational in the decision-making process, and will fully utilize all the available information. On the other hand, behavioral economics might be seen as rather depressing—showing that human beings very often are incapable of making good decisions since humans are "emotional, myopic, and easily confused and distracted" (Ariely, 2009). The underlying assumption of behavioral economics suggests that cognitive biases often prevent individuals from behaving rationally, despite their best efforts.

Some authors argue that poor financial behavior is a result of low level of education or low quality of education, complex and incomplete financial information (Chang & Hanna, 1992; Schuchardt, 1998; Taylor & Overbey, 1999). Several other studies conclude that individuals' financial behavior, besides knowledge and education, is determined by many external and internal factors, including a number of economic, demographic, social, and psychological factors. However, they all conclude that no matter the situation, decisions are ultimately always made by individuals themselves (Robb & Woodyard, 2011).

Failure to manage personal finance may have long-term negative consequences on the life of individuals and entire families. The latest financial and economic crisis exposed that many individuals behave irrationally, engage in poor financial decision-making and fail to manage their personal finances. This implies the obvious fact—"if humans were book characters, they would be more closely related to Homer Simpson than to Superman" (Ariely, 2009).

The results of this study will indicate whether people behave more like Homo economicus—according to the relevant knowledge and information—or more like Homer

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Simpson—ignoring the acquired knowledge, acting emotionally, unreasonably, short-run-motivated, and externally-oriented.

2 Review of Literature

Financial behavior is a component of overall human behavior that can be defined as any human behavior that is relevant to money management. There is still no generally accepted definition of financial behavior, its components, or the relevant measurement instrument. Proposed determinants of financial behavior include various demographic factors (such as age, gender, income, education, etc.), psychological factors (such as self-efficacy, behavioral control, locus of control, optimism, risk aversion, etc.), as well as financial stressors, financial knowledge, and financial attitudes.

According to the conventional economic theory, efficient financial behavior and better financial management practices should be the result of an increased level of financial knowledge and rational decision-making. Then again, according to the behavioral economics approach, financial behavior of individuals is largely determined by psychological factors, feelings and emotions, and therefore even financially knowledgeable individuals might be incapable of making rational decisions. Two types of cognitive processes may explain the difference in these two approaches, for which Stanovich and West (2000) introduced labels of System 1 and System 2. Kahneman (2003) further developed the architecture of cognition, exploring the functions of System 1 and System 2 (Fig. 1).

The effort invested in certain mental processes is the main indicator of whether a certain operation should be assigned to System 1 or System 2. System 1 is characterized by fast, automatic, effortless, associative, and often emotionally charged operations that are intuitive and directed by habit, and therefore difficult to control or change (Kahneman, 2003). Operations within System 2 are slow, serial, deliberately controlled, effortful, and potentially rule-governed. System 2 is also engaged in monitoring and correcting the activities of System 1. However, since it requires high level of mental effort, it is often turned off and the actions of the individual rely solely on the activities of System 1.

Conventional economists believe in the perfect functioning of System 2. Homo economicus could be described as a cognitive system that has logical ability of a flawless System 2 and the low computing costs of System 1. Behavioral economists are much close to explaining human behavior mainly based on the activities ran by System 1. They retained the elementary architecture, adding assumptions about cognitive limitations and intuitive behavior. Kahneman (2003) argues that the crucial characteristic of the human behavior "is not guided by what they are able to compute, but what they happen to see at a given moment".

2.1 Financial Knowledge and Financial Behavior

The relationship between financial knowledge and subsequent financial behavior is increasingly recognized as an area of great financial importance. As a common cure for numerous negative consequences of the 2008 financial and economic crisis, many government agencies, financial institutions, and nonprofit organizations prescribed financial education and developed programs designed to increase consumers' financial literacy. As an outcome, there is an extensive diversity of initiatives intended at educating consumers about financial matters, where the majority is focused

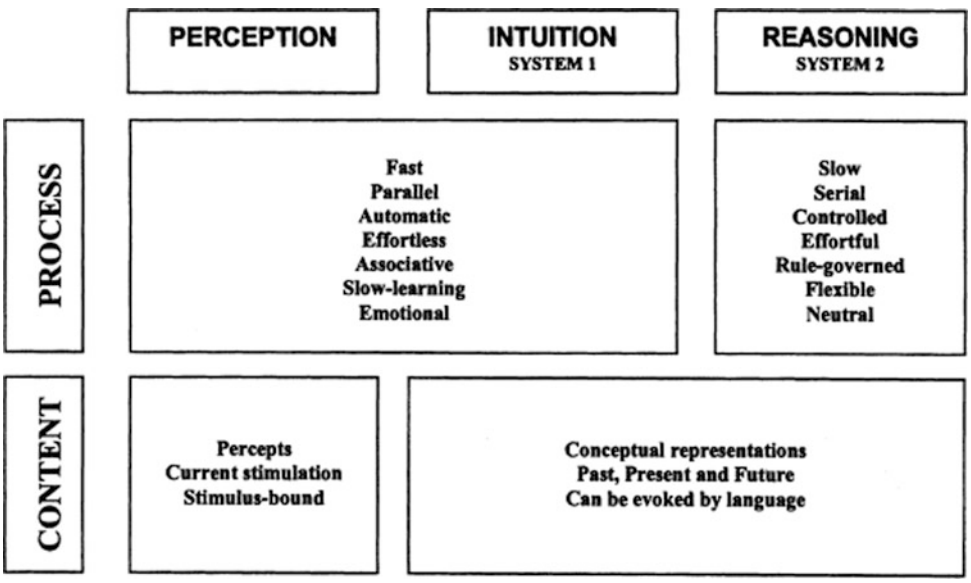

Fig. 1 Three cognitive systems
Source (Kahneman, 2003)

on increasing the level of financial knowledge as a mean of improving (or completely changing) financial behavior of the average consumer.

There is insubstantial empirical research on the relationship between financial knowledge and financial behavior, which is imperative to know in order to evaluate whether the present policies are appropriately addressing the right concerns. Furthermore, the empirical research on the relationship between financial knowledge and individual financial behavior is unclear. The evidence implies that the relationship between knowledge and behavior is much more complicated than it might seem at first, and that improved knowledge may not be automatically transformed into better financial behavior (Braunstein & Welch, 2002).

In theory, increased financial knowledge should result in more effective decision-making, and improved financial behavior (Liebermann & Flint-Goor, 1996). However, many studies failed to provide evidence of the direct link between financial knowledge and financial behavior. Several studies provided evidence of the significant relationship between the mentioned variables. However, the results vary in the means used to measure both knowledge and behavior. Findings of Bergheim et al. indicate that respondents that are more knowledgeable will exhibit better financial behavior (Bernheim & Garrett, 1996). Furthermore, Chen and Volpe (1998) and some other authors (Barbić, Lučić, & Chen, 2018; Barbić, 2017; Boyce & Danes, 1998; Brown & Graf (2013); Hilgert, Hogarth, & Beverly, 2003; Mandell & Schmid Klein, 2007) in their studies came to the same conclusion. Grohmann (2017) explored the relationship between financial literacy and financial behavior in emerging Asian countries and showed that respondents with higher financial literacy exhibit better financial behavior and are more likely to use the wide range of financial services that are offered to them. The results presented by Borden et al. suggest otherwise. In their research, they did not manage to find any evidence of the significant relationship between financial knowledge and financial behavior (Borden, Lee, Seido, & Collins, 2008). They argue that increased financial knowledge may improve individuals' intentions; however, many of them will not turn their plans into actions, i.e., behavior. Findings of Mandell (1997, 2004, 2008) suggest the same.

2.2 Self-efficacy and Financial Behavior

Aside from financial knowledge, a number of factors may facilitate or impede the performance of a behavior. Onkivisist and Shaw (1997), Hira and Mugenda (1999) argue that the way people perceive themselves and the world around them greatly determines their financial behavior.

Psychological factors such as self-efficacy, locus of control, behavioral control, optimism, and many others may have significant influence on the outcome of financial behavior (Perry & Morris, 2005). Hira and Mugenda (1999) indicated that financial behaviors are driven by sociopsychological needs as well as practical and financial ones. Some of these factors, including knowledge and skills, are internal to the individual while others, such as task demands or actions of another person, are external (Ajzen, 1985).

Self-efficacy beliefs reflect internal factors (Armitage & Conner, 1999). It refers to "people's beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives" (Bandura, 1991). Self-efficacy is focused on the ability to perform a particular behavior. It might be defined as "the conviction that one can successfully execute the behavior required to produce certain outcomes" or as "beliefs in one's capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1998). The main attribute of self-efficacy is the control over the behavior itself (Ajzen, 2002). According to Bandura, the attempt to perform particular tasks, or meet certain objectives depends on whether the individual believes he will be successful in performing these actions (Bandura, 1986). The stronger the perceived self-efficacy, the more he or she will employ effort and persevere at a task (Fiske & Taylor, 1991). Barbić et al. (2018) found that financial attitudes, financial literacy, and behavioral control play an important role in explaining responsible financial consumption behavior (RFCB), where all three variables were significantly and positively related to RFCB. Attitude turned out to be the most significant factor, followed by behavioral control and finally by financial literacy.

3 Data and Methods

3.1 Survey Design

The research was conducted using a questionnaire that was administered during financial literacy workshops in seven Croatian cities in the period from October to December 2017. The research was accomplished using the quantitative research method by means of a survey questionnaire on the sample of different age groups.

The measurements of all constructs are based on previous studies. Table 1 shows items that were used to define financial knowledge, self-efficacy, and financial behavior. The financial knowledge scale is based on Lusardi and Mitchell (2011). Individuals' self-efficacy was assessed using three items developed by Nysveen, Pedersen, and Thorbjørnsen (2005). Using three five-point Likert-type statements, the scale measures one's subjective degree of control over performance of a particular behavior, which is defined as self-efficacy. The reliability indicator for

Table 1 Items used to define financial knowledge, self-efficacy, and financial behavior

Financial knowledge	If the interest rate on your savings account was 1% per year and inflation was 2%, after 1 year you will (in real terms) have more money than today
	If today you have 100 HRK in a savings account and the interest rate is 2% per year, after 5 years you will have exactly 102 HRK
	If the buying exchange rate is 5 and selling exchange rate 6, you will give 50 HRK in order to buy 10 CHF
	Bonds are generally riskier than stocks
	If you have a loan with variable interest rate, with the increase in interest rate, the principal amount will also increase
	Mortgage loan with a repayment period of 15 years, usually has a larger installment than a mortgage loan with a repayment period of 30 years, but the total interest paid for the duration of the loan of 15 years will be lower than the interest paid on the loan in 30 years
Self-efficacy	My financial situation depends entirely on me
	I own resources and means necessary for success
	I am free to choose the way I make my own financial decisions
Financial behavior	I live in accordance with my financial possibilities
	I try to plan and predict my future expenses
	I pay my bills and other financial obligations on time
	I try to behave rationally in my everyday purchases
	I try to be well informed and well educated on personal finance matters
	When making a purchasing decision I always think of my budget limitations

self-efficacy Cronbach's alpha equals 0.643. This value is lower than 0.7 which is commonly considered as the satisfactory level. However, this value is regarded as acceptable due to relatively lower number of items for this construct.

While there is no common consensus on measuring financial behavior, both single item and multiple item measures have been used to create valid and reliable results (Grable & Joo, 2004). Used multiple item measures were composed either as scales or domains (Robb & Woodyard, 2011). Financial behavior scale was developed based on Barbić (2017), Cvrlje (2014). Using six, five-point Likert-type statements, the scale measures one's financial behavior. The reliability indicator Cronbach's alpha for financial behavior equals 0.828, which is considered as good.

The study is conducted using the purposive sample of 150 education participants living in Croatia, aged 20–79 years. The first research hypothesis of the paper is that financial knowledge and self-efficacy have positive statistically significant impact on financial behavior. The second research hypothesis is that self-efficacy exhibits stronger impact on financial behavior in relation to financial knowledge.

3.2 Principal Components Analysis of Financial Behavior and Self-efficacy

Variables that relate to financial behavior and self-efficacy are often highly correlated. Because of that, if each item is treated as a separate variable, a multicollinearity problem is expected. Multicollinearity arises when there exists strong linear relationships among independent variables in the model. If multicollinearity is present, one of the assumptions of linear regression models is violated and it is not possible to conduct the proper ordinary least squares (OLS) estimation (Kennedy, 2008). A possible approach to avoiding this problem is using principal components analysis, whereat variables that are highly correlated are combined into components (Tabachnick & Fidell, 2007).

Thus, correlation analysis for items referring to financial behavior and self-efficacy is provided in Table 2, while correlation analysis for items that comprise self-efficacy is given in Table 3.

Since Tables 2 and 3 show that for both constructs the large number of correlation coefficients among items is higher than 0.3, principal component analysis is suitable (see Kinnear & Gray, 2000 for explanation). Moreover, the significance of Bartlett's test for both constructs equals 0.000, which indicates that the correlations between items are statistically significantly different from zero. The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy for financial behavior equals 0.788, which is considered as an acceptable value in line with Kaiser (1974). The KMO measure for self-efficacy equals 0.650, which points to the average quality.

Thus, the principal component analysis is conducted for both financial behavior and self-efficacy. Table 4 presents eigenvalues for each component before and after extraction for financial behavior. After extraction first component

Table 2 Correlation matrix of items referring to financial behavior with *p*-values in parentheses

Correlation (*p*-value)	BEH1	BEH2	BEH3	BEH4	BEH5	BEH6
BEH1	1					
BEH2	0.564* (0.000)	1				
BEH3	0.420* (0.000)	0.569* (0.000)	1			
BEH4	0.505* (0.000)	0.433* (0.000)	0.561* (0.000)	1		
BEH5	0.278* (0.000)	0.374* (0.000)	0.442* (0.000)	0.439* (0.000)	1	
BEH6	0.467* (0.024)	0.399* (0.000)	0.328* (0.000)	0.618* (0.000)	0.278* (0.000)	1

Source Authors' calculation (SPSS 19)
Note * denotes significance of correlation coefficient at 5% level ($p < 0.05$)

Table 3 Correlation matrix of items referring to self-efficacy with *p*-values in parentheses

Correlation (*p*-value)	EFF1	EFF2	EFF3
EFF1	1		
EFF2	0.365* (0.000)	1	
EFF3	0.350* (0.000)	0.434* (0.000)	1

Source Authors' calculation (SPSS 19)
Note * denotes significance of correlation coefficient at 5% level ($p < 0.05$)

Table 4 Total variance explained for financial behavior

Component	Initial eigenvalues			Extraction sums of squared loadings
	Total	% of variance	Cumulative %	Total
1	3.245	54.085	54.085	3.245
2	0.830	13.827	67.912	
3	0.719	11.978	79.890	
4	0.518	8.638	88.528	
5	0.416	6.927	95.456	
6	0.273	4.544	100.000	

Source Authors' calculation (SPSS 19)

explains 54.085% of total variance and for second component, this percentage drops sharply. Thus, the component, which approximates financial behavior in further analysis, is retained.

Table 5 shows the total variance explained for self-efficacy. First component explains 58.922% of total variance for self-efficacy. Due to that, this component is retained in both cases.

After conducted principal component analysis, extracted components are used in further multiple regression analysis, namely, for each individual, the variables—financial behavior denoted by *BEH* and self-efficacy denoted by *EFF*—are calculated using the regression method of calculating factor scores, which is explained in detailed in Field (2011), Tabachnick and Fidell (2007).

3.3 Multiple Regression Modeling of Financial Behavior

After the principal component analysis of financial behavior and self-efficacy, the multiple linear regression model is estimated. The dependent variable in the model is financial behavior approximated by previously extracted *BEH* component. There are two independent variables: the first independent variable *EFF* refers to self-efficacy, and the second

Table 5 Total variance explained for self-efficacy

Component	Initial eigenvalues			Extraction sums of squared loadings
	Total	% of variance	Cumulative %	Total
1	1.768	58.922	58.922	1.768
2	0.667	22.247	81.169	
3	0.565	18.831	100.000	

Source Authors' calculation (SPSS 19)

independent variable is financial knowledge denoted by *KNOW*. Financial knowledge is calculated using respondents' answers to six questions as the simple linear combination. The value of one is attributed to each correct answer, and for the incorrect or missing answer, the value equals zero.

Hence, the estimated multiple linear regression model using ordinary least squares method is given by (1), with *t*-values in parentheses:

$$BEH = -0.401 + 0.364\,EFF + 0.109KNOW \quad (1)$$
$$(-2.079)\quad (4.909)\quad (2.213)$$

The estimated regression model indicated that both self-efficacy and knowledge have statistically significant positive impact on responsible financial behavior. The coefficient of determination—the adjusted coefficient of determination $\bar{R}^2$—equals 0.157 indicating that two independent variables, namely, *EFF* and *KNOW* explain 15.70% of variance in financial behavior. Although $\bar{R}^2$ is not high this is expected with dependent behavioral variable, which is not rare in social research. Financial behavior is affected by other factors that are not included in this research. However, the estimated model offers valuable insight into the impact of self-efficacy and knowledge on financial behavior. Concerning the diagnostics of the model residuals, the *F*-statistic of Breuch–Pagan–Godfrey heteroskedasticity test equals 1.481, with corresponding *p*-value of 0.2309, thus the problem of heteroscedasticity is not present at any reasonable significance level. Moreover, the Breuch–Godfrey residual autocorrelation LM test's F-statistic is calculated using EViews 9 and equals 1.484 with *p*-value of 0.2304, indicating that autocorrelation problem is not present at any reasonable significance level.

Moreover, the model is also estimated using standardized values of variables (denoted by *) in order to compare the strength of the impact of knowledge and self-efficacy on financial behavior. The estimated model with standardized coefficients is given by

$$BEH* = 0.374\,EFF* + 0.169KNOW* \quad (2)$$
$$(4.909)\quad (2.213)$$

The interesting result is that the impact of self-efficacy on financial behavior is much stronger than the impact of knowledge. Hence, the effect of the psychological variable is more pronounced than the effect of knowledge.

In line with the obtained result, the analysis of variance (ANOVA) is used to test whether all group means for six levels of financial knowledge are equal. It is interesting to assess whether the average financial behavior differs between groups with different levels of financial knowledge.

3.4 The Analysis of Variance (ANOVA) Mean Comparison

Prior to ANOVA mean comparison, the Levene's test is conducted to test the homogeneity of variances. Namely, it assesses whether the variances of different groups of respondents grouped by the level of financial knowledge are significantly different. Since Levene's statistic equals 1.731 with *p*-value of 0.131, variances are not significantly different at any reasonable significance level. This result points to the appropriateness of further use of ANOVA, since equal variances are the assumption of ANOVA (Field, 2011).

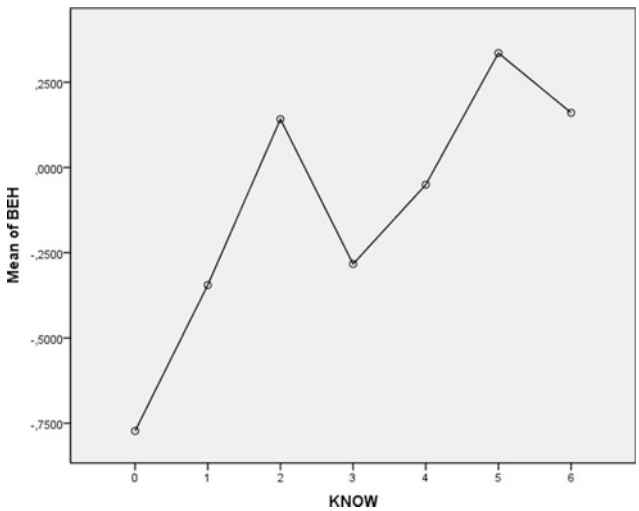

Fig. 2 Means plot of financial behavior for each financial knowledge level *Source* Authors' calculation (SPSS 19)

Table 6 Analysis of variance (ANOVA)

	Sum of squares	df	Mean square	*F*	*p*-value
Between groups	9.452	6	1.575	1.614	0.147
Within groups	139.548	143	0.976		
Total	149.000	149			

Source Authors' calculation (SPSS 19)

Preliminary, the plot of average values of financial behavior is presented in Fig. 2. It can be noticed that average financial behavior differs among groups. Moreover, it is observed, for example, the group with knowledge level 2 exhibits more responsible financial behavior than the group with knowledge level 3 and 4. Also, the group with knowledge level 5 shows better financial behavior than the group with knowledge level 6.

Table 6 shows the analysis of variance (ANOVA), which is used to examine whether the average values of financial behavior different across different knowledge-level groups. Since the variance between groups divided by the variance within groups is not large, the *F*-statistic equals 1.614 with *p*-value of 0.147; thus, the null hypothesis of equal average financial behavior across groups of respondents with different financial knowledge in population cannot be rejected at any reasonable significance level.

Thus, although higher financial knowledge implies better financial behavior, the individuals are not behaving completely rational like Homo economicus. Sometimes individuals who possess higher financial knowledge might have less responsible financial behavior. The possible explanation is in the inclusion of self-efficacy. It is difficult to claim that individuals behave irrationally like Homer Simpson, ignoring financial knowledge.

Nevertheless, this research points to the importance of both financial knowledge and psychological variables for responsible financial behavior. The attention should be put on both determinants, and thus psychological variables should be included in further research of financial behavior and financial successfulness. Psychological variables are gaining in importance in the context of obtained results, where financial knowledge showed relatively weaker impact on financial behavior in relation to self-efficacy. Furthermore, ANOVA has shown that there is no statistically significant difference in financial behavior across groups with different levels of financial knowledge. The psychological variables are considered as the explanation of this result.

4 Conclusion

The connection between financial literacy and consequent behavior is progressively perceived as a very important topic in finance. In the aftermath of the global financial crisis that originated from the United States in 2007, increasing financial literacy gained importance. This research investigates the impact of financial knowledge and self-efficacy on financial behavior. The conducted analysis provides an insight into financial behavior in Croatia based on survey research. The rationality assumption is often incorporated into economic models, indicating that individuals behave financially responsible. However, psychological factors are often underestimated in explaining individual behavior. In this research, the financially responsible individuals are represented by "Homo economicus" who act completely rational, as opposed to "Homer Simpson" as the representative of irrational individuals, led by emotions. Since psychological factors seem to gain in importance in previous research of financial behavior, this paper tests how financial knowledge and self-efficacy affect financial behavior. The regression analysis points to the captivating result. It is shown that self-efficacy impacts financial behavior much stronger than financial knowledge. Furthermore, the analysis of variance points to the equality of average financial behavior across groups of respondents with different financial knowledge. Even though increased financial knowledge enhances responsible financial behavior, Croatian financial consumers do not behave perfectly rationally. People with higher level of knowledge might exhibit less responsible financial behavior, which can be explained by psychological variables such as self-efficacy. However, individuals are not behaving completely irrationally like Homer Simpson, and the truth is somewhere in the middle. Thus, the inclusion of psychological variables is of great importance for adequately modeling financial behavior.

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The Impact of Privatizing Health Insurance on the Utilization of Medical Services in the Kingdom of Saudi Arabia

Mamdouh Hamza Ahmed and Turki Abdullah AL Amri

Abstract

The objectives of this research are to evaluate the effect of privatizing health insurance on medical services utilization in the city of Riyadh, The Kingdom of Saudi Arabia (KSA), and to determine whether the utilization of health care services' behaviors differs according to the availability of private health insurance coverage' compared with unavailability of private health insurance coverage. This study employed a self-administered questionnaire to collect data from privately insured and non-privately insured individuals in Riyadh, KSA. The questionnaire was designed to collect data on some variables related to health services utilization and demographic factors. This research showed that there are no significant static differences in the utilization of medical services between individuals with or without private health insurance coverage except for nationality. This research concludes that privatizing health insurance in KSA will not affect the utilization of medical services in the presence of governmental or public coverage for citizens, i.e., the behaviors will not differ according to the availability of private health insurance coverage compared with the unavailability of private health insurance coverage.

Keywords

Health insurance • Service providers • Utilization • Privatization • Medical services

1 Introduction

In 2005, health insurance was made compulsory for all non-Saudi nationals working in the country under the Cooperative Health Insurance Act No 3 & 4. In 2008, this act was extended to include Saudi nationals working for the private sector. Enforcements of this compulsory coverage include fines for noncompliant companies and a refusal to renew working permits without health insurance.

The Saudi government has given health care services a high priority. During the last two decades, health care services have improved in all aspects. The Saudi government provides all citizens full and free access to all public health care services. Funding for these health care services is a central challenge faced by the Ministry of Health (MOH) (Country cooperation strategy for WHO and Saudi Arabia 2006–2011). Since the total expenditure on public health services comes from the government and the facilities are free of charge, this leads to considerable cost pressure on the government, mainly because of the fast increase in the number of Saudi nationals, the high price of new technology, and the growing public awareness about health and disease among the community (General Authority of Statistics (GAS) 2008). The census shows that in the mid of 2018 the population was 33.4 million, out of the 22.7 Saudi nationals and 10.7 expatriates, where the last official census in 2010 showed that the population was 27.1 million (Walston et al. 2008). This considerable growth increases the demand for health services, which needs in parallel growing of funding and financing for medical services to meet this huge demand.

Saudis and public sector expats are eligible for a comprehensive package of benefits including, public health, preventive, diagnostic, and curative services and pharmaceuticals with few exclusions and no cost-sharing. Most services including state-of-the-art cardiovascular procedures, organ transplants, and cancer treatments (including bone marrow transplants) are covered. Sponsors/employers are

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responsible for paying for an extensive package of services for private sector expatriates.

To meet this growth of several population demands for health care and to ensure the quality of services provided, the Saudi government has established in 1999 the Council for Cooperative Health Insurance (CCHI). The main role of CCHI is to introduce, regulate and supervise a health insurance strategy for the Saudi health care market. The CCHI is an independent government body built by the above decision to regulate and implement this act through (Vision and tasks of the Council of Health Services in Saudi Arabia):

1. Preparing a draft of an executive bylaw for this act.
2. Issuing necessary decisions for regulating changing matters regarding the implementation of the rules governing this act, including implementation phases, the family members of the beneficiary to be covered by this insurance, the way and percentage of contribution by the beneficiary and the employer in the cooperative health insurance, and the maximum limit for this amount based on actuarial and specialist study.
3. Qualifying the cooperative insurance companies to work in the field of the cooperative health insurance.
4. Accrediting the health institutions to provide cooperative health insurance services.
5. Determining the financial compensation for qualifying the cooperative health insurance companies to work in this field, and the financial compensation for the accreditation of health institutions to provide cooperative health insurance services, after consulting the ministry of finance and national economy.

The implementation of Cooperative Health Insurance was planned over 3 phases. In the first phase, the Cooperative Health Insurance was implemented for non-Saudis and Saudis working in the private sector, wherein their employers should pay the cost of insurance. In the second phase, the Cooperative Health Insurance is to be implemented for Saudis and non-Saudis working in the government sector. The government will reimburse the collective health insurance charges for this group of workers. In the last stage, the Cooperative Health Insurance will be implemented for other clusters, such as, pilgrims (Alsharif 2008). The first phase has only been applied at the time of research.

2 Implementing Private Health Insurance for Employees of the Private Sector and their Dependents

The first phase covered companies with 500 or more employees while the second phase applied to employers with more than 100 workers. The third phase included employees of all companies in KSA as well as domestic workers. The Saudi government is now working systematically to apply the remaining two stages for employees in the government sector and pilgrims before they privatize the state-owned healthcare facilities. No information is available yet regarding the cooperative health insurance scheme for the Saudi citizens other than employees and expatriates. While the market for cooperative health insurance in the Kingdom of Saudi Arabia started with only one company in 2004, it currently has 27 companies in 2017 (Middle East Insurance Review; Council of Cooperative Health Insurance Annual Report).

The introduction of the scheme is intended to decrease the financial burden on the KSA government due to the costs associated with providing heath services free of charge. It will also give citizens more opportunity to choose the health services they need. According to this expansion of health insurance business and the availability of private health insurance coverage for more than 10 million people (Saudi and non-Saudi), the demand on the medical care will increase, and the utilization of these medical services will increase as well among the insured people (According to the yearly Annual Reports of the CCHI (Council of Cooperative Health Insurance Annual Report)).

The accessibility to medical care providers and hospitals will be easy for the privately insured people compared to noninsured people that will increase the utilization of services. Private health insurance will give an insured chance to receive health care in proper and less waiting time before receiving the service. Waiting time before receiving treatment represents a significant issue for non-privately insured and publicly insured individuals because of the extended waiting period in the governmental hospital.

Moral hazards associated with the availability of private health insurance is one of the major issues, which can affect directly the utilization of medical services. Individual who has private health insurance will behave differently than non-privately insured one. There are several factors causing

the moral hazards in health insurance (Douglass and Trenam 2006): The first factor, for those who have private health insurance, the cost of medical care services will be less, therefore they overutilize health care services accordingly. On the other hand, non-privately insured individuals will pay more for the same medical services. Thus, their consumption of health care will be less than those who are insured. Second factor causing moral hazard is the inequality of information between the patient and the medical service providers. Medical service providers may order some further investigations without informing the patient about the benefit of this action. Physician self-interest in the billing of treatment will take place in such situation. The third cause of moral hazards is the inequality of information between the insurance company and the insured. The insurance companies do not know precisely the degree of risk of every individual. Additionally, the insurance companies may have more significant information about service providers with better outcomes in specific diagnosis and treatment, but all of this information is not shared with the insured for many reasons (Douglass and Trenam 2006).

3 Literature Review

Ayako and Hitoshi (2013) examined the influence of the massive expansion of health insurance coverage in Japan on health and health care utilization, which reached widespread coverage through universal health insurance for its entire population in 1961 (Ayako and Hitoshi 2013). There were three major findings in his research: First, health care utilization increases more than it would be expected from previous estimates of the elasticities of individual-level changes in health insurance status. Second, increases in the supply of health care services tend to be smaller than increases in the demand for these services. The size of the supply response differs across different types of services, while the number of beds increases, effects on the numbers of medical institutions, physicians and nurses are negligible or inconclusive. Third, no evidence of reduced mortality rates is found at least in the short run.

The results suggested two lessons for countries planning a large expansion in health insurance coverage: first, it requires financial resources for the surge in health care expenditures, which is likely to be much larger than predicted from individual-level changes in insurance status; second, the slow supply-side response may constrain the ability of the health care system to meet increased demand. The research recognized the consequences of insurance by using geographical differences in health insurance coverage before the full implementation of universal coverage. The authors have also studied the influence of the significant increase of private health insurance plans in Japan on health care utilization and health results. They reported abundant increases in health care utilization, which were remarkably higher than what other research determined (Manning et al. 1987; Shigeoka 2014). They do not report that the enhancement of insurance increases the volume of health facilities. Furthermore, their evidence showed an increase in the number of beds as a response to the development of health insurance coverage, which indicates that there was a substantial demand for health care services.

A study by Anderson et al. (2012) reported that "reducing health insurance decreases utilization of emergency care and inpatient care in the United States. They studied the influence of the difference in coverage using emergency department administrative reports and hospital admission records from several states in the USA. They have estimated that the decrease in the insurance coverage rate among emergency department patients reduced emergency department visits, and a decrease in the insurance coverage rate among hospital patients lowered hospital visits. The reduction in hospital visits was stronger for non-urgent admissions and concentrated among for-profit and not-for-profit hospitals, as opposed to public hospitals. Their result identified several uncertainties about the impacts of insurance coverage on utilization of health care services. First, losing insurance coverage resulted in a net decrease in emergency department care. Secondly, losing insurance did increase the proportion of care that individuals receive at public hospitals".

Jeon and Kwon (2013) examined the relationship between private health insurance status and health care utilization in South Korea. After controlling the other independent variables (e.g., gender, age, marital status, education, public health financing, income, employment, number of chronic diseases, physical activity, smoking, and self-rated health), two alternative independent variables of whether or not enrolled in private health insurance, the amount of private health insurance purchased is used for each model. The analysis showed the results of the logistic regression, which examined the probability of any outpatient care utilization in one year. Individuals who have private health insurance were significantly more likely to use outpatient care more than those who did not have it. After eliminating the selection bias using regression analysis, the private health insurance purchasers were more likely to use outpatient care.

The number of private health insurance contracts was also an essential factor, and the higher the number of private health insurance contracts that a respondent purchased, the higher the chances of using any outpatient care. The second part estimators show the impact of private health insurance on the quantity and expenditure of health care utilization among those who used outpatient care at least once. The results indicated that private health insurance status did not have a significant impact on the number of outpatient visits.

The result also showed that individuals with private health insurance spent more on outpatient care than those who did not have private health insurance.

Private health insurance also influenced the probability of inpatient care utilization. The analysis showed that people who had private health insurance were significantly more likely to utilize inpatient care than people who did not have it. When an alternative independent variable of the number of private health insurance was used, people with more private health insurance contracts had a higher tendency to seek inpatient care. In addition, analysis for those who used inpatient care services at least once showed that private health insurance status, regarding whether or not enrolled in private health insurance, and the number of private health insurance purchased, had little impact on the number of inpatient days and total inpatient expenditure. These results implied that private health insurance had a positive effect on the initiation of inpatient care utilization.

In Germany, Patrick Hullegie and Tobias J. Klein estimated the effect of private health insurance on the number of doctor visits, the number of nights spent in a hospital, and self-assessed health in Germany (Patrick and Tobias 2010). They found a significant unfavorable influence of private health insurance on the number of physician visits for people who see the doctor at least once. At the same time, they noticed no impact on private health insurance on the number of nights of hospitalization and a positive effect on self-assessed health. They suggested that private health insurance either had a positive influence on finance in prevention, because of the economic encouragements that were given to the insured or that privately insured patients received more favorable services every time to visit the health facility.

Linda J. Blumberg in New Zealand measured path to care, use of health services produced by particular kind of service providers, and use of specific types of examinations and preventive steps (Blumberg 2006). People with private health insurance are markedly likely than those without private health coverage to having a usual source for receiving therapeutic care. The individuals with private health coverage were less likely to report having a problem reaching GP services in the prior month; however, that may be associated with the insured having more substantial salary and no health care needs.

There was no statistical discrepancy between the percentages of each group having at least one GP appointment in the last 12 months, nor did they vary in the percentage having at least one nursing visit or having had one prescription for their use. However, the privately insured were more likely to report having had at least one specialist visit in the last 12 months than those without private health coverage.

4 Study Design

A review of the relevant literature was carried out to select important variables that may have influenced the respondent's choice while filling out the survey (Deborah and Helen 2005). Three groups of independent variables were used in the study: sociodemographic, health-related and health services utilization, which may influence the dependent variable, which is whether having private health insurance coverage or not. These variables were selected based on several similar studies in the research literature on the use of health services from different countries around the world.

The study was conducted among citizens living in Riyadh city, the capital of the Kingdom of Saudi Arabia. According to the last official national statistic, the number of citizen in Riyadh reached eight million. The study population involved adult individuals (20 years of age and older). A random sampling size equation was used to collect data from this population and the sample size was 384 respondents with a confidence level of 95%. We distributed 400 questionnaires by manual handling or electronically as weblink via SMS and e-mails. The response rate was 74.22% (285 respondents).

We applied an analytical study using a self-administered questionnaire (Arabic and English). The survey was designed to collect data on different variables, which will help to meet the purpose of this study. The questionnaire was divided into two sections: seven questions on the sociodemographic variables and health-related variables including: availability of private health insurance, gender, age, educational level, marital status, income, chronic diseases and health status, and nine questions for health services utilization including: number of dentist visit, number of health care provider visits, number of ER visits, time spent in the hospital, number of nights spent in the hospital, X-ray, blood analysis or lab test, and prescription of medicine used. All of these questions cover a period over the past 12 months (Aman and Todd 2006).

Descriptive statistical analysis, Mann–Whitney test, and Kruskal–Wallis test were used to determine whether there are statistically significant differences between the individuals who have private health insurance coverage and those who do not have and if there are, what is the effect on the utilization of health care services.

We tested 17 hypotheses: H_o: there is no statistically significant difference in the medical service utilization between individuals with and without private health insurance coverage for all the following variables: nationality (Saudi, Non-Saudi), age, gender, marital status, educational status, having private health insurance, general health status, having chronic disease, number of dentist visit, number of

Table 1 Statistical analysis

#	Variable	Test	P value	Decision
	Adequacy of sample size	Kaiser–Meyer–Olkin [KMO]	0.000	Sample size is adequate as KMO = 0.659
	Reliability factor	Cranach's Alpha	0.666	Coefficient of validity 81.6%
1	Nationality	Mann–Whitney test	0.02	Less than 0.05, we reject H_o
2	Age	Chi-Square test	0.161	Greater than 0.05, we accept H_0
3	Gender (number)	Mann–Whitney test	0.941	Greater than 0.05, we accept H_0
4	Marital status	Mann–Whitney test	0.296	Greater than 0.05, we accept H_0
5	Educational	Mann–Whitney test	0.093	Greater than 0.05, we accept H_0
6	Having private health	Chi-Square test	0.391	Greater than 0.05, we accept H_0
7	General health status	Mann–Whitney test	0.249	Greater than 0.05, we accept H_0
8	Having chronic disease	Mann–Whitney test	0.320	Greater than 0.05, we accept H_0
9	Number of dentist visit	Chi-Square test	0.092	Greater than 0.05, we accept H_0
10	Emergency department visit	Chi-Square test	0.515	Greater than 0.05, we accept H_0
11	Number of medical providers visit	Chi-Square test	0.092	Greater than 0.05, we accept H_0
12	Time staying in the hospital	Chi-Square test	0.471	Greater than 0.05, we accept H_0
13	Number of nights spent in the hospital	Chi-Square test	0.916	Greater than 0.05, we accept H_0
14	Prescription of medicine use	Chi-Square test	0.309	Greater than 0.05, we accept H_0
15	Number of X-ray or other diagnostic images	Chi-Square test	0.403	Greater than 0.05, we accept H_0
16	The number of laboratory test or blood analysis	Chi-Square test	0.035	Greater than 0.05, we reject H_1
17	Income average	Kruskal–Wallis test	0.391	Greater than 0.05, we reject H_1

emergency department visit in the last 12 months, number of medical providers visit in the last 12 months, inpatient numbers in the hospital in the last 12 months, the number of inpatient nights spent in the hospital in the past 12 months, frequency of prescription of medicine used in the past 12 months, number of X-ray or other diagnostic images in the past 12 months, and number of laboratory test or blood analysis in the past 12 months.

According to the hypothesis testing (see Table 1), we accepted all null hypotheses (H_o) that there is no statistical hypothesis difference in the medical service utilization between individuals with and without private health insurance coverage except the nationality where we rejected (H_o) that there is no statistically significant difference between medical service utilization according to nationality. This is an expected result as under the governmental or public coverage, utilization of health care services is limited to non-Saudi nationality as most of them are blue-collar workers who are allowed to clinics only not the hospitals, so when they have private health insurance they utilize health care services more.

5 Conclusion

The objectives of this research were to evaluate the effect of privatizing health insurance on medical services utilization in the city of Riyadh, the Kingdom of Saudi Arabia (KSA), and to determine whether the utilization of health care services' behaviors differ according to the availability of private health insurance coverage compared with unavailability of private health insurance coverage. This research concludes that there are no statistically significant differences in the utilization of medical services between individuals with and without private health insurance coverage according to all variables except for nationality.

6 Limitations and Recommendations

In this study, the presented results provided a valuable understanding of some factors that might affect the utilization of health care services in KSA. However, this paper did not include all possible factors. Therefore, we recommend that future studies may take into account such variables that may signify the utilization of medical facilities.

Another deficiency that could have affected the results presented here is that the data was collected from one city, the capital of the KSA, Riyadh. Therefore, in the future, we recommend that when the government or any researcher conducts this research, he or she should take into account many different cities that represent the population of the KSA.

Finally, we recommend that future studies should collect data from the records of the medical service providers to make the result more accurate and to use it in planning for a universal health care system in the KSA.

Appendix 1

Testing the adequacy of the sample size

KMO and Bartlett's test			
Kaiser–Meyer–Olkin measure of sampling adequacy	0.659		
Bartlett's test of sphericity	Approx. Chi-Square	828.893	
	df	66	
	Sig.	0.000	
Case processing summary			
		N	%
Cases	Valid	285	100.0
	Excluded[a]	0	0.0
	Total	285	100.0
Reliability statistics			
Cronbach's alpha	N of items		
0.666	12		

[a]Listwise deletion based on all variables in the procedure

Appendix 2

Table 2 Significant difference in the health insurance utilization according to the nationality (Saudi, Non-Saudi)

Mann–Whitney test				
What is your nationality?	Ranks	N	Mean rank	Sum of ranks
Do you have private health instance?	Saudi	270	146.06	39435.00
	Other	15	88.00	1320.00
	Total	285		
Test statistics[a]				
	Do you have private health insurance?			
Mann–Whitney U	1200.000			
Wilcoxon W	1320.000			
Z	−3.113			
Asymp. Sig. (2-tailed)	0.002			

[a]Grouping Variable: What is your nationality?

Table 3 Results of one-way analysis in the utilization of health insurance according to the age

Kruskal–Wallis test			
Ranks			
What is your age category?	Age category	N	Mean rank
Do you have private health insurance?	20–29	72	128.77
	30–39	136	146.47
	40–49	52	144.45
	50–64	25	162.10
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	5.146		
df	3		
Asymp. Sig.	0.161		

[a]Kruskal–Wallis test
[b]Grouping Variable: What is your age category?

Table 4 Results of t-test in the utilization of health insurance according to gender (Male–Female)

Mann–Whitney test				
Ranks				
Do you have private health insurance?	What is your gender?	N	Mean rank	Sum of ranks
	Male	218	143.17	31211.00
	Female	67	142.45	9544.00
	Total	285		
Test statistics[a]				
	Do you have private health insurance?			
Mann–Whitney test U	7266.000			
Wilcoxon W	9544.000			
Z	−0.074			
Asymp. Sig. (2-tailed)	0.941			

[a]Grouping Variable: What is your gender?

Table 5 Results of t-test in the utilization of health insurance according to the marital status

Mann–Whitney test					
Ranks					
What is your marital status?			N	Mean rank	Sum of ranks
Do you have private health insurance?	dimension 1	Married	219	145.39	31840.50
		Other	66	135.07	8914.50
		Total	285		
Test statistics[a]					
	Do you have private health insurance?				
Mann–Whitney U	6703.500				
Wilcoxon W	8914.500				
Z	−1.045				
Asymp. Sig. (2-tailed)	0.296				

[a]Grouping Variable: What is your marital status?

Table 6 Results of t-test in the utilization of health insurance according to the educational status

Mann–Whitney test				
Ranks				
	What is your educational status?	N	Mean rank	Sum of ranks
Do you have private health insurance?	High school or less	57	157.00	8949.00
	College or more	228	139.50	31806.00
	Total	285		

(continued)

Table 6 (continued)

Test statistics[a]	
	Do you have private health insurance?
Mann–Whitney test	5700.000
Wilcoxon W	31806.000
Z	1.681
Asymp. Sig. (2-tailed)	0.093

[a]Grouping Variable: What is your educational status?

Table 7 Results of one-way test in health insurance according to having private health insurance

Kruskal–Wallis test			
Ranks			
	What is your approximate average income?	N	Mean rank
Do you have private health insurance?	0–5000	44	137.23
	5000–10,000	52	136.23
	10,000–15,000	96	153.02
	15,000 or more	93	139.18
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	3.001		
df	3		
Asymp. Sig.	0.391		

[a]Kruskal–Wallis test
[b]Grouping Variable: What is your approximate average income?

Table 8 Results of one-way test in health insurance according to the general health status (good–bad)

Mann–Whitney test				
Ranks				
	What is your general health status?	N	Mean rank	Sum of ranks
Do you have private health insurance?	Good	259	141.48	36643.00
	Poor	26	158.15	4112.00
	Total	285		
Test statistics[a]				
	Do you have private health insurance?			
Mann–Whitney U	2973.000			
Wilcoxon W	36643.000			
Z	−1.153			
Asymp. Sig. (2-tailed)	0.249			

[a]Grouping Variable: What is your general health status?

Table 9 Results of one-way test in health insurance according to having a chronic disease

Mann–Whitney test				
Ranks				
	Do you have any chronic disease?	N	Mean rank	Sum of ranks
Do you have private health insurance?	Yes	46	152.43	7012.00
	No	239	141.18	33743.00
	Total	285		
Test statistics[a]				
	Do you have private health insurance?			
Mann–Whitney U	5063.000			
Wilcoxon W	33743.000			
Z	−0.994			
Asymp. Sig. (2-tailed)	0.320			

[a]Grouping Variable: Do you have any chronic disease?

Table 10 Results of one-way test in health insurance according to the number of dentist visit

Kruskal–Wallis test			
Ranks			
	Number of medical providers visit in the past 12 months?	N	Mean rank
Do you have private health insurance?	No visit	25	156.40
	Once	56	158.74
	Twice	101	131.46
	Three or more	103	142.51
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	6.442		
df	3		
Asymp. Sig.	0.092		

[a]Kruskal Wallis test
[b]Grouping Variable: Number of medical providers visit in the past 12 months?

Table 11 Results of one-way test in health insurance according to the emergency department visit

Kruskal–Wallis test			
Ranks			
	Number of emergency department visit in the past 12 months?	N	Mean rank
Do you have private health insurance?	No visit	134	145.64
	Once	66	148.02
	Twice	45	129.17
	Three to more	40	141.44
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	2.287		
df	3		
Asymp. Sig.	0.515		

[a]Kruskal–Wallis test
[b]Grouping Variable: Number of emergency department visits in the past 12 months?

Table 12 Results of one-way test in health insurance according to the number of medical providers visit

Kruskal–Wallis test			
Ranks			
	Number of medical providers visit in the past 12 months?	N	Mean rank
Do you have private health insurance?	No visit	25	156.40
	Once	56	158.74
	Twice	101	131.46
	Three to more	103	142.51
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	6.442		
df	3		
Asymp. Sig.	0.092		

[a]Kruskal–Wallis test
[b]Grouping Variable: Number of medical providers visit in the past 12 months?

Table 13 Results of one-way test in health insurance according to time staying in the hospital in the last 12 months

Kruskal–Wallis test			
Ranks			
	Time staying in the hospital in the past 12 months?	N	Mean rank
Do you have private health insurance?	Nill	236	140.41
	Once	40	159.25
	Twice	7	140.93
	Three to more	2	130.75
	Total	285	

Table 13 (continued)

Kruskal–Wallis test	
Test statistics[a,b]	
	Do you have private health insurance?
Chi-square	2.523
df	3
Asymp. Sig.	0.471

[a]Kruskal–Wallis test
[b]Grouping Variable: Time staying in the hospital in the past 12 months?

Table 14 Results of one-way test in health insurance according to the number of nights spent in the hospital in the past 12 months

Kruskal–Wallis test			
Ranks			
	Number of nights spent in the hospital in the past 12 months?	N	Mean rank
Do you have private health insurance?	0	237	141.87
	1–7	43	148.98
	8–30	3	154.50
	31 nights or more	2	130.75
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	0.512		
df	3		
Asymp. Sig.	0.916		

[a]Kruskal–Wallis test
[b]Grouping Variable: Number of nights spent in the hospital in the past 12 months?

Table 15 Results of one-way test in health insurance according to the prescription of medicine use in the past 12 months?

Kruskal–Wallis test			
Ranks			
	Prescription of medicine use in the past 12 months?	N	Mean rank
Do you have private health insurance?	Never taken	48	154.50
	Ever taken, not always	148	137.49
	Always	89	145.96
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	2.351		
df	2		
Asymp. Sig.	0.309		

[a]Kruskal–Wallis test
[b]Grouping Variable: Prescription of medicine use in the past 12 months?

Table 16 Results of one-way test in health insurance according to the number of X-ray or other diagnostic images in the past 12 months

Kruskal–Wallis test			
Ranks			
	Number of X-ray or other diagnostic images in the past 12 months?	N	Mean rank
Do you have private health insurance?	0	137	147.91
	Once	95	133.00
	Twice	38	149.50
	Three or more	15	145.00
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	2.927		
df	3		
Asymp. Sig.	0.403		

[a]Kruskal–Wallis test
[b]Grouping Variable: Number of X-ray or other diagnostic images in the past 12 months?

Table 17 Results of one-way test in health insurance according to the number of laboratory test or blood analysis in the past 12 months

Kruskal–Wallis test			
Ranks			
	Number of laboratory test or blood analysis in the past 12 months?	N	Mean rank
Do you have private health insurance?	0	93	152.97
	Once	92	146.24
	Twice	61	120.24
	Three or more	39	147.19
	Total	285	
Test statistics[a,b]			
	Do you have private health insurance?		
Chi-square	8.596		
df	3		
Asymp. Sig.	0.035		

[a]Kruskal–Wallis test
[b]Grouping Variable: Number of laboratory test or blood analysis in the past 12 months?

Table 18 Results of one-way test in health insurance according to the average income

Descriptive statistics					
	N	Mean	Std. deviation	Minimum	Maximum
Health insurance	285	1.5860	0.49342	1.00	2.00
Income	285	2.8351	1.05023	1.00	4.00

(continued)

Table 18 (continued)

Descriptive statistics			
Kruskal–Wallis test			
Ranks			
	Income	N	Mean rank
Health insurance	0–5000	44	137.23
	5000–10,000	52	136.23
	10,000–15,000	96	153.02
	15,000 or more	93	139.18
	Total	285	
Test statistics[a,b]			
	Health insurance		
Chi-Square	3.001		
df	3		
Asymp. Sig.	0.391		

[a]Kruskal–Wallis test

Appendix 3

Table 19 Frequency distribution according to sociodemographic variables

Variables	Frequency N = 285	Percentage (%)
Health insurance		
Yes	118	41.4
No	167	58.6
Age		
20–29	72	25.3
30–39	136	47.7
40–49	52	18.2
50–64	25	8.8
Gender		
Male	218	76.5
Female	67	23.5
Educational status		
High school or less	57	20
College or more	228	80
Marital status		
Married	219	76.8
Other	66	23.2
Income		
0–5000	44	15.4
5000–10,000	52	18.2
10,000–15,000	96	33.7
15,000 or more	93	32.6
Nationality		
Saudi	270	94.7
Other	15	5.3
Chronic disease		
Yes	46	16.1
No	239	83.9
Health status		
Good	259	90.9
Poor	26	9.1

Table 20 Frequency distribution according to utilization variables

Variables	Frequency N = 285	Percentage (%)
Dentist visit in the past 12 months		
Nil	91	31.9
Once	74	26
Twice	85	20.4
Three or more	62	21.8
Medical providers visit in the past 12 months		
Nil	25	8.8
Once	56	19.6
Twice	101	35.4
Three or more	103	36.1
Emergency Department visit in the past 12 months		
Nil	134	47
Once	66	23.2
Twice	45	15.8
Three or more	40	14
Hospitalization in the past 12 months		
Nil	236	82.8
Once	40	14
Twice	7	2.5
Three or more	2	0.7
Nights spent in the hospital in the past 12 months		
0	237	83.2
1–7	43	15.1
8–30	3	1.1
31 or more	2	0.7
Prescription of medicine use in past 12 months		
Never taken	48	16.8
Ever taken, not always	148	51.9

Table 20 (continued)

Variables	Frequency N = 285	Percentage (%)
Always	89	31.2
Laboratory test or blood analysis in the past 12 months		
Nil	93	32.6
Once	92	32.3
Twice	61	21.4
Three or more	39	13.7
X-ray or other diagnostic images in the past 12 months		
Nil	137	48.1
Once	95	33.3
Twice	38	13.3
Three or more	15	5.3

Table 21 Sociodemographic variables for privately insured individuals and non-privately insured people

Variables	Private insurance	No private insurance
Age		
20–29	37 (31.4%)	35 (21%)
30–39	53 (44.9%)	83 (49.7%)
40–49	21 (17.8%)	31 (18.6%)
50–64	7 (5.9%)	18 (10.8%)
Gender		
Male	90 (76.3%)	128 (76.6%)
Female	28 (23.7%)	39 (23.4%)
Educational status		
High school or less	18 (15.3%)	39 (23.4%)
College or more	100 (84.7%)	128 (76.6%)
Marital status		
Married	87 (73.7%)	132 (79%)
Other	31(26.3%)	35 (21%)
Income		
0–5000	20 (16.9%)	24 (14.4%)
5000–10,000	(%20) 24	(%16.8) 28
10,000–15,000	33 (28%)	63 (37.7%)
15,000 or more	41 (34.7%)	52 (31.1%)
Nationality		
Saudi	106 (89.8%)	164 (98.2%)
Other	12 (10.2%)	3 (1.8%)
Chronic disease		
Yes	16 (13.6%)	30 (18%)
No	102 (86.4%)	137 (82%)
Health status		
Good	110 (93.2%)	149 (89.2%)
Poor	8 (6.8%)	18 (10.8%)

Table 22 Utilization variables for privately insured individuals and non-privately insured people

Variables	Private insurance	No private insurance
Dentist visit in the past 12 months		
No visit	39 (33.1%)	52 (31.1%)
Once	28 (23.7%)	46 (27.5%)
Twice	25 (21.2%)	33 (19.8%)
Three or more	26 (22%)	36 (21.6%)
Medical providers visit in the past 12 months		
No visit	8 (6.8%)	17 (10.2%)
Once	17 (14.4%)	39 (23.4%)
Twice	50 (42.4%)	51 (30.5%)
Three or more	43 (36.4%)	60 (35.9%)
Emergency department visit in the past 12 months		
No visit	53 (44.9%)	81 (48.5%)
Once	25 (21.2%)	41 (24.6%)
Twice	23 (19.5%)	22 (13.2%)
Three or more	17 (14.4%)	23 (13.8%)
Hospitalization l in the past 12 months		
Nil	102 (86.4%)	134 (82%)
Once	12 (10.2%)	28 (16.8%)
Twice	3 (2.5%)	4 (2.4%)
Three or more	1 (.8%)	1 (.6%)
Nights spent in the hospital in the past 12 months		
0	100 (84.7%)	137 (82%)
1–7	16 (13.6%)	27 (16.2%)
8–30	1 (.8%)	2 (1.2%)
31 or more	1 (.8%)	1 (.6%)
Prescription of medicine use in past 12 months		
Never taken	16 (13.6%)	32 (19.2%)
Ever taken, not always	67 (56.8%)	81 (48.5%)
Always	35 (29.7%)	54 (32.3%)
Laboratory test or blood analysis in the past 12 months		
Nil	32 (27.1%)	61 (36.5%)
Once	36 (30.5%)	56 (33.5%)
Twice	35 (29.7%)	26 (15.6%)
Three or more	15 (12.7%)	24 (14.4%)
X-ray or other diagnostic images in the past 12 months		
Nil	52 (44.1%)	85 (50.9%)
Once	46 (39%)	49 (29.3%)
Twice	14 (11.9%)	24 (14.4%)
Three or more	6 (5.1%)	9 (5.4%)

Appendix 4

Questionnaire used in the survey

Dear Participant,
Thank you for your participation. The questionnaire is brief, and it will take few minutes to fill it out. The questionnaire designed to examine the impact of privatizing health insurance on the use of medical services in Riyadh, Saudi Arabia
Please be assured that all information you provide will be kept strictly confidential.
1. Do you have private health insurance?
• Yes
• No
2. What is your nationality?
• Saudi
• Other
3. What is your age category?
• 20–29
• 30–39
• 40–49
• 50–64
4. What is your gender?
• Male
• Female
5. What is your marital status
• Married
• Other
6. What is your educational status
• High school or less
7. What is your approximate average income?
• 0–5000
• 5000–10,000
• 10,000–15,000
• 15,000 or more
8. What is your general health status?
• Good
• Poor
9. Do you have any chronic disease
• Yes
• No
10. Number of medical providers visit in the last 12 months
• No visit
• once
• twice
• Three or more
11. Number of dentists visit in the last 12 months
• No visit
• Once
• Twice
• Three or more
12. Number of emergency department visit in the last 12 months
• No visit
• Once
• Twice
• Three or more
13. Inpatient numbers in the hospital in the last 12 months
• Nil
• Once
• Twice
• Three or more
14. Number of inpatient nights spent in the hospital in the last 12 months
• 0
• 1–7
• 8–30
• nights or more 31
15. Prescription of medicine use in the last 12 months
• Never taken
• taken, not always
• Always
16. Number of X-ray or other diagnostic images in the last 12 months
• 0
• Once
• Twice
• Three or more
17. Number of Laboratory test or blood analysis in the last 12 months
• 0
• Once
• Twice
• Three or more

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The Impacts of Education on the Sustainable Development in United Arab Emirates: A Simultaneous Equations Approach

Akram Masoud Haddad

Abstract

The United Arab Emirates (UAE) is an Asian country that consists of seven emirates. UAE is the eighth largest oil producer in the world which is the main source used for development. UAE is a member of the Gulf Cooperation Countries (GCC) council. UAE is one of the world's most open and successful economies. UAE maintains a free-market economy and is one of the most politically stable and secure in the region. All together ensures that UAE has a robust competitive edge since it is the region's premier commercial hub and the second largest economy. In addition, this economic environment encourages the establishment of private universities and branches of well-known foreign universities in UAE. In this study, the impact of education on the sustainable economic development is measured by human development index (HDI) using simultaneous equations approach of two equations. The results show that there are more than one million students enrolled in primary and secondary schools and more than 60 thousand enrolled in territory education in more than 561 programs distributed over 70 institutions, around 40% of them are noncitizens. The regression results show that there are impacts of education on the sustainable economic development at UAE. These results emphasize the role of education in creating sustainable development in UAE, in particular, as well as the rational policy of the UAE and confirm the results of other studies.

Keywords

Human development index • Education • United Arab Emirates • Sustainable development

1 Introduction

The role of education in sustainable development is pronounced by the Target 4.7 of the UNESCO which says "that by 2030, ensure that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles, human rights, gender equality, promotion of a culture of peace and nonviolence, global citizenship, and appreciation of cultural diversity and of culture's contribution to sustainable development" (Shaker, 2015).

In this regard the widely used definition of sustainable development by most of the authors is given by World Commission on Environment and Development which defines it as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This necessitates to consider and protect the environment and natural resources on which its current and future development depend on. This is achieved only through the integration and acknowledgement of economic, environmental, and social concerns throughout the decision-making process" (Blewitt, 2015; Kahle & Gurel-Atay, 2014; Robert, Parris, & Leiserowitz, 2005).

Incidentally there are two big questions: what to sustain and what to develop. Under the second question, there are three major categories that are nature, life support systems, and community, in addition to intermediate categories for each. The answer to the second question includes three things: first is the people which includes child survival, life expectancy, education equity, equal opportunity, and the second is the economy which includes wealth, productive sectors, consumption, and third the society which means institutions, social capital, states and regions (Kahle & Gurel-Atay, 2014; Robert et al., 2005).

Therefore, it seems that sustainable development can be more well represented and measured by human development index (HDI) which was created and published annually by

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the United Nation Development Program (UNDP) since 1990 to highlight that people and their capabilities should be the ultimate criteria for assessing and evaluating the development of any countrynot only the economic growth, which is used in most of the previous studies. The HDI is a measure which captured, in addition, the income, poverty, literacy, education, average life expectancy and other indicators of the countries (UNDP, 2016). HDI is composed of life quality measured by both life expectancy index (LEI), and life expectancy at birth (in years); education index (EI) which is measured by mean years of schooling (in years), expected years of schooling (in years), and finally the Income Index (II) which is measured by Per capita income measured by Purchasing power parity (PPP $).

The United Arab Emirates (UAE) is a federation state of seven autonomous Emirates found in 1971, located on the western part of Asia, on the southeast end of the Arabian Peninsula of the Gulf, with an area of 83.6 thousand square kilometers, and total population of around ten million in 2018. According to federation constitution of UAE, each emirate is governed by a ruler handling all authorities that are not mentioned by the Constitution with exception of the foreign affairs, defense, security and social services, and adopt a common immigration policy (Haddad, 2018).

Although the UAE is the third regional and eighth world largest oil producer, it implements successful efforts at economic diversification in order to decrease dependence on oil and gas and their products. In this regard, UAE maintains a free-market economy, in addition of that, UAE is one of the most politically stable and secure country in the region, plus it is a strategically geographic location; all these give and ensure the country robust competitive edge as the region's premier commercial hub and second largest economy. In addition to that, the leadership of the UAE considers education as one of the highest priorities of UAE and the vehicle for development and knowledge economy. Quoted from His Highness Sheikh Zayed Bin Sultan Al Nahyan, the founder of the UAE, his famous saying is "The greatest use that can be made of wealth is to invest it in creating generations of educated and trained people". To facilitate the entrance of private universities and other international universities and be a center of higher education in the region, UAE established universities special zones and encouraged the investment in education. As a result, there is sharp increase in private and public investment in education at all levels of education, so that UAE is the residence of more than 33 private universities and higher education institutions besides those owned by the public sector (Ministry of Education, 2018; FCSA, 2019).

Therefore, this study represents an attempt to investigate the impact of education on sustainable development measured by HDI as a proxy of sustainable development and education, using data from one of the strongest economies in the world that is UAE.

2 Review of Literature

Odit, Dookhan, and Fauzel (2010) analyze the investment impacts of education on economic growth in case of Mauritius, and to investigate the extent of education level of the Mauritian labor force that affects the economic growth, which is the output level of labor. The study finds that human capital plays significant role in economic growth largely as an engine for improvement of the output level of labor. There is compelling evidence that human capital increases productivity, and proposed that education enhance productivity rather than just a mechanism used by individuals as an indicator of their level of capability to the employer.

Pritchett (2001) argued that poor institutions and policies enclose vulnerable growth in many of the least developed economies in the world, directing skilled labor into somewhat unproductive activities; for this reason interrupts the relationship between education and growth in the studied countries, which include less-developed economies. The results of the study confirm that human capital and indigenous innovation impacts are tremendously important to the economic growth in Portugal, particularly, the indirect effect of human capital throughout innovation emerges as critical, showing that a reasonably high human capital stock is necessary to enable a state to harvest and obtain the benefits of its indigenous innovation efforts. The results of Teixeira and Fortuna (2004) also emphasize that human capital and indigenous innovation efforts that are of great importance to the process of economic growth in Portuguese during 1960–2001.

Based on previous literature, Kotásková et al. (2018) established a unique insight along with new evidence about the relationship between education and economic growth in India during 1975–2016, focusing on primary, secondary, and tertiary levels of education. The research argues that education plays a fundamental and significant role in economic growth in India. Accordingly, other countries can utilize the case of India as an example for development. The results provide compelling evidence that confirm the positive relationship between education and economic growth in India. This evidence perhaps influences governmental actions and forms the future in India.

Pribac and Anghelina (2015) constructed a conceptual research model based on the economic increase models that explain the approach in which the revenue per resident is

created considering the mechanisms, channels, and influence factors. The model is applied to the European Union members as an example and provided results that confirmed the existence of positive impacts of human capital (measured by education) on economic growth in these countries.

Cooray (2009) investigated the impacts of the quantity and quality of education on economic growth using many proxy variables in a cross-section sample of low- and medium-income countries. The result retrieves that education quantity measured by enrolment ratios unambiguously influences economic growth and indirectly affects government expenditure on economic growth. Jalil and Idrees (2013) evaluated the level and growth impacts of education on the economic growth in Pakistan using the data of 1960–2010. The results of this study clearly provides evidences for positive impacts of different levels of education on the economic growth, which confirms that investments in education possibly increase and promote economic growth.

Mallick, Das and Pradhan (2016) found that the impacts of expenditure on education on economic growth in selected sample of (14) main countries in Asia (the sample consists of Saudi Arabia, Pakistan, Bangladesh, India, Sri Lanka, Nepal, China, Hong Kong Japan, Malaysia, Singapore, Thailand, Philippines, and Turkey) are positive and statistically significant in all those countries. Moreover, there are short and long run unidirectional Granger causality resulting from economic growth to expenditure on education. On the contrary, there is Granger causality of expenditure on education on economic growth in long runs only and not in the short-runs in sample. Analysis of the data of the sample as a group shows positive impact of expenditure on education on economic growth. That is, the education sector is one of the important elements of economic growth in all of the sample countries which should be given high priority, and a reasonable share of total expenditure of the governments should be allocated to the education sector to improve all levels and types of education so that the country can utilize skilled workforce in economic development in the long run.

Başar (2016) explores the impacts of education on economic growth in transition economies during the period 1998–2005; the sample consists of 24 countries. This study used as proxies for education human capital, education index, enrollment ratio, and literacy rate, respectively. The results provide evidence that human capital, education, and literacy rate positively impact the economic growth, and effect of human development and literacy rate in the long run, while enrollment ratio impact is positive and insignificant in the short run. However, the effects of human capital and literacy are greater than those of physical capital.

Review of studies on the channels by which education affects economic growth is done by Ding (2017). He shows that the relation between education and economic growth is relatively complicated due to the fact that educational economics lag behind the development of economic theory so that the process of economic growth turn into more complex, and the process of economic growth is divided into product function of technological progress, human resource, and consumption preference. The results show that there are many ways of how education affects economic growth.

In the meantime, higher education plays a well-known role in determining the competitiveness of any country or region. For this reason, Zhu, Peng, and Zhang (2018) developed a comprehensive proxy for education used to study the impacts of higher education scale and quality on economic growth in the six provinces of central China using panel data during the period 2003–2014. The empirical results illustrate that higher education scale has significant positive impact on economic growth of central China; on the contrary, the impacts of the quality of higher education seem to have an insignificant impact. Furthermore, technological innovation has remarkably positive role on economic growth of provinces of the central China.

Akinwale and Grobler [2019] proved that there is causality from education and economic growth to trade openness and from education and trade openness to economic growth, as well as from economic growth and trade openness to education in the long run. On the opposite side, there is only causality from trade openness to economic growth in the short run. The indication of impulse response function pointed out that economic growth responds more to trade openness than education. Therefore, increase in governmental expenditure on education as well as the improvement of trade openness, in particular, are very important factors to create economic growth in emerging economies such as South Africa. Therefore, it is recommended that both the continuous expenditure on education and trade openness are crucial and essential to strengthen local and institutional capabilities, which positively affect economic growth and development in South Africa.

The long-run relationship between education and economic growth in Nepal during the period 1995–2013 is investigated by Nowak and Dahal [2016]. The study pointed out that the secondary and higher education contribute significantly to the per capita real gross domestic production (GDP) in Nepal while the impacts of elementary education are positively influencing economic growth with less significance. However, the results of cointegration test confirmed the presence of long-run relationship between education and real GDP per capita. This means to keep education as a top priority in public policies, take serious efforts to improve the education sector to achieve continued economic growth.

3 Data and Model Specification

The main objective of the study is to investigate the impact of education on the sustainable development and economic growth in UAE. Time series data cover the period 1980–2017, which were collected from different national and international resources. Data from the international organization such as UNDP, World Bank, UNCTAD, as well as from UAE institutions, namely, the Federal Competitiveness and Statistics Authority (FCSA), Federal Ministry of Education (MoE), and Commission for Academic Accreditation (CAA), were used to provide the variables in this study.

A Simultaneous Equations Approach (SEA) is used. This approach is known to be an appropriate methodology to explore the reciprocity impact of education on sustainable development. The approach involves a system of two or more equations that allow each variable to be dependent in one or more equations and independent in one or more equations in the system. Therefore, the model of the study is

$$\begin{aligned} Y &= F(x) \\ X &= F(y) \end{aligned} \tag{1}$$

where Y is proxy of the sustainable development and X is the education proxy.

Since both variables depend on other variables such as population, investment (foreign, domestic), enrollment in education, Gross Domestic Product, Public Expenditure on Education, Gross Capital Formation, Adult Literacy Rate, Unemployment Rate, and other variables, the system can be written as

HDI = F (GDP growth rate, export, domestic investment, FDI, population growth, inflation, exchange rate, gross capital formation, education, export, labor force).

EDU = F (HDI, population growth, GDP, inflation, education expenditure, adult literacy rate, enrollment rate in primary, secondary and tertiary education, labor force).

4 Education System and Features in the UAE

4.1 Background

According to (Ministry of Education, 2018), education in UAE has passed through three stages of development and improvement. These stages are

1. The first stage is before the year 1953; in this stage the education depends on what is so-called the Motawa'a in which a person allocates a space in his home and teach children without any curriculum mainly how to read, write, and religious subjects.
2. The second stage started in 1953 up to independency and establishment of the UAE or so-called the educational mission's stage. It is the beginning of organized formal education. Formal schools are established with the educational missions that came from the emirates that untied as UAE. In 1953, the first school was established and only 230 students enrolled in that school. After that the number of schools and students increased to reach 22,325 students enrolled in 61 schools in the period 1969/1970 and 32,862 students enrolled in 73 schools in the year of dependency. It is worth to mention that the first girls' school was established in 1955/1956 with only 30 girls while at the end of this stage (1971/1792), the number of girl's school account for 31 schools teaching more than 11,000 girls.
3. The third stage began after the formation of UAE until now; after the establishments of the union, the number of students and schools is increasing sharply to reach a total of 1226 schools (53.7% are public schools, with more than one million students and 36% are public schools.)

Ministry of Education (UAE-MOE) is the ministry responsible for education in the country. The ministry vision is innovative education for a knowledge, pioneering, and global society; the mission is to develop an innovative education system for a knowledge and global competitive society, that includes all age groups to meet future labor market demand, by ensuring quality of the ministry of education outputs, and provision of best services for internal and external customers (Ministry of Education, 2018). To achieve this vision, Ministry sets the following strategic objectives as quoted from the Ministry website (Ministry of Education, 2018):

1. Ensure inclusive quality education including preschool education.
2. Achieve excellent leaderships and educational efficiency.
3. Ensure quality, efficiency, good governance of educational and institutional performance, as well as the delivery of teaching.
4. Ensure safe, conducive and challenging learning environments.
5. Attract and prepare students to enroll in higher education inside and outside the country, in light of labor market needs.
6. Strengthen the capacity for scientific research and innovation in accordance with the quality, efficiency, and transparency standards.
7. Provision of quality, efficient, and transparent administrative services, in accordance with the quality, efficiency, and transparency standards.

8. Establish a culture of innovation in an institutional working environment.

The education system in UAE is similar to other countries and consists of the following stages (Ministry of Education, 2018).

1. The general education (K-12 Programs)

The first objective of MOE in the UAE is to transform the (K to 12) programs so that it ensures that the students are fully prepared to attend universities in UAE as well as those around the world and compete in the global marketplace. The education system in UAE focuses on better preparation, greater accountability, higher standards, and improved professionalism. Rote learning instruction is being replaced by more interactive forms of learning, in addition English language education was integrated into other subjects, such as math and science. This stage is supervised by many authorities including the Abu Dhabi Education Council (ADEC), the Dubai Education Council (DEC), the Sharjah Education Council, in addition to the UAE Ministry of Education, at the national and federation level. For each of the above-mentioned entities there are specific tasks to reform the educational program in the UAE and preserving local traditions, principles, and the cultural identity of the country.

This stage includes the preschool, primary (6 years), middle (3 years), and secondary (3 years) schools. The primary education is compulsory and free for all the residents while all stages including the higher education are free for the citizens of the UAE. There are two types of secondary schools, the first is the ordinary secondary, that is, schools teach academic subjects ended by secondary school certificate, which allow students who pass the exams to be enrolled in universities. The second is the technical secondary schools (specific skill) offering a technical secondary diploma which can help in the labor market.

UAE signed the Optional Protocol to the UN Convention on the Rights of Persons with Disabilities and enforced by Federal Law 29/2006 so that to guarantee rights for people with special needs and provide them with the needed education and learning services being in the center of the education process. In addition, efforts are made to include special needs students in mainstream educational settings. Nowadays, the total schools in UAE are 1226, out of them 659 schools are public, and the rest are private schools. The total number of students at the general education is around one million students (73.6% of total students are non-national students). This means that UAE contributes to the developments of other nations around the world as there is a high percentage of non-national students in all levels of education in UAE as a result of the non-citizen workforce and their families residence in the state and contributing to the prosperous development of the UAE.

2. The Higher Education

As a result of the policy adopted and implemented by the federal and local governments (as mentioned earlier in this study) and established special universities' zones (Dubai Knowledge Village and Academic City), UAE becomes a home of wide range of public and private universities. Many international universities have established campuses and/or programs in the UAE, and well-known universities established branches in UAE such as The Sorbonne, Johns Hopkins' Bloomberg School of Public Health, New York University, the University of Washington, Boston University, and Rochester Institute of Technology.

The government of UAE offers free higher education for UAE citizens in public institutions and universities. The rate of enrollments at higher education level is the highest than that in the world. Statistics show that 95% of female and 80% of male in the final year of secondary school apply for admission and gets enrolled in tertiary (higher) education institutions and universities. In addition, technical education is provided by government through training and applied technology instructions, which is on the top of the priories of the education system of UAE.

There are many well-known centers such as the Center of Excellence for Applied Research and Training (CERT) founded in 1997, and other vocational and technical educational centers are sponsored by the Emirates Institute for Banking and Finance, Dubai School of Government, Emirates Aviation College for Aerospace and Academic Studies, Abu Dhabi National Oil Company Career Development Center, Petroleum Institute. Vocational education is provided by national qualifications authority which mandate is to coordinate the efforts of a network of vocational skills training centers throughout UAE in order to ensure the quality of outcomes of those institutions with assignment in accordance with UAE national priorities.

4.2 Higher Education Quality

To ensure that tertiary education institutions (colleges and universities) in UAE operate at international levels of quality, that the students, graduates, and the public are confident that licensed institutions and accredited programs will provide the needed quality of higher education that they expect and deserve. UAE established The Commission for Academic Accreditation (CAA), which is the Federal Government Quality Assurance Agency belonging to the Ministry

of Education, it is responsible for and in charge of promoting educational excellence across diverse institutions of higher education in UAE. This is done through licensure of the all post-secondary educational institutions and accreditation of individual programs in those institutions. CAA strives to assure high-quality education, consistent with higher education international standards. The goals of the CAA are as follows (FCSA, 2019):

1. Ensuring the quality and academic standards: CAA maintains and implements a quality framework which assures that institutions of higher education operate in line with international academic, administrative, managerial, and operational standards.
2. Diversifying services: CAA offers a broad range of suitable services and activities that further enhances quality.
3. Ensuring an effective operation: CAA delivers an efficient and effective quality enhancing process to help developing the higher education sector.
4. International profile: CAA plays an active, cooperative, and influential role in the international community of quality assurance organizations for higher education.

To achieve the goals mentioned above, the CAA conducts a program of licensure for institutions of higher education and accreditation for each of the academic programs provided by those institutions in UAE. Moreover, the CAA published in 2011 has a new refined edition of Licensure and Accreditation standards to ensure that all existing and newly established institutions and programs meet high levels of quality. This edition consists of (11) standards that provide measures of quality that all institutions in UAE must meet in order to obtain the necessary licensure and accreditation of the programs offered by these institution and reflect a consensus within the international higher education community on the essential characteristics that are mandatorily required for the higher education institutions to achieve continuous improvement.

4.3 Adult Education

Since the foundation of UAE in 1971, the country mandated a vision of building a knowledge-based economy comprised of skilled and professional citizens who can help in realizing the nation's forward vision. Considering that only 48% of UAE adults were literate at the date of foundation, and therefore in parallel with general and technical education, adult education is offered free to those who do not have the education and are willing to gain the opportunity to start and gain another opportunity for education. Adult education consists of three stages which are: Elementary stage (Circle one) of total 4 years, Elementary stage (Circle two) of total 3 years and Secondary stage (3 years). The government established and operated many centers for adult education and teaching; as a result nowadays the literate rate has increased over 93%.

4.4 Trends in Education in UAE

The total number of higher education institutions in UAE reached about (94) institutions offering first and second degrees in (967) programs according to the figures of UAE's Commission for Academic Accreditation; in 2016 this number decreased to 87 entities. The number of higher education entities varies from year to year depending on the fulfillment of the accreditation measures.

The total number of universities was 38 in 2016 and decreased to 32. The total number of private universities is 29 in 2017, three of these universities are public and this number is constant over the period 2011–2017, while the rest are private universities. However, the number of colleges varies and reached 48 in 2016 and decreased to 42 in 2018; out of them, five are public colleges and the rest are private colleges. Institutes are 13 in 2017. The variation may be is a result of confusing in definition between college and institute as the number of universities is almost constant.

The total number of enrolling students in the higher education in 2017 was about 174.9 thousand students—53.8 of them are non-national students. The students in the public universities are around 46.6 thousand—7.5% of them are enrolled in public universities while the student enrolled in private universities are about 128.3 thousand—70.7% of them are non-national. The total enrolled students in the higher education system almost doubled during the last six years; most of the increase is coming from the increase in the number of students enrolled in the private universities (by 83.5%), while the number of students in the public universities has increased by only 16.8% (see Fig. 1).

The enrolled students are distributed among different academic programs; the main program is the Business Administration (30.1%), Engineering (18.5%), Law & Sharia (12.5%), Mass Communication (8%), Humanities & Social Sciences (7%), Environment & Health Sciences (5.3%), Medical Sciences (4.8%), Information Technology (3.8), Education (3.3%) and Foundation (3.2%) and Arts & Design (2.5%).

5 Results of the Regression Analysis

It is obvious that the simultaneous approach is different from the single model equations in which the simultaneous approach measures the mutual impact of the variables in the

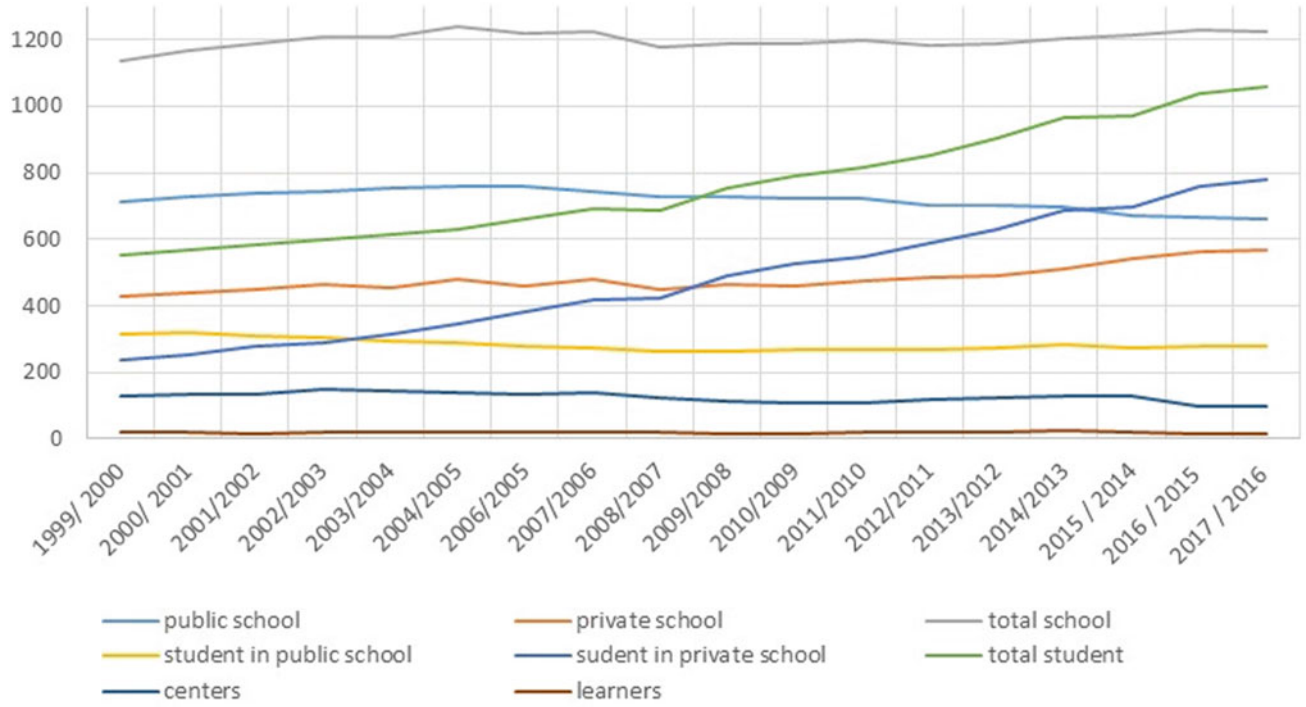

Fig. 1 Trends of some education indicators in UAE

system, in other words, the impact of one variable on the other and vice versa. Considering the main objective of the current study and the results from the previous research, as well as to find the reciprocal relationship between education and sustainable development, the simultaneous equation approach was used. It represents a system of two equations that is used to measure the impact of education on the sustainable development in UAE during the period 1990–2017. The system is solved using two-stage regression analysis. The results of the system analysis are presented in Table 1.

Table 1 shows that both the education variable and development variable, measured by the human development index (HDI), have a significant impact on each other. That is, education increases the level of the development measured as HDI, which represents the level of health services, education, income, and life level in any country in general, and

Table 1 Results of the regression

Variables	Development		Education	
	Coefficient	*P*-value	Coefficient	*P*-value
HDI			46.12	0.04
Export	16.70929	0.037		0.02
Domestic investment	0.00059	0.04	0.731	0.04
FDI	0.00003	0.04	0.00001	0.04
Exchange rate	0.00002	0.001	0.00002	0.001
Gross capital formation	0.148	0.04	0.00049	0.04
EDU	0.000062	0.03		0.03
Education expenditure			0.136	0.04
Labor force	−0.00034	0.04	2.039	0.04
GDP growth rate	0.00002	0.001	0.00001	0.02
Inflation	0.00048	0.04	−0.331	0.02
Population growth	0.000299	0.03	0.000000001	0.001
Constant	−60.609	0.04	4278.71	(0.005)

UAE in particular, and the development on the other hand improves the education and education outcomes. However, the impact of each is different and it is estimated to be (0.0086) for the impact of education on the development in UAE, and (0.146) for the impact of the development on education. In other words, the increase of one unit of the education index will create an increase of (0.0086) units of development (respectively, 0.0086 units of HDI), while the increase of one unit in the development (one unit of HDI) will create an increase of (0.146) units in the education.

This result leads to the conclusion that the impact of education on the development is less than the impact of development on education, since there are many other factors that impact the development, among and mainly in the UAE, these are the oil returns to the countries as well as the fact that UAE is an attractive country for high qualified and well-educated workforce. In addition, these are the motivations for young population and students to enroll in tertiary education as well as the results of the large and big efforts (and investments) by the government in adult education which is provided free of charge for all population in different centers that cover all parts of the country. So, there is a large percentage of literacy increase which exceeded 90% during the last decades after it was 40%, that is, an increase by more than 50 percentage points which is considered as unprecedented efforts all over the world.

In addition, Table 1 shows the impact of other variables on both the education and the development in UAE, during the period under the analysis. The values of significant (*P*-value) in the table indicate that all the estimated coefficients of the explanatory variables show significant impact on both education and development in UAE during the study period. The sign of the coefficient indicates the relationship between the variables. If it is negative, this means that there is negative relationship, that is, the increase in the value of one variable creates decrease in the other variable, and the positive sign means that the increase in one creates increase in the other one. Therefore, some of the variable' show negative impacts on the education as well as the development, while others shows a positive impact.

All other variables used in the system equation show positive impact on education. For example, the impact of FDI is about (0.00001), that is, the increase of one unit of FDI will increase the education by (0.00001) units; this is due to the high foreign direct investment impact on education, which resulted in high number of private universities as well as private schools, in addition to the branches of foreign universities and international schools as discussed in the previous section. This leads to increase in the rate of enrollments of the student at primary, secondary, and tertiary education institutions which consequently increases the HDI.

The results shown in Table 1 emphases that the increase of the FDI augments the level of the HDI by (0.00003) for each unit of FDI increase. The same thing can be said for the domestic investment, which has a significant impact on both the development and education, as shown in the table. Inflation negatively impacts both education and development as inflation affects the income, which leads to the reduction of the capability of the person to purchase the services, including the education. Other variables that affect the income and GDP such as the exports, has positive impact on the HDI. This is due to the fact that income is one of FDI components.

The coefficient of the education expenditure by government shows positive impact on education. That is an increase of one unit of education expenditure will increase the education index by (0.136). This is due to mainly to the efforts of UAE government in sharply reducing the illiterate rate during the past years to be less than 5% by giving the opportunity for adults to enroll in systemic educational program; it is worth to be mentioned that more than 0.8 million of adults studied in more than 136 centers during the last 30 years. However, the government of UAE provides free education to all the citizens of UAE and forces all citizens in age of primary education to enroll in schools. However, the government of UAE has also introduced programs for scholarship for students to get higherdegrees aboard.

Labor force variable shows insignificant impact on education and development as measured as HDI, due to the fact that UAE is an attractive country for labor, especially the high qualified labor force. Population shows positive impact on development as measured by the HDI, while it has insignificant impact on education. Although, the increase in the total population will put high burden on the government to provide services for the population, especially health and education, it increases most of the components of the HDI such as life expected age and health.

6 Conclusion

The UAE is making big progress in education and facilitates the national and foreign private investment in education at all levels of education. That is, more than 46% of the total schools are private; moreover, 73.5% of the students are in general education sector, 57.6% of students enrolled at universities are non-national students, which means that the UAE government helps other nations in building their human capital.

After the independence of the UAE, the number of schools and enrolled students increase sharply in addition to the adult centers that have more than 0.8 million enrolled

students during the period 1990–2017. This helps putting UAE on the top of the countries in education output. However, universities are subjected to high international standards to keep high quality of education.

The results of the simultaneous equations approach show that there is a strong impact of education on improving the sustainable development of the UAE; this means that part of the improvement of economy and the life level in UAE is a result of improving the education as well as other factors; visa versa, the improvement of the education is a result of the better development of the UAE and the increased income of the UAE and the higher investment and public expenditures on education, labor force, and population growth rate.

The results of the current study conclude that there are very strong efforts done by the government of UAE and its ambitious objectives that have been set at the dependence stage and is fully achieved. This makes UAE a good example that exploits all available resources for the development and welfare of its population; this can be achieved only by the availability of effective political efforts by the country leadership and the long term vision of the state.

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The Influence of Entrepreneurship Orientation on the Sustainability of Small Enterprises

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Abstract

Small enterprises are companies with limited recourses, employees, and networks, however, their existence is fundamental to the country's economic growth as they are one of the driving forces of the country's financial progression. Furthermore, due to the globalization emergence, complexity, and uncertainty were delivered to the business environment. Hence, the level of the competition has radically raised during the past decade among small enterprises, and their survival depended on searching and implementing new methods and practices to sustain in both local and foreigner markets. On the other has, globalization had a positive influence on the diversification of social, environmental, and economic goals; it also created both challenges and opportunities for small enterprises. Moreover, there is a number of important aspects that affect international business sustainability, such as national culture and entrepreneurial orientation, which enhances the level of productivity and competitiveness domestically and globally within different types of small enterprises. The main objective of this study is to investigate the influence of entrepreneurial orientation to achieve global sustainability of small enterprises in different markets such as developed and emerging markets. Additionally, it analyzes the role of national culture as a moderator in creating a sustainable business environment in a foreign market.

Keywords

Globalization • Small enterprises • Sustainability • Entrepreneurial orientation • Entrepreneurship

1 Introduction

Many scholars were concerned for decades about the rapid internationalization of Small and Medium-Sized Enterprises (SMEs), since it provides modern technology improvement in advance, emerges and develops nations, contributes to the economic improvement, represents a diversified job opportunities and incomes mobility (Peng and Meyer 2016).

Congruently, international business requires particular competencies, resources, and strategies to inspire entrepreneurs to start an International New Venture (INV), and create their international strategies, for instance, building an entrepreneurial team with a global competence, cooperating with international proactive firms, acquiring recourses abroad through establishing new connections and learning from others' experiences (Peng and Meyer 2016).

Lately, business sustainability has become one of the ultimate concerns between different firms worldwide. It provides success to different businesses by implementing a diversified entrepreneurial practice. Consequently, entrepreneurs have to explore the right methods and practices that serve their determination of variation. They frequently exploit change as an opportunity to diversify their services and businesses. According to Drucker (1985), an entrepreneur has to recognize and use the standards of effective innovative practices to sustain, grow, and even raise internationally.

Recently, UAE leaders have encouraged entrepreneurship practices and have become the main source of government incubation; they ensure that local entrepreneurs have received all the support needed such as networking opportunities, government partnerships, training programs, and law taxation.

Furthermore, there are many public and nonpublic organizations and institutions that provide support to local SMEs both financially and nonfinancially, for example, Emirates foundation, the UAE's Ministry E, Khalifa funds for enterprises development, WOMENA.co, Emirate Entrepreneurs

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Association, and Abu Dhabi Council for Economic Development.

Regarding to The Global Entrepreneurship Monitor, (TEA), the UAE's level of innovation lead by economy is at an equivalent level of Singapore and Norway, while, the UAE's (TEA) score is less than the one in Australia, Netherland, and USA (Emirates Foundation 2017).

The aim of this study is to investigate the impact of entrepreneurial orientation to obtain the international sustainability of small enterprises in developed and emerging markets. In addition, emphasizing the role of national culture as a moderate of small enterprises' international sustainability.

2 Literature Review

2.1 Theoretical Framework

International business has become for more than three decades a universal phenomenon. Theories have been generated to explicate the international business concept and importance worldwide. This study reviewed some of the main theories of business globalization and INV. There are four theories that have tackled the international business area: the classical theory, early market imperfections theory, later-fay market imperfections theory, and the internationalization theory; each theory included more than one theory in order to get to the nearest explanation to the ***International Business*** concept (Mtigwe 2006).

According to Buckley and Casson (1976, 1985), globalization delivers a better awareness about the firm's capabilities and the new foreign markets. When the small enterprise creates its production line based on the new market attraction, the firm will gain higher profits with lower production costs (see Table 1).

2.2 International Entrepreneurship Theory

International Entrepreneurship (IE) theory is one of the most important theories that covered the area of international business, entrepreneurship, entrepreneurial orientation, and strategic management. During the past two decades, the theory has been updated and created many different approaches that have been followed (Young et al. 2003). Unfortunately, the theory does not have a solid theoretical framework (Mtigwe 2006). The previous limitation of the theory leads us to the requirement of updating the organization's strategies, business model, and structure as a result of globalization. The organization's targets need to be defined outside its nation-state or it needs to involve cross-border activities. Also, at management level, it has to be based on a multinational context (comparative or cross-cultural); therefore, the organization will be able to utilize its risks, resources, and benefits. It has to enquire a very high level of knowledge for the foreign environment, culture, market, and customers' demand.

2.3 Entrepreneurial Orientation

During the last three decades, the concept of entrepreneurial orientation (EO) has become the major focus of entrepreneurship literature, which found that EO positively impacted the level of implementations of entrepreneurial activities within different organizations. Many articles have delivered the EO terminology in different tags to clarify the phenomena. Regarding to Dess and Lunpkin (Covin and Wales 2012), the phenomena of EO is the "organizational level phenomena involving key decisions made behalf of the entire organization (Covin and Wales 2012)." Covin and Slevin (Covin and Wales 2012) mentioned that "entrepreneurial firms are those in which top managers have entrepreneurial management styles, as evidenced by the firms' strategic decisions and operating management philosophy (Covin and Wales 2012)".

The flexibility of SMEs gives them more chances to enter foreign markets than large organizations because they are less hindered by the firm's structures that provide sustainability and improved productivity (Bos-Brouwers 2010). So, small enterprises are able to achieve sustainable by implementing innovative practices rapidly, similarly they are able to study cultural differences in many different places to provide sustainability to their practices easily (Jamsa et al. 2011). Besides, small enterprises have more opportunities to increase their expansion through implementing their entrepreneurial practices abroad, evaluating, and identifying risks and benefits that they may gain from these foreign investments, so top managers may be able to make decisions to attain their goals (Peng and Meyer 2016).

Some articles presented major role of SMEs in international business. Nevertheless, the implementation of entrepreneurial activities in some developing countries is critical. For example, both entrepreneurial orientation and the local environment in Kenya impact negatively the competitive strategies which were adopted to enhance SME's performance.

2.4 The Role of National Culture

National culture is considered as one of the most difficult challenges that need to be well studied before starting any business in a new venture. It is a complex concept that

Table 1 International business (IB) theories (Mtigwe 2006)

Theory type	Theoretical base	Founder	Year	Theoretical emphasis	Literature background
Classical theories	Theory of absolute advantage	Smith	1776	A country (A nation) gains sustainability and competitive advantage by generating unique products and services to other nations based on their available competencies and resources to enhance a nation's national economic growth	Smith (1776)
	Theory of comparative advantage	Ricardo	1817		Ricardo (1817)
	The Hecksher–Ohlin factor proportion theory	Hecksher and Ohlin	1953		Hecksher and Ohlin (1933)
Early market imperfection theories	Foreign direct investment theory	Hymer	1960	• Market imperfections are existing in different forms, for example, government host encouragements to internationalize • International business patterns are market expansion and technological in innovation, which is the key factor to create and develop new products	Hymer (1960)
	The product life cycle theory	Vernon	1966 1971		Vernon (1966) (1971)
	International production theory	Dunning	1977	• In order to spread its product in a foreign country it needs to rely on finding an exclusive attraction of the firm's home country compared with the advantages of being in a foreign country and resource implications	Dunning (1977)
Internationalization theories	Internationalization theory	Buckley and Casson	1976	Internationalization provides a better understanding of both foreign markets the firm may enter and its capabilities to start foreign production. By creating a firm's international market, the small enterprise will gain more profits by lowering the production cost	Buckley and Casson (1976), (1985)
	International entrepreneurship theory	Oviatt and McDougall	1994		Oviatt and McDougall (1994)
	Network theory	Johanson and Mattson	1988		Johanson and Mattson (1988)

includes laws, customs arts, beliefs, morals, habits, and knowledge; it also became necessary for any organization to study the culture of the new venture.

3 Research Framework

This paper aims to investigate the relationship between entrepreneurship orientation and the sustainability of small enterprises development to emphasize the influence of entrepreneurship on both economic growth and sustainability of small enterprises.

4 Methodology

This paper reviewed 20 articles from the existing literature on entrepreneurship, business sustainability, entrepreneurship orientation, globalization, and how to survive in a foreign market to reach our goal and prove the generated hypotheses, which were produced by the written research framework.

H_1: *There is a positive relationship between entrepreneurial orientation and the sustainability of small enterprises internationally.*
H_2: *There is a significant connection between national culture as a moderator and the sustainability of small enterprise internationally.*

5 Findings

As a result of innovative practices, strategies, technology, quality, customer demand, and the sustainable comparative advantage, there is a positive association between entrepreneurship orientation and the sustainability of the small enterprise. Therefore, business sustainability leads to economic growth, risk management, job opportunities,

enhancing the level of quality and performance. Additionally, the use of appropriate and newest entrepreneurship orientation will help minimize the internationalization challenges and maximize market opportunities.

6 Conclusion

The rapid continuous change in the global markets forces firms to modify their strategies, management, and activities. Therefore, through implementing entrepreneurial activities they will be able to reach the dynamic level of continuous change, which enables SMEs to move globally.

Within the appearance of innovation capability firms may have sustainable comparative advantage, be able to take risks and make the right decisions based on the firm's knowledge about customer demand, external environment, and market attraction. As a result of new innovative strategies, innovative practices and the use of technology, an increase of the firm's quality, the awareness of customer demand and market attraction, the sustainable comparative advantage is observed, as well as positive involvement among entrepreneurship orientation and small enterprise sustainability. Therefore, sustainability of international business leads firms to risk management, increases the level of quality performance, economic growth, and job opportunities. Furthermore, using the suitable and newest entrepreneurship orientation will help small enterprises minimize globalization challenges and maximize market's opportunities.

Moreover, it is essential to have a better awareness about the national culture before entering a new venture. A firm will evaluate risks, opportunities and benefits of any new project in a foreign country through learning its law, customs demand, capabilities, beliefs, morals, market attraction, and habits to be able to adapt its entrepreneurial activities and practices to sustain in the new environment.

The UAE government support and encouragement have been always the source of entrepreneurial success. This support is well-diversified, for example, through offering low taxes, nonprofitable loan, training programs to be qualified leaders, and networking opportunities. A good example is the EXPO 2020, which will create new opportunities for local and foreign investment, accommodate foreign entrepreneurs from worldwide and allow for exchange of knowledge, experience, create new networks, opportunities, and establish new international enterprises on new foreign land.

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The Model of Sustainable Marketing as a Responsible Approach to Marketing in the Era of Industry 4.0

Marek Seretny and Deepika Gaur

Abstract

This paper presents an innovative scientific proposal on sustainability in marketing activities combined with the latest trends in psychological research. The analysis is supported by the previous literature, research, and scientific reflections of the authors and implies that in recent markets, the implementation of the sustainability theory underlying the Model of Sustainable Marketing (MSM) has a significant impact on business. This paper links the concept of sustainable marketing to the employees and consumers on one hand and authentic leadership on the other. This establishes a new framework linking the responsibility factor for developing a psychological capital. In addition, the implication of authentic leadership style gives a boost to the development of the psychological capital of employees and responsible consumers. This completes the model of sustainable development. The practical implication of the research lies in fusing the theory of psychological capital that emphasizes building self-efficacy and optimism, with sustainable marketing to enhance performance. The proposed concepts are worthy subject matters on which to conduct future research.

Keywords

Sustainability • Sustainable marketing • Authentic leadership • Psychological capital

1 Literature Review

A digital transformation is now present in the modern world and businesses are experiencing it. Regardless of the level of business transformation, change will transform every branch of industry. Digital transformation includes more than updates or changes to technology. Today, clients, employees, and business partners expect a digital transformation. Whether businesses appreciate it or not—they cannot hide from digitalization as consumers prefer this solution to the old, more traditional, solutions.

What energizes technological innovation in the business environment? In principle, customer experience is the key component. Digital transformation occurs most rapidly at the intersection of people and technology. Digital transformation aims to create better, smarter, and faster businesses that can better anticipate and meet customer needs.

To function efficiently in the digital era of Industry 4.0, organizations need new digital management talent, knowledge and management skills to plan, organize, lead, and control its socioeconomic activity, and to find and develop employees who can prepare goods to meet the needs of new "connected consumers" (Kotler et al. 2017). The organization also needs different marketing knowledge and skills to adapt to the changing nature of customer footpaths in the digital economy. Businesses need to understand what customers expect and consequently, to rationally develop a product or service that satisfies customers' needs. Then, they need to start producing, valuating, promoting—by announcing the product or service exists. Finally, businesses must deliver their product or service, with a commitment of guaranteeing satisfaction during and after the sale. In this new era, a new marketing approach is required. At the beginning of 2017, Kotler, Kartajaya, and Setiawan introduced a new approach to marketing, giving it the name "Marketing 4.0" (Kotler et al. 2017).

At the same time, challenges to planetary boundaries and associated ecological, social, and economic crises confront

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the global community on a daily basis. Sustainability is now accepted, at least in principle, as a crucial requirement that business organizations must address moving forward. The number of publications on multinational enterprise management of sustainability issues is growing (Burritt et al. 2018).

Companies have become sustainable when the mutual responsible benefits of employees, clients, and organizations with whom the company cooperates are visible—this transpires when the marketing approach is focused on responsible activities both on the organization's and client's side. The increase in the value of a responsible company with this approach should translate into an increase in the satisfaction of all stakeholders. The treatment of sustainable marketing is based on the general approach to achieving social, economic, and ecological results (Dahlstrom and Crosno 2018).

The nature of socioeconomic challenges presented in the "Agenda 2030" (The Sustainable Development Goals Report 2017) with 17 goals for sustainable development to be achieved by 2030, makes it extremely important to increase the investment in changing the attitudes of both businesses and consumers. The strength of the market economy is, on the one hand, the attitude of enterprises and their leaders, and on the other—the involvement of consumers; the entire society is involved in the debate and activities affecting economic development, exploration but also protection of natural resources, and active participation in the sustainable economy of the planet.

Business development cannot exist without a consumer. A conscious, responsible consumer is the driving force of sustainable economic growth! Thus, a conscious and responsible society can easily make changes in its lifestyle by changing its consumption patterns, thus affecting the behavior of other market participants.

Unfortunately, current patterns of consumption and production are clearly unsustainable. High levels of resource use, toxic pollution, and greenhouse gas emissions are causing irreversible damage to ecosystems, biodiversity, and the natural cycles of water, carbon, nitrogen, and soil. Averting climate change requires a 90% reduction in greenhouse gas emissions. Meanwhile humanity's way of life, particularly in the northern hemisphere, far exceeds the natural capacity of earth to provide energy, land, and water (The Quaker Council for European Affairs (QCEA) 2011).

Bocken (2017) argues that—to mitigate negative human-induced impact on the planet, society, and the economy—consumption patterns need to be changed urgently and that companies can apply individual, social, and wider contextual influencing tactics to encourage sustainable consumption.

Marketing is a powerful institution. Over the years, marketing has proven it has the ability to improve lives, sustain livelihoods, strengthen societies, and benefit the world at large. Businesses can use social marketing-type techniques and business model innovation to drive sustainable consumption and further a sustainable lifestyle (Bocken 2017). Sustainability as a vital element is a challenge for product developers too. Sustainable production brings new opportunities for companies. However, consumers typically do not purchase sustainable products. Hosseinpour et al. (2016) claim the main reason behind this is that consumers lack essential knowledge about the attributes of sustainable products.

There is a growing awareness that specialty retailers may have a vital role to play in promoting more sustainable patterns of consumption and production. The European Commission and a number of the UK's leading retailers, along with several of their European counterparts, launched a "retail forum" as part of an initiative to increase sustainable consumption (Jones et al. 2011).

Determinants such as attitude, belief, knowledge, and trust strengthen consumers' decisions to select sustainable products (Hosseinpour et al. 2016). Studies on consumer purchase behavior suggest that attitude is one of the most effective factors (Hosseinpour et al. 2016). For example, an attitude favoring environmentally friendly behavior, such as a positive attitude toward organic food, is one of the major predictors of the four determinants. After the determinant attitude, belief, and knowledge are also significant factors for customers' behavior regarding sustainable product consumption. If a customer believes by engaging in a particular behavior he/she might contribute positively or negatively to society, their assessment can affect their attitude. Furthermore, general knowledge about the concept of sustainability can change a person's attitude toward that concept (Hosseinpour et al. 2016). Trust is another significant factor of sustainable purchasing behavior (Seretny 2018). Trust is also a multidimensional concept. Mutual loyalty must be built on trust. A company's basic task is to gain the customer's confidence by delivering quality products or services but also by treating the environment and society in which it operates in a responsible manner.

Selvefors et al. (2011) claim sustainability is a key component of innovation from a technology and business perspective. Sustainability measures are constantly increasing within product development and design. Approaches such as Design for the Environment and Product Stewardship introduce methods to reduce the environmental impact of products throughout their entire life cycle. Research presented by Selvefors et al. (2011) concludes that in order to reduce a product's environmental and social impact specifically during the usage phase, a behavioral perspective could be integrated into a product's design in addition to technological aspects. He suggests that Design for

Sustainable Behavior can encourage solutions aiming to foster resource-efficient behaviors and thus reduce the environmental and social impact during the usage of products.

Therefore, to achieve sustainability on a grand scale there is a need to bridge business management, social science, civil engineering, product design, and environmental science with the technologies of the future. In our opinion, *sustainable marketing is the solution.* Sustainable marketing is the implementation of all reasonable efforts to produce, price, distribute, consume, and reclaim products in a manner to achieve ecological, economic, and social objectives. Sustainable marketing may be viewed as a response to the "classic" marketing approach. When one considers the concept of sustainability, he/she typically thinks about renewable energy resources, reducing carbon dioxide emissions, protecting the environment, and balancing the delicate ecosystem of our planet. While these are all goals of sustainability, the concept is broader. The concept of sustainably includes goals to protect our natural environment, human health, and ecology. Sustainability marketing should drive responsible economic development as well as social development and not compromise our lifestyle and the lifestyle of future generations.

2 The Integration of Sustainability into Marketing Curricula

A literature review reveals that entrepreneurs and their potential clients maintain considerable differences in their respective understandings of the philosophy of responsible business and marketing (Perera and Hewege 2014; Thomas and Day 2014). The Model of Sustainable Marketing presented in this paper supports the implementation of sustainability philosophy within an organization. However, the understanding of sustainability among consumers remains an issue. Therefore, conclusions resulting from the analysis of global and local environmental, economic, and social situations entitle us to recommend undertaking an educational effort, which will result in the introduction of the Sustainable Marketing Model proposed at academic level. As sustainability is a relatively new phenomenon, and related business strategies are still emerging, new educational programs in the field of sustainable development should be introduced (Perera and Hewege 2014).

The Australian sustainability education context could be the example. Thomas and Day (2014) examined 38 Australian universities to assess their graduate programs with a view into understanding how they incorporate sustainability education into their curriculum. Universities and the education they impart to their graduates influence future workplaces and society. Researchers are giving increased attention to the relationship between what is sought by organizations hiring graduates and how universities provide relevant educational experiences. Australian universities have over four decades of research experience on the impact of education on environmental and related issues. Australian research is closely related to the international community, combining these issues within the development of sustainable concepts. There are articles examining the direction that Australian universities have taken to develop educational approaches to provide graduates with the capacity to work towards sustainability through the articulation of graduate capabilities.

A growing body of research illustrates that authentic leadership creates a positive effect on the quality of life and on the efficiency of employees in the workplace. Authentic leaders are defined as those leaders who have awareness of their actions toward others; understand how others perceive them; understand their own values and morals and those of others; have a keen insight about the social environment in which they are working, and maintain a high level of optimism (Avolio et al. 2004). A study conducted to investigate the relationship between positive psychological capital and authentic leadership discovered that authentic leaders develop trust in their employees and as a result increase employee performance (Clapp-Smith et al. 2009).

Authentic leadership influences job performance, organizational performance, and citizenship behavior. Woolley et al. (2011) observed that authentic leadership fosters their followers' psychological capital development due to the change in the organizational work climate.

Researchers have discovered that positive psychological capital creates positive psychological states, which then contribute to a higher level of effectiveness and efficiency in the workplace (Woolley et al. 2011). Psychological Capital is best described as a link between self-efficacy, hope, optimism, and resilience. Enhancing positive Psychological Capital in an organization through authentic leadership provides a method of creating and increasing the quality of life and the efficiency of employees in the workplace.

3 Model of Sustainable Marketing

The Model of Sustainable Marketing (MSM)[1] embodies the challenges faced in the marketing sciences. Scientists and entrepreneurs are faced with the task of changing the current paradigm predicated on the belief that marketing and responsibility are adversarial. To effectively implement the principles of *sustainable marketing*, a Model of Sustainable Marketing (MSM) has been developed that takes the form of connecting the mechanism supporting business and social relationships in terms of responsibility and business competitiveness.

The term "model" is understood here as a simplified representation of the complex marketing management process of an enterprise. The proposal of the model's construction is aimed at presenting the functioning of the complex state of affairs.

At the heart of MSM is the understanding that *sustainable marketing* is not merely about producing "healthier, better, and cheaper" goods, which satisfy customer needs. It is the authentic, practical value of running a business, influencing productivity, inspiring creativity, promoting, and nurturing business collaboration with the social and market environment. By maintaining the long-term balance between the needs of people, the global environment, and the development of the economy, *sustainable marketing* gives businesses and organizations the confidence and strength to produce more while using less resources, while taking into account the needs of today's and tomorrow's generations of customers and a global society.

On an operational level, the MSM is designed to influence the behavior of both the management and staff of the organization and its customers in order to create positive social and environmental changes and thereby achieve profit in a reasonable way. It also influences what the customer receives—by creating a brand that fits into the commercial and social future. Finally, it is important to influence the delivery of goods and services, thanks to responsible management and being open to cooperation in fair and ethical marketing communications.

The idea underlying MSM is a business proposition that can meet the needs of people, increase the efficiency of global society development, create new jobs and increase the quality of life today and in the future. The use of MSM allows building a new marketing mindset in the organizations that use it, based on the principles of *sustainability*. The proposed MSM is based on three pillars (see Fig. 1):

- responsible leadership,
- a brand that is positioned as responsible,
- popularization of responsible consumption.

In the business management space, MSM encourages the sustainable enterprise to be managed responsibly in three areas: economic, social, and ecological, and stipulates that the leadership be based on the ***noble attitude and character*** of those responsible for managing the company. Especially today, where the topic of business ethics is emerging, which in turn should lead every organization in the socioeconomic space to pay attention to the concept of a common good. Representatives of science and practice increasingly see that without ethical principles it is impossible to lead an enterprise. For the development of a *sustainable enterprise,* it is important that the leaders take responsibility for the performance of the activity not only in the economic but also in the social and environmental aspects. In the chain of values, the sustainable enterprise should strive to maintain a balance between the creation of a market offering and its distribution, the impact on the environment, business development, and the impact on social development both inside and outside the enterprise. A company run by a responsible leader should create value for the consumer and the investor as well as society as a whole, to meet their needs by using environmental resources in a harmonious way.

Another pillar of the MSM is the well-established, well-positioned, and well-managed brand—as a sum of associations and preferences related to the organization, but also a collection of actual experiences, recommendations, and attributes of its quality. Brand is understood as a complex combination of functional and emotional values.

The *sustainable enterprise* should ensure that its brand lives with the organization both within and outside its environment. The most successful brands are characterized by two qualities: vitality and rank. Each of these features has two dimensions: the brand is vital when it is differentiated in the minds of customers from other brands and when that diversity matches the needs of customers. A brand has a high rank when it is highly respected and well known on the target market. The vitality and rank of the *sustainable enterprise* should be based on values such as integrity, morality, and the resulting business ethics (Kotler 1999), which underlie the *sustainability theory*. Brand is a fundamental aspect of marketing and at the same time it is crowning. All the organizations operating on the market and their brands have a specific identity, name, and reputation. The art of marketing is the art of brand building. If an

[1]The Model is the result of scientific inquiry, market experience, and research carried out as part of Marek Seretny's Ph.D. dissertation presented to the public on October 14, 2014 at the Faculty of Management of the Warsaw University of Technology. The validity of assumptions presented by the Model has been verified in the conducted research. Apart from the public defense of the dissertation, the Model has been repeatedly presented to scientists and business representatives at conferences and seminars both nationally and internationally, where it has received recognition and approval.

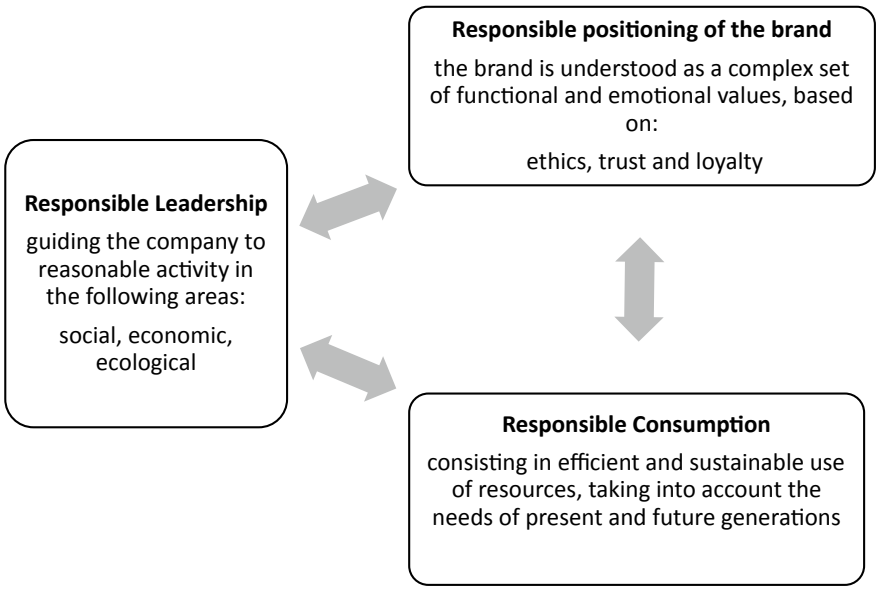

Fig. 1 The model of sustainable marketing

organization is unable to build a strong brand, it means that its marketing efforts are flawed, and not accepted according to the art of marketing. In an enterprise that will implement MSM, the basis of market action is *sustainable marketing* and brand identity is built on the basis of: responsible products, safe and fair trade, fair dealing, responsible customer relationship management, corporate business responsibility, and profitability.

Last but not least, MSM also points to the need to promote *sustainable consumption* by using goods more efficiently and responsibly, suggesting a fair distribution of resources between rich and poor, while taking into account the needs of today's and future generations of consumers.

By implementing MSM, we should promote sustainable consumption as satisfying the needs justified by the requirements of a decent human existence. Consumption means the use of resources in order to directly meet human needs.

Based on scientific reflection, more than twenty years of marketing managerial experience, an analysis of literature, as well as previously conducted own research, the authors believe that leadership is the key pillar of the Sustainable Marketing Model. Therefore, we have attempted to analyze sustainable leadership from the perspective of a positive psychology capital (PsyCap).

The proposed extended Model (see Fig. 2) combines the principles of MSM and the approach of positive psychology capital.

Authentic leadership fosters a positive effect on meeting the needs of people, enhances the efficiency of societal development, and leads toward a better quality of life, which strengthens positive psychological capital within an organization. Positive psychological capital encourages a higher level of effectiveness and an efficient working environment as discovered through previous research literature. Hence, sustainable market behavior gets its support from the

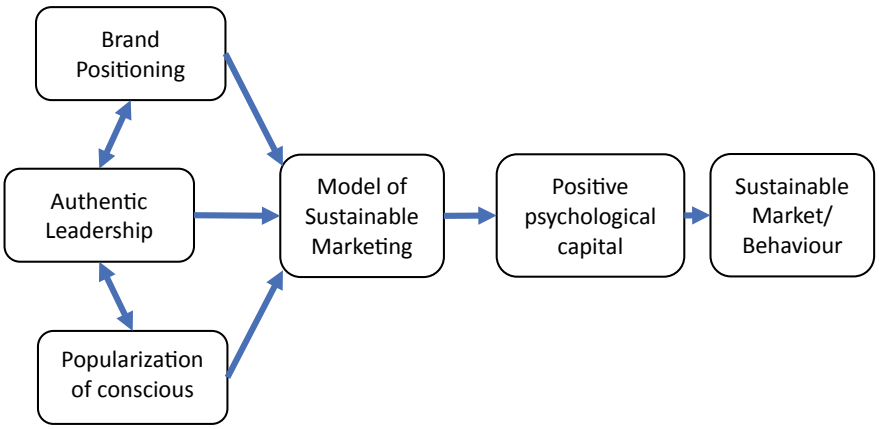

Fig. 2 The model of sustainable marketing linking to positive psychological capital

relationship between the model of sustainable leadership and positive psychological capital development. A leader being aware and responsible of the actions toward others leads in an authentic way and creates an impact on the confidence of people to perform. Thus, a positive psychological state of development is created in an organization, which leads to an increase in self-efficacy and optimism in people for the attainment of present and future goals of sustainability. Employees and even consumers develop trust in their own actions and in the leadership structure of the market. The ethical principle of leadership connects all the components of the market and fulfills the goal of the Model of Sustainable Marketing.

4 Conclusions and Recommendations

The analysis presented in this paper suggests that in developed markets, the implementation of the *sustainability theory* underlying MSM has a significant impact on business. Both academics and business representatives point out that companies seeking to build a lasting foundation of success in the face of the challenges of the global market should be based on responsible actions. MSM consists of creating formal solutions, comprising of a system of sustainable management, based on the assumption of a triple bottom line.

The key to the effective implementation of corporate sustainability is the example set by top management, as most employees follow the standards of their leaders. The commitment of employees involved in executing the corporate responsibility concept is a guarantee of the success of any implemented strategy because employees are the ones who will practice it in their day-to-day accountabilities.

In addition, it is important to implement a lasting, open, and active dialogue with all stakeholders, but particularly, with clients, ensuring the successful creation of positive relationships, which are the cornerstone of the company's success. At the root of such a dialogue on responsibility, there is a strong brand that offers promise, verbalizes what one might expect from a given enterprise, and predicts what might be expected of those involved in providing value to buyers.

By analyzing situations in developed markets, it has been shown that customers engage in the idea of social responsibility when they see that businesses and their employees sincerely and genuinely believe in everything the brand symbolizes and are committed to creating value. Dialogue is a tool for engaging all stakeholders in the organization's activities—to meet their needs, educate and learn from them, allowing the company to translate acquired knowledge into products and services, as well as internal processes. Customer engagement is crucial for the development of sustainable consumption, where consumers consciously undertake a variety of social activities, building trust-based social capital and cooperation, bonding and engaging, thereby giving the company a significant competitive advantage.

Thus, the resulting trust not only becomes the foundation of human relations in the relationship between the client and the organization, but it also influences the opportunities for social development and the building of successful global development for future generations.

The limitations of the present study exist in the implementation of the model. To overcome this restriction, the author's future research will be focused on application of the model on control and experimental groups and observing the implications of the MSM and its link to positive psychological development. The scope of this study was limited to the analysis of data clarifying the concept of the model specified in the research. However, cognitive influences toward the positive behavior of employees are also critical to understand the positive psychological development. Consequently, future research should incorporate both cognitive behavior approach and positive psychology of the mindfulness approach to study the implications of the MSM on both employees and consumers. We believe the amplifying effects of sustainable process (authentic leadership, brand positioning, and popularization of responsible consumption) can serve as antecedents to positive psychological development (need of people, increasing efficiency of society, and enhancing the quality of life) and thus, result in the reinforcement of desirable behavior. A cognitive framework of awareness through inducing mindfulness concepts and analyzing the developed schema might provide a fruitful structure of future research.

Thus, future research may also take into consideration the aspect of mindfulness by the positioning of the sustainable brand and popularization of responsible consumption under the umbrella of authentic leadership to build the cognitive aspects of positive psychological capital (PsyCap). On the other hand, researchers may also study the already developed schema of society and then test the given model in the organizational setting to induce mindfulness to the existing schema and then attempt to introduce behavioral change. We predict the outcome of such experimentation would result in the expansion of responsible leadership and in turn.

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T-Mix: A Threshold Cryptography Mixing Service for Bitcoin

Wafa F. Aldamegh and Laith A. Alsulaiman

Abstract

Bitcoin is the first successful implementation of the blockchain, which eliminates the role of trusted centralized settlement entities. Although Bitcoin was designed with anonymity in mind, it has recently faced privacy challenges as some users' identities have been revealed (Biryukov and Khovratovich 2014; Fleder et al. 2015; Maesa et al. 2016, 2017) To address this issue, mixing services are used in Bitcoin to increase user anonymity. Mixcoin provides a centralized mixing service that reduces the impact of blockchain transaction analysis by hiding the links among transaction addresses to preserve users' anonymity. However, Mixcoin has shortcomings against active attacks in which the attacker can compromise mixing service and inject fraudulent transaction addresses to steal funds. Mixcoin has an integrity issue in that the mixing service enabled dishonest behavior. This paper proposes T-Mix, a protocol that addresses Mixcoin's shortcomings by enhancing its availability and integrity using threshold cryptography. We present Mixcoin's threat model followed by a description of T-Mix.

Keywords

Blockchain • Cryptocurrency • Bitcoin • Threshold cryptography • Information security • Privacy

1 Introduction

Blockchain is a distributed immutable digital ledger system implemented without a central authority that is available publicly to a community of users and enables them to record transactions in ledgers. Each ledger comprises a chain of data packages called blocks. Each block contains cryptographically signed transactions linked to the previous block, which makes the system difficult to modify, which ensures the integrity of the ledger (Yaga et al. 2019).

One major area of blockchain use is the financial field, in which it is the main basis for many cryptocurrencies such as Bitcoin. Bitcoin was invented by Satoshi Nakamoto in 2008 (Nakamoto 2008), and now has a market value of approximately 60.1 billion dollars (CoinMarketCap 2018). Other cryptocurrencies such as Ethereum (2015) and Monero (2014) also rely on blockchain.

Bitcoin is a decentralized digital currency based on cryptographic proof, which enables it to implement a digital cash system without the need for a trusted third party to control the currency and eliminated the central single point of failure of trusted dealers that exists in traditional systems. Each Bitcoin user has a public and private key. The private key is used to sign transactions, and the public key is used as a Bitcoin address, which provides pseudonymity to the users. The transaction can have multiple inputs and outputs. Inputs and outputs are the source coin and beneficiary addresses, respectively. All transactions are logged in a public blockchain to prevent double-spending attacks (Narayanan et al. 2016).

1.1 Bitcoin Privacy

One of the essential features of Bitcoin protocol is the public key anonymity as Bitcoin provides pseudonymity to users. However, recently, some studies demonstrated that Bitcoin users' identities could be revealed by analyzing the stored

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transactions on the blockchain (Biryukov and Khovratovich 2014; Fleder et al. 2015; Maesa et al. 2016, 2017). When at least one transaction's address is linked to the real user's identity, then all the user's past and future transactions may be exposed, which compromises anonymity. Figure 1 shows the classification of proposed solutions to address this Bitcoin privacy issue, which we will discuss in Sect. 3.

1.2 Mixing Service

Mixing protocols maintain anonymity by hiding the map between the transaction's input and output addresses (Bitcoin Wiki 2018). Based on the way of mixing, we classify them into two categories: centralized and decentralized mixing protocols (see Fig. 1).

Mixcoin (Bonneau et al. 2014) is a centralized mixing service that hides the relationship between two transacting parties. Mixcoin introduced a mix of indistinguishability property in which the mixing transactions cannot be distinguished from non-mixing transactions. This property uses a normal Bitcoin transaction with fresh addresses for each mixing operation. This increases anonymity against passive attacks. Although Mixcoin contains concepts that increase anonymity, it has shortcomings in protecting against active attacks and integrity issues as discussed in Sect. 2.2.

1.3 Contribution of the Research

Our contributions in this paper are as follows:

- *Increased service availability* by redesigning the protocol to accommodate threshold cryptography, which prevents the service from being a single point of failure, as the active attacker needs to compromise $j - i + 1$ mixing servers to make the mixing service unusable.
- *Increased service integrity* as tampering with the number of coins or output address requires compromised $j - i + 1$ mixers.
- *Valid proof of the theft complaint* by proving ownership of the addresses published in the theft complaint.

The paper is organized as follows: Sect. 2 presents the background, Sect. 3 discusses related work, Sect. 4 describes T-Mix, and Sect. 5 presents conclusions and suggests future work.

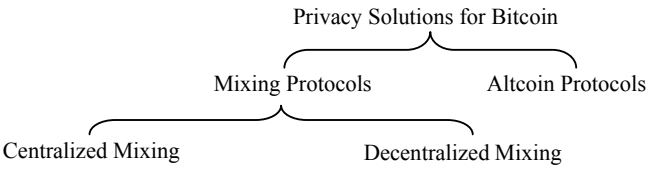

Fig. 1 Privacy solutions for improving Bitcoin anonymity

2 Background

In this section, we present a high-level description of threshold cryptography and the basic Mixcoin model.

2.1 Threshold Cryptography

A cryptographic mechanism allows a group of users to participate in encrypting or decrypting data or verifying a digital signature (Shamir 1979). In a threshold signature, an *(i, j)* threshold indicates that the private key splits into j pieces, which are shared and distributed over j participants. Each participant receives a share of the private key. Any subset of participants with size equal or greater than i can construct a digital signature, while the subset with size less than i cannot. Verifying the validity of the threshold digital signature requires first reconstructing i signatures then verifying these using the associated public key.

The main feature of threshold signatures is that the private key is never stored in a single location, which ensures that no single point of failure exists from which to steal the private key. The attacker also cannot reconstruct or reveal the private key without knowing i partial private keys (Boneh and Shoup 2017). Bitcoin protocol uses the Elliptic Curve Digital Signature Algorithm (ECDSA) as public key cryptography (Bitcoin Wiki 2017) and its threshold signature (Ibrahim et al. 2003) is compatible with Bitcoin (Goldfeder et al. 2015).

2.2 Mixcoin

Mixcoin provides a mixing service with a cryptography layer. If Alice has coins at her address k_{in} and wants to transfer her fund to a fresh address k_{out} without linking the two addresses, she contacts a mixer M who offers a mixing service in exchange for a fee. When Alice and M agree on the mixing terms, Alice sends her funds to M's escrow address k_{esc}. At the agreed time, M sends an equal value to k_{out}. Besides the mixing fees, M has a virtual reputation to maintain, which incentives M to act honestly. Mixcoin design is based on the following properties:

1. Accountability: Mixcoin guarantees that it can detect when M misbehaves, by giving Alice a signed warranty, that roughly says: "If Alice sends me v coins by time t_1, I will send back v coins to her k_{out} by time t_2". This signed warranty enables Alice to prove M's misbehavior by

publishing the warranty on the network. Doing so would destroy M's reputation and affect its business.
2. Randomized mixing fee: Mixcoin applied a randomized mixing fee to improve the anonymity by using the beacon function, which is a publicly verifiable random function used to produce a random number in the range [0, 1].
3. Mix indistinguishability: Mixcoin guarantees that it will hide the interaction between Alice and M from passive attacks.
4. Sequential mixing: Mixcoin's design supports multiple repetitions of the mixing process through independent mixers, which maintains anonymity against active attacks, but costs time and mixing fees.

However, Mixcoin represents a single point of failure where an attacker could gain access to the mixing server and reveal mixing process records to a malicious third party. The attacker could also steal Alice's funds by sending her coins to its own secret address instead of Alice's k_{out} address.

Moreover, although Mixcoin allows Alice to detect the theft when it occurs and expose M, the protocol does not prove the validity of the complaint. There are two possible cases of theft complaint. In the first case, the theft complaint is valid because M acts dishonestly by stealing Alice's funds. In the second case, the theft complaint is invalid because M acts honestly, and Alice generates a fake complaint to damage M's reputation. Invalid complaints are not detected by Mixcoin because the mixing process uses fresh addresses that have no transaction history, and no mechanism proves ownership of the addresses published in the theft complaint.

3 Related Work

In this section, we discuss the related work that has proposed improving Bitcoin users' anonymity and other works that use threshold cryptography within Bitcoin.

3.1 Bitcoin Privacy Solutions

Mixing Protocols. This category proposes a solution that improves anonymity without requiring modifications to the Bitcoin protocol. Table 1 shows a comparison of the related mixing protocols.

Centralized Mixing Protocols. Besides Mixcoin, Blindcoin (Valenta and Rowan 2015) improves upon Mixcoin by using a blind signature with a public log to hide the mapping

Table 1 Comparison of Bitcoin mixing protocols

Attribute Name	Mixcoin (Bonneau et al. 2014)	Blindcoin (Valenta and Rowan 2015)	CoinJoin (Maxwell 2013)	CoinShuffle (Ruffing et al. 2014)
Category	Centralized	Centralized	Decentralized	Decentralized
Mixing process performed by	Single mixer	Single mixer	Set of participant users	Set of participant users
Cryptograph layer	Signed warranty	Signed warranty, blind signature, public log	Group transaction	Group transaction and public key encryption
DoS attack against mixing process	Prevented	Prevented	Not prevented	Not prevented
Internal unlinkability	Not guaranteed	Guaranteed	Not guaranteed	Guaranteed
External unlinkability	Guaranteed	Not guaranteed	Guaranteed	Guaranteed
Theft issue	Detectable	Detectable	Prevented	Prevented
Anonymity set dependency	Set of clients use mixer at same time	Set of clients use mixer at same time	Set of participant users	Set of participant users
Scalability	Scalable	Scalable	Limited	Limited
Cost	Mixing fee and two transaction fees	Mixing fee and four transaction fees	One transaction fee	One transaction fee

between input and output addresses from the mixer. However, Blindcoin loses mix indistinguishability, adds additional cost and delay, and does not eliminate the theft issue.

Decentralized Mixing Protocols. These are based on a collaboration of untrusted Bitcoin users permuting their ownership of their coins without any trusted third party. CoinJoin (Maxwell 2013) relies on participants agreeing on transaction inputs and outputs to create a group transaction. CoinShuffle (Ruffing et al. 2014) improves CoinJoin's cryptograph layer to solve the internal unlinkability issue.

Altcoin Protocols. This category proposes solutions based on advanced cryptography to provide strong anonymity, but it must substantially modify Bitcoin. Also, it requires more storage and computational power per transaction than Bitcoin, which created new cryptocurrencies such as Monero (2014).

3.2 Bitcoin Wallets

Some works use threshold signature in Bitcoin wallets to provide a security policy to control sharing of the wallet and protect it from theft or loss of stored private keys (Goldfeder et al. 2015; Dikshit and Singh 2017). These approaches have the additional benefit of providing some anonymity by hiding the relationship between authorized users and reducing transaction fees because they use a single key.

4 T-Mix Protocol

T-Mix maintains Mixcoin design properties and enhances its availability and integrity. It comprises of two entities, a mixing service M and client Alice. M comprises j mixers, where M determines the threshold value *i-out-of-j* mixers that participate in signing the warranty. M sets up the mixing parameters and the threshold value i once at the creation of the mixing service. Based on the threshold signature scheme in (Ibrahim et al. 2003), these j mixers connect through a private network. The communication channel is dedicated because if m_i broadcasts a message other mixers will recognize that it came from m_i. All j mixers use a master clock to ensure system synchronism and an agreement protocol (Berman et al. 1992) to agree on the mixing operation. Alice must deal with i mixers in the M service to mix her funds. The mixing parameters are as follows:

v the value to be mixed,
t_1 the deadline for Alice to send funds to M;
t_2 the deadline for M to return funds to Alice;
k_{out} the address to which Alice wishes to transfer her funds;
p the mixing fee rate Alice will pay;
n a nonce, used to determine payment of randomized mixing fee;
w number of blocks M require to confirm Alice's payment.

Other parameters used in the protocol:

k_{esc} the escrow address, that M provides for Alice to transfer v;
k'_{esc} the escrow address, that M uses to transfer v to Alice's k_{out};
K_M the M long-term key;
k_{in} Alice's input address;
K_{out} private key of Alice's output address.

Figure 2 illustrates the protocol steps for mixing Alice's funds. The notation $\{x\}_K$ indicates that K signs the message x and the notation $\{x\}_{K(1,\ldots,i)}$ indicates that the message x is signed by threshold (i, j) of the key K.

Step (1). Alice contacts M by multicasting the mixing request to j mixers, which contains the mixing parameters encrypted by M's service public key K_M.

Step (1.1). j mixers in M perform the Phase King algorithm (Berman et al. 1992) to agree on whether to accept or reject Alice's mixing request.

Step (2a). When M accepts the terms, j mixers create a threshold escrow address k_{esc} and distribute the private key without a trusted dealer, as in (Ibrahim et al. 2003). Each mixer sends a warranty back to Alice, which contains the k_{esc} address with mixing parameters but signed by a different mixer key K_{Mi}. Alice receives i warranties signed by i partial keys.

Step (2b). If Alice does not receive acceptance of i mixers, then Alice's request is rejected, and k_{out} will be destroyed.

Step (3). Alice reconstructs the received i signed warranties and verifies signature.

Step (3.1). Invalid warranty. If Alice finds out the warranty is invalid, she will know that the M service is compromised and aborts the protocol and destroys the k_{out}. In this case, Alice cannot publish a complaint to the network to influence the reputation of M because the network cannot verify whether the whole service has been compromised.

Step (3.2). Valid warranty. If the warranty is valid, Alice proceeds with the protocol.

Step (3.2.1). Alice does not pay. If Alice does not transfer funds to k_{esc} by deadline t_1, M's mixers agree to abort the protocol and delete the record.

Step (4). Alice transfers the agreed value v from her address k_{in} to k_{esc} by time t_1. After this step, M is obligated to transfer an equal value of coins to k_{out} by time t_2.

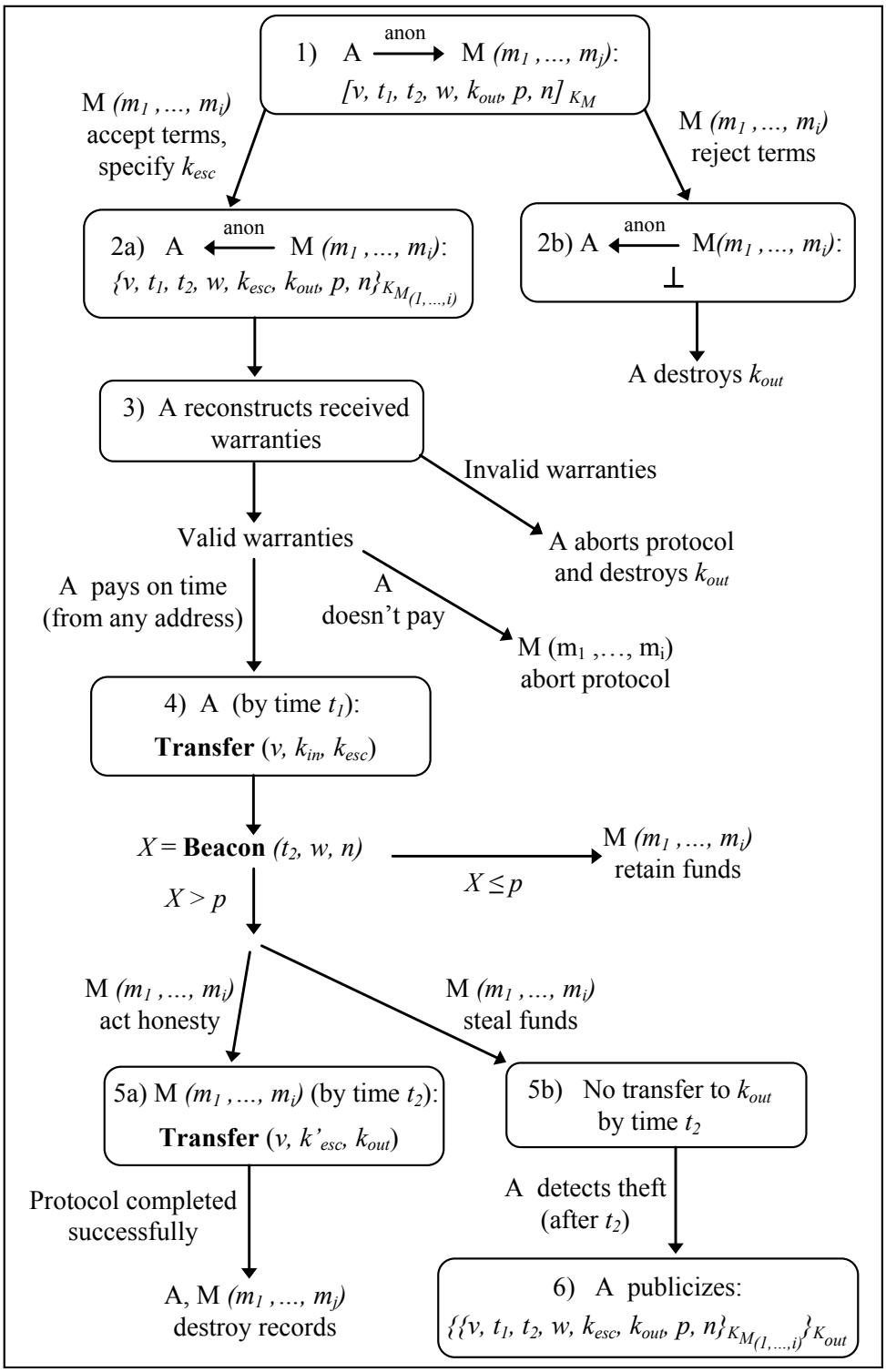

Fig. 2 T-Mix protocol design

Step (4.1). Compute beacon function. If the produced random number is less than or equal to the value p from mixing parameters, then the funds are kept by M as a mixing fee. Otherwise, the protocol moves to the next step.

Step (5a). M service acts honestly when i mixers agree to mixing Alice's funds. By time t_2, she will receive v coins in her address k_{out}. Both Alice and M should then destroy their records to ensure anonymity.

Step (5b). If M steals Alice's funds and fails to transfer v to k_{out} by time t_2, then Alice detects theft.

Step (6). Alice signs and publishes the signed warranties that she received in step (2a). Any third party in the network

Table 2 Differences between the Mixcoin and T-Mix steps

Step	Mixcoin	T-Mix	Description
Step (1)	Alice sends mixing request to M	Alice multicasts encrypted mixing request to M(m_i,...,m_j)	In Mixcoin, Alice contacts a single mixer, while in T-Mix contacts j mixers by sending an encrypted mixing request
Step (2a)	M creates a regular k_{esc} address and sends a single signed warranty	M creates a threshold k_{esc} address and i mixers send back to Alice a signed warranty	In Mixcoin, Alice receives a single complete warranty and k_{esc} controlled by a single mixer, while in T-Mix, receives warranty signed with a partial key of M and k_{esc} controlled by $j - i + 1$ mixers
Step (2b)	Alice does not receive an acceptance from M	Alice does not receive acceptance replies from at least i mixers	In Mixcoin, Alice needs to receive acceptance only from single mixer to proceed protocol, while in T-Mix, requires acceptance from i mixers
Step (3)	Does not have an equivalent step	Alice reconstructs received warranties and verifies it	Mixcoin does not require this step since Alice receives single complete warranty. In T-Mix, she needs to reconstruct received warranties to verify it
Step (5a)	M creates a regular k'_{esc} address	M creates a threshold k'_{esc} address	Mixcoin, M transfers Alice's funds to k_{out} through k'_{esc} that controlled by a single mixer, while in T-Mix, k'_{esc} controlled by $j - i + 1$ mixers
Step (6)	Alice publishes received warranty without signing it	Alice signs and publishes received warranty	To prove ownership of the addresses in the published warranty, Alice in T-Mix signs the warranty by her key

can verify that M cheated because the warranty signed by M's long-term key K_M and the transaction in step (4) are presented publicly in the blockchain before time t_1, and the published warranty signed by Alice's private key K_{out} to prove the correctness of the theft complaint.

Table 2 presents changes in the steps done by T-Mix over original Mixcoin.

5 Conclusion and Future Work

We presented T-Mix by redesigning Mixcoin to accommodate threshold cryptography. T-Mix increases availability and integrity of the service by preventing service from being a single point of failure and requires compromised ($j - i + 1$) mixers to tamper with the service, reducing the probability of compromising the mixing service by active attacks. Additionally, it avoids fake theft complaints by proving the ownership of the addresses published in the theft complaint. In future work, we will redesign the way the mixer's reputation is calculated to be a dynamic way by considering variable attributes such as service occupancy rate, history, and user rate to increase trust in the provided service. We will then implement and test T-Mix's anonymity and efficiency in the Bitcoin testnet network. Finally, we will redesign it to support other cryptocurrencies.

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Towards an Understanding of the Sources of Sustainable Competitive Advantage: A Literature Review and Conceptual Framework

Nihal El Daly

Abstract

While the concept of sustainable competitive advantage is pivotal to firm success and the subject of much debate in the literature, empirical research investigating it is limited, and few frameworks reflect the divergence of perspectives on the matter. This article aims to advance the understanding of the sources of sustainable competitive advantage by critically spanning a large part of the literature on this subject and synthesizing the findings in a conceptual framework. The review covers perspectives starting from the industry-based explanations of industrial economists such as Porter (1980) to the resource-based explanations favoured by many such as Barney (1991), to more market-oriented views (Day 1994; De Wit and Meyer 2005). The *Resource Based View* (RBV) is discussed in detail as making a key contribution to developing and delivering competitive advantage (Chaharbaghi and Lynch 1999). The research also covers the more recent insights from the Dynamic Capabilities Thinking, inspired by the rising pressure on businesses to evolve rapidly in an increasingly complex and dynamic environment, reinforcing the importance of the firm's ability to renew its resources and capabilities in light of market dynamics (Tondolo and Bitencourt 2014). The resulting conceptual framework will be empirically tested and further addressed in subsequent work.

Keywords

Sustainable competitive advantage • Advantage-creating resources • The resource based view

1 Introduction

Competitive advantage is one of the most lasting themes in the strategic management literature. The correlation of *superior performance* to the existence of competitive advantage has fuelled the search for *Sustainable Competitive Advantage* as a dominant theme in the study of firm strategy for many years (Chaharbaghi and Lynch 1999). A wide array of different perspectives exists on the determinants of competitive advantage, starting from the industry-based explanations of industrial economists such as Porter (1980) to the resource-based explanations favoured by many authors such as Barney (1991), to more market-oriented views (Day 1994; De Wit and Meyer 2005). In recent years, the *Resource Based View* (RBV) of the firm has also been recognised as making a key contribution to developing and delivering competitive advantage (Chaharbaghi and Lynch 1999), and will be an important starting point for this research where we explore the sources of *Sustainable Competitive Advantage* (SCA). Despite the proven link between high profitability relative to competitors and the possession of competitive advantage according to Thomas (1986) and Grant (1998) (as cited in Sigalas and Economou 2013), it is surprising that the concept of SCA, a "cornerstone concept in strategic management", is relatively new and poorly defined in the literature (Sigalas and Economou 2013).

This article aims to provide a better understanding of the sources of SCA by spanning a large part of the literature on this subject, comparing and contrasting the major views and summarising the findings in a conceptual framework which

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can guide further empirical testing. It starts by discussing two pivotal theories of Competitive Advantage: Porter's Market Theory and the RBV. Then, a number of proposed sources of competitive advantage that have more recently appeared in the literature and are highly supported, namely Market Orientation, Knowledge Management and Quality of Execution, are covered. Finally, some deficiencies in the literature are highlighted, followed by the development of a Conceptual Framework.

The concept of SCA appeared in 1984, when Day (1994) referred to strategies that can enable companies to maintain a competitive advantage that they achieved. Subsequently, in 1985, the specific phrase of SCA was created when the Porter's thinking on the types of competitive strategies came into place (as cited in Hoffman 2000). Barney (1991) has defined SCA as follows: "a firm is said to have sustained competitive advantage when it is implementing a value creating strategy not simultaneously being implemented by any current or potential competitors and when these firms are unable to duplicate the benefits of this strategy" (as cited in Hoffman 2000). This definition interestingly highlights the *sustainability* of competitive advantage by emphasising the importance of the inability of the competition to duplicate the firm's strategy.

This idea is supported by Porter as he argues that competitive advantage cannot be sustained by merely being more efficient at running the business. Porter believes that companies are too pre-occupied with operational effectiveness re-structuring, re-engineering and improving efficiencies, and that the latter improvements are necessary but not sufficient (Porter 1985).

2 Porter's Market Approach

In his book, Competitive Advantage: Creating and sustaining superior performance (1985), he outlined three key sources of competitive advantage: cost leadership, differentiation, and focus, explaining how each source could lead to competitive advantage. As indicated by the name, ***cost leadership*** refers to a situation where the firm pursues a cost below the industry average. This cost advantage is only valuable if the firm is able to maintain average industry prices as opposed to operating at a discount, diluting its cost advantage. It can be achieved via a number of strategies, including economies of scale, advantageous access to raw materials and patented technology. At the other end of the spectrum, the concept of ***differentiation*** allows a firm to price its goods and services above industry average or maintain a high sales volume by striving to make its goods and services unique, either via functional features such as the product, the delivery system or superior quality, or via emotional features such as the brand image and what it stands for. Differentiated features are likely to entail a higher cost. It is thus imperative that they are valuable to the customer in order to allow the firm to recover the incremental cost in higher pricing. Finally, the ***focus*** strategy refers to a firm's effort to either offer a specific benefit to a unique subset of customers, which is not available from other firms (differentiation) or to focus on a cost advantage which may arise from more efficient machinery or production processes.

The concept of *Differentiation* as a source of competitive advantage was also addressed by the RBV of competitive advantage, and notably by Peteraf, under the name of Heterogeneity (Peteraf 1993). The latter in Peteraf's article refers to the fact that firms with superior resources will as a result achieve a competitive advantage over their peers. Peteraf has developed a general model of resource and firm performance, building on previous work done on the *resource-based view* of the firm. A basic assumption of resource-based work is that the resource bundles and capabilities underlying production are *heterogeneous* across firms (Barney 1991).

3 The Resource-Based View

The *Resource-Based View (RBV)* of the firm is of particular interest in the context of this research as its principal contribution to date has been a *theory of competitive advantage*. The resource-based view makes a key assumption, which is attaining SCA is the a objective of firms, driven by its leaders. It consequently examines in detail how this sustainable advantage can be attained, which, according to the RBV, is via the possession of "key resources", which have specific characteristics that may include barriers to duplication and appropriability.

3.1 Understanding the Resource-Based View (RBV) and Its Assumptions

The central focus of the resource-based strategies is on the continuous search for *rents* or above average returns (Chaharbaghi and Lynch 1999). The firm's ultimate objective in a resource-based approach is generally taken to be above normal returns (as in IO related theories) (Conner 1991). Obtaining such returns according to RBV requires either that the firm's products be distinctive in the eyes of the buyers or that the firm selling an identical product relative to competitors must have a low-cost position (Conner 1991).

Thus in RBV, the key focus for an organisation is to either have unique products or a uniquely low cost, both are linked in the RBV to the resources that the company uses to manufacture the product in question. This theory also notes

that this should not be achieved in a manner that would jeopardise the company's superior returns (Conner 1991).

The RBV makes ***two main assumptions*** in analysing SCA:

- Resource differentiation may exist between companies of the same industry
- The resources in question may be immobile and thus heterogeneity may be long lived (Barney 1991).

The RBV advances that the possession of unique positions in terms of resources that are valuable to production and distribution is key to an organisation's capacity to reach and sustain profitable market positions (Conner 1991). This advantageous position will stem from the focus on costly-to-copy attributes of the firm as sources of economic rent and thus as the fundamental drivers of performance and SCA (Conner 1991). The attainment of above normal returns or rents is achievable through valuable resources that are scarce (Chaharbaghi and Lynch 1999). The resource-based view defines a firm as composed of groups of resources. It also claims that resource differentiation may exist between different organisations and even more, that a firm has the ability to maintain this differentiation over time as the theory advances that resources are immobile as well as difficult to imitate.

Fahy (2000) summarises the ***three key tenants*** of the Resource-Based View below:

- SCA and superior performance
- Unique resources with key features that benefit the firm
- Strategic choices made by the firm.

3.2 The Relationship Between the RBV and SCA

According to Fahy (2000), the main area where the resource-based view has made a significant impact is in the framework of competitive advantage. Its key assumption is that the achievement of sustainable competitive advantage is the main focus of management activity. Once the firm is in possession of SCA, it is able to reach economic rents. Resource-based theories highlight rents as opposed to profits when discussing sustainable competitive advantage driven by a number of factors. Most importantly, it advances that profit is a purely accounting, quantitative concept, which does not allow the firm to evaluate the quality of its resources. In addition, the value of the latter is based on historical costs (Chaharbaghi and Lynch 1999).

The resource-based view focuses on the important role of management in making strategic choices related to obtaining and nurturing the right resources to enhance returns. This consequently emphasises the manner in which companies acquire and maintain competitive advantage, an area addressed in detail in the RBV literature in general (Fahy 2000). It also proposes that the possession of certain key resources is critical to building SCA. These resources are described as having the characteristics of value, barriers to duplication and appropriability. Peteraf expands on this by proposing that the value of superior resources lies largely in their restricted availability. They will likely generate a sustainable competitive advantage only if competitors cannot easily replicate them (Peteraf 1993). *An SCA can be obtained not only if the firm possesses these resources but also deploys them appropriately in its product-markets*.

The below model by Fahy (2000) is a representation of the resource-based model and summarises many of the discussion points raised above. It represents a snapshot of how the main elements of the RBV, namely, key resources, SCA, superior performance and management choices interact with each other in the RBV framework (Fig. 1).

3.3 Understanding the Resource-Based View (RBV) and Its Assumptions

The above classification of resources by Fahy appears to suggest that "Capabilities" are also one kind of resource, as he argues the "label resources is best adopted as a general, all-embracing one" (Fahy 2000). As will be explained in the coming sections, many subsequent authors make a clear distinction between "resources" and "capabilities". In light of the Dynamic Capabilities (DC) Theory, which will be further elaborated on, "Dynamic Capabilities" may be defined as the organization's ability to integrate, build and reconfigure internal and external competencies to address rapidly changing environments. This concept emphasizes the DC as a set of processes that result in changes in the feature set and current capabilities of an organization in order to adapt the organization to cope with environmental changes. (Tondolo and Bitencourt 2014).

3.4 The Characteristics of Advantage-Creating Resources

As previously discussed, a key tenant of the resource-based view is that resources do not all have the same value and they do not all have the potential to generate SCA. Much of RBV literature thus attempts to shed light on the characteristics of advantage-creating resources. Many over-lapping views can be found on that topic. Barney (1991) proposes that advantage-creating resources must meet four main criteria: *value, rareness, inimitability, and non-substitutability*, while Grant (1991) puts forth the *level of durability,*

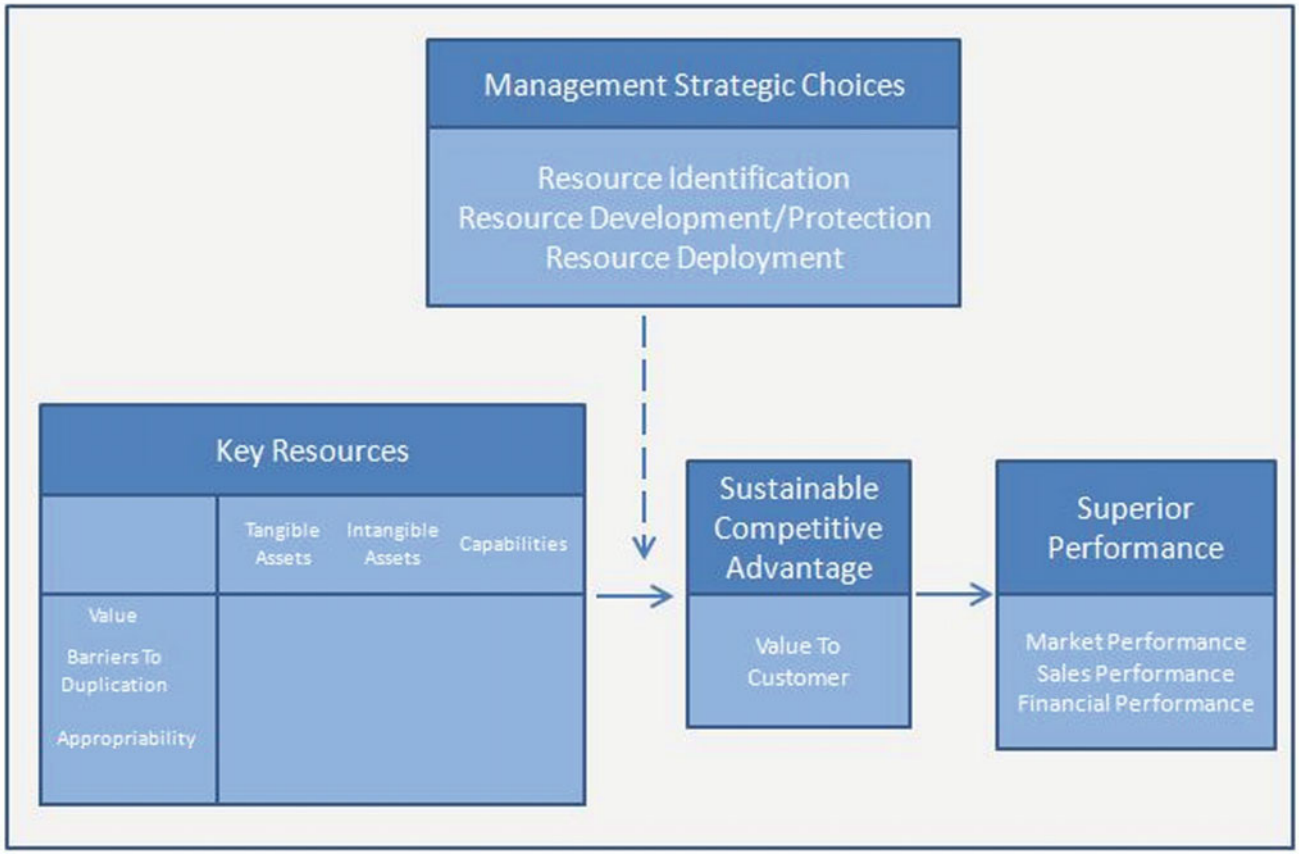

Fig. 1 A resource-based model of sustainable competitive advantage (Barney 1986)

transparency, transferability and replicability as the important criteria for these advantage-creating resources. Collis and Montgomery (1995) address the topic in the form of "tests". The five tests they propose are *inimitability, durability, appropriability, substitutability and competitive superiority* (Collis and Montgomery 1995). Amit and Schoemaker echo the first 4 of the 5 tests proposed by Collis and Montgomery and add another 4, for a total of eight criteria. Those four include *complementarity, scarcity, low tradability and overlap with strategic industry factors* (Amit and Schoemaker 1993).

Views thus abound on what characteristics define these resources. Some major commonalties can however be distinguished and the main themes can be summarised under the headings of value, barriers to duplication, and appropriability (Fahy 2000).

Value to customers is an essential component of competitive advantage. It thus ensues that in order to create a competitive advantage, a resource should possess the capability of creating value. According to Barney, valuable resources enable firms to better respond to customer needs, thus guiding the creation and implementation of stronger strategies. The importance of better understanding customers in the context of competitive advantage is also highlighted in environmental models of competitive advantage (Barney 1991; Collis and Montgomery 1995).

A resource can be described as possessing barriers to duplication or inimitability if it cannot be clearly identified or if it is unclear whether it has the ability to generate superior performance. This is also linked to a particularly interesting feature, i.e. transparency, described by Reed and DeFillipi (1990) and others as causal ambiguity. The essence of this feature is that the best protection against imitability by competition is the lack of clear and proven links between those resources that create advantage and the superior performance of the organisation that possesses them. Such causal ambiguity exists where resources are highly tacit, highly complex or are the result of accumulated, firm-specific activities (Reed and DeFillippi 1990). In other words, causal ambiguity is witnessed in situations where the firm finds it challenging to understand exactly which resources have led to a sustained advantage or how they achieved it. It naturally ensues that the competition in this case would also find it difficult to identify and imitate what made a specific company successful. There are parallels here to the concept of tacit knowledge where employees will find

it difficult to articulate the reasons for their success. Inimitability is at the heart of value creation because it limits competition. If a resource is inimitable, then any profit stream it generates is more likely to be sustainable (Collis and Montgomery 1995).

Finally, appropriability encourages managers to question: who captures the value that the resource creates? Basing a strategy on resources that are not inextricably bound to the company can make profits hard to capture (Collis and Montgomery 1995).

3.5 General Comments on the Evolution of the Resource Based View

Recent investigations of the RBV move beyond a direct resources-performance link and attempt to more fully capture the RBV by assessing the "action" component of its underlying framework. The RBV has been developing over many years to incorporate more focus on the actions that need to be perpetrated to best utilize the resources to generate competitive advantage and thus improve performance. These resources, if possessing the right characteristics, will also enable the firm to take stronger strategic actions (Ketchen et al. 2007). There is empirical evidence that firm resources can be a driving factor in creating firm competitiveness (Ritthaisong et al. 2014) (Fig. 2).

3.6 Dynamic Capabilities: Extending the Argument of the RBV

In the previous section, it was explained that the RBV maintains that the firm's ability to attain and keep profitable market positions relies on its ability to gain and maintain advantageous positions in 'underlying resources' that are valuable, rare, imperfectly imitable and imperfectly substitutable (Conner 1991). The underlying assumptions on which the RBV is built are that resources are heterogeneous across organizations and that this heterogeneity is sustainable over time. It is essentially a static theory, which does not explain how future valuable resources can be created or how the current stock of valuable, rare, inimitable, un-substitutable resources can be refreshed to respond to the needs of a changing environment (Ambrosini and Bowman 2009). The dynamic capability perspective addresses exactly those challenges by focusing specifically on how companies can change their valuable resources over time and do so persistently, namely via dynamic capabilities, which may be argued to help firms sustain their advantage, as will be debated in the coming sections. This perspective is argued to be an extension of the RBV and has received increased interest and focus in recent literature. Ambrosini et al. (2009) propose that the concept of dynamic capabilities has evolved from the resource-based view of the firm. They state that the dynamic capabilities perspective adds value to the RBV as it

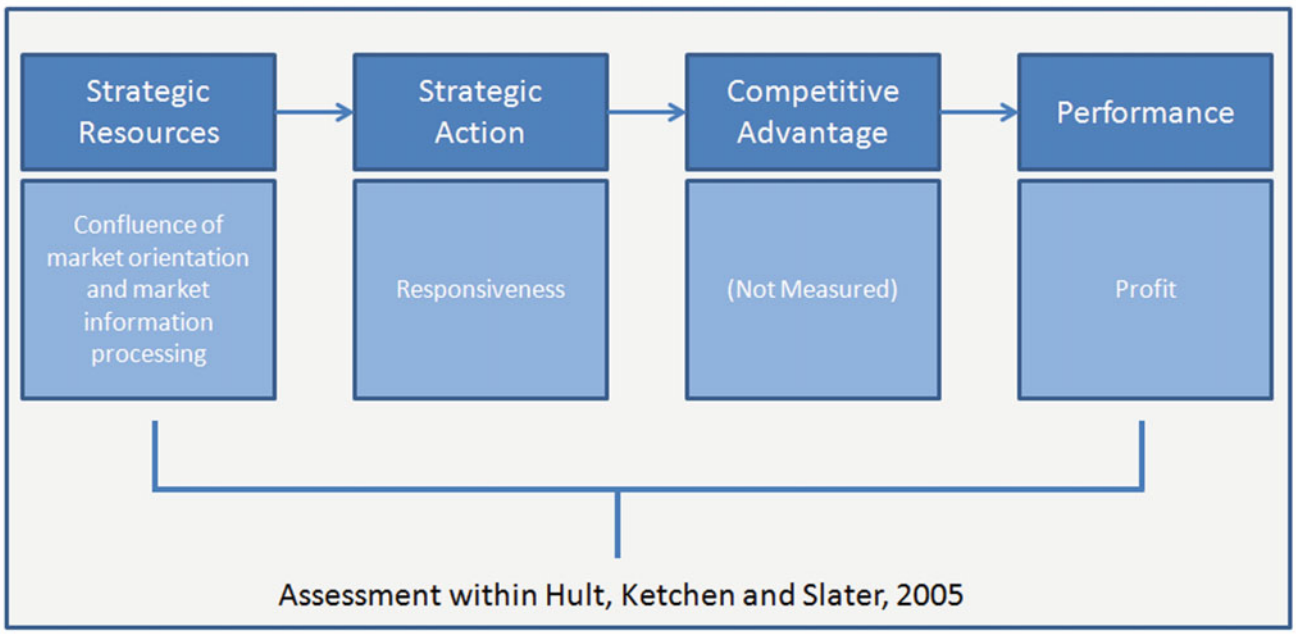

Fig. 2 The core concepts of the resource-based view (Grant 1996)

transforms what is essentially a static view into one that can encompass competitive advantage in a dynamic context.

3.7 Understanding Dynamic Capabilities Versus Resources

The more recent Dynamic Capabilities (DC) Theory makes a clear distinction between resources and capabilities. Eisenhardt and Martin propose a definition of resources as 'those specific physical, human and organisational assets that can be used to implement value creating strategies" (Eisenhardt and Martin 2000). The dynamic resources view advances that if a firm possesses valuable resources but does not evolve them, using dynamic capabilities, based on environmental dynamics, then it cannot sustain its related advantage. The many definitions of dynamic capabilities existing in the literature reflect this notion and distinguish dynamic capabilities from resources as illustrated in the following definitions. The original definition by Teece et al. (1997) is "the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments". Another definition by Helfat et al. (2007) states that dynamic capabilities are "the capacity of an organization to purposefully create, extend, or modify its resource base". Eisenhardt and Martin (2000) also shares this definition: dynamic capabilities are the antecedent organisational and strategic routines by which managers alter their resource base, acquire and shed resources, integrate them together and recombine them to create value creating strategies. Having shared these definitions, many authors believe that the concept still requires conceptual and empirical developments, and that the scarcity of empirical work around it makes it difficult to translate it to management recommendations (Ambrosini and Bowman 2009).

3.8 Dynamic Capabilities and Competitive Advantage

There is a divergence of opinions in the literature regarding the link between dynamic capabilities and competitive advantage. However, at least one empirical research by Breznik and Lahovnik (2014) demonstrated the link between dynamic capabilities, sustained competitive advantage and ultimately superior firm performance. In their paper "Renewing the resource base in line with dynamic capabilities: a key to sustained competitive advantage in the IT Industry", they indicate that firms which renew their resource base in line with the dynamic capabilities view can generate and sustain a competitive advantage and thus the related firm performance. They have specifically found that firms with a stronger commitment to deploying dynamic capabilities were more successful, and vice versa. This was concluded based on a research involving in-depth interviews in six representative of IT firms. Their results also suggest that firms need to continuously deploy all relevant dynamic capabilities. A gap in the literature around dynamic capabilities was highlighted by Pisano (2017) to be a lack of focus on how a capability strategy is to be put together. His research proceeds to offer a perspective on how to build this strategy based on concepts, commitment and search (Pisano 2017). This is an area where further research would be very beneficial.

3.9 The Relevance of Dynamic Capabilities in Today's World

Today's business world is a rapidly evolving one with multi-faceted challenges. On the one hand, consumers and customers have increasingly demanding needs of innovation, customization, availability, and on the other hand, the business environment displays increasing VUCA (Volatile, Uncertain, Complex, and Ambiguous). The digital transformation also poses another set of challenges for today's businesses as consumers are exposed to many more competing media and have access to new supply chains (e-commerce, for example). In light of this, there is increasing pressure on businesses to evolve rapidly to respond to changes in the increasingly complex and dynamic environment. In this context, the Dynamic Capabilities Thinking reinforces the importance of the firm's ability to renew its resources and capabilities to deal with the environmental changes and the dynamics of the market, looking beyond the firm's specific industry at the total business ecosystem (Tondolo and Bitencourt 2014).

4 The Paradox of Resources Versus Markets

Despite the fact that the RBV incorporates some discussions on market orientation under the heading of "capabilities/intangible assets", by its very definition, the RBV places a firm's resources (as opposed to the environment) at the heart of the strategy generation process. This has led de Wit and Meyer to describe the RBV as an inside-out perspective in their book on Strategy Synthesis (De Wit and Meyer 2005). At the other end of the spectrum lies the Market orientation view, described by the same authors as the outside-in perspective. De Wit and Meyer summarize the paradox of markets and resources (Fig. 3).

It is appropriate at this stage to examine Porter's definition of competitive advantage, at the heart of which lies the concept of sustainability. The latter describes a competitive advantage when it is enduring despite of environmental

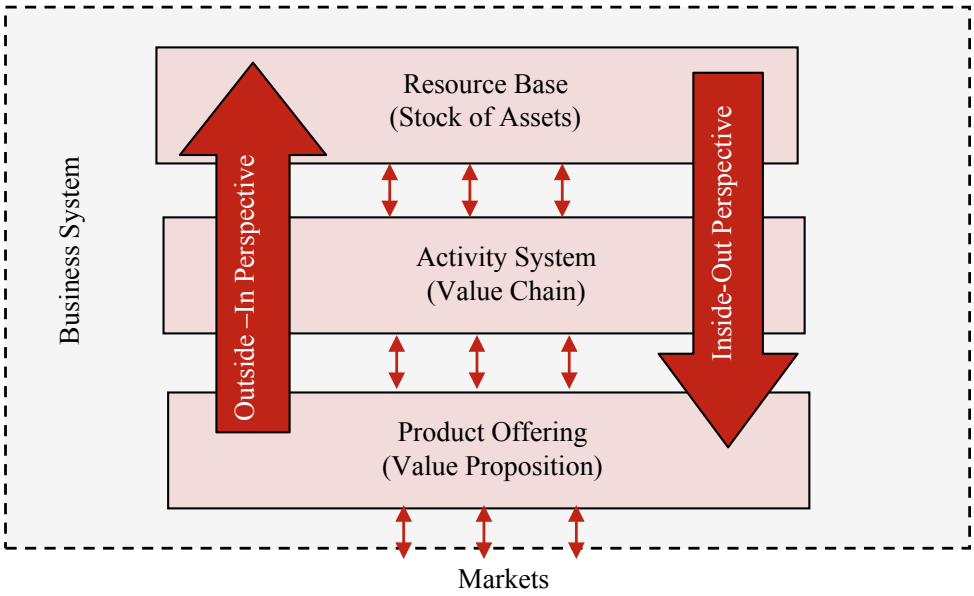

Fig. 3 The two perspectives on shaping the business system (Ambrosini and Bowman 2009)

changes and difficult to replicate by the firm's competitors (Porter 1980). De Wit and Meyer (2005) associate two key elements with sustainability, namely, defendability, which can strongly be explained by the company's strengths, including the quality of its resources, and, environmental consonance. The latter requires continuous adaptation of the firm to the variations and demands of the market place and the opportunities it presents. In order for a firm to be successful, it must ensure it adequately adapts to its environment, despite the seemingly opposite pressures these factors present (De Wit and Meyer 2005).

Managers with an outside-in perspective believe that the environment in which they operate should be the starting point of their strategy generation process. Scrutinizing the environment may include identifying lucrative market prospects and possible customers, and analyzing the competition. Strategy creation here is focused on a good comprehension of the market and the actions taken to navigate environmental changes. It is also referred to as "The Positioning Approach".

On the other end of the spectrum, managers with an inside-out perspective build their company strategies around the company strengths as opposed to around external opportunities. The fundamental strategic question here becomes how to identify, obtain and develop unique competencies and resources. The latter can then form a strong basis that can be used to take advantage of market prospects (De Wit and Meyer 2005). De Wit and Meyer argue that the firm should strive to adapt to its environment (De Wit and Meyer 2005). In other words, the choice and development of the resources of the firm must be guided by an outside-in perspective in order to ensure that these resources are indeed valuable to generate competitive advantage. There is, however, no consensus in the field of strategic management on how to balance markets and resources (De Wit and Meyer 2005) and thus managerial judgement will play a big role in individual company choices.

The above sections have covered two prominent theories of competitive advantage, namely Porter's market approach and the Resource based view. Within the latter, market orientation was quoted by multiple authors as an important 'intangible' resource helping the organization to reach sustainable competitive advantage, as explained above. Independent of the resource-based view, market orientation was also discussed as a source of SCA. The next section explores these views, followed by a discussion on two further prominent sources of SCA debated in the literature: knowledge management and quality of execution.

5 Market Orientation as a Source of Sustainable Competitive Advantage

Market-based learning has been recognised as an important source of sustainable competitive advantage (Hult and Ketchen 2001). Hult and Ketchen provide evidence that a market-focussed culture, market information processing and organisational responsiveness function all together influence success. In the context of the RBV, market orientation is also positioned as one of several capabilities that collectively give rise to a positional advantage for some firms, as proposed by Day (1994). Hult and Ketchen also suggest that market orientation, together with entrepreneurship, innovation and organisational learning, can collectively contribute to the creation of the unique resource of positional advantage (Hult and Ketchen 2001). The latter is thought to be rare,

valuable, and difficult to imitate, and thus should lead to superior performance (Barney 1991).

An important conclusion was reached in the recent literature by Vorhies and Morgan (2005) which has supported *the theory that marketing capabilities associated with superior business performance can be identified* and the marketing capability gap between top-performing benchmarks and other firms explains significant variance in business performance (Vorhies and Morgan 2005). This sheds some light on another important source of SCA, namely, Marketing Orientation, discussed below.

5.1 Definition of Market Orientation

Focus on the definition and measurement of market orientation has only started in the 1990s, despite the existence of the notion of marketing well ahead of that. There have been some indications from previous research that three activities pertaining to market orientation lead to superior performance, they are namely: the thorough collection of market information, especially with relation to both present and evolving customer needs; the adequate distribution of the acquired information across the firm,, and finally the actions taken across the company in response to this information (Hooley and Broderick 1998). These conclusions not only emphasize the importance of market orientation for firm performance but interestingly, the importance of **knowledge management** in ensuring that market orientation is pervasive enough in the organisation to impact performance. Knowledge management will be addressed in detail in the subsequent section.

Tuominen et al. (2005) have defined **market driven intangibles** as any attribute, intellectual or relational, that can be deployed advantageously in the market place. Weerawardena (2003) offered a complementary view defining marketing capability as integrative processes designed to apply the collective knowledge, skills, and resources of the firm to the market-related needs of the business, enabling the business to add value to its goods and services to meet demands.

According to Day (1994), market orientation represents superior skills in understanding and satisfying customers. Its principle features are:

- A set of beliefs that puts the customer's interest first as stated by Deshpanade (as cited in Day 1994).
- The ability of the organisation to generate, disseminate and use superior information about customers and competitors as stated by Kohl (as cited in Day 1994).
- The coordinated application of inter-functional resources to the creation of superior customer value as stated by Narver and Slater, Shapiro (as cited in Day 1994).

Another definition presented by Kohli and Jaworski (1990) is that market orientation is the generation and dissemination of organisation-wide information and the appropriate responses related to customer needs and preferences, and the competition (Kumar et al. 2011).

5.2 Market Orientation Effect on Performance

According to Kumar et al. (2011), a firm's strong market orientation gives it a superior chance to perform better due to the focus and information that its managers have on its consumer and customer base as well as its competitive environment. This important information can then enable the company to achieve sustainable competitive advantage, if it is used in a structured and adequate manner (Kumar et al. 2011).

Market orientation has been positively associated with superior performance by many authors (Day 1994). Tuominen et al. (2005) argue that superior performance is initiated by the degree of market orientation and market driven capabilities. Performance advantage is defined as the achievement of overall profit levels, profit margins and ROI, emphasising especially financial outcomes (Tuominen et al. 2005).

5.3 Competitive Positioning and Innovation as Marketing Resources

The following section examines some of the reasons why market orientation leads to sustainable competitive advantage. The literature is lacking in this area as the only two variables that the researcher has found to be discussed in the literature explaining why market orientation leads to superior performance, are: ***competitive positioning***, and ***innovation***, with an implicit assumption that the latter two subjects are integral to the market orientation arena.

The first aspect of market orientation as a driver of performance to be addressed is **competitive positioning**, defined as the decisions that the firm makes with regards to the markets it will do business in as well as the manner it will compete there (Hooley and Greenley 2005). Judgements on positioning seek to find a match between market requirements and company ability to match them (Hooley and Broderick 1998).

Hooley and Greenley (2005) draw a very interesting parallel between the possession of unique distinct resources as sources of competitive advantage in the framework of the Resource-Based View and the creation of competitive positions. They contend that parallels can be drawn between the creation of a sustainable competitive position and a sustainable competitive advantage, namely that both can be

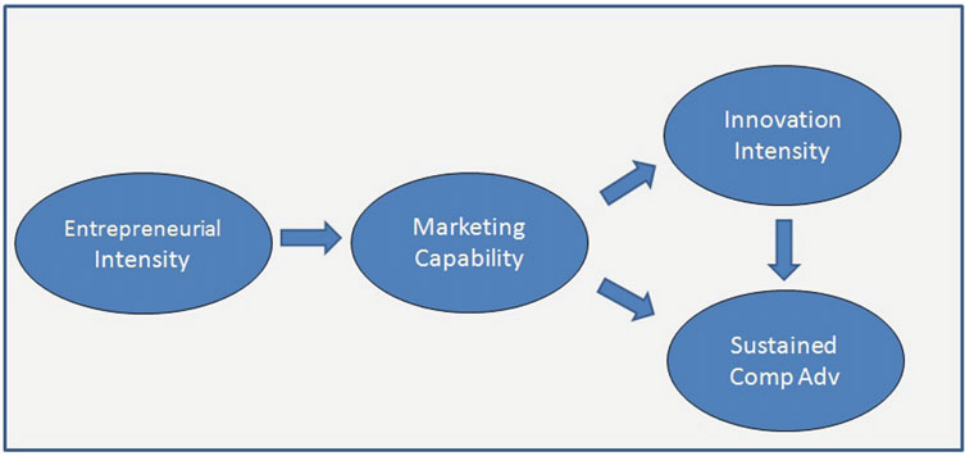

Fig. 4 The detailed conceptual model with hypothesized relationships (Prahalad and Hamel 1990)

equally traced back to the existence of superior and inimitable resources that are valuable to the firm's customers and consumers, possessed by an organisation, as is stipulated in the thinking of the resource-based view.

An important aspect of the sustainability of the positioning as a competitive advantage stems from the fact that it is quite challenging for any competitor to fully understand the nature of the resources that have been used in achieving this positioning and exactly how they were used. A specific positioning also usually results from a sophisticated set of intricate decisions taken by the firm, which also would make it difficult to decipher by any competitor. Lippman and Rumelt (1982) refer to this problem as **Causal Ambiguity**, explained in an earlier section of this paper in the context of the resource-based view. Examples of the positioning advanced by Hooley and Greenley (2005) are: price, technical product/service quality, service, innovation, and customisation. Their research has demonstrated that the positioning most likely to lead to competitive advantage in a sustainable way is related to ***service and innovation, as they exhibit greater inimitability through causal ambiguity or rely on non-tradable resources*** (Hooley and Greenley 2005).

Another important aspect of market orientation covered in the literature is **innovation**. Weerawardena (2003) has demonstrated that marketing capability has a strong impact both on the firm's rate of innovation as well as its competitive advantage. In turn, it is claimed that unique marketing skills are largely the results of the efforts of key decision makers in the firm. The conceptual framework below details the findings of the research (Fig. 4).

One of the explanations of the link between innovation and superior performance advanced by Kumar, Jones, Venkatesan and Leone (2011) is that organisations that embrace market orientation at an early stage have a better chance at spotting and meeting customer and consumer unmet needs, and offering products and services to address them. Innovation was also recently linked to competitive advantage in a study by Hosseini et al. (2018) where innovation was linked to new product development and increased competitive advantage in an empirical study.

5.4 The Sustainability of the Market-Orientation Advantage

An intricate link exists between the assumptions of the RBV and the sustainability of the market orientation advantage. This advantage will only be sustainable and thus truly impact firm performance positively on the long term if it demonstrates the barriers to duplication and inimitability described in the RBV literature. Barriers to duplication can be achieved via "**isolating mechanisms**", an expression that refers to some of the actions and capabilities that a firm may possess which contribute to protecting its competitive advantage from being imitated, such as corporate culture, the effectiveness of its leaders, the mechanisms in place to manage its resources, intellectual and property rights. These mechanisms are mostly generated by the specific ways of working within an organisation, especially in relation to the use of its resources and how these are acquired and developed over time. Inimitability, path dependency, inability to transfer or trade, and sustainability, are all thought to contribute to creating isolating mechanisms (Hooley et al. 2001).

Another important determinant of the sustainability of market orientation as a competitive advantage is the ability of the firm to capture the *knowledge* created around market orientation, turn it into useful learnings and disseminate it adequately throughout the organisation. This is captured under the topic of Knowledge Management, studied in detail in the coming section.

Despite the incorporation of market orientation as an asset within the RBV context, some authors such as

Srivastava, Fahey and Christensen (2001) believe that the attention given to the marketing role in the resource-based theory is not commensurate with its potential importance. In addition, the growing theoretical and conceptual work on marketing research is not supported by empirical investigations (Milfelner et al. 2008). A large body of literature has thus emerged, discussing Market Orientation as a source of superior performance and Sustainable Competitive Advantage, at the other end of the continuum from the RBV as will be demonstrated in the below sections.

6 Knowledge Management as a Source of Sustainable Competitive Advantage

The VUCA (Volatile, Uncertain, Complex, Ambiguous) environment that is the characteristic of today's day and age poses a number of new challenges for organisations, accelerated also by globalisation and digitisation, which impose different ways of doing things than in the past. In this context, the rapid dissemination of knowledge and its widespread and rapid availability to consumers has generated important discussions around the important role that Knowledge Management and knowledge based resources (as opposed to purely tangible ones) must now play in creating and sustaining competitive advantage and superior performance (Nguyen et al. 2009).

Consequently, another important intangible asset often quoted to be a source of competitive advantage is knowledge management. Knowledge is the key competitive advantage for an organisation according to Grant (1996).

The Resource-Based View is gradually placing more emphasis on the importance of the firm's knowledge as a driver in maintaining a company's competitive advantage (Narasimha 2000). In the RBV concept (Wernerfelt, Barney, Prahalad & Hamel, Peteraf, Conner), knowledge has the ability to become a source of SCA for a firm, if adequately managed (as cited in Halawi and Aronson 2005).

Knowledge is broadly defined as credible information that is of potential value to the organisation (Hult 2003). Knowledge can be dissected as inbound and outbound knowledge. The inbound aspect of knowledge pertains to generation of knowledge, which entails compilation and sharing of information and coding this information into widely agreed messages and conclusions, i.e. useful information that could guide decision making within the organisation (Ketchen et al. 2003). The outbound aspect of the knowledge management process addresses the deployment of knowledge to gain an edge in the market place, which is a much more difficult task.

Hult (2003) defines knowledge management as the structured and methodical manner in which knowledge is accumulated and shared within an organisation and subsequently utilised it in a manner that builds competitive advantage for the firm, by drawing on explicit as well as tacit knowledge.

Despite widespread agreement by managers regarding the strategic importance of knowledge, most face challenges in extracting real benefits for their business from their knowledge management efforts. An important contributor to this challenge is the fact that it is often assumed that merely acquiring knowledge will automatically yield benefits (Murray 2002). In fact, mere possession of the knowledge will not inspire action if it is not adequately disseminated.

Murray advances four logical steps, described below, to deliver tangible benefits from Knowledge Management (KM) initiatives.

Step 1: KM as a demand-led business activity. Knowledge Management can only generate positive business results if it is capitalised on in such a way that serves business objectives, as driven by the management of the organisation. It must be seen as only an enabler. In this context, KM must thus focus on delivering positive business impact (Fig. 5).

The DIKAR (Data, Information, Knowledge, Action, Results) model illustrates that closer to the supply side which is highly data driven, the emphasis will be more on technological data gathering and procedures. As the process evolves more towards delivering results, it must be more driven by strategic thinking from the business in order to ensure the data ultimately supports the delivery of the desired business results.

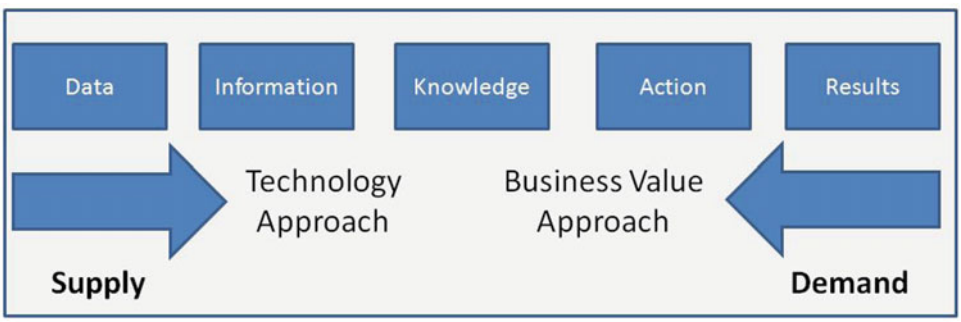

Fig. 5 The DIKAR model (Hosseini et al. 2018)

Step 2: Focussing KM for business benefits: having established that Knowledge Management is best utilised from the lens of the required business results, the next step is to identify which results KM will support, and then to keep all KM activities focussed on these results. It is helpful in this respect to look at the RAKID model, which is the mirror image of the DIKAR model above which guides managers in a step-by-step manner to identify the data required (supply) to support an agreed set of results (demand).

It is widely agreed that the ultimate benefits of KM would be to make an organisation more competitive and more profitable. This can be achieved by ensuring a firm offers products or services that are uniquely tailor-made to respond to customer and consumer needs or that are delivered to them in a way that is superior to their competition. In order to achieve this, a thorough knowledge of consumer and customer needs is required, which is where Knowledge Management can play a big role, both in understanding the organisations capabilities internally but also in shedding light on market and consumer trends, customer channel evolution and insights and the likes (Murray 2002).

The next step is an important one, which is to establish how KM can lead to those advantages.

Step 3: Knowledge Management for real benefits: After identifying the business results that KM is meant to affect and focussing KM efforts towards them, the real benefits only result from individual behaviour. It is only when individuals adopt different ways of working that performance ultimately improves. It is people behaviour that will yield the benefits, and not the technology. The above can be summarised in 2 sequential steps where in the first, the right ways of working are identified, and then technology and organisational enablers such as the creation of appropriate teams, agreements, or processes, come into play to realise the benefits.

Step 4: Knowledge Teams and where to use them. Knowledge can be thought of as being present in three places: as codified information sets, inside the heads of individuals, and within teams. Table 1 below explains the challenges posed by each of these as organisations strive to leverage that knowledge.

The two key objectives for KM are:

- To help the firm succeed by supporting well-informed decisions.
- To ensure the optimum utilization of the firm's knowledge base (Murray 2002).

Lubit (2001) has suggested two routes that firms can adopt to generate a competitive advantage out of knowledge management. The first one, known as *tacit knowledge*, is where the company generates and disseminates knowledge internally, which is difficult for other companies to

Table 1 The three types of knowledge (Hosseini et al. 2018)

	Knowledge as body of information	Knowledge as know—*How the individual*	Manage phase know—*How the team*
Nature of Knowledge	Explicit Codifiable IS can play a part Packaged	Tacit Personal Diffuse	Tacit Fluid Dependent on team dynamics Diffuse
KM Issues	Finding it Validation Value assessment Obtaining it at reasonable cost Integration with own systems Making available to the right population in the right form Sensible use of technology Ensuring subsequent beneficial use	Establishing suitable extraction processes Tight ownership Reluctance to impact Motivation and reward Experiential so hard to encode Trust Finding suitable way to pass on learning Limited role for technology	Formal management of essentially free—form activity Establishing suitable frameworks and processes Members' own perception of their role Mutual trust = need 100% buy-in Formal learning mechanics Dissemination Creating and using Knowledge repositories Technology has background work
Common KM Issues	Knowledge about knowledge (knowing it exists and where: Its context and hence its importance) Understanding the relevant business context Ownership and buy-in to KM processes Updating and reuse of knowledge Demonstrating casual link between KM activity and business benefit		

understand or copy. The second route entails the development of *superior knowledge management capabilities*, which encourages continuous innovation (Lubit 2001). Elaborating on the former as an inimitable advantage often overlooked by practitioners; tacit knowledge can be described as knowledge that is difficult to verbalise or share in a structured way. It becomes part of the individual's way of thinking as opposed to a visible repository of knowledge as would be the case with explicit knowledge. Tacit knowledge is unconsciously acquired from the experience one has while immersed in an environment and often allows us to perform at a higher level than that which our explicit knowledge does.

Tacit knowledge can be broadly categorised into four different types: know-how, mental models, problem solving techniques, and ways of working. The very nature of tacit knowledge (being hard to share in a structured way) helps the company to protect it from the competition. If the organisation itself cannot codify its own tacit knowledge, it is possible to imagine how difficult it would be for the competition to replicate it. It ensues from this that tacit knowledge lends itself naturally to being a strong source of sustainable competitive advantage, provided the firm can make use of its own tacit knowledge by embedding it into the organisation's ways of working. In summary, a key reason why tacit knowledge may lead to sustainable competitive advantage is that it is embedded within an organisation's ways of working, but is challenging for other organisations to copy. It is important in the development of tacit knowledge that a firm captures organisational learning over time, encouraging the documentation of case studies and best practice, especially from more experienced managers. It is also then critical to turn this knowledge into learning and ways of working as employees learn and practice their own tacit knowledge over time, making it a unique knowledge base for the organisation.

With respect to attaining SCA by building on Knowledge Management, it is important to note that, like with other assets, its value will gradually decrease and it will lose uniqueness within the context of current or future operations. Two important factors that might delay this erosion are *learning culture and climate* as well as *information processing* (Hult 2003).

7 Quality of Execution as a Source of SCA

Possession of the sharpest market orientation, excellent resources, with comprehensive knowledge management will not result in a Sustainable Competitive Advantage without flawless execution. For this reason, execution discipline has recently been quoted as a source of competitive advantage.[1] According to Ram Charan (2008), "Execution is a discipline and discipline is key to competitive advantage". This concept merits further investigation.

8 Deficiencies in the Literature

After reviewing extant literature on the sources of sustainable competitive advantage, a number of deficiencies have become apparent. The overwhelming lack of empirical research in the developing economies in general, is the first observation. Although the literature has moved from the internal focussed "resources" as the main source of competitive advantage in the resource-based view in early days to a more market-centric, there is still insufficient research devoted to the important area of market orientation or marketing practise as a source of sustainable competitive advantage. Even the literature that does exist on the latter often fails to explain the exact mechanism by which market orientation will lead to sustained superior performance, which makes the conclusions difficult to implement as learnings. Moreover, very little literature exists on an emerging topic in the area of competitive advantage, namely, execution or implementation and the role the latter plays in the sustained success of the organisation relative to its peers.

Finally, there are also definitional problems in the literature on competitive advantage. There appears to be a lack of a clear definition of competitive advantage per se (Sigalas and Economou 2013). The many and contradictory definitions of competitive advantage lead to a lack of semantic content and the inability to operationalise the construct of competitive advantage in an empirical research study (Sigalas and Economou 2013).

9 Literature Review Synthesis

The literature review demonstrates the varied points of view existing regarding the sources of sustainable competitive advantage ever since the concept appeared until present days.

Two prominent theories of competitive advantage, were summarised, compared and contrasted, namely Porter's market view and the resource-based view. The two theories

[1]Ram Charan, Strategy Execution Workshop, Fairmont Hotel, Cairo, Egypt, 11th August 2008.

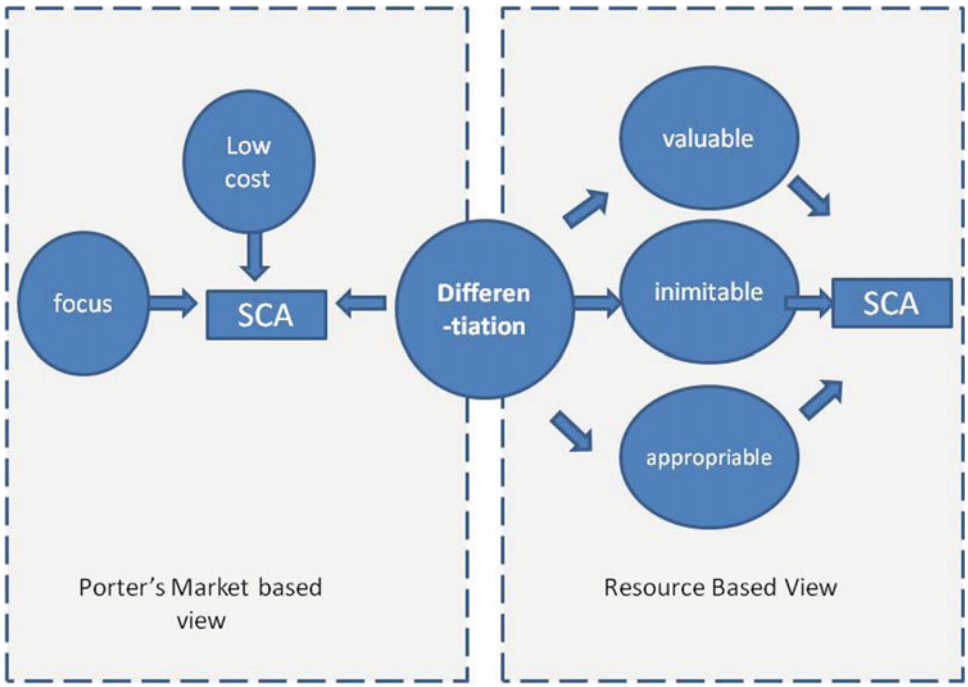

Fig. 6 Overlap between Porter's market view and the RBV on differentiation

appear to have opposing starting points as explained by De Wit and Meyer (2005) who argue that the former is an 'outside in' perspective while the latter is an 'inside out' perspective. Their recommendation is that a combination of the two is the optimal way to pursue competitive advantage, as there must be a fit between an organisation and its environment to build SCA.

Despite the difference in their starting points, Porter's market view and the resource-based view converge on one important element, namely, the importance of ***differentiation***. On the one hand, Porter discusses the differentiation of products and services while on the other hand, the resource-based view discusses the importance of differentiation of resources (heterogeneity). The below figure illustrates this overlap (Fig. 6).

Other important contributions to the theory of competitive advantage have emerged more recently, in continued efforts on the part of researchers and scholars to define what leads to SCA. Some of the key concepts that the researcher covered in this chapter are Market Orientation, Knowledge Management and Quality of Execution.

The different theories and views surrounding the topic of SCA and discussed in the above review, are summarized in the below table which attempts to map the key insights found in the literature, highlighting important comparisons as well as gaps.

The review of the literature and above summary demonstrate the complexity of the topic of SCA and the variety of the proposed concepts explaining it. It also is evident from the review that there is no comprehensive model of SCA combining an integrated view, covering the more classic theories of RBV and Porter's market approach with the newer thinking around concepts such as market orientation, knowledge management, dynamic capabilities and execution quality. Hence, this highlights the significance of attempting to depict these views in an integrated model

A comprehensive model of sustainable competitive advantage reflecting the range of theories and concepts described above would be most useful to researchers and practitioners alike. It can be argued that a firm pursuing SCA will require a combination of the afore-mentioned concepts to establish a lasting advantage, which will in turn translate

Author	Date	Key Insights	Comparision and Gaps
Day	1984	The concept of SCA appears.	
Porter	1985	The specific phrase of SCA is developed by Porter. His market approach defines cost leadership, differentiation, and focus as sources of SCA and is grounded in industrial economics.	Porter's approach is an external market orientation , an inside-out perspective. This is in contrast to the later developed RBV, which is an inside-out perspective on competitive advantage as compared and contrasted by De-Vit and Meyer (2005). The RBV can also be seen as *complementing* this external orientation with an internally focused resource perspective on SCA.
Barney	1991	SCA defined as "implementing a value creating strategy not simultaneously being implemented by any current or potential competitors". The RBV makes two main assumptions: resource differentiation may exist between companies of the same industry, the resources in question may be immobile and thus ***heterogeneity*** may be long lived.	Despite the difference in their starting points, Porter's market view and the resource-based view converge on one important element, namely, the importance of ***differentiation*** . On the one hand, Porter discusses the differentiation of products and services while on the other hand, the resource-based view discusses the importance of differentiation of resources (heterogeneity).
Conner	1991	In RBV, the key focus for an organisation is to either have unique products or a uniquely low cost, both are linked in the Resource Based View to the resources that the company uses to manufacture the product in question. This theory also notes that this should not be achieved in a manner that would jeopardise the company's superior returns.	Porter also argues that cost differentiation may be a source of SCA. The "Unique Products" concept in the RBV is also reflected in Porter's "Differentiation" concept.
Peteraf	1993	Based on the RBV, Peteraf defines a model of competitive advantage. The model includes the concept of differentiation, as with the Porter market approach, under the term "heterogeneity".	The model by Peteraf is quite static in nature. It also almost entirely relies on the RBV thinking, omitting some of the relevant market orientation insights that might also importantly contribute to SCA.
Chaharbaghi & Lynch	1999	The central focus of the RBV is on the continuous search for rents or above average returns. The attainment of the latter is achievable through valuable resurces that are scarce.	Two important assumptions that are made by the RBV and debated in the literature are: resources can actually be different across different firms of the same industry, resources can remain different.
Fahy	2000	The possession of certain key resources is critical to building SCA. Fahy summarises 3 key tenants of RBV: SCA and superior performance; unique resources; strategic choices.	This is in contrast to Porter's market-based perspective which focuses on the firm's external positioning in the industry versus its internal resources to build SCA. It can be argued, however, that both the right respources as well as the right positioning are needed to build SCA. it is useful to see these theories as complimentary rather than opposing.
Hult & Ketchen	2001	Market-based learning has been recognized as an important source of sustainable competitive advantage	
Vorhies & Morgan	2005	Vorhies and Morgan support the theory that marketing capabilities associated with superior business performance can be identified and that the marketing capabiliy gap between top performing benchmarks and other firms explains a significant variance in performance.	The concept of Market-based learning and market orientation contrasts with the RBV's internal focus but also contrasts with Porter's focus on market positioning as market based learning focuses on undrstanding customer and consumer needs and using them to guide strategy.
Nguyen, Neck and Nguyen	2009	Knowledge management and knowledge-based resources (as opposed to purely tangible ones) must now play an important role in creating and sustaining competitive advantage and superior performance	The Resource Based View, more recently, places emphasis on the importance of the firm's knowledge as a driver in maintaining a company's competitive advantage . In the RBV (Barney, Peteraf, Conner), knowledge has the ability to become a source of SCA for a firm, if adequately managed.
Ambrosini, Bowman and Collier	2009	Dynamic Capabilities perspective adds value to the RBV as it transforms what is essentially a static view into a more dynamic one by discussing how valuable resources can be evolved over time.	
Breznik and Lahovnik	2014	Demonstrate in an empirical research the link between dynamic capabilities, sustained competitive advantage and superior performance	
Pisano	2017	Pisano highlights a gap in the literature on Dynamic Capalbilities as the lack of focus on how a capability strategy is to be formulated.	

NB:

SCA: Sustainable Competitive Advantage

RBV: Resource-based View

into superior performance. The development of this model is explained in the following sections.

10 The Adopted Model from the Literature by Peteraf

The researcher has chosen the 'Cornerstones of Competitive Advantage' model by Peteraf (1993) presented on Fig. 7 as a starting point for the conceptual framework.

Peteraf's work has built on the Resource-Based View to develop a model explaining the sources of sustainable competitive advantage which in effect encompasses many of the factors that were previously discussed in the literature and reviewed above. The stated objective of the Peteraf model is to integrate previous research on the subject in a concise form and to provide a common ground for subsequent research. Peteraf's work addresses key issues on the subject and discusses potential implications. "The essence of the model is that four conditions underlie sustained competitive advantage". The four conditions must all exist to generate SCA, according to the author. Peteraf has proposed these conditions to include superior resources (they must be differentiated within an industry), "ex post limits to competition, imperfect resource mobility and ex ante limits to competition." (Peteraf 1993).

These four conditions required to achieve SCA, heterogeneity of resources, imperfect resource mobility, ex post limits to competition, ex ante limits to competition, are discussed next. **Heterogeneity** being the most basic of the four ones, is the key pre-requisite of competitive advantage. One of the core propositions of the resource-based view of the firm is that resource heterogeneity is associated with superior performance in the market place measured in market in financial terms. It is not however sufficient to have heterogeneity, but the firm must also sustain it. When heterogeneity is preserved, the second source of sustained competitive advantage according to Peteraf exists: "**Ex post limits to competition".** Moreover, as long as a firm's assets are imperfectly mobile, inimitable, and non-substitutable, its strategy will be difficult to replicate by other companies (Barney 1986). In simpler words, "Ex Post Limits to Competition" can be re-phrased as "Difficulty to Imitate". **Imperfect mobility** implies that resources are somewhat specialised to firm-specific needs. The last condition that must be met for the firm to have competitive advantage, is **"Ex ante limits to competition"**. The latter means that, prior to any firm's establishing a superior resource position, there must be limited competition for that position.

Main Limitations of the Peteraf Model lie in the fact that it does not take into account the ***dynamic nature*** of the Sustainable competitive advantage concept. It can be argued that obtaining and sustaining competitive advantage is far from static. It is not just a matter of developing the right characteristics or coveting the right resources. On the contrary, it is a very dynamic and flexible process, a constant strive to rise above one's competition and break one's own records of excellence. By broadening the definition of competition to encompass firms that are not operating directly in the same field but compete for the consumer's pocket, the job is even more challenging. It can also be argued that it can be a cyclical process whereby the competitive advantages reached by a firm are sought after and imitated by competition (even if over a long period of time), which competes away the advantages built. In other words, competitive advantage, no matter how differentiated or difficult to imitate on the short run becomes difficult to sustain in the long run amidst active competition striving to excel equally. The key thus is to constantly seek for building new and more differentiated sources of competitive advantage. Teece et al. (1997) have addressed this limitation of the RBV in their article 'Dynamic Capabilities and Strategic

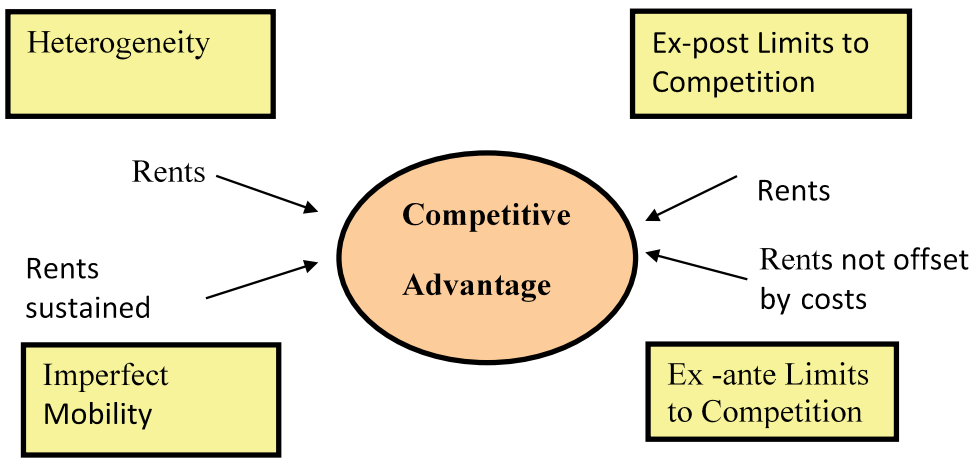

Fig. 7 The cornerstones of competitive advantage (The Adopted Model) (Ketchen et al. 2007)

Management' by developing the 'dynamic capabilities' approach where the term 'dynamic' refers to the capacity to renew competences to strengthen the ability to deal with the changing business environment. Their thinking addresses the limitation of the Peteraf model described here and will be incorporated in the proposed framework.

In addition, the model is deliberately limited to the reflection of the RBV, which thus excludes some important other factors of SCA, as was discussed in the review of the literature.

The limitations of the Peteraf Model will be addressed in the proposed conceptual framework detailed in the next section. This model was evolved to include some of the more recent view in the literature and reflect the dynamic nature of Competitive advantage, to develop a revised conceptual framework, details of which will be explained below.

11 The Proposed Conceptual Framework

The proposed conceptual framework shown in Fig. 8, uses the starting point of the Peteraf model (1993) and is evolved by the author to reflect deductions from the literature. This has resulted in a more comprehensive model than the original one, which takes in account different perspectives on the subject matter from the literature.

The proposed framework was evolved to cover two main limitations: the static nature of the Peteraf model as discussed in previous sections, and the fact that Peteraf has mostly relied on the RBV approach. Accordingly, the proposed framework attempts to capture the dynamic nature of Competitive Advantage and include important variables affecting the latter as discussed in the literature. There are two new constructs in the proposed model, namely Knowledge Management and Market Orientation. The new constructs reflect the dynamism proposed by Teece et al. (1997) by recognising the importance of firms evolving their strategy to meet changing market circumstances and needs. As advanced by Teece, Pisano and Shuen, "in rapidly changing environments, there is obviously value in the ability to sense the need to reconfigure the firm's asset structure, and to accomplish the necessary internal and external transformation" (Teece et al. 1997).

The evolved model extends current thinking in the following ways: it takes the model beyond the realm of the RBA which was the focus for the Peteraf model, it includes constructs from other schools of thought, making the model more comprehensive, and it adds a more dynamic nature to the model developed by Peteraf, incorporating thinking from the Teece, Pisano and Shuen's Dynamic Capabilities discussion (1997).

Constructs of the proposed conceptual framework. The proposed model is composed of four existing constructs from the original Peteraf model ('Heterogeneity', 'Imperfect Mobility', 'Ex-Post Limits to Competition' and 'Ex-Ante Limits to Competition'), to which two new constructs were added based on the literature review and explained below.

Fig. 8 A proposed conceptual framework of sustainable competitive advantage

1- Market Orientation

According to Kohli and Jaworski (1990) market orientation refers to the compilation and distribution of information on customer and competitive needs across a firm as well as the suitable responses to those needs (as sited in Kumar et al. 2011). When a firm has a strong market orientation, this entails a thorough understanding of its customer and consumer needs, a focus on customer satisfaction as well as a strong understanding of its competitive environment, preparing it for superior performance (Kumar et al. 2011).

Marketing capability has recently been identified as a contributor to business success by a number of authors, including Day (1994) and Hooley et al. (1999) (as cited in Weerawardena 2003). Day (1994) advances that marketing capability helps the business to compete strongly, enhancing its products and services via a better systematic and integrated application of "collective knowledge" and skills that address its consumer and customer needs (as cited in Weerawardena 2003). This construct was added to the model as it is believed to bridge some of the gap earlier described in the dynamism of the Peteraf model, by allowing the firm to evolve its strategies based on an on-going understanding of its relevant environment. This is also touched upon by Teece, Pisano and Shuen (1997) as they discuss the importance of 'constant surveillance of markets and technologies and the willingness to adopt best practice.'

2- Knowledge Management

The second construct that was added to the proposed model by the researcher is knowledge management. Weerawardena (2003) advances that according to Day (1994), Grant (1991, 1996), marketing capabilities arise when learning is generated over time as teams use their knowledge to address a company's marketing challenges. Knowledge management is difficult to define because it has multiple interpretations (Halawi and Aronson 2005). Knowledge management is the deliberate action of making appropriate knowledge available to the right audience in a timely way and also enabling this audience to use this information effectively to benefit firm performance (Halawi and Aronson 2005). Teece et al. (1997) have also discussed the importance of knowledge management in this context as they highlight that clarity on how to recognise, grow and sustain unique advantages that are hard to imitate is crucial in the development of a dynamic capabilities conceptual framework. They also mention the importance of **'learning'** as a 'process by which repetition and experimentation enable tasks to be performed better and quicker as **organisational knowledge** is generated'.

12 Implications and Future Research

This research examines the extant literature on the sources of sustainable competitive advantage, reflecting the divergent opinions on the matter. It advances the existing knowledge in this field by comparing and contrasting different views, and proposing a conceptual framework which can be used by practitioners as a multi-faceted tool to examine and build competitive advantage in a systematic way. It would be very useful to empirically test the proposed conceptual famework. The purpose of empirical validation would be to practically test the constructs of the framework amongst practitioners, understand if there are any further constructs that merit inclusion in the framework and generally validate the usefulness of the framework as a tool to systematically understand sustainable competitive advantage as well as help build it. This will be covered in a future research.

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Treatment of Industrial Alkaline Solid Wastes Using Carbon Dioxide

Maisa El Gamal, Abdel-Mohsen Mohamed, and Suhaib Hameedi

Abstract

Carbon dioxide capture and storage (CCS) is an effective method of reducing CO_2 emissions into the atmosphere. In this study, improved mineral carbonation is evaluated as a potential for CCS, where CO_2 is sequestered in a permanent stable carbonated form. Raw materials were selected from the UAE industrial residues like steel-making, cement and acetylene production because they have calcium-rich content as calcium oxide and/or calcium silicate, which have the potential to store CO_2 in the form of permanently stable carbonate minerals. The solid particles were pre-treated, then subjected to direct gas–solid carbonation reaction. Gas analyzer was installed at the output stream of the testing unit to measure the concentration of unreacted CO_2 consequently, and calculate CO_2 captured by the difference between the initial and final concentration. The carbonated products were characterized using pH, conductivity, TDS, thermal gravimetric analysis (TGA) and scanning electron microscope (SEM) to determine the overall sequestration capacity and efficiency of these waste materials for CCS. Based on the total calcium content, the calculated sequestration of CO_2 was: 0.27 kg CO_2/kg-ladle furnace (LF) slag, 0.72 kg CO_2/kg cement kiln dust (CKD) and 0.58 kg CO_2/kg carbide lime waste (CLW).

Keywords

Mineral carbonation • Carbon capture and storage • Product thermal • Chemical stability

1 Introduction

Global warming is the resultant effect of climate change caused by abnormal out-of-managing emissions of greenhouse gases (GHGs) into the atmosphere. Therefore, serious attention has been taken by governments, organizations and industrial partners worldwide. CO_2 has the major contribution to these GHGs, and so it took the most studies and concerns. CO_2 puts us at the greatest risk of irreversible changes if it continues to accumulate unabated in the atmosphere (Davison 2007; Ganopolski et al. 2016). Carbon capture and storage is one noticeable way to minimize emissions of CO_2 gas, the major contributing source of GHGs (Benson and Orr 2008; Huijgen and Comans 2005). CO_2 mineralization can be accomplished via accelerated carbonation. It has been proven that accelerated carbonation process is thermodynamically practical to enhance the natural weathering (Herzog and Golomb 2004; Lackner et al. 1995). In this process, gaseous CO_2 can be mineralized as a thermodynamically stable precipitate, thereby being rarely released after mineralization. CO_2 mineralization via accelerated carbonation can be categorized into three main processes: (a) direct carbonation, which is associated with production of green concretes/cements such as supplementary cementitious materials, (b) indirect carbonation, which is related to the production of high value-added chemicals, such as precipitated calcium carbonates and (c) carbonation curing for concrete block and/or cement mortar to enhance their strength and durability.

Mineral carbonation has been known as reasonable method of carbon capture and storage through geochemical stability and safe storage of mineral carbonates avoiding the need for costly gas separation (Lackner et al. 1995; Olajire 2013). Alkaline waste materials can be used for carbonation due to the presence of alkaline oxides, hydroxides or silicates in their composition (Huijgen et al. 2005). The mineral carbonation of alkaline wastes involves the reaction of

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calcium and magnesium oxides with CO_2 to form stable mineral carbonates. CO_2 can react with divalent metal oxides or metal silicates to form the corresponding carbonate. Accelerated carbonation is an exothermic reaction, where the amount of heat released depends on the reactive metal and on the material containing this metal oxide (El-Naas et al. 2015). In the case of alkaline solid wastes, residues with a native pH value of greater than 10 typically contain portlandite ($Ca(OH)_2$), which controls the solubility of calcium ions and the pH of solution (Olajire 2013) Portlandite can be carbonated with CO_2. The theoretical CO_2 fixation capacity of alkaline solid wastes can be estimated based on the chemical compositions of the wastes (Mohamed and El Gamal 2011, 2014).

The aim of this study is to investigate and evaluate the efficiency of the alkaline solid wastes on CCS, using different industrial waste residues from various industrial sectors in UAE such as steel, cement and acetylene factories as feedstock material for mineral carbonation. The effect of reaction variables on the sequestration potential is studied. The degree of carbonation and carbonation efficiency as a function of various process variables are investigated.

2 Experimental Work

2.1 Raw Materials, Types and Characterization

Alkaline solid wastes were provided from different local industrial factories; waste categories, type and the collection area are shown in Table 1. The chemical composition of these wastes was characterized using ICP-AES, as shown in Table 2. The cumulative grain size distributions of the solid waste particles were determined by sieving analysis. Figure 1 shows the cumulative grain size distribution ranging from 1000 to 38 µm. External morphology of the waste particles was characterized by scanning electron microscopy (SEM).

2.2 Technical Instrumentations

i. *Carbonation reactor*. It is a chemical reactor that lets gas pass upward through distributor plate and mix solid particles, the industrial wastes, loaded inside to achieve mineral carbonation.
ii. Gas analyzer. California gas analyzer instrument (CAI-600 series) was used. It is the unit of detecting and measuring the concentration of the captured CO_2. It measures the reading of CO_2 gas from the carbonation reactor outlet, where it is the way to calculate the amount of CO_2 captured by the integration of CO_2 flow rate versus time curve (El-Naas et al. 2017).
iii. Myron L Company $6PFC^E$ ultra-meter: It measures pH, total dissolved solids (TDS) beside electrical conductivity, resistivity and oxidation reduction potential (ORP).
iv. JOEL JSM-5600 scanning electron microscope was used for microstructure characterization.
v. TA Q500 thermal gravimetric analyzer (TGA) was used to determine CO_2 sequestrated in terms of weight changes versus temperature, with heating rate of 20 °C/min.
vi. ICP-AES inductively coupled plasma-atomic emission (ICP) spectrometry was used to determine the alkali metals and heavy metals.

2.3 Methodology

Solid waste residues were pre-treated before running the carbonation progressions through hydration followed by free drying and sieving. Direct gas–solid carbonation reaction with pressurized CO_2 gas mixture existed in a cylinder with 10% (v/v) CO_2, balanced with air. The concentration of the outlet CO_2 gas from the testing reactor was measured using a

Table 1 Alkaline solid wastes, origins and types

Categories	Type of wastes	Collection area of wastes
Wastes generated in cement industry	Cement kiln dust (CKD)	Cement kiln dust residues were supplied by a cement factory in Al Ain, UAE. Samples were taken from open storage piles in the weathering area
Wastes generation in steel industry	Ladle furnace (LF) slag	Steel-making residues were collected from Emirates Steel in Abu Dhabi, UAE, from an open storage weathering yard
Acetylene by-product	Carbide lime waste (CLW)	carbide lime wastes were obtained from Sharjah oxygen company, UAE

Table 2 Chemical analysis of solid wastes using ICP

Type of waste	SiO_2	Al_2O_3	FeO	CaO	MgO
LF slag	30.41	10.12	2.34	42.08	4.33
CKD	12.63	2.26	2.08	46.41	0.89
CLW	2.50	1.30	0.06	68.30	0.17

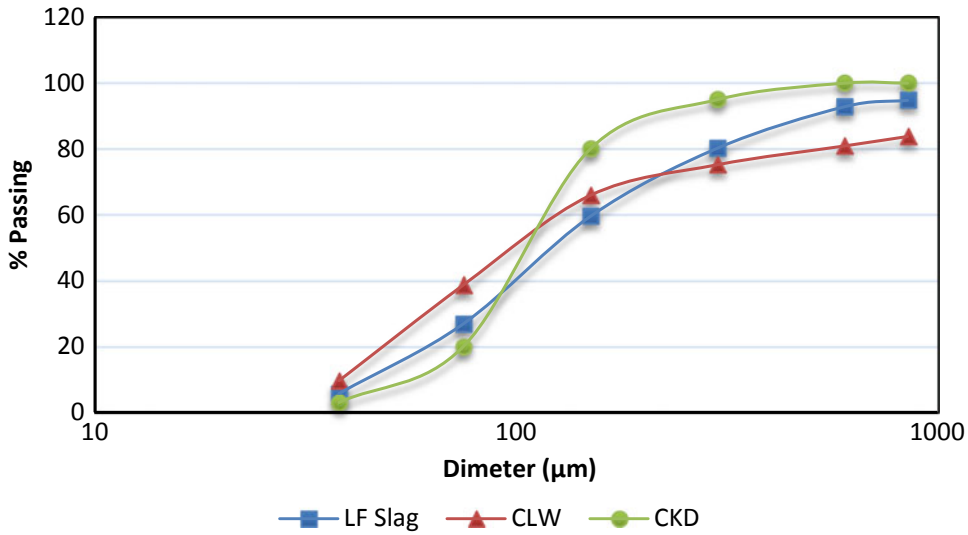

Fig. 1 Grain size distribution of LF slag, CLW and CKD

Table 3 pH and TDS of solid wastes before and after carbonation

Type of waste	pH		TDS (ppm)	
	Before	After	Before	After
LF slag	11.80	10.10	644	108
CKD	12.48	08.86	13,150	7460
CLW	12.27	11.08	8240	5370

gas analyzer, CAI-NDIR-600 series. Readings are taken automated via professional data acquisition program operated by LabView 14. After the selected reaction period, the testing reactor was opened and the carbonated solid was removed for its weight determination and further investigation.

3 Results and Discussion

The selected industrial wastes were used as a good source of calcium and magnesium oxides for carbon capture and sequestration. The measured pH of LF slag, CKD and CLW indicates high alkalinity. The reactions of alkaline oxides with water are spontaneous and exothermic. Free lime and magnesia readily react with water, even at ambient conditions, to form calcium hydroxide (portlandite) and magnesium hydroxide (brucite), respectively. Carbonation of solid wastes was performed by the circulation of CO_2 through the solid particles in the designed testing unit. The pH and TDS were reduced after carbonation due to the conversion of alkaline metal oxides and silicates into insoluble carbonates (see Table 3).

3.1 Measurements of CO_2 Captured

Development concentration of output gas stream was measured by the gas analyzer instrument. LabView program was used to measure the readings of the gas analyzer and then saved the data in an Microsoft Excel sheet. The program has an option to specify the period to record the readings, even in milliseconds. LabView program was used as data acquisition to connect with laptop and read from the gas analyzer. It then allows to calculate the amount of CO_2 consumed through carbonation by subtracting the instantaneous reading

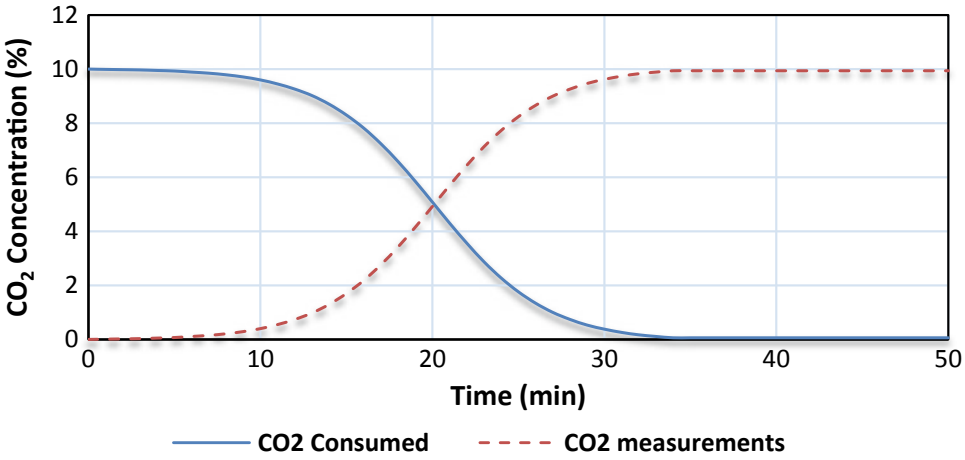

Fig. 2 CO_2 captured through carbonation of LF slag

shown on the gas analyzer from the fixed entrance concentration supplied by gas mixture cylinder, 10% CO_2 balanced with air.

Figures 2, 3 and 4 show the instantaneous CO_2 concentration while running a carbonation experiment. The plot gives the total amount of CO_2 consumed during the carbonation process. It is clearly noted that the saturation time is directly proportional with the amount of alkaline oxides contained in the waste materials. Moreover, the nature of solid wastes, particle size distribution and porosity affect the saturation time.

3.2 Extent of Carbonation

Depending on the thermal analysis TGA, three major weight fractions were obtained: (a) 25–105 °C for the moisture, (b) 105–500 °C for organic elemental carbon (Huijgen and Comans 2005) and (c) 500–1000 °C for inorganic carbon (carbonates). The TGA results of the residues are displayed in Table 4.

The weight fraction of the TGA curve ($\Delta m_{500-1000\,^{\circ}C}$) based on dry weight ($m_{105^{\circ}C}$) was used as the calcium carbonate content, expressed in terms of CO_2 (wt%), as shown by Eq. 1 and CO_2 sequestration efficiency is calculated by Eq. 2:

$$CO_2 wt(\%) = \frac{\Delta m_{500-1000^{\circ}C}}{m_{105^{\circ}C}} \times 100 \quad (1)$$

$$CO_2 \text{ sequestration efficiency } (\%) = \frac{\text{Maximum } CO_2 \text{ sequestration capacity}}{\text{Theortical } CO_2 \text{ sequestration efficiency}} \times 100 \quad (2)$$

where the theoretical total carbon content based on basic metal oxides present in the fresh samples was calculated using Eq. (3) (Steinour 1959).

$$\%CO_2 = 0.785(\%CaO - 0.56\%CaCO_3 - 0.7\%SO_3) + 1.091\%MgO + 0.71\%Na_2O + 0.468\%K_2O \quad (3)$$

Carbonation degree ξCa (%) can be determined from the carbonate content measured based on TGA analysis, the

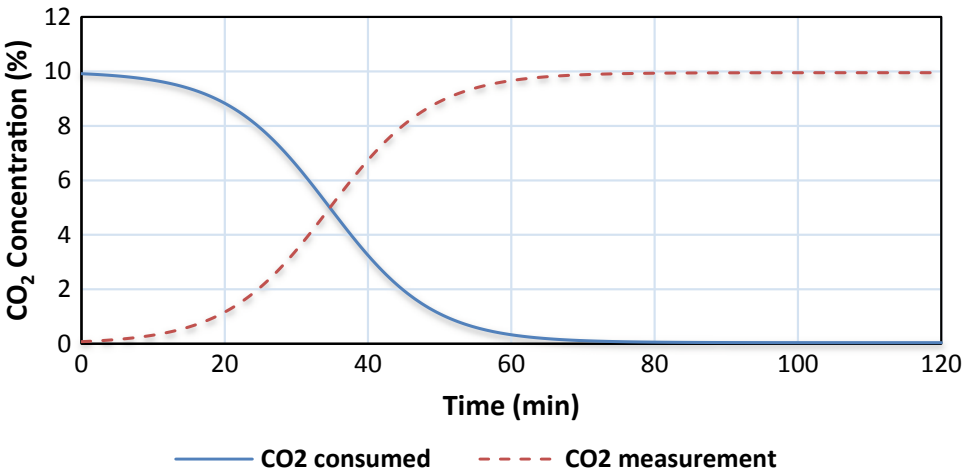

Fig. 3 CO_2 captured through carbonation of CKD

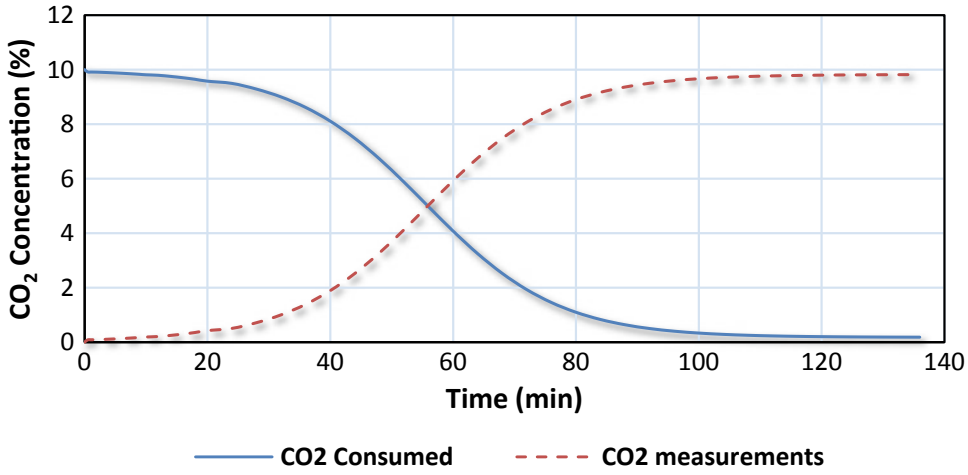

Fig. 4 CO_2 captured through carbonation of carbide lime

Table 4 TGA analysis of the carbonated residues

Solid waste	Loss on ignition (500–1000 °C)		CO_2 content after carbonation (wt%)
	Fresh	Carbonated	
LF slag	0.8	8.9	8.5
CKD	25	36	26.3
CLW	7.3	22	28.1

Table 5 Carbonation effectiveness

Solid residues	Carbonation efficiency (%)	Carbonation degree (%)	Maximum sequestration kg CO_2/kg waste
LF slag	22.7	22.9	0.2657
CKD	88.2	97.6	0.720
CLW	55.5	72.8	0.685

molar weights of Ca (Mw Ca), the molar weights of CO_2 (Mw CO_2) and the total theoretical Ca content of the fresh solid waste (Ca total), determined from ICP analysis, as expressed by Eq. 4:

$$\xi\,\mathrm{Ca}(\%) = \frac{\frac{\mathrm{CO_2(wt\%)}}{100-\mathrm{CO_2(wt\%)}} \times \frac{\mathrm{MW_{Ca}(kg/mol)}}{\mathrm{MW_{CO_2}(kg/mol)}}}{\mathrm{Ca_{total}(kg/kg)}} \times 100 \quad (4)$$

Table 5 indicates the carbonation efficiency using (a) the newly designed reactor, (b) the maximum CO_2 sequestration capacity from TGA data and (c) the calculated theoretical maximum CO_2 sequestration capacity; the carbonation efficiency was calculated as 88.2, 55.5 and 22.7% for CKD, CLW and LF slag, respectively. The degree of carbonation was determined from (a) the carbonate content measured based on TGA analysis, (b) the molar weights of Ca (Mw Ca), (c) the molar weights of CO_2 (Mw CO_2) and the (d) total theoretical Ca content of the fresh solid waste (Ca total) that was determined from ICP analysis. In addition, the maximum sequestration of CO_2 in the pre-treated carbonated wastes was calculated based on the total calcium content. Such results emphasize the potential use of these industrial wastes as effective materials to capture and sequester high amounts of industrially emitted CO_2.

3.3 Microstructure Examination (SEM)

Characterization of the solid waste particles before and after the carbonation was performed using SEM micrographs. SEM micrographs reveal that the non-carbonated solid wastes enclose angular granules of amorphous calcium oxides, calcium aluminum silicate and larnite (calcium silicate). Figure 5 indicated that the carbonation products of LF slag are aragonite wheat bundles. Well-defined rhombohedra calcite and vaterite crystals are formed after carbonation of CKD and CLW (see Fig. 5).

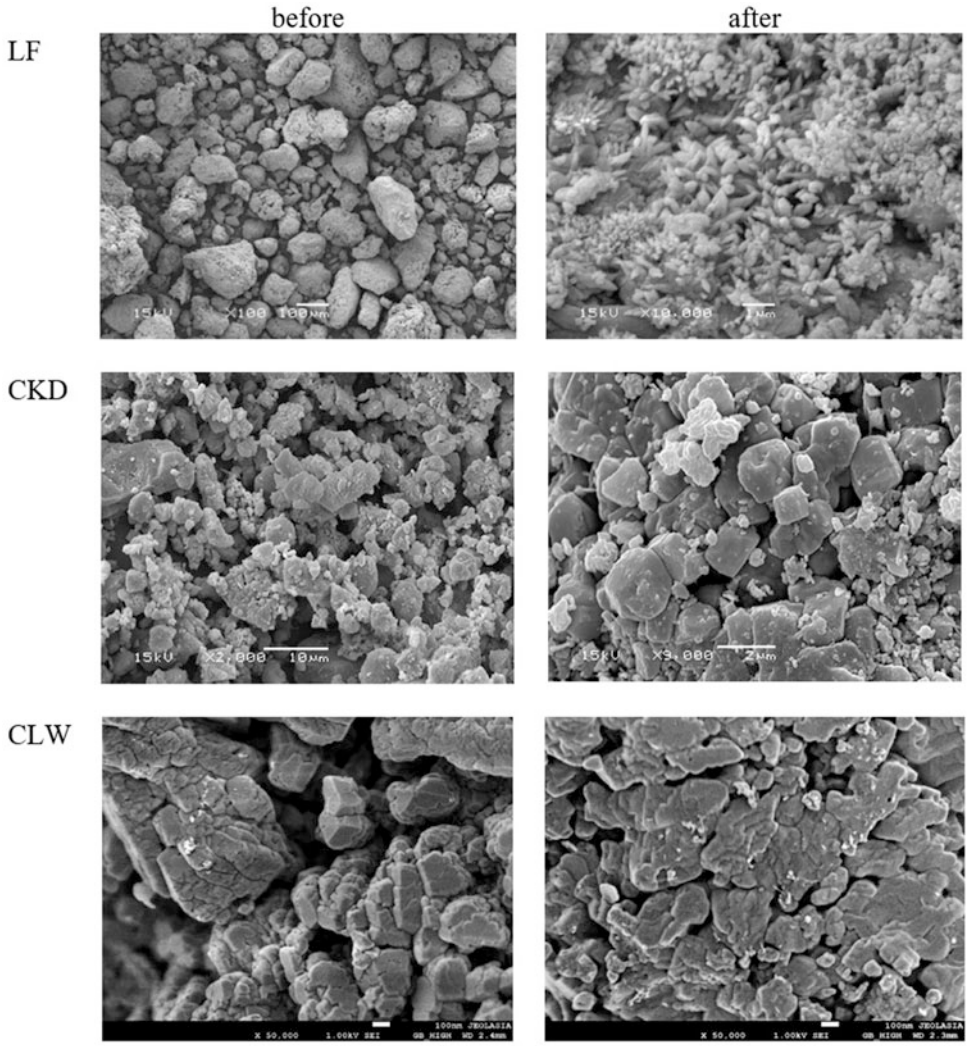

Fig. 5 SEM images show the formation of calcium carbonates as rhombohedral, vaterite and aragonite structures

3.4 Cost of Carbonation

The purpose of CCS technology is to capture and store CO_2. However, in generally used methods, stored CO_2 requires continuous monitoring to ensure stability (Fricker and Park 2013). Since the normally used processes involved high cost, the economic cost cannot justify their primary benefit. Based on previous studies, mineral carbonation shows relatively high commercial cost, which limits its application, because it includes cost of mining, pre-treatment, operational technologies of CO_2 sequestration and others.

It is widely known that improved reaction processes are the most promising route to cutting both the capital and operating costs for mineral carbonation (Wang and Maroto-Valer 2011). In this study, the method described considered integrated processes to reduce the cost and energy consumption via: (a) utilization of industrial solid wastes, that is, no need for mining, (b) no need for grinding; the solid wastes were fine enough for the CO_2 sequestration and (c) no need for energy consumption through the application of direct gas–solid carbonation in the testing unit at room temperature since using the pressurized CO_2 provides a well mixing process of particles with low operation cost. Therefore, the newly developed process, described in this study, demonstrated superior material stability over other proposed methods of CO_2 sequestration, and reduced cost and energy required during carbonation.

4 Conclusion

The goal of this study was to use some of the industrial wastes produced in the UAE as low-cost materials for carbon capture and sequestration. Mineral carbonation was selected not only to stabilize the active minerals but also to reduce the emission of CO_2. The mineral carbonation involves the reaction of calcium, magnesium oxides and silicates of the industrial alkaline wastes with CO_2 to form stable mineral

carbonates. The experimental and theoretical results described in this study highlighted the potential use of this methodology as an efficient method to provide economical, stable, safe and eco-friendly process for future industrial application.

The future research work could be extended through on-site recycling of the produced wastes, where there is no need for costly transportation at sites. For example, in cement factories, it will be of immense environmental and economical achievement if CO_2 is directly sequestered in the active cement kiln dust waste on-site and the large quantities of produced carbonates can be utilized in the main cement production line. For other production sites like in acetylene and steel factories, different carbonated minerals can be produced in different morphologies and particle sizes through controlling carbonation conditions. Very fine and pure calcium carbonate can be used as filler in plastics and paper industry. Similarly, it can be utilized in cosmetic, medical, paint, agricultural and in the construction industries.

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