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Finance & Economics Readings

Selected Papers from Asia-Pacific Conference on Economics & Finance, 2017

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Preface

The 2017 Asia-Pacific Conference on Economics & Finance (APEF 2017), organized by East Asia Research and supported by BEFfore from Universiti Malaysia Sarawak, was held on the 27th and 28th July 2017 in Singapore at the Holiday Inn Singapore Atrium.

APEF 2017 conference looks at the worrying changes and slowdown amid continued uncertainty in Asian financial markets and economies. What are the effects from Xi Jinping and Premier Li Keqiang led economics measure of shifting away from the once sacred economic policy of rapid economic growth? Is Abenomics the solution to Japan's problem of disinflation and low growth?

APEF 2017 achieved the objective of bringing together leading scholars, students and practitioners from overseas to Singapore for an academic exchange. The programme consisted of an opening speech by Dr. Evan Lau, Associate Professor, Director of Centre for Business Economics & Finance Forecasting (BEFfore), UNIMAS, and a keynote speech by Dr. James Reade, Associate Professor, Department of Economics, School of Politics, Economics and International Relations, University of Reading.

A total of 50 registered delegates from the following countries attended APEF 2017: Australia, Canada, Chile, China, Czech Republic, France, Hong Kong, India, Indonesia, Japan, Malaysia, the Netherlands, Nigeria, Norway, Oman, Pakistan, Singapore, Thailand, UK and USA and Vietnam. Participants were invited to submit papers to the present volume. We wish to thank APEF 2017 conference Chair Dr. Evan Lau, Associate Professor, Director of Centre for Business Economics & Finance Forecasting (BEFfore), UNIMAS, for coordinating the reviewing of the submitted papers.

East Asia Research (EAR)

Established in Singapore in 2015, East Asia Research (EAR) envisions to be the gateway to improving lives and enhancing productivity in Asia through promoting cross-geographical exchange of ideas and knowledge in various faculties. This will

be achieved through the dissemination of knowledge from the Asia-focused research conferences and publications by EAR.

EAR academic conferences provide a meaningful platform for researchers, postgraduates, academicians, and industry practitioners to share unique insights and drive innovation. This is a great opportunity for expanding contact networks beyond a singular field and kick-starting a strategic collaboration. Such partnership can bridge the resources and expertise of multiple disciplines to spearhead pioneer movements, giving rise to breakthroughs in long-standing issues.

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Contents

Motivational Factors in International Nongovernmental Organizations in Vietnam

Nhung An and Ayi Gavriel Ayayi

Abstract The paper studies motivation factors of employees working in eight international nongovernmental organizations in Vietnam. We find, using the six factor work extrinsic and intrinsic motivation scale (Tremblay et al. in Can J Behav Sci 41:213–226, 2009) based on the self-determination theory (Deci and Ryan in Intrinsic motivation and self-determination in human behavior. Plenum, New York, 1985), that employees are most influenced by intrinsic motivation. We also find that autonomous regulations have higher impact than controlled regulations. Additionally, we find that external regulation plays more important motivational role in these organizations than introjected regulation. Overall, these findings tend to provide insights for the managers of international nongovernmental organizations in Vietnam on how to attract and retain talents.

Keywords Motivational factors · NGOs · Employees' retention Vietnam

1 Introduction

There were about 820 INGOs currently operating in Vietnam according to the 2015 statistics of the People's Aid Coordinating Committee (PACCOM), a government body which is responsible for relations with INGOs, mobilizing aid and facilitating activities of INGOs in Vietnam. Most of them come from Western Europe, North America, and Asia-Pacific region. The main areas those INGOs operate in are

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health care, poverty reduction and hunger elimination, education, etc. In Vietnam, the People's Aid Coordinating Committee (PACCOM) is responsible for relations with INGOs and for mobilizing aid. PACCOM works closely with INGOs both at the central level and in all 63 provinces and centrally administered cities to facilitate foreign NGOs' activities in Vietnam. They also act as a focal point between INGOs and their Vietnamese counterparts, including ministries, central agencies and institutions, and local authorities. The size of INGOs can range from one staff (whose role is to maintain the legal status of INGO office in Vietnam) to few hundreds. On average, an INGO has close to 20 staff, including both expat and local employees. It can be seen that INGO sector is providing a lot of jobs in the labor market. It gives people the chance to contribute to the development of the country through various development funds, projects, and programs, while being paid to do so. As any other work sectors, INGO sector needs to analyze and understand its strengths and weaknesses to stay competitive in the labor market so as to attract and retain talents to enhance their maximum performance. In order to ensure the optimal performance of the organization, work motivation for employees, it is considered that work motivation is one of the most important momentums. However, little has been studied on the factors that bring motivation for employees working in the NGOs in Vietnam though the subject has been studied thoroughly a lot in other sectors and/or in other countries. The present study therefore aims at analyzing the motivations of the employees in INGOs in Vietnam, in order to determine which factors bring the best performance for employees, so as to help human resource managers in these organizations to attract and retain talents.

Looking back to the aforementioned definition of Morris (2000) of NGO, one difference between INGOs in Vietnam to other country is that while people in INGOs in other countries tend to work as volunteers in their organizations (Morris 2000; Lewis 2009), in Vietnam, it is observed that almost all INGOs offer paid jobs to employees. Moreover, although few surveys have been carried out to compare salary among sectors in Vietnam, it has also been stated that attractive factors of employment in INGOs can be listed as (1) multicultural working environment; (2) modern, professional working style, and (3) good pay (NGOs—Co hoi lam viec 2012). This is a fundamental difference which can bring compelling arguments to the hypotheses whether traditional tangible motivators such as compensation, benefit, and working condition can be seen as the most important motivation factors in nonprofit INGOs in Vietnam.

In order to explore such motivation factors and identify the significance as well as the level of impact of each factor, the study used the Work Extrinsic and Intrinsic Motivation Scale (WEIMS) (Tremblay et al. 2009) based on the self-determination theory (SDT) (Deci and Ryan 1985) as theoretical foundation. According to WEIMS, work extrinsic and intrinsic motivation includes six factors: intrinsic motivation (IM), integrated regulation (IN), identified regulation (ID), introjected regulation (IT), external regulation (EX), and amotivation (AM).

Methodology approach of the research was quantitative research. Data was collected from interviewing 71 employees from eight INGOs in Hanoi, Vietnam,

in 2016. Results show that the most important factor for employees in INGOs in Vietnam was IM. Next in order of importance were IN, ID, EX, and IT. AM played the minimal role, which is a good sign for INGO job sector.

In Sect. 2 below, we will provide an overview of the previous literature about the motivation of employees and the theory we used as a foundation for this study. Section 3 will present the method used to collect and analyze data. Section 4 will analyze data collected, present, and discuss findings. Section 5 concludes the paper.

2 Literature Review

2.1 Classical Theories of Motivation

Motivation subject has been discussed a lot in the literature. Maslow's hierarchy of needs theory (Maslow 1943) suggests that everyone is motivated when their five basic kinds of needs are satisfied. These needs are physiological needs, safety needs, belongingness needs, esteem needs, and self-actualization needs. These needs are hierarchical, which are arranged in an order that can be satisfied from externally (physiological and safety needs) to internally (higher-order needs). Though being greatly recognized in the world, this theory has been argued that people's needs do not always follow hierarchy like that, real-life is much messier than this theory. Little evidence from researches proved that people's needs follow that hierarchy as what is suggested by Maslow and that when people satisfy their need in one level, the need in the next level will motivate them to perform and work hard. Moreover, people may seek to meet multiple need level all at once.

Herzberg (Herzberg et al. 1959) concluded that job satisfiers are related to job content (labeled as motivation factors) and job dissatisfiers are allied to job context (labeled as hygiene factors). The hygiene factors, which are mostly concerned with the work environment, mean basic needs do not give motivation but merely create a conducive work environment. There would be no dissatisfaction among workers when basic needs are fulfilled, but it does not motivate them or give them satisfaction; it only removes dissatisfaction. These factors can be related to the first three externally satisfied needs of Maslow's theory—physiological, safety, and social. The motivation factors are the ones that when fulfilled would give employees satisfaction such as achievement, recognition, or the work itself. Again, these factors can be related to the two internally satisfied needs of the Maslow's hierarchy—esteem needs and self-actualization needs. This compatibility of Herzberg's Theory and the Hierarchy of Needs proves that Herzberg's Theory is different from Maslow's only in the method of categorization. Herzberg recognizes that true motivation comes from within a person and not from the environment or external factors.

From the manager's point of view about motivation, McGregor (1960) founded "Theory X and Theory Y" which analyzes how leaders perceived their employees

in different ways, either that they are lazy, dislike the work, and prefer to be led or that they are self-motivated, capable of taking responsibilities. In Theory X, McGregor believed that by nature people are lazy and work as little as possible. He also believed that man does not have ambition, is resistant to change, is not willing to take responsibility, and prefers to be led. If the managers do not motivate, control, and direct them, they will become passive to the organizational needs and reluctant to take responsibility (McGregor 1960). As employees can only be motivated by good pay and security, it can be said that motivation comes from external factors. On the contrary, Theory Y suggested that by nature people are enthusiastic and ambitious. If they seem to be passive, it is due to organizational management and structure. People's potential for development, their motivation, and their capability for taking responsibility are in fact present naturally in each of them and not something that managers put there. The managers' responsibility is to focus on creating a creative and positive organizational structure and environment, in order to encourage open communication, innovation, participative roles, and recognition (McGregor 1960). Similarity to the concept of higher needs, the self-actualization and esteem needs in the Maslow's Theory, it can be said that motivation comes from internal factors.

2.2 Contemporary Theories of Motivation

While Maslow and Herzberg developed their theories based on internal needs of individual, expectancy theory (Vroom 1964) argued that a person will act in a certain way based on their expectation of a given outcome or based on the attractiveness of that outcome to that person.

The result of these three factors is motivation. This is the driving force that leader can utilize to direct his team to complete an objective. When an employee wants to develop in his job, promotion will be of high valence for that person. If an employee believes that his well-performed work will be appreciated by everyone, it means that this employee has high expectancy. However, if the employee knows that the company will recruit people from outside to fill in the vacant manager position but not promote from internal human resource, that person will have low instrumentality and therefore will be difficult to be promoted to work better.

This theory would be valid if the managers of organization rewarded his staff for performance but not for any other factors. Otherwise, the theory is only idealistic and could only help explain why a lot of employees in organization lose their motivation and effort in performing their work.

Equity theory of motivation (Adams 1963) proposed that motivation can be affected by the perception of fairness in social interactions of an individual. Compared to others, people want to be fairly compensated for their contributions. A person's beliefs regarding what is fair and what is unfair can affect their motivation, attitudes, and behaviors. The equity theory helps explain why high paid

union members go on strike when no one else but members understand why and why millionaire athletes feel they are underpaid and do not feel they are making enough money.

The strengths of this theory are (1) it can help managers accurately predict behaviors of employees, (2) it makes practical sense as it is reasonable to assume that most people do compare "their inputs and outcomes relative to others" (Redmond 2009), and (3) it can fit with other theories (particularly the expectancy theory). For example, employees can use the equity theory to determine if inequity has occurred, and if so, they can use the expectancy theory to act upon the inequity. However, one of the main weaknesses of this theory is that it has little practical value. Therefore, it serves as an explanation after the fact better than as a prediction factor of employee's behavior.

Self-determination theory (SDT) (Deci and Ryan 1985): The theory of intrinsic and extrinsic motivation was developed by Porter and Lawler (1968). According to Porter and Lawler, intrinsic motivation involves people doing an activity because they find it interesting and derive spontaneous satisfaction from the activity itself. Meanwhile, extrinsic motivation requires an instrumentality between the activity and some separable consequences such as tangible or verbal rewards, so satisfaction comes not from the activity itself but rather from the extrinsic consequences to which the activity leads. The theory advocates managers to create working environment with both intrinsic and extrinsic motivators in order to bring total job satisfaction.

This theory generated a lot of researches later in order to refine its approach. Noteworthy research was then developed by Deci and Ryan (1980), arguing in cognitive evaluation theory (CET) that tangible extrinsic rewards such as salary, deadlines, surveillance, and evaluation can be of detrimental to intrinsic motivation. Although this theory was supported by a lot of researches, it still reveals some challenges and problems which set a foundation for Ryan, Deci, and Conell to formulate self-determination theory (SDT) (Deci and Ryan 1985; Ryan and Deci 2000).

SDT describes a self-determination continuum ranging from completely lacks of motivation (AM) to constant self-determination (IM). Between these two ends are types of extrinsic motivation. The first type is *EX*, which means that "doing an activity only to obtain a reward" (Tremblay et al. 2009). Then comes *IT*, which means that behavior functions to avoid negative feelings and maintain self-esteem. Next is *ID,* behavior is more autonomous of which people accept as their own values. *IN* is the regulation which are conformed to one's self in accordance with their own values. In this form, motivation is most internalized so it is called autonomous.

According to SDT, intrinsic factors bring the most positive motivation, consequences and create full attention and effort of people. Then comes integrated and identified regulations. Introjected and external regulations bring negative results and amotivation causes the most negative consequences, which may "include counterproductive performance and employee withdrawal" (Tremblay et al. 2009).

2.3 Conceptual Model

Being the most holistic theory of motivation, SDT has been selected to be the theoretical foundation of many researches of motivation especially in nonprofit domains "such as education, health care, work, parenting, religion, sustainability, psychotherapy, and sport/exercise contexts" (Ryan 2009). This is because when it comes to motivation researches, before the launch of SDT, CET was widely utilized until it revealed its limitation in terms of promoting performance and satisfaction in work setting. SDT inherited CET in the concept of intrinsic and extrinsic motivations, but it provides more comprehensive view in terms of extrinsic motivation. The following content will provide a close-up to how SDT was supported or criticized in the recent literature.

Intrinsic motivational factors: It has been widely supported in the literature that this plays a key role in motivating employees in both general setting and NGO setting. More specifically, Tippet and Kluvers (2009) have emphasized in their research on employee motivation in Australia nonprofit organizations the importance of intrinsic motivational factors "in both the presence of an employee bonus scheme and in its absence". Their study also revealed that in Australian NPOs people are "motivated by noneconomic rewards" and they love to witness the success of their clients, which is a form of competence needs of SDT.

Then, Schepers et al. (2005) in their article on how employees of nonprofit sector are motivated also stated that important motivators in educational setting are affiliation, altruism (needs of relatedness), and personal growth (need of competence). Their article also confirmed that autonomy is positively related to the work quality of people.

Moreover, besides the feeling of doing something of great significance, value congruence was found by Ernst and Valvanne (2012) in their research on employee motivation in Finnish social businesses as the most crucial factor for the employees. Having the same purpose of serving the society and improving the lives of the poor as NGO sector, social businesses were found to bring most motivation to their employees when their values match with the personal values of their people. This is because in that case people find their work easier "as they do not have to think on which basis they have to make their decisions. They work according to their own values and in doing so they also represent the company values." This helps people to achieve their needs for autonomy and relatedness.

Considering intrinsic work motivational factors from a different angle, Kummerfeldt (2011) in his study of job satisfaction, performance, and retention strategies for volunteers in an NPO has found some important factors that leaders of the organization could do to improve job satisfaction, retain volunteers, and bring high performance. "Communication of the mission and vision of the nonprofit organization" is one important factor among those. This can be seen as a factor that satisfies the need for relatedness of people working in the organization. When vision and mission are well communicated, it improves people's belief in the program and helps people feel they are a part of the organization. On the other way

round, cognitive, instrumental, and prestige work values had significant effects on informational communication satisfaction as according to a study by Jalalkamali et al. (2016). Moreover, they find that communication informational and relational communication satisfaction are significantly related to both dimensions of employees contextual and task job performance.

In short, it can be stated that the literature has been consistent in supporting the theory that intrinsic motivational factors bring positive impacts to the people working in NGO job sector.

Extrinsic motivational factors: While it is quite clearly proved that strong motivational factors of employees working in NGOs come intrinsically, the extrinsic motivators cannot be found positive easily. Most of the researches supported the theory that extrinsic motivation can be detrimental to the intrinsic motivation in work setting. However, there were also researches delivered the opposite result.

On one extreme side, it has been evidenced in the literature by Shirom et al. (1999) in a research on the effects of pay systems on blue-collar employee's emotional distress in Israel. Although it was not studied in NGO sector, the result was still a surprise when it found that "all types of performance-contingent pay systems exerted a negative influence on employee's somatic complaints and depression" and that pay for performance program may be "hazardous" to employee's "psychological well-being." Additionally, Gagne and Deci (2005) also confirmed in their article that when NPOs introduced its "merit pay programs," it decreases the autonomy of its workers and thus indicates that financial rewards can weaken intrinsic motivation.

In a medium level of impact, Tippet and Kluvers (2009) stated that extrinsic motivation does play a role, but less important than intrinsic factors. In his study, the respondents to his questionnaire remained "ambivalent" to their satisfaction of the financial reward, which can be interpreted as not the most important factor, but cannot be seen as detrimental to the intrinsic factors as stated in the theories. This result corroborated by Speers and Andrea (2012) who contend that extrinsic factors, referred to as "hard, tangible variables (such as salary, benefits, and vacation time)" has less influence on employees' motivation and remain a neutral impact. In another study, Alam et al. (2012) show that in Dhaka urban slums a combination of financial and nonfinancial (social prestige and positive community feedback) incentives play a positive significant role in the improvement of volunteer community health workers.

On the opposite extreme, one can find the positive tangible extrinsic motivators in employee's motivation in the research of Păcesilăm (2014) identifying ways to motivate employees in NGO sector, including long-term employees, members, and volunteers in Romania. The conducted interviews revealed that "classical aspirations (high wages or other financial incentives, satisfactory working conditions) represent a priority" beside other intrinsic motivations. As for the intangible extrinsic motivators, Balthasar and Budiman (2015) show that organizational culture is positively and significantly influencing employee performance, strategic leadership, and job satisfaction. The influence of organizational commitment

toward job satisfaction is positive and significant, but not toward employee performance. The influence of strategic leadership is positive and significant toward employee performance and job satisfaction. Job satisfaction is positively and significantly influencing employee performance. This can be understood that "classical aspirations" or financial rewards and external influencers or extrinsic motivations have higher priority in employees' list of motivators in comparison with other nonfinancial rewards.

In a nutshell, the reviewed literature has shown that a lot of researches have been conducted to show how people could be motivated in general work setting. However, there is still a lack of studies identifying motivational factors in nongovernmental or nonprofit sector, let alone in Vietnamese context. In the few researches reviewed above on the subject in NGO context, intrinsic factors have been well proved to be the main motivators for people working in the organization, while extrinsic factors remained a controversial subject to be determined to which extent they bring motivation to employees.

Within the frame of this paper where only international NGOs were studied, some factors that may influence the motivation of INGO workers have to be identified. Firstly, most of INGOs in Vietnam acquire full time, long-term, and paid employees, while in other countries, volunteers are the main workers in those organizations. Secondly, INGOs in Vietnam operate under the establishment of field offices or representative offices, which mostly adopt human resource and operational policies from their head offices, which are normally based in developed countries. This results in several following factors: (1) compensation and benefit package in INGOs are better than the average range of general employment sectors in Vietnam and (2) working condition must follow the standards set by home offices from developed countries and therefore is better than that in local organizations in a developing country like Vietnam. Lastly, the diversified multicultural environment brings a lot of advantages for its workers such as better cultural awareness, better knowledge, and exposure to international job opportunities. All these extrinsic factors could bring additional working motivation to INGO employees beside intrinsic factors.

Therefore, in order to explore and identify all possible motivation factors in INGOs in the context of Vietnam, it has been found helpful to test all six types of motivation in SDT to see how they work in the context of the present study.

3 Methodology

3.1 Hypotheses

This paper aims to find the answer to the following question: "Among six motivation factors measured by WEIMS (intrinsic motivation (IM), integrated regulation (IN), identified regulation (ID), introjected regulation (IT), external regulation

(EX), and amotivation (AM)), which factor plays the most important role and what is the level of impact of other factors in motivating employees in international nongovernmental organization in Vietnam?" In order to answer this question more easily, we came up with the following hypotheses based on the literature review conducted in the previous part:

H1: IM has the highest influence on employees in INGOs in Vietnam than other motivation factors.
H2: Within the extrinsic motivation, the autonomous regulations (IN and ID) have greater influence than the controlled regulations (IT and EX) on employee's motivation in INGOs in Vietnam.
H3: Within the controlled regulations (IT and EX), EX has greater influence than IT on employee motivation in INGOs in Vietnam.

3.2 Data Collection Method

In the research strategy of this paper, a questionnaire was used in order to describe the general motivation factors of employees having working experience in INGO sector, classified by age, position, and years of working experience. The questionnaire "*Why do you do your work?*" designed and used by Tremblay and his colleagues in their research "Work Extrinsic and Intrinsic Motivation Scale: Its Value for Organizational Psychology Research" (2009) has been asked for permission and allowed to be utilized for this research (see Appendix). The questionnaire includes two parts. Part 1 (added to the original questionnaire design by the researcher) asked about some demographic information, including age, work position, years of experience, and service length in INGO sector. Part 2 included 18 items, divided into six subscales, corresponding to the six types of motivation in SDT (IM, IN, ID, IT, EX, and AM). Participants were asked to indicate their answers on a Likert scale ranging from 1 (does not correspond at all) to 7 (corresponds exactly) expressing the extent to which the items represent the reasons they are presently involved in their work.

3.3 Method of Sampling for Questionnaire Survey

Participants of the survey were first identified from the network of the researcher. They were working in eight different INGOs in Hanoi, namely Chemonics International, Vietnam, Management Sciences for Health, Pact Vietnam, Family Health International 360, Netherlands Development Organization SNV, CARE International, Save the Children, Winrock International. These 8 INGOs out of total 820 INGOs in the country represent less than 1% of INGO population. As the main local counterparts of INGOs are ministries and central authorities, which all base in

the capital city Hanoi of Vietnam, this explains why the eight INGO samples are all from Hanoi.

Snowball sampling method was utilized. After primary participants were contacted, they were asked to identify more members from their own organization and from their wider INGO network. Those second-layered contacts were also asked to identify further participants from their own networks too. This method kept going until the survey reached its deadline and the sample obtained its desirable and manageable size.

This questionnaire was piloted in nine employees of an INGO in Vietnam. The initial results were analyzed to test the reliability of the responses and to see if questions needed any adjustment. After that the questionnaire was disseminated during personal visits to four different INGO offices of four primary contacts in Hanoi. In these visits, about 40 participants answered the printed questionnaires, meaning that those answers came from four primary participants and 36 secondary participants from four INGOs. Soft copy of the questionnaire was also sent to 25 other primary contacts working in other four INGOs by emails and Facebook. Nineteen of them returned the answers. The researcher also received 12 responses by email from secondary contacts, which were identified by the snowball sampling method. The organizations of these secondary contacts were difficult to be identified as we did not include demographic question regarding participant's name and organization's name, in order to ensure the privacy of the participants. In total, there were 71 people from eight INGOs responding to the questionnaire and all of the responses were valid.

3.4 Data Analysis Method

To start analyzing data, all of the results from filled questionnaire were input in an excel spreadsheet. From excel file, data was transformed into Statistical Package for the Social Sciences (SPSS), version 22.0, a program widely used for statistical analysis of quantitative data in social sciences. Two statistical tests were generated from this program to facilitate the analysis of the data: (1) descriptive statistics and (2) one-way analysis of variance or one-way ANOVA.

Descriptive statistical analysis was utilized to describe the characteristics of the survey sample. According to Saunders et al. (2009), people usually describe the "impression of values" of the quantitative data that "could be seen as common, middling, or average" and those measures are called "central tendency." Among the three ways measuring central tendency (mode, mean, median), we are going to use the *mean measure* to describe quantitative data of this research because it is the most frequently used measure in descriptive statistics and because it works well with numerical data (Saunders et al. 2009). The one-way analysis of variance

(ANOVA) was used to determine the difference in motivational factors scores among different age groups (age), between staff and manager-level respondents (position) and among groups with different years of experience (length of service).

4 Findings and Discussions

4.1 General Motivation—Findings and Discussions

In this part, the results of the questionnaire were presented and discussed. In the questionnaire, respondents indicated the level of relevance of the statements of their work motivation by assigning a score from 1 to 7 to each item. The higher the score was, the more relevant that statement was to their work. For the purpose of the analysis, following Tremblay et al. (2009), we group the 16 items of the questionnaire into the 6 types of motivation factor in Table 1 to facilitate the analysis of the results. To that end, in the rest of the section, we present the results and analyze them step-by-step based on the six motivation factors.

Before this detailed analysis, we provide throughout the descriptive statistics and the overview of the outcomes of the results.

4.2 An Overview of the Results

As the survey questionnaire was designed basing on the six types of motivation by WEIMS scale, it is able to see the descriptive statistics about each type of motivation. Descriptive statistics determined for each type of motivation were mean and standard deviation. Table 2 provides a full summary of this descriptive statistics.

Results show that, at the first glance, the factor that created the best motivation to employees of INGOs is IM, which yielded the highest mean of 5.16. This finding confirms the first hypothesis stating that intrinsic motivation has the highest influence on employees in INGOs in Vietnam than other motivation factors. It is also in line with Gagne and Deci (2005) who found that IM is the prominent and dominant motivation factor among other factors.

According to SDT, IM "generally applies to activities that people find interesting, optimally challenging, or aesthetically pleasing. Activities, which are not experienced as such, work for example, are unlikely to be performed unless there is, to some extent, an extrinsic reason for doing them" (Deci and Ryan 2000). This can help explain the reason why intrinsic factor brings the most motivation to INGO employee according to the above result. From observation of the researcher, INGOs have never created boring, routine jobs. On the contrary, people working in INGOs always have to use their creativity to find ways to obtain the organization's development missions. Different mission in different country or different government counterpart would require a different approach, hence no molded solution to be applicable for all.

Table 1 Interpretation of questionnaire items

Type of motivation	Item no. in questionnaire	Description of item
Intrinsic motivation (IM)	Item 4	Because I derive much pleasure from learning new things
	Item 8	For the satisfaction I experience from taking on interesting challenges
	Item 15	For the satisfaction I experience when I am successful at doing difficult tasks
Integrated regulation (IN)	Item 5	Because it has become a fundamental part of who I am
	Item 10	Because it is part of the way in which I have chosen to live my life
	Item 18	Because this job is a part of my life
Identified regulation (ID)	Item 1	Because this is the type of work I chose to do to attain a certain lifestyle
	Item 7	Because I chose this type of work to attain my career goals
	Item 14	Because it is the type of work I have chosen to attain certain important objectives
Introjected regulation (IT)	Item 6	Because I want to succeed at this job, if not I would be very ashamed of myself
	Item 11	Because I want to be very good at this work, otherwise I would be very disappointed
	Item 13	Because I want to be a "winner" in life
External regulation (EX)	Item 2	For the income it provides me
	Item 9	Because it allows me to earn money
	Item 16	Because this type of work provides me with security
Amotivation (AM)	Item 3	I ask myself this question, I don't seem to be able to manage the important tasks related to this work
	Item 12	I don't know why, we are provided with unrealistic working conditions
	Item 17	I don't know, too much is expected of us

Table 2 Descriptive statistics of quantitative survey

Descriptive Statistics					
	N	Minimum	Maximum	Mean	Std. deviation
Intrinsic motivation (IM)	71	2.67	7.00	5.16	1.14
Integrated regulation (IN)	71	2.00	7.00	5.01	1.27
Identified regulation (ID)	71	2.33	7.00	5.02	1.17
Introjected regulation (IT)	71	1.33	7.00	3.75	1.34
External regulation (EX)	71	1.67	7.00	4.93	1.09
Amotivation (AM)	71	1.00	6.33	1.89	0.98

Secondly, for the other two autonomous extrinsic motivation types, i.e., IN and ID, the means are 5.01 and 5.02, respectively, which are very similar. The reasons for their second and third highest results in the survey could be predicted from (1) the characteristics of the working environment that is autonomous supportive and (2) individual's autonomous orientation among the different causality orientations (Gagne and Deci 2005). These predictions can be supported by the fact that the majority of INGOs' rapport with local counterparts, either at central or grassroot level, has to rely on knowledge of local systems. While almost all INGOs in Vietnam are led by expatriates who have limited knowledge about local context, their working level employees are local Vietnamese. Therefore, in order to achieve the best results, leaders have no better way than creating an autonomous work climate for their employees to maximize their knowledge and develop their mastery. This is one reason for the positive result in autonomous extrinsic motivations of the survey. As for the second prediction, individual autonomy orientation "reflects a general tendency to experience social contexts as autonomy supportive and to be self-determined" (Gagne and Deci 2005). This can be supported by a fact that INGOs in Vietnam apply high standards in recruiting staff, especially in foreign language requirement. Naturally, those INGOs attract more people graduated from overseas, who enjoyed advanced education from developed countries characterized by self-determination, self-actualization, integration in personality. These are characteristics of autonomous causality orientation in SDT theory.

Thirdly, for the controlled motivation, i.e., the next two types of external motivation in the self-determination continuum (IT and EX), the means are 3.74 and 4.93, respectively. Same explanation can be taken from the one for the above two autonomous extrinsic types of motivation that INGOs create more autonomous work climate than a controlling one; hence people are working because of autonomous motivation more than controlled motivation. The interesting feature in this table is that external regulation brings more motivation to employees than IT. Its role in motivating people follows the other two types of autonomous motivation closely, proved by its mean at 4.93 in comparison with 5.02 and 5.01 of ID and IN, respectively. A possible explanation for this can account to a fact that INGOs in Vietnam offer relatively attractive compensation package (NGOs—Cơ hội làm việc tại các tổ chức Phi chính phủ 2012) which is one of the main reasons attracting and retaining people staying in the organization and doing their work.

Lastly, AM plays the least role among the six factors, with the mean of only 1.89. Its standard deviation of 0.98 is the lowest among the other motivation factors. In other words, it can be said that the answers are provided by the respondents to the three items (items 3, 12, 17) to grasp amotivation. The answers provided are closer to the mean than that of the amotivation factor.

This is explained by the fact that employees in those organizations are least impersonally oriented. According to Gagne and Deci (2005), impersonal orientation "relates to external locus of control (i.e., the belief that one cannot control

outcomes)." This cannot be the case for INGO sector, where missions and objectives are always clearly set to achieve by projects of 3–5 years. And one can only start doing their work when they see the objectives clearly and believe the outcomes are controllable.

To conclude this part, just by eyeballing the means of motivation factors, it could be pointed out that IM has the highest influence on employees in INGOs in Vietnam than other motivation factors. Autonomous extrinsic motivations, IN and ID, follow closely in terms of level of impact. Within controlled extrinsic motivations, EX plays more significant role than IT. Therefore, through this general analysis, all hypotheses of the research were supported.

In the following parts, the researcher analyzed the results from a different angle to make sure the conclusions are supported or to find out any possible missing factors in these conclusions. The respondents were then grouped by age, position, and length of experience. The six motivations of the SDT continuum would continue to be utilized in order to ensure the consistency of the overall conclusions. One-way ANOVA was used to analyze "the spread of data values, within and between groups of data by comparing means" (Saunders et al. 2009), and help determine if the differences among conditions in each group are significant. Deeper discussion about the results would also be presented to facilitate better understanding of the conclusions.

4.3 Motivation by Age—Findings and Discussions

The ANOVA Table 3 shows us that the significance levels of all six factors in different age groups were less than 5%. This indicated that there was no significant difference in scores of motivational factors among groups of different aged employees. The result would be further demonstrated by the graph below, which then facilitated a discussion about the impact of motivations to employees at different age (Fig. 1).

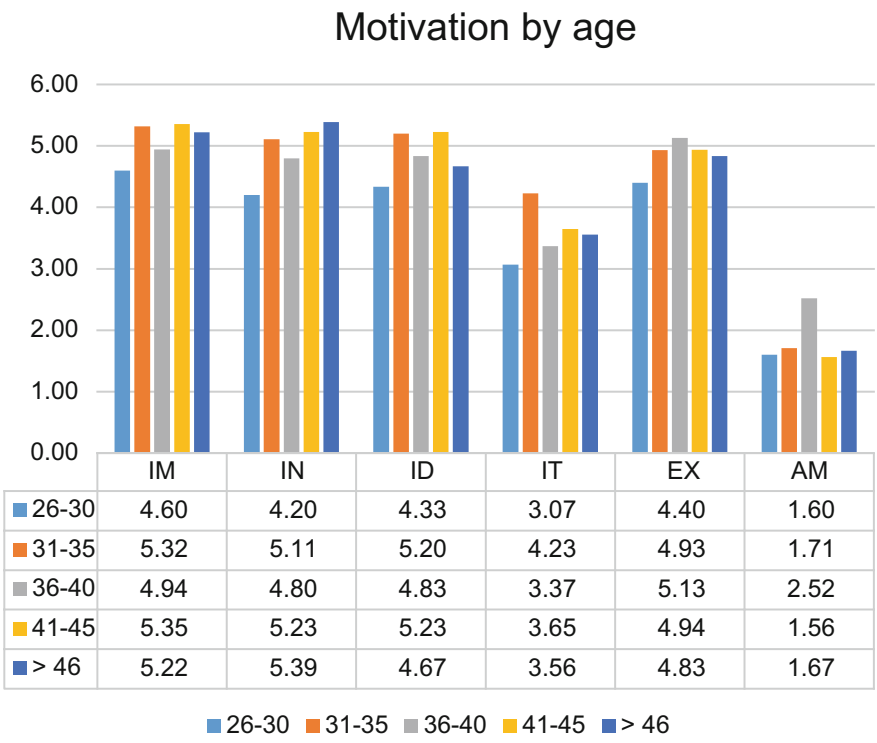
Overall, the IM, IN, and ID factors still play the most important roles in creating motivation for employees, while AM brings the least impact.

As for respondents aged under 30, the chart shows that their level of motivation at work is lowest in most of motivation factors. This may be illuminated by the fact that most people at this age are still busy continuing their higher education. Therefore, work maybe not their first or only priority.

For respondents aged from 31 to 35, it is shown in the chart that the means of their motivations are generally high from IM factor to ID factor and reach a prominent peak in IT regulation factor, which is characterized by "contingent self-esteem, which pressures people to behave in order to feel worthy, and ego involvement, which pressures people to behave in order to buttress their fragile ego"

Table 3 ANOVA for age

		Sum of squares	df	Mean square	F	Sig.
IM	Between groups	4.608	6	0.768	0.571	0.752
	Within groups	86.064	64	1.345		
	Total	90.672	70			
IN	Between groups	7.303	6	1.217	0.743	0.617
	Within groups	104.820	64	1.638		
	Total	112.123	70			
ID	Between groups	7.397	6	1.233	0.886	0.511
	Within groups	89.054	64	1.391		
	Total	96.451	70			
IT	Between groups	14.070	6	2.345	1.342	0.252
	Within groups	111.835	64	1.747		
	Total	125.905	70			
EX	Between groups	4.159	6	0.693	0.559	0.761
	Within groups	79.365	64	1.240		
	Total	83.524	70			
AM	Between groups	11.632	6	1.939	2.237	0.051
	Within groups	55.461	64	0.867		
	Total	67.092	70			



	IM	IN	ID	IT	EX	AM
26-30	4.60	4.20	4.33	3.07	4.40	1.60
31-35	5.32	5.11	5.20	4.23	4.93	1.71
36-40	4.94	4.80	4.83	3.37	5.13	2.52
41-45	5.35	5.23	5.23	3.65	4.94	1.56
> 46	5.22	5.39	4.67	3.56	4.83	1.67

Fig. 1 Motivation by age

(Garne and Deci 2005). This finding is supportive by the following two findings in the literature review. First, internal rewards and punishment, which are characteristics of IT, have a positive role in people's tendencies toward workaholic (Stoeber et al. 2013). Second, the higher people age, the lower their scores of workaholic are (Andreassen et al. 2013). This can be interpreted as people tend to work harder when they are young, because they are more realistic. However, over time they quit working hard because they "wise up and adjust their work pattern over time because of other commitments" (Andreassen et al. 2013) and understand they cannot change the world. These two findings taken together have explained the reason why mean of introjected motivation of participants at this age reaches the highest.

At the age from 36 to 40, participants gave the highest mean result in extrinsic motivation. This may be claimed by the fact that this is the age where people care more about income to stabilize their life. This is also the age at which people start caring for health and retirement. Therefore, compensation and benefit, such as higher income as people obtaining more work experience and being promoted, health insurance, pension plans, which are characteristics of external regulation, have such high impact on their work motivation.

Another interesting finding is that, also at the age from 36 to 40, AM factor of these participants reaches a noticeable top. AM, described by having no intention to act, or impersonal causality orientation, may have suggested the cause of this type of motivation to people at this age. This is the age when their work life has been long enough to achieve a certain kind of promotion or work objectives they set in the earlier phase of their career. More often than not, in every circumstance, when objectives have been achieved, people start losing interest and switching their attention to other work goals or nonwork activities.

To sum up this part, it could be concluded from the graph and findings in this section that even though there were different level of impact of each motivation factor to each age group, general trend in each age group was still consistent with the general conclusions and that all of the hypotheses were supported.

4.4 Motivation by Position—Findings and Discussions

From the ANOVA Table 4, we can see that the significance levels of all six factors were less than 5%. This indicated that there was no significant difference in scores of motivational factors among groups of staff employees and manager employees working in INGOs in Vietnam. The graph below served to illustrate this conclusion and opened a deeper discussion on the motivation factors to the groups of staff and manager employees (Fig. 2).

Table 4 ANOVA for position

		Sum of squares	df	Mean square	F	Sig.
IM	Between groups	0.135	1	0.135	0.103	0.749
	Within groups	90.537	69	1.312		
	Total	90.672	70			
IN	Between groups	0.744	1	0.744	0.461	0.499
	Within groups	111.379	69	1.614		
	Total	112.123	70			
ID	Between groups	0.207	1	0.207	0.148	0.702
	Within Groups	96.245	69	1.395		
	Total	96.451	70			
IT	Between groups	2.711	1	2.711	1.518	0.222
	Within groups	123.194	69	1.785		
	Total	125.905	70			
EX	Between groups	0.016	1	0.016	0.013	0.908
	Within groups	83.508	69	1.210		
	Total	83.524	70			
AM	Between groups	0.543	1	0.543	0.563	0.456
	Within groups	66.549	69	0.964		
	Total	67.092	70			

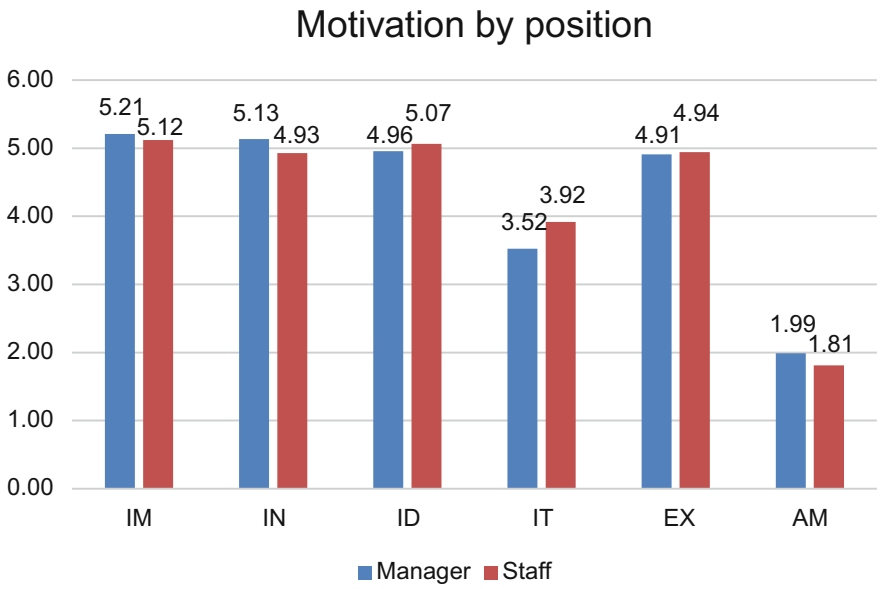


Fig. 2 Motivation by position

Findings in this section once again follow the same pattern as the one in the general findings, i.e., participants are more motivated by autonomous motivators and less by controlled ones. There are not a lot of differences in motivation level between staff and manager level, which can be supported by the literature. According to Shiva et al. (2012), "NGOs are mostly run as one-man-show supported by a handful of professionals and even fewer staff functionaries and are mostly devoid of hierarchy." This is also true to most INGOs in Vietnam, of which offices are set up and human resources are maintained small enough to run one or two projects in a definite timeline. In such circumstances, leaders and managers, who normally lack physical or financial resources, have to "provide a kind of exemplary, selfless, and dedicated service, and develop a service-oriented culture," which are characteristics of transformation leadership. These leaders are the ones who create visions, missions, and values of the organization. When recruiting, they make sure that "there is no mismatch between the basic values, norms, and beliefs of NGOs and those of the potential jobseekers who want to join the NGO" (Shiva et al. 2012). Acting on the same ground of values and beliefs, in a work environment that fosters the use of innovative perspectives in solving problems, it is easy to understand why there is no substantial difference in motivation level between manager and staff in these organizations.

However, taking a closer look to each motivation factor between the staff and manager categories, it could be noted that controlled motivation factors (IT and EX) had more influence on staff than manager. According to Gagne and Deci (2005), if one is motivated by controlled factors, they will act with a "sense of pressure, a sense of having to engage in the actions." This could be explained by the fact that staff in general has less self-control than manager, due to their lack of experience and lack of autonomy at work. Therefore, they have to act under the command and follow the order of their managers. This is why they scored higher for controlled motivations than the managers.

To conclude, these findings remained consistent with results in the general conclusions; hence all hypotheses were supported.

4.5 Motivation by INGO Length of Service—Findings and Discussions

Once again, this ANOVA Table 5 presented that the significance data across all six factors on different lengths of INGO work experience was less than 0.05 meaning that there was no significant difference in scores of motivational factors among employee groups of different years of experience.

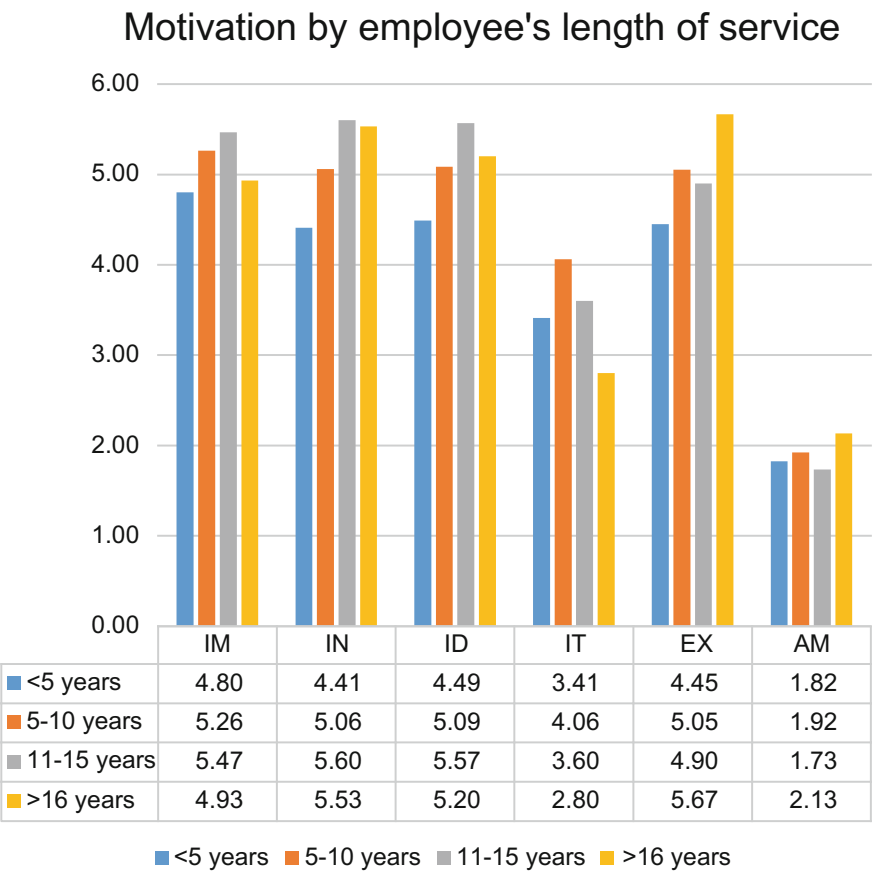
Table 5 ANOVA for employee's length of service in INGOs

		Sum of squares	df	Mean square	F	Sig.
IM	Between groups	3.797	3	1.266	0.976	0.409
	Within groups	86.874	67	1.297		
	Total	90.672	70			
IN	Between groups	11.020	3	3.673	2.434	0.072
	Within groups	101.103	67	1.509		
	Total	112.123	70			
ID	Between groups	8.074	3	2.691	2.040	0.117
	Within groups	88.377	67	1.319		
	Total	96.451	70			
IT	Between groups	10.406	3	3.469	2.012	0.121
	Within groups	115.499	67	1.724		
	Total	125.905	70			
EX	Between groups	7.184	3	2.395	2.102	0.108
	Within groups	76.339	67	1.139		
	Total	83.524	70			
AM	Between groups	0.656	3	0.219	0.221	0.882
	Within groups	66.436	67	0.992		
	Total	67.092	70			

Graph below showed us a more visible presentation of the influence of the six motivation factors to employees of different years of experience (Fig. 3).

From this angle of analysis, same level of motivation pattern was repeated but there were still some interesting findings to be discussed. Considering the first three autonomous motivation factors (IM, IN, and ID), there is a notable trend that the more time people spend with the INGO sector, the higher level they were autonomously motivated. The upward trend in motivation level starts from when people have less than 5 years of NGO experience and keeps increasing steadily until when they reach 15 years of experience. This result can be well explained by the claim that the longer people work for INGO sector, the better they internalize extrinsic motivation. In other words, the longer people work, the more interest they find in the activity, or the better they integrate value and regulation of the activity into themselves. From the different perspective, it can also be explained that people could have quitted their job and switched to other work sector if they had not found their job interesting at a certain time of their service in NGO.

Once again, these findings continued to follow the trend of impact of each motivation in the general analysis. Thus, it could be concluded that research's hypotheses were supported.



	IM	IN	ID	IT	EX	AM
<5 years	4.80	4.41	4.49	3.41	4.45	1.82
5-10 years	5.26	5.06	5.09	4.06	5.05	1.92
11-15 years	5.47	5.60	5.57	3.60	4.90	1.73
>16 years	4.93	5.53	5.20	2.80	5.67	2.13

Fig. 3 Motivation by employee's length of service in INGOs

5 Conclusions

The main purpose of this research is to explore the motivation factors of employees working in INGOs in Vietnam based on the theory of self-determination of Deci and Ryan (1985) on motivation. In order to do this, the research was designed to be conducted using quantitative method, to answer the research question: Among six motivation factors measured by WEIMS (IM, IN, ID, IT, EX, and AM), which factor plays the most important role and what is the level of impact of other factors in motivating employees in international nongovernmental organization in Vietnam?

Findings of our study suggested that the most important factor for employees in INGOs in Vietnam was IM. When the study was divided into subgroups (by age, position, and years of experience) for deeper analysis, the specific findings for each

subgroup remained consistent with that in the general group. Next in order of importance were IN, ID, EX, and IT. AM played the minimal role, which is a good sign for INGO job sector. It therefore facilitates the answer for the research question that among the six motivation factors for employees in INGOs in Vietnam, IM plays the most important role, autonomous extrinsic motivations have higher impact than controlled extrinsic motivations, and EX has higher impact than IT.

These findings supported the previous studies on the positive and utmost impacts of IM to employees (Tippet and Kluvers 2009; Schepers et al. 2005). They were also in line with findings of other studies on how important extrinsic motivation factors are (Păcesilăm 2014). However, regarding EX type of extrinsic motivation, these findings were not supportive to other studies. In the current studies, it was found out that EX, specifically hard, tangible variables (such as salary, benefits, physical working environment), are not necessarily detrimental to the intrinsic motivators (Shirom et al. 1999). On the contrary, they have almost similar influence on employees' motivation as the second and third type of motivators in the SDT continuum (IN and ID). More surprisingly, they even play a prominently higher role in motivating employees in comparison with the preceding motivator in SDT continuum, the introjected regulation.

6 Contributions of Findings and Recommendations

Theoretical contributions: To the best of our knowledge, in the review of the literature on the motivation for employees in INGOs in Vietnam, this is the first study conducted in NGO sector in Vietnam. Moreover, as discussed in the literature review part of the study, according to the self-determination theory on motivation and many other studies, controlled motivation, which includes tangible rewards and evaluation, will yield poorer performance on heuristic task than autonomous motivation (Gagne and Deci 2005), decrease creativity, and diminish deep processing. Despite diversification in findings of follow-on studies, EX (hard and tangible factors) still plays from a neutral to limited role in motivating staff. The paper has proven that EX plays an equal role to some other autonomous motivators, especially in the context of INGO sector in Vietnam, where volunteer work is less popular than that in other countries, and the nature of the work is heuristic and requires a lot of creativity. The contribution of the study, therefore, is that it enriches the existing theory in the way people analyzed and concluded about EX type of motivation.

Practical contributions to HR management practices and recommendations to INGO's managers: The findings of the research have had humble yet positive contributions to the practice of HR management of INGO sector in Vietnam.

Firstly, good news for all INGOs' managers in Vietnam is that staff working in those organizations is mostly motivated by intrinsic factors. This means that people

are working for passion. With this passion, they can find joys in the nature of the work itself. This is the highest level of motivation, which brings highest and electrifying performance that all managers can expect from their staff. In order to nurture such motivation, according to STD, the first thing manager should do is to respect the autonomy of the staff and give them opportunity to master their job.

Secondly, according to the result researcher found on extrinsic autonomous motivators, managers should find ways to satisfy the three psychological needs of staff (mastery, autonomy, and relatedness) to facilitate staff to better internalize the extrinsic motivation, which would lead to better job satisfaction.

Lastly, while the literature suggested that IM is important and EX can be detrimental to IM, especially on heuristic tasks of any INGOs as Chemonics International, Vietnam, the above research results show that EX (i.e., salary, benefit, promotion, physical work environment etc.) plays no less important role in motivating staff. Managers should find out ways to build more generous and fair compensation and benefit package to retain talents. At the same time, they also need to strengthen the performance evaluation practice in order to provide staff fair, encouraging, and constructive feedback for their work.

Practical contributions to the government of Vietnam: In the reality of Vietnam, beside a lot of favorable conditions that the government creates for the INGOs, there are still some obstacles to the implementation of INGO's activities in Vietnam. Among which we can name two main hindrances. The first one is the suspicion about activities of INGOs in Vietnam, especially those that relate to democracy, human rights, and national security in the border areas. This creates lots of difficulties to INGOs in general and to their expat employees in particular. The second one relates to the issuance, extension, amendment of registration of INGOs working in Vietnam by PACCOM. In general, these procedures are too bureaucratic and require a lot of unnecessary steps and papers.

In order to facilitate the old INGOs to continue their activities in Vietnam and to welcome the new ones to enter the country, there are few actions that can be recommended to the government. Firstly, government should create a more effective communication channel with INGOs for them to share their missions and build trust. Once trust is set up, autonomy will be granted, intrinsic motivation is created, and INGOs will be more encouraged to follow and complete their missions. In the same vein, Visser et al. (2016) contend that high levels of autonomy are positively related with work–life balance satisfaction when trust in the management of the organization is high. Secondly, the government should frequently acknowledge the contribution and roles of INGOs in different forms (compliments, friendship medals, acknowledged in documents issued by the government, etc.). At the same time, PACCOM could also find ways to simplify their requirements on permission issuance or extension and so on. These two actions together will more or less create external regulations, which, according to the result of this study, will also enhance the motivation of people working in INGOs.

Appendix: Survey Questionnaire

WHY DO YOU DO YOUR WORK?

Part 1: General information

1. Gender: □ Male □ Female
2. Age: □ Under 21 □ 21 – 25 □ 26 – 30 □ 31 - 35 □ 36 – 40 □ 41 – 45 □ 46 – 50 □ Above 50
3. Years of working experience: _____
4. Years of working experience in INGOs: _____
5. Position: □ Manager □ Staff

Part 2: Why do you do your work?

Using the scale below, please indicate to what extent each of the following items corresponds to the reasons why you are presently involved in your work. Please mark (x) into the appropriate box.

Does not correspond at all Corresponds moderately Corresponds exactly
1 2 3 4 5 6 7

1	Because this is the type of work I chose to do to attain a certain lifestyle.	1	2	3	4	5	6	7
2	For the income it provides me.	1	2	3	4	5	6	7
3	I ask myself this question, I don't seem to be able to manage the important tasks related to this work.	1	2	3	4	5	6	7
4	Because I derive much pleasure from learning new things.	1	2	3	4	5	6	7
5	Because it has become a fundamental part of who I am.	1	2	3	4	5	6	7
6	Because I want to succeed at this job, if not I would be very ashamed of myself.	1	2	3	4	5	6	7

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The Linked Movement of House Price and Stock Price with Shocks

Jae-Ho Yoon

Abstract FIML Markov-switching model originally proposed by Yoon is the simultaneous equations model with Hamilton's Markov-switching filter. FIML Markov-switching model is a general model which includes a various class of models. As we applied the FIML Markov-switching model to house prices and stock prices, we can find common shock periods in the USA and UK. The finding of this paper is that house prices showed common business cycle with stock prices during oil shocks periods, S&L crisis, and the bursting of the housing bubble in 2008. House prices and stock prices are also more volatile with big shock periods. These results showed that international big shocks, such as oil shocks and financial shocks, cause common business cycle of house price and stock price.

Keywords USA · UK · Co-movement · House price · Stock price
FIML Markov-Switching model · Common business cycle · Big shocks
Oil shocks · Financial shocks

1 Introduction

The relationship between house price and stock price has been assumed to be positive and linear in the long run. However, Okunev and Wilson (1997) found that real estate and equity markets are segmented with linear test, whereas the markets are fractionally integrated with nonlinear model. McMillan (2012) also found that house price and stock price are nonlinear co-integrated in the long run.

Thus, the purpose of this paper is to find out whether there really are co-movements between house price and stock price in the USA and UK.

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To establish the nonlinear relationship between house price and stock price, we adopt Markov-switching model by Hamilton (1989) and FIML Markov-switching model proposed by Yoon (2006, 2009, 2017), Yoon and Lee (2014a, b).

The finding of this paper is as follows: House price and stock price are more volatile with big shock periods. Moreover, house price for USA and UK is common business cycle with stock price during 1970s and 1990s oil shocks periods, and house price is also common business cycle with stock price during 1980s, IT bubble collapse, and the bursting of housing bubble in 2008.

This paper is organized as follows. We present FIML Markov-switching model in Sect. 2. We summarize the empirical results in Sect. 3. We conclude this paper in Sect. 4.

2 FIML Markov-Switching Model

We consider the following FIML Markov-switching model in the simultaneous equations.

$$YB_{St} + Z\Gamma_{St} = U_{St} \quad U_{St} \sim N(0,\ \Sigma_{St} \otimes I_T) \tag{1}$$

where Y is the T × M matrix of jointly dependent variables; B_{St} is an M × M matrix and is nonsingular; Z is the T × K matrix of predetermined variables; Γ_{St} is a K × M matrix and rank(Z) = K; and U_{St} is the T × M matrix of the structural disturbances of the system. Consequently, the model has M equations and T observations.

$$E(U'_{St}U_{St}) = \begin{pmatrix} \sigma_{S1t,S1t}I_T & \sigma_{S1t,S2t}I_T & \cdots & \sigma_{S1t,SMt}I_T \\ \sigma_{S2t,S1t}I_T & \sigma_{S2t,S2t}I_T & \cdots & \sigma_{S2t,SMt}I_T \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{SMt,S1t}I_T & \sigma_{SMt,S2t}I_T & \cdots & \sigma_{SMt,SMt}I_T \end{pmatrix} = \Sigma_{St} \otimes I_T$$

$$p_{ij} = \Pr(S_t = j | S_{t-1} = i) \text{ with } \sum_{j=1}^{N} p_{ij} = 1 \text{ for all } i.$$

To derive the FIML Markov-switching model in the simultaneous equations, we can obtain $\Pr(S_t = j|\psi_t)$ by applying a Hamilton filter (1989) as follows:

Step 1: At the beginning of the tth iteration, $\Pr(S_{t-1} = i|\psi_{t-1}), i = 0, 1, \cdots, N$ is given, and we calculate

$$\begin{aligned}\Pr(S_t = j|\psi_{t-1}) &= \sum_{i=1}^{N} \Pr(S_{t-1} = i,\ S_t = j|\psi_{t-1}) \\ &= \sum_{i=1}^{N} \Pr(S_t = j|S_{t-1} = i) \Pr(S_{t-1} = i|\psi_{t-1})\end{aligned}$$

where $\Pr(S_t = j|S_{t-1} = i),\ \ i = 0, 1, \cdots, N,\ \ j = 0, 1, \cdots, N$ are the transition probabilities.

Step 2: Consider the joint conditional density of y_t and unobserved variable $S_t = j$, which is the product of the conditional and marginal densities:

$$f(y_t, S_t = j|\psi_{t-1}) = f(y_t|S_t = j, \psi_{t-1})\ \Pr(S_t = j|\psi_{t-1})$$

from which the marginal density of y_t is obtained by:

$$\begin{aligned}f(y_t|\psi_{t-1}) &= \sum_{j=1}^{N} f(y_t, S_t = j|\psi_{t-1}) \\ &= \sum_{j=1}^{N} f(y_t|S_t = j, \psi_{t-1}) \Pr(S_t = j|\psi_{t-1})\end{aligned}$$

where the conditional density $f(y_t|S_t = j,\ \psi_{t-1})$ is obtained from (2):

$$\begin{aligned}&f(y_t|S_t = j, \psi_{t-1}) \\ &\quad = (2\pi)^{-M/2} \det(\Sigma_{St})^{-1/2} |\det(B_{St})| \\ &\qquad \cdot \exp(-\frac{1}{2}(y_t B_{St} + z_t \Gamma_{St}) \Sigma_{St}^{-1} (y_t B_{St} + z_t \Gamma_{St})') \qquad (2)\end{aligned}$$

where $\Sigma_{St} = \frac{1}{T}(YB_{St} + Z\Gamma_{St})'(YB_{St} + Z\Gamma_{St})$, y_t is the tth row of the $\mathbf{Y}$ matrix, z_t is the tth row of the $\mathbf{Z}$ matrix, and $\boldsymbol{B_{St}}$ and $\boldsymbol{\Gamma_{St}}$ are obtained from (1).

Step 3: Once y_t is observed at the end of time t, we update the probability terms:

$$\begin{aligned}\Pr(S_t = j|\psi_t) = \Pr(S_t = j|\psi_{t-1}, y_t) &= \frac{f(S_t = j, y_t|\psi_{t-1})}{f(y_t|\psi_{t-1})} \\ &= \frac{f(y_t|S_t = j, \psi_{t-1})\ \Pr(S_t = j|\psi_{t-1})}{f(y_t|\psi_{t-1})}\end{aligned}$$

As a byproduct of the filter in Step 2, we obtain the log likelihood function:

$$\ln L = \sum_{t=1}^{T} \ln f(y_t|\psi_{t-1})$$

3 Empirical Results

Lets consider the House Price[1] and the Dow Jones Industrial Average[2] in the USA. The regression analysis for t = 1970:II–2016:III is given by Eq. (3)

$$\Delta Y_t = \alpha + \beta \Delta H_t + e_t \tag{3}$$

where ΔY_t is the log difference of Dow Jones Industrial Average; ΔH_t is the log difference of House Price in the USA.

To find out whether β is really constant during shock periods, we adopt simple Markov-switching model by Hamilton (1989).

$$\Delta Y_t = \alpha_{St} + \beta_{St} \Delta H_t + e_t \tag{4}$$

where

$$\alpha_{St} = \alpha_0 S_t + \alpha_1 (1 - S_t),\ \beta_{St} = \beta_0 S_t + \beta_1 (1 - S_t),$$
$$\Pr(S_t = 0|S_{t-1} = 0) = q,\ \Pr(S_t = 1|S_{t-1} = 1) = p$$

Table 1 reports estimation results in the simple Markov-switching model. The *coefficient* β_0 is significant and negative correlated during the regime 0 periods. The *coefficient* β_1 is also significant and positive correlated during the regime 1 periods. The positive *coefficient* β_1 showed the co-movement between house price and stock price during the regime 1 periods. These findings show the evidence that the *coefficient* β is not stable and linear. The house market ΔH_t is more stable than the stock market ΔY_t because absolute values of ($\beta_0 = -1.1234$) and ($\beta_1 = 1.2251$) are larger than 1. ($\sigma_1^2 = 10.2100$) > ($\sigma_0^2 = 4.1680$) showed the uncertainty of regime 1 periods is larger than that of regime 0 periods.

We can find the linked relationship of house price and stock price in the USA in Figs. 1 and 2. We can also find two-state Markov-switching probabilities during the regime 1 periods in Fig. 3. From Fig. 3, the smoothed probabilities $\Pr(S_t = 1|\Delta Y_T)$ accord with USA recessionary dates during oil shocks periods. This result is same as Hamilton (1989), who find the great uncertainty after two major OPEC oil

[1]Source: BIS Residential Property Price DB.

[2]Source: FRED, Finance Yahoo.

Table 1 Maximum likelihood estimation in the USA

Parameters	USA (1970.II–2016.III)
α_0	4.1499 (0.7860)
α_1	−0.8450 (1.5820)
β_0	−1.1234 (0.3907)
β_1	1.2251 (0.7301)
σ_0^2	4.1680 (0.7553)
σ_1^2	10.2100 (1.0439)
q	0.8718 (0.0564)
p	0.8616 (0.0867)
Log likelihood	−623.95

Standard errors are in the parentheses

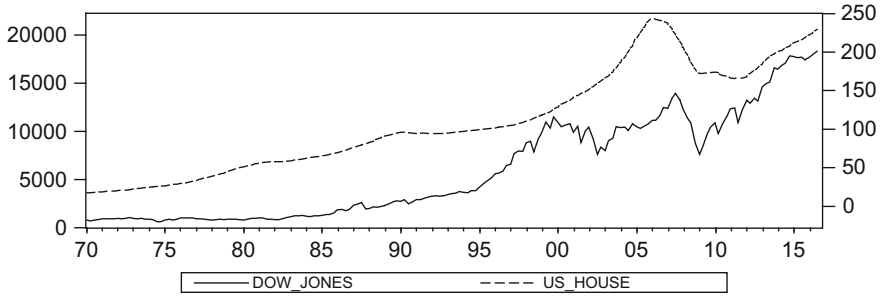

Fig. 1 Dow Jones Industrial Average Y_t and House Price H_t in the USA

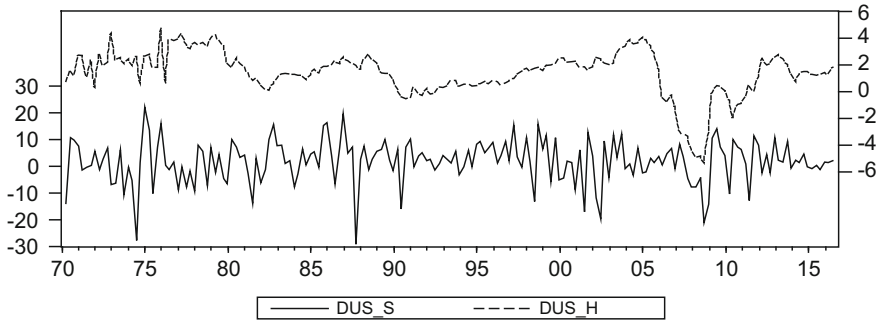

Fig. 2 Dow Jones Industrial Average ΔY_t and House Price ΔH_t

shocks in 1973–1974 and 1979–1980. And, house price is also procyclical in movement with stock price during 1980s, late 1990s, 2000s IT bubble collapse and financial shock. Thus, we can interpret that there is the co-movement of housing bubble burst and stock market crash with economic big shocks.

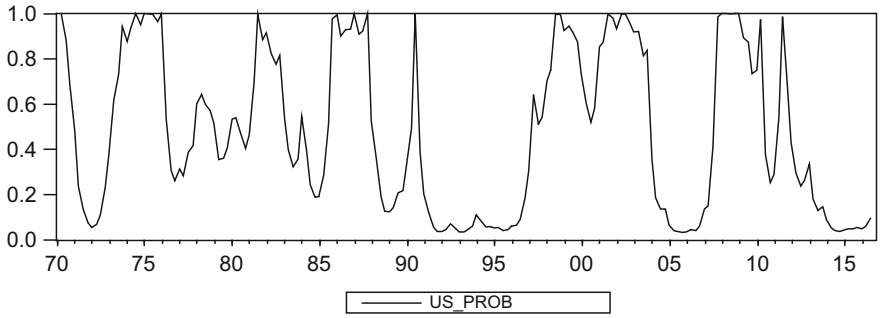

Fig. 3 Smoothed probabilities $\Pr(S_t = 1|\Delta Y_T)$

Table 2 Maximum likelihood estimation in the UK

Parameters	UK (1970.II–2016.III)
α_0	2.5639 (0.6192)
α_1	−2.8784 (3.2128)
β_0	−0.0456 (0.2099)
β_1	0.4584 (0.8519)
σ_0^2	5.0896 (0.3576)
σ_1^2	14.7942 (2.3279)
q	0.9605 (0.0201)
p	0.8276 (0.0947)
Log likelihood	−619.48

Standard errors are in the parentheses

Lets consider the housing price index[3] and Total Share Prices for All Shares Index[4] for the UK. We can find estimation results in the simple Markov-switching model in Table 2.

The *coefficient* β_0 and β_1 are not significant. However, the *variance* σ_0^2 and σ_1^2 are significant. $(\sigma_1^2 = 14.7942) > (\sigma_0^2 = 5.0896)$ showed the uncertainty of regime 1 periods is larger than that of regime 0 periods.

We can find the relationship between house price and stock price in Figs. 3 and 4 (Fig. 5).

From Fig. 6, we can find that the probabilities $\Pr(S_t = 1|\Delta Y_T)$ accord with UK recessionary dates during 1970s oil shocks periods. And, the uncertainty of house price and stock price has risen during bubble collapse in 1980s, in early 2000s, and financial shock in 2008. From Figs. 3 and 6, we can find the similarity in the Markov-switching probabilities between USA and UK.

[3]Source: BIS Residential Property Price DB.

[4]Source: OECD DB.

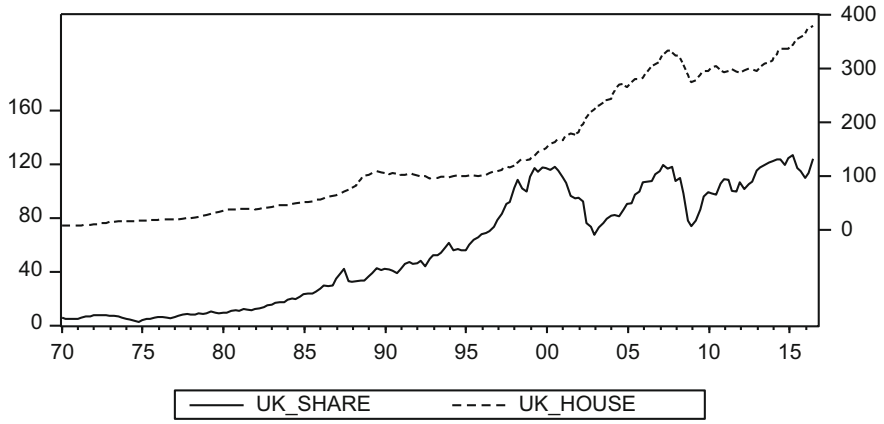

Fig. 4 Total Share Prices for All Shares Index Y_t and House Price H_t in the UK

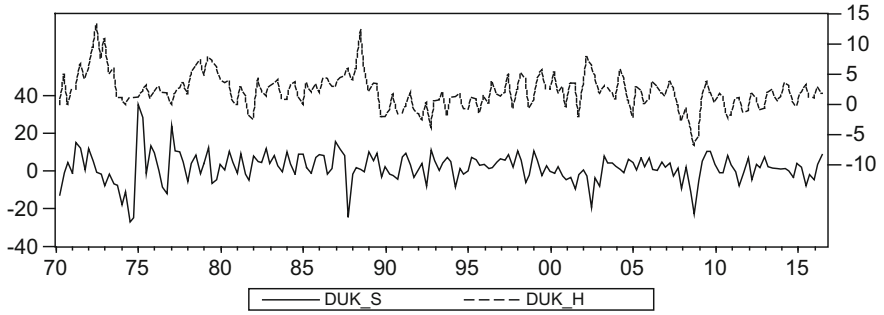

Fig. 5 Total Share Prices for All Shares Index ΔY_t and House Price ΔH_t in the UK

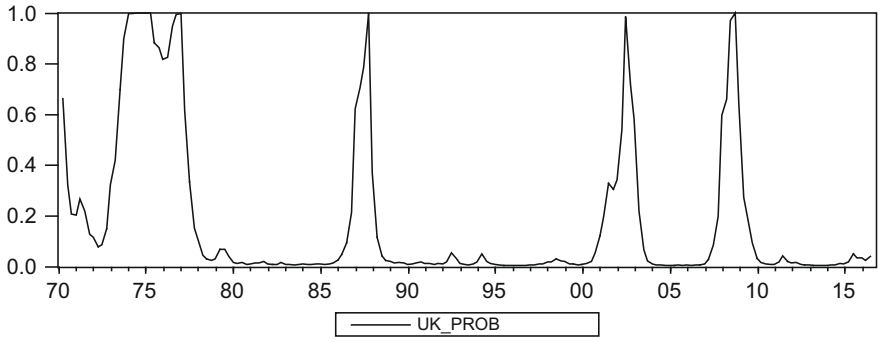

Fig. 6 Smoothed probabilities $\Pr(S_t = 1|\Delta Y_T)$

If we define the probabilities $\Pr(S_t = 1|\Delta Y_T)$ as business cycle in each countries, then we define the common probabilities $\Pr(S_t = 1|\Delta Y_T)$ as common business cycle in each countries.

To find out common business cycle between housing price and stock price for USA and UK, this paper adopted FIML Markov-switching model proposed by Yoon (2006, 2009, 2017), Yoon and Lee (2014a, b).

$$\Delta Y_{\mathrm{US}} = \alpha_{St,\mathrm{US}} + \beta_{St,\mathrm{US}} \Delta H_{\mathrm{US}} + e_{St,\mathrm{US}} \tag{5}$$

$$\Delta Y_{\mathrm{UK}} = \alpha_{St,\mathrm{UK}} + \beta_{St,\mathrm{UK}} \Delta H_{\mathrm{UK}} + e_{St,\mathrm{UK}} \tag{6}$$

where $\alpha_{St} = \alpha_0 S_t + \alpha_1 (1 - S_t)$, $\beta_{St} = \beta_0 S_t + \beta_1 (1 - S_t)$ for USA and UK.

$$\Pr(S_t = 0 | S_{t-1} = 0) = q,\ \Pr(S_t = 1 | S_{t-1} = 1) = p,$$

We can rewrite the Eqs. (5) and (6) as follows:

$$\begin{aligned} [\Delta Y_{US} \quad \Delta Y_{\mathrm{UK}}] * \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} - [\Delta H_{\mathrm{US}} \quad \Delta H_{\mathrm{UK}}] * \begin{bmatrix} \beta_{St,us} & 0 \\ 0 & \beta_{St,\mathrm{UK}} \end{bmatrix} \\ - [\alpha_{St,\mathrm{US}} \quad \alpha_{St,\mathrm{UK}}] = [e_{St,\mathrm{US}} \quad e_{St,\mathrm{UK}}] \end{aligned}$$

where $[e_{St,\mathrm{US}} \quad e_{St,\mathrm{UK}}] \sim i.i.d.N(0, \Sigma_{St} \otimes I_T)$, $\Sigma_{St} = \begin{pmatrix} \sigma^2_{St,\mathrm{US}} & 0 \\ 0 & \sigma^2_{St,\mathrm{UK}} \end{pmatrix}$, $\sigma^2_{St} = \sigma^2_1 S_t + \sigma^2_0 (1 - S_t)$, $\alpha_{St} = \alpha_1 S_t + \alpha_0 (1 - S_t)$, $\beta_{St} = \beta_1 S_t + \beta_0 (1 - S_t)$, $\Pr(S_t = 0 | S_{t-1} = 0) = q$, $\Pr(S_t = 1 | S_{t-1} = 1) = p$

We can find FIML Markov-switching estimation results in Table 3.

The *variance* σ^2_0 is significant. The *variance* σ^2_1 is also significant and showed large volatility during shock periods because *variance* σ^2_1 is larger than σ^2_0.

Table 3 FIML Markov-switching model

Parameters	
$\alpha_{0\ \mathrm{US}}$	4.2675 (0.8202)
$\alpha_{1\ \mathrm{US}}$	−4.9411 (2.2094)
$\alpha_{0\ \mathrm{UK}}$	3.1622 (0.5660)
$\alpha_{1\ \mathrm{UK}}$	−3.1368 (2.4485)
$\beta_{0\ \mathrm{US}}$	−0.7500 (0.4073)
$\beta_{1\ \mathrm{US}}$	1.3317 (0.7328)
$\beta_{0\ \mathrm{UK}}$	−0.1004 (0.1608)
$\beta_{1\ \mathrm{UK}}$	0.3347 (0.6268)
$\sigma^2_{0\ \mathrm{US}}$	29.7702 (5.3398)
$\sigma^2_{1\ \mathrm{US}}$	130.4955 (30.7483)
$\sigma^2_{0\ \mathrm{UK}}$	23.0932 (3.1634)
$\sigma^2_{1\ \mathrm{UK}}$	175.7288 (44.5078)
q	0.9210 (0.0358)
p	0.7444 (0.1036)
Log likelihood	−1243.76

Standard errors are in the parentheses

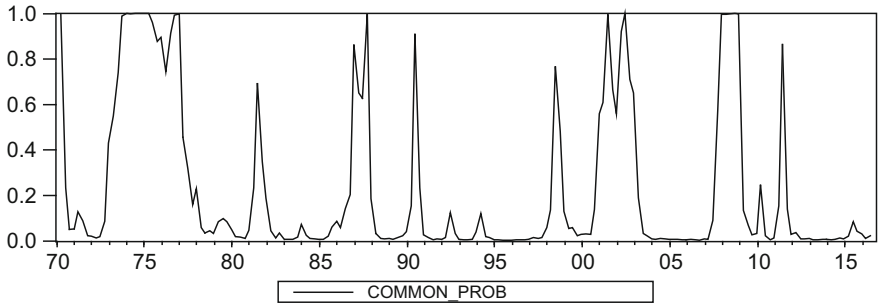

Fig. 7 Common probabilities $\Pr(S_t = 1|\Delta Y_T)$ for USA and UK

Figure 7 shows that common smoothed probabilities $\Pr(S_t = 1|\Delta \mathrm{Y_T})$ seem to accord with USA smoothed probabilities $\Pr(S_t = 1|\Delta \mathrm{Y_T})$. The common periods of regime 0 is 1/(1−0.9210) = 12.7 quarters. However, the common periods of regime 1 is 1/(1−0.7444) = 3.9 quarters which is shorter than regime 0 periods.

Figure 7 shows that common smoothed probabilities accord well with oil price shock periods during 1970s and 1990s. However, there was another common business cycle during S&L crisis (1987:I–1987:IV) and the bursting of housing bubble (2007:IV–2009:I).

From these results in Table 3 and Fig. 7, there was the evidence of the international common business cycle between housing price and stock price with big shocks.

4 Conclusion

As we applied to the Markov-switching model for 1970–2016 periods, we can find the new estimation results as follows: House price is common business cycle with stock price during 1970s and 1990s oil shocks periods, and house price is also common business cycle with stock price during S&L crisis and the bursting of housing bubble in 2008. These results suggest another explanation that house price is common business cycle with stock price with big shocks such as oil shocks and financial shocks.

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Bayesian Estimation of Irregular Stochastic Volatility Model for Developed and Emerging Stock Market

Kirti Arekar, Rinku Jain and Surender Kumar

Abstract This research is to study the irregular stochastic volatility (ASV) for developed and emerging stock markets that are predictable with Markov Chain Monte Carlo (MCMC) model. Data cover daily closing prices for five years from 2010 to 2016. The study is done on secondary data. We considered six developed countries stock returns and six emerging countries stock returns. The arrangement of developed and emerging markets is created on the economic status such as GDP, GNP and per capita income. We used the reference of Human Development Index (HDI) statistics to identify the developed and emerging markets for the study where they rank the countries on the basis of their development. In this article, the developed and emerging countries considered for the study show the mature markets as compared to the countries which we excluded from the study. The data considered were taken from the value-weighted equity market indices of three developed and six emerging countries. According to the MSCI reference, there are six indices, i.e. India (S&P CNX NIFTY and BSE SENSEX), USA (DOWJONES, NASDAQ-100 and S&P-500) and UK(FTSE-100) which are classified as developed markets and six emerging countries stock returns, i.e. France(CAC-40), Spain (IBEX 35), Malaysia (KLSE), Japan (NIKKI-225), Singapore (STRAIT TIMES) and Taiwan (TAIWAN WEIGHTED) which are classified as emerging countries. The findings provided that in the developed stock markets, high volatility persistence was present in USA NASDAQ-100 and India BSE SENSEX and in the emerging stock markets high volatility was present in Malaysia and Singapore. The strong and significant leverage effect present in India S&P CNX NIFTY, USA DOWJONES, USA S&P-500 and UK FTSE-100 from the developed

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countries stock markets and the leverage effect present in France (CAC-40), Spain (IBEX 35) and Japan (NIKKE-225) from the emerging countries stock markets.

Keywords Bayesian estimation · Volatility · Monte Carlo simulation model and irregular stochastic volatility

1 Introduction

The stochastic volatility (SV) models are suppressed procedure and are commonly used in stock market returns. In stochastic model (SV), the irregular property is dependent on the undeviating correlation among the expansions in both the returns and the volatility exists in both the emerging and developed stock markets. In this specific model, some unobserved component follows some latent stochastic process.

Volatility plays a significant role in pricing, portfolio and assets allocation. Volatility of a daily stock market for emerging and developed market is investigated by using irregular stochastic model which is assessed by using Markov Chain Monte Carlo (MCMC) method. Irregular stochastic model considered unobserved components following some latent stochastic process. In a Bayesian approach, the parameters are considered as random—variables with a given priors distribution where we assume the set of unknown parameters.

The general irregular SV model (*ASV*) is as follows:

$$S(t) = \sigma(t)A_1(t)$$
$$\sigma^2(t) = \alpha + \beta\sigma^2(t) + \sigma_v A_2(t)$$

where $A_1\,(t)$ and A_2(t) are two correlated Brownian motion.

The model is expressed as follows:

$$r_t = \sigma_t u_t$$
$$\ln\,\sigma_{t+1}^2 = \alpha + \phi\,\ln\,\sigma_t^2 + \sigma_v v_{t+1}$$

where $r_t = \ln(S_{t+1)}/S_t)$ is the rate of return of stocks in the market and $\varphi = 1 - \beta$, σ_v is the volatility.

Yu (2004) proposed the following Gaussian nonlinear state form which indicates the correlation coefficient ρ:

$$r_t = \sigma_t u_t$$
$$\ln\,\sigma_{t+1}^2 = \alpha + \phi\,\ln\,\sigma_t^2 + \sigma_v\sigma_t^{-1}\rho\,r_t + \sigma_v(1-\rho^2)^{1/2}w_{t+1}$$

The main aim of the research is to study, the irregular stochastic volatility (ASV) for developed and emerging stock markets that is assessed with Markov Chain Monte Carlo (MCMC) model. Irregular stochastic volatility (ASV) is based on the size and magnitude of the stock returns. Irregular impact has identified the relationship between the stock returns and volatility dynamics. The data cover the daily closing prices for five years from 2010 to 2016. The study is based on secondary data. We considered six developed countries stock returns, i.e. India, USA and the UK and six emerging countries stock returns, i.e. France, Spain, Malaysia, Japan, Singapore and Taiwan.

2 Literature Review

Bekaert and Wu (2000) and Wu (2001) findings say that there is a negative association which exists among the stock market index and advance volatility. Harrison and Moore (2012) measured ten stock market index of Central and Eastern European stock markets, and he also concluded that there is the presence of irregular volatility in the Central and Eastern European stock markets.

Aycan Hepsag (2016) also considered irregular stochastic models for Central and Eastern European (CEE) markets. The research identified that the high variability of volatility and high volatility persistence in stock markets of Poland and Lufthansa.

Alizadeh et al. (2002) estimated SV-LS model to identify whether there is the presence of leverage effect with respect to the association of South East Asian National Countries (ASEAN5). Hsu and Chiao (2010) used the Markov chain model by considering two levels of stochastic persistence. They also analysed the time pattern of the stock markets.

Early studies by Black (1976) and Christie (1982) concluded that increase in debt–equity ratio is due to fall in the stock prices, and the risk associated with the respective firm will increase. French et al. (1987) and Campbell and the Hents Cheal (1992) in there study shows the positive relationship among volatility and expected returns whereas Nelson (1991) and Gloston et al. (1993) shows negative relationship associated among predictable stock returns and restricted volatility.

Selcul (2004a, b) shows that there is a negative relationship between persistence in volatility and variability of volatility and also there is a negative correlation among leverage effect and persistence of volatility. Taylor (1994) proposed a stochastic model where the deterministic function of lagged squared return is used as the stochastic function of unobserved latent variables. The advantages of stochastic model are explained by the Carnero et al. (2004), and Das et al. (2009) have the capability to interpret on step ahead forecasting with respect to the stock market index.

3 Research Methodology and Findings

Volatility model for the stationary series of returns r_t is given as follows:

$$r_t = \alpha_t + Z_t$$
$$Z_t = \sigma_t \varepsilon_t$$

where ε_t is the identical independent discrete random variable with mean zero and unit variance and σ_t is the deterministic–stochastic random process which depends on the past values of the returns. α_t is constant and Z_t denotes the stochastic process.

The stochastic volatility model is represented in the following form:

$$Z_t = \exp(k_t/2)\,\varepsilon_t$$
$$K_t = \gamma + \theta K_{t-1} + \eta_t$$

where K_t is the latent stochastic volatility which equals to $\ln \sigma_t^2$, η_t is the i.i.d. (identical independent) a random variable with mean zero and variance σ_n^2 measures the uncertainty about future volatility. θ is the measure of the persistence of shocks to the volatility.

Asai and McAleer (2005) proposed the following specification:

$$Z_t = \exp(K_t/2)\,\varepsilon_t$$
$$K_{t+1} = \mu + \phi K_t + \eta_t; \qquad \varepsilon_t \sim N(0,1),\ \eta_t \sim N(0, \sigma_n^2)$$
$$E(\varepsilon_t \eta_t) = \rho \sigma_n$$

when $\rho < 0$, the type of irregularity exists is dynamic leverage stochastic volatility, whereas when $\rho = 0$, there exists no dynamic leverage among the innovations to returns and volatility (Asai and McAleer 2005).

The classification of developed and emerging markets is based on the economic status such as GDP, GNP and per capita income. We used the reference of Human Development Index (HDI) statistics to identify the developed and emerging markets for the study where they rank the countries on the basis of their development.

In this article, the developed and emerging countries considered for the study show the mature markets as compared to the countries. The data employed in the study are drawn from the value-weighted equity market indices of three developed and six emerging countries. According to the MSCI reference, there are six indices, i.e. India (S&P CNX NIFTY and BSE SENSEX), USA (DOWJONES, NASDAQ-100 and S&P-500) and UK (FTSE-100) which are classified as developed markets and six emerging countries stock returns, i.e. France (CAC-40), Spain (IBEX 35), Malaysia(KLSE), Japan (NIKKI-225), Singapore (STRAIT TIMES) and Taiwan (TAIWAN WEIGHTED) which are classifies as emerging countries.

The datasets involved daily closing price indices of developed and emerging markets. In developed countries, there are six indices, i.e. India (S&P CNX NIFTY

and BSE SENSEX), USA (DOWJONES, NASDAQ-100 and S&P-500) and UK (FTSE-100) and six emerging countries stock returns, i.e. France (CAC-40), Spain (IBEX 35), Malaysia (KLSE), Japan (NIKKI-225), Singapore (STRAIT TIMES) and Taiwan (TAIWAN WEIGHTED) for the period 01/01/2010–31/12/2016, a total 1769 observations. The source of the data is www.econstats.com and www.moneymarket.com.

We considered stock returns from the stock market indices of the selected countries using $\ln(P_t/P_{t-1}) * 100$, where P_t denotes the value of the stock prices indices of each country at time t.

The descriptive statistics for the stock returns of each stock are shown in Table 1 and 2.

The descriptive statistics for the stock returns of each stock market indices for emerging and developed countries are shown in Tables 1 and 2. From the descriptive statistics of developed countries presented in Table 1, we observed that India (S&P CNX NIFTY and BSE SENSEX), USA (NASDAQ-100) and UK (FTSE) show the negative average returns, whereas USA (DOWJONES and S&P-500) shows the positive average returns. All the developed countries stock returns the standard deviation is greater than the mean of the stock returns, indicating that the all the developed countries follow a random walk process. The sample skewness is negative for the USA (DOWJONES and S&P-500). These indicate that irregular tail extends more towards negative values as compared to the positive values. And for rest of developed countries have the positive skewness. Positive skewness ranges from 0.139 India (S&P CNX NIFTY) to 0.340 USA (NASDAQ-100). The sample kurtosis approximation (the lowest, 1.477 India BSE SENSEX and highest, 3.557 USA DOWJONES) indicates that the return distributions for all the developed countries are fat-tailed.

From the descriptive statistics of emerging countries presented in Table 2, we observed that France (CAC 40), Malaysia (KLSE), Japan (Nikkei-225) and Taiwan (Taiwan weighted) show the negative average returns, whereas Singapore shows the positive average returns. All the emerging countries stock returns the standard deviation is greater than the mean of the stock returns, indicating that the all the

Table 1 Summary statistics of the developed stock markets

Countries	n	Mean	Standard deviation	Kurtosis	Skewness	Maximum	Minimum
India S&P CNX NIFTY	1712	−0.0001	0.0045	1.5129	0.139	0.026	−0.016
India BSE SENSEX	1730	−0.0002	0.0102	1.477	0.166	0.061	−0.037
USA DOWJONES	1761	0.00015	0.0039	3.557	−0.385	0.0180	−0.024
USA NASDAQ-100	1727	−0.0002	0.0047	2.815	0.340	0.027	−0.021
USA S&P-500	1790	0.00014	0.0040	4.935	−0.469	0.0299	0.0201
UK FTSE-100	1766	0.00006	0.0044	2.7388	0.253	0.026	−0.021

Table 2 Summary statistics of the emerging stock markets

Countries	n	Mean	Standard deviation	Kurtosis	Skewness	Maximum	Minimum
France (CAC-40)	1756	−0.000	0.0058	0.155	3.4971	0.036	−0.040
Spain (IBEX 35)	1792	0.000	0.0067	6.905	0.140	0.057	−0.058
Malaysia (KLSE)	1645	−0.0001	0.003	0.340	2.425	0.019	−0.014
Japan (NIKKI-225)	1696	−0.0001	0.006	0.448	6.923	0.048	−0.046
Singapore (STRAIT TIMES)	1460	0.0001	0.0035	0.340	2.425	0.019	−0.014
Taiwan (TAIWAN WEIGHTED)	1731	−0.0004	0.004	0.478	2.818	0.024	−0.019

developed countries follows a random walk process. The sample skewness for all the countries from emerging market is positive; these indicate that irregular tail extends more towards positive values as compared to the negative values. The sample kurtosis approximation (the highest, 6.293 Japan NIKKI-225 and lowest, 2.425 Malaysia and Singapore) indicates that the return distributions for all the developed countries are fat-tailed.

From Fig. 1, it is observed that for the developed countries, i.e. USA (DOWJONES, NASDAQ-100 and S&P-500) and UK (FTSE-100), volatility is increasing continuously as compared to India (BSE, NIFTY). The volatility for the Indian market is also increasing, but at the end of the Year 2016, it is decreasing as compared to other developed markets. From Fig. 2, we identified that for the emerging countries, i.e. Japan (NIKKI-225) and France (CAC-40), the volatility is continuously higher than the other emerging countries, i.e. Spain (IBEX-35), Malaysia (KLSE), Singapore (Strait Times) and Taiwan (Taiwan Weighted). Spain (IBEX-35) and Singapore (Strait Times) have a lower level of volatility. Overall, the stock market index for all developed countries seems to be consistently higher than the emerging countries. This relationship helps us to understand the volatility pattern for developed markets and emerging markets.

In this study, we used MCMC approach for estimating leverage model and we used the code provided by Yasuhiro Omori which will be used in the WinBUGS software. For the prior values we considered as $\mu \sim$ Inverse-Normal (−10,1), $\rho \sim$ Inverse-Uniform (−1,1), $\sigma_n^2 \sim$ Inverse-Gamma(2.5,0.025) and $\phi \sim$ Inverse-Beta (20,1.5) and in MCMC model we initialized the values $\mu = -9$, $\sigma_n^2 = 100$, $\phi = 0.095$ and $\rho \sim -0.4$ following also Yasuhiro Omori. We used 95% interval for the posterior means of parameter approximation.

From Table 3, it is observed that the approximations of the volatility determination coefficient ϕ are in among 0.861 USA NASDAQ-100 and 0.956 India BSE

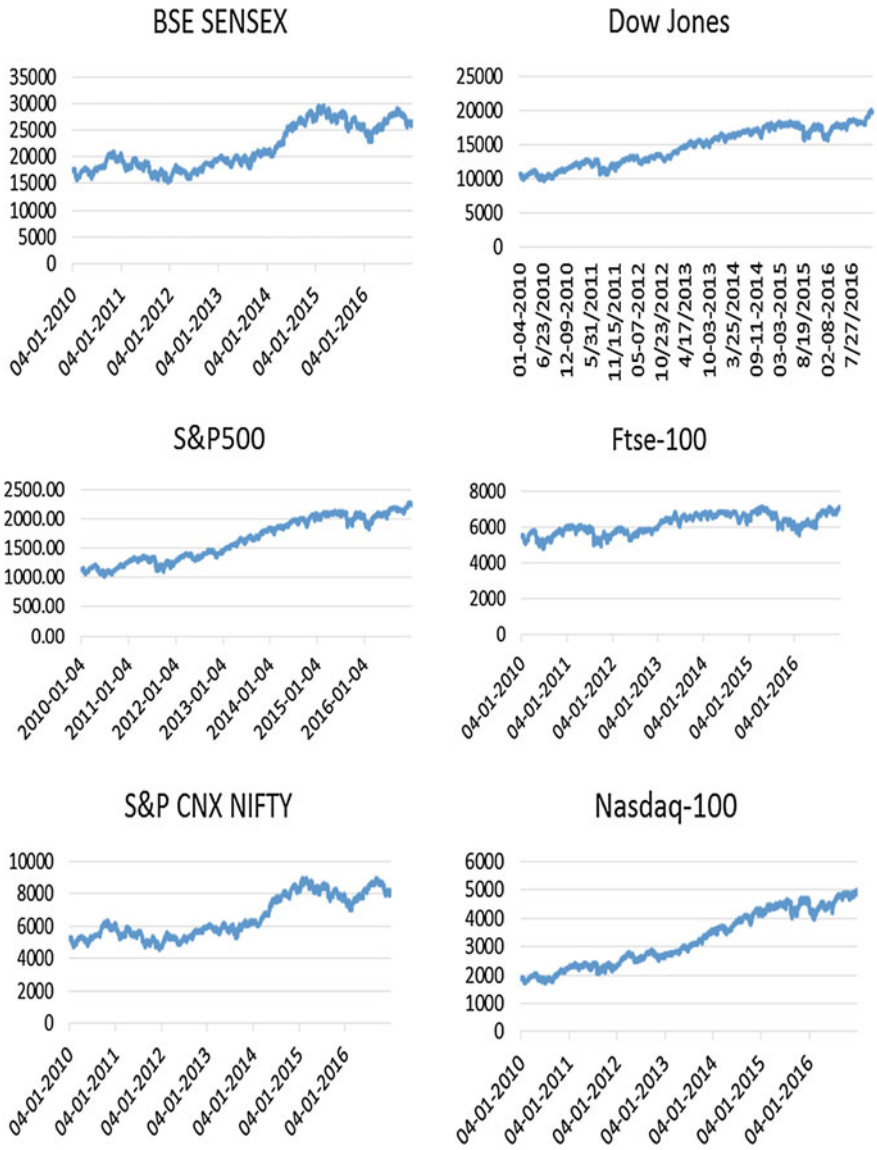

Fig. 1 Volatility pattern for developed markets

SENSEX. The results indicate that there is high volatility persistence in these stocks markets. The upper interval values of 95% credibility intervals are less than 0.99 except India BSE SENSEX and USA NASDAQ-100. These results are consistence with the results suggested by Jacquier et al. (1994, 2004).

The posterior means of the coefficient $\hat{\rho}$ indicate the correlation among shocks to return at time t, and shocks to volatility at time t + 1 are negative for all the

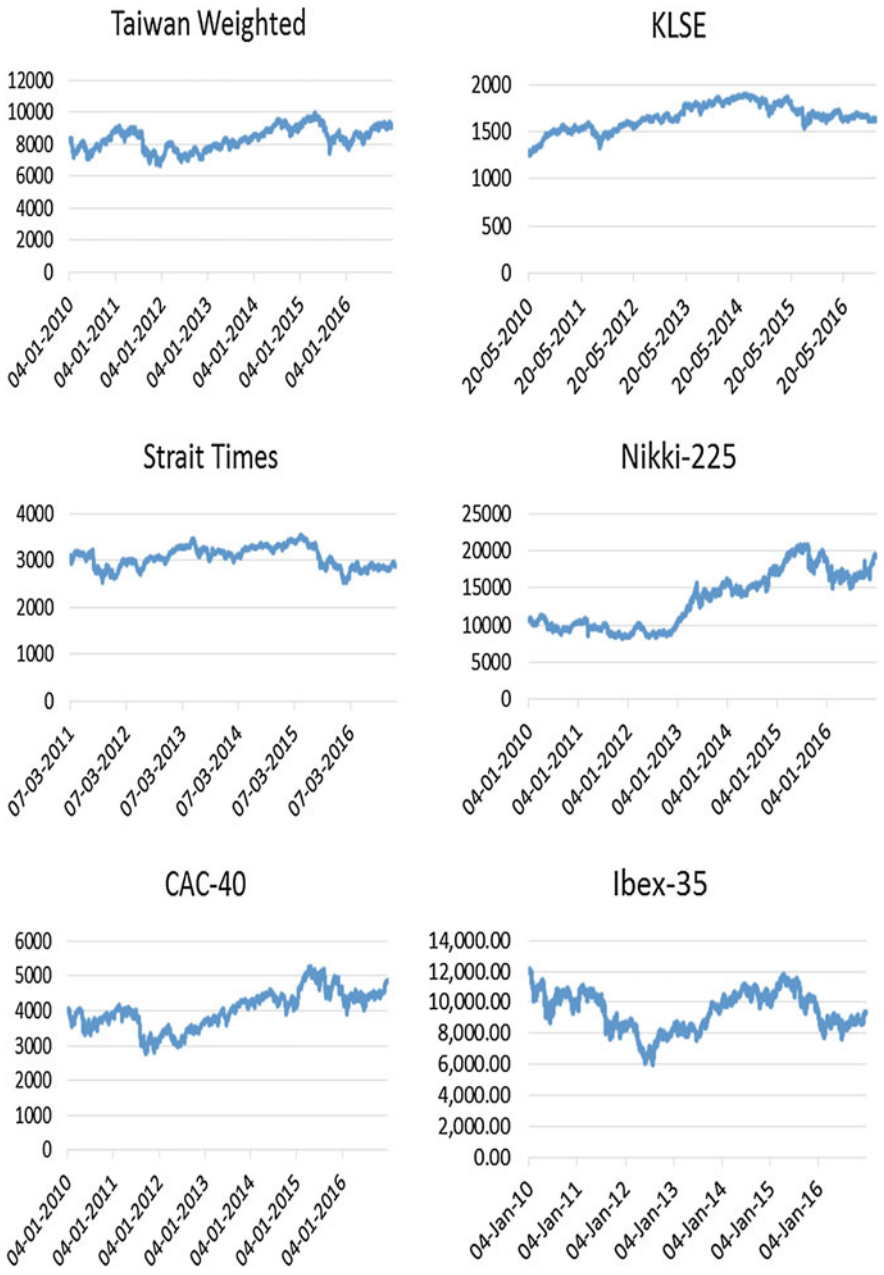

Fig. 2 Volatility pattern for emerging markets

Table 3 Estimation results of the posterior means of parameters for developed countries

Countries	$\hat{\phi}$	$\hat{\rho}$	$\hat{\sigma}$
India S&P CNX NIFTY	0.921, [0.89, 0.95]	−0.321*, [−0.45, − 0.24]	0.14*, [0.01, 0.46]
India BSE SENSEX	0.956, [0.96, 0.99]	−0.009, [−0.31, −0.06]	0.12*, [0.10, 0.34]
USA DOWJONES	0.93, [0.90, 0.96]	−0.121*, [−0.37, −0.21]	0.10*, [0.02, 0.45]
USA NASDAQ-100	0.861, [0.98, 0.99]	−0.323, [−0.31, −0.03]	0.11*,[0.05, 0.39]
USA S&P-500	0.946, [0.93, 0.95]	−0.112*, [−0.17, −0.22]	0.22*, [0.15, 0.42]
UK FTSE-100	0.921, [0.91, 0.97]	−0.621*, [−0.16, −0.01]	0.03*, [0.01, 0.92]

* statistically signifiacnat at 0.05 level of significant

countries. But for the country i.e. India S&P CNX NIFTY, USA DOWJONES, USA S&P-500 and UK FTSE-100 are also statistically significant at 5% level of significance from the sample of developed countries. The smallest is −0.0009 for India BSE SENSEX, and the highest value is −0.621 for UK FTSE 100. So we can conclude that there is a strong and significant leverage effect present in India S&P CNX NIFTY, USA DOWJONES, USA S&P-500 and UK FTSE-100 from the developed countries stock markets.

The posterior means of the volatility of volatility coefficient $\hat{\sigma}$ are within the range of 0.03 (UK FTSE-100) and 0.22 (USA S&P-500).

From Table 4, it is observed that the approximation of the volatility persistence coefficient ϕ is in among 0.802 Japan (NIKKI-225) and 0.956 Malaysia (KLSE). The results indicate that there is high volatility persistence in these stocks markets. The upper intervals values of the 95% credibility intervals are less than 0.99 except

Table 4 Estimation results of the posterior means of parameters for emerging countries

Countries	$\hat{\phi}$	$\hat{\rho}$	$\hat{\sigma}$
France (CAC-40)	0.911, [0.71, 0.92]	0.111*, [−0.35, − 0.22]	0.54*, [0.13, 0.76]
Spain (IBEX 35)	0.921, [0.90, 0.97]	−0.214*, [−0.24, −0.16]	0.46*, [0.19, 0.44]
Malaysia (KLSE)	0.956, [0.97, 0.99]	−0.251, [−0.42, −0.33]	0.56*, [0.42, 0.49]
Japan (NIKKI-225)	0.802, [0.92, 0.94]	−0.006*, [−0.14, −0.04]	0.68* [0.05, 0.52]
Singapore (STRAIT TIMES)	0.947, [0.96, 0.99]	−0.544, [−0.14, −0.35]	0.72*, [0.28, 0.47]
Taiwan (TAIWAN WEIGHTED)	0.910, [0.90, 0.95]	−0.744, [−0.20, −0.45]	0.47*, [0.07, 0.82]

* statistically signifiacnat at 0.05 level of significant

Malaysia (KLSE) and Singapore (STRAIT TIMES). These results are consistence with the results suggested by Asai and Angelo Unite (2010).

The posterior means of the coefficient $\overset{\Lambda}{\rho}$ indicate the correlation among shocks to return at time t, and shocks to volatility at time t + 1 are negative for all the countries. But for the countries like (CAC-40), Spain (IBEX 35) and Japan (NIKKI-225) are also statistically significant at 5% level of significance from the sample of emerging countries. The smallest is −0.006 for Japan (NIKKI-225), and the highest value is −0.744 for Taiwan (TAIWAN WEIGHTED). So we can conclude that there is a strong and significant leverage effect present in France (CAC-40), Spain (IBEX 35) and Japan (NIKKI-225) from the emerging countries stock markets. The posterior means of the volatility of volatility coefficient $\overset{\Lambda}{\sigma}$ are within the range of 0.46 Spain (IBEX 35) and 0.72 Singapore (STRAIT TIMES). The results also suggested that there is the higher variability present in emerging countries stock market as compared to the developed countries stock markets.

4 Conclusions

This research is to study the stock markets volatility exists in different developed and emerging stock markets by using irregular stochastic volatility (ASV) and Markov Chain Monte Carlo (MCMC) models. The datasets involved daily closing prices indices of developed and emerging markets. In developed countries, there are six indices, i.e. India (S&P CNX NIFTY and BSE SENSEX), USA (DOWJONES, NASDAQ-100 and S&P-500) and UK (FTSE-100) and six emerging countries stock returns, i.e. France (CAC-40), Spain (IBEX 35), Malaysia (KLSE), Japan (NIKKI-225), Singapore (STRAIT TIMES) and Taiwan (TAIWAN WEIGHTED) for the period 01/01/2010–31/12/2016, a total 1769 observations.

The empirical evidence provided that in the developed stock markets high volatility persistence was present in USA NASDAQ-100 and India BSE SENSEX and in the emerging stock markets high volatility was present in Malaysia and Singapore. The strong and significant leverage effect present in India S&P CNX NIFTY, USA DOWJONES, USA S&P-500 and UK FTSE-100 from the developed countries stock markets and the leverage effect present in France (CAC-40), Spain (IBEX 35) and Japan (NIKKI-225) from the emerging countries stock markets. The results also suggested that there is a higher variability present in emerging countries stock market as compared to the developed countries stock markets. The results help the investors to invest in developed and emerging countries stock markets.

The approximation for the developed markets and volatility persistence coefficient φ is in among 0.861 USA NASDAQ-100 and 0.956 India BSE SENSEX. The results indicate that there is high volatility determination in these stocks markets. The upper intervals values of 95% credibility intervals are less than 0.99 except India BSE SENSEX and USA NASDAQ-100. These results are consistence with the results suggested by Jacquier et al. (1994, 2004).

The approximation for the emerging countries and volatility determination coefficient ϕ is in among 0.802 Japan (NIKKI-225) and 0.956 Malaysia (KLSE). The results indicate that there is high volatility determination in these stocks markets. The upper intervals values of 95% credibility intervals are less than 0.99 except Malaysia (KLSE) and Singapore (STRAIT TIMES). These results are consistence with the results suggested by Asai and Unite (2010).

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Management of Mobile Financial Services—Review and Way Forward

Per J. Nesse, Oddvar Risnes and Hanne Stine Hallingby

Abstract Mobile financial services (MFS) represent an area of innovation and strategic importance for global initiatives against poverty and mobile telecommunication providers. The World Bank wants financial inclusion of the poor, and the telecommunication providers seek profit. Firstly, this paper introduces a MFS terminology overview before reviewing previous research on MFS and the global MFS industry picture today. The literature review on mobile payment services shows that researchers from late 90s until now have focused mostly on technology and consumer adoption. Only recently the research has picked up on studying MFS as complex ecosystem with lots of tension and dependent on local circumstances. Secondly, we provide key learnings from the Easypaisa MFS case in Pakistan. This is an example of successful management of a complex ecosystem with processes and events that moved a MFS implementation from one state to another—from cash-based OTC solution to a digital mobile wallet-based solutions. The case study is based on interviewees with the mobile operator, agencies, and governmental organizations like Pakistan Telecommunication Authority, the largest social cash transfer program in Pakistan (BISP), and nongovernmental organizations. Finally we present the way forward for MFS including research recommendations.

Keywords Mobile financial services · Ecosystem management
OTC and mobile wallets · Biometric ID · Easypaisa

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1 Introduction

About 2 billion adults in the developing world are considered financially excluded or unbanked, meaning that they do not have access to basic financial services (Bank 2014). However, the majority of the unbanked own or have access to a mobile phone, hence access to mobile financial services. These services can contribute to financial inclusion fostering economic growth, fighting poverty, and improving social conditions for the unbanked and unserved (CGAP 2015; Khan 2016). This is pointed out in national and global strategies for financial inclusion and literacy in several developing countries (State Bank of Pakistan 2015; Khadija et al. 2012; OECD 2013). Mobile operators see MFS as an opportunity for revenue generation through an adjacent business (both basic payment and services such as credit, lending) and recouping of cost and investments through increased data usage by consumers (Dennehy and Simmons 2015). These commercial goals are accompanied by positive socioeconomic effects, i.e., financial inclusion of the unbanked can increase the country's GDP (BCG 2011). Furthermore, the benefits for banks may come from (1) protection of current account and products and avoiding disintermediation by third parties and (2) reduced use of cash, while serving the unbanked in a cost-effective way. For the merchant, higher Point-of-Sale (PoS) throughput, less cost for cash handling, and real-time messaging to users are major benefits with MFS. In addition, a richer personalized shopping offering using digitalized loyalty cards and coupons is also possible. Access to transaction data and ownership of the user interface are also vital benefits (Hernæs 2016). Finally, for the customer, MFS makes payments possible anytime, anywhere, and with reduced risk of theft (cash—especially in underdeveloped countries). Governmental stakeholders that perform many small money transactions to private persons (G2P) will also benefit from mobile solution.

In this paper, we ask which factors that have positively affected uptake of mobile accounts in Pakistan and how the current successful OTC service solution has slowed down the uptake and use of mobile accounts? We answer these questions with a case study of Easypaisa in Pakistan.

2 MFS Terminology and State of the Industry

Mobile financial services is defined as the use of a mobile phone to access financial services and execute financial transactions, i.e., mobile payment, mobile insurance, mobile credit, and mobile savings are all mobile financial services (GSMA 2015). Mobile payment refers to transfer of money (domestic or international) via a mobile money platform, using a mobile device. These transfers can take many forms, including bill payment, bulk disbursement, and money transfers between persons, i.e., person-to-person (P2P), or as government disbursements to private persons, i.e., government-to-person (G2P). Moreover, the payment may occur in a retail

store (proximity) or remotely (online) from account to account (A2A). The service must rely heavily on a network of transaction points outside bank branches and ATMs, which make the service accessible to unbanked and underbanked people. Mobile credit, insurance, and savings are mobile-based versions of familiar financial services, enabling the customers to access microinsurance, loan, and saving services using a basic mobile phone. In a global perspective, the majority of subscribers using such mobile services together with payment services do not have access to traditional bank branches. For these subscribers, mobile money accounts (mobile wallets/mWallets) can fill the role that conventional bank accounts have in mature markets. An active mobile account is defined as an account/wallet which has been used to conduct at least one transaction during a certain period of time, e.g., 90 days (GSMA 2015).

Various enabling technologies are used for mobile payment service. Arthur D. Little (Duvaud-Schelnast and Born 2016) presents an overview of the current situation for enabling technologies. Short message service (SMS)/USSD, mobile Internet, and NFC are the technologies most used for mobile financial services. We can identify three distinct approaches. First, to address the needs of the underserved, the focus has been on providing a service that can be used from a basic mobile device not relying on data coverage. The services being monitored by the GSMA mobile money program fall into this category. SMS/USSD is the enabling technology here; thus, payment services can be done from a basic feature phone and over 2G networks. Also, early implementations in the Nordics have led to a continued use of SMS/USSD-based services in these developed economies. Second, initiatives that stem from mobile Internet providers have—not surprisingly—led to a generic platform for development of payment services, based on mobile broadband connection and "pay-pal look alike" solutions, e.g., (Fung 2016). Chinese players have been dominating this approach. Third, there are initiatives that are based on a strong collaboration between banks and MNOs to build contactless payment services based on NFC.

The number of mobile money services has grown steadily for many years and has now reached 271 services in 93 countries, here defined as services for the underserved, i.e., without bank accounts, and allowing access using a basic mobile phone (GSMA 2015). The sub-Saharan/African continent dominates with roughly 50% of the services in total. Here we find the SMS/Telco-based M-Pesa payment service in Kenya as a major service. The other major region is South Asia. Here we also find Easypaisa in Pakistan and bKash in Bangladesh, as leading examples of payment services (GSMA 2016). So far, we see that the large majority of deployed services are in mobile money (mobile payment). This may be due to mobile operator focuses on satisfying the immediate user needs for providing payment transactions. From 2013, there is a growing uptake of mobile insurance. Mobile saving and mobile credit services that are critical for financial inclusion are still small. However, in 2015, roughly 200 mobile insurance, and credit and saving services were commercially deployed in developing countries. The mobile insurance industry continued to expand in 2015, with 120 live services by the end of December (a 9% increase from 2014). Mobile insurance is now available in 33

emerging markets, predominantly in sub-Saharan Africa (58%), South Asia (19%), and East Asia and Pacific (18%). The majority of mobile insurance services continue to be led by mobile operators (63%), a slight increase from 2014.

Further, the number of mobile insurance policies issued increased by 68% from last year, to 31 million policies by June 2015. As of December 2015, there are 45 live mobile credit services across 16 countries—the vast majority of these services in sub-Saharan Africa (82%), with 9% of services in East Asia and Pacific. Seven new services were launched in 2015, compared to 12 launched in 2014. There are at least 13 planned mobile credit services across sub-Saharan Africa and South Asia, suggesting continued interest in offering mobile credit. Of new services launched in 2015, all were in sub-Saharan Africa. In 2015, the number of live dedicated mobile savings services globally increased by 20%, up to 36 services from 30 services at the end of 2014. Mobile savings services are available in 18 countries, primarily in sub-Saharan Africa (54%), East Asia and Pacific (23%), and South Asia (20%). Six new services are launched in 2015 (all within sub-Saharan Africa), and of these, one-third are a combined mobile savings and mobile credit product, highlighting the relationship between these two products. In 2015, customers are saving more. Based on survey respondents, the number of registered mobile savings accounts increased from 22 million accounts in 2014 to 32 million in 2015. By the end of 2015, 411 million customers have a registered mobile money account (up 31% from 2014). Nearly one hundred million new accounts were opened in 2015, primarily in sub-Saharan Africa and South Asia. This steep growth is a good sign for products like credit and saving, since these services rely on accounts that comply with Know Your Customer (KYC) requirements (GSMA 2016).

3 State-of-the-Art Theory and Related Research

Mobile financial services are better understood with a systemic approach where implementations are contingent on local conditions and outside the control of any market actor (Dahlberg et al. 2015); lately such markets have been called ecosystems (Gawer and Cusumano 2014). Widely used implementations of technological systems are described with characteristics such as being an installed base (Hanseth and Lyytinen 2010), being a platform (Gawer and Cusumano 2002), having acquired momentum (Hughes 1993), and being subject to network externalities (Bergek et al. 2008); these characteristics have the form of being empirical observations of as well as managerial guidelines for how a technology earn wide use. Such systems and dynamics are not controlled by one actor; still, commercial actors enjoy wide use and belonging profits from installed bases, and public bodies enjoy benefits for citizens. Because of such desired benefits, there are also examples of technological systems that were promoted by actors, but failed (Reuver et al. 2014; Ozcan and Santos 2015).

Installed bases and platforms are technological systems that other actors use for further innovation and benefits (Hanseth and Lyytinen 2010; Gawer and Cusumano

2002; Yoo et al. 2010). Although there are indisputable benefits that emerge only when the system is widely available, the literature also discusses the problematic lock-in effect. Lock-in implies high path dependencies, e.g., a system's interdependencies are so high that it takes time, is costly, and perhaps impossible to change (Hanseth and Lyytinen 2010). Interdependencies and lock-in remains a challenging empirical fact (Eriksson and Åkerfalk 2010), despite approaches such as technology modularity (Baldwin and Woodard 2009). Taken together, in existing successful implementations of technology systems, we should in the first instance expect to find dominant installed bases and path dependencies. In the next instance, we should expect to find inertia and lock-in situations when installed bases are challenged. Even though new components introduced into an existing system clearly could bring further benefits, it is the system's former success that hinders the new to emerge.

Mobile financial services in Pakistan demonstrate a successful installed base using a manual over-the-counter solution; it is a platform taking advantage of mobile operators' agent network to provide money transfers between end users. Stakeholders have long worked to transfer users to digital mobile wallet (mWallet) without succeeding. Innovation with the existing solution is present, but the potential innovation is expected to be a lot higher with digital services and a lot is at stake. A sudden event—namely the new biometric requirements for SIM cards—changed this situation. It became easy to establish a mWallet account, and the number of users and frequency of use made a jump. Still, at this point of transformation, the forces from existing and new installed bases draw in different directions: one toward the continued use of OTC, and the other toward the new digital accounts. This is an interesting example of a technical system going through phases of stability—destabilization—re-stabilization.

Thus, it makes sense to analyze mobile financial services with characteristics drawn from technology systems. Their emergence takes an evolutionary path, meaning that they are systemic in nature, and it is difficult to predict one of many possible outcomes or stable situations (Hanseth and Lyytinen 2010; Bergek et al. 2008). Mobile financial services are currently at an early stage (Dahlberg et al. 2015) where we barely have seen the emergence of dominant designs, not to say, the disruption of such. What we see at play in Pakistan is how the current design so far is continuing its dominance. The new design has started to grow, but we do not know to what extent it will succeed. Our intention is to document the forces that have enabled and sustain the current OTC situation. Furthermore, we will explain how the biometric event has fueled off a new design.

The major reviews of the mobile payment field covered two time periods (from 1998 to 2006, and from 2007 to 2014) (Dahlberg et al. 2015). Three focus areas of research were detected—technology, customers, and ecosystem. With respect to technology, the top five research aspects are security including privacy, message protocols, security proofs, public key infrastructure (PKI)/WPKI, and authentication.

Looking at articles published during the years 1998–2006, and then 2007–2014, we find that the maturity of the technology literature has increased. We also found fewer proposals for new technologies. Instead, the majority of descriptive articles discuss how to improve the deployment, use, or impact of an existing technology. Furthermore, most of the 13 articles classified into the proposed constructions have a mathematical or logical evaluative section about the merits of the construction. The relative proportion of empirically evaluated constructions with prototypes has remained at the same level—slightly under the 25% level. As a whole, the technological articles are more mature and sophisticated than before, though they are more fragmented and one-sided.

Concerning consumers, there is an overweight of consumer adoption studies using Technology Acceptance Model (TAM) and other diffusion theories. TAM has limitations: It assumes that there is a single technology available to users, ignoring cultural issues, business environment, alternative methods of making payments, and also various legal and financial regulatory issues (Shin 2009). A review of journals from 2004 to 2014 concludes that the m-banking adoption literature is fragmented and limited by its narrow focus on SMS banking in developing countries (Shaikh and Karjaluoto 2015). The literature on consumer adoption suggests that main factors influencing consumer attention and usage of mobile banking services are compatibility (with user lifestyle), trust (in mobile banking), and perceived usefulness/ease of use/risk/cost and advantage. The results from a survey of mobile payment users in Korea show that early adopters value ease of use, while late adopters value usefulness when it comes to adoption of the MFS services (Kim and Lee 2010).

Finally, regarding the ecosystem area, the majority of articles describe a field where technologies and markets are understood as complex, networked, and interdependent (Dennehy and Simmons 2015). The relationship between technologies and actors is regarded as a main source for explaining both failure and successes, and theories on ecosystem and cooperation (Donovan 2012), collaboration (Reuver et al. 2014), and collective action (Guo and Bouwman 2016) are dominating the field. Several authors have recently applied and acknowledged the business ecosystem approach (GSMA 2015; Zhong 2015). The ecosystem actors or stakeholders most often referred to are financial institutions, mobile network operators, regulators, merchants, consumers, mobile device manufacturers, and technology/SW providers.

4 The Easypaisa Case in Pakistan

This section describes the major events and reasoning behind the development of the Easypaisa mobile payment service in Pakistan and the role of some major ecosystem actors. We elaborate on the factors that can have positively affected the transformation from OTC to mobile wallets and the tensions that occurred during this process.

4.1 Research Methodology

We focus on a single explanatory case study where the current stable and successful situation is potentially destabilized by major events (e.g., enforced re-verification of SIM). The Easypaisa case is an opportunity to observe changes predicted from destabilizing events, and how current stability is still obstacle to changes (Yin 2014). We use the growth of OTC transactions and mobile wallets as dependent variables. The factors that are explaining the growth of these and the change from one to the other are regarded as independent variables. We had semi-structured interviews through e-mail with different stakeholders during 2015. We interviewed different stakeholders in Pakistan, including mobile operator Telenor, agents, and governmental organizations like Pakistan Telecommunication Authority and BISP together with nongovernmental organizations (NGOs). The interviewees were selected based on purposive sampling, which allows the research questions better to be answered (Bryman and Bell 2011). All interviews were recorded and transcribed in full. Furthermore, secondary data sources from Telenor reports, Web sites, press, etc., are utilized along with quantitative user data from State Bank of Pakistan and Telenor.

4.2 Growth of OTC Transactions and Mobile Wallets

According to State Bank of Pakistan (2015) and State Bank of Pakistan (2017), the numbers of accounts increased from 7.5 million in Q1 2015 to almost 24 million in Q1 2017; see more in Table 2. However, the OTC solution remains a demanded solution; the reason given for not transferring to mobile accounts continues to be that people do not need it for their purposes. Although mobile money accounts increased across most demographics, the increase was larger among urban citizens, males, and those above the poverty line, ref the Financial Inclusion Insight (2016). The breakup of OTC transactions shows that fund transfers and utility bill payments are dominant both in terms of number and volume, followed by government-to-person disbursements (State Bank of Pakistan 2017). The breakup of mobile wallets shows that the majority of transactions are contributed by mobile top-ups, followed by cash deposits and withdrawals and fund transfer through mWallets. Government-to-person disbursements also represent a significant value of the transactions. A few are using mobile money solutions for making purchases at a grocery shops or retail stores, partly due to lack of merchants ready to make these digital transactions (finclusion.org 2015).

Figure 1 illustrates the growth in number of OTC transactions and mobile wallet transactions from 2014 to 2015. We also find the mWallet/OTC ratio for the same period depicted in the figure.

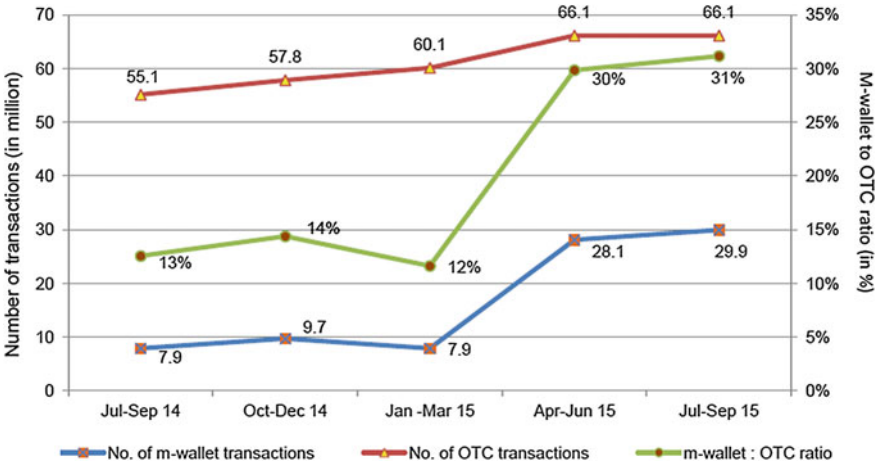

Fig. 1 OTC to wallet from 2014 to 2015 for all providers (State Bank of Pakistan 2015)

From Fig. 1, we see that there is a major shift in the trend in Q1 2015 with respect to number of transactions and the mWallet/OTC ratio. This coincides with the re-verification of SIM cards with biometric ID by the Pakistani authorities in 2014 as well as simplification of the registration process imposed by Easypaisa. Moreover, active involvement in large governmental money transfer and NGO programs through digital solutions was also initiated during this period; see more in Table 1. Figure 2 illustrates the increase in number of mobile money transactions through OTC and mobile wallet delivery solutions and the perceptual ratio until today.

From Fig. 2, we see that the OTC solution reached its top in June 2016 with almost 70 million transactions, but is now declined down to 58.6 million transactions in March 2017. The number of mWallet transactions has increased in the same period from 44.6 million to 77.1 million. The mobile wallet solution (using mobile accounts) now covers roughly 57% of all the transaction (Q1 2017). These transactions are not limited to Easypaisa subscribers only, but cover two other major competing MNO/bank providers in Pakistan; see more in Table 2. We also see that there is a drop in number for OTC transactions in Q2 2016 and lift in number of mobile wallet transactions which most likely is a consequence of the expansion of total number of agents for all mobile network operators in this period—from roughly 267,000 in Q3 2015 to roughly 368,000 in Q1 2017. The number of mobile accounts increased from roughly 13 million to 23 million during this period. Easypaisa also had a major brand and marketing campaign this period designed to educate potential customers about how the Easypaisa mobile account worked and its benefits (convenient and secure money transfers and payment of utility bills (Arif 2016).

Table 1 Development of Easypaisa company and services (State Bank of Pakistan 2017; Arif 2016)

Ecosystem stakeholders	Critical decisions and events	
	2009–2014	2015–tt
Easypaisa services and activities	• 2009: Transactions only over-the-counter (OTC), followed by utility bill payment and money transfer • 2010: Mobile wallets. Airtime top up, savings and insurance • 2013–14: ATM cards, interbank fund transfer • 2014: mWallet registration with biometric verification system	• 2015: Biometric string registration • 2015: Easypay • 2016: Mobile account credit and loans • 2016: Biometric money transfer service • 2014–2015: Marketing campaigns
Regulators	• 2014: Telco regulator implement strict biometric ID requirements for all new mobile subscriptions • 2014: Bank regulator accept mobile subscriptions as basis for level 0 bank accounts, i.e., enables easy account opening	• 2015: Telco regulator implement strict biometric ID re-verification of all mobile subscriptions—all mobile subscriptions can now easily open level 0 bank accounts
Easypaisa competitors	• 2010–12: UBL Omni, Timepay • 2013–14: UPaisa, HBL Express, MCB Lite, MobilePaisa, Mobicash	• 2015: MobiCash, UBL Omni—string registration
Easypaisa agents	• 2009: 8000 Easypaisa agents • 2012: 20,000 Easypaisa agents • 2015: 267,000 agents for all mobile network operators	• 2016: 75,000 Easypaisa agents • 2017: 368,000 agents for all mobile network operators
Easypaisa G2P and B2C disbursement solutions	• 2012: BISP collaboration • 2014: SERP collaboration	• 2016: NESTLE partnership • 2014–2015: For example, Rabat bakers, Coffee planet, Cinepax movie centers
Nongovernmental organizations (NGOs)	• 2010–14: Helix, ACTED, Karandaaz, Intermedia	
All mWallet providers	• 2015 (Q1): mWallet users: 7,5 mill • 2015 (Q1): Active mWallets: 20% • 2015 (Q1): mWallet/OTC ratio: 12%	• 2017 (Q1): mWallets: 23.7 mill. • 2017 (Q1) Active mWallets: 48% • 2016 (Q3): mWallet/OTC ratio: 57%

4.3 Easypaisa—Background and Development

In 2004, Telenor acquired a license for providing GSM services in Pakistan. In March 2008, the State Bank of Pakistan (SBP) issued Branchless Banking Regulation, calling for a bank-led model, which meant that only commercial banks and microfinance banks with an existing banking license were eligible to apply for a

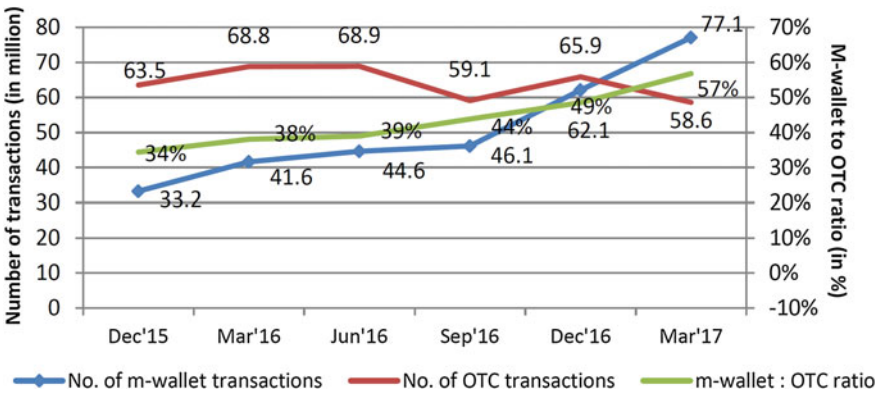

Fig. 2 OTC to wallet from 2015 to 2017 for all providers (State Bank of Pakistan 2017)

Table 2 Mobile money market shares for Easypaisa and major competing mobile operators in Pakistan (State Bank of Pakistan 2015, 2017)

Market shares		Major mobile network operators and *MFS service introduced*		
		Telenor *Easypaisa* (2009) (%)	Mobilink *Mobicash* (2014) (%)	UBL *UBL Omni* (2010) (%)
2015 (Oct–Dec)	Agents	32	19	13
	Mobile accounts	64	20	14
	Active accounts	26	48	23
	Volume of transactions	54	26	14
	Value of transactions	52	23	15
2017 (Jan–Mar)	Agents	31	19	11
	Mobile accounts	45	42	11
	Active accounts	34	51	13
	Volume of transactions	39	47	9
	Value of transactions	47	35	11

branchless banking license. In November 2008, Telenor Pakistan acquired 51% ownership stake in the Pakistani microfinance bank, Tameer Bank, to offer real-time online banking at branches and 24-h service branches and agent shops. A joint Easypaisa management team was established to handle decisions concerning the two companies' responsibilities (McCarty and Bjaerum 2013). In March 2016, Telenor acquired the remaining 49% shares of Tameer Bank, making Tameer a wholly owned entity within the Telenor group.

Table 1 displays the sequences in the development of the Easypaisa mobile money service along with major stakeholders and critical decisions and events. The different stakeholders' role and contribution are covered more in detail further on in the article.

After the launch of Easypaisa in 2009, the portfolio of mobile money services has grown to more advanced services like mobile credit/loan and insurance. Beyond Telenor and Tameer Bank, we also find other MNO/Bank providers, although present with a more limited service portfolio compared to Easypaisa. Regulating authorities for both banks and telecommunication are stakeholders setting the premises for the market evolution. National Database and Registration Authority (NADRA) in Pakistan is a public agency for national biometric ID cards; it is also an actor that has commercial interests in the field of ID. Agents for mobile operator constitute the infrastructure of the current OTC solution and are the interface toward end users. Nongovernmental organizations (NGOs) play a critical role with large transfers of money, The Benazir Income Support Program (BISP) being the major one. In February 2014, Easypaisa won two GSMA awards: "Best Mobile Money Service in the World" and "Best Mobile Money Service for Women in Emerging Markets."

4.4 Critical Decisions and Events

Initially, the Easypaisa team considered a mobile account delivery model—a digital wallet on the customer's phone where they convert cash to digital currency through agents and then perform payment transactions from anywhere. Customers, both Telenor customers and other competing MNO customers, simply went to any Easypaisa agent, presented their CNIC, and handed over cash to the agent who performed the transaction (Khan and Rashid 2015). However, there were several challenges attached to such a model. One was that, e.g., Telenor Pakistan had only 22% market share, and using the mobile account model would exclude about 40 million non-Telenor Pakistan GSM subscribers. A second challenge was the comprehensive Know-Your-Customer (KYC) procedures for mobile account registration; it involved a photograph and a copy of the customer's original government-issued computerized national ID card (CNIC) using an Internet-enabled device (computer or smartphone) on site. The Easypaisa team decided that this would be too cumbersome and costly for the business model and a major barrier to customer adoption, also considering the low educational level and illiteracy among potential customer. Hence, they launched Easypaisa as an OTC service; transactions became agent assisted and no registration was required. The OTC model also ensured buy-in from the agents since it provided them with more transactional revenue versus the mobile account service, in which commission is limited to cash-in and cash-out (CICO) transactions. However, it was recognized that the OTC model had a number of limitations both for the customers, the mobile money providers and the market, that was necessary to deal with going forward. According to Malik (2015), OTC limits the range of financial services to be offered to customers since it is not based on strict KYC requirements. Since there is always cash involved in an OTC transaction, there is a heavy burden on the distribution network to collect cash from high cash-in locations and to ensure cash is available

at high cash-out locations. In 2010, the Easypaisa mWallet solution using mobile accounts with money transfer and bill payment was launched. However, the active use of these accounts was low, and to encounter the agents' bargaining power and spur users' uptake, Easypaisa sets transaction fees between mobile accounts to zero, which may explain the uptake later seen in 2015. Early 2016, a transaction fee was re-introduced, although below the agents' fee.

Early 2015, the situation in Pakistan was revolutionized by a decision to carry out a re-verification of all prepaid SIM cards for mobile subscriptions—almost all subscriptions in Pakistan were prepaid. After a terrible terror attack in late 2014, the decision to re-verify all SIM cards achieved general support. In three months early 2015, the base of 215 million prepaid SIM cards was reduced to 115 million and connected about 45 million unique persons (IDs) to the cards. The process was perceived as a great success for all stakeholders. This implied that all mobile subscriptions in Pakistan are connected to a very strong ID, a biometric ID solution provided and managed by the advanced public body NADRA. The Pakistani telecommunication authority was the one that enforced the re-verification, but it also involved NADRA and the State Bank that administers the KYC requirements for mobile accounts. Telenor Pakistan also participated heavily in the re-verification with their mobile agent stores. The State Bank of Pakistan (2017) reports a strong co-variance between diffusion devices enabling biometric ID and accounts opened implicitly suggest these devices as a direct cause of the increased registering.

Already in 2014, Easypaisa got acceptance from the bank regulatory authorities that the strict ID regime for new mobile subscriptions met the basic KYC requirements for bank accounts. This led to an integrated solution for SIM sales and mobile accounts, and 20,000 agents were equipped with such devices in Q2 2014. Based on the allowance from the State Bank, Easypaisa in March 2015 launched the string solution; customer could dial a specific phone number (string) and automatically open a bank account for the ID connected to the sending phone number. More precisely Telenor subscribers could simply dial *345*3737# while non-Telenor subscribers could open their account by sending "EP<space>CNIC number" to 0345-111-3737. Thus, this service bypassed all the challenges with paperwork, illiteracy, and agent resistance when registering a bank account. However, the full effect of this new service did not appear till the re-verification of all SIM card by the Pakistani authorities.

4.5 Competitors

Currently, Easypaisa is the market leader within mobile money services in Pakistan. UBL Omni introduced their service in 2010, and Mobicash launched theirs in 2014 and are the two other major mobile money providers. Table 2 presents the three major mobile network providers and their market shares with respect to mobile wallet accounts, transaction volume/value, and agent networks' size.

In the past three years, four new providers have entered the market with mobile money solutions, mostly OTC solutions. These late entrants (UPaisa, Timepay, EBL Express, and MCBLite) are still far behind with respect to market share of agents, mobile accounts, volume, and value of transactions. We see from the table that the market share of Telenor (Easypaisa) on mobile account is reduced from 64% in 2015 to 45%. There is also a decline in volume of transactions and value of transactions during this period. However, the share of active mWallets accounts is increased from 26 to 34% during this period. Mobilink (Mobicash) on the other side has experienced a major increase in mobile accounts (20–42%) and volume of transactions (26–47%). In addition, the market share of active accounts is increased (48–51%), but the share of agents (19%) has not increased from 2015 till 2017. The market share increase for Mobilink/Mobicash is due to effective strategies toward registering and education of customers on mobile accounts (Dailytimes 2015). In addition, Mobicash refers to the "string" model and launch of ATM card as contributing causes to growth, the same strategies as Easypaisa's. The third operator UBL only experiences minor changes.

The mobile operators' agents are the main distribution channel for mobile financial services. In addition to agents and franchisees, Easypaisa was offered through Telenor Pakistan's 30 owned and operated sales and services centers and Tameer Bank's 40 bank branches (McCarty and Bjaerum 2013). By the end of its first year (2009), Easypaisa had 8000 agents trained and ready to sell Easypaisa services; three years (2012) after launch, there were 20,000. In 2012, Easypaisa embarked on a major agent training and follow-up program with a third party to retrain the majority of its retailers, and in 2016 their agent network nationwide covered 75,000 agents in more than 800 cities across Pakistan. In 2017, the total number of agents for Easypaisa and the other mobile network competitors counted 368,000 agents. In 2017, the number of active mobile accounts was roughly 11.3 million, a 15% growth from the previous quarter.

However, the popularity of the OTC solution has made the agents "kings" among the stakeholders in the branchless banking ecosystem, and most agents serve more mobile operators. This has become a dilemma to Easypaisa: Firstly, it has made the users dependent upon the agent-based OTC solution and hence reduces the expected transition to mobile wallet; secondly, it cuts into the providers' revenues (Orakzai 2016). The agent has the power—on behalf of the customer—to choose a mobile financial service provider (Easypaisa or their competitors) based on the commission and other incentives provided to him. This has sparked a "commission war" as MNOs compete for a share in the OTC market and cut down on their profit margins. A Karandaaz representative says: "*For every P2P transaction made* via *the agent, MNOs pay half of the fee charged to the franchise which is further split equally between the franchise and the agent. In addition to the regular commission paid, the MNOs spend a considerable amount on trade marketing which offers exorbitant proportions of commissions to the agents; in some cases commissions may amount to over 200% of the value of transaction.*"

4.6 Government and Nongovernmental Organizations

In Pakistan, there has been a willingness to test mobile financial services for government-to-person payments (G2P), i.e., federal and provincial government financial transfers to low-income females. For these organizations, the main objective is to get the money out on time to the women that are entitled to them; traditionally, this has been done with cash, and there have been many issues with fraud. Large money disbursement organizations has paved the way for use of mobile account, *and* the use of digital financial services also corresponds with the objectives of financial inclusion of the poor where products for loan and savings are important, government-to-person payment (G2P) programs in Pakistan reached $9.3 million in 2015. This covers the social cash program and transfer of salaries for public employees. The Benazir Income Support Program (BISP) is the largest social cash program in Pakistan and covers 15% of the entire population and 40% of the population below the poverty (bisp.gov.pk 2016). We will here elaborate on BISP; Easypaisa, however, collaborates with a diverse set of NGOs who transfer money to beneficiaries through mobile money solutions. One example on the BISP support program is the Waseela-e-Haq program launched in 2008, which provides funding small business and entrepreneurship among underprivileged people. The program covers loans with interest free returnable easy loans of Rs. 300,000. Another example is the Waseela-e-Sehet (2010), which is a health insurance scheme covering beneficiaries of all age groups up to maximum of 25,000 rupees per family. We also have the Waseela-e-Rozgar program (2015) which is a vocational training program providing recipients with necessary knowledge and skills to exercise a profession. A stipend of 6000 rupees per month is paid to the trainee during four- to six-month training.

Initially in 2008, 1000 rupees were paid out in cash through post offices each month. Soon BISP realized that this frequent transference of cash was not an optimal solution—the fraud and losses were not sustainable. Payments were reduced to four times a year, and actors started to test other digital solutions. Ideally, money should be easily deposited on an account controlled by the receiver for her to use; the reality is different. The receivers will as a rule withdraw the money as cash in the Pakistani cash economy, a majority are financially illiterate, and they do not trust their money deposited on a mobile device that is not private. Over the years, BISP—and other G2P stakeholders in Pakistan—has experimented with many different digital solutions, and they welcomed the digital mWallet solutions (The World Bank 2012). Although the bodies that transfer money keep the banks and telcos at a professional distance and share the market between actors, they recognize that innovation is dependent on their infrastructure. A BISP representative says: "*Honestly speaking—telcos are not only partners—they are brothers now. Without them—we are sitting on their shoulders. They are carriers. … there is a huge—hard work from the telcos and the from BISP to reach to this point after*

four years. If you had been there in Pakistan four years ago—you would see this nightmare which we had. Like four million beneficiaries and money orders [cash]." Still, agents' interaction with the beneficiary is not always perceived as professional, and the telcos are held as responsible for this part of the process.

5 Discussion and Implications

This paper aims to provide insight into the adoption of a new mobile money solution supporting the financial inclusion of adults in unbanked markets. We started by presenting the state of the art with respect to theory and industry. The latter showed us that MFS is expanding with respect to geography, technology, and products. With respect to the successful adoption of mobile accounts in Pakistan, we see this in relation to the mandatory biometric ID program for SIM cards by NADRA, mobile operators, and Pakistani authorities. After the initial jump from 7.5 million to 28 million mobile account transactions between Q1 and Q2 2015, the number of mobile account transactions continued to increase to 41 million in Q1 2016 until 77 million in Q1 2017. During the same period, the mWallet/OTC ratio increased from 12 to 58%. All in all, the shrinking gap between the number of OTC and mWallet transactions shows positive signals for the usage of mobile wallet account. The answers to why OTC remains the most common way to carry out mobile banking services can be found in the past. However, of the 7.5 million registered mobile accounts in Pakistan in Q1 2015, only 20% were active accounts. The corresponding number of active accounts in Q4 2015 were 41%, while the current share of mobile accounts is 45% today (Q1 2017). Together, the increase in accounts and increase in activity are promising. Still, it indicates that the majority of subscribers struggle with mobile account usage.

The main reasons identified for the slow mWallet uptake after the launch of Easypaisa in 2009 were threefold. Firstly, the OTC customer experience was just too easy for the customers; hence, there were no need to register to transfer money or pay a bill, nor to learn the USSD menu themselves. Moreover, the agents assured the transaction completion with trust and a receipt. Secondly, the product mWallet was practically the same as the OTC offering, providing no additional value to the users. Thirdly, because of the high upfront cost of registration equipment, rolling out OTC transaction points was prioritized over mWallet registration points by Easypaisa. By 2012, 87% of mobile money transactions in Pakistan were OTC rather than through mWallet and Easypaisa's OTC model had become the de facto standard for the Pakistani market. During these first years, users were trained to appreciate, use, and trust the OTC solution, and agents were trained to provide the service and recognized their power and role. In addition to the earned legitimacy and knowledge externalities, the equipment constituted an installed base of hardware and software. Even in the latest surveys provided by Financial Inclusion Insight (2016), users report no

need for anything but the OTC services; however, their awareness of other financial service such as saving and loans is continuing to be low.

The Easypaisa success also builds on the close interaction with other stakeholders, including governmental and nongovernmental program organizations (NGOs)—such as BISP, SERP, and ACTED. These stakeholders are transferring money to beneficiaries and are acknowledging the significant role mobile financial services have—and can have—as enablers for their money transfers to poor (Pickens et al. 2009). However, there is a high will and creativity in Pakistan to get a nonintended and illegitimate share of the money transfers to beneficiaries and the NGOs are continuously looking for and piloting fraud resistant solutions. So far these institutions have not landed on a final digital solution. Still, their activity support uptake of mobile accounts through the legitimation of such services and education of customers in use of digital money. According to Consultative Group to Assist the Poor (CGAP), over 75% of such government flows could be digitized within 5 years if things keep moving forward, as they have in recent years (CGAP 2015).

The new ID requirement to mobile subscriptions in 2015 has been a supporting catalyst for transfer into active digital accounts. However, the OTC solution has still a strong standing due to installed base in the form of existing knowledge, trust, perceived ease, equipment, and impact. Furthermore, even though easy to register, the new mobile accounts have so far low additional value. Providers will have to provide attractive new services and also rely on other stakeholders such as BISP to increase the growth rate in take-up. Easypaisa has been running educational and marketing campaigns and offering incentives to consumers to conduct financial transactions from their mobile accounts and in 2015 a similar campaign with money transfer from person-to-person (P2P) free. If providers and other stakeholders fail to get traction for new services, the diffusion of mobile accounts seems to follow a growth curve that still will use some years to contribute significantly to financial inclusion and base for further digital services.

6 Summary

Inclusion of the financially excluded or unbanked adults can be achieved through mobile financial services (MFS). This article starts with a novel review of the mobile financial services literature, state of industry, and deep insight from one innovative market. The majority of the research covers mobile payment services, whereas mobile loans, insurance, and savings lack sufficient coverage across the research community. A key industry observation is that the MFS sector shows strong growth: Roughly 300 services have been commercially deployed across 100 developing countries, foremost in sub-Saharan Africa and Asia. The development of the Easypaisa mobile financial service case in Pakistan provides insights into why digital mobile wallet user base is growing faster than the conventional agent-assisted OTC solution that was introduced initially, and why the OTC

solution still is popular. The empirical data drawn from major ecosystems stakeholders in Pakistan are analyzed using technological systems and installed base theory. The actions that recently have promoted the active use of mobile wallet accounts is the re-verification of SIM cards with biometric ID as well as simplification of the registration process imposed by Easypaisa. Moreover, active involvement in large governmental money transfer programs through digital solutions also seems to promote the uptake and use of mobile accounts. However, the investments in and current knowledge base, practices, and benefits from the successful OTC solution still obstruct an even stronger uptake of the mobile account solutions. Examples on further research studies include block chain technology and its potential disruption of the current MFS situation, together with data mining and analysis of mobile payment and credit transaction data.

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Effectiveness of Selected Knowledge-Based Determinants in Macroeconomics Development of EU 28 Economies

Viktor Prokop, Jan Stejskal and Petr Hajek

Abstract The stage of development of knowledge-based economy depends not only on the effectiveness of the innovation system but on the effectiveness of economic and institutional regime, education of population and information and communication technology. The aim of this paper is to determine which of the selected determinants of the knowledge-based economy provide the intended macroeconomic effects. The measurement of the effectiveness is performed by data envelopment analysis. In the case of inefficient determinants, DEA enables to detect how such a determinant should be regulated or modified to become more effective. We employed DEA models and analysed the effectiveness of inputs involved in the macroeconomic processes. We used data from Eurostat for EU 28 countries in the years 2011–2015. The results show that minority of EU countries were efficient and that these countries were at different levels of knowledge economy. The implications can be generalized for several types of knowledge-based economies.

Keywords Effectiveness · Knowledge-based economy · Determinant Macroeconomics development · EU 28

1 Introduction

In today's globalized world economy, national governments increasingly aspire to become knowledge-based economies. The crucial aspect is to increase the effectiveness of traditional production factors (labour force and capital) by new

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productivity determinants, such as knowledge, skills and ability to learn. These have become the key determinants of contemporary national competitive advantage. Economic entities in knowledge-based economies have to be able to acquire, transfer and apply the knowledge, as well as to create innovations. In addition to governments, the key actors in knowledge-based economies include firms, universities and non-profit organizations. Their interactions also provide support to the development of knowledge-based economy.

The stage of development of knowledge-based economy depends not only on the effectiveness of the national innovation system but also on the effectiveness of economic and institutional regime, education and skills of population and information and communication technology. Previous research has mainly focused on how to measure the determinants of knowledge-based economy. However, it is also important to make an international comparison of the effectiveness of these determinants in generating macroeconomic outputs. This could give the national governments and public policy makers the guidance for decision-making (e.g. in science, technology and innovation policies).

The structure of this paper is divided into following: Sect. 2 consists of theoretical background that clarifies the issue of innovation determinants and the influence on selected economic macroeconomic indicators. Section 3 will be dedicated to describe our methodology which utilizes own DEA model and used data. In the last section, we discuss the main results and conclusions.

2 Theoretical Background

The knowledge is the key competitive factor in every business all over the world. Government at the every level prepare the public policy (especially at the regional level—regional policy) where knowledge and so innovations have been moved to the foreground and have been considered mandatory for surviving in a dynamic market environment (Tödtling and Trippl 2005; Seidler-de Alwis and Hartmann 2008; Asheim et al. 2011). Therefore, governments try to support by this policy (and mainly by the financial schemes) engines of economic growth. We have to point out that innovations are the fundamental force for global, national and also local economic and social growth. Innovations influence industrial sector (firms' competitiveness), households and also the welfare of the society (Galia and Legros 2004; Tödtling and Trippl 2005; Hudson and Minea 2013; Stejskal et al. 2016).

The experiences from many researches and also many scholars highlighted that innovation processes are accelerated by the environment in which they are being implemented. Innovations do not take place in isolation; rather interaction is central to the process of innovation. The innovation milieu consists from many entities (firms, companies, universities, R&D organizations), also from governmental organizations. The networking, relationships or some knowledge-based or cooperative-based ties are integral part of this environment. All these assets are present in most of the developed regions. But, actual growth performance depends

on how well a region (or enterprise) is able to mobilize its assets in order to fully exploit its potential for growth (Papacharalambous and McCalman 2004). The knowledge sector is the necessary part of every modern tool in regional development. The industrial clusters, research centres, centres of excellence, etc., interact with many entities in the regional and also with their external environment (Guellec and Wunsch-Vincent 2009). The cooperative links deepen the technological, creative and innovative competence of the actors (Tsai and Wang 2009). The collaboration with research organizations helps a firm broaden its technological knowledge and firms can acquire new scientific knowledge to benefit their product or process innovations by interacting formally and informally with universities and research institutes (Cowan and Zinovyeva 2013).

There are many determinants what influence the innovation (or knowledge) environment. Tavassoli (2015) analyses how the influence of firm-level innovation determinants varies over the industry life cycle. Two sets of determinants are distinguished: (1) determinants of a firm's innovation propensity, i.e. the likelihood of being innovative and (2) determinants of its innovation intensity, i.e. innovation sales. He shows in Sweden case study that the importance of the stage of life cycle of the industry where the firm belongs. Ulusoy et al. (2014) analyse the comprehensive model of innovation determinants in Turkey. This study investigates how significant is an antecedent compared to others. Such knowledge is invaluable for the decision-makers in order to manage their innovation strategies and provides a guideline for effective allocation of their limited resources to be more innovative. The analysis reveals that among all possible determinants considered, the intellectual capital has the highest impact on innovativeness followed by the organizational culture. In Spain, Fraj et al. (2015) analyse the links between proactive environmental strategies, organizational capabilities and competitiveness. According to their results, knowledge, ability to learn and innovations are conceived not only as drivers for adopting pro-environmental policies, but also as determinants of competitiveness. The determinants of innovation activities were examined also in China. Liu et al. (2014) used the panel data analysis for the high-technology industries and analysed the impact of foreign competition on innovation activities at industry level in a large emerging economy. The results indicate that the intensity of competition from foreign-invested enterprises and domestic skill intensity affects industry buy and make activities. Further, the findings show that domestic skill intensity weakens the impact of foreign competitive pressure on innovation activities. In USA, Wang et al. (2014) explored specific determinants: network of collaborations between researchers and in a knowledge network composed of linkages between knowledge elements.

There are also many other determinants of the knowledge economy in individual EU countries. These determinants are divided into four drivers (pillars) such as (i) economic incentive and institutional regime, (ii) educated and qualified workers, (iii) an effective innovation system, and (iv) information infrastructure (Dahlman and Anderson 2000; Chen and Dahlman 2005). Also, a knowledge stock seems to be a specific innovation determinant. Roper and Hewitt-Dundas (2015) analysed the role and interaction of firms' existing knowledge stocks and current knowledge

flows in shaping innovation success. Their paper contributed to understanding of the determinants of firms' innovation outputs and provides new information on the relationship between knowledge stocks, as measured by patents, and innovation output indicators. They stated that existing knowledge stocks have weak negative rather than positive impacts on firms' innovation outputs, reflecting potential core-rigidities or negative path dependencies rather than the accumulation of competitive advantages. Second, knowledge flows derived from internal investment and external search dominate the effect of existing knowledge stocks on innovation performance. Both results of this study emphasize the importance of firms' knowledge search strategies.

It is necessary to examine relevance of the innovation determinants and effectiveness and to draw implications from conclusions that will help to increase the level of knowledge economy in practice. Therefore, the aim of this paper is to determine which of the selected determinants of the knowledge-based economy provide the intended macroeconomic effects.

3 Research Methodology and Data

Data envelopment analysis (DEA) was used for our analyses. DEA is a parametric approach used as a model specialized tool for assessing the effectiveness, performance and productivity of comparable production units (homogeneous units, also decision-making units—DMUs) based on the size of inputs and outputs. DMUs convert multiple inputs into outputs, meaning a set of units that produce the same or equivalent effects that are referred as the outputs of these units (Staničkova and Melecky 2011). DEA has become the most prominent method for performance measurement.

DEA models are derived from Farrell's model for measuring the effectiveness of units with one input and one output. These DEA models use mathematical programming models to estimate best-practice frontiers without a priori underlying functional form assumption through computing multi-input/multi-output values and calculate a maximal performance measure for each DMU relative to all DMUs in the countries (EU 28) under observation (Guan et al. 2006; Stejskal and Hajek 2016). The DEA model can be built on the assumption of constant returns to scale (one unit of input generates one unit of output), when all DMUs are operating at optimal scale (CCR model). Rather unrealistic condition is solved by introducing variable returns to scale (VRS) considering all types of returns: increasing, constant or decreasing (BCC model). The efficiency can be increased either by increasing outputs under increasing returns to scale or by reduction in outputs under decreasing returns to scale (Hudec and Prochádzková 2013; Hajkova and Hajek 2014).

For our analyses, we used two input-oriented VRS models (Model 1 and Model 2) operating with variable returns to scale and data from Eurostat databases (2017). These models measured efficiency of DMUs, (i) provide implications on how to

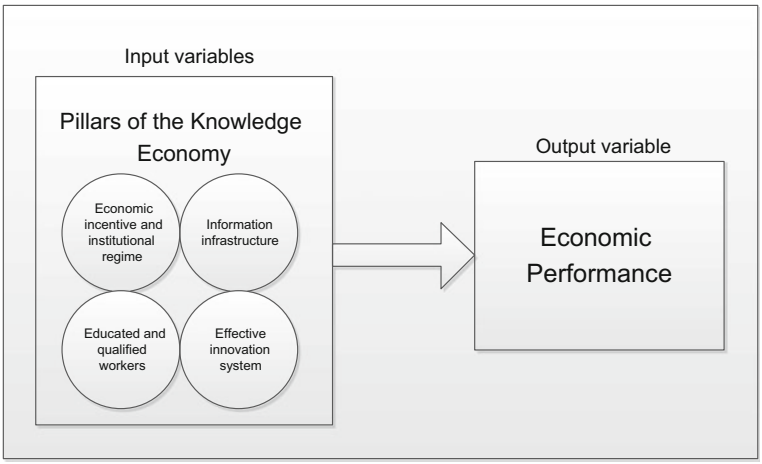

Fig. 1 Relation between input and output variables in Model 1. *Source* Own

change inputs within inefficient DMUs to become (more) efficient and (ii) show the importance of knowledge (and accumulated knowledge stock) within the process of economic development.

In Model 1 (see Fig. 1), we analyse and evaluate countries' efficiency of using determinants of knowledge economy within the process of increasing their economic performance (represented by value added). These determinants are divided into four drivers (pillars, see Table 1) such as (Parcero and Ryan 2016; de la Paz-Marín et al. 2015; Hajek et al. 2014): (i) economic incentive and institutional regime, (ii) educated and qualified workers, (iii) an effective innovation system and (iv) information infrastructure. The optimal time delay between input and output variables was analysed by number of researchers (e.g. Hollanders and Celikel-Esser 2007; Wang and Huang 2007). Following previous studies (Guan and Chen 2012; Hudec and Procházková 2013), we chose four years' time delay.

In Model 2 (see Fig. 2), the same variables were used (see Table 1). However, following previous literature (e.g. Wu and Shanley 2009; Villar et al. 2014) we add other input variable expressing the country's knowledge stock that represents the accumulated know-how from practicing research and development activities and should support the share of knowledge, learning processes and country's development (Biemans et al. 2007). Wu and Shanley (2009) argued linkage between exploration–exploitation and innovative performance and, therefore, we assume the importance of accumulated knowledge stock allowing share of knowledge, learning and gaining higher rate of countries' efficiency.

Knowledge stock represents accumulated knowledge within the country in last years. To express accumulated knowledge stock, there are number of ways—e.g. by patents, scientific citations or products in development (DeCarolis and Deeds 1999). Firms' and countries' patent portfolio is one possible means to describe and capture the characteristics of a firms' (countries') knowledge stock because a patent,

Table 1 Variables involved in the model

Input variables		
Pillar	Variable	Description of the selection of variable
Economic incentive and institutional regime	Government R&D expenditures (in Euros)	Effective use of public funds, particularly in research and development may lead to creation of positive effects and promote economic growth in the long term (Gemmell et al. 2015)
Educated and qualified workers	The number of people with tertiary education (15–74 years)	The number of people with tertiary education allows the creation of new knowledge, as well as strengthening the absorption capacity of individual countries and companies (Barro 2013)
Information infrastructure	Employees in ICT (total)	ICT sector affects corporate growth and innovation capability (Taruté and Gatautis 2014), while the number and quality (skills) of its employees are one of the main determinants
Effective innovation system	The number of employees working in the field of science and technology (15–74 years)	Employees in the field of science and technology (S&T) represent one of the fundamental elements, and their effective use can lead to greater dissemination of knowledge and the creation of synergies, as well as to the emergence of more innovative outputs, and thus influence the continuous economic growth (Yanadori and Cui 2013; Gelec and Wagner 2014)
Output variable		
Pillar	Variable	Description of the selection of variable
Economic performance	Value added (in Euros)	The value added is another possible determinant of economic growth and identifier of the growth of commercial gain (Guan and Chen 2012; Hudec and Procházková 2013)

Source Own

by definition, represents a unique and novel element of knowledge (Ahuja and Katila 2001; Wu and Shanley 2009). A set of patents then represents a collection of discrete, distinct units of knowledge. Identifying a set of patents that have been used in the firm can be the basis for identifying the revealed knowledge base of a firm. Therefore, accumulated patents represent the knowledge that the firm (country) is acknowledged as having created (Jaffe et al. 1993). For our study, following

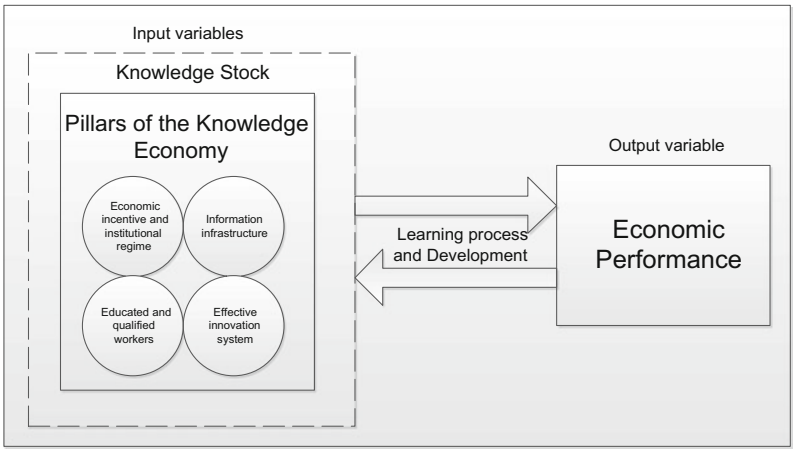

Fig. 2 Relation between input and output variables in Model 2 extended by Knowledge Stock. *Source* Own

arguments above and previous studies (e.g. Guan and Chen 2012; Hudec and Procházková 2013) we express knowledge stock by number of patents granted by USPTO between 2006 and 2010.

4 Results

Results of input-oriented VRS Model 1 and Model 2 are shown in Tables 2 and 3. DMUs (countries of EU 28) that efficiently used selected determinants of knowledge economy reached the rate of effectiveness 1000. Countries that did not reach the rate of effectiveness 1000 were not considered as effective (less rate of effectiveness means less efficiency of the country).

Results of Model 1 show that only eight countries of EU 28 (32%) were effective. These countries were Germany, Ireland, France, Italy, Luxembourg, Malta, Austria and UK (on the same rank, efficiency is 1.00000). On the other hand, Bulgaria was the least effective country within EU 28 (the last rank, efficiency 0.24918). The advantage of the DEA models is that they provide practical implications (for each country) on how to improve and how to change inputs and outputs to become (more) efficient. Input-oriented models propose changes focusing primarily on input variables (or even minor changes on the output side). Table 2 therefore shows both original values (obtained from the Eurostat databases) and adjusted values (provided by DEA) that show how the input (output) variables should be reduced/increased. We can see that the selected determinants were inefficiently used in most countries of EU 28.

Table 2 Results of input-oriented VRS Model 1

Country	Efficiency	Input variables (2011)								Output variable (2015)	
		Government R&D expenditures		Tertiary educated		Employees in ICT		Employees in S&T		Value added	
		Original	Adjusted	Orig.	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted
BE	0.90464	658,600	483,387.3	2368	1371.6	138	124.8	1632	1476.4	410.351	367.354
BG	0.24918	78,711	19,613.1	1124	180.9	67.5	15.7	697	121.8	45,286.5	39,138.1
CZ	0.40923	504,383	206,410.0	1269	519.3	145.1	50.2	1553	635.5	166,964.1	150,119.6
DK	0.94535	148,052	139,961.6	1086	1026.7	110.1	76.1	1119	609.3	271,786.1	235,907.7
DE	**1.00000**	10,974,300	10,974,300.0	14,245	14,245.0	1235.9	1235.9	14,600	14,600.0	3,032,820	2,729,662
EE	0.50524	31,097	15,711.4	315	80.4	16.7	8.4	196	68.7	20,251.7	17,496.7
IE	**1.00000**	131,900	131,900.0	1041	1041.0	76.3	76.3	592	592.0	25,5815.1	236,813.5
GR	0.62549	331,727	207,492.7	1703	565.8	75.5	47.2	1034	519.2	175,697.4	155,098.3
ES	0.83609	2,762,385	1,055,361.5	9567	5571.1	532.6	431.5	5022	4198.8	1,075,639	975,795
FR	**1.00000**	6,248,990	6,248,990.0	11,378	11,378.0	760.6	760.6	9430	9430.0	2,181,064	1,949,825
HR	0.33250	92,105	30,624.8	498	161.4	42.3	14.1	410	113.9	43,846.9	36,823.9
IT	**1.00000**	2,653,600	2,653,600.0	5512	5512.0	544.3	544.3	6944	6944.0	1,642,443.8	1,475,046.8
CY	0.80392	14,731	11,842.6	202	73.9	10	8.0	119	64.5	17,637.2	15,520.7
LV	0.39738	32,846	13,052.2	360	101.8	25.3	10.1	252	79.3	24,348.5	215,46.6
LT	0.51357	55,346	28,424.2	617	147.6	25.5	13.1	422	106.3	37,330.5	33,576.5
LU	**1.00000**	147,788	147,788.0	117	117.0	8.5	8.5	115	115.0	51,216.2	46,230.2
HU	0.34432	189,839	65,365.8	1339	398.8	89.2	30.7	1128	244.5	10,9674.2	91977.7
MT	**1.00000**	1999	1999.0	46	46.0	6.2	6.2	48	48.0	9250.3	8129.3
NL	0.77451	1,319,387	860,757.5	3315	2466.5	284.1	220.0	3211	2486.9	67,6531	607,860
AT	**1.00000**	425,222	425,222.0	1017	1017.0	99.7	99.7	1329	1329.0	339,896	302,652.9
PL	0.43771	979,421	428,699.9	5569	1558.3	299	130.9	4354	1339.6	429,794.2	381,271

(continued)

Table 2 (continued)

Country	Efficiency	Input variables (2011)								Output variable (2015)	
		Government R&D expenditures		Tertiary educated		Employees in ICT		Employees in S&T		Value added	
		Original	Adjusted	Orig.	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted
PT	0.61626	189,330	116,675.7	1149	668.9	80.2	49.4	1083	395.4	179,539.9	15,6612.2
RO	0.37429	267,643	100,175.1	1860	604.7	120.4	45.1	1751	358.7	159,963.7	140,569.1
SI	0.38729	127,831	49,507.4	334	129.4	29.9	11.6	313	106.3	38,570	33,311.4
SK	0.44311	129,575	57,415.5	675	299.1	56.5	25.0	704	223.2	78,685.6	70,993.6
FI	0.56609	633,712	180,012.7	1275	717.4	99.3	56.2	943	533.8	209,149	180,358
SE	0.80509	566,901	456,407.2	2002	1611.8	191.4	136.3	1908	1409.4	447,009.5	39,5501.1
UK	**1.00000**	2,706,303	2,706,303.0	13,670	13,670.0	1066.6	1066.6	10,647	10,647.0	2,577,280.1	2,296,927.7

Note Government R&D expenditures, tertiary educated, employees in ICT, employees in S&T are in thousands Euros, value added is in million Euros; EU 28 countries are marked according to international country codes

Source Own

Table 3 Results of input-oriented VRS Model 2 extended by knowledge stock

Country		Input variable (2006-2010)		Input variables (2011)								Output variable (2015)	
	Efficiency	Knowledge stock		Government R&D expenditures		Tertiary educated		Employees in ICT		Employees in S&T		Value added	
		Original	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted
BE	0.90468	3536.4	3199.3	658,600	482,832.0	2368	1372.5	138	124.8	1632	1475.0	410,351	367,354
BG	0.50934	121.2	61.7	78,711	40,090.6	1124	271.8	67.5	21.4	697	257.3	45,286.5	39,138.1
CZ	0.71255	530.6	378.1	504,383	232,378.8	1269	904.2	145.1	66.9	1553	894.3	166,964.1	150,119.6
DK	0.94535	3025.9	1496.9	148,052	139,961.6	1086	1026.7	110.1	76.1	1119	609.3	271,786.1	235,907.7
DE	**1.00000**	55,838.9	55,838.9	10,974,300	10,974,300.0	14,245	14,245.0	1235.9	1235.9	14,600	14,600.0	3,032,820	2,729,662
EE	0.52997	127.4	67.5	31,097	16,480.4	315	86.7	16.7	8.9	196	77.7	202,51.7	17,496.7
IE	**1.00000**	1441.6	1441.6	131,900	131,900.0	1041	1041.0	76.3	76.3	592	592.0	255,815.1	236,813.5
GR	0.99233	269.8	267.8	331,727	210,310.4	1703	1047.6	75.5	74.9	1034	1007.3	175,697.4	155,098.3
ES	**1.00000**	2671	2671.0	2,762,385	2,762,385.0	9567	9567.0	532.6	532.6	5022	5022.0	1,075,639	975,795
FR	**1.00000**	22,313.6	22,313.6	6,248,990	6,248,990.0	11,378	11,378.0	760.6	760.6	9430	9430.0	2,181,064	1,949,825
HR	0.62594	79.3	49.6	92,105	39,708.4	498	303.9	42.3	20.6	410	256.6	43,846.9	36,823.9
IT	**1.00000**	8823.1	8823.1	2,653,600	2,653,600.0	5512	5512.0	544.3	544.3	6944	6944.0	1,642,443.8	1,475,046.8
CY	**1.00000**	26.1	26.1	14,731	14731.0	202	202.0	10	10.0	119	119.0	17,637.2	15,520.7
LV	**1.00000**	26.5	26.5	32,846	32,846.0	360	360.0	25.3	25.3	252	252.0	24,348.5	21,546.6
LT	**1.00000**	33.3	33.3	55,346	55,346.0	617	617.0	25.5	25.5	422	422.0	37,330.5	33,576.5
LU	**1.00000**	195.5	195.5	147,788	147,788.0	117	117.0	8.5	8.5	115	115.0	51,216.2	46,230.2
HU	0.49128	443.9	218.1	189,839	93,263.6	1339	602.2	89.2	43.8	1128	533.4	109,674.2	91,977.7
MT	**1.00000**	23.6	23.6	1999	1999.0	46	46.0	6.2	6.2	48	48.0	9250.3	8129.3
NL	0.77451	8055.1	3749.9	1,319,387	860,757.5	3315	2466.5	284.1	220.0	3211	2486.9	676,531	607,860
AT	**1.00000**	3667.3	3667.3	425,222	425,222.0	1017	1017.0	99.7	99.7	1329	1329.0	339,896	302,652.9
PL	**1.00000**	413.9	413.9	979,421	979,421.0	5569	5569.0	299	299.0	4354	4354.0	429,794.2	381,271
PT	**1.00000**	169.2	169.2	189,330	189,330.0	1149	1149.0	80.2	80.2	1083	1083.0	179,539.9	156,612.2

(continued)

Table 3 (continued)

Country		Input variable (2006-2010)		Input variables (2011)								Output variable (2015)	
	Efficiency	Knowledge stock		Government R&D expenditures		Tertiary educated		Employees in ICT		Employees in S&T		Value added	
		Original	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted	Original	Adjusted
RO	0.75530	199.8	150.9	267,643	202,151.6	1860	1180.6	120.4	81.7	1751	1098.3	159,963.7	140,569.1
SI	0.54240	156.1	84.7	127,831	60,224.3	334	175.7	29.9	14.2	313	169.8	38,570	33,311.4
SK	**1.00000**	73.2	73.2	129,575	129,575.0	675	675.0	56.5	56.5	704	704.0	78,685.6	70,993.6
FI	0.56609	4039.9	1333.3	633,712	180,012.7	1275	717.4	99.3	56.2	943	533.8	209,149	180,358
SE	0.80509	8233.5	2402.9	566,901	456,407.2	2002	1611.8	191.4	136.3	1908	1409.4	447,009.5	39,5501.1
UK	**1.00000**	19,556.9	19,556.9	2,706,303	2,706,303.0	13,670	13,670.0	1066.6	1066.6	10,647	10,647.0	2,577,280.1	2,296,927.7

Note Knowledge stock represent number of patents accumulated between 2006 and 2010; Government R&D expenditures, tertiary educated, employees in ICT, employees in S&T are in thousands Euros, value added is in million Euros; EU 28 countries are marked according to international country codes

Source Own

These countries should focus on input variables, such as providing government R&D subsidies, as well as on human resources within universities and ICT sectors.

For example, we show proposed reductions for the less effective country—Bulgaria: government R&D expenditures: from 78,711 thousands Euros to 19,613.1 thousands Euros; tertiary educated: from 1124 thousands to 180.9 thousands; ICT employees: from 67.5 thousands to 15.7 thousands; employees in S&T: from 697 thousands to 121.8 thousands.

Results in Table 3 show how the knowledge stock influences countries' efficiency, and plays the important role in the process of development. In Model 2, 15 countries were considered as effective. These countries are Germany, Ireland, Estonia, France, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Malta, Austria, Poland, Portugal, Slovakia and UK. In this Model 2, Hungary was the least effective country within EU 28.

The used DEA method showed which countries are able to apply selected determinants and generate outputs with the highest efficiency rate. Given the high number of countries with high efficiency, it is possible to say that DEA method is only primary. The method makes it possible to divide countries according to their effectiveness and explore these clusters using other methods. Many studies in their investigations end just by stating that some countries are more efficient. The scholars are not already thinking about why (by what cause) they are able to be the most efficient country. Finding the cause is important for the future and for portability to other countries and their public policies.

5 Discussion and Conclusion

In this study, we show the importance of the knowledge and accumulated knowledge stock in gaining (improving) countries' efficiency. It is important to know that the level of efficiency of the inputs' use (resources) is, among other things, the competitive advantage of a country or of its enterprises (and other entities). The ability to use the resources to the maximum, or to get more than 100% of them (synergistic effect), will also differentiate individual economies and countries in the future. It is necessary to know the variables that affect and create the knowledge base and public policies which can support (support their emergence) them effectively, apply and draw on the resulting benefits. It should be remembered that synergistic and spillover effects provide benefits even around standing entities (third parties).

We conducted two DEA models to show how the proper creation and use of accumulated knowledge within countries could affect their efficiency in the process of value added creation. It is clear from the previous results that if a country has a good knowledge infrastructure and a knowledge base in individual economic entities, this country appears to be effective in any comparison and model (Germany is the typical example). This confirms the previous assertion that a knowledge base is an essential prerequisite for developing the knowledge economy and creating positive effects in it. From our results, it is possible to determine which input must

be improved by the national or regional government and by benchmarking, it is possible to find out what and how to do in order to improve its effectiveness.

Our results allow us to recommend some practical implications for policy makers within countries. We recommend qualitative modifications in strategies for public funding (specifically system of science and technology funding), to improve the position of economies in the ranking of competitiveness in international comparison. This could lead to encourage more companies to invest in their research and development (e.g. through tax benefits). It is also necessary to change government's policies on tertiary education (promotion of science, technology, language skills, higher mathematical literacy and natural sciences). It should influence the innovation potential of companies, scientific and research potential of R&D institutions and universities in the future). Next, we propose supporting relationship with practice, as done in Germany through vocational education and training system which is aimed at promoting cooperation between firms, universities and public research centres. Finally, we recommend creating high-quality concept of support of knowledge-intensive industries (including the creation of a modern communication infrastructure) and creation of knowledge stocks. For the future research, we plan to follow our results and analyse microeconomic conditions (firm level) within EU 28 countries in the concept of knowledge economy.

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Determinants of Firms' Innovation Activities: A Case Study of German Knowledge-Intensive Industries

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Abstract Business innovation environment varies across countries and industries. Various determinants should therefore be studied in both sectoral and national context. This enables to find effective instruments that promote firm innovation activities. Most importantly, these determinants should be examined in innovation leader countries. For the same reason, knowledge-intensive industries have attracted increasing attention. Germany is one of the most innovative economies in the world, and in addition, it is the largest economy in the European Union. Therefore, we aim to analyze determinants of innovation activities in knowledge-intensive industries in Germany. We use truncated regression models to show that in contrast to knowledge-intensive business services, university knowledge spillovers are critical for the innovation performance of German knowledge-intensive manufacturing industries. Our findings provide (1) an initial analysis of innovation activity in German knowledge-intensive industries and (2) practical implications and recommendations for policy makers.

Keywords Innovation activities · Case study · Germany · Knowledge-intensive industries

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1 Introduction

Many scholars have confirmed that the business environment is essential for achieving the competitive advantages of firms in today's globalized world. This environment significantly affects the firms' activities, especially their absorption and ability to convert the knowledge, innovativeness, and creativity to market innovation. Business (innovation) milieu affects both the economic entities (firms) and knowledge-based organizations (universities and R&D organizations), as well as local and national governments. Public organizations can influence the environment through government (or regional) policies (typically through Investment Incentives Act, system of FDI support, etc.) and also specific financial schemes. These should be provided to help the specific groups of firms in selected industries. Many studies have shown that these policies must be clearly targeted and must promote cooperative ties between market players (Stejskal et al. 2016). This could increase the efficiency of public subsidies, since a synergistic effect can be expected (Stejskal and Hajek 2016). Various determinants should therefore be studied in both sectoral and national contexts. Thus, effective instruments can be found that affect the innovation activities in the firms. Above all, it is necessary to analyze these determinants in countries which are the leaders in innovation production and are ranked highly competitive (Prokop and Stejskal 2017). For the same reason, knowledge-intensive industries have attracted increasing attention.

Germany is the largest economy in the European Union and one of the strongest and most competitive economies in the world. Recent studies have suggested that knowledge-intensive industries in Germany represent an important mechanism to overcome economic and financial crises (Golova and Suhovey 2015). In addition, these knowledge-intensive industries are reported to grow fast, employing about 40% of all employees in German industries. Large industrial parks, like Berlin Adlershof, contribute substantially to this rapid development (Golova and Suhovey 2015).

Therefore, the goal of this paper is to analyze the selected determinants of innovation activities in German knowledge-intensive industries. Owing to the characteristics of the innovation output, we employed truncated regression models to analyze the determinants of innovation activities. For the analysis, we used data from the German Community Innovation Survey in the years 2010–2012.

This study makes several noteworthy contributions to the current literature. First, the empirical findings on the effect of knowledge-related determinants on innovation performance are provided in the specific context of an innovation leader country. Second, knowledge-intensive manufacturing and business services are compared with non-knowledge-intensive firms. This may provide a new understanding of how the innovation output is generated in knowledge-intensive firms. Moreover, previous studies mostly used industry as a control variable only. Thirdly, we focus on knowledge-related determinants. Specifically, we identify several types of knowledge spillovers and examine their impact on innovation performance. To obtain the values for each of knowledge spillover, confirmatory factor analysis is

performed. To obtain unbiased and robust estimates of regression coefficients, we employ truncated regression models.

This paper is organized as follows. First, theoretical background is provided on the role of knowledge-related determinants in innovation performance. Second, research methodology and underlying data are described. The next section provides the results of truncated regression models. Final section concludes this paper and discusses the results and political implications.

2 Theoretical Background

The competitive position of the firm in globalizing and knowledge economy is not based on static comparative advantage but on dynamic competitive advantage. This is strongly determined by innovation policies and related regulatory and institutional settings (Asheim and Coenen 2006; Doh and Kim 2014). The firms must find (own or hire) the specific production factor which help them to gain and sustain their competitive advantage. Many scholars proved that knowledge (ability to learn and creativity) can be this specific production factor. It will help to create and realize the innovation processes. In the existing literature, it is empirically proved that the innovation growth promotes economic growth (Bilbao-Osorio and Rodríguez-Pose 2004; Asheim and Coenen 2006; Kafouros and Forsans 2012; Rehak et al. 2013).

Everything mentioned is intertwined, and a knowledge economy is emerging. This concept was popularized by Drucker (1969). He defined the knowledge economy as the use of knowledge to generate tangible and intangible values. This is usually explained by the development of new technologies and new industries. This is why new policies and institutions are needed to address these changes in economies (Tewarie and Escalante 2016). In condition of knowledge economy, firms have to respond to the increasing demand for improved products and services. This leads to increased complexity of firms' knowledge processes (De Faria et al. 2010; Schilirò 2010; Priem and Carr 2012).

The creation of innovation and learning is considered together to be key factors in regional development within institutional economics and has impact on the development and competitive position of companies (Baron and Tang 2011; Boons et al. 2013). Therefore, firms have to collaborate in R&D and create innovations in close relations with suppliers, customers, universities, and other firms (the concept of so-called open innovation) (De Faria et al. 2010; Sleuwaegen and Boiardi 2014).

More and more studies confirm that human is a decisive production factor. It is not just about knowledge itself, but about a skilled human who is the creator, the bearer, the disseminator of knowledge. In fact, the knowledge economy is becoming more human economy (Tewarie and Escalante 2016).

Whether the knowledge economy or human economy, in both approaches we can meet similar principles and mechanisms. There are big private or public investments to the development of the economy; triple-helix-based collaboration ties; new cooperative basis leading to new types of functions or activities

(the entrepreneurial universities or science–industry relationships are the typical examples; Stejskal and Hajek 2017). The bridging between the science sphere and the industry fields should be the main aim for the next period and the big task for the public administration or local governments. It is an interest that is shared among the various actors in the economy. Firms acquire knowledge and produce innovations, universities or R&D can get additional resources for research and development, governments can achieve the goals of their public policies (Ranga et al. 2003). This creates a favorable innovation environment in which innovations are created with the help of human potential. A stimulating environment creates space for the firms which become knowledge intensive and produce the specific products or services. In addition, scholars unanimously agree that knowledge-intensive firms (KIFs) promote innovation and new job creation (Audretsch and Keilbachm 2004; Piergiovanni et al. 2012; Viturka et al. 2013).

The importance and influence of these KIFs has been explored in several countries by some scholars. For example, using a sample of German high-technology start-ups, it was demonstrated that the location choices of the start-ups are affected by the opportunity to acquire knowledge from universities (Audretsch and Keilbach 2005). In Italy, Bonaccorsi et al. (2014) investigated the spatial characteristics of university knowledge in relation to the creation of KIFs. Their results indicate the positive effects of scientific publications and university graduates are local (within the province). In contrast, academic patents are an important driver of the creation of KIFs that goes beyond the boundaries of the district. This holds true for high-quality universities. In Spain, Pinto et al. (2015) found that absorptive capacity represents a central determinant of firm–university interactions and the use of knowledge-intensive business services (KIBS). In Norway, Herstad and Ebersberger (2015) explored the role of location in urban labor market regions in spatial collaborative linkages with clients. There are not enough journal papers describing the environment in which the KIFs are located in Germany. Generally, Germany represents the group of countries that are able to develop their innovation potential and one of the global leaders in innovation and competitiveness, not only in the context of the knowledge economy. Therefore, the goal of this paper is to analyze the selected determinants of innovation activities in German knowledge-intensive industries.

3 Research Methodology and Data

The intensity of in-house/external R&D has been considered as an important determinant of innovation activity in most empirical studies (Frenz and Ietto-Gillies 2009). In addition, public financial support has been found as a significant determinant (Hottenrott and Lopes-Bento 2014). Recent literature has also demonstrated that knowledge spillovers represent important determinants of innovation performance (Montoro-Sánchez et al. 2011). These are effects that occur as a result of knowledge transfer and interaction between entities. The effects result in stronger

firms' innovation and absorptive capacity. Internal knowledge spillovers are based on unique firm knowledge base. They may also promote the creation of external knowledge spillovers (Filatotchev et al. 2011). Knowledge acquired from customers is of particular importance for innovation activity (Elvers et al. 2016). In agreement with previous literature, knowledge spillovers were approximated by using the importance of chosen communication sources (Kaiser 2002; Simonen and McCann 2008; Montoro-Sánchez et al. 2011; Hajek and Stejskal 2015). Specifically, firms assigned importance to the following sources: (1) internal, (2) market, (3) educational, and (4) other external sources. Recent empirical evidence suggests that collaboration promotes innovation activity. This has been reported for both collaboration inside firms (West and Bogers 2014) and collaboration with external partners (Frenz and Ietto-Gillies 2009). Based on the above-mentioned reasons, the determinants of innovation performance were used as presented in Table 1.

To perform the empirical analysis, we collected and preprocessed the data from the German Community Innovation Survey (CIS). This survey uses the Eurostat's harmonized questionnaire designed for all EU Member States and combines

Table 1 Variables used in this study

Factor	Variable description (existing literature)	Measurement
Innovation output	Percentage of total turnover in 2012 from new or significantly improved product/service introduced during the years 2010–2012 (Block et al. 2013)	Numerical (percentage)
R&D expenditure	In-house (RRDINX) and external R&D expenditure (RRDEXX), and acquisition of existing knowledge (ROEKX) (Frenz and Ietto-Gillies 2009)	Numerical variables
Public support	The enterprise received public financial support for innovation activities from (Hottenrott and Lopes-Bento 2014): Local or regional authorities (FUNLOC) Central government (FUNGMT) The European Union (FUNEU)	Dummy variables: Yes (1)/No (0)
Knowledge spillovers	How important is the following information source to innovation activities (Montoro-Sánchez et al. 2011; Filatotchev et al. 2011; Elvers et al. 2016)	
Market	Suppliers (SSUP), clients or customers—private (SCLPR), clients or customers—public (SCLPU), competitors (SCOM), and consultants (SINS)	Ordinal variables: Not used (0) Low (1) Medium (2) High (3)
Educational	Universities (SUNI) and government or public research institutes (SGMT)	
Other external	Conferences (SCON), scientific journals (SJOU), and professional associations (SPRO)	
Internal	Within an enterprise or enterprise group (SENTG)	
Collaboration	Collaboration on R&D activities with other enterprises or institutions (Frenz and Ietto-Gillies 2009; West and Bogers 2014)	Dummy variable: Yes (1)/No (0)

stratified random sampling with exhaustive surveys. It was carried out at firm level for the period 2010–2012 with a response rate >60%. The CIS is reported as comprehensive because it covers both the measures of innovation performance and factors influencing innovation (Frenz and Ietto-Gillies 2009). As a result of this survey, data was gathered for a total of 6328 German firms. Note that only firms with more than 10 employees were surveyed.

In this study, we focused on KIFs, including knowledge-intensive manufacturing industries and KIBS. These are not only major employers, but they are also important because these sectors comprise small and medium enterprises, which are efficient generators of technological/non-technological innovation. These firms are also forced to use collaboration to decrease the costs of generating innovations (Stejskal and Hajek 2015). Finally, they are also less susceptible to economic turbulence compared with large firms.

The basic descriptive characteristics of the sample are given in Table 2. Small and medium enterprises predominated in the data sample. The categorization of knowledge-intensive firms includes knowledge-intensive manufacturing industries and KIBS. This is based on the European industrial activity classification (NACE Rev. 2). Knowledge-intensive industries include those with more than 33% tertiary educated persons employed of the total employment in that industry. Knowledge-intensive manufacturing industries include NACE 21 and 26 (9.3% of all firms in the sample), while KIBS represents NACE 51, 58–66, 69–75, 78–79, 84–86, 90, 91, 94, and 99 (25.2% of the sample). Central government support

Table 2 Basic characteristics of the sample

	Frequency/Average
Size category (%)	
Under 50 employees	46.4
50–249	27.7
249–499	6.2
500 and more	19.7
Industry category (%)	
Knowledge-intensive manufacturing	9.3
KIBS	25.2
Non-knowledge intensive	65.5
Public support—local (FUNLOC) (%)	9.7
Public support—government (FUNGMT) (%)	20.4
Public support—EU (FUNEU) (%)	8.5
Turnover in 2012 (mil. EUR)	372.7
In-house R&D expenditure (RRDINX) (% of turnover)	2.03
External R&D expenditure (RRDEXX) (% of turnover)	0.32
Acquisition of existing knowledge (ROEKX) (% of turnover)	0.08
N	6328

Table 3 Importance of knowledge sources for innovation activities

Knowledge source	Average importance
Within company	1.42
Suppliers	0.77
Private customers	1.11
Public customers	0.51
Competitors	0.92
Consultants	0.48
Universities	0.64
Government	0.18
Conferences	0.88
Scientific journals	0.79
Professional associations	0.56

with 20.4% was most the frequent from the sources of public financial support for innovation activities. Finally, the in-house R&D expenditure was more than six times higher than the external one.

Table 3 shows the average degrees of importance of knowledge sources for innovation activities. These values were scaled from 0 (not used) to 3 (highly important). Knowledge sources within company were most important, followed by the knowledge from private customers. Government knowledge was least important.

In agreement with previous related studies (Frenz and Ietto-Gillies 2009), the percentage of total turnover from new or significantly improved product/service (new to market/new to firm) was used as the dependent variables. Figure 1 shows

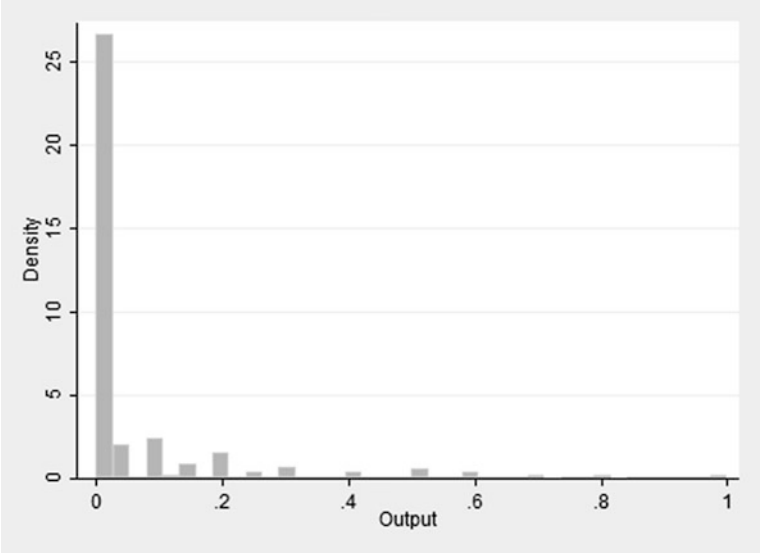

Fig. 1 Histogram of output variable—percentage of total turnover in 2012 from innovative products/services (new to market/new to firm)

that this variable is heavily truncated to the left (zero), requiring the use of specific regression models. Truncated regression addresses the bias introduced when using multiple linear regression with truncated data.

4 Results

To avoid multicollinearity issues, was first performed a confirmatory factor analysis with maximum likelihood estimates on the set of input variables. Table 1 presents the average factor loadings for the three truncated regression models (for knowledge-intensive manufacturing industries, knowledge-intensive business industries, and non-knowledge-intensive industries). Cronbach's alpha > 0.60 indicates internal consistency of the three models (Table 4).

To perform truncated regression, we used robust variance estimators. The confidence level of 0.95 was set to perform likelihood-ratio test. Constant term was not suppressed. Table 5 shows the results obtained for the knowledge-intensive manufacturing industries. R&D expenditure and public support were the most important determinants of innovation activity. In addition, university knowledge spillovers were another significant determinant. The remaining factors were not significant.

This is different from the KIBS presented in Table 6. In that case, knowledge spillovers are surprisingly not significant at all. Finally, Table 7 shows the results for the non-knowledge-intensive firms. In this model, neither R&D intensity nor public financial support played an important role. This clearly demonstrates the critical role of R&D intensity and public financial support for KIFs.

Regarding the overall quality of the regression models, the best results (lowest estimated standard error) were achieved for the knowledge-intensive manufacturing industries, followed by the KIBS and non-knowledge-intensive industries, respectively. Anyway, the errors of all the regression models were significant at $p = 0.05$.

Table 4 Confirmatory factor analysis (factor loadings) of input variables

R&D exp.	Public sup.	Market spill.	Univ. spill.	Other spill.
RRDINX 0.447	FUNLOC 0.575	SSUP 0.669	SUNI 0.808	SCON 0.835
RRDEXX 0.985	FUNGMT 0.669	SCLPR 0.706	SGMT 0.808	SJOU 0.875
ROEKX 0.942	FUNEU 0.604	SCLPU 0.540		SPRO 0.801
		SCOM 0.782		
		SINS 0.523		

Table 5 Results of truncated regression for knowledge-intensive manufacturing industries

Variable	Coef.	Std. Err.	p value	
Intercept	−0.785	0.343	0.022	**
R&D expenditure	0.111	0.075	0.000	***
Public support	0.173	0.075	0.021	**
Market spillovers	−0.006	0.136	0.964	
University spillovers	0.146	0.078	0.062	*
Other external spillovers	0.033	0.086	0.702	
Internal spillovers	0.073	0.087	0.399	
R&D collaboration	−0.203	0.185	0.272	
Estimated standard error	0.495	0.078	0.000	***
Log pseudolikelihood	115.26			
$p > \chi^2$	0.002			

*Statistically significant at $p = 0.10$, **at $p = 0.05$ and ***at $p = 0.1$

Table 6 Results of truncated regression for knowledge-intensive business services

Variable	Coef.	Std. Err.	p value	
Intercept	−3.705	2.373	0.118	
R&D expenditure	0.294	0.147	0.046	**
Public support	0.581	0.303	0.055	*
Market spillovers	−0.114	0.352	0.746	
University spillovers	0.176	0.218	0.419	
Other external spillovers	0.204	0.258	0.429	
Internal spillovers	−0.269	0.283	0.341	
R&D collaboration	0.050	0.476	0.916	
Estimated standard error	1.003	0.279	0.000	***
Log pseudolikelihood	184.80			
$p > \chi^2$	0.678			

*Statistically significant at $p = 0.10$, **at $p = 0.05$ and ***at $p = 0.1$

However, the results in terms of χ^2 statistics suggest that only the model of knowledge-intensive manufacturing industries is significant.

To test for the robustness of the results, we further examined regression models using only those variables that were significant in previous models; see Table 8. The quality of the regression models was slightly worse compared to the models with all variables in terms of estimated standard error. Again, the χ^2 statistics suggests that only the model of knowledge-intensive manufacturing industries is significant. Overall, the results confirm the previous findings on the role of input variables in firm innovation performance.

Table 7 Results of truncated regression for non-knowledge-intensive industries

Variable	Coef.	Std. err.	p value	
Intercept	−8.577	7.974	0.282	
R&D expenditure	5.366	4.116	0.192	
Public support	0.714	0.660	0.280	
Market spillovers	−1.444	1.272	0.256	
University spillovers	−0.113	0.279	0.685	
Other external spillovers	−0.030	0.315	0.923	
Internal spillovers	0.772	0.706	0.275	
R&D collaboration	−0.197	0.694	0.777	
Estimated standard error	1.395	0.617	0.024	**
Log pseudolikelihood	585.46			
$p > \chi^2$	0.972			

** Statistically significant at $p = 0.05$

Table 8 Results of truncated regression using significant variables—coef. (p value)

Variable	Knowledge-intensive manufacturing	Knowledge-intensive business services	Non-knowledge-intensive industries
Intercept	−0.832(0.023)**	−5.014(0.162)	−13.981(0.438)
R&D expenditure	0.112(0.000)***	0.364(0.090)*	8.004(0.373)
Public support	0.143(0.031)**	0.756(0.082)*	0.999(0.412)
Market spillovers	–	–	–
University spillovers	0.132(0.079)*	0.211(0.385)	−0.534(0.465)
Other external spillovers	–	–	–
Internal spillovers	–	–	–
R&D collaboration	–	–	–
Estimated standard error	0.519	1.124	1.783
Log pseudolikelihood	114.95	202.37	621.56
$p > \chi^2$	0.000	0.342	0.850

*Statistically significant at $p = 0.10$, **at $p = 0.05$ and ***at $p = 0.1$

5 Conclusions

As concluded in various scientific studies, the innovation activities of the firms are determined by various indicators. Knowledge-intensive firms and their knowledge sector are influenced mainly by knowledge-related indicators and innovation environment. Those strongly affect knowledge creation, knowledge acquisition and transfer. There are also various kinds of unintended spillover effects that presumably have a positive impact on stakeholders.

It is clear that each region (and country) provides support by using various modern economic development tools such as networking or open innovation initiatives that aim to improve its knowledge base. It should be noted that not all regions are sufficiently mature to use the advanced tools. The tools need to be chosen and mixed appropriately, and public policies should create specific conditions that enable to use these tools effectively. Similarly, politicians should develop those strategies that will accentuate the development in the coming decade and support the upgrading version of these tools. Networking (and its upgrading to advanced type of system—regional innovation system) is the typical example of such an application. The results of this study suggest that the support of university–firm links in manufacturing may be effective, in particular.

A further extension of this process allows to utilize effective links both inside the system (working on the triple-helix base—between individual entities, enterprises, universities, and knowledge organizations) and links outside the system (the interconnection between global production chains and other national/regional innovation systems, both inside or outside of the country and internationally too).

Our study proves that R&D and public support are the most important innovation factors in German knowledge-intensive sector. This is mainly due to the demands on the quality of the technologies, their up-to-date, which requires constant big innovations. Similarly, the results correspond to the specificities of the knowledge-intensive sector—in a skilled workforce demand. The government and the national/municipal budget can effectively help with these two problems. We can discuss the question of how much these public interventions distort market equilibrium and whether this public support is permissible with Single Market Act in the EU.

The results also confirm that knowledge spillover is a significant determinant of innovation activities in analyzed industries. This has been demonstrated by a number of other above-mentioned studies in other countries. Among the investigated spillover effects, the effect from collaboration with universities is the most important. However, according to the results of the analysis, German knowledge-intensive industries are not sufficiently prepared to effectively cooperate with other firms and public research institutions. This is mainly due to the specific missions of university sector, into which the entrepreneurial universities enter just slowly and gradually. Another form of knowledge acquisition and cooperation was found to be insignificant.

Surprisingly, the opposite results were recorded for KIBS and for firms that do not use knowledge as a production factor at all. Here, we did not find that these firms gain any significant benefits of knowledge-related factors. R&D intensity and public financial support did not play a significant role in this model either. This clearly demonstrates the crucial role of R&D intensity and public financial support for KIFs. Future research should therefore concentrate on these determinants in more detail and study the effectiveness of public financial support. In addition, international comparative studies are required to generalize the empirical findings of this study.

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CVA for Discretely Monitored Barrier Option Under Stochastic Jump Model

Yaqin Feng and Min Wang

Abstract Counterparty credit risk (CCR) has come to be a hot topic from 2007. This paper investigates the impacts of stochastic volatility and jumps on evaluating credit valuation adjustment (CVA) and exposures for vanilla options and exotic option products under stressed market conditions. As examples, we develop a dynamic framework for evaluating exposure profiles of European, discretely monitored barrier option under the Heston and Bates models (stochastic jump model). We use Monte Carlo and Fourier-based cosine expansion method to assess model risk on counterparty credit risk (CCR). Numerical results exhibit that both stochastic volatility and jump are important in pricing exposures and CVA.

Keywords CVA · Discretely monitored barrier option · Heston model
Bates model · EE · PFE

1 Introduction

Counterparty credit risk (CCR) has been considered to be one of major drivers of 2007 financial crisis. Banks suffered significant CCR losses on their over-the-counter (OTC) derivatives contracts during credit crisis. CCR is the risk that a counterparty of a financial contract will fail to make the required payments prior to the expiration of the contract, causing losses to the other party. As indicated in Basel Committee on Banking Supervision (2011): "two-thirds of losses attributed to CCR is due to the credit valuation adjustment (CVA)." The valuation of CVA thus becomes important to manage the CCR. By definition, CVA is the difference

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between the market price of portfolio and the risk-free price of a portfolio with consideration of a counterparty's default (Milev and Tagliani 2010).

CVA has been studied in numerous literature in the past. Pykhtin and Zhu (2007) provided a guide to model the exposure and CCR. Lipton and Sepp (2009) discussed the CVA for a structural default model and studied the role of the asset jumps. Brigo et al. (2001), Gregory (2009, 2010, 2015), and Lipton and Savescu (2014) investigated the bilateral counterparty risk.

It is well known that the computation of CVA is complex. In simplest setting, CVA estimation can be decomposed into the following parts: the computation of expected exposure (EE) and the measurement of credit risk parameter such as the estimation of default probability and recovery rate. Our focus of this paper is to understand the CVA, expect exposure profiles for discretely monitored barrier options. We examine two stochastic volatility models, the Heston model and the Bates model. Heston model is quite popular in industry due to its analytic tractability as well as its ability to replicate market observed phenomena. Betas model extends Heston model by allowing jumps. The need of inclusion of jump has been studied in many works. Bates (1996) found evidence supporting the need for adding the jumps in the stock price. Other related work can be found in Bakshi et al. (1997), Andersen et al. (2002), Broadie et al. (2007). All the related study indicates that: The introduction of the jumps is needed for better matching the market observed data. Although the introduction of the jump will increase the model complexity, it increased the flexibility of the model.

Several approaches have been developed to assess CVA for options with path-dependent features. The class of regression-based methods is widely used. Carriere (1996), Tsitsiklis and Van Roy (2001) developed the method of simulation and regression for pricing option. Longstaff and Schwartz (2001) developed least squared method (LSM), and Jain and Oosterlee (2012) introduced stochastic grid method (SGM). More details of regression method can be found in Glasserman (2004). The second type of method is based on PDE method. Related work can be found in Graaf et al. (2014) and Grzelak et al. (2014). As mentioned in Feng and Linetsky (2008), PDE approach has been broadly used in the literature and very popular in practice. Feng (2017) studies CVA with stochastic intensity use PDE method. However, the PDE-based methods involve two and higher dimension discretization; the discretization systems can be dense and computationally intensive.

In order to price expected exposure and assess CVA for discretely monitored barrier option, we construct the following Monte Carlo (MC) framework: Firstly, asset paths are generated through MC simulation at each time lattice; secondly, option values at each of time grid along the path are determined to calculate the EE. Because EE involves the calculation of option value at all future time along all paths, computation efficiency is a major challenge. Meanwhile, path-dependent feature of discretely monitored barrier option increases the complexity of the pricing problem. In this paper, we will adopt Fourier-based cosine expansion method for valuation. Cosine expansion method was introduced by Fang and Oosterlee (2008) and Fang (2010). It is quite popular because of its calculation accuracy and speed. Our framework combines Monte Carlo and grid-based analytic

approach (cosine expansion), which is proved to be stable and efficient through numerical tests. Meanwhile, because of the complexity and computationally demand, practitioners usually do not evaluate CVA under stochastic jump model. Therefore, understanding the impact of the jump and model risk is important.

The skeleton of this paper is the following. We introduce the definition of CVA and describe the models in Sect. 2. In Sect. 3, we describe the basic Monte Carlo framework and cosine expansion method for CVA pricing. In Sect. 4, numerical outcomes are given. Conclusions are presented in Sect. 5.

2 Preliminary

2.1 EE, PFE, and CVA

CCR is the risk that arises from the possibility of counterparty's default. CCR is different from other forms of financial risk with the following two features. One feature is that CCR is based on the uncertainty of exposure. The other feature of CCR is its bilateral nature (Pykhtin and Zhu 2007).

CCR arises from the asymmetry of potential losses w.r.t. the underlying contracts. CCR is closely related to the relevant contract's value. If the value is positive, the counterparty is unable to make the contractual payment in the case of default. The institution will have a claim on the amount and expect to recover a fraction of the claim. If the value is less than zero, the institution is obliged to pay this amount to the counterparty. From the institution's view, it does not loss or gain from the counterparty's default. The credit exposure is the maximum of zero and the portfolio's market value if the counterparty were to default. Let $V(t)$ be the portfolio's market value at t, and the exposure $E(t)$ is defined as $\max\{V(t), 0\}$. Assume that the probability space is $(\Omega, \mathcal{F}_t, P)$, P is the risk-neutral probability, and $\mathcal{F}_t$ is the filtration on Ω. Expected exposure (EE) is the average exposure at a future time:

$$\mathrm{EE}(t) = E\{\max(V(t), 0)|\mathcal{F}_0\}. \tag{1}$$

Potential future exposure (PFE) is the maximum exposure that is expected to loss in the case of counterparty's default at a given level of confidence. For example, given a confidence level of $\alpha = 97.5\%$, PFE is level of exposure that is exceeded with 2.5% probability.

$$\mathrm{PFE}(t) = \inf\{y|P(V(t) < y|\mathcal{F}_0) > \alpha\}, \tag{2}$$

Credit value adjustment (CVA) is the market value of the credit risk due to the counterparty's default. It is the difference between the risky value of a portfolio and risk-free value of the portfolio. Assume the portfolio expires at T and $0 = t_0 < t_1 < \cdots < t_n = T$. When default occurs, only some percentage amount can

be recovered. Denote the recovery percentage by R, the time of counterparty default by τ_{cpty}, and the time of bank default by τ_{bank}, then

$$\text{CVA} = (1-R)\sum_{j=1}^{n} E\left[P(0,t_j)\cdot\max\left(V(t_j),0\right)\cdot 1_{\left\{t_{j-1}<\tau_{\text{cpty}}<t_j,\tau_{\text{bank}}>t_j\right\}}\right], \quad (3)$$

where $P(0,t_j)$ is the discount factor at time t_j.

If we assume exposure and counterparty default are dependent, Eq. (3) can be simplified to:

$$\text{CVA} = (1-R)\sum_{j=1}^{n} P(0,t_j)\cdot \text{EE}(t_j)\cdot \text{PD}(t_{j-1},t_j), \quad (4)$$

where $\text{PD}(t_{j-1},t_j)$ is the counterparty default probability between date t_{j-1} and t_j.

In Eq. (4), the key elements to calculate CVA are the expected exposure $\text{EE}(t_j)$ and default probability. For CVA calculation, we will assume the exposure and the default probability are dependent and the recovery rate is a constant. Wrong way risk will not be considered. We will mainly focus on calculation of $\text{EE}(t_j)$. We are also concerned with the valuation of $\text{PFE}(t_j)$. Therefore, it becomes crucial to compute the exposure at all discrete time during the lifetime of portfolio.

2.2 Discretely Monitored Barrier Option

A barrier option is an exotic option. The payoff depends on whether or not the price of the underlying asset crosses a predetermined level (barrier). There are different types of barrier options such as down-and-in call, up-and-in call, and so on. For example, a down-and-out option becomes worthless if underlying asset price drops to a certain level before the option expiration date. Barrier options are more flexible than vanilla options and are widely traded in the markets.

One important issue of pricing barrier options is how the barrier crossing is monitored. Many models assume continuous monitoring of the barrier. Related work can be found in Merton (1973), Kunitomo and Ikeda (1992), Heynen and Kat (1994a, b), Kou (2003) and Kou and Wang (2001). However, most market traded barrier options are discretely monitored. Pricing discretely monitored barrier options is more difficult than the continuous monitored barrier options. Many studies focused on the pricing for discretely monitored barrier options. Heynen and Kat (1994a) developed an analytic solution based on multivariate normal distribution functions. Fusai et al. (2006) used WienerHopf equation and derived an analytical formula. Chen et al. (2010) studied analytic solutions for a class of derivative with discretely monitored feature. Milev and Tagliani (2010) and Hong et al. (2015) used the numerical method.

For CVA calculation purpose, we need to evaluate the option value over the lifetime of the option. Only the time zero value of option is known with certainty, the future value of the option is uncertain. Valuation at future time presents some challenges, especially for barrier option. It is not known with certainty whether or not the barrier option is still alive. In order to price discretely monitored barrier option, we will use the cosine expansion method and derive recursive formulas. The computation is efficient based on the method. Details will be presented in Sect. 3.2.

2.3 Stochastic Volatility Models

2.3.1 Heston Model

Heston model is one of most popular stochastic volatility models. Heston (1993) introduced the model in 1993. The model specifies the following dynamics:

$$\begin{aligned} \mathrm{d}S(t) &= rS(t)\mathrm{d}t + \sqrt{V(t)}S(t)\mathrm{d}W_1(t) \\ \mathrm{d}V(t) &= \kappa(\theta - V(t))\mathrm{d}t + \sigma\sqrt{V(t)}\mathrm{d}W_2(t) \end{aligned} \tag{5}$$

where r is the risk-free interest rate, $W_1(t)$ and $W_2(t)$ are two Brownian motions, the correction between them is ρ, κ is the mean reversion rate, θ is the long-term mean reversion level, σ is the volatility of variance, and $V(0)$ is variance at initial time zero. Since the characteristic function of Heston model can be derived in close form, price of European options can be found easily through the analytical formula.

2.3.2 Bates Model

Bates model is a jump-diffusion model. The idea behind the "stochastic volatility plus jumps in the underlying" model is that there is a combination between stock price jumps and stochastic volatility (Kienitz and Wetterau (2013)).

Let us consider the SDE:

$$\begin{aligned} \mathrm{d}S(t) &= rS(t)\mathrm{d}t + \sqrt{V(t)}S(t)\mathrm{d}W_1(t) + (Y-1)S(t)\mathrm{d}N(t), \\ \mathrm{d}V(t) &= \kappa(\theta - V(t))\mathrm{d}t + \sigma\sqrt{V(t)}\mathrm{d}W_2(t), \end{aligned} \tag{6}$$

where $N(t)$ is the standard Poisson process with intensity λ_J. It models the numbers of the jumps. The jump size Y follows a lognormal distribution. That is to say,

$$Y = \mu_\mathrm{J}\exp\left(-\tfrac{1}{2}\sigma_\mathrm{J}^2 + \sigma_\mathrm{J}Z\right), \quad Z \sim N(0,1). \tag{7}$$

All other parameters have the same meaning as listed in Heston model. Bates model extends Heston model by adding the jump term. The characteristic function

of Bates model has the same appearance as that in Heston model, with the only difference of jump part. As we know, Heston models are able to model skew and smile of implied volatility surface. The introduction of jump term in Bates model allows extra flexibility for a more significant smile.

3 General Scheme for CVA Pricing for Discretely Monitored Barrier Option

In order to assess expect exposure and calculate CVA, we develop the following dynamic framework. We first generate paths for stock price and variance over time based on MC simulation. To calculate the discretely monitored barrier option price at each future time grid, cosine expansion method is then applied. For barrier option, we need to check whether the stock price along each path hits the barrier. If the underlying price hits the barrier, the exposure is set to be zero at later time.

3.1 Monte Carlo Simulation

Many methods have been developed to simulate the path in the context of Heston model. Standard techniques such as Euler scheme, Milstein scheme, and implicit Milstein scheme can be found in Rouah and Heston (2013). Note that the variance $V(t)$ follows non-center chi-square distribution, and the dynamics allows possibility of negative variance. In order to avoid negative values, quadratic exponential (QE) scheme is applied. QE scheme switches between two different approximations depending on the value of $V(t)$. For more details of QE, we refer to Rouah and Heston (2013).

In order to simulate the path for Bates model, we treat the diffusion part and jump part separately. Similar to Heston model, QE scheme is used to simulate the diffusion part. Asset path $S(t)$ is then obtained by multiplying the jump part and diffusion part together at the end.

Along each path simulated, we need to evaluate the EE and PFE. For discrete monitored barrier option, we will apply cosine expansion method for valuation under Heston and Bates model.

3.2 Expected Exposure Estimation Based on Cosine Expansion Method

Cosine expansion method was introduced by Fang and Oosterlee (2009) and Fang (2010) to price European options. The option value is approximated by the Fourier

cosine series expansion of the expected payoff. By replacing the probability density function by its cosine expansion and standard techniques, option prices can be written in terms of cosine series expansion. The coefficients of the series can be expressed in term of the characteristic function. This method can be applied to a wide class such as Levy process, Heston process. For Heston model, the detailed description can be found in Fang and Oosterlee (2009) and Fang (2010). In order to find the option value in Bates model, we will apply similar technique.

We consider a down-and-out call option with strike K and barrier B as an example. Assume that the barrier option is monitored on the following set of observation dates $t_1 < \cdots < t_n < \cdots < t_M = T$. Let $\xi = \log\left(\frac{B}{K}\right)$, $x_n = \log(S_n)$ and $v_n = \log(V_n)$, from Fang (2010), then the option price in Heston setting will be written in the following format:

$$c(x_n, v_n, t_n) := \mathrm{e}^{-r(t_{n+1}-t_n)} Re\left\{\sum_{m=0}^{N-1} \beta_m(v_n, t_n)\mathrm{e}^{im\pi}\right\}, \tag{8}$$

where

$$\beta_m(v_n, t_n) := \sum_{i=1}^{I} w_i V_{m,i}(t_{n+1})\tilde{\phi}\left(\tfrac{m\pi}{b-\mathrm{a}}; \zeta_i, v_m\right), \tag{9}$$

$$V_{m,i}(t_{n+1}) := \tfrac{2}{b-a}\int_a^b c(x_{n+1}, v_i, t_{n+1})\cos\left(m\pi\tfrac{x_{n+1}-a}{b-a}\right)\mathrm{d}x_{n+1}, \tag{10}$$

and

$$\tilde{\phi}(w, v_{n+1}, v_n) := f_v(v_{n+1}|v_n)\cdot\phi(w; 0, \mathrm{e}^{v_{n+1}}, \mathrm{e}^{v_n}). \tag{11}$$

Here w_i is the weight of Gauss–Legendre quadrature integration at nodes v_i for $i = 1, 2, \ldots, I$ and $[a, b] := \left[\xi_1 - L\sqrt{|\xi_2| + \sqrt{|\xi_4|}}, \xi_1 + L\sqrt{|\xi_2| + \sqrt{|\xi_4|}}\right]$, ξ_n denotes the *nth* cumulant of the log-stock process and $L \in [6, 12]$ is a constant. We will take $L = 10$. r is the risk-free interest rate.

As we can see, pricing formulas (8) and (9) are the general recursive formulas. The calculation depends on two important components. The first component is the Fourier cosine expansion coefficients $V_{m,i}(t_{n+1})$. In terms of discrete monitored barrier option down-and-out call option, at maturity date $\mathrm{T} = t_{\mathrm{M}}$,

$$V_{m,i}(t_{\mathrm{M}}) = \tfrac{2}{b-a}\int_{\xi}^{b} K(\mathrm{e}^y - 1)^+\cos\left(m\pi\tfrac{y-a}{b-a}\right)\mathrm{d}y, \tag{12}$$

where $x^+ = \max(x, 0)$. Therefore, we can compute $V_{m,i}(t_{n+1})$ analytically at $t = t_{\mathrm{M}}$. Given the terminal coefficient $V_{m,i}(t_M)$, the coefficients $V_{m,i}(t_{n+1})$ at all previous time $t_{M-1}, \ldots, t_2, t_1$ can be obtained through the backward

recursive formula. The second component is the term $\tilde{\phi}(w, v_{n+1}, v_n)$. $\tilde{\phi}(w, v_{n+1}, v_n)$ is the product of the conditional probability density of the log variance $f_v(v_{n+1}|v_n)$ and the characteristic function $\phi(w; 0, e^{v_{n+1}}, e^{v_n})$. It is well known that the variance process for both Heston model and Bates model follows non-central chi-square distribution, so the term $f_v(v_{n+1}|v_n)$ has a closed form formula:

$$f_v(v_{n+1}|v_n) = \chi e^{-\chi\left(e^{v_n - \kappa(t_{n+1}-t_n)} + e^{v_{n+1}}\right)} \left(\frac{e^{v_{n+1}}}{e^{v_n - \kappa(t_{n+1}-t_n)}}\right)^{p/2} e^{v_n} I_p\left(2\chi e^{0.5(v_n + v_{n+1} - \kappa(t_{n+1}-t_n))}\right), \tag{13}$$

where $\chi = \frac{2\kappa\theta}{(1-e^{-\kappa(t_{n+1}-t_n)})\sigma^2}$, $p = \left(\frac{2\kappa\theta}{\sigma^2}\right) - 1$, and $I_p(x)$ is the modified Bessel function of the first kind with order p. The characteristic function $\phi(w; 0, e^{v_{n+1}}, e^{v_n})$ is the term that differentiates Heston model and Bates model. Compared to Heston model, Bates model incorporates an independent jump term in the SDE for stock process. The dependency between the jump term and diffusion term makes the calculation of characteristic function straightforward. We will not listed the details here.

For the calculation of CVA, exposure at each of future time is estimated using cosine expansion method as listed above. The average along each path at each future time is calculated to obtain the EE. 97.5% quantile is used to find the corresponding PFE.

4 Numerical Results

In this section, several numerical test results are presented. We first discuss calibration of the parameters between Bates model and Heston model. We then illustrate the EE and PFE profiles for both vanilla European option and discretely monitored barrier option. In the last part, we discussed the model risk for EE by examining the impact of the model parameters.

4.1 Calibration

In order to fairly compare the model risk between Heston model and Bates model and study the impact of jump, we calibrate Bates model to the market and Heston model to the benchmark model. Because Bates model contains more parameters, we will use Bates model as our benchmark model.

The calibration process is a straightforward process of minimizing the value of the objective function, so that the model prices are as close as possible to the market price. Suppose we have a set of N_T maturities τ_t, $(t = 1, \ldots, N_T)$ and a set of N_k strikes K_k, $(k = 1, \ldots, N_k)$. For each maturity-strike combination (τ_t, K_k),

we have a market price $C(\tau_t, K_k) = C_{tk}$ and a corresponding model price $C(\tau_t, K_k; \text{parameter}) = C_{tk}^{\text{parameter}}$ implied by the models. The parameter is then obtained by minimizing

$$\frac{1}{N}\sum_{t,k}\left(C_{tk} - C_{tk}^{\text{parameter}}\right)^2 \tag{14}$$

where N is the number of quotes.

Since we calibrate Heston model to Bates model, the plots of quoted implied volatility (from Bates model) and implied volatility generated from Heston prices are illustrated in Fig. 1. From Fig. 1, we notice that Heston models fit the implied volatility very well for long-term volatility slices. However, the differences are more significant for short-term volatility slices such as maturity = 0.2 and maturity = 0.25. It shows that the fit of the implied volatility is slightly worse for short-term options than for longer-term ones in Heston model. Bates model introduces extra parameters and provides flexibility to fit the short time volatility. Table 1 presents the calibration results. Note that for study purpose, we consider a stressed market.

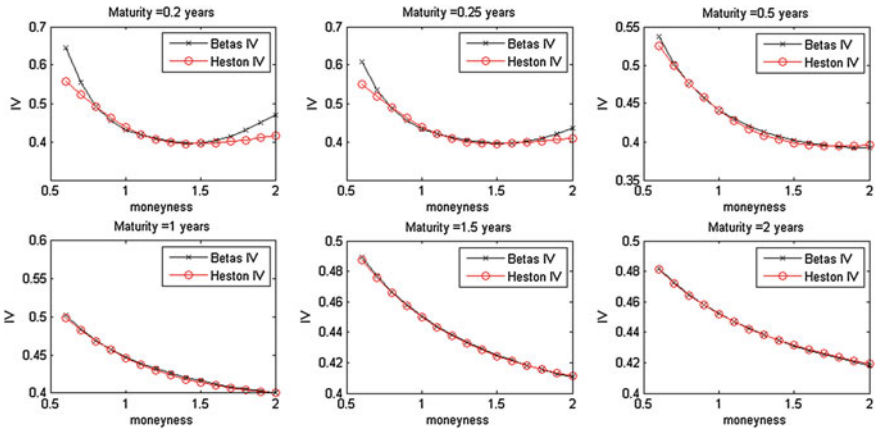

Fig. 1 Calibration result

Table 1 Base parameters

Bates model	$\kappa = 2$, $\theta = 0.16$, $\sigma = 0.25$, $\rho = -0.5$, $V_0 = 0.16$, $\lambda_J = 0.2$, $\mu_J = -0.5$, $\sigma_J = 0.4$
Heston model	$\kappa = 4.244$, $\theta = 0.2263$, $\sigma = 1.0752$, $\rho = -0.4883$, $V_0 = 0.1971$

4.2 EE and PFE Profile for European Option and Barrier Option

4.2.1 European Option

In order to gain some intuition for the EE and PFE profile, we first show EE and PFE profiles for European option using the parameters listed in Table 1. Assume risk-free interest rate r and dividend q are zero, we consider the following European call option with maturity $T = 2.0$ and initial stock price $S_0 = 100.0$. We consider three different strikes: $K = 80$, $K = 100$, and $K = 120$. It represents the in the money (ITM) option, at the money (ATM) option and out of the money (OTM) option, respectively. Figures 2, 3, and 4 show the results. From the figures, we have:

- For European options, EE profile for both Heston and Bates model is relatively close to each other for all OTM, ATM, and ITM cases. This behavior is expected since we calibrate Heston models to Bates models.
- EE for both models starts from an initial level and oscillates in the lifetime and resumes to initial level at expiration date. This part can be explained by the martingale tests proposed by Tang and Li (2007).
- PFE profiles are overlapped with each other at beginning stage; however at the later lifetime of the option ($t > 1.5$), we see some discrepancy between two models. As we pointed out in Sect. 4.1, comparing to Bates model, Heston model might have problems to fit the short maturities options (see, in particular Fig. 1). The diffusion in Heston model cannot generate substantial underlying asset movements that are implied by the short maturity options. As option gets close to expiration dates, this difference is reflected in the tailed distribution for calculation of PFE.

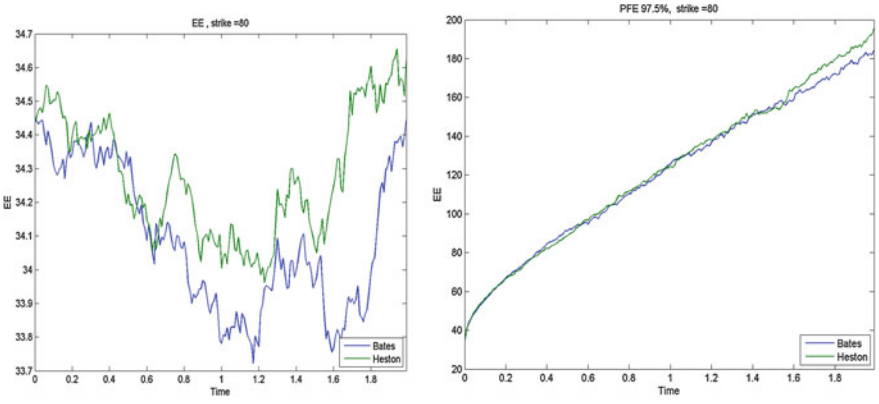

Fig. 2 ITM European option

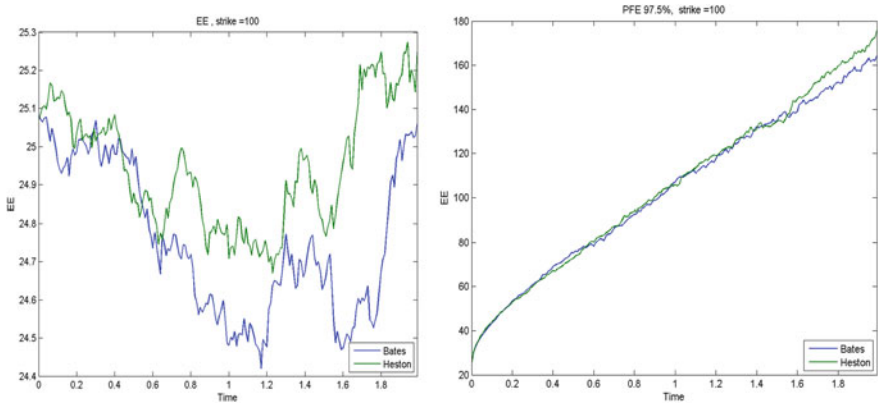

Fig. 3 ATM European option

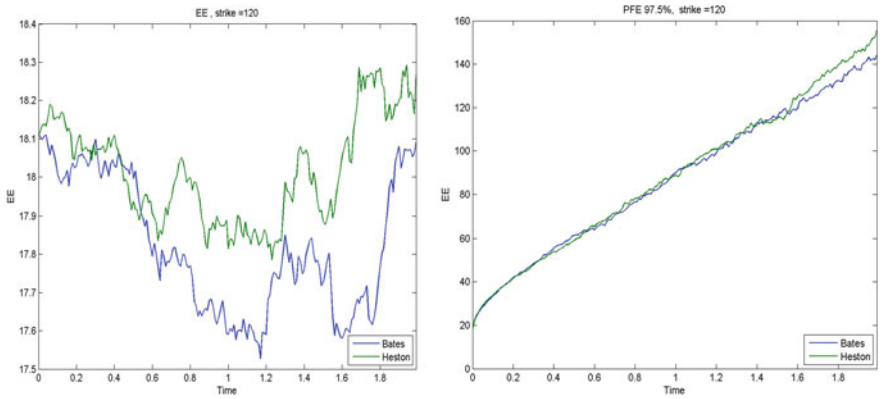

Fig. 4 OTM European option

4.2.2 Barrier Option

In this part, we will show the EE and PFE profile for a discretely monitored barrier option. The model parameters are the same as their counterpart for European option discussed above. The barrier option is a daily monitored down-and-out call option with barrier $B = 95$. Test results are displayed in Figs. 5, 6, and 7. We note:

- Unneglectable differences are observed for EE and PFE in all test cases. The model differences [see Eq. (15)] for EE are 10.34, 11.89, and 13.89% for ITM, ATM, and OTM options.
- Similar to European option, EE for both models starts from certain point and oscillates in the lifetime and resumes to the initial level at maturity. This part again can be explained by the martingale test theory: When there is only one payment, the discounted cash flow is a martingale.

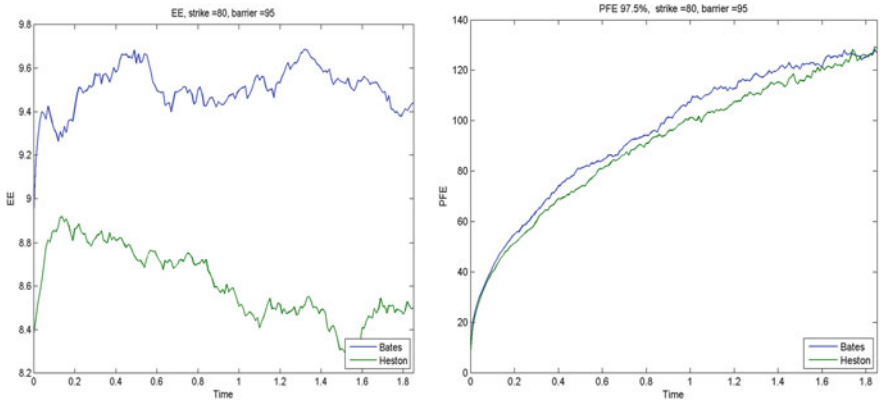

Fig. 5 ITM barrier option

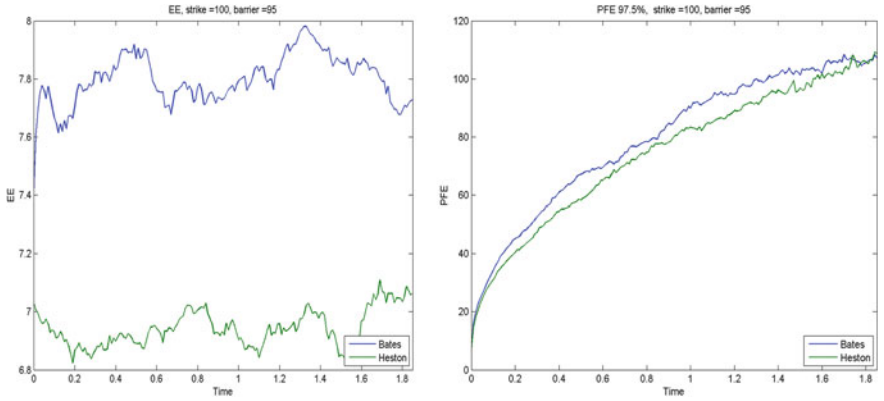

Fig. 6 ATM barrier option

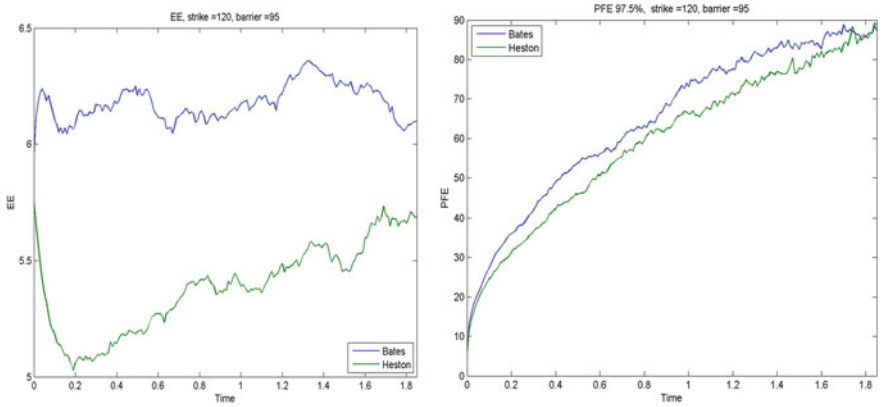

Fig. 7 OTM barrier option

In order to understand the source of the differences, we will study the impact of model parameters in the following section. Since Bates models have extra jump parameters, we mainly focus on three jump parameters.

4.3 Impact of Parameters

In the following section, we compare the EE for different parameter settings. For all the tests, we examine the model difference between the Bates model and Heston model. We define the model difference for EE profiles between two models as the following:

$$\text{model difference} = \frac{\sum_{j=1}^{n}\left(\text{abs}\left(\text{EE}(t_j)^{\text{Betas}} - \text{EE}(t_j)^{\text{Heston}}\right)\right)}{n \cdot \left(\frac{\text{EE}(t_0)^{\text{Betas}} + \text{EE}(t_0)^{\text{Heston}}}{2}\right)} \tag{15}$$

where $\text{EE}(t_j)^{\text{Betas}}$ and $\text{EE}(t_j)^{\text{Heston}}$ are the EE values obtained by the cosine expansion method at the time t_j, $\text{EE}(t_0)^{\text{Betas}}$ and $\text{EE}(t_0)^{\text{Heston}}$ are current value $(t = 0)$ of the option for Bates and Heston model. Bates model extends Heston model by introducing extra jumps. The jump terms provide extra flexibility the model and allow for a more pronounced smile shape for short-term volatility. In order to study the influence of the jump, we use Bates parameters listed in Table 1 as the base Bates scenario. By increasing or decreasing one of the parameters while keeping other parameters fixed, we first calibrate the Heston model parameters, then compare the model difference between two models. We consider a down-and-out barrier option with barrier $H = 95$ and maturity $T = 2$, and the initial stock price S_0 is 100. Since ATM option and OTM option are more sensitive to the model parameters, we will only present the result for strike = 100 and strike = 120.

4.3.1 Impact of Parameter λ_J

We present the results by varying parameter λ_J for the Bates model. Table 2 summarizes the model differences for strike = 100 and strike = 120. The EE and PFE profile results are shown in Figs. 8 and 9. The model difference between Heston model and Bates model for both ATM and OTM option can be large around 20%. As we know, λ_J is the jump intensity and represents the peakness of the

Table 2 Impact of λ_J

Impact of λ_J	$\lambda_J = 0.1$	$\lambda_J = 0.2$	$\lambda_J = 0.3$
Strike = 100	5.33%	11.89%	19.98%
Strike = 120	6.6%	13.68%	22.91%

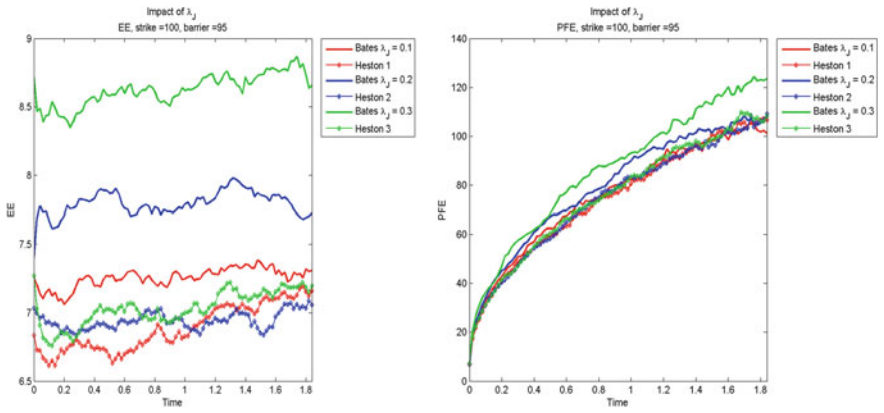

Fig. 8 Strike = 100

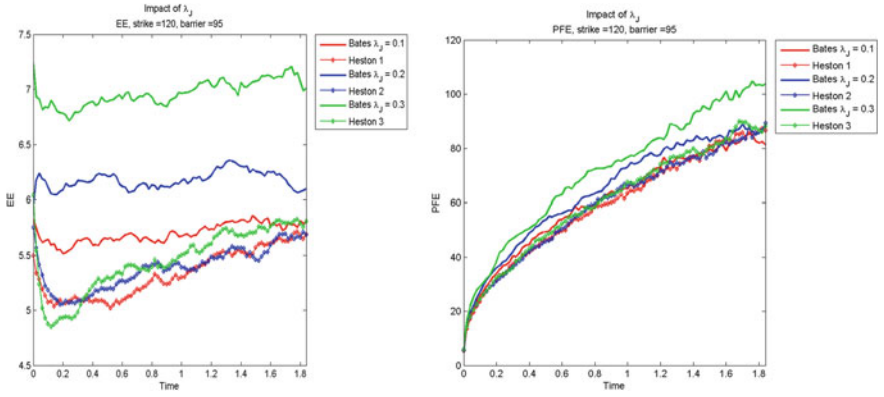

Fig. 9 Strike = 120

distribution. As λ_J increases, the model difference increases correspondingly. The results demonstrate that the impact of λ_J could be significant.

4.3.2 Impact of Parameter σ_J

Table 3 shows results by varying parameter σ_J. σ_J is the volatility of jump, and it determines the width of the distribution. We can easily see that the impact of σ_J on model difference is unneglectable for both strike = 100 and strike = 120.

Table 3 Impact of σ_J

Impact of σ_J	$\sigma_J = 0.2$	$\sigma_J = 0.4$	$\sigma_J = 0.55$
Strike = 100	12.83%	11.89%	12.82%
Strike = 120	13.68%	13.68%	15.99%

Table 4 Impact of μ_J

Impact of μ_J	$\mu_J = -0.5$	$\mu_J = -0.2$	$\mu_J = 0$
Strike = 100	11.89%	4.93%	1.56%
Strike = 120	13.68%	6.65%	3.77%

4.3.3 Impact of Parameter μ_J

Table 4 shows results by varying parameter μ_J. μ_J determines the location of the mean value. When μ_J increases from −0.5 to 0, the model difference decreases from 13.68% to 3.77% for strike = 120. For strike = 100, the model difference reduces from 11.89% to 1.56%. μ_J reflects the impact of the tail distribution for the model difference.

4.3.4 Impact of Parameter σ

Since volatility is an important feature for stochastic model, we also investigate impact of the σ on the model risk. Table 5 summarizes results by varying parameter σ. Actually, σ plays similar role as σ_J as it controls the overall volatility as well. The impact on model difference in our tests is around 10–14%.

4.3.5 Impact of Parameter ρ

Table 6 shows results by varying parameter ρ. The impact of ρ is similar to μ_J in some sense, and ρ has the effect on the tail distribution. The model difference for EE is greater than 9% for all the ρ test cases.

Table 5 Impact of σ

Impact of σ	$\sigma = 0.25$	$\sigma = 0.4$
Strike = 100	11.89%	12.16%
Strike = 120	13.86%	13.24%

Table 6 Impact of ρ

Table 1:Impact of ρ	$\rho = -0.5$	$\rho = 0$	$\rho = 0.5$
Strike = 100	11.89%	9.16%	12.97%
Strike = 120	13.68%	12.42%	16.61%

Comparing to normal option pricing, the model difference in CVA and EE calculation is determined by twofolds: the forward distribution of risk factors and the valuation of the option at the future time. Therefore, the analysis of model difference will be more complicated in CVA. In this part, we study the impact of the three extra jump parameters from Bates models versus Heston model. Meanwhile, the impact of volatility and correction is also investigated. We found that in the stressed situation, all the parameters can have a noticeable impact on model difference. The difference reflects both the model risk and calibration risk.

5 Conclusion

In the paper, we have applied Monte Carlo and Fourier-based cosine expansion method for computation of the exposure profiles and PFE profile for discretely monitored barrier option. The underlying asset is driven by Bates model and Heston model. Comparing to Heston model, Bates model provides a good fit for short-term option. Since Bates model allows jumps to the underlying process, it allows for a significant smile for short-term options. The impact of jump between two models (model risk) is studied.

All the numerical analysis shows that the dynamic framework (for CVA pricing) developed by us is efficient and stable. Based on the framework, we have systematically studied the model risk and the impact of jumps. Our results show that the impact of jump intensity, volatility of jump size and volatility of volatility parameters could result in unneglectable model difference between Bates model and Heston model. The jump mean and correction parameters that control the skew of the distribution also contribute to noticeable model differences. The stochastic volatility and jump that are widely ignored by practitioners are important in evaluating CVA and expected exposures, particularly for stressed market conditions.

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Family Affair—Insider Trading and Family Firms: Evidence from Thailand

Rapeepat Ingkasit and Arnat Leemakdej

Abstract Thai insiders can earn significant abnormal returns from trading shares of their firms. The effect is more pronounced when trades occurred prior to earnings announcement. The results provide reasoning for regulation that prohibits the insiders to trade prior to earnings announcement. Both family ownership and control structure affect the magnitude of market reaction. The findings support the entrenchment effect in family firms. The presence of specific categories of blockholder has monitoring effect, while some types of blockholder seem to exhance the insiders' signal and strengthen the market reaction. Significant reduction in abnormal returns earned by insiders in the firm with voluntary blackout policy suggests that the policy effectively forbid the insiders to trade when they possess valuable information that is not available to the public.

Keywords Insider trading · Family firms · Blackout policy · Corporate governance

1 Introduction

Over the last few years, family firms have attracted attention from academic researchers. Some researches consider family ownership as the most prevalent form of corporate in the world, while this type of ownership is uncommon in the USA. Villalonga and Amit (2006) suggest that if individual or family holds substantial voting rights, it is likely to lead Agency Problem II to overshadow Agency Problem I. Thus, the majority shareholders may seek the personal benefits at the expense of minority shareholders.

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Trading their own stocks is one technique that controls shareholders, managers, and members of the board of directors, so-called insiders, in family firm may gain their personal benefits. Insiders usually have more insights about their company than outsiders such as minority shareholders. Thus, they can gain abnormal returns from information advantages at the expense of the minority shareholders.

Insider trading in Thailand is unique in its own setting due to highly concentrated ownership structure and weak legal protection. Suehiro and Waileardsak (2004) collected data on 220 Thai family firms and documented that these firms generate more than 62% of nominal GDP in 1997. They also documented that family businesses are present in wide range of industries. The figures reaffirm the dominant presence of family firms in Thailand. These characteristics may result in predominant agency problem between large controlling and minority shareholders.

Building from the extended literatures about insider trading, this paper mainly focuses on how family-controlled structure can influence the information asymmetry of insider trading. This study also explores how corporate governance factors play a role to mitigate information asymmetry and how effectiveness of a blackout period policy which prevents insiders to trade during large information asymmetry period such as before earning announcements in Stock Exchange of Thailand. The authors implement two methodologies to capture the effect: event study and cross-sectional regressions. This study has at least two contributions. First, it complements the existing literature on family businesses in emerging markets. Second, the study provides more evidence to the researches on insider trading. To the best of our knowledge, the issues of how family-controlled structure affects insider trading behavior in developing countries have not been systematically documented.

2 Literature Review and Hypotheses

The existing empirical literature uses two different methodologies to measure the effect of insider trading on share prices. Some studies implement performance evaluation methods by forming portfolios according to the signal which insiders provide. The other strands of the literature apply an event study methodology to measure the abnormal return in the short period of time around insider trades.

Many studies are conducted around the world that observes abnormal returns from insiders trading. In the UK, Fidrmuc et al. (2006) document significant abnormal returns of the expected sign for 2- and 5-day after insiders' transaction announcement. For Italian market, Bajo and Petracci (2006) show that insiders can earn abnormal returns 3.18% for purchase and −3.67% for sales within 10-day event window. Betzer and Theissen (2009) use German market dataset which has the diverse reporting delays from 2 days to more than 30 days. The authors capture absolute 2% CARs for both purchases and sales within 11-day event window.

In developing countries like Thailand, Boonyawat et al. (2005) document that corporate insiders can gain abnormal returns from buy-side transactions. Their

findings also suggest that outsiders can earn abnormal returns by following insiders' purchases signal. Budsaratragoon et al. (2012) show that insiders earn abnormal returns from trading around firm's earnings announcement. They argue corporate insiders are likely to take their informational advantages to gain personal profits.

As a first step in our further analysis, we test the convention hypothesis that both directors and large shareholders trading contain private information or at least the traders are convinced that insiders' trades contain valuable information. In Thailand, due to the high concentrated ownership structure, the outcome may differ. Franks et al. (2001) propose the entrenchment effect which implies that shareholders with considerable voting rights may become unaccountable and exploit their private benefits at the expense of minority shareholders. Therefore, the market may respond negatively to insiders' purchase. We expect the latter effect overshadows the former. Our first hypothesis is summarized as follows:

Hypothesis 1:

(a) Insiders' purchases result in positive market reaction.
(b) Insiders' sales result in negative market reaction.
(c) Absolute value of market reaction to insiders' purchases is lower compare to sales.

Next, we focus on insiders trading in family-controlled firms. By structure, family firms have little conflict of interest between management and shareholders or so-called classic agency problem (Anderson and Reeb 2003). In some cases, family firms are managed by unaffiliated professional CEOs but the classic agency problem is still insignificant due to 'lock-in effect' (Maug 1998) which means the large shareholders have incentives to monitor and sufficient voting power to control managements. On the other hand, concentrated ownership structure allows large or controlling shareholders to exploit resources from minority shareholders.

Another factor that is included in our consideration is whether CEOs of the family firms are family member or outsiders. Anderson and Reeb (2004) suggest that family shareholders can gain an information advantage by sending one of their family members to hold an active role in management. The next hypothesis can be summarized as follows:

Hypothesis 2:

(a) The market reaction to the transactions of family firms' insiders is larger than non-family firms' insiders.
(b) The market reaction to the insiders' transactions of family firms with family member as CEOs is higher than the transactions of family firms with outsiders as CEOs.

The authors proceed by relating information asymmetry to corporate governance mechanism. In this study, we implement abnormal returns earned by insiders, as informed traders, can represent information asymmetry.

In concentrated ownership structure settings, there are the possibilities that the significant shareholder(s) is only one ultimate owner or with a second controlling shareholder who owns at least 10 or 20% voting rights. The presence of second major shareholder makes the first owner more difficult to solely control the board of directors. Fidrmuc et al. (2006) suggest that market reaction from insiders' trades inclines to be smaller in firms with the presence of major outside blockholders due to monitoring activities.

Chung and Zhang (2011) argue that good governance structure reduces asymmetric information and improves corporate transparency. Budsaratragoon et al. (2012) assert that performance of informed traders is lower in firms with strong monitoring and great accountability of executive. Many studies document the relationship between corporate governance mechanism and firm performance. The most commonly used variables are (1) the separate of chairman and CEOs (2) the fraction of independent directors to board member (3) the number of board member. In this study, we also include voluntary 'blackout policy' which deters insiders to trade during the large informational asymmetry period, e.g., before quarterly earnings announcement, as one of governance mechanism.

In Thailand, there is no blackout period regulation like one in the UK to prevent corporate insiders from trading shares of their firms two months prior to earnings announcements and the month before quarterly earnings announcements. Due to this institutional gap, the authors hypothetically implement the UK regulations in Thailand and test whether transactions during blackout period convey more information than transactions at other times. The third hypothesis can be summarized as follows:

Hypothesis 3:

(a) The market reaction to the insiders' transactions is weakened by the presence of an outside blockholders.
(b) The market reaction to insiders' transactions can be mitigated by good governance structure.
(c) The market reaction to insiders' transactions during blackout period is larger than insiders' transactions at other times.

3 Data Sources, Descriptive Statistics, and Methodology

3.1 Data

The sources of insiders' transactions information are the 59-2 forms provided by the Securities Exchange Commission (SEC). The insiders are obliged to report with no

exception. In case of multiple trades on the same day, the authors aggregate (e.g., purchasing 5000 shares and 10,000 shares equal to purchasing 15,000 shares) or net the transactions (e.g., purchasing 10,000 shares and selling 5000 shares equal to purchasing 5000 shares) irrespective of whether the trades are conducted by the same or different insiders.

Stocks included in the sample are listed stocks and have at least 10 months return prior to event day to ensure that the data are sufficient to perform the event study. The study period covers January 2006 to December 2015. We exclude insiders' trades after exercise of employee stock options because this kind of trades may be parts of remuneration package and do not contain valuable information. This study does not exclude the delisted firm to avoid the survival bias. We also exclude insiders' trades in financial firms because of their different set of monitoring mechanisms.

The data set also covers company-specific information such as accounting information, ownership structure, member of the boards, number of shares outstanding, governance structure, and corporate earnings announcement date which are collected from Stock Exchange of Thailand, SETSMART, DATASTREAM, and companies' consolidated financial statements, Annual Report and Annual Registration Statements (56-1 form).

3.2 Family Firm in Thailand

For family firm identification, we implement 25% as ultimate shareholders' cut-off level. The 1992 Limited Public Company Act allows shareholders who own at least 25% to veto some important resolutions such as issuing seasoned shares.

We combine the fractional equity ownership of the family and their sons' or daughters' spouses to complete the whole picture of family ownership by the sum of the weakest links along each control chain. We collect both direct and indirect links of controlling shareholders from corpus platform which allows users to track the target firms' parents and subsidiaries. Thus, this study can clearly specify the ultimate family shareholders compare to other literatures which are commonly observe only Tier I ownership structure.

The ownership structure of Thai listed companies, especially family firms, is not complex. They are less preferable to maintain their control through pyramid and cross-holding structures compared to other companies in East Asian markets (Claessens et al. 2000).

Our sample firms have similar ownership and control structure compared to the sample firms in Glaewketgarn (2013). The mean and median ownerships of largest shareholder are 40.25 and 38.55% (40.28 and 41.17%) for purchases (sales), respectively. These descriptive statistics imply that the firms' ownership structure is fairly concentrated. These features are commonly observed in East Asian market.

3.3 Descriptive Statistics

Table 1 presents summary statistics of our sample. Panel A presents no. of trades per firm per year is the average number of trades per firm per year (include only the year that the transactions occur). Percent of market capitalization is the average fraction of number of shares traded by insiders over the number of shares outstanding. The no. of firms refers to number of the firms that insiders' transactions satisfy the conditions previously described. Panel B, C, and D exhibit the descriptive statistics of insiders' all transactions, large transactions, and small transactions, respectively.

The sample description is comparable to Lakonishok and Lee (2001) for the USA and Fidrmuc et al. (2006); for the UK Panel B, C, and D shows the statistics on transaction size in both absolute and relative terms for all transactions, large transactions (at least 0.1% of the market capitalization) and small transactions (less than 0.1% of the market capitalization) respectively. The transaction size of both purchases and sales is heavily skewed as shows in large differences between mean and median.

In our sample, purchases account for 59.7% of all transactions. In contrast, both mean and median of purchases are considerably small compare to mean and median of sales. Their average size is 6356.57 and 335.30 thousand baht representing 0.099 and 0.006% of the value of shares outstanding (mean and median, respectively), whereas the size of sales is approximately twice as large; 15,502.54 and 750 thousand baht representing 0.226 and 0.006% of the value of shares outstanding (mean and median, respectively).

3.4 Methodology

3.4.1 Event Study

The authors implement a standard event study methodology to observe the market reaction from insiders' trades and perform event studies for insider purchases and sales separately, and the event date is defined as the trading day.

We compute cumulative abnormal returns by using market model as the benchmark. Brown and Warner (1985) suggest that OLS can be implemented to obtain the beta without misspecifications. The event windows are 20 days prior to and after the event date. Because Thai insiders are not allowed to make transactions until the public evaluate recent corporate news, e.g., merger or acquisition, thoroughly, we have to ascertain that significant CAR is due to information value of insiders' trades rather than sensitive news. This is the reason behind 20 days observation period prior to the event date. The beta is estimated from 200 to

Table 1 Summary statistics for insiders' transactions, from 2006 to 2015

Panel A: Thailand sample description			
	All	Purchase	Sales
No. of trades per firm per year	6.70	4.27	3.01
No. of firms	420	386	387
Panel B: Insiders' all transactions			
	Mean	Median	
Net purchases (15,902 transactions)			
Transaction value (฿'000)	6356.57	335.30	
% Market capitalization	0.099	0.006	
Net sales (10,732 transactions)			
Transaction value (฿'000)	15,502.54	750.00	
% Market capitalization	0.226	0.006	
Panel C: Insiders' large transactions (Market capitalization > 0.1%)			
	Mean	Median	
Net purchases (1357 transactions)			
Transaction value (฿'000)	52,781.59	6870.00	
% Market capitalization	1.019	0.220	
Net sales (1228 transactions)			
Transaction value (฿'000)	118,662.94	10,123.00	
% Market capitalization	1.915	0.322	
Panel D: Insiders' small transactions (Market capitalization < 0.1%)			
	Mean	Median	
Net purchases (14,545 transactions)			
Transaction value (฿'000)	2025.27	278.40	
% Market capitalization	0.013	0.005	
Net sales (9527 transactions)			
Transaction value (฿'000)	2459.61	579.00	
% Market capitalization	0.005	0.013	

Panel A shows the summary statistics for 26,634 insiders' transaction during 2006–2015. *No. of trades per firm per year* is the average number of trades per firm per year (include only the year that transactions occur). *% Market Capitalization* is the average fraction of number of shares traded by insiders over the number of shares outstanding. *No. of firms* refer to number of the firms that included in the study. Panel B, C, and D exhibit the descriptive statistics of insiders' all transactions, large transactions, and small transactions, respectively

21 days before the event dates. To test the null hypotheses, this study follows Barber and Lyon (1997) and implements the following cross-sectional test statistics:

$$t_{CAAR_{t1,t2}} = CAAR_{t1,t2} \Big/ \left(S_{CAR_{t1,t2}} \Big/ N^{1/2} \right) \quad (1)$$

where $CAAR_{t1,t2}$ represents cumulative average abnormal returns from period t_1 to t_2, $S_{CAR_{t1,t2}}$ is the cross-sectional sample standard deviation of the individual

cumulative abnormal returns, and t_{CAAR} is the test statistic following student t distribution with $N - 1$ degrees of freedom.

3.4.2 Cross-Sectional Regression Analysis

For testing Hypotheses 2(c) and 3(a), we implement cross-sectional OLS analysis with the value of CAR (1, 20) as dependent variables because it can represent the complete market reaction to insider trades. TRANS is the set of dummy variables representing the characteristics of transaction. FAMILY is the set of dummy variables representing whether the firm is a family firm and family member holds CEOs office. BLOCK is the set of dummy variables representing three types of blockholder: corporations, institutional investors, and other individuals or families. The dummies are equal to one if corresponding type has its ownership exceeds 5%. GOV is the set of variables representing governance mechanism in the firm including (1) the separation of chairman and CEOs, (2) the fraction of independent directors to board members, (3) the number of board members, and (4) whether the company has voluntary blackout period policy. CONTROL is the set of control variables that include firm's specific revenue, market to book value, return to equity, and leverage.

$$\begin{aligned}\text{CAR}\ (1,20) = a_0 + a_1(\text{TRANS}) + a_2(\text{FAMILY}) + a_3(\text{BLOCK}) \\ + a_4(\text{GOV}) + a_5(\text{CONTROL})\end{aligned}$$

4 Results

4.1 Abnormal Returns Around Insider Trading

Table 2 reports the market reaction to both purchases and sales. The table demonstrates CAARs in three different panels—large trades, all trades, and trades during blackout period for Panel A and B, respectively. This study follows Fidrmuc et al. (2006) by applying cut-off level of large transactions as those exceeding 0.1% of the firm's market capitalization.

The results in Table 2 support Hypothesis 1(a) which states that there are positive market reactions following insiders' purchases. The post-event CAARs ($CAAR_{1,10}$ and $CAAR_{1,20}$) in all trades are 0.42 and 0.48%, respectively. Both values are significantly different from zero regardless of the statistic used. For large trades, $CAAR_{1,20}$ is almost twice as large (0.73%) compare to all trades although it is not statistically different from zero.

Insiders' sales have significant negative impact on prices regardless of transaction size. Panel A shows market reaction to insiders large sales. The post-event CAARs in large trades are significantly different from zero (−1.82 and −3.96% in

Table 2 Market reaction around insiders' transaction

Panel A: Market reaction around insiders' transaction								
	Purchases				Sales			
	CAAR (−20, 0)	CAAR (1, 10)	CAAR (1, 20)	No. of observations	CAAR (−20, 0)	CAAR (1, 10)	CAAR (1, 20)	No. of observations
Large trades	1.12%	0.48%	0.73%	1357	5.07%	−1.82%	−3.96%	807
t_{CAAR}	2.04[b]	1.36	1.32		7.70 [a]	−5.37[a]	−7.36[a]	
All trades	−1.65%	0.42%	0.48%	1205	4.15%	−1.15%	−1.95%	398
t_{CAAR}	−14.54[a]	6.41[a]	4.77[a]		28.27[a]	−13.42[a]	−15.33[a]	
Panel B: Market reaction during blackout period								
Blackout period	−0.86%	1.09%	1.09%	5243	5.32%	−0.91%	−2.22%	3507
t_{CAAR}	−4.37[a]	8.98[a]	5.29[a]		20.34[a]	−5.80[a]	−8.94[a]	
Other times	−2.04%	0.09%	0.18%	10,659	3.59%	−1.27%	−1.82%	7225
t_{CAAR}	−14.68[a]	1.18	1.61		20.26[a]	−12.43[a]	−12.51[a]	

This table shows the cumulative average abnormal returns (CAARs) for insiders' purchases and sales for six intervals around the trading date: pre-event period (−20, 0) and post-event periods (1, 10) and (1, 20). The authors categorize transactions into two subgroups. Panel A covers the trades of at least 0.1% of firm's market capitalization and all trades, and Panel B covers the transactions that occur during blackout period (within 1 month prior to quarterly earnings announcement and 2 months preceding annually earnings announcement) compared with the transactions that occur other times outside the period. Our estimation period is (−200, −21)-day. We present test statistics which are described in methodology section

[a]Significance at the 1% level

[b]Significance at the 5% level

10- and 20-day window, respectively). $CAAR_{1,20}$ for large sales is twice as large compare to all trades (−1.95%). The authors conclude that insiders' sales can be interpreted as unfavorable signal. Hence, our result validates Hypothesis 1(b).

The pre-event and post-event CAARs for both purchases and sales transactions have similar pattern. In the pre-event period, CAARs are significantly negative (positive) and then revert after the insiders' purchases (sales). However, they do not return to their initial level. The insiders seem to have information about intrinsic price and time their trades accordingly. The complete picture of purchases and sales patterns is illustrated in Fig. 1 which shows that CAARs increase and then decrease after the event date.

The authors hypothesize that an absolute value of market reaction from insiders' purchases is lower compare to sales. For all trades, the absolute $CAARs_{1,20}$ for sales are approximately four times larger than purchases. For large trades CAARs present in Panel A, the sales' abnormal return is 5.4 times larger comparing to purchases. Hence, we failed to reject Hypothesis 1(c).

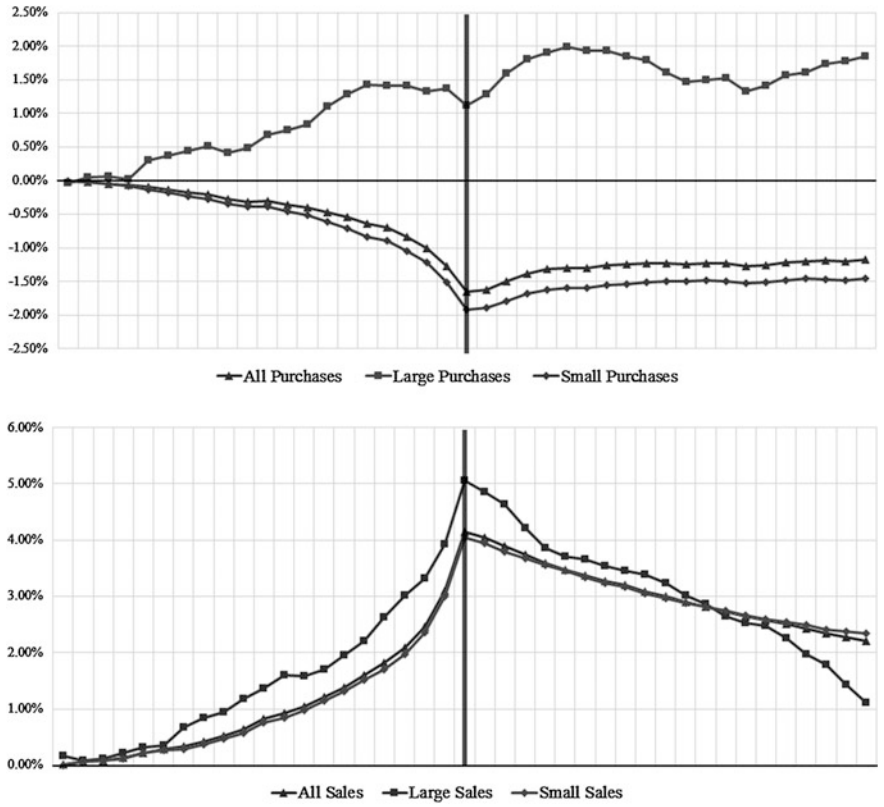

Fig. 1 CAARs of purchases and sales transactions. Both figures illustrate CAARs over the event window period (−20, 20) of purchases and sales transactions, respectively. Each comprises of three transactions categories as follows: all transactions, large transactions, and small transactions. The black vertical line indicates the event date

In panel B, the insider trades are sorted into two groups. The first group consists of insiders' transactions that occurred during the blackout period. The second group contains insiders' trades outside the blackout period. CAARs and test statistic obtained from event study are reported in Table 2.

Notably, insider purchases during the blackout period have an impact on prices as measured by the $CAARs_{1,20}$, which shows almost six times larger than purchases occurring outside blackout period. The results of insider sales also have similar pattern, but the differences of trades within blackout period and the other times are slightly small. Most of the CAARs are significantly different from zero. These results indicate that insiders exploit their informational advantages during high informational asymmetries period such as before earnings announcement. Therefore, we fail to reject Hypothesis 3(c).

4.2 The Effect of Family Ownership and Control

In this section, we investigate further on how family ownership affects the CAARs earned by the insiders. Table 3 reports the market reaction according to family

Table 3 Market reaction to insiders' transaction, family ownership, and control

Panel A: Family ownership (All trades)						
	Purchases			Sales		
	CAAR (−20, 0)	CAAR (1, 20)	Obs.	CAAR (−20, 0)	CAAR (1, 20)	Obs.
Family firms	−1.43%	0.50%	10,461	4.36%	−2.71%	6294
t_{CAAR}	−10.08[a]	4.07[a]		22.03[a]	−15.48[a]	
Non-family Firms	−2.08%	0.44%	5441	3.87%	−0.87%	4438
t_{CAAR}	−11.01[a]	2.52[b]		17.74[a]	−4.84[a]	
Family CEOs	−1.60%	0.65%	6506	4.47%	−2.54%	4341
t_{CAAR}	−8.44[a]	4.49[a]		19.02[a]	−12.75[a]	
Non-family CEOs	−1.15%	0.26%	3858	4.23%	−3.10%	1886
t_{CAAR}	−5.41[a]	1.16		11.20[a]	−8.58[a]	

This table shows the cumulative average abnormal returns (CAARs) for insiders' purchases and sales for three intervals around the trading date: pre-event period (−20, 0) and post-event period (1, 20). The authors categorize transactions into three subgroups according to family ownership and control. Panel A compares the trades of family firms and non-family firms. Panel B compares CAARs of trades by the insiders from family firms with family member as CEOs (family-controlled firms) and family firms with hired CEOs. We describe the test statistics in methodology section

[a]Significance at the 1% level

[b]Significance at the 5% level

[c]Significance at the 10% level

ownership and control. We use 25% cut-off level to separate family firms and non-family firms. Panel A summarizes the CAARs of all transactions. Panel B presents different characteristics of family firms whether CEOs are family member or outsiders.

CAARs presented in Panel A indicate that both insiders in family and non-family firms follow similar pattern and earn insignificantly different post-event CAARs for purchases. In contrast with sales transactions, the insiders of family firms earn almost four times CAARs more than the insiders of non-family firms. These CAARs are also significantly different from zero. This evidently supports that the insiders of family firms can derive benefits from private information, especially in selling company's shares. Hence, our results partly support Hypothesis 2(a).

For Hypothesis 2(b), we expect that the insiders of the family firms with a family member held top management office (family-controlled firms) can earn higher abnormal return from an informational advantage. The results in Panel B partly support this argument.

4.3 The Effect of Outside Blockholders and Governance Structure

We further investigate the impact of the presence of blockholders and governance structure to the abnormal returns earned by the corporate insiders (Hypothesis 3(a) and 3(b)) by applying cross-sectional regressions. The 20-day post-event CARs are regressed on a set of outside blockholders variables that measure the presence of individuals, families, corporations, and institutional investors that own at least 5% of the firm's equity. We also include three determinants of governance structure: (1) the separation dummy equals to one when the chairman of the board and the CEO are not related, (2) the board size, and (3) fraction of independent directors in the board. In addition, we incorporate blackout policy dummy in the models. It represents whether the firm has voluntary blackout policy which recommends the insiders to refrain from performing shares transactions during specifically defined periods of time such as prior to earnings announcement or when they receive the information that is not publicly available.

The regression results are presented in Table 4 for both purchases and sales. The results from Models 1 and 2 moderately support Hypothesis 3(a), but the results are slightly mixed. The coefficients measuring the monitoring effect of individuals or families in purchases and corporations in sales follow the expected sign, showing that outside blockholders weaken the market reaction, but only the latter is statistically different from zero. The presence of individuals or families as blockholders tend enhances the sales signal, while corporations' blockholders enhance the purchases signal. On the other hand, the presence of institutional investors has no significant impact on abnormal returns.

Table 4 Market reaction to insiders' transactions and governance structure

Variables	Purchases	Sales
	Model 1	Model 2
Family firm	0.000796	−0.0144***
	(0.00216)	(0.00276)
Blackout period	0.00839***	−0.00333
	(0.00213)	(0.00270)
Blockholder dummies		
Individuals/families	−0.00136	−0.00612**
	(0.00220)	(0.00278)
Corporations	0.00307	0.00773**
	(0.00261)	(0.00366)
Institutional investors	0.00117	0.000574
	(0.00302)	(0.00327)
Separation	0.00195	−0.000976
	(0.00221)	(0.00288)
Board size	0.00126***	−0.000903
	(0.000395)	(0.000584)
Fraction of independent directors	0.00354	−0.00458
	(0.0121)	(0.00878)
Blackout policy	−0.00423**	0.00533**
	(0.00209)	(0.00265)
Transaction value	0.000829*	−0.00258***
	(0.000490)	(0.000614)
Multiple trades	−0.00191	0.00194
	(0.00296)	(0.00330)
ROE	0.000366	0.0160***
	(0.00306)	(0.00258)
D/E	0.00137***	0.00401***
	(0.000514)	(0.000568)
Size	−0.000875	0.00141
	(0.000762)	(0.000941)
M/B ratio	−0.00552***	−0.00523***
	(0.000404)	(0.000394)
Constant	0.0118	−0.0304***
	(0.00916)	(0.0101)
Observations	15,902	10,732
R-squared (%)	1.5	2.8

The table presents the results of cross-sectional analysis regressions with $CAR_{1,20}$ as dependent variable, and the event date is the trading date. *Family Firm*, *Family CEOs*, *Non-family CEOs*, *Blackout Period*, *Transaction Value*, *Multiple Trades*, *ROE*, *D/E*, *Size* and *M/B ratio* are described in methodology section. Blockholder dummies include three types of blockholders: *Individuals/Families, Corporations, and Institutional Investors*. All these blockholder dummies equal to one if they own at least 5% of the voting rights or zero otherwise. *Separation* is set to one if chairman of the board and CEOs is not family related. *Board Size* is the number of members of the board. *Fraction of Independent Directors* is the number of independent directors divided by the board size. *Blackout Policy* equals to one if company has voluntary blackout policy. The standard errors are reported in parentheses

*$p < 0$, **$p < 0.05$, ***$p < 0.01$

Hypothesis 3(b) expects that good governance structure, which refers to separation in management and control, small board size and high proportion of independent directors, can reduce the opportunistic insiders trading. The results in Models 1 and 2 representing in Table 4 show that larger board size leads to less effective at performing fiduciary duty due to its strong correlations with abnormal returns earned by the insiders, especially for purchases.

Unexpectedly, the fraction of independent directors is also positively associated to the abnormal returns. It is supported by some studies that put the question to the benefits of board independence because of information asymmetry or fear of litigation (Jensen 1993). The separation between chairman of the board and top management does not reduce the information value of director purchases and sales.

The coefficients that identify firms with voluntary blackout policy strongly support Hypothesis 3(b) and statistically different from zero in both purchase and sales. This indicates that the policy forbids the insiders to trade when they possess the valuable information that is not available to the public.

In conclusion, the effects of outside blockholders and governance structure are still perplexed. These mixed effects of blockholders are also documented by Fidrmuc et al. (2006). In this section, the authors portray the dynamic interaction between the presence of blockholders, governance structure, and family ownership. These results partly support Hypothesis 3(a) and 3(b).

5 Conclusion

Our sample consists of 26,634 insiders' transactions performed between January 2006 and December 2015. Several conclusions come to light. First, insiders' purchases and sales affect shares price significantly. The results are consistent with most existing studies in both developed and emerging markets.

Second, the transactions that take place prior to quarterly and annually earnings announcement trigger higher market reactions. Compared to other times, the results indicate that insiders exploit their informational advantages during the period of large informational asymmetries between corporate insiders and outsiders.

Third, there is a strong relationship between family ownership and control structure with the price reaction to insiders' trades. The insiders of family firms earn almost four times CAARs when compared to the insiders of non-family firms for sales. However, we do not find significant difference in purchases.

Fourth, the share price reactions to family firms with professional CEOs are significantly low because the controlling family closely monitors the opportunistic trades. However, there is no evidence that supports these effects for sales.

Fifth, the presence of blockholders matters. The presence of individuals or families as blockholders can reduce the price reaction to insiders' purchases, whereas the corporate blockholders have the same effect to insiders' sales. The institutional investors have no significant impact on abnormal returns.

Lastly, the evidence supports that smaller board size can reduce opportunistic insiders trading, while an increase in proportion of independent directors of separation of ownership has no effect. The significant reduction in abnormal returns earned by the insiders of the firm with voluntary blackout policy suggests that the policy effectively forbids the insiders to trade when they possess the valuable information.

Our results have numerous implications. First, there is clear evidence that even insiders are abided to publicly report their transactions; they can earn significant abnormal returns. Thus, the current regulations are not effectively prohibiting the opportunistic insider trading behavior. Second, the insiders can earn significantly higher abnormal returns when transactions occur during blackout period. Therefore, the regulators may forbid the insiders from trading their shares during that period. Finally, firms' ownership and control structures are important factors that indicate the performance of insider trading and current governance structures, and monitoring roles of blockholders do not mitigate the problems.

This topic of insider trading can be investigated further in number of ways. Most important is to find the factors driving the opportunistic behavior of insiders or other misconduct occurring in the stock market. The study can be extended by developing methodologies to observe signal of illegally informed trading. In addition, our methodologies can be implemented in some East Asian countries which have publicly available insider trading data. The complications are ultimate ownership indentification process because the pyramid shareholding structure and cross-holdings among firms are typical ownership structure in the region.

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Pattern of R&D Expenditure in the Indian Service Sector: A Firm-Level Analysis Since 1999

Sonia Mukherjee

Abstract The study examines the behavior pattern of the Indian Service Firms in matters related to the research and development (R&D) expenditure since 1999. A Firm-Level Analysis was done using data from Centre for Monitoring of the Indian Economy, prowess database. With the advent of new services over time, many non-tradeable services have become increasingly tradeable henceforth, the exports of services have improved and surpassed the merchandise exports. Taking this backdrop in mind, the study examines the role of R&D in promoting service exports. Results conclude that the innovation activity performed by the Indian service firms were less than 10%. The majority of innovating service firms were found to be firms concentrated in trading, gas and distribution, electricity generation, business consultancy, ITES, computer software, and other miscellaneous services. Hence, the more technology led innovation requires to be done as the innovation propensity of the service firm has declined.

Keywords Indian service firm · R&D expenditure · Innovation

1 Introduction

Many rapidly growing emerging economies like Korea and China have witnessed a declining share of agriculture in the gross domestic product (GDP) share followed by a rising share in the manufacturing sector in GDP in its growth process. But in contrast to their growth story, India's decline in the agricultural sector in the GDP share has been picked up by the service sector instead of the manufacturing sector. The manufacturing sector witnessed a stagnation since the year 1991 onwards stabilizing at around 15 percent of the GDP (Panagariya 2008). However, the Indian Service sector are contributing a higher share in the value-added as well as

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GDP. Presently, it's contribution stands to be around sixty percent and India is witnessing a service-led growth.

The service sector can be classified using either the country's own definition or by using the definition provided by **United Nations Central Product Classification (UNCPC)**. In the case of India, the National Industrial Classification (NIC) provides a comprehensive outline for the services.

According to the NIC classification, services comprises of "*wholesale and retail trade; repair of motor vehicles and motorcycles, transportation and storage, accommodation and food service activities, information and communication, financial and insurance activities, real estate activities, professional, scientific and technical activities, administrative and support service activities, public administration and defense, education, other service activities, arts, entertainment and recreation and activities of extraterritorial organization and bodies*". However, the NIC has undergone a definitional change from time to time. At present, the NIC (2008) classification is being used to categorize Indian services.

Among the fastest-growing developing countries, India is unique for its role regarding the service sector. India had to a greater extent relied on the services sector for its growth and vibrantly stood out for its dynamism of its service sector. The growth of the Indian service sector started accelerating since the mid-1980s. In the late 1990s, the service sector surpassed the other two sectors, agriculture and manufacturing, and became the fastest growing sector of the Indian Economy. Even in times of the global slowdown, the Indian service sector remained resilient to the external shocks. In the financial year 2009–10, the Indian service sector grew at 9.96% compared to 8.81% growth in the industries and 1.57% in agriculture. Presently, in the financial year 2016-17, the Indian Service sector has grown at an average of 7.7 percent at constant prices, as per Central Statistics Office.

According to the Economic Survey (2014–15), the growth of the services sector in the GDP share has been higher than that of the overall GDP between the periods FY2001 to FY2014. The Economic Survey (2013–14) said that India has the second fastest growing service sector where its compound annual growth rate is at around 9%, just below China's 10.9% during the last eleven year period from 2001 till 2012. However, the service sector which was growing at a steady rate of around 10% since the year 2005–06 had shown a subdued performance in the last three years. Chances of revival are there with the expansion of increased business activity in the Indian economy.

Within the Indian service sector, some of the services like software and telecommunication services had grown faster not only in terms of India's GDP share but also in terms of India's trade and foreign direct investment (Banga 2005). Consistent with the expansion of the services sector, India's service exports have grown rapidly over the last two decades. The India's share in the world service exports increased from around 0.6% in the year 1990 to around 1.1% in the year 2000 and further to 3.3% in the year 2013. This growth in the service's share has been faster than the growth in the world's merchandise exports. The growth or

expansion of the services[1] has been supported by a relatively cheap labor, a large tertiary-educated work force and the fact that English is spoken widely as an official language. This further gives an edge to the Indian economy to engage in business with the multinationals and foreign companies. The Indian service sector exports accounted for nearly about 8%[2] of the GDP in 2011. Figures show that in the Q1, Q2, and Q3 of 2014, the world services exports grew around 5.7, 6.4, and 4.7%, respectively, whereas the India's service export growth was around 7.4% in Q1 but decelerated to 2.8 and 2.7% in Q2 and Q3. India's share in global exports of commercial services further increased to 3.2% in 2013 from 1.2% in the year 2000, and its ranking stood to be sixth among the leading exporters in 2013.

In the first half of **2014–15**, the India's services export grew up by 3.7% to US $75.9 billion. The major Indian service exports in the 2013–14 were computer services (45.8% share) followed by business services (18.8% share), professional and consulting services (10.2%), and trade and technical services (7.8%), travel (11.8% share), pension, insurance, and financial services (5.8% share). However, for the year 2013–14, there was a slight deceleration in the export growth of the software services to 5.4% and a negative growth of travel (−0.4%) and marginal growth in transport (0.3%) and business services (0.1%). However, moving in tandem with the global exports of financial services, India's exports of financial services registered a high growth of 34.4%. Among the world's top 15 countries in terms of GDP, India ranked 10th in matter of overall GDP and 11th in terms of services GDP in the year 2013. Lastly, for the period 2001–13, the maximum increase in services share in GDP was recorded by Spain (8.6 pp) followed by India.

According to the IMF report (2010), Balance of Payments Statistics, the share of India's services trade in total trade (merchandise and services) has increased considerably over the years, from around 17.8% in the year 1995 to around 35.4% in 2008. This growth of the service exports was mainly due to increase in exports of information technology-enabled services (ITES) and other business services. Also, as per report, India's gross domestic product also grew at a rate of 10.6% in case of India. This growth rate was higher as compared to the other developing countries including China. The service sector was responsible for the surge in the average GDP growth rate of the Indian economy. Presently, the service sector is said to be a major contributor to the India's GDP growth (Bhattacharya and Mitra 1990).

According to a recent report by **Confederation of Indian Industry Report 2016 (CII)**, the Indian service sector contributed to about nearly 61% to India's GDP growing strongly at roughly about 10% per annum in the financial year 2015–16. The report also said that India is currently the second fastest growing service economy in the world. According to CII, the India's share in the global service

[1]The growth in the Indian services is relatively labor intensive in nature as compared to manufacturing or mining.

[2]This share is more or less higher than most of the advanced countries with the exception of South Korea.

exports was nearly 3.2% in the financial year 2014–15, double that of its merchandise exports. Report also says that nearly 50% of the current account deficit is met from service exports. This fact has become very much true since the time when the service exports had overtaken the merchandise exports. Presently, India has secured an eighth place among the top ten exporters of service in the world.

Since the post-crisis (after 2008), service export growth has decelerated in all major economies. According to the latest data reported by the Economic Survey, 2016–17, India's Compound Annual Growth Rate (CAGR) from 2001–08 was thirty percent followed by Russia (28%) and China at 23.6 percent. In contrast to this, the CAGR for 2010–16, declined to 5.6 percent for India and Mexico registering the highest growth at 7.9 percent. Statistics also report that in the year 2015, India's merchandise and service exports were all in negative territory. Lastly, the post-crisis period witnessed a decleration in the service exports growth as compared to the world service exports growth.

Latest data released by the World Trade Organization (2016) reveal that service exports growth was in negative territory for many economies. India was an exception with a positive growth of 3.6 percent.

According to the Economic Survey, 2016–17, service exports growth recorded a positive growth of 5.7 percent. This was mainly due to the pick-up in the growth rate of some of its sub-sectors like transportation, business and financial services followed by a good increase in travel. However, software service exports accounting for around 45.2 percent of the services recorded a decline of 0.7 percent as domestic companies faced pricing pressure on traditional products and also due to the challenging global business conditions prevalent in the world.

Hence, all these data and facts point towards a solution which can enhance the service export growth in the future apart from entering into a number of regional and multilateral trade agreements with the other countries. Hence, a more composite solution like more focus on the technology-part embedded part within the service products may increase the demand of service exports in the world market. Keeping this background, the study will be discussing about the Indian service sector in details, Sect. 2 will summarize a brief literature review followed by Sect. 3 elaborating on the pattern of the R&D expenditures in the Indian service section, followed by the conclusion in Sect. 4.

2 Literature Review on R&D and Service Firms

Innovative activity can be measured in various ways: by research and development (R&D) effort, by patents, and by identifying innovations of major importance. The continuous creation of new services and the uninterrupted commercialization, industrialization, and reorganization of services on a global scale suggests that services are at the fundamental of the modern structural change in the present economies. Technology and innovation activities represent a major force behind

such structural transformation with the role of information and communication technology playing a central role in transforming the ways the most of the traditional services being produced, traded, and delivered. An increasing number of evidence shows that technology plays an important role in services. Service industries are heavily relying on the information technologies, and the bulk of the information technology investment is actually used by services,[3] that is, around 80% in the UK and USA (OECD 1996). Recent studies also do show that services are those industries which have benefitted in terms of productivity gains from the use of embodied technology in the new capital goods (OECD 1996).

Firms competing in the international foreign markets face the challenge and opportunities of changes in the market and technologies. Given the less certain returns and shorter life cycles, R&D expenses have become very much important for the survival of the firm.

The significant role played by innovation in elucidating the dynamic properties of firms, industries, and economic systems had been recognized since the origin of economic thought, i.e., from the works of Smith and Marx. This is nowadays part of the general consensus among the most noted economists. The topic was further highlighted and advanced by Joseph Schumpeter. He had put the topic of innovation at the core of his first major contribution, the theory of economic development (Schumpeter 1942). In this work, the role of innovation was fully endogenized and considered first and primary as an "entrepreneurial fact" which is the principal of competition and the dynamic efficiency of firms. Whatever be the main source of technical advance and technological change, it is the fruitful introduction of product, process, and managerial innovation that permits the firms to supersede the pre-existing circumstances of markets and further improvement of market shares at the cost of the non-innovating firms.

Dynamic efficiency is what matters in the procedure of creative destruction brought through innovation. Innovation permits the firm to form monopolistic rents which tend to be gradually eroded alongside the imitative diffusion of new products and developments. The significance of this mechanism is nowadays recognized by neo-Schumpeterian scholars and gradually by neo-classical economists (Verspagen 2005).

Over the time, services have been widely recognized as important actors in innovation processes. In the context of the Indian economy, service's role as R&D performers still spears to be problematic. Until recently, very few services (as evident from Table 1) were believed to be performing R&D. However, several pioneering studies related to service innovation find practically no evidence of services being engaged in formal R&D. For example, Belleflamme et al. (1986) studied a sample of innovative Belgian service companies. They found that the R&D activities which were not identified were typically performed by ad hoc groups rather than by permanent departments. Lastly, they found out that the R&D

[3]Here, services signify the financial and communication services being the major technology adopters within the services sector.

Table 1 R&D investment/expenditure of Indian service firm since 1999

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Air transport infrastructure services	1999–2015	G M R Group	Zero
Air transport services	1999–2015	Finolex (Chhabria P.P.) Group	Zero
		Private (Indian)	
		Wadia (Bombay Dyeing) Group	
		Central Govt.—Commercial Enterprises	
Auto finance services	1999–2015	Private (Indian)	Zero
Banking services	1999–2015	Private (Foreign)	Zero
		Co-operative Sector	
		Central Govt.—Commercial Enterprises	
Books and cards	1999–2015	Network 18 Group	Zero
Business consultancy	1999–2015	State and Private sector	42.1 million
		Private (Foreign)	
		Private (Indian)	
		Hinduja (Ashok Leyland) Group	
		Adani Group	
		SPML Group	
Commercial complexes	1999–2015	Emami Group	131.5 million
		Private (Indian)	
		Piramal Ajay Group	
		Private (Indian)	
		Nagarjuna Group	
		Ansal Group	
		Anant Raj Group	
		DLF Group	
		Omaxe Group	
		DS Group	
		Ackruti City Group	
		Adani Group	
Computer software	1999–2015	I.C.I.C.I. Group	3848.2 million
		WIPRO Group	
		Kale Consultants	
		Group	
		Private (Indian)	
		RPG Enterprises Group	
Courier services	1999–2015	Private (Indian)	Zero

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Electricity distribution	1999–2015	Adani Group	Zero
		State Electricity Boards	
		State Govt.—Commercial Enterprises	
		Reliance Group [Anil Ambani]	
Electricity generation	1999–2015	Central Govt.—Commercial Enterprises	8822.4 million
		Tata Group	
		Om Prakash Jindal Group	
		State Electricity Boards	
		Udyar Group	
		GVK Reddy (Novopan) Group	
		Shriram Transport Group	
		TCI-Bhoruka Group	
Health services	1999–2015	Private (Indian)	Zero
		Adani Group	
		Ranbaxy Group	
		Apollo Hospitals Group	
		Private (Foreign)	
		Modi Umesh Kumar	
		Wockhardt Group	
Hotels and restaurants	1999–2015	Unitech Group	Zero
		SSI Group	
		Manjeera group	
		Provogue Group	
		Oberoi M.S. Group	
		State Govt.—Commercial Enterprises	
		Private (Indian)	
		Morepen Group	
		DB Realty Group	
		Private (Foreign)	
		Leela Hotel Group	
		I.T.C. (F) Group	

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Industrial construction	1999–2015	Private (Indian)	1227.6 million
		Central Govt.—Commercial Enterprises	
		State Govt.—Commercial Enterprises	
		Private (Foreign)	
		Larsen & Toubro Group	
		ATV Group	
		Reliance Group [Anil Ambani]	
Infrastructural construction	1999–2015	Private (Indian)	Zero
		Gammon India Group	
		IRB group	
		State Govt.—Commercial Enterprises	
		Valecha Group	
		Kalpataru Group	
		Peerless Group	
		Private (Foreign)	
		SPML Group	
		Lanco Group	
		ABG Group	
		Bharat Vijay Mills Group	
Infrastructure finance services	1999–2015	Central Govt.—Commercial Enterprises	4.2 million
		State Govt.—Statutory Bodies	
Media-broadcasting	1999–2015	Private (Indian)	Zero
		Hinduja (Ashok Leyland) Group	
		Essel Group	
		Zee Telefilms Group	
		Sahu Jain (Times of India) Group	
Natural gas, trading and distribution	1999–2015	Central Govt.—Commercial Enterprises	2484.6 million
		GSPC Group	
		Adani Group	

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Other asset financing services	1999–2015	Private (Indian)	Zero
		A2Z Group	
		ABG Group	
		Ackruti City Group	
		Holcim (F) Group	
		Kotak Mahindra Group	
		Dabur Group	
		A.V. Thomas Group	
		Adani Group	
		Raunaq Singh Group	
		Lalbhai Group	
		Gulabchand Doshi Group	
		Pioneer Group	
Other fee-based financial services	1999–2015	Central Govt.—Commercial Enterprises	Zero
		Private (Indian)	
Other financial services	1999–2015	Neterwala Group	7.7 million
		Private (Indian)	
		Royal Orchid Group	
		Hinduja (Ashok Leyland) Group	
		Mardia Rasiklal Group	
		Hari Shankar Singhania Group	
		Adani Group	
		Bangur G.D. Group	
		Godrej Group	
		State Govt.—Commercial Enterprises	
		Indian Express (R.N. Goenka) Group	
		Tanna Group	
		Patel Roadways Group	
		I C L Group	
		Turner Morrison Group	
		Anant Raj Group	
		Private (Foreign)	
		I L & F S Group	
		NSL Group	

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Other construction and allied activities	1999–2015	Private (Indian)	Zero
		Ansal Group	
		Godrej Group	
		DB Realty Group	
		Lanco Group	
		Ackruti City Group	
		Anant Raj Group	
		Universal Capsules Group	
		Unitech Group	
		Puravankara Group	
		Larsen & Toubro Group	
		Sahara India Group	
		I L & F S Group	
		Siva Group (Sterling Infotech)	
		Vasparr Group	
		Sri Adhikari Brothers Group	
Other fund-based financial services	1999–2015	I.T.C. (F) Group	63.4 million
		Vardhman Group	
		Private (Indian)	
Other miscellaneous services	1999–2015	Essar (Ruia) Group	57.8 million
		Modi Bhupendra Kumar	
		Borosil Group (Kheruka) Group	
		Private (Indian)	
Other recreational services	1999–2015	Private (Indian)	Zero
		Eenadu-Margadarsi Group	
		RPG Enterprises Group	
		Usha Martin Group	
Railway transport services	1999–2015	State Govt.—Commercial Enterprises	Zero
Road transport services	1999–2015	I L & F S Group	Zero
		I.T.C. (F) Group	
		Private (Indian)	
Retail trading	1999–2015	Future Group	Zero
		Private (Indian)	

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Road transport infrastructure services	1999–2015	Private (Indian)	Zero
		IRB Group	
		Gammon India Group	
		Kalpataru Group	
		I L & F S Group	
		Nagarjuna Group	
Trading	1999–2015	Private (Indian)	404.9 million
		Birla C.K. Group	
		Raheja Rajan Group	
		Shriram Industrial Enterprises Group	
		Zenith Infotech Group	
		Amrit Banaspati Group	
		I.T.C. (F) Group	
		Parekh Group	
		Sakthi Group	
		Weizmann Group	
		Chhabria M.R. Group	
		Jain Pipe Group	
		Grapco Granite Group	
		Central Govt.—Commercial Enterprises	
		Shapoorji Pallonji Group	
		Reliance Group [Anil Ambani]	
		Uniworth (Indo Rama) Group	
		Usha Rectifier Group	
		IMFA Group	
		Adani Group	
		Turner Morrison Group	
Transport logistic services	1999–2015	Central Government	Zero
		Private (Indian)	
		ABG Group	
		TCI-Bhoruka Group	
		Air Freight (Guzder) Group	
		Adani Group	
		Chhabria M.R. Group	
		Gammon India Group	

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Education	1999–2015	Aurobindo Pharma Group	Zero
		Kalyani (Bharat Forge) Group	
		Private (Indian)	
		A2Z Group	
		Globsyn Group	
		Gulabchand Doshi Group	
		Birla K.K. Group	
		Jiwrajka Group	
Housing construction	1999-2015	Private (Indian)	Zero
		Lodha Group	
		Adani Group	
		DLF Group	
		Sahara India Group	
Housing finance services	1999–2015	Wadhawan Group (Rajesh Kumar)	Zero
		Private (Indian)	
		Central Govt.—Commercial Enterprises	
ITES	1999–2015	Asea Brown Boveri (F) Group	60 million
		I.C.I.C.I. Group	
		Private (Foreign)	
		Surana Udyog Group	
		State Govt.—Commercial Enterprises	
		WIPRO Group	
		Gadgil Western Group	
		Adani Group	
Securities and broking	1999–2015	Private (Indian)	0.7 million
		Winsome Group	
Telecommunication services	1999–2015	Videocon Group	Zero
		Private (Indian)	
		Birla K.K. Group	
		Private (Foreign)	
		Tata Group	
		Private (Foreign)	
		Essar (Ruia) Group	
		Infoedge Group	

(continued)

Table 1 (continued)

Indian service firms	Time period	Ownership group	R&D expenses (in million)
Shipping transport infrastructure services	1999–2015	Adani Group	Zero
		Essar (Ruia) Group	
		Vedanta Group	
Shipping transport services	1999–2015	Garware Group	Zero
		Private (Indian)	
		Khatau Group	
		Private (Foreign)	
Tourism	1999–2015	Private (Indian)	Zero
		Pearl Pet Group	
Storage and distribution	1999–2015	Private (Indian)	Zero
		Adani Group	
		GSPC Group	
Production and distribution of films	1999–2015	Private (Indian)	Zero
		Raheja Rajan Group	

Source Author's calculation from the CMIE prowess database

activities were not recorded or reported. Sundbo (1993, 1997) did not find either in-house research nor R&D departments in case of the Danish firms. Gadrey et al. (1995) found little by way of discussion of services and R&D and concluded that the concept of R&D has evolved in lune historic sans services (p. 272). However, presently, there is overwhelming evidence of service activities in R&D. For example, Microsoft[4] spent over US$6.5 billion on R&D in 2006 and made it fifth among the world's largest R&D spenders in the USA. A study by Leiponen's (2005) align with the suggestion that corporate service innovation is often ad hoc in nature. Also, R&D investments on permanent R&D units are weakly associated with the overview of new services. However, the CIS studies have documented that service firms tend to rely more than manufacturing firms on consulting companies as sources of inputs for innovation.

Examples by Hipp and Grupp (2005: 532) conclude that the import of R&D inputs in services is indefinite (p. 532) and Cainelli et al. (2006) suggest that R&D "is not at all appropriate as an indicator for service firms" innovation activity (p. 436). In other words, service innovation is less reliant on R&D activities as compared with manufacturing innovation.

In summary, studies done suggest that many service firms are innovative in nature, but they are relatively more likely than manufacturing firms to make non-technological innovations that are disembodied, organizational, and market

[4]Microsoft is classified as a software company, and while it does supply computer services but of course a great deal of Micro-soft's activity concerns packaged software-more a manufactured product like print publications than a classic computer service.

oriented. The innovation process is also most likely to be based on individual's skills, professional knowledge, and cooperation rather than R&D (Howells (2007) Tether (2004); Tether 2001).

Taking this backdrop in mind, we would like to further explore the R&D expenditure or investment pattern for the Indian service firms since 1999.

3 Pattern of R&D Expenditure and Indian Service Firms

The Indian service sector has been readily investing in the Information, Communication and Technology (ICT) and other modern services[5] in improving its performance in terms of productivity and competitiveness. Many non-tradeable services have become increasingly tradeable with the usage of the updated ICT technologies. This has further helped in boosting the service exports (especially computer software) in the global market. India has notched a top place in matters of service exports. Investment in human capital goods has yielded a positive return. The Indian service sectors have profoundly invested in human resources, which is one of the key competitive elements, of the firms' innovative strategies. However, in spite of that, an unsatisfactory picture comes in front when we talk regarding innovation.

As evident from the prowess database, the degree of innovation performed by the Indian service firms is done in the form of R&D expenditures. A preliminary snapshot shows that the Indian service firms have not innovated much as compared to the Indian manufacturing firms. For example, in the Indian manufacturing sector, extensive R&D expenditure has been done by the pharmaceuticals, electronics and food and tobacco group of firms. As compared to this, the R&D expenditure done on banking services,[6] and R&D related to electronic banking and insurance, internet-related services, and e-commerce applications stands to be zero since 1999. A similar picture can be seen if we look into the R&D related to improved financial services (new concepts for accounts, loans, insurance, and saving instruments). Very few service firm groups such as commercial complexes, computer software and IT-enabled services, natural gas and distribution, and electricity distribution have done considerable expenditure on R&D. However, some important services like education, courier, transport, health, and telecommunication services still remain excluded on matter regarding R&D expenditures. All the group firms and private firms operating have reported a zero value on the R&D expenditure.

[5]Business services and knowledge processing outsourced services

[6]R&D on banking services encompasses banking and insurance mathematical research relating to financial risk analysis, development of risk models for credit policy, experiment development of new software for home banking.

Hence, a big question comes in mind as to how the Indian service firms can innovate its important services in the future and retains its position (i.e., in terms of service exports) in the global market.

The aim of the study is to examine the pattern and trend of R&D expenditures over the years (since 1999). The aim of the article is twofold: first, to observe the trend of R&D expenditure over the years and second, how this pattern has undergone a change and what policies should be adopted so that Indian firms do innovation (i.e., in terms of R&D expenditure) on a regular basis. The study contributes to the literature by investigating the pattern and trend of R&D expenditure of service firms in India. The database, CMIE prowess database, is a broad sample of around 2300 service firms, unbalanced and heterogeneous in nature. This database contains extensive information about the R&D expenditures and ownership group as reported since 1999. The highly diversified nature of the Indian service firms, changing ownership pattern, and a preliminary analysis since 1999[7] reveal that the Indian service firms have witnessed a decline in the R&D expenditure in the coming years. The majority of Indian service firms have not been keen in investing in R&D with exceptions.[8] Keeping this backdrop in mind, a detailed analysis on the R&D expenditure done by the Indian services firms is presented in the table (Table 1).

Table 1 clearly shows the majority of Indian service sector firms investing a lump-sum amount R&D consist of a few. Electricity generation, natural gas and distribution and computer software firms were the only ones who had invested in R&D in the last fifteen years. The other notable investors found were commercial complexes, business consultancy, fund-based financial services, other miscellaneous services, trading, other financial services, and industrial construction. The service firms investing in latest technology in their products had done that through either through their own internal R&D arrangements or outsourced from external vendors (via cheap suppliers). However, when compared with the Indian manufacturing sector, more needs to be done in terms of innovation. It may be in either way, such as outsourcing R&D facility or setting up an in-house R&D. This will help the service firms to retain their position in the global markets. One of the reasons attributed behind the low R&D expenditure is that the service firms have never felt the necessity of investing in updated technology as service exports have gained a good position in the world market (within the top 15 countries). Henceforth, over the years, the percentage of non-innovating service group of firms has increased, whereas the innovating group firms have declined. This is evident from the table (Table 2).

[7]The year 1999 has been chosen due to the availability of data for service firms in CMIE (prowess) database and also to see the impact of the second economic reforms undertaken by India.

[8]The exceptions include airport transport infrastructure services, banking services, and courier services.

Table 2 Innovating and non-innovating service firms

Years	Innovating service firms (R&D)	Non-innovating service firms
1999	21	2101
2000	20	2103
2005	28	2096
2012	16	2116
2014	12	2116

Source Author's calculation from the CMIE prowess database

From Table 2, the trend shows that the number of innovating service firms has declined over the time.[9] With the decline, the pace of innovation has also slowed down. The overall picture clearly indicates a further need for product, process, and organizational innovation to be done as in the case of Indian manufacturing firms. Another important conclusion is that some important sectors such as health, education, and telecommunication are clearly outliers in matters of R&D. More technology enabled expenditure is needed in these sectors in the near future.

Looking at the different groups of service firms, like computer software, and others, we tend to find a similar picture. Firms such as computer software, ITES, other miscellaneous services, commercial complexes, and business consultancy have invested in R&D, but the pattern of and amount of investment have varied across the years. All these service firms have more or less shown a declining trend in terms of R&D investment, and the ownership structure has also undergone a similar change. The private firms have entered, and the group firms have exited with time. Tables 3, 4, 5, 6, 7, 8, and 9 elaborate the situation in details.

Table 3 clearly shows that R&D expenses made by the computer software firms have witnessed a decline over the years. There was a slight increase in the year 2005. However, the overall picture shows a decline. The reason attributed behind the decline in the share of R&D investment in the computer software could be due to the subdued performance of the service sector in the last three years. Lastly, the ad hoc group firms were also replaced by the private firms over the years.

Table 4 shows that the R&D expenses of the business consultancy services firms had declined on a regular basis after the time period (1999). The ownership structure had also undergone a slight change with the exit of the private (foreign) firms and retention of the state and the private (Indian) firms. Lastly, the amount invested in the R&D had not been of a significant amount as compared to the computer software firms.

Table 5 clearly shows R&D expenses in IT-enabled service firm have begun only after the year 2010. One significant group firm, Asea Brown Boveri group, was found to incur a large amount of R&D expenses. This leaves scope for other services firms in the future to invest more in the IT-enabled service, in terms of

[9]Data on service firms available till the year 2014 as per reporting by the Indian service firms to CMIE.

Table 3 Pattern of R&D investment in the computer software firms

Computer software	Year	R&D expenses (in million)
WIPRO Group	1999	205.5
Kale Consultants Group	1999	17.6
Private (Indian)	1999	11.3
Total		**234.4**
WIPRO Group	2000	80.5
Kale Consultants Group	2000	36.8
Private (Indian)	2000	14
Private (Indian)	2000	0.1
Total		**131.4**
Private (Indian)	2005	85.6
Kale Consultants Group	2005	66.2
I.C.I.C.I. Group	2005	17
Private (Indian)	2005	0.1
Total		**168.9**
I.C.I.C.I. Group	2009	**416.7**
I.C.I.C.I. Group	2014	163.4
Private (Indian)	2014	12
RPG Enterprises Group	2014	0.2
Total		**175.6**
I.C.I.C.I. Group	2015	58.3
Private (Indian)	2015	0
RPG Enterprises Group	2015	0
Total		**58.3**

Source Author's calculation from CMIE prowess database

Table 4 Pattern of R&D investment in the business consultancy firm

Business consultancy	Year	R&D expenses (in million)
Private (Foreign)	1999	2.3
State and Private sector	1999	0.3
Total		**2.6**
Private (Indian)	2005	1.8
Private (Foreign)	2005	0.8
Total		2.6
Private (Indian)	2009	**0.2**
Private (Indian)	2013	0.3
State and Private sector	2013	0
Total		**0.3**

Source Author's calculation from CMIE prowess database

Table 5 Patterns of R&D investment for ITES firms

ITES	Year	R&D expenses (in million)
Asea Brown Boveri (F) group	2011	21.5
Asea Brown Boveri (F) group	2012	19.4
Asea Brown Boveri (F) group	2013	11.4
Asea Brown Boveri (F) group	2014	7.7

Source Author's calculation from CMIE prowess database

Table 6 Pattern of R&D investment in other financial services firms

Other financial services	Year	R&D expenses (in million)
Neterwala Group	2000	1.5
Neterwala Group	2004	1.3
Neterwala Group	2005	1.9

Source Author's calculation from CMIE prowess database

Table 7 Pattern of R&D expenditure in other fund-based financial services

Other fund based financial services	Year	R&D expenses (in million)
I.T.C. (F) Group	1999	4.2
Vardhman Group	1999	0.2
I.T.C. (F) Group	2000	4.7
Vardhman Group	2000	1.2
I.T.C. (F) Group	2004	2.5
Vardhman Group	2004	3.4
I.T.C. (F) Group	2005	3.5
Vardhman Group	2005	0.1
Private (Indian)	2009	0.9

Source Author's calculation from CMIE prowess database

Table 8 Pattern of R&D in other miscellaneous services firms

Other miscellaneous services	Year	R&D expenses (in million)
Essar (Ruia) Group	1999	6
Borosil Group (Kheruka) Group	1999	0.2
Modi Bhupendra Kumar	2000	6.8
Essar (Ruia) Group	2004	5.2
Modi Bhupendra Kumar	2004	2.1
Essar (Ruia) Group	2005	9.4
Modi Bhupendra Kumar	2005	2.1
Modi Bhupendra Kumar	2009	0.9
Private (Indian)	2014	0.1
Private (Indian)	2015	0

Source Author's calculation from CMIE prowess database

Table 9 Pattern of R&D in commercial complexes

Commercial complexes	Year	R&D expenses (in million)
Emami Group	2000	11
Emami Group	2001	7.9
Emami Group	2002	16.2
Emami Group	2008	18.7
Emami Group	2009	3.5
Private (Indian)	2011	0.5
Private (Indian)	2012	0.3

Source Author's calculation from CMIE prowess database

R&D in the future. Lastly, the R&D expenditure shows a downward trend, and more innovative activities can improve the quality of the service exports in the future.

Table 6 clearly shows that not much investment in R&D has been done since 1999. Hence, to carry out innovation, more R&D expenditures are needed to be done. Only one service group has invested in R&D which gives sufficient scope for other groups and private firms to invest in R&D in the near future.

From Table 7, it is clear that the investment in R&D increased till 2004. However, since 2005, it declined on a continuous basis (until 2009[10]). Two main groups, ITC group and Vardhaman group, operated till 2005. However, the current scenario indicates that the private Indian service firms are the only one involved in the R&D activity. Lastly, the amount of R&D expenditure appeared to be of a meager amount since 2005.

For the miscellaneous service sector[11] firms, we see that the maximum investment had been done by the Essar (Ruia) group till the year 2005. This was followed by the Modi Bhupendra Kumar group. However, data reveal that both these groups have exited the market since 2009. It is evident from the table that the group firms had a prominent share in R&D. However, from 2009 onwards, private players have entered their space. No prominent group firm was found in the miscellaneous service sector.

From Table 9, it is evident that the commercial complex was considered to be the monopoly of the Emami Group. They had invested a good amount in the R&D and were functional till 2009. However, thereafter the private service firms replaced the group firm (Emami Group) and started investing in R&D. In spite of that, there has been a decline in R&D expenditure since 2009.

[10]Data by the Indian service firms have been reported until the year 2009 in the prowess database.

[11]The miscellaneous service sector comprises a wide array of service firms like repair services, commission agent's services, sanitary services, and others.

4 Conclusion

From the consecutive tables (Tables 2, 3, 4, 5, 6, 7, 8, and 9), we find that innovation in the Indian service firms has witnessed a considerable decline, i.e., in terms of R&D expenditures. The decline has been sharp since 2009 onwards followed by a shift in the pattern of ownership from ad hoc group firms to private firms. However, the reason behind the change in the ownership pattern is yet to be explored. One probable reason behind this decline may be subdued to subdued performance of the economy since the global economic crisis. However, if we compare the service sector firms with the Indian manufacturing firms, we see that considerable amount of innovation in terms pf patents, licenses, and R&D expenses has risen over the years. The percentage of innovating firm or the number of innovating firms has risen in case of the Indian manufacturing firms.

Still much remains to be done for improving this innovation scenario in the services. Although diversified groups of service firms operate in the Indian service sector, many of them have either not reported their R&D expenses or not invested in R&D. Some foreign and Indian service group firms had initially done a good amount of R&D expenses (from 1999 to 2005). However, this process has slowed down since 2009.

The solution to the problem is either setting up a R&D house investing in latest technological equipments or outsourcing through specialized external suppliers. All these should be done on an urgent basis. One priority is the health services that require latest technological improvement in order to treat and satisfy its consumer.

The India's service sector was found to be technologically sound through usage of latest services like ICT, knowledge based and various other services, investment in human capital, but the pace of the innovation through R&D is quite low. Some of the service firms like telecommunication service firms, tourism service firms, education have not yet invested in R&D since the last fifteen year. They can think of investing in R&D in the future in order to remain competitive in the international level.

Another problem which can develop in the future is diversification of the service export in non-English speaking region. Many Indian service firms have increased their service export considerably over the years mainly through ITES exports[12] to export base like USA, UK, and Europe. However, to remain competitive in the global markets, some form of quality improvement and product differentiation is always required. If a customer finds that the product quality is better, superior, and sound from the Indian service exporters, then the demand for the service exports will automatically increase in the future. However, if this is not the case, the service exports will tend to decline in the coming future. Service firms need to have a good in-house R&D or enter into contracts/agreements with external suppliers or resort to

[12]Information technology accounted for nearly $108 billion worth of services exports in the last financial year, exporting primarily to destinations like USA, UK, and Europe.

licenses and patents. In short, a service firm has to innovate its product on a continuous basis for maintenance in position in the export market.

It is generally found that the services firms do normally rely on a wide range of innovation in the form of acquisition of software, purchase of machinery, and training of employee and engaging more in the form of engineering, technical consultancy, business consultancy, computer software, and ITES. Such techniques can also be used or applied by the Indian service firms.

With the service sector, financial services are considered to be the most innovative service sectors. Special focus should be given to improve the financial services in terms of innovation. ITES is also considered to be a priority service sector. Interestingly, in case of India, the ITES export has not reached the non-English speaking countries. It is being more or less confined to two destinations (US and UK). Hence, to diversify the export market further, more investment in R&D should be done. Latest technology could be clubbed with the export product itself to increase its demand further.

Lastly, the Indian service firms can also take assistance from in-house production departments, clients, outside suppliers of materials and equipment when introducing an innovation on a massive scale. Apart from this, help from public and private research institutions can also go a long way in matters of service innovation.

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The Role of Ownership Structure in Moderating the Effects of Corporate Financial Structure and Macroeconomic Condition on Financial Performance in Nigeria

Musa Abdullahi Bayero

Abstract Review of empirical studies from both developed and developing countries shows that the findings on the effect of corporate financial structure on financial performance continue to yield conflicting and inconsistent findings. While some findings reveal positive and significant effects, many studies show negative and significant findings. At the same time, there are some studies that show insignificant effects and as such the debate continue to call for more empirical investigation. The objective of this study is to investigate how employing ownership structure could moderate the effect of corporate financial structure and macroeconomic condition on a firm's long-term performance using return on assets (ROA) and Tobin's Q as measures of corporate financial performance. The participating firms of this study are Deposit Money Banks (DMBs) that are actively listed in Nigerian Stock Exchange (NSE) during the 8-year period (2010–2017). The paper will employ an empirical quantitative method of panel data regression analysis.

Keywords Banking industry · Debt financing · Equity financing
Financial performance · Financial structure · Ownership structure

1 Introduction

The banking industry performance is critical to the growth and development of any economy, and Nigeria is not an exception. Hence, good firm's performance results into achieving strong competitiveness, high return on investment for shareholders, generating employment in a country, and increase in Goss Domestic Products

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(GDP) of an economy. Conversely, poor corporate performance in the industry is capable of triggering a prolonged crisis that can adversely affect the industry's competitiveness, economic stability, as well as the relevant stakeholder returns. Therefore, firm's performance in the banking industry remains a major contentious issue for researchers, practitioners as well as policy makers. This is particularly important in Nigerian banking industry which has undergone remarkable changes in terms of financial and ownership structures amidst varying macroeconomic conditions all aimed at improving the performance of the banking industry in the last decade.

Throughout the history of banking industry in Nigeria, bank performance has been a central issue that attracts interest of all stakeholders in the industry. In 2009, the Central Bank of Nigeria (CBN) announced the results of the examination of 10 banks and determined that five banks were insolvent—Oceanic Bank, Union Bank, Afri Bank, Finbank, and Intercontinental Bank. The aggregate percentage of non-performing loans of these five banks was 40.81%. In addition, the five banks were considered chronic borrowers at the Expended Discount Window (EDW) of the CBN, indicating that they had little cash at hand. To improve the banks' liquidity positions, CBN, as the lender of last resort, injected N429 billion (roughly $US2.8 billion) into these banks in the form of a subordinate loan. These banks, when aggregated, represented a significant systemic risk as they held about 30% of the deposits in the Nigerian banking system. Other senior executives of the insolvent banks were charged with various crimes and list of the names of debtors of non-performing loans held by Nigerian banks was published.

Subsequently, the CBN completed special examination of the remaining 14 universal banks in Nigeria to determine their solvency, and as a result, CEOs of three additional insolvent banks—Bank PHB, Spring Bank, and Equatorial Trust Bank—were dismissed and additional N200 billion was injected into these banks by the CBN. Thus far, eight banks have received N620 billion or approximately US $4.1 billion from the CBN, representing 2.5% of Nigeria's entire GDP of US$167 billion. Following the special examination and during the period from December 2008 to December 2009, Nigerian banks wrote off loans equivalent to 66% of their total capital; most of these write-offs occurred in the eight banks receiving loans from the CBN. By January 2010, CBN issued a circular which provided the type and format of financial information that must be disclosed by banks in their yearly financial statements. The major intent of the CBN was to aggressively pursue accounting reforms aim at improving disclosure to regulators, investors, and depositors regarding the financial health of Nigerian banks. In addition, the CBN issued regulations limiting the terms of CEOs of banks to a maximum of 10 years, which will require some sitting CEOs to resign by July 2010. The intent of the regulation was to improve corporate governance of Nigerian banks by avoiding 'sit-tight syndrome' where bank executives manage the bank as a personal business as opposed to a publicly held corporation accountable to shareholders, depositors, and government regulators (Alford 2011).

In its quest to achieve good firm performance in the banking industry, the CBN conducted a Liquidity Stress Test (LST) as contained in the CBN financial stability

report released on 31st October 2015 and it revealed that capital position of some of the Nigerian banks has fallen below regulatory capital requirement. This was reported by the CBN Director Financial Policy and Regulation Department Kelvin Amugo, where he asserted that the LST was conducted using Implied Cash Flow Analysis (ICFA) and maturity mismatch/rollover to assess the resilience of the banking industry to liquidity and funding shocks. The reports which cover the period December 31, 2014–June 30, 2015 revealed that Capital Adequacy Ratio (CAR) for the affected banks has fallen below the regulatory threshold (Amugo 2015).

In a similar development in 2015, the CBN issued a warning to some commercial banks to further recapitalize or risk losing their operating license due to poor performance (The Paradigm 2015). In 2016, the CBN issued a directive for the affected banks to recapitalize again on or before June 2016 because they could not pass the Liquidity Stress Test (The Nation 2015). This development came after the CBN enforced Treasury Single Account (TSA) policy which revealed that some of the banks still heavily relied on public sector deposit. Precisely, publication released by Sahara reporters (2015) revealed that the nine (9) banks affected by the test were; Diamond Bank, United Bank for Africa (UBA), Sterling Bank, First Bank, Unity Bank, Skye Bank, Fidelity Bank, Wema Bank, and Heritage Bank, respectively. According to the source, the banks could not meet the healthy capital liquidity levels and are thereby tethering on the brink of collapse.

In this vein, cumulatively the performance of Nigerian banks is further deteriorating where investigation revealed that the banks recently lost eighty percent of their profit (Muhammad et al. 2016). The report further revealed that the overall industry's Capital Adequacy Ratio (CAR) has reduced from 17 to 16.5% as in April 2016. The industry's overall Profit Before Tax (PBT) also declined from N222 billion as at April 2015 to N198 billion for the month ended April 2016. The ROA and ROE were 2.17 and 16.17, respectively, in February 2016 which is less than 2.42 and 19.39, respectively, in the same period during the year 2015. Overall, the total industry's Profit After Tax (PAT) for the first quarter of 2016 stood at N90.7 billion as against 100.59 billion for the corresponding period in 2015. Sanusi, a former governor of the Central Bank of Nigeria, attributed the financial crisis to macroeconomic instability, fundamental failure in corporate governance at banks (which ownership structure is a key), lack of investor and consumer sophistication, inadequate and disclosure and transparency about financial positions of banks among other factors. Hence, the CBN plays a major role in deciding on the structure of the Nigerian financial system (Alford 2011).

Moreover, when it comes to the issue of ownership structure, bank owners' direct interventions in the internal management of banks have contributed to the financial distress in most banks. This is because some shareholders borrow funds in excess of the capital they invested to start the banks, and this is usually done through companies that are directly linked to them. It is also a common practice for banks to borrow from the CBN to fund directors' loan. In addition, loans and advances to owner government and their agencies were neither often repaid nor were the loans collaterised. Therefore, it is pertinent to note that the pervasive incidence of non-performing loans is one of the major causes of distress in the

banking system over the years. Debts owed by governments and their agencies constitute a significant portion of banks' non-performing loans particularly in banks where state governments have controlling interests. The failure of state governments and their agencies to honour obligations has continued to undermine the efforts of regulatory authorities in addressing the problem of ailing banks (Ebhodaghe 2015).

Mangunyi (2011) explored ownership structure and corporate governance and its effects on performance of firms. The findings revealed that there was no significant difference between type of ownership and financial performance and between banks ownership structure and corporate governance practices. Further results revealed that there was significant difference between corporate governance and financial performance of banks. However, foreign-owned banks had slightly better performance than domestically owned banks. As a suggestion for further studies, he proposed that future research could usefully focus on the macroeconomic conditions necessary to promote maximum performance, i.e., causes of performance differences that are not related to ownership structure. In the same vein, Osamwonyi and Michael (2014) investigated the impact of macroeconomic variables on profitability of banks in Nigeria. The findings from the empirical point of view show that Gross Domestic Product (GDP) has a significant positive effect on return on equity (ROE) while interest rate has a significant negative effect on return on equity but inflation is not significant at all levels of significance. Therefore, considering the decline in GDP, and rise in inflation as well interest rate and fall of the exchange rate it will be good to investigate how they impact on firm performance through a moderator in the form of ownership structure. Consequently, this study is designed to investigate if ownership structure moderates the relationship between corporate financial structure, macroeconomic conditions, and firm performance in Nigeria banking industry.

Based on the above discussion, it is quite clear that empirical studies regarding the relationship between capital structure and financial performance from both developed and developing countries continue to provide mixed and contradicting evidence. In addition, none of the above studies reported or attempted to examine the moderating role of ownership structure on the relationship between capital structure and firm performance. Consequently, there is the need to uncover the recent developments in the association among corporate financial structure, macroeconomic condition, ownership structure, and firm performance. The present study extends the literature on the impact of capital structure on firm's performance by introducing a moderator in the form of ownership structure.

Corporate financial structure and its effect on firm performance attracted considerable attention in the literature (Modigliani and Miller 1958; Myers 1977; Jensen and Meckling 1976; Harris and Raviv 1991; Margiratis and Pslilaki 2007; Akeem et al. 2014; Nwaolisa and Chijindu 2016). However, some observers (Skopljak and Luo 2012) argued that these studies are very general in their conclusions and their reach to the financial sector is relatively limited. The often justification is that the financial sector has its own unique set of regulations and is generally highly leveraged. Nevertheless, the underlying imperatives still apply to

the financial sector just as they do for firms across other disciplines. In addition, Skopljak and Luo (2012) posit that financial sector is fundamentally different from any other sector of the market in terms of its high leverage and regulation, and as such the results obtained from other studies using data across multiple sectors in the market cannot be directly carried over to the financial sector with a high degree of confidence. Based on the foregoing, this study focuses solely on the banking industry to investigate the impact of corporate financial structure, macroeconomic condition on firm performance using ownership structure as a moderator.

Twairesh (2014) argued that while the literature examining the performance implications of corporate financial structure choices is immense in developed markets, there is paucity of empirical investigation known about such implications in emerging or transition economies where capital market is less efficient and incomplete and suffers from intense information asymmetry. Hence, the environment of the market may cause financing decisions to be incomplete and subject to a considerable degree of irregularity. In addition, Santoso (2005) stated that preference for short-term financing over the longer ones in emerging economies of East Asia hinders the development of long-term capital market, such as bond market until recently. There are many significant differences that exist between these two business settings in terms of corporate financial structure practices and ownership structure which will ultimately influence firm performance. To corroborate this assertion, Zeitun and Tian (2007) observed that corporate ownership structure depends on a country's social, political, economic, and cultural factors they tend to differ in their entirety from those of developed countries, which may limit the application of empirical models tested in mature markets. The unique features of these economies are that ownership is highly concentrated in the hands of few directors of firms. In such firms, the traditional principal-agent agency conflict is alleviated due to the large shareholders' greater incentives to monitor the manager. Nevertheless, conflict emerges as large shareholders exercise their substantial control and influence over firm matters and, as agency theory suggests, they have incentives to consume the firm's resources at the expense of the minority shareholders (Anderson and Reeb 2004). Based on the foregoing, it can be argued that differences in terms of corporate financial structure practices and ownership structure between developed and developing economies would influence firm performance differently. This study will fill this gap in knowledge by investigating the effect of corporate financial structure practices on firm performance in the context of Nigerian banks as an emerging market.

Four important research gaps are identified by this study on firm performance. Firstly, the study will investigate the impact of corporate financial structure and macroeconomic conditions on firm performance. Secondly, the study will investigate the effect of ownership structure on firm performance. Thirdly, the study will examine the moderating role of ownership structure. Fourthly, the study will further confirm the proposition made by pecking order theory and agency theory. Finally, the study will fill a contextual gap by examining the effect of corporate financial structure and macroeconomic condition on firm performance of Nigerian banking industry. Based on these, the study will answer the following research questions.

i. To what extent does corporate financial structure affect performance of Deposit Money Banks in Nigeria?
ii. To what extent does macroeconomic condition affect performance of Deposit Money Banks in Nigeria?
iii. To what extent does ownership structure affect performance of Deposit Money Banks in Nigeria?
iv. To what extent does ownership structure moderate the relationship between corporate financial structure and performance of Deposit Money Banks in Nigeria?
v. To what extent does ownership structure moderate the relationship between macroeconomic condition and performance of Deposit Money Banks in Nigeria?

The study is important both on the theoretical level as well as on the empirical level. On the theoretical level, aside from the dearth of literature on corporate financial structure in the context of sub-Saharan countries, there are some contradictions in the research findings in the literature. It is pertinent to note that there is increasing awareness that theories originating from developed countries may have limited applicability to emerging markets like Nigeria. Emerging markets have different characteristics such as different political, economic, and institutional conditions which may limit the application of developed markets' empirical models. This study is an attempt to bridge the gap on the theoretical level as well as on the empirical level on those factors.

In addition, this study could hopefully provide some useful insights for future reference on the subject of corporate financial structure and to gain clearer pictures in explaining the performance of banks particularly within the setting of developing countries. There are very few researches done in Nigeria in regard to corporate financial structure. It is therefore necessary to enhance the knowledge of corporate financial structure, especially to ascertain the factors which contribute to the improvement of banks' performance in Nigerian banking industry. Therefore, on the empirical level, this research is hoped to provide some important answers on few conflicting issues in corporate financial structure, corporate governance, ownership structure which in turn could be used to assist government, regulators, banks owners and managers, and other stakeholders to choose better financing and ownership structures, improved corporate governance in order to improve their performance when dealing banking crisis in the future.

2 Literature Review

2.1 Corporate Financial Performance

Performance of a firm can be analyzed in terms of profitability, dividend growth, sales turnover, asset base, capital employed among others (Almajali et al. 2012).

However, there is still ongoing debate regarding how to measure performance of firms and the factors that affect financial performance of companies (Liargovas and Skandalis 2008). Some observers (Elvin and Hamid 2016) contend that a single factor cannot reflect every aspect of a company performance and therefore the use of several factors allows a better evaluation of the financial profile of firms. In line with other previous studies that used accounting measures of performance, this study uses two measures of performance; namely, accounting measures of performance (return on asset) and market measure of performance (Tobin's Q). Specifically, in line with the study of Vafaei et al. (2015), this study employs two measures of firm performance to increase the reliability of the results. These are one accounting-based measure (ROA) and a market-based measure (Tobin's Q). Accounting-based measures of firm performance are based on an assessment of how the company has performed in the past, while market-based measures indicate the current position of a company and its potential in the future (Wang and Clift 2009; Haslam et al. 2010).

2.2 Corporate Financial Structure

Available evidence from the literature shows that previous studies on corporate financial structure, ownership structure, macroeconomic condition, and firm performance on banking industry were largely conducted in developed countries (Li et al. 2014, 2015; Skopljak and Luo 2012; Vintil et al. 2015; Sakawa and Watanabel 2011; Ang et al. 2000; Cornett et al. 2003; Daniels and Iacobucci 2000; Demsetz 1983; Demsetz and Lehn 1985; Demsetz and Villalonga 2001; Emmons and Schmid 1998; Margaritis and Psillaki 2009; Short and Keasey 1999; Thomsen and Pedersen 2000). Particularly, despite prevailing capital inadequacy, unstable macroeconomic conditions, prevalence of poor corporate governance practices and agency problems in Nigerian banking industry, review of literature revealed that study investigating the effect of corporate financial structure, macroeconomic condition, ownership structure and financial performance received limited attention. Specifically, studies conducted in the Nigerian banking industry has largely focused on examining pre- and post-consolidation performance ratios (Adegbaju and Olokoyo 2008; Dabo 2012; Igyo et al. 2016; Jabar and Awoyemi 2015; Ningi 2013; Nwankwo 2013; Obienusi and Obienusi 2015; Odeleye 2014; Ojong et al. 2014; Olokoyo 2013; Oluchukwu and Emeka 2012; Owolabi and Ogunlalu 2013).

Some of the few studies that investigated the impact of corporate financial structure on firm performance include the work of Oladeji et al. (2015) who analyzed the impact of capital structure on firm performance in Nigeria. The study found that a negative relationship exists between leverage and firm performance. However, the study considers only some selected oil companies and hence the sample was inadequate to allow generalization. Similarly, Akeem et al. (2014) conducted a study on the effect of capital structure on firm's performance of manufacturing companies in Nigeria. They observed that capital structure measures (total debt and debt to equity ratio) are negatively related to firm performance.

Contrary to the above studies, Adesina et al. (2015) conducted a study on the impact of capital structure and financial performance of banks in Nigeria and the findings of their study suggest that capital structure has a significant positive relationship with the financial performance of Nigeria quoted banks. However, Nwaolisa and Chijindu (2016) examined the impact of financial structure on firm performance in Nigerian agricultural and healthcare sectors. The analysis for the agricultural firms revealed that financial structure significantly impacts on earnings per share but does not impact on return on equity, return on asset, and profit before tax. For healthcare firms, financial structure significantly impacts on earnings per share and profit before tax but does not impact on return on equity and return on assets. The study was conducted in a non-financial sector and the findings are mixed. In another study on the impact of debt financing on the performance of privatized-firms in Nigeria (Usman et al. 2015), the findings suggest that corporate financial structure through debt tends to increase post-privatization performance of firms up to a given level, after which any addition to the proportion of debt in the capital (assets) of firms reduces their performance.

From the reviewed literatures, it is evidently clear that studies regarding the relationship between corporate financial structure and firm performance provided mixed and contradictory evidence, thus calling for more empirical investigations in the form of moderating role of relevant variables

2.3 Macroeconomic Condition

Osamwonyi and Michael (2014) investigated the impact of macroeconomic variables on profitability of banks in Nigeria. The findings from the empirical point of view show that Gross Domestic Product (GDP) has a significant positive effect on return on equity (ROE) while interest rate has a significant negative effect on return on equity but inflation is not significant at all levels of significance. Therefore, considering the decline in GDP, and rise in inflation as well interest rate and fall of the exchange rate, it will be good to investigate how they impact on firm performance through a moderator in the form of ownership structure. Similarly, Mangunyi (2011) suggested that future research could usefully focus on the macroeconomic conditions necessary to promote maximum performance. In other words, he suggested that causes of performance differences that are not related to ownership structure should be explored.

2.4 Corporate Ownership Structure

On the other hand, studies on ownership structure conducted in Nigeria so far include that of Kwanbo and Abdul-qadir (2013) who investigated relationship between dispersed equity holding and financial performance of banks in Nigeria.

The study revealed that dispersed equity holding has a significant impact on financial performance because these healthy banks actually work with the directives enshrined in the code of best practice and employed several other strategies to achieve both operational and financial performance. Even though the study was conducted on the banking industry, it only concentrated on equity financing and ownership concentration only. Similarly, the work of Uwuigbe and Olusanmi (2012) dwelt on the relationship between ownership structure and the financial performance of listed firms in the financial sector of the Nigerian economy. The study as part of its findings observed that institutional ownership has a significant positive impact on the performance of the selected listed firms in Nigeria. In addition, the study also revealed that there is a significant positive relationship between foreign ownership and the firm performance in Nigeria. However, the study did not consider possible indirect effect of other variables such as ownership structure.

Other related studies on ownership structure include Gugong et al. (2014) who investigated the impact of ownership structure on the financial performance of listed insurance firms in Nigeria. The findings indicate that there is a positive significant relationship between ownership structure and firm's performance as measured by ROA and ROE. However, the study considered only managerial and institutional shareholding while ignoring other forms of ownership as well as ownership concentration. Also, Aanu et al. (2016) studied the impact of institutional shareholder engagement and financial performance of selected listed firms in Nigeria. The findings of the study indicate that there is no significant relationship between institutional shareholder engagement and firms' financial performance in Nigeria. However, the results were mixed with the performance indicators in terms of ROA, ROE, and Tobin's Q. Further, Dada and Ghazali (2016) carried out study on ownership structure and firms performance in Nigeria. The findings revealed that ownership concentration maintains negative significant relationship with market performance while it shows positive significant with accounting performance. Also, the foreign ownership result shows positive statistically significant relationship with market performance and negative significant relationship over accounting performance. However, this study excluded finance sector and concentrated only on ownership concentration and foreign ownership.

Earlier, the study of Aburime (2008) which was an empirical analysis of the impact of ownership structure on bank profitability in Nigeria that was conducted to examine whether the composition and spread of bank ownership significantly impinge on returns of 98 commercial and merchant banks for the period 1989–2004. Results suggest that the composition and spread of ownership have had no significant effect on bank profitability in Nigeria. The study has many weaknesses. It was based on the composition and spread of their ownership into foreign banks, domestic banks, state banks, private banks, quoted banks, and non-quoted banks. The study was done before the banking sector recapitalization and as such it failed to address new ownership structure that accompanied the reform. Further, Andow and David (2016) assessed the impact of ownership structure on the financial performance, using listed conglomerate firms in Nigeria. Findings show that

managerial and foreign ownership have negatively impacted the performance of listed conglomerate firms within the study period.

2.5 Corporate Ownership Structure as a Moderator

This study considers introducing ownership structure as a moderating variable. Previous studies employ varied variables of interest with ownership structure as a moderator. There are studies that use this type of mechanism; moderating effect of ownership structure on bank performance using banks specific and macroeconomic variables in Kenya (Ongore and Kusa 2013). Kongmanila and Kimbara (2007) conducted a study on the moderating effects of ownership types and management styles to corporate financial structure on the performance of SMEs in Lao People's Democratic Republic. However, the study has some weaknesses as it focuses only on SMEs and hence its findings may not be generalized to larger corporate organizations. It used only one form of ownership structure which is family or non-family ownership and incorporates owner-managed firms as well as non-owner-managed firms, and thus debate on principal-agent proposed by agency theory is thereby compromised. Finally, the study over emphasized on retained earnings and short-term term debt ignoring other sources of financing. However, in spite of all the shortcomings, the study suggests that both debt and equity have statistically significant and positive impacts on profitability when considering the moderating effects of ownership types and management styles. The explanatory power of the model increases when compared to the model that does not consider the moderating effects and hence provide a clue for further academic debate in large corporate organizations.

Similarly, Muiruri et al. (2015) examined the moderating effects of bank ownership on relationship between securitization uptake and financial performance of commercial banks in Kenya. The results indicate that the banks' financial performance had been almost progressing over the operational periods considered for the study. Other related studies dwelt on impact of ownership structure on firm value using research and development as a moderator (Ting et al. 2016). Another study determined the effect of intellectual capital on firm value using ownership structure as a moderating variable (Bemby et al. 2015), and the findings show a mixed result. Similar study was carried out by Quang and Xin (2014) to investigate the combined impact of ownership structure and capital structure on financial performance of Vietnamese firms. Based on the research findings, capital structure has a negative impact with statistical significance on financial performance. The higher level of state ownership in ownership structure of a firm is the better financial performance it has. While clear evidences with statistical significance of the impact of managerial ownership on financial performance have not been found, the study found out that the level of entrenchment of managers in state-owned enterprises (SOEs) is higher than that of businesses of other types.

Available evidence so far shows that most literatures investigate the direct impact of either corporate financial structure on firm performance or ownership structure on firm performance. However, most of the findings are mixed and inconsistent and some studies reported weak correlation. Thus, in line with Baron and Kenny (1986) since strength of most findings on the impact of corporate financial structure on firm performance is weak and mixed, and this study will fill the gap by examining the moderating role of ownership structure.

2.6 *Theoretical Framework and Conceptual Model*

Based on the preceding discussion, a conceptual framework is proposed as shown in Fig. 1. To conceptualize the relationship between corporate financial structure, macroeconomic condition, ownership structure, and financial performance, pecking order theory (Donaldson 1961; Myers and Majluf 1984) and agency theory (Jensen and Meckling 1976) will be used. Pecking order theory argued that, in order to finance the company, managers consider the hierarchy of financing options by starting with internal funds such as retained earnings to external financing where debts will be preferred first and equity will be the last resort of financing. Myers and Majluf (1984) argued that internal sources of financing have a lower level of information asymmetry cost and seem to be safety. For that reason, it will be given first order then after utilization of internal source, debt financing will be the second

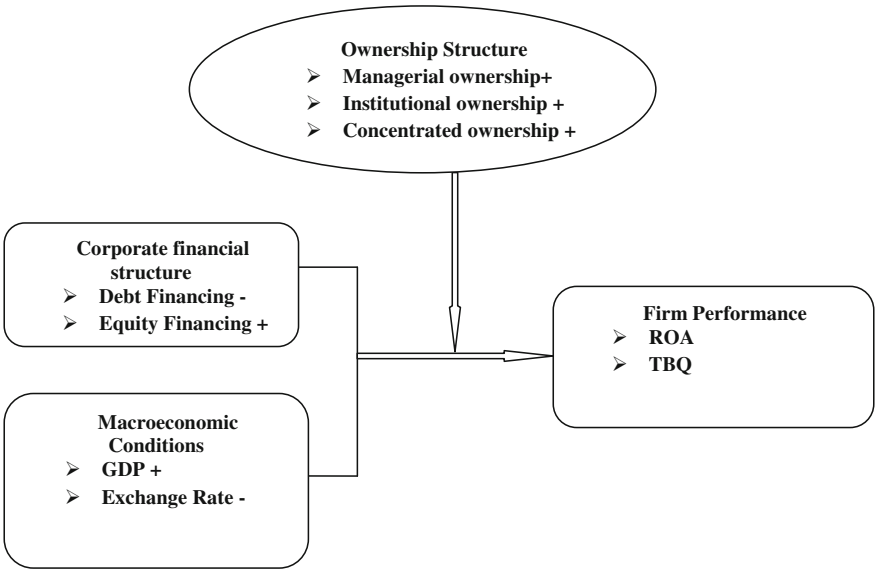

Fig. 1 Proposed conceptual framework

order, and lastly externally equity (new issue of shares) will be the last resort due to the high cost of information asymmetry. The theory presumes there is no targeted debt ratio (optimal capital structure) but managers are just observing the order of financing as capital structure decision is concerned (Mwambuli 2015). Jensen and Meckling (1976) explored the ownership structure of firms, involving how equity ownership by managers aligns managers' interests with those of owners. As a result, they found that if the contract between the principal and agent is outcome based; the agent is more likely to behave in the interests of the principal.

The agency theory proposed possible conflicts of interest between related parties when firms make financial decisions: conflict between shareholders and managers, and conflicts between shareholders and debt holders (Jensen 1986; Jensen and Meckling 1976). The agency theory postulates that agency costs arise from the conflict of interest between corporate managers and shareholders, and is due to the separation of ownership and control. The conflict is a potential determinant of capital structure. The agency cost is known as free cash flow hypothesis (Jensen 1986). Corporate managers possess substantial free cash flow tend to increase resources under their control and invest in low-return projects but not distributing to shareholders. Firms could change capital structure to solve this agency problem. Specifically, the leverage level could be increased in order to constrain management activities. If the firm has expected future growth opportunities, debt obligation helps to limit the overinvestment of free cash flow. Debt could also be used to indicate management's willingness to pay out cash flows (Harvey et al. 2004). Increased debt forces managers to pay future excess free cash flows for the settlement of interest and repayment. Thus, firms reduce agency costs of free cash flow through debt. Besides, high level of debt increases the bankruptcy risk if firm could not repay debt in time. The potential bankruptcy costs force managers to work hard to make valuable investment decisions and consequently reduce the risk of bankruptcy (Grossman and Hart 1980).

Another potential conflict arises between shareholders and debt holders which causes agency costs of debt financing (Jensen and Meckling 1976). Firstly, managers may choose to invest in high-risk projects to maximize returns of shareholders but damage the benefits of debt holders. On the one hand, if the investment successfully attracts high returns, shareholders receive most of the extra benefits against debt holders. On the other hand, if the investment fails, debt holders undertake the failure cost. As a result, shareholders might benefit from investing in risky projects even if they are values decreasing (Harris and Raviv 1991). Secondly, as Myers (1977) discussed, when firms have high amount of debt, the expected benefits of investing in profitable projects will be used to repay debt. Thus, shareholders will lack incentives to support these investments or they will invest sub-optimally. Similarly, corporate governance literatures also stress the conflict of interest between large controlling shareholders and minority shareholders (Hassan and Butt 2009; Liu et al. 2011; Shi 2010). The expropriation hypothesis suggests that, with concentrated ownership, large controlling shareholders expropriate wealth from minority shareholders and this conflict decreases firm value (Shleifer and Vishny 1997).

Therefore, when firm uses debt financing, it decreases the conflict of interest between managers and shareholders, but increases the conflict between shareholders and debt holders. Thus, the agency theory states that the optimal capital structure of the firm could be determined by minimizing the possible agency costs arising from stakeholders involved in conflicts.

Consequently, conceptual framework of this study is designed to test the role of ownership structure in moderating the effects of corporate financial structure and macroeconomic condition on financial performance. The framework is depicted in Fig. 1.

3 Research Methodology

This study will employ ex-post factor research design using panel data for the 8-year (2010–2017) period under study. This type of research design is used where the phenomenon under study has already taken place. The choice of the study period is informed by the need to study performance of the Deposit Money Banks (DMBs) in the post-crisis period of the Nigerian banking industry. This allows for the collection of past and multi-dimensional data which provides basis for the full establishment of the relationship among corporate financial structure, macroeconomic condition, ownership structure, and firm performance of listed Deposit Money Banks (DMBs). The data will be obtained from the annual reports of the listed DMBs and Website of Nigerian Stock Exchange (NSE).

The population of the study includes all the 15 listed DMBs in NSE within the period of the study. This is because only listed banks can be termed a public bank (Plc.) which implies that they comply fully with requirement of the Central Bank of Nigeria and Securities and Exchange Commission with respect to capital structure requirement, ownership structure requirement as well publication their annual reports. Therefore, the working population of this study consists of 15 listed DMBs. Moreover, these DMBs are also taken as the sample size of the study. The banks as well as their year of incorporation are Access Bank Plc (1998), Diamond Bank Plc (2005), Eco Bank Plc (2006), Fidelity Bank Plc (2005), First Bank Plc (1971), First City Monument Bank (2004), Guaranty Trust Bank (1996), Skye Bank Plc (2005), Stanbic IBTC Plc (2005), Sterling Bank Plc (1993), Union Bank Plc (1970), United Bank for Africa Plc (1970), Unity Bank Plc (2005), Wema Bank Plc (1991), and Zenith Bank Plc (2004).

This study will investigate the moderating role of ownership structure on the relationship between corporate financial structure and firm performance in the Nigerian banking industry for 8 year period from 2010–2017. Corporate financial structure is the independent variable while firm performance is the dependent variable, and ownership structure serving as the moderator in the study. The following subsections explain the proxies of the variables and how they will be measured in conducting the study as used in relevant previous studies.

The dependent variable that will be used in this study is firm performance. The study will use two broad measurements of financial performance, i.e., accounting-based measures and market-based measures.

The study will use return on assets (ROA) as one of the common accounting measures of performance. The use of accounting-based measures in this study is informed by use of similar measures in other previous related studies (Gugong et al. 2014; Mwambuli 2016; Twairesh 2014; Vintilă et al. 2014). In addition, the capital market in Nigeria is relatively inefficient and inactive as such the use of accounting measures to measure past performance of firms is seen as more appropriate. Similarly, it will enable comparison with previous studies that use the same measures possible as they were mostly used in previous studies. Return on assets (ROA) is calculated by taking the ratio of net profit of the firm to the total assets of the firm. Thus, the return on assets is calculated by dividing net income with total assets Tobin's Q is a popular measure of firm performance in empirical studies in corporate finance. It is considered a forward-looking measure for firm performance as it can capture the market value of a firm's assets (Dezsö and Ross 2012); thus, this study will use Tobin's Q as the firm market-based performance measure. Tobin's Q is measured as the sum of market value of equity and book value of liabilities divided by the book value of total assets at the balance sheet date. This simple version of Tobin's Q is applied widely in corporate finance literature (Vafaei et al. 2015).

Corporate financial structure is the independent variable in this study with the following proxies and measurements; debt financing is the proportion of capital of the firm owned through debt and it measured as the ratio of total debt to total assets of the firm (Usman et al. 2015); and equity financing is the proportion of capital of the firm owned through seasoned equity offerings and it is measured as the ratio of total equity to total asset of the firm.

Macroeconomic condition is the second independent variable in the study. In this study, gross Domestic Product (GDP) and Exchange Rate (EX) are the two dimensions of the macroeconomic conditions to be used by this study. Review of extant literature indicates that macroeconomic factors, often referred to as external factors, tend to affect bank industry performance (Demirguc-Kunt and Huizinga 2000). The external factors are the characteristics of the economy of the country where a bank operates, and which are beyond the control of the bank, and thereby affect bank performance (Abdul Jamal et al. 2012; Adesina et al. 2015). Khanna et al. (2015) noted that no firm remains unaffected by macroeconomic factors. Hence, understanding the dynamics of these factors on the firm will enable management to be more efficient in their decision-making process. It is through knowing the effect of macroeconomic factors and other key variables on firm performance, the management can ameliorate the impact of the unexpected fluctuations in the economy to improve their performance. This study will use Real Gross Domestic Product (GDP) proxied by annual growth rate of the economy, and Exchange Rate will be measured using average exchange rate of US Dollar to the domestic currency (Nigerian Naira) during the period of the study (Knezevic and Dobromirov 2016; Kanwal and Nadeem 2013; Khanna et al. 2015)

Ownership structure is used in this study as the moderating variable between corporate financial structure and firm performance. Zouari and Taktak (2014) argue that studying the relation between ownership and performance is useful to predict the probability (Claessens et al. 2002; Zeitun and Tian 2007). The concept of ownership structure can be defined along two concepts: ownership concentration which refers to the share of the largest owner, and ownership mix related to the major owner identity (Xu and Wang 1999; Zeitun 2009).

Ownership Concentration: To determine the ultimate owner's concentration, various measures of ownership concentration are constructed. However, ownership concentration in this study is measured by fraction of shareholders who hold five percent of share or more of the firm. In other words, ownership concentration is sum of shares owned by shareholders who hold more than five percent of a company's total shares at the reporting date (Dada and Ghazali 2016; Vafaei et al. 2015).

Ownership Mix/Identity: Based on the information available in the annual reports of the DMBs, managerial and institutional ownerships are going to be used as proxies for ownership identity in this study. On the one hand, institutional ownership is measured as the percentage of shareholdings owned by the institutional shareholder (Zhang and Kyaw 2017). On the other hand, managerial ownership is measured by the percentage of shareholdings owned by the executive directors (Khamis et al. 2015).

In addition to the above and based on the review of literature, control variables have been introduced based on the notion that firm performance may also be affected by other factors not captured in the explanatory variable. The control variables of the study include firm size, firm age, liquidity, and management efficiency. Firm size is measured by the natural logarithm of total assets of the firm (Skopljak and Luo 2012); while firm age is measured by natural logarithm of the number of years from the time of its incorporation (Elvin and Hamid 2016). The use of natural logarithm in this study is in line with extant literature particularly when the figures are too large or when there is need to standardize the figures in running the analysis. Liquidity (LIQ) is measured by the ratio of current assets to current liabilities (Wahba 2013); and finally, management efficiency (OPEX) measured by dividing operational expenses on total assets (Al-Jafari and Alchami 2014).

The data that are going to be used in this study will be generated from the audited annual financial statements of the 15 DMBs under study covering a period of 7 years (2010–2016). This method of data collection will be adopted because of the availability of data, convenience as well as the nature of the research design that is adopted in the study. The adopted method requires that past and documented facts emanating from the units of analysis (DMBs) will form the basis for performance evaluation of the banks.

However, due to different regulatory requirements data will be further screen using the following criteria: (1), the bank is listed in Nigeria Stock Exchange before 2010; (2), the bank has 8 years of complete data from 2010 to 2017; (3), the bank is categorized as Deposit Money Bank (DMB) by the Central Bank of Nigeria; (4), the bank has not undergone major restructuring or reorganization that led to change in

name within the 2010–2017 period; (5), the bank has full information that is relevant to the variables of interest in the study.

4 Conclusion

This study is an explanatory research which seeks to explain the causal connections between phenomena. Specifically, the study examines the relationship between corporate financial structure and firm performance as well as the impact of ownership structure on the relationship between corporate financial structure and firm performance. In order to achieve these objectives, this study will design multivariate tests, particularly ordinary least square (OLS) regression models, which control various variables that prior relevant literature identifies as affecting firm performance. Therefore, the study will use hierarchical moderated regression analysis in measuring the collected data by using statistical software 'Stata Version 11' in order to examine the relationship among all the variables of interest in the study.

The study is an attempt to propose ownership structure as a moderating variable. This will help to provide better knowledge of how corporate financial structure and macroeconomic condition can affect firm performance in a new perspective. Therefore, investigating factors that influence bank performance is not only essential for the bank managers, but also for other stakeholders like the central bank, government, and other financial regulators. Analysing these factors can help both the bank managers and regulators in formulating evidence-based policies and actions toward improving the profitability of banks in Nigeria.

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