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Determinants of Financial Inclusion: The Case of 125 Countries from 2004 to 2017

Nader Alber

Abstract This paper attempts to investigate the effects of GDP growth, GDP per capita, inflation rate and interest rate spread on financial inclusion. Financial inclusion has been measured by account ownership at a financial institution for ages 15+ and for ages 25+, automated teller machines and depositors with commercial banks. This has been conducted using a sample of 145 countries, over the period from the 2004 to 2017. Results indicate that GDP per capita may have a significant positive effect on financial inclusion, while each of GDP growth, and interest rate spread may have a significant negative effect. Besides, inflation rate seems to have no significant effect on financial inclusion. Moreover, robustness check assures these findings.

Keywords Financial inclusion · GMM technique · Panel analysis

1 Introduction

Financial inclusion allows the unbanked segments of society to join the formal financial system, which ultimately helps to alleviate poverty, promote job security and improve social empowerment. Recently, financial inclusion is demonstrated in terms of each of financial stability, financial integrity and customer protection. Therefore, numerous countries have formally endorsed financial inclusion (I) as a domestic policy objective alongside stability, integrity, and protection objectives (collectively, "I- SIP").

Financial inclusion concerns with improved effective access to financial services by those who lack it (GPFI 2011). It aims at encouraging the unbanked population to join the formal financial system to access financial services such as savings, payments, and transfers to credit and insurance (Demirguç-Kunt et al. 2008). It's also defines as "a state in which all working age adults have effective access to

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credit, savings, payments, and insurance from formal service providers (GPFI 2011).

Financial inclusion, generally refers to the wide availability of financial services and to their usage by low-income households and other disadvantaged groups. Shettar (2016) defines financial inclusion as the delivery of financial services at affordable costs to vast sections of low-income groups. In other words, financial inclusion tends to the integration of people who are economically and socially excluded from access to easy, safe and affordable financial services.

According to (Sharma and Kukreja 2013), the financial Inclusion is needed to achieve many objectives that include: (1) economic objectives (for equitable growth), (2) financial objectives (through mobilization of savings), (3) social objectives (through poverty eradication) and (4) political objectives- (where it provides government programs with effective directions).

According to Damodaran (2013), the main reasons for financial exclusion, from the demand side are lack of awareness, low income, poverty and illiteracy; and from the supply side is distance from branch, branch timings and unsuitable products.

It is important to distinguish between voluntary and involuntary financial exclusion. The World Bank (2014) defines voluntary exclusion as a condition in which a segment of the population or firms chooses not to use financial services, either because they have no need for them or for cultural or religious reasons.

Adopting financial inclusion includes two steps (Singh 2017). The first step is being able to have access to a transaction account: Since a transaction account allows people to store money, and send and receive payments. A transaction account serves as a gateway to other financial services. Financial access facilitates day-to-day living, and helps families and businesses plan for everything from long-term goals to unexpected emergencies. The second one is moving from access to account-to-account usage which should be adopted in countries where 80% or more of the population have accounts.

World Bank (2014) suggests that achieving financial inclusion requires: (1) dealing with market failures, such as asymmetric information and moral hazard, (2) designing products that fit consumer needs at reasonable prices, (3) educating and protecting consumers so they avoid making costly mistakes upon entering into financial contracts, (4) engagement of both private sector and government to expand the financial inclusion, and (5) technological progress.

Financial inclusion can be measured through the following dimensions (Hannig and Jansen 2010): (1) access (the ability to use available financial services and products from formal institutions), (2) quality (the relevance of the financial service or product to the lifestyle needs of the consumer), (3) usage (permanence and depth of financial service and product use) and (4) impact (changes in the lives of consumers that can be attributed to the usage of a financial device or service).

Besides, financial inclusion could be measured using data sources such as The Global Findex, The FinScope Survey, FinAccess/Access to Financial Services Surveys, Financial Inclusion Tracker Surveys (FITS), Financial Inclusion Insight Surveys (FII), The IMF Financial Access Survey (FAS), GSMA Mobile Money

Adoption Survey, Word Bank's Global Payment Survey, The MIX's Geospatial Maps and Fspmaps.com.

In brief, this study tries to answer these four main questions:

1. Does "GDP growth" affect the "financial inclusion"?
2. Does "GDP per capita" affect the "financial inclusion"?
3. Does "inflation rate" affect the "financial inclusion"?
4. Does "interest rate spread" affect the "financial inclusion"?

The paper is arranged as follows: after this introduction, Sect. 2 reviews research literature that has concerned with "financial inclusion". Section 3 explains how to develop hypotheses and measure variables. Section 4 presents descriptive and diagnostic statistics. Section 5 is for empirical work, presenting results, discussing how these results answer research questions with a robustness check. Section 6 summarizes the paper and provides remarks about conclusions.

2 Literature Review

This section tries to present some of previous work, which has been conducted in the field of financial inclusion. Some papers concern with measuring financial inclusion (e.g. Honohan 2007; Sarma 2008; Amidžić et al. 2014 and Camara and Tuesta 2014). Others indicate its importance (e.g. Sarma 2010; Subrahmanyam and Acharya 2017; Sethi and Acharyaa 2018; Inoue 2018; Neaime and Gaysset 2018; Bakar and Sulong 2018). Recently, financial inclusion is demonstrated in terms I-SIP (e.g. Nsanzabaganwa 2014; Alber 2019).

Regarding measuring financial inclusion, constructs a financial access indicator that captures the fraction of the adult population in each economy with access to formal financial intermediaries, which captures only one dimension of financial inclusion. Besides, Sarma (2008) computes a sub-index for each dimension of financial inclusion (access, availability, and usage) and aggregates each index as the normalized inverse of Euclidean distance. The advantage of this approach is that it is easy to compute and does not impose varying weights for each dimension.

Amidžić et al. (2014) constructs a financial inclusion indicator as a composite of variables pertaining to multiple dimensions: outreach (geographic and demographic penetration), usage (deposit and lending), and quality (disclosure requirement, dispute resolution, and cost of usage). Each measure is normalized, statistically identified for each dimension, and then aggregated using statistical weights, the aggregation following a weighted geometric mean. Camara and Tuesta (2014) uses two-stage principal component analysis, where, in the first stage, the authors estimate three sub-indices: usage, access, and barriers and construct a weighted average index. In the second stage, they estimate the dimension weights and the overall financial inclusion index by using the dimension sub-indices.

Regarding the importance of financial inclusion, Sarma (2010) indicates that the importance of financial inclusion is due to its role in (a) facilitating efficient allocation of productive resources, (b) providing access to appropriate financial services can significantly improve the day-to-day management of finances, and (c) reducing the growth of informal sources of credit (such as moneylenders). Besides, Demirguc and Klapper (2012) finds that the higher financial inclusion in a given countries the higher the growth of the economy. Likewise, Subrahmanyam and Acharya (2017) argues that, financial inclusion boost growth compared with demand following approach. Moreover, Sethi and Acharyaa (2018) indicates that financial inclusion encourage growth for 31 countries using dynamic OLS (DOLS) and fully modified OLS (FMOLS) techniques.

Inoue (2018) investigates the effect of financial development on poverty conditions in India. The results indicate that financial inclusion and financial deepening affect the poverty ratio significantly negative for public sector banks, but not significant for private sector banks. Besides, Naime and Gaysett (2018) demonstrates the impact of financial inclusion on income inequality, poverty, and financial stability. Results indicate that while financial integration is a contributing factor to financial instability in MENA, financial inclusion contributes positively to financial stability. Besides, financial inclusion affects income inequality negatively. However, it has no effects on poverty.

In terms of I-SIP framework, Bakar and Sulong (2018) demonstrates the effect of financial inclusion on economic growth. The optimistic views for financial inclusion on growth, based on the accessibility of financial services includes; expansion of bank branches, minimizing a barrier in access to finance and contribution of banking sector. On other hand, the negative contribution of financial inclusion on growth is due to weak financial system, low availability of financial system. It is suggested that, using a multidimensional variable may lead to better assessment of the effect of financial inclusion on growth.

Moreover, Nsanzabaganwa (2014) explores the linkage between financial inclusion, stability, integrity, and consumer protection using the Rwandan case. This study argues that so far, managing the trade-offs and harnessing the synergies between financial inclusion, financial stability, financial integrity and financial consumer protection in Rwanda has been a difficult but feasible. Recently, Alber (2019) attempts to demonstrate the 4 dimensions of I-SIP in terms of both of its conceptual framework, measurement indicators and related literature. Moreover, it tries to present and discuss the linkages between financial inclusion and the other 3 dimensions.

Comparing with previous work, the current study tries to investigate the determinants of financial inclusion, while previous work tends to address its measurements, importance and linkages with other I-SIP dimensions. Besides, this study uses a sample of 145 countries, over the period from the 2004 to 2017, which seems to have more coverage.

3 Measuring Variables and Developing Hypotheses

Financial inclusion has been measured by account ownership at a financial institution for ages 15+ and for 25+, automated teller machines and depositors with commercial. Independent variables to be examined are GDP growth, GDP per capita, inflation rate and interest rate spread.

Date are collected from World Development Indicators available by World Bank (https://databank.worldbank.org/data/source/world-development-indicators/preview/on). Tables 1 and 2 illustrate these variables as follows.

Table 1 Measuring the dependent variables

Dependent variable	Sign
Account ownership at a financial institution or with a mobile-money-service provider (% of population ages 15+)	ACC15
Account ownership at a financial institution or with a mobile-money-service provider, older adults (% of population ages 25+)	ACC25
Automated teller machines (ATMs) (per 100,000 adults)	ATMs
Depositors with commercial banks (per 1000 adults)	DEPs

Table 2 Measuring the independent variables

Independent variable	Sign
GDP growth (annual %)	GDPG
GDP per capita (current US$)	GDPC
Inflation, consumer prices (annual %)	INF
Interest rate spread (lending rate minus deposit rate, %)	SPR

This paper aims at testing the following four hypotheses:

1. There's no significant effect of "GDP growth" on "financial inclusion".
2. There's no significant effect of "GDP per capita" on "financial inclusion".
3. There's no significant effect of "inflation rate" on "financial inclusion".
4. There's no significant effect of "interest rate spread" on "financial inclusion".

This means that alternative hypothesis Ha: $\beta \neq 0$ versus null hypothesis Hb: $\beta = 0$, where β is the regression coefficient of the following functions.

$$\text{Acc\_15} = \alpha + \beta_1 \text{GDPG} + \beta_2 \text{GDPC} + \beta_3 \text{INF} + \beta_4 \text{SPR} + \varepsilon$$
$$\text{Acc\_25} = \alpha + \beta_1 \text{GDPG} + \beta_2 \text{GDPC} + \beta_3 \text{INF} + \beta_4 \text{SPR} + \varepsilon$$
$$\text{ATMs} = \alpha + \beta_1 \text{GDPG} + \beta_2 \text{GDPC} + \beta_3 \text{INF} + \beta_4 \text{SPR} + \varepsilon$$
$$\text{DEPs} = \alpha + \beta_1 \text{GDPG} + \beta_2 \text{GDPC} + \beta_3 \text{INF} + \beta_4 \text{SPR} + \varepsilon$$

4 Descriptive and Diagnostic Statistics

Tables 3 and 4 illustrate descriptive statistics of the research variables using a sample of 145 countries, over the period from the 2004 to 2017 as follows.

Table 3 Descriptive statistics of dependent variables

Variables	ACC15	ACC25	ATMs	DEPs
Mean	53.02848	56.08546	35.42127	993.8670
Median	47.99082	52.11043	24.66877	681.5037
Maximum	100.0000	100.0000	222.9892	7987.930
Minimum	2.534857	2.702704	0.000000	1.300208
Std. Dev.	27.78345	27.44092	37.63612	1047.415
Skewness	0.175239	0.089105	1.910396	2.987966
Kurtosis	1.842274	1.849876	7.509612	16.28771
Observations	304	304	1706	1238
Jarque-Bera	11.54535	10.02396	111.7578	670.4588
Probability	0.0031	0.0067	0.0000	0.0000
Observations	304	304	1706	1238

Source Outputs of data processing using EViews 10

Table 4 Descriptive statistics of independent variables

Variables	GDPG	GDPC	INF	SPR
Mean	4.423891	10512.64	19.38214	7.118858
Median	4.498253	3784.676	4.228076	6.494527
Maximum	34.50000	103059.2	24411.03	66.89482
Minimum	−36.69995	194.1668	−35.83668	−13.20763
Std. Dev.	4.080401	16240.01	565.3583	5.477896
Skewness	0.041311	2.464993	43.02917	3.412784
Kurtosis	15.39157	9.486569	1856.776	29.02782
Jarque-Bera	4391.183	15866.68	19503.89	30309.62
Probability	0.0000	0.0000	0.0000	0.0000
Observations	1895	1896	1868	1484

Source Outputs of data processing using EViews 10

Regarding normality, Jarque-Bera values indicate that all variables are normally distributed at p-value of 0.01. Regarding multicollinearity, Table 5 illustrates the correlation coefficients between independent variables as follows.

Table 5 Correlation coefficients between independent variables

Variables	GDPG	GDPC	INF	SPR
GDPG	1			
GDPC	−0.0673	1		
INF	0.1395	−0.1754	1	
SPR	0.0987	−0.2254	0.1835	1

Source Outputs of data processing using EViews 10

Table 5 shows that correlation coefficients between independent variables range from −0.2254 to 0.1835, which indicates that multicollinearity problem does not exist.

5 Testing Hypotheses

This section is for investigating the effect of each of GDP growth (GDPG), GDP per capita (GDPC), inflation rate (INF) and interest rate spread (SPR) on "financial inclusion" measured by account ownership at a financial institution for ages 15+, for ages 25+, automated teller machines and depositors with commercial banks. Models (1), (2), (3) and (4) attempt to assess the determinants of "Acc_15", "Acc_25", "ATMs" and "DEPs" respectively. To control for income level, 1, 2, 3, 4 and 5 denote low, lower middle, middle, upper middle and high-income countries respectively. Then, controlling for income level, models (5), (6), (7) and (8) try to assess the determinants of "Acc_15", "Acc_25", "ATMs" and "DEPs" respectively.

To investigate these effects, a panel data analysis has been conducted using GMM technique and provides the following results (Table 6).

Table 6 Determinants of financial Inclusion using GMM techniques

	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Variable	Acc_15		Acc_25		ATMs		DEPs	
C	45.9393 (5.5892) ***	27.3937 (6.944) ***	49.1729 (5.5220) ***	30.3006 (6.0292) ***	32.5451 (3.1891) ***	10.4397 (2.7917)***	1026.342 (130.66) ***	586.508 (137.36) ***
GDP growth	−0.952053 (0.8687)	−0.44908 (0.8804)	−0.977144 (0.8463)	−0.454905 (0.8512)	**−1.69237** (0.3177) ***	**−1.658068** (0.3201)***	**−50.096** (13.769) ***	**−60.0524** (16.679) ***
GDP per capita	**0.000903** (0.0002) ***	**0.000606** (0.0002) ***	**0.000869** (0.0002) ***	**0.000567** (0.0002) ***	**0.001107** (0.0002) ***	**0.000656** (0.0001)***	**0.04791** (0.0148) ***	**0.03751** (0.0140) ***
Inflation rate	−0.213283 (0.1999)	−0.191234 (0.1875)	−0.154915 (0.2248)	−0.130081 (0.2085)	−0.22671 (0.1969)	−0.159154 (0.1844)	−4.54524 (12.0248)	−1.5514 (12.4941)
Interest rate spread	**−0.99311** (0.2933) ***	**−0.807365** (0.2802) ***	**−1.005383** (0.2886) ***	**−0.82057** (0.2730) ***	**−0.72593** (0.1892) ***	**−0.541687** (0.1447***)	**−25.990** (7.5797) ***	**−20.3469** (6.3548) ***
Income Level		**5.970205** (1.5741) ***		**6.050356** (1.6022) ***		**8.28933** (1.9093)***		**193.0977** (37.265) ***
Controlling for Income	No	Yes	No	Yes	No	Yes	No	Yes
R^2	0.4147	0.4850	0.3985	0.4713	0.4406	0.5458	0.4152	0.4566
Obs.	82,027	82,027	82,027	82,027	82,027	82,027	82,027	82,027

Source Outputs of data processing using EViews 10

Model (1) supports the significance of "GDP per capita" and "interest rate spread" effects on "financial inclusion" measured by Acc_15 with explanation power of 41.47%. So, for the second and fourth hypotheses, the null hypothesis is rejected and the alternative one could be accepted.
Model (3) indicates the significance of "GDP per capita" and "interest rate spread" effects on "financial inclusion" measured by Acc_25 with explanation power of 39.85%. So, for the second and fourth hypotheses, the null hypothesis is rejected and the alternative one could be accepted.
Model (5) shows the significance of "GDP growth", "GDP per capita" and "interest rate spread" effects on "financial inclusion" measured by ATMs with explanation power of 44.06%. So, for the first, second and fourth hypotheses, the null hypothesis is rejected and the alternative one could be accepted.
Model (7) illustrates the significance of "GDP growth", "GDP per capita" and "interest rate spread" effects on "financial inclusion" measured by DEPs with explanation power of 41.52%. So, for the first, second and fourth hypotheses, the null hypothesis is rejected and the alternative one could be accepted.

Signs of regression coefficients β_1 and β_4 are negative, while β_2 is positive. This means that financial inclusion is affected positively by "GDP per capita" and negatively by each of "GDP growth" and "interest rate spread". "Inflation rate" seems to have no effect on financial inclusion. So, results indicate that the null hypotheses could be rejected for the first, second and fourth hypothesis, while it could be accepted for the third hypotheses.

When using income level as a control variable, a panel data analysis has been conducted and provides the same results obtained in Models (1), (3), (5) and (7). This could be considered as a robustness check where the same significances have been supported with a slightly higher R^2, where model (2) provides R^2 of 48.50% (compared with 41.47%), model (4) has R^2 of 47.13% (compared with 39.85%), model (6) provides R^2 of 54.58% (compared with 44.06%) and model (8) has R^2 of 45.66% (compared with 41.52%).

Regarding the problem of autocorrelation, Variance Inflation Factor (VIF) test has been conducted for the 8 models and provides the following results.

Table 7 shows that VIF values range from 1.028037 to 1.553450, which means that autocorrelation problem does not exist, as VIF values are between 1 and 10.

Regarding the problem of heteroskedasticity, Breusch-Pagen-Godfery test has been conducted for the 8 models and provides the following results.

Table 8 shows that controlling for income level enhances the probability from 0.0027 (in model 1) to 0.0726 (in model 2), and from 0.0020 (in model 3) to 0.0523 (in model 4), which means that heteroskedasticity problem has been fixed when using income level as a control variable in case of "Acc_15" and "Acc_25". This problem has not been fixed for "ATMs" and "DEPs".

Table 7 Variance inflation factors

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
GDPG	1.033221	1.090938	1.033221	1.090938	1.028037	1.031418	1.080195	1.083319
GDPC	1.052590	1.452380	1.052590	1.452380	1.081965	1.422490	1.174794	1.463690
INF	1.036383	1.038001	1.036383	1.038001	1.064657	1.064714	1.152563	1.160457
SPR	1.073634	1.099932	1.073634	1.099932	1.085767	1.112406	1.121971	1.149594
INC	–	1.553450	–	1.553450	–	1.416514	–	1.416876

Source Outputs of data processing using EViews 10

Table 8 Breusch-Pagen-Godfery test

Variables	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)	Model (8)
Breusch-Pagen-Godfery	4.2839	2.0768	4.4724	2.2622	14.7534	10.4043	58.1330	31.9377
Probability	0.0027	0.0726	0.0200	0.0523	0.0000	0.0000	0.0000	0.0000

Source Outputs of data processing using EViews 10

6 Summary and Concluded Remarks

This paper attempts to investigate the effects of GDP growth (annual %), GDP per capita (current US$), Inflation, consumer prices (annual %) and interest rate spread (lending rate minus deposit rate, %) on financial inclusion. Financial inclusion has been measured by account ownership at a financial institution or with a mobile-money-service provider (% of population ages 15+), account ownership at a financial institution or with a mobile-money-service provider, older adults (% of population ages 25+), automated teller machines (ATMs) (per 100,000 adults) and depositors with commercial banks (per 1000 adults).

This has been conducted using panel analysis according GMM technique for a sample of 145 countries, over the period from the 2004 to 2017. Results indicate that GDP per capita may have a significant positive effect on financial inclusion, while each of GDP growth, and interest rate spread may have a significant negative effect. Besides, inflation rate seems to have no significant effect on financial inclusion. Moreover, controlling for income level supports these results with a higher explanation power.

GDP per capita seems to affect financial inclusion positively due to financial systems seem to be sensitive to economic activity. Interest rate spread may have a significant negative effect on financial inclusion, which may indicate that the more the risk banks face, the more the spreads determined by banks, and the less the financial inclusion encouraged by depositors and borrowers. The negative effect of GDP growth needs to be more elaborated.

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Asymmetric Effects of Credit Growth on the Current Account Balance: Panel Data Evidence

Mehmet Fatih Ekinci and Tolga Omay

Abstract Expanding current account balances (both surpluses and deficits) prior to the global economic crisis dominated academic and policy debates over the past decade. Understanding the role of credit growth on the current account balance has become a priority particularly with the rebalancing experience in the post-crisis period. In this study, we adopt a comprehensive framework by constructing an empirical model that accommodates asymmetric adjustments of current account balance to the changes in the total and household credit growth. We consider the asymmetric effects in two dimensions. When we discriminate between credit expansion and contraction episodes, our results show that credit growth has a stronger negative impact on the current account balance during credit expansion periods. Furthermore, negative effects of total and household credit growth on the current account balance are more pronounced during current account deficit episodes.

Keywords Credit growth · Current account balance · Loan Growth · Global imbalances · Household credit · Panel data econometrics

1 Introduction

Global imbalances have been a key policy issue in policy discussions over the past decade. Persistent widening of current account (CA) balances (both surpluses and deficits) has been a symptom of distortions which can be harmful for growth prospects. As a measure of imbalances, we present the sum of absolute values of CA balances as a percent of world GDP between 1980 and 2015 in Fig. 1.

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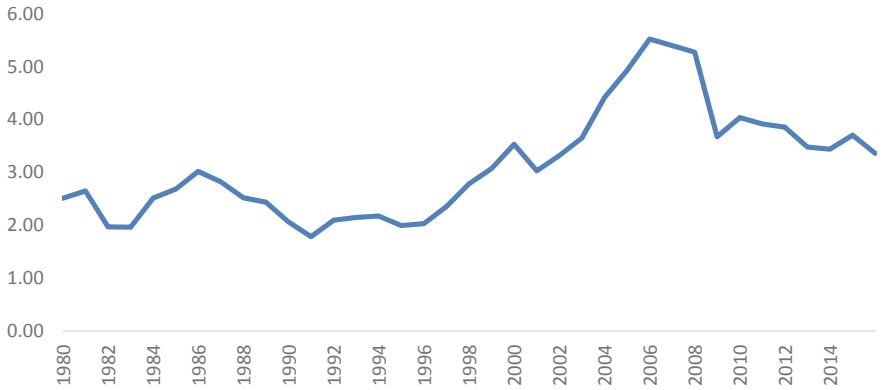

Fig. 1 Aggregate current account balance (Sum of absolute values of country current account balances, percent of World GDP)

We observe an increase in the global imbalances starting at the second half of 1990's. This trend reaches at a peak level prior to the global economic crisis.

For the pre-crisis period, a domestic bank-intermediated demand booms have been experienced especially in advanced economies. These demand booms spilled over to imports and consequently increased the CA deficits. Demand booms and associated CA deficits have been financed by the savings in the emerging market economies. Potential risks and distortions increased with widening external positions. These developments caused an excessive build-up of debt for both households and firms, and created excessive leverage in the banking system.

We experienced a significant rebalancing episode after the global economic crisis. Despite the rebalancing process, Fig. 1 shows that the amount of imbalances is still above the level of 1980's. The existence of large and persistent excess imbalances reveals a sub-par performance of the global economy in terms of foregone product and employment. Although some imbalances are justifiable due to structural factors,[1] the key challenge is to determine the appropriate amount of external balance. Identifying excessive imbalances has become a priority for policy maker institutions.

There is ample evidence[2] which indicates that a demand boom generated by excessive credit expansion leads to a weaker CA balance. Demonstrating and analyzing this issue[3] for two major economies, we plot the CA balance and credit growth for US and China in Figs. 2 and 3 between 2004 and 2011.

[1]Demographic factors, fiscal balances, economic growth prospects and net foreign asset positions are major structural factors which influence the CA balance. See Philips et al. (2013) for a detailed discussion.

[2]See Atoyan et al. (2013), Ekinci et al. (2015), Ekinci and Omay (2019) and Philips et al. (2013).

[3]Prior to the global economic crisis, global imbalances typically referred to the persistent, large CA deficit in the US matched by CA surpluses in the rest of the world, especially China.

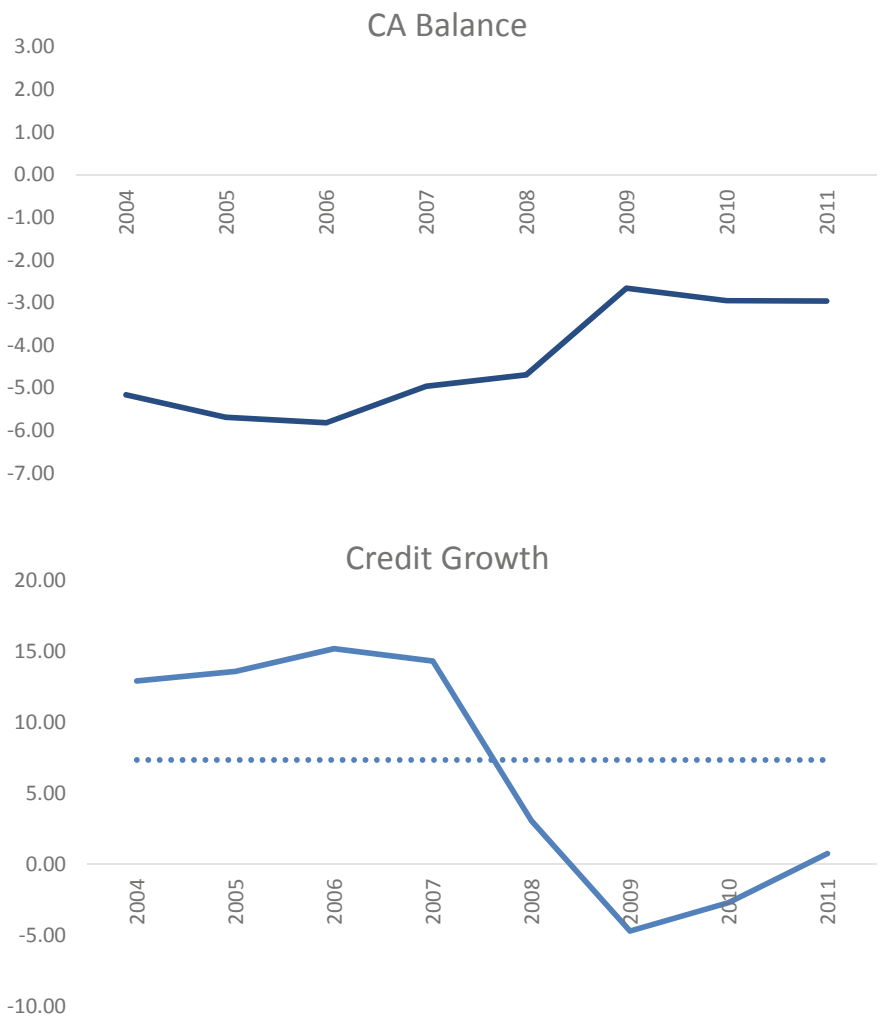

Fig. 2 Current account balance and credit growth: US (CA balance is the ratio to GDP. Credit growth is the ratio of change in total credit stock to GDP. Dotted line plots the average credit growth)

The developments in these two major economies are consistent with the hypothesis which states that credit growth is a major determinant of CA balance. Figure 2 presents the contribution of US to the global imbalances. Prior to the global economic crisis, US experienced large CA deficits along with a credit expansion. We observe that credit growth exhibits a sharp decline below the long term trend level after the crisis. Rebalancing in the post-crisis episode yields a substantial decline in the CA deficit. When we examine Fig. 3, we observe China

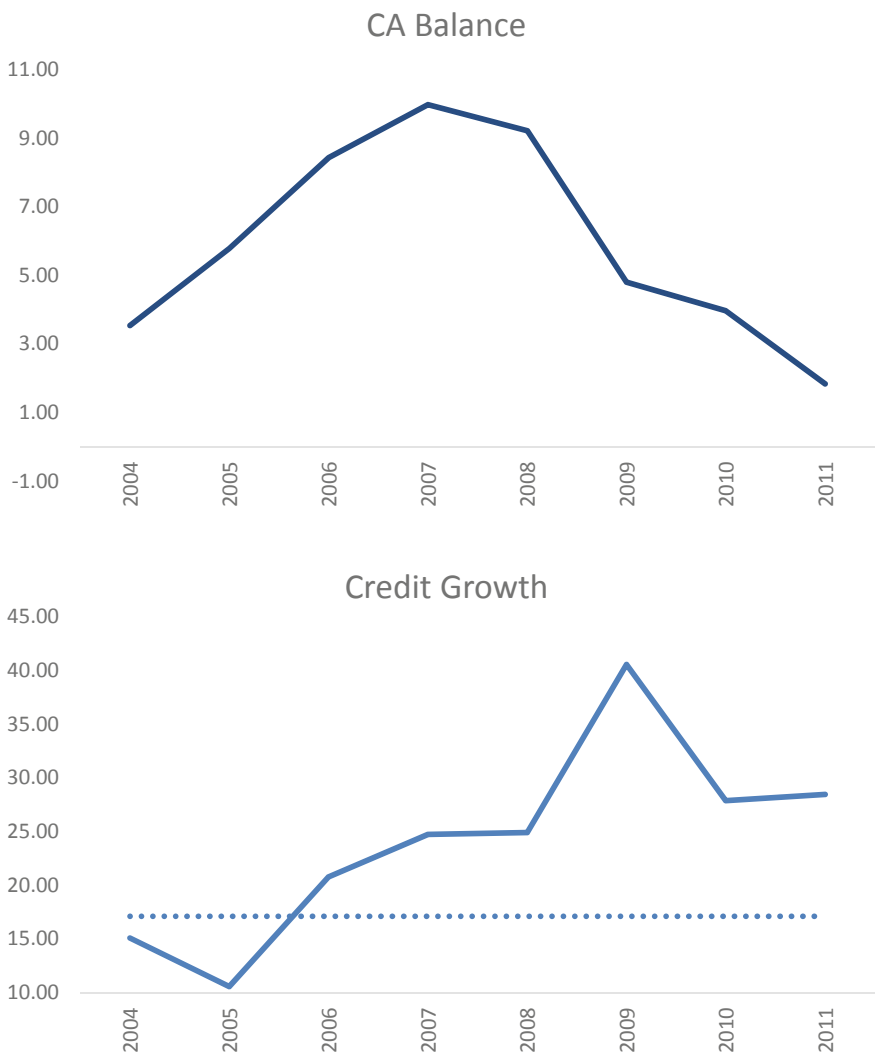

Fig. 3 Current account balance and credit growth: China (CA balance is the ratio to GDP. Credit growth is the ratio of change in total credit stock to GDP. Dotted line plots the average credit growth)

runs a CA surplus for the whole period. However, CA surpluses are at lower levels with rising internal demand which is fueled by a credit expansion.

Even though observations from Figs. 2 and 3 are consistent with the view which suggests credit growth as a major determinant of the CA balance, there are different adjustment paths. First difference is the sign of the credit growth. There is a credit expansion associated with a larger CA deficit in the pre-crisis period for the US. This episode has been followed by a credit contraction and an improvement of CA

balance. On the other hand, China experienced a positive credit growth for the whole period. Secondly, we observe a CA deficit for the US whereas China experienced a CA surplus.

Despite the different phases of external adjustment, the effect of credit growth on CA balance has been assumed to be symmetric by the literature. That is, the decrease in the CA balance caused by a credit expansion is assumed to have the same magnitude as the improvement in the CA balance due to a credit contraction. Also, magnitude of the impact is assumed to have the same size for an episode of CA deficit with a CA surplus. Considering the adjustment processes and differences between economic and financial cycles,[4] we adopt a more comprehensive framework by constructing an empirical model that accommodates asymmetric adjustments of CA balance to the changes in total and household credit growth. First, we investigate whether the effect of credit growth is at the similar magnitude during a credit expansion and a credit contraction. Next, we estimate the effect of credit growth on CA balance by discriminating between periods of CA surpluses and CA deficits.

In order to study asymmetric effects of credit growth on CA balance, we build a dataset for 43 countries. Our dataset covers the period between 1986 and 2015. Credit stock is decomposed into household and business credit. First, we show that total credit growth causes to a weaker CA balance using a symmetric empirical model following Ekinci and Omay (2019). Furthermore, we find that business loans have no significant effect on CA balance. Effect of credit developments on CA balance is driven by household credit.

Using an empirical model which accommodates asymmetric effects of credit growth on CA balance, we show that credit growth has a larger negative impact on CA balance when credit growth is positive. Our results indicate that there is a substantial divergence between the estimates obtained for CA surplus and CA deficit episodes. The negative effects of total and household credit growth on CA balance are more pronounced when there is a CA deficit.

The next section describes the data and methodology for the symmetric model. Third section presents the results from the symmetric model. Fourth section provides the results from the asymmetric empirical models. Final section concludes the paper.

2 Data and Methodology

Our panel dataset includes annual data for 43 countries between 1986 and 2015. Table 1 lists the countries in the sample. Total credit growth is the ratio of the change in total credit stock to GDP. For household and business loans, credit growth rates are defined as the ratio of change in respective credit stock to GDP.

[4]See Borio (2012) and Hiebert et al. (2018) for a detailed comparison of financial and economic cycles.

Table 1 Countries in the sample

Argentina	Japan
Australia	Korea
Austria	Luxembourg
Belgium	Malaysia
Brazil	Mexico
Canada	Netherlands
Chile	New Zealand
China	Norway
Colombia	Poland
Czech Republic	Portugal
Denmark	Russia
Finland	Saudi Arabia
France	Singapore
Germany	South Africa
Greece	Spain
Hong Kong	Sweden
Hungary	Switzerland
India	Thailand
Indonesia	Turkey
Ireland	United Kingdom
Israel	United States
Italy	

Variables included in the empirical model as determinants of CA balance are described in Table 2. Last column of Table 2 provides the expected sign of the impact.

At the early stages of economic development, countries require higher investment and need to import more capital. A measure of average growth and relative income is included in our model. Average growth is the arithmetic average of growth rate of GDP in the past 5 years. Relative income is with respect to US per capita GDP. Higher growth rate and lower relative income are expected to cause a negative effect on CA balance.

A higher NFA position is expected to improve the CA balance. We also include a dummy variable for high indebtedness. This dummy variable is 1 if the level of NFA is lower than −60% of GDP. This level is suggested as a threshold by Catao and Milesi-Ferretti (2014). High indebtedness is expected to lower the CA balance.

Oil balance variable is as a proxy for the effect of the oil prices, as well as oil production and consumption patterns on the CA balance. A higher oil trade balance is expected to increase CA balance.

A higher government fiscal balance is expected to increase the national savings unless Ricardian equivalence holds. There is very limited evidence which supports the Ricardian equivalence. Thus, an increase in fiscal balance improves CA balance.

Table 2 Variable descriptions

Variable	Source	Notes	Effect on CA balance
CA to GDP ratio	Lane and Milesi-Ferretti (2012) dataset		–
Credit growth (total)	Bank for International Settlements database	Ratio of new lendings to the private sector within a year to GDP	Negative
Credit growth (household)	Bank for International Settlements database	Ratio of new lendings to households within a year to GDP	Negative
Credit growth (business)	Bank for International Settlements database	Ratio of new lendings to non-financial corporations within a year to GDP	Ambiguous
Average growth rate	IMF WEO database	5-year average growth rate of GDP	Negative
Relative income	IMF WEO database	Ratio of own per capita GDP to the US per capita GDP	Positive
NFA to GDP ratio	Updated Lane and Milesi-Ferretti (2012) dataset	Lagged one period	Positive
Dummy for high debt		Equals 1 if $\frac{NFA}{GDP} < -60\%$	Negative
Oil balance to GDP ratio	IMF EBA and WEO database		Positive
Fiscal balance	IMF WEO database	General government net lending/ borrowing (percent of GDP)	Positive
Reserve share	IMF WEO database	Own currency share in world reserves	Negative
Dependency ratio	World Bank WDI database	Population over 65/working-age population	Negative
Population growth	World Bank WDI database		Negative

We include reserve currency countries' share in total world reserves into our estimation. When reserve currency countries can finance CA deficits via money liabilities, reserve share has a negative effect on CA balance.

Demographic trends have life-cycle implications which influence the CA balance. Saving amount is expected to increase as the fraction of dependent population becomes larger, thereby causing a weaker CA balance. We include old-age dependency ratio and annual growth rate of the population in the empirical model.

We conduct the necessary diagnostic tests[5] to investigate the effect of credit growth on CA balance. As a result, we estimate the following empirical model with fixed effects,

$$\left(\frac{CA}{GDP}\right)_{it} = \beta_{0,i} + \beta_1\left(\frac{\Delta Credit}{GDP}\right)_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (1)$$

CA balance is the dependent variable. As explanatory variables, we use total credit growth and other variables which are explained above. Control variables are denoted as X_{it}.

To understand the role of the components of credit, we include household and business credit growth in our empirical model. The following empirical model is estimated to study the components of credit,

$$\left(\frac{CA}{GDP}\right)_{it} = \beta_{0,i} + \beta_1\left(\frac{\Delta HHC}{GDP}\right)_{it} + \beta_2\left(\frac{\Delta Business\ Cred}{GDP}\right)_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad (2)$$

In this specification, total credit growth is dropped from the estimation process.

3 Panel Estimation Results

Considering the estimation results reported in Table 3, we find that control variables have expected theoretical signs in general. Point estimates are also consistent with earlier work.

Focusing on the role of credit, our findings suggest that total credit growth has a significant and negative effect on CA balance. According to point estimates, a 10% increase in growth rate of total credit causes a decrease in CA balance by 0.57% of GDP. Since our model imposes symmetry, same amount of a decrease in the credit growth causes an improvement of 0.57% in the CA balance.

Results on total credit are in line with the previous studies[6] and empirical results on the household credit growth in Table 3 are consistent with theoretical predictions explained in Ekinci and Omay (2019). We find that if there is an increase in household credit growth by 10%, CA balance decreases by 1.93%. Similarly, CA balance is presumed to respond equally in sign and magnitude to a credit contraction. Hence, this estimate implies a symmetric improvement in the CA balance when there is a decline in the household credit growth.

[5]Using the models with total credit growth and growth rates of the components of credit stock, we conduct Breusch-Pagan Lagrange multiplier tests and Hausman tests. Our results support the fixed effects specification for both empirical models. We also include time effects which are found to be jointly significant for both models.

[6]See Atoyan et al. (2013), Ekinci et al. (2015), Ekinci and Omay (2019) and Philips et al. (2013).

Table 3 Panel estimation results dependent variable is CA balance symmetric model

	Total credit		Household and business credit	
Total credit growth	−0.060***	−0.057***		
	(0.008)	(0.008)		
Household credit growth			−0.187***	−0.193***
			(0.030)	(0.027)
Business credit growth			0.002	0.000
			(0.015)	(0.014)
Average growth		−0.593***		−0.540***
		(0.076)		(0.088)
Relative income		0.019		0.061**
		(0.021)		(0.026)
NFA (lagged)		0.015***		0.014**
		(0.004)		(0.004)
Dummy for high debt		−0.005 (0.005)		−0.001 (0.006)
Oil balance		0.567***		0.437***
		(0.059)		(0.065)
Fiscal balance		0.308***		0.370***
		(0.036)		(0.037)
Reserve share		−0.123***		−0.114**
		(0.021)		(0.023)
Dependency ratio		−0.106		−0.035
		(0.067)		(0.070)
Population growth		−1.254		−1.460***
		(0.249)		(0.271)
Number of observations	1209	1063	959	893
Number of countries	43	43	43	43
R-square	0.113	0.393	0.107	0.371
Root MSE	0.036	0.030	0.034	0.029

Note Standard errors are reported in brackets: ***p < 0.01, **p < 0.05, *p < 0.1

As noted in Table 2, the net effect of business credit growth on CA balance is uncertain. Business loans may increase CA balance by enhancing productive capacity in export sectors. However, if the imports to obtain capital and production inputs increase, overall effect might be negative. Estimation results in Table 3 shows that these effects offset each other. Our findings suggest that business loans have no significant impact on CA balance.

Overall evidence presented at Table 3 shows that credit growth (driven by household credit) has a significant and negative impact on CA balance.

4 Results from Asymmetric Empirical Models

The results using a symmetric specification show that targeted policy measures on the household loans are more effective. This finding is very important particularly for a rebalancing process.

In this section, we focus on the asymmetries observed in the effect of credit growth on CA balance. First, we construct an empirical model which accommodates asymmetric adjustments of CA balance during credit expansions and credit contractions. Next, we study the implications of an asymmetric empirical model by discriminating between periods of CA surpluses and CA deficits.

4.1 Asymmetries in Credit Growth

In order to analyze the asymmetries by separating credit expansions and credit contractions, we define dummy variable which takes the value of 1 when the total credit growth is positive.

$$\begin{aligned} D^{TCR} &\equiv 1, \quad if \left(\tfrac{\Delta Credit}{GDP}\right)_{it} \geq 0 \\ D^{TCR} &\equiv 0, \quad otherwise. \end{aligned}$$

Next, the following equation is estimated,

$$\left(\frac{CA}{GDP}\right)_{it} = \beta_{0,i} + \beta_1^{CR+} D^{TCR} \left(\frac{\Delta Credit}{GDP}\right)_{it} + \beta_1^{CR-} \left(1 - D^{TCR}\right) \left(\frac{\Delta Credit}{GDP}\right)_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (3)$$

where β_1^{CR+} is the impact of credit growth during a credit expansion. Similarly, β_1^{CR-} denotes the coefficient of total credit growth when we observe a credit contraction. Table 4 reports the results from this specification.

The symmetric empirical model suggests that a 10% increase (decrease) in credit growth causes a decline (improvement) in CA balance by 0.57%. Our model which incorporates asymmetric CA balance adjustments to the credit growth shows that the effect of credit growth on CA balance is stronger during credit expansions. Results suggest that a credit expansion by 10% causes a 0.68% decrease in the CA balance. The same amount of a decrease in the credit growth results in an improvement of 0.41 percentage points in the CA balance.

Table 4 Panel estimation results dependent variable is CA balance asymmetric effects of total credit growth

	(1)	(2)	(3)	(4)
Total credit growth	−0.060***	−0.057***		
	(0.008)	(0.008)		
Total credit growth × D ($TCG \geq 0$)			−0.065***	−0.068***
			(0.012)	(0.012)
Total credit growth × D ($TCG < 0$)			−0.051***	−0.041**
			(0.015)	(0.014)
Number of observations	1209	1063	1209	1063
Number of countries	43	43	43	43
Control variables	No	Yes	No	Yes
Country fixed effects	Yes	Yes	Yes	Yes
R-square	0.113	0.393	0.114	0.394
Root MSE	0.036	0.030	0.036	0.030

Note 1 TCG is the total credit growth

Note 2 Standard errors are reported in brackets, ***p < 0.01, **p < 0.05, *p < 0.1

In order to extend our analysis using the components of credit, we define the following dummy variable to discriminate between the observations where household credit growth is positive and negative,

$$D^{HHCR} \equiv 1, \quad if \left(\frac{\Delta HHC}{GDP}\right)_{it} \geq 0$$
$$D^{HHCR} \equiv 0, \quad otherwise.$$

Following equation is estimated to examine the role of asymmetries,

$$\left(\frac{CA}{GDP}\right)_{it} = \beta_{0,i} + \beta_1^{HHCR+} D^{HHCR} \left(\frac{\Delta HHC}{GDP}\right)_{it} + \beta_1^{HHCR-} \left(1 - D^{HHCR}\right) \left(\frac{\Delta HHC}{GDP}\right)_{it} + \beta_2 \left(\frac{\Delta Business\ Cred}{GDP}\right)_{it} + \beta_3 X_{it} + \varepsilon_{it} \tag{4}$$

In this specification, β_1^{HHCR+} is the impact of household credit growth when household credit growth is positive. Similarly, β_1^{HHCR-} is the coefficient of household credit growth when household credit growth is negative. Table 5 reports the results from this specification. Results show that business loans have no significant effect on the CA balance for both symmetric and asymmetric empirical models. In other words, our results suggest that the effect of credit developments on CA balance is driven by household credit.

Table 5 Panel estimation results dependent variable is CA balance asymmetric effects of household credit growth

	(1)	(2)	(3)	(4)
Household credit growth	−0.187***	−0.193***		
	(0.030)	(0.027)		
Business credit growth	0.002	0.000	−0.001	−0.003
	(0.015)	(0.014)	(0.015)	(0.014)
Household credit growth × D ($HHCG \geq 0$)			−0.228***	−0.240***
			(0.038)	(0.035)
Household credit growth × D ($HHCG < 0$)			−0.113***	−0.115**
			(0.053)	(0.046)
Number of observations	959	893	959	893
Number of countries	43	43	43	43
Control variables	No	Yes	No	Yes
Country fixed effects	Yes	Yes	Yes	Yes
R-square	0.107	0.371	0.110	0.374
Root MSE	0.034	0.029	0.034	0.029

*Note*1 HHCG is the household credit growth
Note 2 Standard errors are reported in brackets, ***p < 0.01, **p < 0.05, *p < 0.1

Our symmetric model suggests that a 10% increase (decrease) in household credit growth leads a decrease (improvement) in the CA balance by 1.93%. On the other hand, asymmetric empirical model indicates that effect of household credit growth on CA balance is stronger during household credit booms. A household credit expansion by 10% causes to a 2.40% decrease in CA balance. Decrease in the household credit growth by the same amount leads in an improvement of 1.15 percentage points in the CA balance.

4.2 Asymmetries in CA Balance

Another source of asymmetry considered in this framework is the level of CA balance. This asymmetry is accommodated via use of a dummy variable which conditions on the level of CA balance,

$$D^{CA} \equiv 1, \quad if \left(\frac{\Delta CA}{GDP}\right)_{it} \geq 0$$
$$D^{CA} \equiv 0, \quad otherwise.$$

D^{CA} takes the value of zero during an episode of CA deficit, and it is equal to 1 when there is a CA surplus. To make an assessment of asymmetric adjustments of CA balance to changes in total credit growth, following equation is estimated,

$$\left(\frac{CA}{GDP}\right)_{it} = \beta_{0,i} + \beta_1^{CA+} D^{CA} \left(\frac{\Delta Credit}{GDP}\right)_{it} + \beta_1^{CA-} (1 - D^{CA}) \left(\frac{\Delta Credit}{GDP}\right)_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (5)$$

In this case, β_1^{CA+} is the impact of total credit growth when there is a CA surplus. Similarly, β_1^{CA-} is the coefficient of total credit growth when we observe a CA deficit. Table 6 reports the estimation results. Compared to symmetric empirical model, we observe a substantial divergence between the estimates obtained for CA surplus and CA deficit episodes. A 10% point credit growth increase causes a 0.27% decrease in CA balance when there is a CA surplus. Same amount of credit growth increase leads to a 1.30% deterioration during a CA deficit.

Next, following equation is estimated to make an assessment of asymmetries in household credit growth,

$$\left(\frac{CA}{GDP}\right)_{it} = \beta_{0,i} + \beta_1^{CA+} D^{CA} \left(\frac{\Delta HHC}{GDP}\right)_{it} + \beta_1^{CA-} (1 - D^{CA}) \left(\frac{\Delta HHC}{GDP}\right)_{it} + \beta_2 \left(\frac{\Delta Business\ Cred}{GDP}\right)_{it} + \beta_3 X_{it} + \varepsilon_{it} \quad (6)$$

Table 6 Panel estimation results dependent variable is CA balance impact of total credit growth conditional on CA balance

	(1)	(2)	(3)	(4)
Total credit growth	−0.060***	−0.057***		
	(0.008)	(0.008)		
Total credit growth × D($CA \geq 0$)			−0.012	−0.027***
			(0.009)	(0.009)
Total credit growth × D($CA < 0$)			−0.155***	−0.130**
			(0.012)	(0.012)
Number of observations	1209	1063	1209	1063
Number of countries	43	43	43	43
Control variables	No	Yes	No	Yes
Country fixed effects	Yes	Yes	Yes	Yes
R-square	0.113	0.393	0.198	0.435
Root MSE	0.036	0.030	0.035	0.029

Note 1 Standard errors are reported in brackets, ***p < 0.01, **p < 0.05, *p < 0.1

Table 7 Panel estimation results dependent variable is CA balance impact of total credit growth conditional on CA balance

	(1)	(2)	(3)	(4)
Household credit growth	−0.187***	−0.193***		
	(0.030)	(0.027)		
Business credit growth	0.002	0.000	−0.003	−0.006
	(0.015)	(0.014)	(0.014)	(0.014)
Household credit growth × D ($CA \geq 0$)			−0.069**	−0.121***
			(0.033)	(0.031)
Household credit growth × D ($CA < 0$)			−0.303***	−0.270**
			(0.034)	(0.032)
Number of observations	959	893	959	893
Number of countries	43	43	43	43
Control variables	No	Yes	No	Yes
Country fixed effects	Yes	Yes	Yes	Yes
R-square	0.107	0.371	0.149	0.386
Root MSE	0.034	0.029	0.033	0.029

Note 1 Standard errors are reported in brackets, ***p < 0.01, **p < 0.05, *p < 0.1

where β_1^{CA+} is the impact of household credit growth when there is a CA surplus and β_1^{CA-} is the coefficient of household credit growth when we observe a CA deficit. Results from this specification is reported at Table 7. Our results from the asymmetric model shows that a 10% household credit growth increase causes a 2.7% decrease in CA balance during a CA deficit. Similar amount of household credit growth increase causes a CA balance decrease by 1.21% when there is a CA surplus.

Results from estimating asymmetric empirical models indicate that credit growth has a larger negative impact on CA balance particularly in periods of positive credit growth and during the CA deficit episodes.

5 Conclusion

The effect of credit developments on the CA balance has been at the center of policy debates especially after the global economic crisis. Recent literature presents evidence which shows that credit growth increase leads to a significantly weaker CA balance. However, effects of a credit expansion and credit contraction are assumed to have the same magnitude. Similarly, periods of CA surpluses and CA deficits have been presumed to have the same dynamics. This study investigates the

asymmetric effects of credit growth on CA balance considering these two dimensions.

First, we report the negative and significant impact of credit growth on CA balance using a symmetric empirical model following Ekinci and Omay (2019). Our results show that business loan growth has no effect, and negative effect of credit growth on CA balance is driven by household credit. Next, we construct an empirical CA model that accommodates asymmetric adjustments of CA balance to the changes in the credit growth. Our results indicate that credit growth has a larger negative impact on the CA particularly in periods of positive credit growth. Furthermore, we observe a substantial divergence between the estimates obtained for CA surplus and CA deficit episodes. The negative effects of total and household credit growth on CA balance are more pronounced during CA deficit episodes.

These results show that assessments of external imbalances should account for asymmetric effects of credit developments on CA balance. Compared to the estimates obtained from symmetric empirical model, the magnitude of the negative effect of credit growth on CA balance is larger particularly during credit expansion episodes and CA deficit periods.

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What Drives the Banking Performance? Case of Eurasian Economic Union Countries

Alimshan Faizulayev and Isah Wada

Abstract The aim of this study is empirically evaluate the determinants of financial performance of banks in new classification of transition countries—Eurasian Economic Union. We used bank specific variables to see the impacts on profitability of banks in the above mentioned countries. GLS approach employed to do the empirical analysis for the period of 2011–2017. The result showed that there is profitability persistency in the banking market. Risk management, such as, liquidity and credit risk significantly explain the performance of the banks. Many approaches that can be taken by governments, managers and practitioners to improve banking sector in these countries.

Keywords Market structure · Bank performance · Eurasia

1 Introduction

For three decades old Soviet system countries have tried to convert into market based economy system. In market based system for transition countries, the promotion of economic growth depends on bank based financial system (Belousova et al. 2018). In order to stimulate the economy of any specific country the government does this via banking system by using "Monetary Tools". Moreover, all of the finance and business transactions that we are being involved in are done through the banks. Therefore, it is very crucial to evaluate the financial performance of banks in Eurasian Economic Union Countries.

There many studies conducted empirical analysis on banking by focusing on the transition of countries of Central and Eastern Europe (CEE) (Fries and Taci 2005;

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Kenjegalieva and Simper 2011), and very few studies focusing on Post-Soviet countries (Djalilov and Piesse 2012, 2016; Schobert 2006). Up to our knowledge, there is no studies performed on banking in Eurasian Economic Union (EAEU), it is a new classification of late transition of countries.

In the existing literature, researchers used internal and external variables to evaluate profitability of banks for different countries and periods. Internal factors are linked to bank specific variables such as: capital adequacy, asset quality, management efficiency, liquidity management and size. On the other side, external factors are macroeconomic variables such as: GDP growth, inflation, exchange rate, real interest rate, money supply and so on. Examples of studies that examined financial performance of banks on country and cross country levels are: Djalilov and Piesse (2016), Shaista Wasiuzzaman (2017), Muda et al. (2013), Hassan and Bashir (2005), Pasiouras and Kosmidou (2007), Demirguc-Kunt and Huizinga (2000), Gul et al. (2011), Faizulayev and Bektas (2018), Hirsch and Gschwandtner (2013), Athanasoglou et al. (2008) and Goddard and Wilson (1996).

Studies related to internal determinants of financial performance in Islamic and conventional banks employ variables such as capital adequacy, bank size, expense management and risk management. The size plays significant role in determining the financial performance of banks as it takes into consideration economies and diseconomies of scales (Djalilov and Piesse 2016). In accordance with existing literature, the effect of size on profitability is not obvious. Because some evidence show that there is positive relationship between profitability and size (Smirlock and Yawitz 1985). Risk management, as a buffer against risk, plays a crucial role in banking industry. As stated by Athansoglou et al. (2008), poor asset quality and low levels of liquidity are among the major risks that financial institutions face consistently, especially during global financial crises. As the asymmetry of information increases in the financial markets, financial institutions may decide to diversify their assets and increase liquidity in order to reduce their risk exposure (Faizulayev et al. 2018). Managerial efficiency is an important aspect of the banking sector, as it affects the profitability of banks. For instance, there is a positive significant relationship between higher management quality and bank profits (Dietrich and Wanzenried 2014).

2 Data and Methodology

The panel data is used to conduct the empirical analysis on the determinants of profitability and competition level for IBs and CBs. Cross-country bank-level and macroeconomic data have been collected from Orbis Bank Focus Database, banks' websites, World Bank and the central bank's databases of the selected countries over the period 2011–2017 in Eurasian Economic Union (EAEU). We considered after global financial crisis period by taking 661 financial institutions into our

empirical analysis. The main purpose of this study is to evaluate financial performance in new transition countries by using bank specific variables. EAEU has the following countries: Armenia, Belarus, Kazakhstan, Kyrgyzstan, and Russia.

Panel root test have been employed to the variables, in order to test the data whether data is stationary or not. According to methodologies developed by Levin, Lin and Chu (LLC) the data reject the null hypothesis, that is to say the unit root does not exist in our whole model or the data is stationary. Likewise, if data was not stationary then Level Equation and ECM by using ARDL method, Bound Test and Ganger Causality test would be applied, in order to find out whether there is or not long run relationship between the variables. Furthermore, the presence of multi-collinearity in our regression model is tested. According to correlation between independent variables are very low in model, R square are very low which proves the absence of multicollinearity, correlation table is represented in Table 1. For validity of absence multicollinearity, we used VIF estimation which is provided in Table 2. And model has been corrected for heteroskedasticity.

In this comparative study ordinary regression equation is employed to measure and evaluate the difference in financial performance of banks. We conduct regression analysis by using Stata software program to estimate our equation. In accordance with Hausman test which is done in panel data regression analysis as well, the "Random Effects" model has been used because our sample data does not represent whole population. Furthermore, dependent variable used in this linear least squares NIM. Other variables are considered as independent ones and demonstrated below in the models:

$$\begin{aligned} \mathrm{NIM} = {} & \alpha 3 + \beta 1(\mathrm{PLLTL}) + \beta 2(\mathrm{TETA}) + \beta 3(\mathrm{LTA}) + \beta 4(\mathrm{CII}) + \beta 5(\mathrm{LIQQ}) \\ & + \beta 6(\mathrm{LOANS312M}) + \beta 7(\mathrm{LOANS5Y}) + \beta 8(\mathrm{TIMEDUMMY}) + \varepsilon \end{aligned}$$

where:

NIMbt	represents the Net Interest Margin,
$\alpha 1$	represents alpha (constant) for each model respectively,
β	represents the coefficients of the regression equation,
CII	represents the Cost to Revenue,
TETA	represents Total Equity to Total Asset,
PLLTL	represents Provision of Loan Losses over Total Loans,
LTA	represent the logarithmic of Total Assets,
LIQQ	represents Liquid Assets to Deposits,
LOANS312M	represent loan with shorter maturity from 3 to 12 months
LOANS5Y	represents loans with 5 and more years maturity
TIMEDUMMY	represents dummy variable that captures time effect
E	represents error term.

Table 1 Correlation analysis

	NIM	PLLTL	CAP	LTA	CII	LIQQ	LOA ~ 312M	LOANS5Y
NIM	1							
PLLTL	0.1307	1.0000						
CAP	0.3971	0.0585	1.0000					
LTA	−0.4291	−0.1671	−0.4509	1.0000				
CII	−0.0298	0.0745	0.0527	−0.2630	1.0000			
LIQQ	0.1968	0.3222	0.4956	−0.3027	0.0558	1.0000		
LOANS312M	−0.0644	−0.0591	−0.0768	0.3637	−0.0606	−0.0703	1.0000	
LOANS5Y	−0.0512	−0.0391	−0.0533	0.2911	−0.0462	−0.0543	0.8755	1.0000

Table 2 VIF estimation

Variable	VIF	1/VIF
LOANS312M	4.55	0.219737
LOANS5Y	4.30	0.232525
LTA	1.60	0.624140
CAP	1.59	0.628501
LIQQ	1.50	0.666192
PLLTL	1.15	0.866142
CII	1.08	0.922434
Mean VIF	**2.25**	

3 Empirical Results

According to results which is given in Table 3, we can see that PLLTL affects positively profitability of banks in EAEU regions, and it is statistically significant. After global financial crisis when banks get recovered, as they provide the loans to customers who are less creditworthy, they provide the loans with higher interest rate of charge that in return brings more profit. Capital adequacy affects positively net interest margin and it is statistically significant. Well-capitalized banks have a lower probability of entering into bankruptcy henceforth, obtain low-cost funds that increase profitability. This result is in line with Kosmidou (2008) and Faizulayev et al. (2018). Size negatively affects the profitability of banks across these regions. A possible explanation for this result is that all banks are not benefiting from economies of scale. Not surprisingly, cost to income affects negatively the financial

Table 3 Empirical results

NIM	Coef.	Prob values		
PLLTL	0.041	0.035		
CAP	0.030	0.001		
LTA	−2.071	0.001		
CII	−0.007	0.003		
LIQQ	0.006	0.192		
LOANS312M	0.001	0.167		
LOANS5Y	0.004	0.250	F stat	7.070
			F prob	0.000
Years			R sqr	0.606
2012	0.4	0.050		
2013	−0.3	0.322		
2014	−0.3	0.204		
2015	−1.0	0.001		
2016	−0.4	0.144		
2017	−0.1	0.846		
_cons	0.8	0.000		

performance of banks and it is highly significant. Liquidity management does not affect the profitability in this regions. Changing the maturity of loans does not impact the financial performance of banks. After recovery period we can see that financial performance of banks get improved and in 2015 it is diminishing due to the foreign exchange crisis that took the place that period in these countries. To check the validity of the model we use F probability value, where we can say that the whole model is best fitted.

4 Conclusion

EAEU regions plays significant role in among the transition countries, as it will create efficiency and effectiveness in trading goods and services, as it happened in Europe. The main purpose was to evaluate the profitability determinants of banks in the above mentioned countries. These EAEU has been established in 2011, after global financial crisis. Crisis consequences motivated transition countries more to work on union issues.

In accordance with empirical results, we can see that there are variables that are not important in determining the profitability of these banks, such as: liquidity, short and long term loans and some time-dummy variables. After global financial crisis, banks started to get better, but currency exchange crisis took the place between 2013 and 2015, where the financial performance of banks deteriorated. Banks in this regions should pay attention to credit risk management and capital adequacy. They should not expand their business with the hope to benefit from economies of scale.

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Education Matters for the Bottom of the Pyramid in Economic Development

Amna Khaliq

Abstract The research article is addressed around the education initiatives undertaken by the local non-profit sectors for the poor and marginalized population in Pakistan. The research also focuses on education initiatives and constraints faced by poor students, untrained teachers, and non-profit organizations. Child labor, family relocation, poor health and sanitation practices, and poor leadership are among the many hurdles. It is a world of actions, reactions and it continues to cycle. Decisions to attend school are not a choice, but a necessity for poor students. It is observed that children are confident, friendly, and have a burning desire for a better standard of living. Overall, the children are learning in both philanthropic and self-help approach, but learning levels are not meeting the goals set by the Higher Education Commission in Pakistan. To bring a paradigm shift in the system, parent-teacher meetings, and training teachers on elite-oriented curricula, English-spoken classes, giving financial incentives to both students and their parents can work as an incentive to motivate learning and overall economic development of Pakistan. The future of a nation is only bright when people are considered an asset.

Keywords Education · Economic development · The bottom of the pyramid · Pakistan · Poverty · Education innovation · Educational policy · Poor and marginalized population · Constraints · Education outcomes

1 Importance of Education for the Bottom of the Pyramid

Bottom of the pyramid (BOP) is a socio-economic concept that deals with the world's poorest citizens, roughly 4 billion people (The World Bank 2015). It is an unserved market block with the high barriers that prevent them from exploring their full potential and human capital. It is the largest segment. 2.7 billion People live

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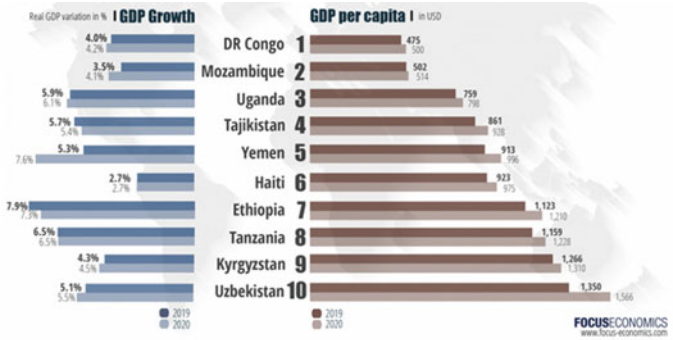

Fig. 1 The worlds' poorest countries (Focus in Economics 2018)

under the international line of poverty $1.90 every day (The World Bank 2015). In 2005, it was $1.25; however, the real value of $1.90 is the same as $1.25 for an international line of poverty (The World Bank 2015). The line of poverty is the cost of basic food, clothing and shelter around the globe. Here are the ten poorest countries around the globe (Fig. 1).

Many causes of poverty could be lack of education, inequality in the system, wars, lack of infrastructure, limited authority of government, high corruption, injustice, no access of jobs, overpopulation, high divorce rate, epidemic diseases (HIV, AIDS, Malaria), environmental problems, weather factors (drought, heavy rainfall, flooding) etc.

Education is the most important tool to bring out a nation from a poor state. Today, it is a privilege and an asset. Education includes both formal and informal learning, and it is transferable from generation to generation. Education brings structural change within the system. For a person, it is the human capital. You can learn, relearn, but unlearn. For a country, it is a transformation and empowerment. For BOP to survive, to lessen the Rich-Poor gap, and minimize the digital divide, education is an important social, cultural and economical aspect. Sadly, many BOP countries are illiterate where people live in a rural area with less access and poor quality of resources, and educational institutes (school, university, technical college).

Redneck technology is another avenue that BOP attempts to survive within their limited resources. It is a legitimate attempt to make their lives easier with what they have available. It involves creativity, thinking out of box and strategy. Moreover, multi-billion dollar corporates are also focused on the BOP sector to build new markets. They are engaged in activities to understand what these markets need, and how these needs can be fulfilled in less amount. BOP market leader, Unilever, generates more than half of its sales from developing countries (Mahajan 2016). Unilever business strategy is to spread self-awareness, market development, product design, communication, distribution and empower women (Mahajan 2016). The products and services used by BOP are social-responsible, cheap and

innovative. Other social programs are microfinance, academic/doctors without borders, and farmers' assistance programs to make the livelihoods better for BOP.

1.1 Islamic Republic of Pakistan

The information in this paragraph is taken from CIA World Factbook, 2019. Islamic Republic of Pakistan borders with India on east, Iran and Afghanistan on the west and China in the north (2019). It has more than 207 million population where Islam is the dominant religion (96.4%) and Punjabi ethnic group 44%. 38% of its population is between the ages of 25–54 years with 1.41% growth rate. Male and female life expectancy at birth is 66 and 70 years respectively. 2.8% is spent on education from GDP and 57% population is literate (male: 69% and female 45%). 6% is the unemployment rate where 29.5% of the population lives below the poverty line (CIA World Factbook 2019). Pakistan is expected to rank at number 12 in GDP per Capita in 2019 (Focus Economics 2018).

The information in this paragraph is taken from Zaidi, 2014. Furthermore, Pakistan is the world's 26th largest economy with the 7th largest standing force. It has the fourth most intelligent people with the seventh largest collection of scientists and engineers. It has the world's second largest peak K-2, Trango Towers—rooftop of the world, with Biafo Glacier—the world's longest glacial system outside the Polar Regions. It has the world's largest salt mine and the world's largest railway station system and human made forest. Edhi Foundation is Pakistan's largest non-profit social welfare program that has the world's largest ambulance network in Pakistan (Zaidi 2014) (Fig. 2).

1.2 Economic Development

Economic Development comes under the economic, political and social system's umbrella for the wellbeing of citizens. Richer are getting rich, and poor are getting poorer perhaps the result of a top-down approach. Economic development is a bottom-up approach where business development, geographic region and institutional building at the community level are important. Globalization, governments, and education play a huge role. It is an inclusive approach to all members of various poor communities where strong inequalities exist among social problems. Part of the problem is globalization and the fast-paced technological advancement where it has many advantages. It does come at a cost. Globalization is an economic tsunami (Collins 2015). Liability of foreignness, job losses to other countries, brain drain, high barrier entry, culture pollution, unfair working conditions, tax heavens and exploitation of labor (Collins 2015). Social welfare or safety nets are under great pressure because of globalization and job loss (Collins 2015). Instead, leveraging on job creation (small business, neighborhood, workforce, and real-estate

Fig. 2 Map of Pakistan (CIA World Factbook 2019)

development and technological transformation), high quality of education, government role, and culture aspect should be used for shared goals. Economic development works to bridge the gap between the poor and the rich. Economic development forces companies to invest in corporate social responsibility. In economic development, both individual (community) and social (community) are inter-related. Making and implementing the right set of policies also affects community economic development. The bottom line of economic development is made communities self-sufficient within their resources, so that they accomplish social missions. Leadership and education in economic development are very crucial to create special economic districts around the world.

1.3 Role of Economic Development in Education

One of the most important economic development goals is to increase the literacy rate and to decrease the poverty rate. Health and education are closely interlinked in economic growth. Economic development programs are not rigid, but flexible. It is

a process that does not have an end state. Countries will evolve with time and bring positive results in long-term with a new trade, approaches, styles and techniques. Economic development is not possible without change. Change is a natural occurrence as the future is constantly coming. Change is not possible without growth. And growth in only possible if humans learn. Education is number four sustainable development goal under United Nations target goals (United Nations 2019). By 2030, some of UN Sustainable Development goals are: all girls and boys free primary and secondary education, all women and men affordable technical, vocational and tertiary education, and eliminate gender disparities in education and equal access (United Nations 2019).

2 Research Question

For this research document, the question is raised about the economic development with the efforts of non-profit organizations and individual community member's to increase the number of resources to attain education and reduce literacy rate for the marginal people of the society, especially child labor in Pakistan. Also, the research focuses on education initiatives and constraints faced by poor students, untrained teachers and non-profit organizations. It also finds solutions to increase the interest of child labor to attain education rather working and earning wages. The research document explores the relationship between access of education by child labor, their families' influence while the contributions from the non-profit organizations and community members.

3 Critical Literature Review

Napoleon quote, "Give me an educated mother, I shall promise you the birth of a civilized, education nation." Education is an ongoing process. It is a world of actions, reactions and its continue to cycle. Decisions to attend school is not a choice, but a necessity for poor students.

3.1 Pakistan Education System

Unfortunately, Pakistan education system is not according to the constitution of Pakistan 1973. It has both public and private education system with private and public schools, vocational and university training. However, the private system is better in quality. There is a huge gap that can be observed between the critical thinking of both institutes' students, their confidence level and behavior. It is

already creating a system of injustice in Pakistan. There needs to be a uniform, equal access to education for all including child labor.

After grade 12, Higher Education Commission (HEC) grants public funds from the government to universities. Colleges are funded and regulated by the provincial government. Research is mostly conducted in public universities; however, the admission and research work is on rising in private universities. Higher education refers to education above grade 12 in Pakistan. The Government of Pakistan had a clear commitment to improving higher education and revised it in early 2002. Since then, the education system has made some progress; however, the quality of education is not the same everywhere as not many teachers are trained. If the teachers are of high quality, the products (students) will be of good quality that will impact positively on our economic development (Khan 2015). Instead of putting teachers training on priority and urgent basis, society considers the teaching profession as a low paid job which creates more problems to attract future teachers. Teachers are the agent of change (Khan 2015). Their salary should be revised, and they should be encouraged to attend training workshops, seminars and conferences. Khan (2015) continued stating that the elementary education system is even worse in Pakistan. The media showed a completely different picture of what has happened in the school system. Media propaganda the new system as a reform, but it was not. Many of the reasons of the poor education system are overcrowding classrooms, focus on memorization as compared to critical thinking, poor methods and matter, poor management and leadership and no research culture (Khan 2015). The face of Pakistan elementary education system needs to be changed where only rich people are on the advantage at present.

3.2 NGO Efforts in Pakistan

Child labor, family relocation, corruption, poor health and sanitation practices, and poor leadership are among the many hurdles for a high quality of education for all. Pakistan has a large number of non-profit organizations who are providing education with a little or no cost at all to the poor, child labor. Many of these non-profit education-based organizations started on their own to help their communities. Many community members also contribute to increasing education awareness in their surroundings. Overall the children are learning in both philanthropic and self-help approach, but learning levels are not meeting the goals set by the Higher Education Commission in Pakistan. The concern is if these many education NGOs are running, why there is not a change in the system yet? Why don't we see literate street kids? Where is the money going when the NGOs are supported by international institutions? Sadly, there is corruption involved in the system to educate street kids.

4 Research Design Methods

The primary data is collected by running a workshop at one of the local Zindagi Trust schools in Lahore, Pakistan. After the workshop, the unstructured interview was taken place with students, teachers and staff members from Zindagi Trust Organization. This primary data is then compared to secondary data to get to the root cause of low level of education even though non-profit sectors has taken many initiatives for the poor and marginalized population in Pakistan. For this reason, information from the secondary research and the data from the first-hand qualitative research is collected. Secondary qualitative data is only used to have a comparison. The research question will be answered by content analysis of both primary and secondary qualitative data (Fig. 3).

4.1 Primary Data Results

In December 2018, I had a chance to run a seminar with a school of Zindagi Trust Organization located near to Rangers Headquarter on Ring Road in Lahore. The organization has 7–12 actively running campus in Lahore (Zindagi Trust Organization 2019). I was particularly interested in Zindagi Trust as the organization was successful in reforming two government schools in Karachi where lower middle-class students are given education. They have a paid to learn program that only runs in Lahore now. According to this program, the students are given 1000 rupees based on their 80% or more attendance after the completion of the program [grade 1–5] in 2 years (Zindagi Trust Organization 2019). Students spend four months in one class. They are also given admission, stationary and clothes for their grade 6 admission in a local neighborhood school. From the local school,

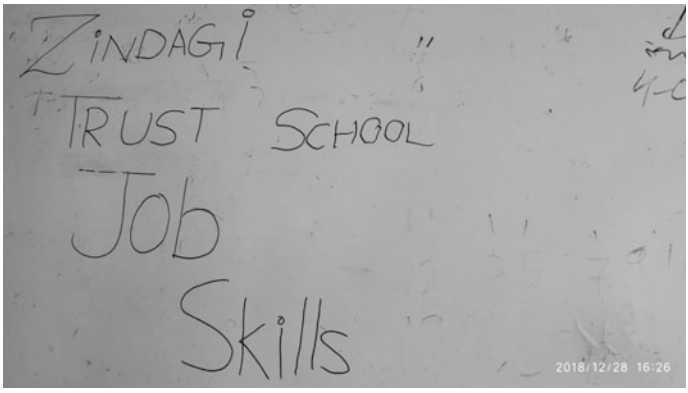

Fig. 3 Zindagi Trust school job skills program

Fig. 4 Students are learning at Zindagi Trust Organization School

students pass grade 10 and continue their education goal. The program is mainly run by local and international donors which have impacted the masses (Fig. 4).

Teachers are high school, bachelor or master graduates. They are a volunteer or earn a very small salary. They teach math, English, Urdu, and arts. They understand that students come from diverse backgrounds with a high financial burden on their shoulders. Almost all students are working at home or on the streets. Students have Iqbal day activities, Eid parties, and Christmas events. Recently, they had a trip with students where they were taught the value of plants and greenery. The program runs under the supervision of a Regional Academic Coordinator who reports to Karachi's Headquarter. From time to time, they do get volunteers who teach students about water value, skills, cleanliness, etc. Most of the workers are working at the organization for the past 3–4 years. They said it is a very respectful working environment, and the author seconds the statement. The staff members were supportive and kind towards each other and their students (Fig. 5).

A team of Zindagi Trust mentioned that the students drop rate is high in this Paid to Learn Program because families move from one location to another. A lot of smart students have to move to another location, so they are not able to continue their education. Teachers told me that sometimes students would correct them in the class, or remind them of a new idea. Teachers said that they also learn from their respective students. They never punish students. If they have to discipline them, they ask students to stand on their seat. They also focus on the interaction between males and females as this is what they will do in the real world. Teachers are not given any formal job training; however, volunteer trainers come to the organization and provide teachers training from time to time. Every morning they have an

Fig. 5 Students are learning from their teacher at Zindagi Trust Organization school

assembly and a roll call is taken in the classes. Students are coming from different religions, so the organization does not force any religious doctrine.

During my time at the organization, I observed that students were coming from very poor backgrounds. They don't have basic water or electricity access in their homes. When I asked about their dreams. The girls wanted to open up a beauty parlor, study further or work in government. Boys wanted to become a car mechanic, doctor or tailor. They told me that when they go home; they will do their work to earn some money. They were happy kids. They didn't complain about why they were poor. They had a sense of maturity where they understood they were poor, but they didn't complain about it instead they believe in taking actions They were content, but wanted to continue to work harder to come out of poverty. I noticed that students were helping each other. They didn't have any competition between them (Fig. 6).

Overall, children were confident, friendly and had a burning desire for a better standard of living. They were well-behaved, kind and smiling. They were supportive of each other. When a student is not able to answer the question, they raised their hands with enthusiasm to answer the same question or helped the student. Even though they were from different classes (1–5) they all looked like one big group to me. They were energetic and wanted to do something for their families. They were internally motivated and didn't care about running water or electricity. They were very clear that attaining education will help them to survive in their

Fig. 6 Students at Zindagi Trust Lahore branch with the author

future, or otherwise, they would be like their parents struggling financially for the rest of their lives. They didn't come to school because it was something asked or required from them. They came to school because they genuinely wanted to get an education. Getting education was their only way out of poverty. At this young age, they were mentally mature. They already knew the great value of education. For them, the education provided to them, their teachers and the school was of high quality, not low. They didn't complain about electricity blackouts or the poor condition of the school. For them, it was a fresh breath of air after all the labor work.

5 Primary and Secondary Data Analysis

The information in this paragraph is taken from Hasan article 'Taking school to the street children', 2016. In Karachi, a school is in running under the Bahria Icon Tower Flyover where 15–20 children are taught how to read and write every day. The kids have a different level of education and age background, so they are given individual attention from teachers. These teachers are volunteers who have worked as teachers or have a high school education. They also teach them manners such as thank you, please and sorry. Some of these students are homeless or need more than education. So, they are given Rs. Fifty per day to learn their lessons with fruits and snacks. Since they are teaching on the road, they had to be registered as an NGO named, Ocean Welfare Organization (Hasan 2016) (Fig. 7).

Fig. 7 Taking school to the street children by Ocean Welfare Organization (Hasan 2016)

The information in this paragraph is taken from Salman Yousufzai, article 'Vanity project or haven? A look at PTI's street children campaign', 2016. Another interesting initiative by The Government of KPK is to build a place, Zamong Kor, where street children are given shelter, food, and clothing. They are given classes and sports lessons. More than 1000 children are living in the compound. It is by the existing KP Child Protection Act 2010 and Welfare Commission (KPCWC) for sustainable and healthy child protection system in the province. UNICEF helped to establish the child protection Act in Pakistan. Their mission is to change children from street children to state children. These children come from abusive and divorced families, welfare houses, are mentally sick or homeless (Yousufzai 2016) (Fig. 8).

The information in this paragraph is taken from Yusra Salim's article, 'Bringing education to the streets of Karachi', in 2016. Salim (2016) mentioned Shireen and Hassan (both siblings) who teach English, Math and Urdu to the street and disabled kids. Shireen asked her brother Hassan to help her in this cause. They both believe that if kids cannot afford to come to school, we can bring the school to them. Shireen stated that children are committed and are given Rs. 20 from her pocket if they have memorized the course material. The siblings are teaching kids every day for 85 min. Some of their students sell crackers on the streets and then come to their school. After the school hour, kids go back to selling the crackers (Salim 2016) (Fig. 9).

Examples mentioned above clearly show that individuals are doing their part with the help of NGOs to make the country educated and developed economically. However, there is a lot more need to be done. The individuals are not aware of the rules and regulations. The Government of Pakistan needs to run campaigns as

Fig. 8 Vanity project or haven? A look at PTI's street children campaign (Yousufzai 2016)

Fig. 9 Shireen and Hassan teach street children (Salim 2016)

individuals or NGOs are interested in teaching, but there is nothing that shows them the correct path. For example, they had to file as an NGO because they were teaching kids on the street. They came to know about this on the spot when the government officials came to close their setup on the road. They are helping their selves from their own pocket money. Also, there is not much awareness and information regarding educating kids or training teachers. Sadly, they have many ideas but no resources. Certainly, these individuals and many more like them, need

encouragement and support to broaden the impact of their initiatives. On the other hand, NGOs like, Zindagi Trust, are trying their best to provide the free of cost education, but they don't have the proper system of enrolling and retaining students. Students' families' decisions are crucial for retaining students. The families have to understand the educational value and its importance in the lives of their children. Given a conservative society where a large number of people are illustrated, it is hard to bring a paradigm shift in the mindsets. Their focus is survival. When survival is required education is taken as a luxury. No wonder, education is a privilege. Also, when things are given for free people do not value them as much as they normally would. Teachers are not given much training with lesson preparation and class execution. They are working with little or no experience. They are trained on the job if they are lucky. Having said this, NGOs are trying to provide free of cost education, but this education system is not very high quality and does not cover high classes material. It is mostly used to make students read, write and do basic math. However, any source of providing education is helpful in the long run for a country to flourish.

6 Conclusion

To conclude, this research paper believes that education is a must for all for the economic development of a person and a nation. It is the main reason behind any country success or failure. Bottom of the pyramid is the largest section of people, and that is why our focus should be on a practical solution to increase the interest and access of education among them. These child labor should be considered as equally valuable as higher social status students. The government should focus on teachers training as they are the main force behind student success or failure in life. They are the ones who can make or break a student's life. The paper tried to see the reasons behind the gap that existed between the child labor, education level and the efforts of NGOs and individuals in Pakistan. It also focused on the many constraints and hurdles faced by students, teachers, staff members and the overall education sector in Pakistan.

6.1 Recommendations

To bring a paradigm shift in the system, volunteering should be made mandatory among students, government employees and job seekers. Volunteer work helps to learn both soft and hard skills. Here are some more recommendations: first of all, the parents should be equally involved in their kid education. I understand that parents are more focused on meeting the ends; however, if they are involved, they will slowly realize the positive changes in their kids. It could be manners, solving a math problem or a high confidence level. That is why a parent-teacher meeting

should be held once in 3 months to make parents understand their child education development. Parents need to understand how important education is. So, if they need to relocate to another city they can find an NGO or a volunteer to teach their child. The process of learning should not be stopped just because they moved to another city. Secondly, teachers should be trained in elite-oriented curricula. No formal training was given to teachers. They need to understand that speaking English is a requirement of today. Teachers should be trained with the proper instruments and should not feel ashamed to learn something new. Proper teacher training is a must with a high-quality curriculum. Thirdly, giving financial incentives to both students and their parents can work as an incentive to motivate learning and overall economic development of Pakistan. Financial incentives may not be considered as the main motivation factor; however, it is the main reason behind every action in a developing country. When parents are receiving money; they are less likely to stop their kids to attend schools. Receiving education is a luxury when food, cloth and shelter are needed to survive. Fundraising, government grants and foreign financial support can play a major role in this. The future of a nation is only bright when people are considered an asset.

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The Behaviour of the Financing Decision of the Russian Listed Companies

Bezhan Rustamov

Abstract This study investigates the presence of the market timing theory in the case of Russian firms for the periods of 1992–2013 and 2003–2013 using the two-step system GMM panel estimators (Arellano and Bover in J Econ 68:29–51, 1995; Blundell and Bond in Econ Rev 19:321–340, 1998) and the Fama and MacBeth two-step procedure (Fama and MacBeth in J Polit Econ, 607–636, 1973). The main aim of the study is to observe the effect of the market timing on the capital structure by controlling the key determinants of firms' financing decision. The two-step system GMM results imply that the calculated historical market to book measure has a negative coefficient and it indicates the presence of the market timing on capital structure. The persistence effect of market timing is confirmed by employing the Fama and MacBeth two-step procedure (Fama and MacBeth in J Polit Econ, 607–636, 1973). The result of the test reveals that even in 10 years the 55% persistency of the initial effect of the market timing on the capital structure for the matured listed Russian firms is observed.

Keywords Capital structure · Market timing · GMM · Tax

1 Introduction

The Russian Federation (hereafter, Russia) has been in the transitional phase of planned economy to market economy since 1991. In this transition period, firms shifted from government-controlled entities to increasingly being privatized. The privatization process allowed firms to obtain liberalization (Chen 2009) and decide

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on the financing decision of the firm at individual basis (Sutela 1998). The development of the stock market has provided to firms alternative source of funding through issuing stocks compare to the internal debt market. In 1991 the market capitalization of domestic listed companies were only 244 million USD, which has increased to 877 billion USD in 2012. The increase of the market capitalization is not the result of a one-year stock issuance, and it may suggest that Russian firms issue the stock based on the past market valuation (market timing).

Equity market timing is one of the practices determining the firms' financial decision on capital structure. It contemplates that firms with low (high) leverage at current time had higher (lower) share prices in the past. According to the market timing theory (Baker and Wurgler 2002), capital structure is based on aggregated effects of past attempts to capture the equity market valuation. This practice contradicts to the efficient market hypothesis (Taggart 1977), but the empirical evidences show that equity market timing of capital structure is a considerable practice in the corporate finance (Baker and Wurgle 2002; Welch 2004; Alti 2006; Virk 2014; Vallandro et al. 2015). Baker and Wurgler (2002) have supported the proposed market timing theory by the empirical study as well. Their main finding is the persistent effect of the market valuation on capital structure of the U.S. firms for at least ten years. This outcome is unobservable in other theories (trade-off, pecking-order) of capital structure.

Researchers observed the impact of high and low market valuation to issue and repurchase shares even prior to the theoretical and empirical proposition of Baker and Wurgler (2002). They found that firms intend to issue the stocks at the time of high market valuation (Taggart 1977; Korajczyk et al. 1991; Loughran et al. 1994), and in the contrary case they repurchase shares (Ikenberry et al. 1995).

Following the seminal work of Baker and Wurgler (2002), market timing has attracted attention of many researchers. Especially, for the last decade researchers have investigated the presence of persistent effect of the market valuation in the firms' capital structure of developed (Leary and Roberts 2005; Alti 2006; Mahajan and Tartaroglu 2008; Bruinshoofd and De Haan 2011) and developing countries (Virk 2014; Vallandro et al. 2015). Findings are not consistent across countries. Although, there is support for market timing and its persistent effect (Huang and Ritter 2005), however others found short effect (Alti 2006; Kayhan and Titman 2007), and even no effect (Hogfeldt and Oborenko 2005) on firms' capital structure.

Despite of these many empirical studies, investigation on the persistent market timing of capital structure in the case of Russian firms has been ignored. This ignorance is surprising because there are several reasons that make Russian firms an important case to be investigated.

This study makes several main contributions to the literature. The first contribution is to test the effect of the market timing on capital structure of Russian domestic listed firms that has not been investigated before in the corporate finance literature. The second contribution is the dataset of the study: (1) It comprises of all the domestic listed companies of Russian stock market for the period of 1992–2013. (2) The taxation data is collected from the tax codes of Russian Federation, which is not observed in the literature. The third distinctive contribution is to investigate the

impact of the market timing for the overall period and after year 2002 on firms' capital structure to capture the tax effect. The 69% corporate tax decline is the important exogenous shock that may affect significantly the leverage level of the firms. Separation of the analysis into periods will allow concentrating on the identical timing to capture the effect of the market timing. The fourth contribution of the study is to apply the two steps System General Method of Moments (GMM) (Blundell and Bond 1998) to solve the endogeneity problems in the panel data (Davidson and Mackinnon 2004). GMM works well even without considering assumption on distribution, and its results with the minimum biased when there is heteroskedasticity in the model (Verbeek 2008). As we use panel data models, the system GMM reduces the sample bias (Hayakawa 2007) and increases the accuracy (Blundell and Bond 2000) as well.

2 Literature Review

The traditional irrelevance hypothesis of the capital structure proposed by Modigliani and Miller (1958) has puzzled many theorists and researchers. Their irrelevance proposition advocates that restructuring firm's capital structure does not affect the firm's value in a perfect market. This facilitated in developing main theories of the capital structure such as Trade-off, Pecking Order and Market Timing (Huang and Ritter 2009) to identify the determinants of the financing decision.

The trade-off theory is based on the balancing tax benefits of leverage and bankruptcy costs (Kraus and Litzenberger 1973). This benefit is associated with the tax advantages of debt because of the tax deductibility of interest payments, and it creates opportunities for firms to finance their projects with the leverage (Homaifar et al. 1994). Yet the bankruptcy costs may arise due to increase of the debt (Modigliani and Miller 1963). This indicates that firms increase the leverage financing only up to the point when the tax benefits of debt exceed the bankruptcy costs.

The pecking-order theory advocates the hierarchy of the firms' financing decision based on the existing of asymmetry information between management and investors (Myers 1984; Myers and Majluf 1984). This hierarchy proposes that firms use the retained earnings as a priority for financing their projects. They use leverage financing, if the retained earnings are not sufficient. The equity financing will be a last resort, because of existing of high asymmetry information costs. The role of the price of the stock in determining the leverage financing (Myers 1984; Myers and Majluf 1984) is examined in the pecking-order theory. It suggests that the higher the market to book value of the firm the lower the leverage financing. Firms therefore sell the new issue of equity when market conditions are favorable. It is the time when the stock prices are high (Taggart 1977), and the asymmetry information costs are low (Mayer and Majluf 1984; Lucas and McDonald 1990; Bayless and Chaplinsky 1996). Baker and Wurgler (2002) expand this hypothesis to the market timing theory. The market timing theory is grounded on the relationship between

the equity issuance and stock prices. They affirmed that the aggregated past attempts to time the equity market when stock prices are high is the determinant of firms' financing decision to issue the equity.

Baker and Wurgler (2002) suggest a measure to estimate the impact of the market timing on the leverage financing. The proposed measure is the "external finance weighted-average" market to book ratios. Their main result confirms the negative relationship between the leverage and the weighted average of the past market to book ratio. It means that when the market to book ratios are high, firms tend to decrease the leverage and issue the equity. Unlike Baker and Wurgler (2002), Welch (2004) applies the "implied debt ratio" to observe the impact of the market timing on the capital structure. The measure is based on the actual debt ratio, where the equity is replaced with the market value of the equity multiplied by the stock return of the next year. According to Welch (2004), the stock returns are the best determinants of the market based financing decision. Firms issue the debt when stock returns are low, and issue the equity when stock returns are high. Despite two different applied measures, the consistent result is observed that there is a long-run persistence of the market timing on the capital structure in the case of the U.S. firms.

Following Baker and Wurgler (2002) and Welch (2004), the effect of equity market timing on the financing decision of the U.S. firms is confirmed by many studies (Leary and Roberts 2005; Alti 2006; Hovakimian 2006; Huang and Ritter 2006; Kayhan and Titman 2007) as well. Huang and Ritter (2005) confirm the long-run persistence of the market timing on the capital structure. Other studies however find that the effect of issuing equity during hot IPO markets are small and temporary (Alti 2006; Hovakimian 2006; Kayhan and Titman 2007) on firms' financing decision, therefore equity market timing has the short lasting effect on the capital structure. It is observed that over two and four years firms' capital structure is affected by the changes in stock prices and equity issuance by rebalancing the leverage (Leary and Roberts 2005, Mahajan and Tartaroglu 2008). It means that firms' respond to the effect of the equity market timing is temporary (Hovakimian 2006).

Evidence for the short run persistence of the equity market on the firms' decision is observed also in other developed countries. Mahajan and Tartaroglu (2008) examine the timing of equity in the case of Canada, France, Germany, Italy, UK, US, Japan and find similar result to the findings of Leary and Roberts (2005). Their investigation reveals that historical market-to-book ratio in all observed countries are negatively related with the firms' leverage which provides support for the market timing hypothesis.

The presence of the long-run and/or short-run effect of the equity market timing on firms' capital structure are not observed in all developed European countries. Unlike in for the U.S. firms, the changes in leverage for Swedish firms cannot be predicted with market timing, because Swedish firms' behavior much related to the pecking order of financing rather than market timing (Hogfeldt and Oborenko 2005). Similar to Swedish firms, the Netherlands's firms also concern mostly about the deficit of internal financing (De Bie and De Haan 2007) and considering the

market-to-book ratios are not the priority. During the increase of the stock prices, Dutch firms even increase the issuance of equity and debt securities, which find its support for market timing. However, persistent effect of the market timing is not observed in the capital structure of the Dutch firms. The respond of the firms in developed European countries to the equity market timing are not consistent mostly with the behavior of the U.S. firms. The reason is in the differences of financing and financial system. European firms mostly rely on the long-term debt financing (Bruinshoofd and Haan 2011) due to less market oriented financial system compare with the U.S. financial system (DeBie and DeHaan 2007).

Firms in developing countries have the similar characteristics as the developed European countries. The effect of the equity market timing is short lasting on the firms' capital structure. When the historical market-to-book values are high, firms in Pakistan issue only temporary the stocks (Virk, Ahmed and Nisar 2014). The similar evidence is observed also in Brazil (Vallandro and Trez 2015). The evidence is consistent with the findings in the case of Sweden (Hogfeldt and Oborenko 2005), the Netherlands (DeBie and DeHaan 2007), and Italy (Mahajan and Tartaroglu 2008).

To the best of the authors' knowledge, the literature lacks empirical studies on investigating the market timing on Russian firms capital structure. This study will be the first to observe the long- run persistent effect of the equity market timing on the financing decision of the Russian firms.

3 Data, Methodology and Model Specification

3.1 Data

The data set consists of 521 listed firms and taxation data for the period of 1992–2013. It is the largest data set of Russian listed firms is being analyzed empirically in the literature. The firm data are collected from Thomson Reuters Datastream Database, and from the firms' financial reports. The taxation data has been collected from the Russian Tax codes.

The historical market to book ratio is calculated through the formula of Baker and Wurgler (2002):

$$EFWMB_{t-1} = \sum_{s=0}^{t-1} \frac{e_s + d_s}{\sum_{r=0}^{t-1} e_r + d_r} * MTBV_s \tag{1}$$

The EFWMB is the historical market to book ratio. It is the variable that measures the effect of the market timing. The e is the net equity issues, and d is the net debt issues. The MTBV is the market to book ratio.

The main five determinants of capital structure are used to control for other effects. They are: market to book ratio (MTBV) is calculated as ratio of market

value to book value; tangibility (TANG) is calculated as total fixed assets divided by total assets; profitability (PROF) is measured as the return on assets ratio; size (SIZE) is calculated as log of total assets; and effective tax rate (TAXES) is measured as the total tax paid over earning before interest and taxes. The first four control variables are the main determinants of the capital structure (Rajan and Zingales 1995). The same variables Baker and Wurgler (2002) used to control for the other effects that may affect the leverage of the firms, except the taxes. We include taxes also as it is one of the main determinant of the capital structure, due to major tax reforms in Russia. These reforms affected the capital structure of the listed firms. The leverage of the firms decreased after these reforms. These institutional changes can be captured through using taxes in the model.

Table 1 provides the summary statistics and correlation matrix for the series for the period of 1992–2013 in Panels A and B respectively. The normal distribution of the series are violated. The values of skewness reveal that distribution of the series is not asymmetry, except the TANG, PROF and SIZE. However, kurtosis values show that PROF and SIZE's distribution are peaked relative to the normal, because their values exceeds 3. TANG variable has a flat distribution relative to the normality. The same violation of the normality is observed in series for the period of 2003–2013 (Table 2). The mean of the debt ratio (DR) for the whole sample is larger than for the 2003–2013 period. The reason is the decrease in the corporate tax rates, which induced firms to shift to other alternative source of finance. The higher corporate tax rates encourages firms to borrow more due to tax advantages of debt.

Table 1 Descriptive statistics and correlation matrix (1992–2013)

Panel A							
Statistics	DR	EFWMB	MTBV	TANG	PROF	SIZE	TAXES
Mean	0.366	1.139	1.054	0.584	0.065	15.606	0.360
Median	0.319	1.129	0.303	0.484	0.050	15.410	0.340
Max	3.383	2.585	10.000	0.999	1.510	23.321	1.858
Min	0.000	−5.269	0.000	0.000	−1.830	4.605	0.000
Standard deviation	0.278	0.3819	1.838	0.239	0.135	2.041	0.210
Skewness	3.209	−11.681	2.948	0.000	−0.102	0.357	1.598
Kurtosis	27.378	78.95	12.898	2.035	27.169	3.841	7.546

Panel B							
Variables	DR	EFWMB	MTBV	TANG	PROF	SIZE	TAXES
DR	1						
EFWMB	0.006	1					
MTBV	0.0310*	0.0320*	1				
TANG	0.0395**	−0.0431**	0.0421**	1			
ROA	−0.211***	0.0102	0.139***	0.0275	1		
SIZE	0.0529***	−0.0201	0.138***	0.382***	0.166***	1	
TAXES	−0.0963***	−0.0449**	−0.0186	−0.0640***	0.0565***	0.00357	1

Note *p < 0.05, **p < 0.01, ***p < 0.001

Table 2 Descriptive statistics and correlation matrix (2003–2013)

Panel A							
Statistics	DR	EFWMB	MTBV	TANG	PROF	SIZE	TAXES
Mean	0.251	1.141	1.073	0.472	0.065	15.557	0.255
Median	0.225	1.133	0.297	0.466	0.051	15.368	0.241
Max	2.23	2.585	10.000	0.999	1.441	23.321	1.858
Min	0.000	−5.269	0.000	0.000	−0.083	4.605	0.000
Standard deviation	0.282	0.378	1.866	0.236	0.136	2.029	0.230
Skewness	3.181	−11.904	2.897	0.046	−0.109	0.380	1.578
Kurtosis	26.901	86.694	12.491	2.07	27.360	3.960	7.441

Panel B							
Variables	DR	EFWMB	MTBV	TANG	PROF	SIZE	TAXES
DR	1						
EFWMB	−0.012***	1					
MTBV	−0.0420*	0.0330*	1				
TANG	0.063***	−0.0427**	0.056***	1			
ROA	−0.213***	0.0126	0.140***	0.0417**	1		
SIZE	0.0661***	−0.0150	0.151***	0.384***	0.169***	1	
TAXES	0.020***	−0.0502**	−0.0213	−0.0640***	0.0566***	−0.005	1

Note *p < 0.05, **p < 0.01, ***p < 0.001

The average taxes for the period of 1992–2013 are higher than for the 2003–2013 period. It is apparent, because the corporate tax rate before 2002 was 35%, and in 2002 it decreased to 24%.

Panel B shows that the correlation between DR and EFWMB is positive and insignificant for the whole sample. However, if to observe their correlation for the 2003–2013 period is negative and significant at 10% level. It shows the importance of analyzing the market timing persistence on capital structure for two periods. The MTBV has a positive correlation with DR for the whole period, and it is significant. Their correlation is negative for the period of 2003–2013. The correlation matrix (Panel B) reveals contrasting relationships between TAXES and DR for two different periods. There is a positive correlation for the period of 1992–2013, and the correlation is negative and significant for the period of 2003–2013.

3.2 Methodology

In this paper, we apply the two-step system GMM panel estimators (Arellano and Bover 1995; Blundell and Bond 1998) to test the determinants of the capital structure. The two-step system GMM solves the endogeneity problems in the panel data (Davidson and Mackinnon 2004) and it works well even without considering assumption on distribution. In the presence of heteroskedasticity in the model,

the two-step system GMM will have the minimum biased in estimators (Verbeek 2008). The system GMM panel data model increases the accuracy (Blundell et al. 2000) and also reduces the sample bias (Hayakawa 2007).

According to Arellano and Bover (1995) and Blundell and Bond (1998), the two-system GMM estimator based on the following moment conditions:

$$\varepsilon(\mathrm{dr}it - s\ \Delta \mathrm{u}it) = 0 \tag{2}$$

$$\varepsilon(\Delta \mathrm{dr}it - 1(\varphi i + \mathrm{u}it)) = 0 \tag{3}$$

where, dr$it - s$ is the preferred lags of the dependent variable. t = 3,…,T and in Eq. (2) $2 \leq s \leq T - 1$.

For the purposes of robustness tests the J-statistic of Hansen (1982) to identify the over identifying restrictions and Arellano and Bond (1991) to examine the existence of autocorrelation are employed. The null hypothesis of the J-statistic of Hansen (1982) test is the instruments are not valid. The null hypothesis under Arellano and Bond (1991) test is the presence of autocorrelation.

To test the persistency of the effect of the market timing on the capital structure the Fama and MacBeth two-step procedure (1973) is applied. First step, a cross-sectional regression is carried:

$$y_{it} = \vartheta_t \beta_i + \varepsilon_{it} \tag{4}$$

Expressed in the matrix form y_{it} is a $t \times 1$ vector of dependent variable, ϑ is a $t \times (\mu + 1)$ matrix of factors. ε_{it} is a $t \times 1$ vector of error terms. The second step provides the average coefficients based on the first regression (Hoechle 2011):

$$\hat{\theta} = \sum_{i=1}^{T} \hat{\phi}_{\mathrm{t}} \tag{5}$$

Expressed in the matrix form $\hat{\theta}$ is an $n \times 1$ vector of average dependent variable, all elements in the first column are 1, and $\hat{\theta}$ is a $(\mu + 1) \times 1$ vector.

3.3 Model Specification

The dynamic model is applied to test the existence and effect of the market timing on the capital structure of Russian listed firms:

$$DR_{it} = \alpha DR_{it-1} + b_1(EFWMB_{it-1}) + \sum_{k=1}^{k} b_k X_{kit-1} + u_{it} \tag{6}$$

where, i represents firms, t indicates time and k indicates firm specific variable. α and b_1 are the coefficients of the lagged debt ratio and the historical market to book ratio relatively. DR is the debt ratio, and X_{kit-1} are the control variables in the model. u_{it} is the error term.

We follow the models that Baker and Wurgler (2002) utilized to test the persistency of the market timing on the capital structure of the US firms. The following three models are employed to test the persistency of the effect of the historical market to book ratio (EFWMB):

$$DR_{t+1} = a_1 + b_1(EFWMB_t) + \sum_{k=1}^{k} b_k X_{kt} + u_{1,t+1} \tag{7}$$

$$DR_{t+\tau} = a_2 + b_2(EFWMB_t) + \sum_{k=1}^{k} b_k X_{kt} + u_{2,t+\tau} \tag{8}$$

$$DR_{t+\tau} = a_3 + b_3(EFWMB_t) + \sum_{k=1}^{k} b_k X_{k,t+\tau-1} + u_{3,t+\tau} \tag{9}$$

The model (7) will test the effect of the historical market to book ratio at time t on the current debt ratio at time t + 1. The model (8) will look on the effect of historical market to book ratio at time t to the future debt ratio at time $t+\tau$. Control variables in the models (7) and (8) will be at time t. In the model (9), we will regress historical market to book ratio at time t on the capital structure at time $t+\tau$ with control variables at time $t+\tau-1$.

4 Empirical Findings

Table 3 shows the results of the determinants of the debt ratio. The historical market to book ratio is negative and significant in the short and long term of 2003–2013 period. However, the coefficient is the highest in the short term. It shows the effect of the market timing, and its importance on the capital structure of listed firms. The result is consistent with the findings of Mahajan and Tartaroglu (2008) for the developed countries. However, Mahajan and Tartaroglu (2008) could not observe the longer persistency of the market timing. In our study, the coefficient of the historical market to book ratio decreases with longer periods but it is significant. It reveals that the persistency of the market timing is observed in the case of Russia. The effect of the market timing at T + 10 and for the All Firms of the period 2003–2013 is close to each other. This finding is consistent with the main finding of Baker and Wurgler (2002) in the case of the US, which later has found support in the study of Huang and Ritter (2006).

Table 3 Determinants of the debt ratio

Variables	Year				
	2003–2013			2003–2013	1992–2013
	T + 3	T + 5	T + 10	All firms	All firms
DR_{t-1}	0.92 (8.58)***	0.75 (7.45)***	0.73 (4.67)***	0.81 (7.34)***	0.70 (6.23)***
$EFWMB_{t-1}$	−1.40 (−3.01)***	−0.10 (2.39)**	−0.08 (−3.79)***	−0.07 (−2.66)***	−0.02 (0.96)
$MTBR_{t-1}$	−2.4 (4.3)***	0.003 (0.11)	−0.012 (2.72)***	−0.09 (−3.48)***	0.08 (1.39)
$TANG_{t-1}$	1.3 (2.5)**	−0.76 (−1.27)	−0.11 (−0.50)	0.09 (0.27)	−0.12 (−0.26)
$PROF_{t-1}$	−2.8 (−3.2)***	−0.77 (−2.37)**	−0.21 (−2.71)***	−0.06 (−0.09)	−1.09 (−3.34)***
$SIZE_{t-1}$	0.010 (0.35)	0.07 (1.52)	0.05 (2.97)***	0.04 (1.31)	0.010 (0.35)
$TAXES_{t-1}$	0.17 (3.60)*	0.12 (2.34)**	0.13 (2.48)**	0.16 (2.36)**	0.99 (1.60)
Number of instruments	30	10	28	28	30
AR(2)	0.45	0.72	0.58	0.27	0.62
Hansen test	0.18	0.24	0.20	0.18	0.15

Note DR is the debt ratio; EFWMB is the historical market to book ratio; MTBV is the market to book ratio; TANG is the tangibility ratio; PROF is the profitability ratio; SIZE is the size of the company; TAXES is the effective tax rate. The values of the AR(2) and Hansen Test are the significant levels of the second-order serial autocorrelation and J statistic (Hansen p-value) respectively. *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. Instruments are PROF and MTBR in T + 3, and T + 5 periods; PROF and SIZE in T + 10 time period; PROF, SIZE, MTBR in the ALL FIRMS (2003–2013) and ALL FIRMS (1992–2013). Settings are applied for xtabond2 codes are small, robust and two step and collapse

The analysis of 1992–2013 reveals also negative coefficient for the historical market to book ratio, but it is insignificant. The reason is apparent, because the stock market becomes the important source of fund after 2001 and 2002 tax reforms due to decrease in the corporate tax rate. The coefficient of the TAXES is high compare to 2003–2013 periods however it is insignificant. It is due to different tax regimes and tax rates before and after 2002.

The market to book ratio is another important indicator of market timing. It is significant and higher for the T + 3. Its effect decreases with the longer period. For T + 3, the coefficient of MTBR is higher than EFWMB. In short period, the effect of the market to book ratio is greater to the capital structure than the effect of the

historical market to book ratio. The younger the listed firm, the importance of the historical market to book ratio is lessened compare to the one-lagged market to book ratio. The capital structure of the matured listed firms more affected by the historical market to book ratio rather than one-lagged market to book ratio.

The results of 1992–2013 periods for All Firms show insignificant result and positive coefficient for the one-lagged market to book ratio. The development of the stock market was in the process for the period of 1992–2001 with small number of listed firms. The tax advantage of debt was another reason for firms to concentrate on leverage, due to high corporate tax rate.

The AR(2) test statistics shows that there is no second-order serial autocorrelation of the residuals. It means that the estimates are consistent in all the cases. Based on the Hansen test we examine the validity of the instruments, which is not rejected. It means that all our instruments are valid because p-values of Hansen test are between 0.10 and 0.25. Roodman (2009) suggested that p-values of greater than 0.25 should be seen as a sign of instrument proliferation, that should be controlled in order to have unbiased results.

The historical and one-lagged market to book ratio has a negative coefficient and significant power over time. In this respect, it needs to be tested on the persistency of the market timing effect on the capital structure of the listed firms. Table 4 reveals the results of Fama–Macbeth regressions for T + 1, T + 3, T + 5 and T + 10 for the period of 2003–2013. The ratios of coefficients, which show the persistency of the market timing over time, are also calculated. For T + 1, the ratio is equal to 1.00, which is obvious as the market to book ratio and historical market to book ratio are the same. The b_2/b_1 ratio is not calculated, because b_2 coefficient is not significant. The b_2/b_1 ratio for the T + 10 is 0.55, which shows the existence of 55% persistent effect even after 10 years. The b_3/b_1 ratio also shows persistent effect for the matured listed firms with 66% persistency of the initial effect.

Table 4 Fama–Macbeth regression

$EFWMB_t$ coefficient	T + 1	T + 3	T + 5	T + 10
b_1	−1.50 (1.86)*	−1.35 (2.21)**	−0.11 (2.35)**	−0.09 (2.56)**
b_2	−1.50 (1.86)*	−0.87 (1.97)**	−0.09 (1.05)	−0.05 (1.89)*
b_3	−1.50 (1.86)*	−1.02 (2.34)**	−0.06 (1.96)*	−0.06 (2.45)**
b_2/b_1	1.00	0.64	–	0.55
b_3/b_1	1.00	0.75	0.54	0.66

Note The result is based on debt ratio. Robust t-statistics and p-values (in parentheses) are reported. *p < 0.05, **p < 0.01, ***p < 0.001

5 Conclusion

In this paper, the presence of persistent effect of the market valuation in the firms' capital structure in the case of Russia was investigated for the periods of 1992–2013 and 2003–2013. To this aim, the key variables like profitability ratio, size, tangibility, market to book values, taxes, historical market to book and debt ratios of 521 listed firms are collected. The main aim of the study was to test the market timing theory and to observe whether Russian firms issue the stock when the market value of stocks rises. For this purpose, the two-step system GMM dynamic panel estimators (Arellano and Bover 1995; Blundell and Bond 1998) and the Fama and MacBeth two-step procedure (1973) tests were applied.

The descriptive analysis revealed the differences in the key ratios, which suggested the importance of analyzing the effect of the historical market to book ratio on leverage for two periods: (1) 1992–2013 and (2) 2003–2013. The statistical analysis showed that our series are violates the normality assumptions, in this respect to test the determinants of the capital structure, we applied the two-step system GMM dynamic panel estimators (Arellano and Bover 1995; Blundell and Bond 1998). Because, the two-step system GMM works well even without considering assumption on distribution and it solves the endogeneity problems in the panel data. It was found that the historical market to book ratio has a negative coefficient at T + 3, T + 5, and even T + 10, which supports the existence of short and long term market timing in Russian firms. To test the persistency of the effect of the market timing on the capital structure we employed the Fama and MacBeth two-step procedure (1973). The result of the test revealed that even after 10 years there existed the 55% persistent effect of market timing on capital structure of Russian firms.

This paper contributes to the literature by testing for the first time the presence of the market-timing hypothesis in the case of Russian firms. The negative coefficient of the calculated historical market to book ratio measure is the indicator of the effect of the market timing on the capital structure. We conclude that the reason behind our findings is the development of the stock market and privatization process that allowed firms to obtain liberalization (Chen 2009) and decide on the financing decision of the firm at individual basis (Sutela 1998). The tax reforms of 2001 and 2002 also induced firms to shift to the alternative form of financing. Decrease in the corporate tax rate lessened power of the tax advantages of debt. Firms followed the market-timing hypothesis to decide on financing decision. Our results are consistent with the findings of Baker and Wurgler (2002) who also observed the long run persistence of the market timing but in the case of the US. Similar to the US firms, Russian firms follow the market timing theory. The results indicate that the capital structure is "the cumulative outcome of past attempts to time the equity market" (Baker and Wurgler 2002; p. 30).

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Fiscal Sustainability from a Nonlinear Framework: Evidence from 14 European Countries

Esra Hasdemir and Tolga Omay

Abstract This study examines the fiscal sustainability of 14 European Union (EU) Member countries in the long run. For this purpose, a linear Augmented Dickey Fuller (ADF) and a variety of nonlinear univariate unit root tests are applied to the debt-to-GDP series of the 14 EU Member countries; Belgium, Czech Republic, Denmark, Finland, France, Greece, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Slovakia and Sweden. In addition to that, the nonlinear unit root tests applied in this study are classified according to the source of nonlinearities: (i) time dependent nonlinearity (structural break(s)), (ii) state dependent nonlinearity and (iii) hybrid nonlinearity. Thus, the nonlinearities and their sources in data generating process of debt-to-GDP series of every country can be determined. The findings of this study show that the null of linear unit root cannot be rejected for none of the countries by applying linear ADF whereas it can be rejected as a result of nonlinear unit root tests for considerable number of countries, i.e. 11 out of 14 countries exhibit time dependent nonlinearity, 6 out of 14 exhibit state dependent nonlinearity and 10 out of 14 exhibit hybrid nonlinearity in their relevant data. So, the source of nonlinearities in the relevant data differs according to the country. That is, for testing the fiscal sustainability, the nonlinearities in the data need to be taken into account. Ignoring the nonlinearities in the testing procedure can lead misleading results in the decision of fiscal sustainability in the long run.

Keywords Fiscal sustainability · Nonlinearity · Unit root tests

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1 Introduction

The fiscal sustainability is an essential concept for governments, policy makers and researchers. Basically, sustainability of fiscal policy can be defined as the ability of governments to operate their current fiscal positions (Quintos 1995). Theoretically, sustainable budget imbalance requires the government's intertemporal budget constraint (IBC) to hold in the long run, providing that the country's current value of debt is equal to the discounted sum of expected future surpluses (Bajo-Rubio et al. 2008; Berenguer-Rico and Carrion-i Silvestre 2011; Chen 2014).

There is two common econometric methodologies suggested in the empirical literature to test whether the IBC holds in the long-run. The first approach utilizes univariate time series analysis, i.e., unit root testing procedures, is applied to debt-to-GDP series to test the fiscal sustainability hypothesis (Hamilton and Falvin 1986; Wilcox 1989; Makrydakis et al. 1999). The second approach applies cointegration analysis either with or without structural break, is conducted to analyze whether there is a long-run relationship between government revenues and government expenditures (Trehan and Walsh 1988; Quintos 1995; Payne 1997; Martin 2000; Afonso 2005; Kalyoncu 2005; Baharumshah and Lau 2007; Bajo-Rubio et al. 2004, 2008). Due to high statistical power of panel data, the unit root analysis and cointegration analysis techniques for panel data are also applied to debt-to-GDP data to conclude about the fiscal sustainability (Ehrhart and Lorca 2008; Afonso and Rault 2010).

In the unit root testing procedure for fiscal sustainability, the null hypothesis of linear unit root is tested against the alternative of linear stationarity of the debt-to-GDP series. If the null of linear unit root is rejected, that is, the government's intertemporal budget constraint holds. Here, main assumption of the analysis is that the data generating process (DGP) of debt-to-GDP ratio is linear. That is, the adjustment process to the equilibrium of the debt-to-GDP data is occurred with a continuously same speed and symmetric. Additionally, according to Bohn (1998), linear unit root tests fail to detect the mean-reversion of the series and have low power when the alternative hypothesis consists of autoregressive coefficients that are close to one. So, it is important to consider the DGP of the data in the analysis. Analyses that do not consider nonlinearities in the DGP may cause misleading results, both for unit root and cointegration analysis. Hence, recent empirical literature on testing the fiscal sustainability includes an increasing number of studies taking the possible nonlinearities into consideration (Arestis et al. 2004; Bajo-Rubio et al. 2004; Payne and Mohammadi 2006; Ono 2008; Chen 2014).

Nonlinearities in the debt-to-GDP series may arise because of the response of policy makers to the deviation of budget imbalances (deficit/surplus) from its long-run equilibrium. The governments may counter to primary deficits when public debt is high, or they may counter to primary surpluses are low, which involves nonlinearities in the debt-to-GDP series (Sarno 2001). The other factor for arising nonlinearities may be the movement in business cycle. For instance, budget

deficit is affected by movements of business cycles by means of fiscal stabilizers and discretionary fiscal measures (Payne and Mohammadi 2006).

In this study, we examine the fiscal sustainability of 14 EU Member countries by using a variety of nonlinear unit root tests, in addition to Augmented Dickey Fuller (ADF) linear unit root test. Furthermore, the unit root tests applied in this study determine the source of nonlinearity. The null hypothesis of every unit root tests applied in this study have a linear unit root. The alternative hypothesis of these tests differs according to the source of nonlinearities as time dependent nonlinearity (structural break(s)), state dependent nonlinearity and hybrid nonlinearity that is a combination of the former two. In doing so, we consider the nonlinear property of the debt-to-GDP data and the source of the nonlinearity at the same time.

The rest of the paper organized as follows; Sect. 2 states the analytical framework for IBC. Section 3 introduces data and econometric methodology. Section 4 displays the empirical results of the tests and Sect. 5 concludes.

2 Analytical Framework

The necessary conditions for fiscal sustainability are pointed out in the government's intertemporal budget constraint (IBC) model. The IBC is introduced by following the studies of Bajo-Rubio et al. (2008) and Berenguer-Rico and Carrion-i Silvestre (2011). Following the abovementioned studies, we consider one-period government budget constraint:

$$\Delta B_t = G_t - R_t \tag{1}$$

where B_t, G_t and R_t represent real market value of government debt, real government expenditure inclusive of interest payment and real tax revenues, respectively. Furthermore, the real interest rate, i_t, is assumed to have stationary process around a mean i, so that we can write

$$G_t = GE_t + i_t B_{t-1} \tag{2}$$

In Eq. (2), GE_t is the real expenditure exclusive of interest payments and the second term on the right-hand side is interest payments on the level of debt accumulated at the end of the previous period. From this viewpoint, we can define the debt as

$$B_t = (1+i)B_{t-1} + EXP_t - R_t \tag{3}$$

where, $EXP_t = GE_t + (i_t - i)B_{t-1}$. Since it is assumed that Eq. (3) does hold every period, solving the equation for B_t and iterating forward over an infinite horizon generate the IBC:

$$B_t = \sum_{j=0}^{\infty} \left(\frac{1}{1+i}\right)^{J+1} \left(R_{t+j+1} - EXP_{t+j+1}\right) + \lim_{j\to\infty} \left(\frac{1}{1+i}\right)^{j+1} B_{t+j+1} \quad (4)$$

The intertemporal budget constraint or budget deficit sustainability does hold if the current value of outstanding government debt is equal to the present value of future budget surpluses. Hence, the condition stating in Eq. (5) must be hold.

$$\lim_{j\to\infty} E_t \left(\frac{1}{1+i}\right)^{j+1} B_{t+j+1} = 0 \quad (5)$$

where $E_t(.)$ stand for the expectation which is conditional information at time t. The condition in Eq. (5) shows the transversality condition. That is, if the transversality condition holds in the long run, then the deficit is sustainable, since the stock of debt held by the public is expected to grow no faster, on average, than the growth rate of the economy (Berenguer-Rico and Carrion-i Silvestre 2011; Chen 2014). According to Berenguer-Rico and Carrion-i Silvestre (2011), being satisfied of the condition in the Eq. (5) states that there is a sustainable budget deficit through the debt.

3 Data and Econometric Methodology

The fiscal sustainability hypothesis is tested by using the ratio of debt imbalance to GDP of 14 EU Member countries: Belgium, Czech Republic, Denmark, Finland, France, Greece, Hungary, Italy, Netherlands, Poland, Portugal, Romania, Slovakia and Sweden. The sample period is 1999: Q1–2017: Q4.[1] All data are obtained from International Financial Statistics launched by IMF.

In order to test the fiscal sustainability, a variety of nonlinear univariate unit root tests are applied to debt-to-GDP series of 14 EU Member countries. The nonlinear unit root tests are classified according to the ability to determine the source of nonlinearity covered in the DGP of the data. The source of nonlinearities are classified as time dependent nonlinearity, state dependent nonlinearity and hybrid nonlinearity that includes of the time and state dependent nonlinearity at the same time.

[1]The sample period is determined according to the availability of data.

3.1 Unit Root Tests for Time Dependent Nonlinearity

Time dependent nonlinearity occurs in the form of structural break(s) in the deterministic part of the DGP. In this study, the two nonlinear unit root tests are used for capturing time dependent nonlinearities in the series; Leybourne et al. (1998), and Omay (2015), namely.

First unit root test applied in this study for time dependent nonlinearity is developed by Leybourne, Newbold and Vougas (1998; LNV henceforth). LNV utilizes logistic smooth transition (LSTR) function to allow an LSTR nonlinear trend having one smooth or sharp break depending on parameter denoting the smoothness, γ,

Leybourne et al. (1998) considers three LSTR models as follows:

$$\text{Model A:} \quad X_t = \alpha_1 + \alpha_2 S_t(\gamma, m) + \upsilon_t \tag{6}$$

$$\text{Model B:} \quad X_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\gamma, m) + \upsilon_t \tag{7}$$

$$\text{Model C:} \quad X_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\gamma, m) + \beta_2 t S_t(\gamma, m) + \upsilon_t \tag{8}$$

where υ_t is a zero-mean I(0) process and $S_t(\gamma, m)$ is the LSTR function:

$$S_t(\gamma, m) = [1 + \exp\{-\gamma(t - mT)\}]^{-1} \tag{9}$$

Since $S_t(\gamma, m)$ is a continuous function, it allows the transition between two different regimes having the extreme values as 0 and 1. The parameters γ and m denote the speed of transition and location between two regimes, respectively. Since the value of $S_t(\gamma, m)$ depends on the value of the parameter, the transition between two regimes is very slow for small values of γ whereas the transition between the regimes becomes almost instantaneous at time $t = mT$ for very large values of γ. When $\gamma = 0$, then $S_t(\gamma, m) = 0.5$ for all values of t. Therefore, in Eq. (6), X_t is stationary around a mean that changes from α_1 to $\alpha_1 + \alpha_2$ Eq. (7) allows for a fixed slope term where the intercept term changes from α_1 to $\alpha_1 + \alpha_2$. In Eq. (8), in addition to the similar changes in the intercept, the slope changes from β_1 to $\beta_1 + \beta_2$ at the same time (Leybourne et al. 1998).

The null and alternative hypotheses of the LNV are as follows:

$$H_0 = X_t = \mu_t, \mu_t = \mu_{t-1} + \varepsilon_t, \mu_0 = \Psi$$
$$H_1 = \text{Model A, Model B or Model C}$$

or

$$H_0 = X_t = \mu_t, \mu_t = K + \mu_{t-1} + \varepsilon_t, \mu_0 = \Psi$$
$$H_1 = \text{Model B or Model C}$$

Hypothesis testing procedure starts with the estimation of Model A, B and C through nonlinear least squares (NLS) and the computation of residuals, afterwards. As a second step, ADF test statistics, the t ratio associated with $\hat{\rho}$ in the ordinary least squares (OLS) regression are computed from the following equation:

$$\Delta\hat{v}_t = \hat{\rho}\hat{v}_{t-1} + \sum_{i=1}^{k} \hat{\delta}\Delta\hat{v}_{t-1} + \hat{\eta}_t.$$

Second unit root test applied in this study for time dependent nonlinearity is developed by Omay (2015) that allows for multiple smooth structural breaks. Omay (2015) extends the study of Enders and Lee (2012a, b; EL henceforth) that makes use of an Augmented-Dickey Fuller (ADF) type unit root test allowing for a flexible nonlinear trend using a Fourier approximation in an integer frequency Fourier form, to the case in which a fractional flexible frequency Fourier function is used (Hasdemir et al. 2019).

Omay (2015) considers the following Dickey–Fuller test equation:

$$y_t = d(t) + \phi_1 y_{t-1} + \lambda t + \varepsilon_t \tag{10}$$

where ε_t is a disturbance term that has a stationary process and constant variance, σ^2; $d(t)$ is a deterministic function of t. The initial value is assumed to be a fixed value and ε_t is weakly dependent as in the study of Enders and Lee (2012a, b). If the functional form of $d(t)$ is known, testing the null of unit root is possible. If the functional form of $d(t)$ is unknown, Omay (2015) and EL tests are employing the Fourier expansion to provide the approximation of $d(t)$:

$$d(t) = \alpha_0 + \alpha \sin\left(\frac{2\pi kt}{T}\right) + \beta_k \cos\left(\frac{2\pi kt}{T}\right) \tag{11}$$

k and T denote a frequency and the number of observations, respectively. $\alpha_k = \beta_k = 0$ states that there is no nonlinear trend in all values of α_k and β_k and this refers to a special case of the test, namely the DF test. In Omay (2015), single and fractional frequency are used.

In order for selecting the best fitting fractional single frequency, following Davies (1987), the grid searching in Omay (2015) is used as follows: run a regression using Eq. (10) by using the single frequency between the intervals $0.1 \leq k^{fr} \leq k^{fr}_{\max}$, where $k_{\max} = 2$. For fractional frequencies k = 0.1 is selected as increments of the selected frequencies. They obtain $k = \hat{k}^f$ that minimizes the SSR. Besides, $\left(\hat{k}^f\right) = \max F\left(\hat{k}^f\right)$ test statistics are obtained following Enders and Lee (2012a, b). The testing regression of the model with intercept and trend is in Eq. (12):

$$\Delta X_{t-1} = \rho X_{t-1} + c_1 + c_2 t + c_3 \sin\left(\frac{2\pi k^{fr} t}{T}\right) + c_3 \cos\left(\frac{2\pi k^{fr} t}{T}\right) + e_t \tag{12}$$

3.2 Unit Root Tests for State Dependent Nonlinearity

The deviations from the equilibrium level might occur because of the intervention of policy makers for budget deficit/surplus. Therefore, there should be a mean-reverting behavior of the debt-to-GDP ratio only when they are above a threshold value (Arestis et al. 2004). Through employing nonlinear techniques, one may able to capture asymmetric movements in the adjustment process encompassing sign and size of the deviations from the equilibrium level and the speed of the adjustment towards the equilibrium (Clarida et al. 2007).

The first unit root test applied in this study allowing the state dependent nonlinearity is developed by Enders and Granger (1998; EG henceforth). EG is a threshold autoregressive (TAR) type nonlinear unit root test and utilizes an indicator function with a threshold value, instead of a logistic transition function. In EG test, the null of linear unit root is tested against stationary asymmetric adjustment to the mean or deterministic trend (Engle and Granger 1998). In other words, EG test enables us to test the sign nonlinearity.

The threshold autoregressive model (TAR) used by EG is as follows:

$$\Delta X_t = I_t \rho_1 X_{t-1} + (1 - I_t)\rho_2 X_{t-1} + \sum_{i=1}^{k} \widehat{\delta}_i \Delta X_{t-1} + \eta_t \tag{13}$$

I_t is the Heaviside indicator function such that

$$I_t = \begin{cases} 1, & if\ X_{t-1} \geq 0 \\ 0, & if\ X_{t-1} < 0 \end{cases}$$

If there is a convergence, then $X_{t-1} = 0$ is value of the long-run equilibrium. If X_{t-1} is above or below its long-run equilibrium, the adjustment is $\rho_1 X_{t-1}$, and $\rho_2 X_{t-1}$, respectively. If adjustment is symmetric, then $\rho_1 = \rho_2$.

The null and alternative hypotheses of the EG unit root test are as follows:

$$H_0 = \rho_1 = \rho_2 = 0$$
$$H_{11} = \rho_1 = \rho_2 < 0$$
$$H_{12} = \rho_1 < 0, \rho_2 < 0$$

H_0 states that there is symmetric adjustment to the equilibrium and the series has a unit root process whereas H_{11} states that there might be an assumption of constant variances assumption is deteriorated and therefore there exist a nonlinearity (Engle and Granger 1998). H_{11} and H_{12} display asymmetric adjustment.

The second nonlinear unit root test employed in this study for allowing state dependent nonlinearity is proposed by Kapetanios, Shin and Snell (2003; KSS henceforth). KSS detects the size nonlinearity that represents the asymmetric adjustment speed towards equilibrium. The governments react more strongly to budget deficits when the deviation of the debt-to-GDP ratio from equilibrium is large in absolute size indicates that the larger the deviation from the long-run equilibrium of the debt-to-GDP ratio the stronger will be the tendency to move back to equilibrium (Sarno 2001).

KSS considers the models in the Eqs. (6)–(8) and uses the exponential smooth transition autoregressive (ESTAR) function for modelling the size of the symmetric adjustment towards equilibrium. By using KSS, the null of linear unit root is tested against the symmetric globally stationary nonlinear processes.[2]

In order to find out the existence of size nonlinearity, Kapetanios et al. (2003) considers an exponential smooth transition autoregressive model (ESTAR):

$$X_t = \beta X_{t-1} + \gamma X_{t-1}\left[1 - \exp\left(-\theta X_{t-1}^2\right)\right] + \varepsilon_t \tag{14}$$

after reparameterizing, we have

$$\Delta X_t = \beta X_{t-1} + \gamma X_{t-1}\left[1 - \exp\left(-\theta X_{t-1}^2\right)\right] + \varepsilon_t \tag{15}$$

We can also write the model as follows:

$$\Delta X_t = \beta X_{t-1} + \gamma X_{t-1} G(.) + \varepsilon_t \tag{16}$$

where β determines the speed of mean reversion. $G(.)$ is the transition function. The null and alternative hypothesis are $H_0 = \beta = 0$ and $H_1 = \beta > 0$. $H_1 = \beta > 0$ states the globally stationary process. From the transition speed of the ESTAR function we can decide whether the series alternatively nonlinear stationary.

Testing the null hypothesis directly is not feasible, since γ is not identified under the null (Kapetanios et al. 2003). By using the first order Taylor approximation, this test becomes more feasible to test by using unit root methodology and they get the auxiliary regression as follows:

$$\Delta X_t = \delta X_{t-1}^3 + error \tag{17}$$

Then they obtain the t-statistic for testing the $\delta = 0$ against $\delta < 0$ as $t_{NL} = \hat{\delta}/s.e.(\hat{\delta})$.

[2]For the detailed explanation of globally stationary nonlinear process, see Kapetanios et al. (2003).

The authors extend the model in order to eliminate the possible serial correlated errors in the ESTAR model given in Eq. (14). The more general form is as follows:

$$\Delta X_t = \sum_{j=1}^{p} \rho_j \Delta X_{t-j} + \gamma X_{t-1}\left\{1 - \exp\left(-\theta X_{t-1}^2\right)\right\} + \varepsilon_t$$

The sign and size of the budget imbalances may have a key role in the adjustment process. Sollis (2009)[3] developed a nonlinear unit root test that allows both size and sign nonlinearities simultaneously.

Sollis (2009) is an extension of KSS and implies testing the asymmetric state dependent nonlinearity with intercept and trend deterministic terms in its alternative hypothesis by using an extended version of the ESTAR model that allows for symmetric and asymmetric nonlinear adjustment towards equilibrium.

In this test, both an exponential function and a logistic function are employed as follows:

$$\Delta X_t = G_t(\gamma_1, X_{t-1})\{S_t(\gamma_2, X_{t-1})\rho_1 + (1 - S_t(\gamma_2, X_{t-1}))\rho_2\}X_{t-1} + \varepsilon_t$$

$$G_t(\gamma_1, X_{t-1}) = 1 - \exp\left(-\gamma_1\left(X_{t-1}^2\right)\right) \quad \gamma_1 \geq 0 \tag{18}$$

$$S_t(\gamma_2, X_{t-1}) = [1 + \exp(-\gamma_2(X_{t-1}))]^{-1} \quad \gamma_2 \geq 0 \tag{19}$$

where the transition variable is X_{t-1} and $\varepsilon_t \sim iid(0, \sigma^2)$.

By using the first order Taylor approximation of ESTAR model, the asymmetric ESTAR (AESTAR) can be extended to allow for higher-order dynamics:

$$\Delta X_t = G_t(\gamma_1, X_{t-1})\{S_t(\gamma_2, X_{t-1})\rho_1 + (1 - S_t(\gamma_2, X_{t-1}))\rho_2\}X_{t-1} + \sum_{i=1}^{k} \delta_i \Delta X_{t-i} + \varepsilon_t \tag{20}$$

The extension of AESTAR model is based on Sollis et al. (2002), Kapetanios et al. (2003) and Park and Shintani (2005).

For the extension of exponential smooth transition autoregressive model (ESTAR) in Sollis (2009), $k = 0$ is assumed in the Eq. (20) and replacing $G_t(\gamma_1, X_{t-1})$ in Eq. (20) with a first order Taylor approximation around $\gamma_1 = 0$ gives

$$\Delta X_t = \rho_1 \gamma_1 X_{t-1}^3 S_t(\gamma_2, X_{t-1}) + \rho_2 \gamma_1 X_{t-1}^3 (1 - S_t(\gamma_2, X_{t-1})) + \epsilon_t \tag{21}$$

After rearranging Eq. (21), we have finally the extension of LSTAR as follows:

$$\Delta X_t = \Phi_1 X_{t-1}^3 + \Phi_2 X_{t-1}^4 + \epsilon_t$$

[3]See Sollis (2009) for the proof in detail.

In Sollis (2009) test, the null of linear unit root is tested against the asymmetric nonlinear stationarity.

3.3 Unit Root Tests for Hybrid Nonlinearity

The DGP of the debt-to-GDP series may have the time and state dependent nonlinearity at the same time. For this purpose, in this study, two newly developed hybrid nonlinear unit root tests are used to examine the possible existence of hybrid type of nonlinearity in the DGP.

The first unit root test applied in this study for hybrid nonlinearity is developed by Omay and Yildirim (2014; OY henceforth) that combines the LNV and KSS. In other words, the OY can capture a smooth structural break and size nonlinearity at the same time.

OY uses the Eqs. (6)–(8) and employs the LSTR as the transition function that is given in Eq. (9) for smooth structural break or nonlinear trend. That is, the structural break is modeled as smooth transition between different regimes rather than instantaneous structural break (Leybourne et al. 1998). After de-trending the nonlinear trend from the series the residuals obtained are used in KSS. In the OY, the null of linear unit root can be tested against nonlinear and stationary around smoothly changing trend and intercept (Omay and Yildirim 2014).

The last and the most comprehensive unit root test of this study that allows hybrid nonlinearity is developed by Omay, Emirmahmutoglu and Hasanov (2018; OEH henceforth). OEH is a combination of LNV and Sollis (2009) unit root tests. By applying the OEH (2018) unit root test, size and sign of the adjustment of the disequilibrium and structural break(s) can be determined simultaneously.

The OEH test utilizes the following equation for modelling the gradual structural breaks:

$$y_t = \phi(t) + u_t \tag{22}$$

$\phi(t)$ is the deterministic nonlinear trend function and u_t is the deviation from the trend. A LSTR and a Fourier function are used to model the deterministic nonlinear trend function of Eq. (22). To do so, logistics smooth transition equations stated in Eq. (6)–(8) are used and LSTAR function for a single gradual structural break and Fourier function for detecting multiple structural breaks are utilized. The Fourier function is in Eq. (23).

$$\phi(t) = \alpha_0 + \delta t + \sum_{k=1}^{n} a_k \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^{n} b_k \cos\left(\frac{2\pi kt}{T}\right) + u_t; \quad n < \frac{T}{2} \tag{23}$$

n represents the number of cumulative frequencies contained in the approximation. k is the selected frequency in the approximation process. a_i and b_i are the measurements for the amplitude and displacement of the sinusoidal components of the deterministic function. Under the assumption of $a_i = b_i = 0$ for all i, the Fourier function becomes a linear model without a structural break. If Eq. (23) allows for a structural break, the min frequency component must be at least one. As a result, the rejection of the null of $a_i = b_i = 0$, implies a structural break(s) in the series.

The OEH test also utilizes an AESTAR model to capture the nonlinear asymmetric adjustment process as mentioned in Sollis (2009). The AESTAR model considers both a logistic function and an exponential function as follows:

$$\Delta u_t = G_t(\theta_1, u_{t-1})\{F_t(\theta_2, u_{t-1})\rho_1 + (1 - F_t(\theta_2, u_{t-1}))\rho_2\}u_{t-1} + \epsilon_t \tag{24}$$

$$G_t(\theta_1, u_{t-1}) = 1 - \exp\left(-\theta_1\left(u_{t-1}^2\right)\right) \quad \theta_1 > 0 \tag{25}$$

$$F_t(\theta_2, u_{t-1}) = [1 + \exp(-\theta_2(u_{t-1}))]^{-1} \quad \theta_2 > 0 \tag{26}$$

where $\epsilon_t \sim iid(0, \sigma^2)$.

As u_t is a zero mean variable, $F_t(\theta_2, u_{t-1})$, the logistic transition function for two regimes is determined by the positive and negative deviations from the equilibrium of u_t (i.e. the sign of disequilibrium.) $G_t(\theta_1, u_{t-1})$, the U-shaped symmetric ESTAR function ranged from 0 and 1 determines the small and large deviations from the equilibrium in absolute terms.

The globally stationarity of AESTAR function requires $\theta_1 > 0$, $\rho_1 < 0$ and $\rho_2 < 0$. If $\rho_1 \neq \rho_2$ is the case, the adjustment process captures not only sign but also size adjustment to the equilibrium. On the other hand, if $\rho_1 = \rho_2$ is the case, the adjustment to the equilibrium becomes a symmetric ESTAR process.

The null hypothesis of a linear unit root can be tested against the alternative hypothesis of a globally stationary AESTAR process as in the following: $H_0 = \theta_1 = 0$; $H_1 = \theta_1 > 0$. Nevertheless, due to the existence of unidentified nuisance parameters under the null hypothesis, the transition functions are rearranged by using a first order Taylor approximation and the model is follows:

$$\Delta u_t = \varphi_1 u_{t-1}^3 + \varphi_2 u_{t-1}^4 + \omega_t \tag{27}$$

After the rearrangement above, the null hypothesis takes the form of $H_0 : \varphi_1 = \varphi_2 = 0$. In order to allow for serial correlation, the regression equation is augmented as follows:

$$\Delta u_t = G_t(\theta_1, u_{t-1})\{F_t(\theta_2, u_{t-1})\rho_1 + (1 - F_t(\theta_2, u_{t-1}))\rho_2\}u_{t-1} + \sum_{j=1}^{p} \delta_j \Delta u_{t-j}\epsilon_t \tag{28}$$

where $\epsilon_t \sim iid(0, \sigma^2)$. Therefore, the following auxiliary regression is used to test the null hypothesis $H_0 : \varphi_1 = \varphi_2 = 0$:

$$\Delta u_t = \varphi_1 u_{t-1}^3 + \varphi_2 u_{t-1}^4 + \sum_{j=1}^{p} \delta_j \Delta u_{t-j} + \vartheta_t \tag{29}$$

The testing procedure of the OEH test consists of two steps. As a first step, one estimates the preferred component form the Eqs. (6)–(8) and obtain residuals, $\hat{u}_t$. In the second step, one uses the residuals and estimate the regression in Eq. (29) by OLS and testing the null hypothesis by using F test.

For the case of logistic trend functions, nonlinear least squares (NLS) can be used for estimating the deterministic trend. By using OLS, the coefficients of Fourier series can be estimated for the frequency, k that is determined by the estimation of the trend function in the range of $1 \leq k \leq k_{\max}$ and chosen the one with having the smallest sum of squared residuals.

OEH suggests two test statistics as F_{LBAE} and F_{FSAE}. F_{LBAE} is for modelling the gradual break by using LSTR functions given in the Eqs. (6)–(8). F_{FSAE} is for the case of modelling breaks by using the Fourier series given in Eq. (23).

4 Empirical Results

As a first step, the linear ADF unit root test with a trend is applied for the debt-to-GDP ratios of 14 EU Member countries. According to the ADF unit root test results, the null hypothesis of a linear unit root cannot be rejected for any country in the sample. Therefore, it can be concluded that 14 EU Member countries don't have sustainable fiscal position in the long run.

The empirical results of the unit root tests allowing for time dependent non-linearity, LNV and Omay (2015) unit root tests, are displayed in Table 1.

The null hypothesis of a linear unit root against the alternative of a stationary nonlinear time trend is tested by the LNV and Omay (2015) tests. The LNV test results displayed in Table I suggest that the null hypothesis of the linear unit root can be rejected for Finland, Slovakia and Sweden for the sample period. That is, the debt-to-GDP ratios of Finland, Slovakia and Sweden have a stationary process and nonlinear trend around the deterministic component of the DGP. The test results of Omay (2015) affirms that Belgium, Czech Republic, Finland, France, Greece, Hungary, Italy, Netherlands, Portugal, Romania and Sweden have a stationary process and nonlinear trend around the deterministic component in their debt-to-GDP series. These 11 out of 14 countries have multiple structural breaks in their relevant series. Therefore, taking account of the time dependent nonlinearity is essential for debt-to-GDP ratios of the sample of countries. By considering the time dependent nonlinearity (i.e. structural break(s)), one can conclude that Belgium,

Table 1 LNV and Omay (2015) nonlinear unit root test results

	LNV			FFFFF	
Country	Model A	Model B	Model C	$\tau_{DF\_C}^{fr}$	$\tau_{DF\_\tau}^{fr}$
Belgium	−1.676	−2.042	−2.472	−1.95262	**−5.227***
Czech	−2.308	−2.338	−3.538	−1.50302	**−5.072***
Denmark	1.881	−2.938	−2.884	−1.90357	−2.285
Finland	**−4.531****	−4.504	−4.526	−1.83245	**−11.004***
France	−2.566	−1.984	−3.936	−2.24051	**−5.300***
Greece	−0.474	−3.828	−4.343	−1.65802	**−6.025***
Hungary	−2.096	−2.891	−3.244	−2.58065	**−7.347***
Italy	−1.916	−3.175	−3.109	−2.44497	**−9.217***
Netherlands	−1.414	−2.454	−3.706	−1.94116	**−5.253***
Poland	−3.389	−3.528	−3.243	−2.13820	−4.032
Portugal	−2.617	−2.803	**−7.275***	−2.34822	**−5.844***
Romania	−2.590	−2.265	−2.256	−2.19473	**−4.698****
Slovakia	−3.290	−3.535	**−4.821***	−2.16193	−2.973
Sweden	−2.352	**−4.234***	−4.247	−1.56665	**−6.471***

Note The values displayed in bold are significant; * denotes 10% significance level; ** denotes 5% significance level; *** denotes 1% significance level

Czech Republic, Finland, France, Greece, Hungary, Italy, Netherlands, Portugal, Romania and Sweden have sustainable fiscal positions in the long-run.

The results of the unit root tests allowing for state dependent nonlinearity, EG, KSS and Sollis (2009) unit root tests, are displayed in Table 2. According to the EG tests results, debt-to-GDP ratios of France, Poland, Romania and Slovakia model nonlinear asymmetric stationarity to the equilibrium. KSS test results indicate that debt-to-GDP ratios of Finland and Greece have a globally stationary nonlinear ESTAR process in the relevant series. Finally, the results of Sollis (2009) displays that Finland, Greece and Slovakia have a symmetric or an asymmetric ESTAR nonlinear stationary process in their debt-to-GDP series. After considering the state dependent nonlinearity, we can conclude that France, Poland, Romania, Slovakia, Finland and Greece can sustain their fiscal position in the long-run.

The results of the unit root tests allowing for the hybrid nonlinearity can be seen in Table 3.

The OY test results indicate that the null of the linear unit root can not be rejected for any country, except Greece. That is, the debt-to-GDP ratio of Greece has nonlinearity and stationarity around smoothly changing trend and intercept. After considering the nonlinearity obtained in the OY test, we can conclude that Greece has the fiscal sustainability in the long-run.

The OEH consists of two parts as mentioned above. The results of the first part, of OEHa, only Netherlands has nonlinearity and stationarity around nonlinear trend and intercept as well as globally stationary asymmetric ESTAR nonlinearity in the DGP of the debt-to-GDP series. On the other hand, the results of the second part of

Table 2 EG, KSS and Sollis (2009) nonlinear unit root test results

	EG		KSS		Sollis (2009)	
Country	Φ_{μ}	Φ_{T}	Case 2	Case 3	$F_{AE,\mu}$	$F_{AE,t}$
Belgium	1.778	1.959	−1.857	−1.878	1.702	1.742
Czech	1.048	2.914	0.014	−0.702	0.335	0.530
Denmark	2.122	2.151	−1.883	−2.025	2.012	2.325
Finland	1.243	2.278	−2.654	**−3.145***	**4.666***	4.993
France	**4.330***	4.918	−0.462	−0.391	0.194	0.331
Greece	1.654	1.849	**−3.672*****	**−3.725****	**7.270*****	**7.428****
Hungary	1.586	2.676	−0.943	−1.035	0.473	0.535
Italy	2.040	2.428	1.471	1.272	1.167	0.812
Netherlands	2.516	2.147	−1.816	−1.718	2.314	1.599
Poland	2.436	**6.204***	−0.835	−1.772	0.718	1.547
Portugal	2.318	2.249	−2.505	−2.658	3.229	3.632
Romania	**4.008***	4.033	−1.238	−1.229	1.309	1.295
Slovakia	3.765	**5.684***	−2.150	−2.539	**4.438***	**6.301***
Sweden	2.895	2.685	−1.336	−1.364	2.076	2.155

Note The values displayed in bold are significant; * denotes 10% significance level; ** denotes 5% significance level; *** denotes 1% significance level

Table 3 OY and OEH unit root test results

	OY			OEH				
				OEHa (F_{LBAE})			OEHb (F_{FSAE})	
Country	$s_{nl,\alpha}$	$s_{nl,\tau}$	$s_{nl,(\tau)}$	$s_{Anl,\alpha}$	$s_{Anl,\tau}$	$s_{Anl,(\tau)}$	τ_{NL,DF_C}	τ_{NL,DF_τ}
Belgium	−1.292	−0.928	−0.595	0.822	0.669	0.288	0.839(1)	1.428(1)
Czech	−0.785	1.106	1.145	0.317	1.047	1.059	**12.773(2)*****	**9.653(2)*****
Denmark	−2.515	−1.879	−1.684	3.123	3.889	2.266	1.838(2)	4.057(2)
Finland	−0.998	−0.962	−0.923	0.675	0.622	0.571	**24.822(1)*****	7.074(1)
France	−0.029	−0.728	−0.534	0.141	0.698	1.865	2.838(1)	2.962(1)
Greece	**−3.62***	−3.72	−2.621	7.106	5.390	4.386	**8.017(1)****	4.063(1)
Hungary	−1.060	−1.078	−1.340	0.612	0.544	0.950	**16.298(1)*****	7.153(1)
Italy	−0.347	0.336	0.313	0.352	0.105	0.587	**40.282(3)*****	**56.624(2)*****
Netherlands	−2.101	−3.557	−2.392	2.928	**9.602***	3.697	**12.608(1)*****	5.727(2)
Poland	−2.626	−0.79	−0.767	3.402	0.674	0.677	**6.408(2)***	6.916(3)
Portugal	−2.681	−1.757	−0.895	3.543	1.638	1.092	**9.725(1)****	6.199(1)
Romania	−1.00	−1.200	−1.154	0.801	0.725	0.674	**6.368(2)****	1.800(2)
Slovakia	−3.219	−1.470	−1.669	5.530	4.143	5.675	4.467(2)	5.456(2)
Sweden	−1.604	−2.683	−2.686	1.977	3.881	3.879	**28.812(2)*****	**11.152(2)*****

Note The values displayed in bold are significant; * denotes 10% significance level; **denotes 5% significance level; *** denotes 1% significance level

Table 4 Summary table

Country	Time dependent nonlinearity (structural break)		State dependent nonlinearity			Hybrid nonlinearity		
	Single	Multiple				LNV-KSS	LNV-Sollis (2009)	
	LNV	FFFFF	EG	KSS	Sollis (2009)	OY	OEH	
							OEH (a)	OEH (b)
Belgium		+						
Czech		+						+
Denmark								
Finland	+	+		+	+			+
France		+	+					
Greece		+		+	+	+		+
Hungary		+						+
Italy		+						+
Netherlands		+					+	+
Poland			+					+
Portugal	+							+
Romania		+	+					+
Slovakia	+		+		+			
Sweden	+	+						+

OEH, OEHb, reveals that except Belgium, Denmark, France and Slovakia, every country has sustainable fiscal position after considering the multiple structural breaks with an asymmetric ESTAR type of behaviour around the nonlinear trend in their debt-to-GDP ratios.

The summary table of the unit root test results is given in Table 4.

5 Conclusion

This study explores the fiscal sustainability of 14 EU Member countries in the sample period covering 1999: Q1–2017: Q4. A linear ADF and a battery of nonlinear unit root tests are applied to the debt-to-GDP series of relevant countries in order to reach more accurate results, after considering both the nonlinearity in the DGP and the source of nonlinearity. The unit root tests applied and the results of these unit root tests are tabulated in Table 4 which offers the summary of the results.

The first result of this study indicates that none of the 14 countries have sustainable budget imbalance in the long-run according to the linear ADF unit root test.

The second result displays that without considering the nonlinearities in the DGP, one can conclude misleading results. As it can be seen from the nonlinear unit root test results, many countries have a single smooth structural break or multiple smooth structural breaks in their debt-to-GDP data. Generally speaking, time dependent nonlinearity must be taken into account when testing the sustainability of fiscal imbalances. The third result of this study is in addition to time dependent nonlinearity, 6 out of 14 countries exhibit state dependent nonlinearity in their relevant data. The last result of this study emphasizes the importance of hybrid nonlinearity which states the occurrence of a combination of time and state dependent nonlinearity at the same time, as it is seen from the results if OEHb test.

As a conclusion, we can emphasize that while testing the fiscal sustainability of countries, the nonlinearities and the source of nonlinearities in the DGP of debt-to-GDP series need to be taken into account in order to prevent the misleading policy decisions that are taken by the policy makers.

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Corporate Governance: Achieving Good Corporate Governance in order to Deal with the Contagion Effects of Financial Crisis

Mustafa Avcin

Abstract This paper investigates the contagion effects of the financial crisis between selected stock markets using the ARCH and ARMA models. Further investigation has been conducted to pursue the importance of corporate governance elements involved in the proposed research models, and a set of mediator variables (dummy variables) have been used to capture the variations, significantly accounting for variations in the financial market contagion. The statistical outcomes revealed that corporate governance performance is positively related to internal and external governance behavior and negatively associated with financial market contagion. The empirical evidence exhibits, after controlling for corporate culture and corporate legality elements, that there has been a significant decrease in the financial market contagion during and post-crisis. The results also imply that it is more important to establish the right firm based corporate governance mechanism for companies prior to reforming capital market provisions to deal with the complexities of market contagion. Also, the objective of establishing the right legal system will continue to be a main priority on the politician's agenda in order to prevent the impact of financial market contagion. The results could be helpful for investors in portfolio analysis for decision-making and for policymakers for reducing financial instability in crisis periods.

Keywords ARCH · ARMA · Corporate culture · Corporate legality · Market contagion · Portfolio analysis

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1 Introduction

This paper corroborates that, corporate governance is linked to Collaborate, Control, Create, Compete, Board of Directors and Managerial Incentives, Capital Structure Provisions and Control Systems, Law and Regulations and Capital Market elements that drives the overall power of an organization (Avcın and Balcıoğlu 2017a, b). Hence, corporate governance has been linked to a system of management orientation, organization culture types and value drivers that help establish financial value and social value (greatest happiness) for the whole society (Avcın and Balcıoğlu 2017a, b). Furthermore, corporate governance incorporates these core elements into organisation structures to generate better internal and external governance behaviour and help manage negative impacts of external factors and issues (Gillan 2006: 383).

On the other hand, financial market contagion has been linked to the crisis across financial markets caused by the collapse of the USA housing market because of subprime mortgages and bankruptcy of financial institutions such as the Lehman Brothers leading to a fall in the overall asset prices in all over the world, Diddier et al. (2010). According to Di Patti and Sette (2012) the 2008 crisis accelerated with turmoil in capital markets leading to unstable interest rates making borrowing and lending difficult and leading to an uncertainty in the equity markets. Furthermore, (Reinhart and Rogoff 2011) argued that, 21st century financial chaos has been linked to lack of expertise and general knowledge of regulators, lacking self-confidence of investors and thoughtless actions of both. Furthermore, has been linked to financial turmoil spread that has led to the rise in the international debt crisis for many countries asking for financial help such as, Ukraine and Iceland obtaining emergency funding from the World Bank (IMF), Mollah et al. (2014). Therefore, the financial market contagion is greatly fundamental risk for those nations that have integrated their financial mechanisms with global financial markets. Financial contagion has become an issue at national and at the international level because of growing integration of world economies which made it more important unusual occurrence since these countries become more interdependent.

First, this study seeks to investigate the relationship between co-movements in more precise case, the 2008 financial crisis so called, contagion between stock markets of US, EU countries and Turkey. The examination consist of the justification of Autoregressive Conditional Heteroscedasticity between these markets using the ARMA (1, 1) similar to ARCH (1, 1) model (Engle 2002).

Secondly, the paper aims to find an answer whether the provisions of corporate culture and corporate legality elements drive an organisation to a good corporate power that help reduce the impact of financial market contagion during and after the crisis.

2 Literature Review

It can be deduced that, the spill over effects of contagion can be spread globally as negative externalities strongly impacting on many countries creating similar or same adverse effects so called "co-movements" indicating contagion. Hence, financial market contagion is about highly correlated stock markets in different countries that have created a crisis leading to a more rise in shocks (Forbes and Rigobon 2002). Therefore, this kind of an external shock from the first financial market can impact on others reacting in similar way which may result in financial contagion and such actions would show a sign of co-movements of financial markets. Therefore, it is extremely fundamental to examine the behaviour and the co-movement between countries stock markets and the reasons that have created instability and vulnerability in global financial markets. Furthermore, Chittedi (2015: 50–51) defined contagion as the "co-movements" triggered by the "common shocks" and she has found that, there was a strong correlation between the stock markets during the crisis and after the crisis periods. Hence, there was co-movement between the US and Indian stock markets indicating contagion.

This paper aims to stress the validity of the eight elements are complementary that help create a governance system for organisations to provide the right and consistent provisions in line with laws to fight against contagion during and after crisis. One of the reasons for such examination would be to stress that, there has been a limited investigation on how firms should behave and maintain the right provisions and extension strategies to overcome the negative impacts of co-movements of financial markets so called contagion. Therefore, the above discussion clearly exhibits that, the positive relationship between the key elements of corporate culture with firms' internal governance behaviour (market culture) and a significant positive association of the key elements of corporate legality with firms' external governance behaviour (capital market culture) will lead to an adoption of better corporate governance practices to fight against market contagion. Also, the policy makers and regulators should be aware about the readiness of how the capital markets run and enhance their understanding about the validity of corporate governance as a system and recommend severe and strict set of defined actions on corporate governance in financial institutions. Therefore, the research model of corporate governance in this study provides valuable insights in helping policy makers to improve the regulatory framework and for researchers to measure dual value at firm based performance in order to resist co-movements of financial shocks.

In the last decade there has been a vast amount of research in forecasting future volatility of equity markets. Table 1 illustrates some completed work about market contagion by various researchers.

The ARCH model used in the study provides an assumption that, the future expected return's variance will equal the squared residuals' weighted average which was first improved by Engle (1982). However, a better model would be the GARCH model a more generalised ARCH model first constructed by Bollerslev (1986) which is similar in structure to an ARMA model. The simple ARCH model

Table 1 Financial market contagion research outcomes

Year	Research outcome	Reference
2012	**Stock market integration: Case of the Philippines** Found that the world crisis was caused by the relative changes in the correlation between nations that changes with time	Tan (2012)
2014	**Modeling international stock market contagion using multivariate fractionally integrated APARCH approach** There was a co-movement effect between Brazil and Mexico indicating a strong contagion in the early days of the crisis and after the bankruptcy of the Lehman brothers in the US but correlations has decreased after 2009 between Brazil and US	Mansouri and Mighri (2014)
2014	**Price limit and financial contagion: Protection or illusion? The Tunisian stock exchange case** They showed that, the "price limits" had a role in stabilizing the market and in other markets. However, the 2008 crisis have caused a fall in the asset prices in Tunisia	Dabbou and Silem (2014)
2015	**Financial crisis and contagion effects to indian stock market: 'DCC–GARCH' analysis** The author found that there was a strong correlation between the stock markets during the crisis and after the crisis periods. Hence, there was a co-movement between the US and Indian stock markets indicating contagion	Chittedi (2015)
2012	**Contagion in international stock markets during the sub prime mortgage crisis** The author have examined the contagion effect across international financial markets after the mortgage crisis in the housing market in US. The author found that not all but some of the countries have been badly effected from the contagion caused by the sub-prime mortgages in the US	Lee (2012)
2011	**Contagion effect of financial crisis on OECD stock markets** The researchers have examined the co-movement so called contagion effect between US and OECD countries caused by the global financial turmoil between 2007 and 2009. They used the DCC method and found that there was a significant increase in the mean of DCC between US and OECD indicating the existence of contagion	Kazi et al. (2011)

Notes During the investigation of the above research outcomes it is noted that financial contagion was the cause of subprime mortgage crisis in the USA and that co-movement of financial markets led to the world financial crisis

involves Autoregressive Conditional Heteroscedasticity which helps to forecast future volatility based on information today. The ARCH effect is analysed by estimating autocorrelations of the squared residuals at a condition that they are significant which will imply the GARCH (1, 1) model and when the outcome of the p values are all zero it indicates Autoregressive Conditional Heteroscedasticity (ARCH) or vice-versa.

3 Methodology

The investigation proceeds by using the ARMA (1, 1) model to examine financial market contagion between stock markets of US, EU countries and Turkey. In the model the (AR) states the value of a variable in the future compared to previous periods and AR (p) indicates lags with mean constant and the number for lagged variable in time. (MA) illustrates the interconnection between a parameter and residuals from the previous periods where, MA (q) shows the moving average with q lags.

The ARMA model:

ARMA (p, q)

$$x_t = \sum_{j=1}^{p} a_j x_{t-j} + \sum_{j=1}^{q} b_j \varepsilon_{t-j} + \varepsilon_t,$$

where $\{\varepsilon t\}$ *is* white noise with mean constant and is uncorrelated with the x_t –n. The left hand side of the equation is the process of AR and the right hand side of the equation is the process of MA. The representation of the (AR (∞)) is as follow:

$$x_t = \sum_{j=1}^{\infty} \pi_j x_{t-j} + \varepsilon_t,$$

where π_j are constants with $\Sigma \pi_j^2 < \infty$.

The study seeks to find out that, co-movement of financial market shocks exist between the selected equity markets, and further pursue deeper investigation to demonstrate the validity of corporate governance provisions based on the research model to overcome the negative impact of contagion so called co-movement of financial market shocks. Hypotheses 1, 2, 3, and 4 will be tested to capture the variations significantly account for variations in the financial market contagion. Hypotheses 5, 6, 7, and 8 will be tested by using set of mediator variables (dummy variables) based on the research model (Fig. 1a) in the study. Propositions are introduced to help to establish the right firm based corporate governance culture for better running companies in order to deal with the complexities of market contagion.

3.1 Data

The data covers the daily stock prices from 2002 to 2017 before, during and after the 2008 crisis and results of a survey questions which consisted of two sections

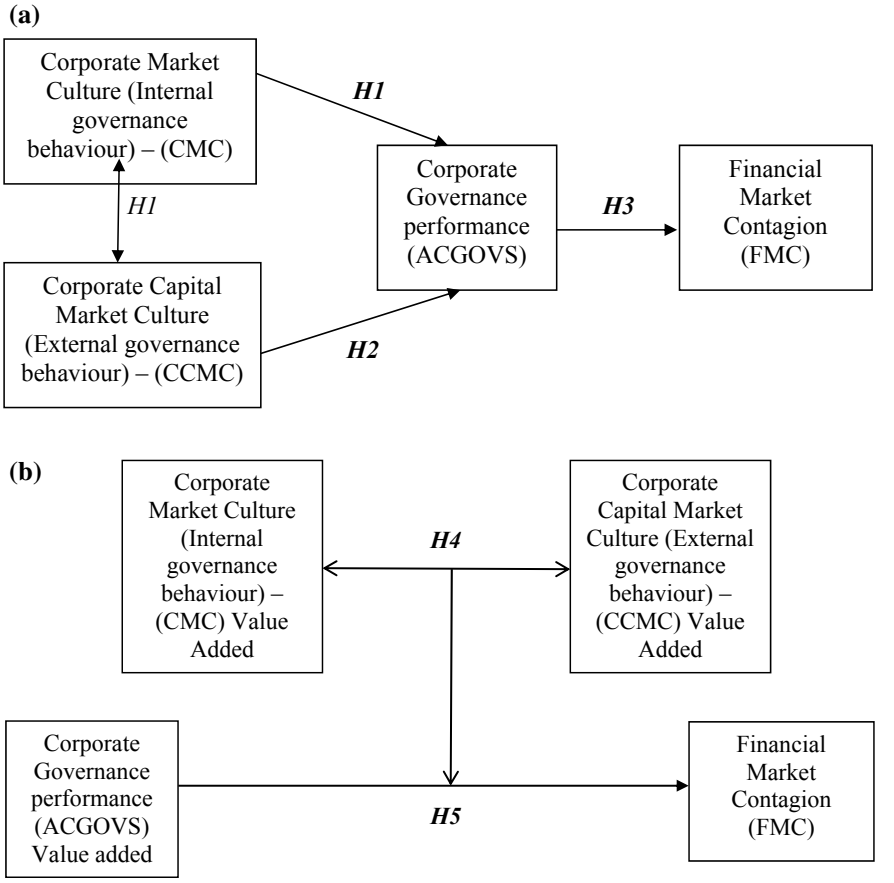

Fig. 1 **a** Corporate Governance and financial market contagion research model. **b** Corporate governance and financial market contagion empirical condition for mediation

and, the first sets of 44 questions were distributed to the employees and the second sets of 45 questions were distributed to the employers and members of the board of directors to complete. Out of the 380 questionnaires sent, 320 were completed in total. The sample size was determined by the sample size calculator with a confidence level of 95% out of 15,000 populations. The results of the survey revealed that, on average 69.26% of Collaboration; 69.14% of Board of Directors and Managerial Incentives; 40.70% of Control; 77.77% of Capital Structure and Control Systems; 56.88% of Creativity; 45.85% of Law and Regulations; 70.22% of Compete (Market Culture) and 70,40% of Capital Markets provisions had "NO" answers (*see Panel D in Appendix*). Therefore, improvements in these provisions having to see "YES" answers will add value to the organisation and develop a strong corporate governance mechanism to combat issues of financial contagion.

Moreover, the assumption would be that, firms should also provide these provisions in order to establish better corporate governance mechanism to face the complexities arise from financial markets contagion. Hence, the data for examining the co-movements between stock markets were obtained from https://www.investing.com—Stock Market Quotes & Financial News.

4 The Research Model

Hypotheses

Hypothesis 1 Corporate market culture behaviour has positive impact on corporate governance performance that leads to better running companies.

Hypothesis 2 Corporate capital market culture behaviour has a positive impact on corporate governance performance that leads to better running companies.

Hypothesis 3 Corporate governance performance has positive relationship with financial *market contagion*.

In order to capture the variations significantly account for variations in the financial market contagion, a set of mediator variables are constructed based on the Corporate Governance and Financial Market Contagion Research Model (Fig. 1b) in the study.

Therefore, the following propositions and hypotheses were formed. In sound conditions and requirements,

Proposition 1 *Corporate Market Culture (internal governance) and Corporate Capital Market Culture (external governance) provisions are complementary and help firms achieve good corporate governance mechanism that positively impact on corporate performance and profitability.*

Hypothesis 4 Corporate governance is significantly related to corporate market culture (internal governance) and corporate capital market culture (external governance) provisions and improvements add value to corporate governance performance and profitability.

Hence, firms with better and strong corporate governance mechanism would be able to combat financial market contagion. In sound conditions and requirements,

Proposition 2 *Firms with good corporate governance mechanism is less likely to interact with instable financial markets. They have established the right governance mechanism that help combat financial market contagion prior to any expected adverse effects. Therefore, firms achieving good corporate governance mechanism would be in a position to combat financial market contagion.*

Hypothesis 5 Firms achieving good corporate governance performance help combat financial *market contagion*.

5 Empirical Results—Section One

Before getting to the interpretation of the results resoundingly, it may be relevant to reveal the importance of the ARCH effect that refers to the estimation of auto-correlations of the squared residuals at a condition that, they are significant which will imply the GARCH (1, 1) model. The outcome of the *p* values indicates Autoregressive Conditional Heteroscedasticity (ARCH) and proves that, there is financial market contagion between stock markets chosen in the investigation and indicates the validity of corporate governance elements involved in the research model to combat against financial crisis.

The empirical results of Table 2 and 3 illustrate that, the *p* values in the last column for those stocks that do not have zero to four places imply no Auto Regressive Conditional Heteroscedasticity (no ARCH) where the null hypothesis is

Table 2 Autocorrelations of daily stock prices from 2002 to 2017

	S&P 500			FTSE 100			BIST 100		
Lag	AC	Q-Stat	*p value*	AC	Q-Stat	*p value*	AC	Q-Stat	*p value*
1	−0.102	29.51	0.000	−0.045	7.68	0.006	0.005	0.098	0.754
2	−0.057	38.91	0.000	−0.034	11.97	0.003	0.012	0.672	0.714
3	0.035	42.43	0.000	−0.063	27.08	0.000	−0.001	0.678	0.878
4	−0.023	43.91	0.000	0.048	36.01	0.000	−0.019	2.08	0.719
5	−0.049	50.64	0.000	−0.061	50.19	0.000	0.012	2.67	0.750
6	0.017	51.48	0.000	−0.028	53.28	0.000	−0.049	11.77	0.067
7	−0.024	53.09	0.000	0.015	54.18	0.000	−0.013	12.46	0.086
8	0.023	54.58	0.000	0.037	59.43	0.000	−0.012	12.98	0.113
9	−0.017	55.37	0.000	−0.005	59.51	0.000	0.025	15.40	0.080
10	0.044	60.84	0.000	−0.016	60.54	0.000	0.060	29.28	0.001
11	−0.025	62.66	0.000	−0.024	62.72	0.000	−0.009	29.59	0.002
12	0.033	65.83	0.000	−0.004	62.79	0.000	0.012	30.13	0.003
13	0.005	65.92	0.000	0.002	62.80	0.000	0.029	33.32	0.002
14	−0.040	70.47	0.000	−0.016	63.80	0.000	0.033	37.55	0.001
15	−0.050	77.56	0.000	0.005	63.90	0.000	−0.015	38.39	0.001

a. The underlying process assumed is independence (white noise)

b. Based on the asymptotic chi-square approximation

Notes The values of the autocorrelations from the first order are significant after 15 lags which imply ARCH (1, 1) or ARMA (1, 1) and most generally the GARCH (1, 1) model. The test p values in the last column for those stocks that do not have zero to four places imply no Auto Regressive Conditional Heteroscedasticity (no ARCH) where the null hypothesis is rejected. In this case S&P 500, FTSE 100 have ARCH

Table 3 Autocorrelations of daily stock prices from 2002 to 2017

CAC 40				DAX 30			MICEX		
Lag	AC	Q-Stat	*p value*	AC	Q-Stat	*p value*	AC	Q-Stat	*p value*
1	−0.030	3.52	0.061	−0.014	0.742	0.389	0.018	1.21	0.270
2	−0.034	7.96	0.019	−0.022	2.53	0.282	−0.016	2.14	0.343
3	−0.059	21.40	0.000	−0.027	5.32	0.149	−0.018	3.30	0.347
4	0.013	22.06	0.000	0.008	5.55	0.235	−0.029	6.45	0.168
5	−0.073	42.46	0.000	−0.064	21.09	0.001	0.013	7.11	0.212
6	−0.016	43.47	0.000	−0.001	21.09	0.002	−0.019	8.45	0.206
7	0.022	45.29	0.000	0.003	21.11	0.004	0.014	9.22	0.237
8	0.029	48.39	0.000	0.028	24.03	0.002	−0.015	10.10	0.258
9	−0.028	51.44	0.000	0.000	24.03	0.004	−0.016	11.11	0.268
10	−0.034	55.89	0.000	−0.024	26.18	0.004	−0.035	15.79	0.106
11	0.009	56.19	0.000	0.035	30.89	0.001	−0.039	21.68	0.027
12	−0.001	56.20	0.000	−0.002	30.90	0.002	0.011	22.13	0.036
13	0.007	56.41	0.000	−0.009	31.24	0.003	0.004	22.19	0.052
14	0.011	56.89	0.000	−0.007	31.43	0.005	0.074	43.11	0.000
15	−0.005	57.00	0.000	−0.012	31.95	0.007	0.025	45.48	0.000

a. The underlying process assumed is independence (white noise)

b. Based on the asymptotic chi-square approximation

Notes The values of the autocorrelations from the first order are significant after 15 lags which imply ARCH (1, 1) or ARMA (1, 1) and most generally the GARCH (1, 1) model. The test p values in the last column for those stocks that have no zero to four places imply Auto Regressive Conditional Heteroscedasticity (ARCH) where the null hypothesis is rejected. In this case BIST 100, DAX 30 and MICEX stocks have no Auto Regressive Conditional Heteroscedasticity (no ARCH). Hence, these stocks have constant volatility

not rejected. In this case S&P 500, FTSE 100 and CAC40 have ARCH. However, BIST 100, DAX 30 and MICEX stocks have no Auto Regressive Conditional Heteroscedasticity (no ARCH). Hence, these stocks have no constant volatility. Also, the results of the portfolio data presented in Table 4, based on the daily standard deviations, the most volatile is the BIST 100 and second is DAX 30. The value of Kurtosis is less than 3 indicating that all the stocks have no fat tails. The negative skewness implies that, the left tail is particularly extreme. In this case FTSE100, BIST 100 and MICEX have strong left tails.

These outcomes reveal that, there is evidence of co-movements between stock markets indicating constant volatility and hence contagion. In order to show evidence of volatility of the percentage stock returns and daily stock prices from 2002 to 2017 sequence charts have been reproduced as seen in Fig. 2 and 3.

All chosen stock markets fluctuated during crisis time and after crisis time characterized by volatility clustering indicating the existence of heteroscedasticity. Hence, Table 5 shows regional comparison of average daily stock returns from 2002 to 2017 which implies that, the average daily percentage stock market returns in Euro-Asian countries during crisis and pre crisis periods in this case Russia and

Table 4 Portfolio data from 2002 to 2017

	Mean	Std. dev	Skewness	Kurtosis
SXP 500 US	1521.87	399.97	0.347	−0.908
FTSE 100	5621.73	930.91	−0.351	−0.871
BIST 100	50232.86	24069.97	−0.147	−1.206
CAC 40	4114.22	778.73	0.405	−0.488
DAX 30	6761.93	2427.98	0.393	−0.721
MICEX	1266.58	511.30	−0.527	−0.898

Sample: April 02, 2002 to April 28, 2017 except S&P 500 sample is from Jan 04, 2006 to May 01, 2017

Notes It is clearly evident from the daily standard deviations that the most volatile is the BIST 100 AND DAX 30. The values of Kurtosis is less then 3 indicating that all the stocks have no fat tails and negative skewness means the left tail is particularly extreme. In this case FTSE100, BIST 100 and MICEX have strong left tails

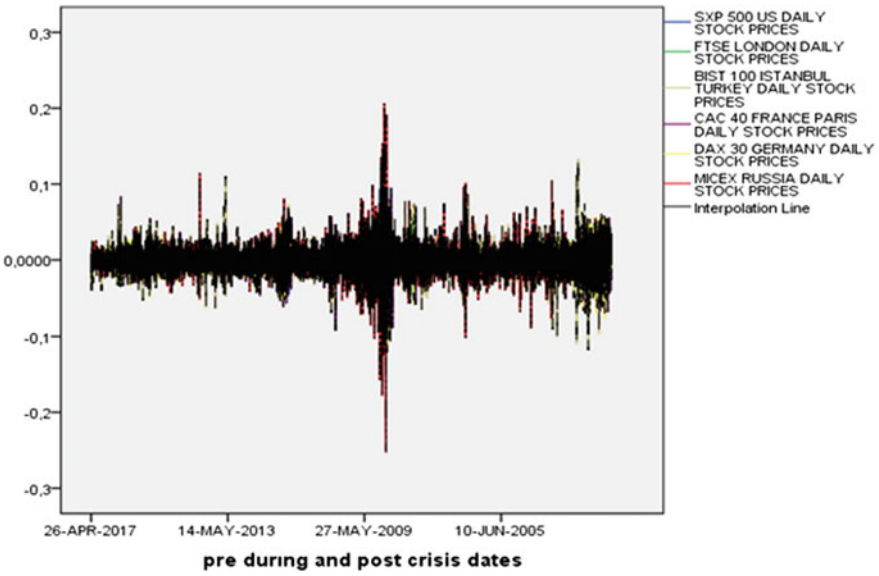

Fig. 2 Daily stock prices from 2002 to 2017. *Source* Authors own. Data obtained from https://www.investing.com/indices/historical-data

Turkey have been higher than those in North America and Europe. These results are consistent with the results of (Tan 2012: 81). However, during post crisis period it is evident that the average stock returns have matured.

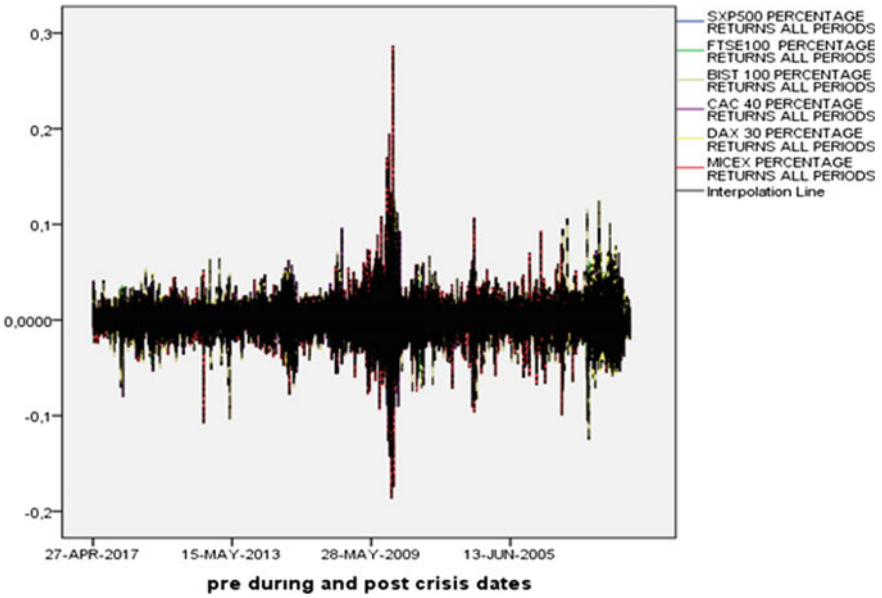

Fig. 3 Daily percentage stock returns from 2002 to 2017. *Source* Authors own. Data obtained from https://www.investing.com/indices/historical-data

Table 5 Summary statistics of average daily percentage stock returns on international stock indexes from 2002 to 2017

Region	Country	Stock markets	Pre-crisis period from Jan. 2002 to Dec. 2007 (%)	During crisis period from Jan 2008 to Dec. 2012 (%)	Post crisis period from Jan. 2013 to Apr. 2017 (%)
North America	US	S&P 500	0.03	0.01	0.05
Europe	UK	FTSE 100	0.02	0.00	0.02
	France	CAC 40	0.02	−0.02	0.04
	Germany	DAX 30	0.04	0.01	0.05
Euro-Asia	Russia	MICEX	0.15	0.02	0.04
	Turkey	BIST 100	0.13	0.04	0.03

Notes During the crisis period the daily average returns for all countries have decreased and for France has been negative. During the pre-crisis period the average stock returns are all positive and there have been higher returns in Turkey and Russia respectively. However, after the crisis of 2008 up to April 2017 there has been an improvement in France, US, Germany, but a sharp fall in Turkey and Russia. Additionally, Russia and Turkey stock returns have fallen compared to pre-crisis period of January 2002 to December 2007

Source Authors own SPSS 20.0. Data obtained from https://www.investing.com/indices/historical-data

6 Empirical Results—Section Two

Table 6 shows the test results for *Hypothesis 1 corporate market culture behaviour has positive impact on corporate governance performance and Hypothesis 2 corporate capital market culture behaviour has a positive impact on corporate governance performance that lead to better running companies*. Hence, Table 8 exhibits the test result for *Hypothesis 3 corporate governance performance has positive relationship with financial market contagion* (Table 7).

Result of Hypothesis 3 reveals that, corporate governance has no association with market contagion.

Next the study concentrates and examines the validity of the following question;

1. How to achieve good corporate governance in order to deal with during and post contagion effects of financial crisis?

The study aims to explore that, the firm level governance interaction with financial markets matters more influencing corporate performance and profitability. To proceed with the investigation about the validity of the improvements in the cultural and legality elements it was necessary to assume that "NO" answers will be "YES" answers for the following questions as illustrated in Panel D in the Appendix. The contribution of the "YES" answers to the internal and external governance is the weighted average of the mean values of the questions representing the "NO" answers indicated as a value added "YES" answers to the Average Corporate Governance Score (ACGOVS) index respectively.

Table 6 Results for Hypotheses 1 and 2

Dependent variable: Average Corporate Governance Score (ACGOVS)							
	Hyp	Intercept	R^2	F stat	t	p-value	Unstandardized coefficients β
Corporate market culture elements (CMC) corporate	*HI*	25.58	0.90	108.426	10.41	0.000	1.082
Capital market culture elements (CCMC)	*H2*	7.77	0.26	4.01	2.00	0.0 70	1.648

Number of observations 320

Notes All sample mean corporate governance score has been determined by the corporate market culture elements and corporate capital market elements. The weights are as follows: Average Corporate Governance Score = 25.58(constant term) + 1.082 (Unstandardized Betas for corporate market culture elements) + 0.104 (error term). Average Corporate Governance Score = 7.77 (constant term) + 1.648 ((Unstandardized Betas for corporate capital market culture elements) + 0.823 (error term). The p values below 0.05 *, **, and *** indicate significance at 10%, 5%, and 1% respectively

Table 7 Overall summary statistics

	Corporate Market Culture elements	Corporate Capital Market Culture elements	Average Corporate Governance Score
1	32.73	26.10	58.83
2	28.47	26.36	54.83
3	24.93	29.36	54.29
4	22.20	26.90	49.10
5	24.60	28.20	52.80
6	28.86	25.80	54.66
7	31.33	29.10	60.43
8	27.40	30.20	57.60
9	21.20	28.20	49.40
10	22.26	27.00	49.26
11	28.86	27.80	56.66
12	26.26	30.10	56.36
13	12.75	25.00	37.75
Total Number of firms	13	13	13
Mean	**25.52**	**27.70**	**53.22**
Median	26.26	27.80	54.66
Minimum	12.75	25.00	37.75
Maximum	32.73	30.20	60.43
Std. deviation	5.20	1.67	5.89

a. Limited to first 100 cases

Notes The distribution of ACGOVS index across firms in North Cyprus has been 53.22% and as shown the sample almost is equally distributed across firms. These summary statistics points out that firm corporate governance practices varies implying that firms in North Cyprus on average have lower governance rankings because the overall legal framework is inefficient

Source Authors own

Table 8 Result for Hypothesis 3

Dependent variable: Contagion—average percentage returns 2001–2017							
	Hyp	Intercept	R^2	F stat	t	p-value	Unstandardized Coefficients β
ACGOVS	*H3*	0.007	0.021	2.768	−1.664	0.09	−0.002

Number of observations 320

Notes All sample mean corporate governance score has been determined by the corporate market culture elements and corporate capital market elements. The weights are as follows: Average Corporate Governance Score = 0.007 (constant term) − 0.002 (Unstandardized Betas for corporate market culture elements and corporate capital market elements) + 0.001 (error term). The p value below 0.05 indicates significance at 10%, 5%, and 1% respectively

Table 9 Results for Hypothesis 4

Dependent variable: average corporate governance score (ACGOVS)							
	Hyp	Intercept	R^2	F stat	t	p-value	Unstandardized coefficients β
Corporate market culture elements | value added (CMCVA)	*H4*	6.45	0.99	682.046	31.59	0.000	0.569
Corporate capital market culture elements value added (CCMCVA)					9.64	0.000	0.519

Number of observations 320

Notes All sample mean corporate governance score has been determined by the corporate market culture elements and corporate capital market elements. The weights are as follows: Average Corporate Governance Score = 6.45 (constant term) + 0.569 (Unstandardized Betas for corporate market culture elements value added) + 0.519 (Unstandardized Betas for corporate capital market culture elements value added) + 0.072 (error term). The p values below 0.05 indicate insignificance at 10%, 5%, and 1% respectively

Results of Table 9 reveals the overall impact of the "YES" answers to the overall corporate performance of firms indicating the importance of the complementarity of the internal and external governance elements where the *p* values are significant at 10%, 5% and 1% respectively. Hence, Table 10 represents the overall value added ACGOV scores for firms.

7 Empirical Results—Section Three

Regression results

See Table 11.

Table 10 Overall Summary statistic

For legality elements 132 and for cultural elements 188 observations have been obtained. The overall mean CGOV value added rankings are 86.58% and vary from a firm average of 61.75% to 98.14%. The corporate governance ranking varies from 36.08% to 133.13% respectively.

Panel G: Firm level corporate governance indices (CGOV) value added

Firms	No. of observations	Mean	Median	Minimum	Maximum	Standard deviation
All sample	320	86.58	83.05	45.15	125.53	26.80
1	25	95.40	94.00	69.52	129.89	7.31
2*	26	89.05	89.22	53.59	123.58	10.20
3*	26	88.39	82.98	50.41	122.05	9.79
4	25	79.95	75.72	39.26	120.39	12.01
5	25	85.93	82.98	36.08	131.48	19.55
6	25	88.74	86.87	53.59	131.54	13.78
7	25	98.14	97.32	40.92	126.76	11.71
8	25	93.71	92.54	36.08	130.01	16.94
9	25	80.51	76.61	40.85	113.96	9.41
10	25	80.22	77.31	39.26	120.39	11.91
11	25	92.06	85.27	42.51	133.13	16.13
12	25	91.73	82.98	48.82	131.61	13.92
13*	18	61.76	55.78	36.08	117.15	15.41

Notes The distribution of CGOV value added index across firms in North Cyprus has been 86.58% and the sample almost is equally distributed across firms. These summary statistics points out that firms corporate governance practices in North Cyprus on average have better governance rankings because the overall legal framework has improved

Source Authors own

Table 11 Contagion, internal governance, external governance, firm level performance

Sample (adjusted): 2002–2017
Contagion included observations: 3769
Firms included observations: 320
Standard errors in () & t-statistics in []

	(1)	(2)	(3)	(4)
Panel A: Test of internal and external governance				
Internal governance	0.001 [0.705]	−0.004 [−1.040]	−0.007 [−1.661]	−0.007 [−1.609]
	(0.002)	(0.004)	(0.004)	(0.004)
Internal governance × value added		0.258 [1.462] (0.007)	0.013 [1.557] (0.008)	0.012 [1.466] (0.008)

(continued)

Table 11 (continued)

Sample (adjusted): 2002–2017 Contagion included observations: 3769 Firms included observations: 320 Standard errors in () & t-statistics in []				
	(1)	(2)	(3)	(4)
External governance			−0.004 [−1.754]	−0.012 [−1.504]
			(0.002)	(0.008)
External governance × value added				0.014 [1.057] (0.013)
	NO	*YES*	*NO/YES*	*YES*
R^2	*0.003*	*0.014*	*0.045*	*0.053*
AR^2	*−0.003*	*0.003*	*0.023*	*0.023*
p	*(0.482)*	*(0.270)*	*(0.116)*	*(0.135)*
Panel B: Test of firm level performance				
Corporate governance score average	−0.002 [−1.664] (0.001)	−0.008 [−2.207] (0.004)	−0.008 [−2.185] (0.004)	−0.007 [−2.020] (0.004)
Corporate governance score × average value added		0.011 [1.695] (0.007)	0.014 [2.139] (0.007)	0.016 [2.288] (0.007)
MC dummy omitted		–	−0.007 [−1.892] (0.004)	−0008 [−2.072] (0.004)
CMC dummy omitted				−0.004 [−0.861] (0.004)
	NO	*YES*	*YES/NO*	*YES/NO*
R^2	*0.021*	*0.042*	*0.068*	*0.074*
AR^2	*0.013*	*0.027*	*0.046*	*0.044*
p	*(0.099)*	*(0.062)*	*(0.028)*	*(0.044)*

Notes The dependent variable in all regressions is Contagion, which are the co-movements of financial markets weighted average returns between 2002 and 2017. Internal governance is the weighted average of Collaboration, Control, Creativity and Market Culture elements and external governance is the weighted average of Board of Directors and Managerial Incentives, Capital Structure and Control Systems, Law and regulations and Capital Market elements. Corporate Governance Score (CGOVS) is the weighted average of the eight elements and Corporate Governance Value Added (CGOVVA) is the weighted average of the eight elements plus the weighted average of the dummy variables that contributed to the improvement of corporate governance performance. All dummies are equal to 1 if the answer is YES rather than NO. All regressions include 13 firms and 132 employers and 188 employees' contribution. p values are in () and indicate significance at 10%, 5%, and 1% respectively

8 Discussion

The study has stressed the importance of the right corporate governance provisions that are necessary to maintain better internal and external governance behaviour to fight against impacts of financial market contagion.

In section one, the study has proven that, there is financial market contagion between markets and the investigation has indicated that the validity of the corporate governance elements can help combat against financial crisis. In order to prove this case, it was really fundamental to draw attention to the Auto Regressive Conditional Heteroscedasticity (no ARCH) between chosen and investigated stock markets and reproduced sequence charts of the daily stock prices and daily percentage returns of stock prices from 2002 to 2017 between pre, during and post crisis dates.

In section two, the study has investigated the relationship between firms' corporate culture and capital market culture behaviour on corporate performance and financial market contagion. It was extremely important to see that, firm level governance interaction with financial markets mattered more influencing profitability. In order to proceed with the investigation the "NO" answers for cultural and legality elements were assumed to be "YES" answers that have added value to the firms' Average Corporate Governance Scores (ACGOVS) implying improvements in their governance mechanism and corporate performance and able to combat with the contagion effects of financial crisis.

In section three, further investigation has been conducted with a set of mediator variables (dummy variables) to capture the variations significantly account for variations in the financial market contagion and corporate performance.

9 Conclusion

The paper revealed that, prior to interaction with financial markets, it is fundamentally important for firms to establish their firm based internal and external governance provisions in order to deal with the complexities of contagion. The paper exhibits that, depending on the improvements in the internal and external governance provisions at firm level and controlling for corporate culture and corporate legality elements' provisions there has been a decrease in the negative impact of financial market contagion. It was found out that, during crisis periods the provisions of internal and external elements acted as mediators determining the impact of financial market contagion. Therefore, achieving good corporate governance performance definitely can help firms to combat financial market contagion. Hence, having the right corporate governance mechanism in place will surely help firms to protect themselves against the adverse effects of market contagion which in this study the omitted dummy variables have significantly reduced the negative impacts of financial market contagion.

10 Recommendations

Corporate Governance and Financial Market Contagion Research Model and the Corporate Governance and Financial Market Contagion Empirical condition for Mediation model could also be used by future researchers to measure corporate management level in terms of social and financial value and also to predict the influence on their ability to deal with adverse effects coming from countries with market contagion. Both models may help organisations to find ways of improving their practices prior to implementation. There are opportunities to create more hypotheses other than those presented in the study to measure and predict corporate performance and market contagion.

11 Limitations

It is unsure whether the models may fit for specific countries. It is not an easy task to measure the quality of corporate governance and financial contagion since the models do not take into account other external factors. The study do not refer to the long-term effects of poor quality of corporate governance and financial market contagion.

Appendix

From the survey it was noted that, most of the participants have answered *NO* to the following questions regarding the provisions of the key elements of corporate culture.

Collaboration Provisions; Refer to Questionnaire Table 1

5. In the organization departments provide employees with right information about ownership interests and profit sharing rights. *70.70% answered NO*.
6. All employees are given the right to negotiate power and openly reach collaborative decisions. *54.30% answered NO*.
8. Employees in departments are assigned to work on a project. *77.70% answered NO*.
10. Employees are happy with the way the reward system and the modes of conduct provisions are implemented in the organization. *50.50% answered NO*.
11. Employees are allowed to own shares within their company. *93.10% answered NO*.

Control Provisions; Refer to Questionnaire Table 2

8. Your organization has a management strategy (Mission Statement) to help maintain competitive edge within the environment. *36.20% answered NO*.
9. Your organization have a Customer Charter (CC) policy (number of standardized rules) to establish excellent customer service. *45.20% answered NO*.

Creativity Provisions; Refer to Questionnaire Table 3

5. Your organization currently is working on a new innovation. *52.60% answered NO*.
6. Your organization recently launched a new product.*58.50% answered NO*.
8. Your organization acquires new resources in order to establish new product uniqueness. *62.70% answered NO*.
9. Your organization maintains a management strategy of doing things first to maintain external discretion. *52.60% answered NO*.
10. Your organization has a team of Market Research (MR) to help find information about product innovation. *58.00% answered NO*.

Compete (Market Culture) Provisions; Refer to Questionnaire Table 4

7. Your organization provides feedback forms to customers. *59.90% answered NO*.
8. Your organization received a market award in last decade. *69.60% answered NO*.
9. Your organization follows international trading and quality standards (e.g. ISO 9000). *52.60% answered NO*.
10. Your organization is a member of a trading bloc such as the European Union (EU). *79.20% answered NO*.
11. You have received a share of profit from your organization in the last decade. *89.80% answered NO*.

From the survey it was noted that, most of the participants have answered *NO* to the following questions regarding the provisions of the key elements of corporate legality.

Board of Directors and Managerial Incentives Provisions; Refer to Questionnaire Table 5

1. Your organization has independent board members that are actively involved with the provisions of directing and controlling. *67.70% answered NO*.
2. Your organization maintains a system of advice to investors and all stakeholders consistent with the current situation regarding the financial position and investment targets. *59.30% answered NO*.
4. Your company has compensation regulations actively used. *59.30% answered NO*.
8. Your organization allows more shareholders and employees involvement in terms of dept and voting rights. *91.70% answered NO*.
12. Shareholders have cumulative voting rights to increase and decrease board size and amend charter/bylaws. *67.70% answered NO*.

The Capital Structure Provisions and Control System Provisions; Refer to Questionnaire Table 6

1. Your company has an outstanding debt instruments at present in the dept market. *83.30% answered NO*.
2. Your company has outstanding corporate equities in the equity market. *91.70% answered NO*.
9. Your company has a strategy investment finance committee. *58.30% answered NO*.

Law and Regulations Provisions; Refer to Questionnaire Table 7

8. Your organization has a reward system. *50.00% answered NO*.
11. Your company has its own teams and executives that gather information from external sources and analyse current market situations in order to do things first and fast. *41.70% answered NO*.

Capital Markets Provisions; Refer to Questionnaire Table 8

7. Your company has a dividend and public information policy. *58.30% answered NO*.
8. Your organization has an information policy that informs the public about its way of implementing and use of new developments regarding capital market

instruments (financial innovations) in accordance with the current law. *67.70% answered NO*.

9. Your company clearly discloses with evidence of any used capital market instruments abroad, such as in a foreign securities exchange results and financial status of its operations. *75.00% answered NO*.
10. Your company provides information about its total share capital and voting rights under current laws. *59.30% answered NO*.
11. All transactions performed by the Board are disclosed to the public. *91.70% answered NO*.

Summary statistics[a]

Panel D: Firm level corporate governance—frequencies of "*NO*" answers for corporate market culture (internal governance) and corporate legality (external governance)

	Collaboration	Control	Creativity	Compete	Board of Directors and Managerial Incentives	Capital Structure and Control Systems	Law and Regulation	Capital Markets
1	Q5 70.70	Q8 36.20	Q5 52.60	Q7 59.90	Q1 67.70	Q1 83.30	Q8 50.00	Q7 58.30
2	Q6 54.30	Q9 45.20	Q6 58.50	Q8 69.60	Q2 59.30	Q2 91.70	Q11 41.70	Q8 67.70
3	Q8 77.70	–	Q8 62.70	Q9 52.60	Q4 59.30	Q9 58.30	–	Q9 75.00
4	Q10 50.50	–	Q9 52.60	Q10 79.20	Q8 91.70	–	–	Q10 59.30
5	Q11 93.10	–	Q10 58.00	Q11 89.80	Q12 67.70	–	–	Q11 91.70
Mean	69.26	40.70	56.88	70.22	69.14	77.76	45.85	70.40
Sum	346.30	81.40	284.40	351.10	345.70	233.30	91.70	352.00

[a]Limited to first 100 cases

Notes The average value added that would contribute to the internal governance is the weighted average of the mean values of (69.26% + 40.70% + 56.88% + 70.22% = 59.27% representing Collaboration, Control, Creativity and Compete elements. Thus, the average value added that would contribute to the external governance is the weighted average of the mean values of (69.14% + 77.76% + 45.85% + 70.40% = 65.79% representing Board of Directors and Managerial Incentives, Capital Structure and Control Systems, Law and Regulation and Capital Markets. The weighted average values have been value added to the CGOV score index illustrating the impact of "YES" answers respectively. Results are presented in Panel E and F

See Figs. 4, 5, 6, 7, 8, 9, 10, 11, 12.

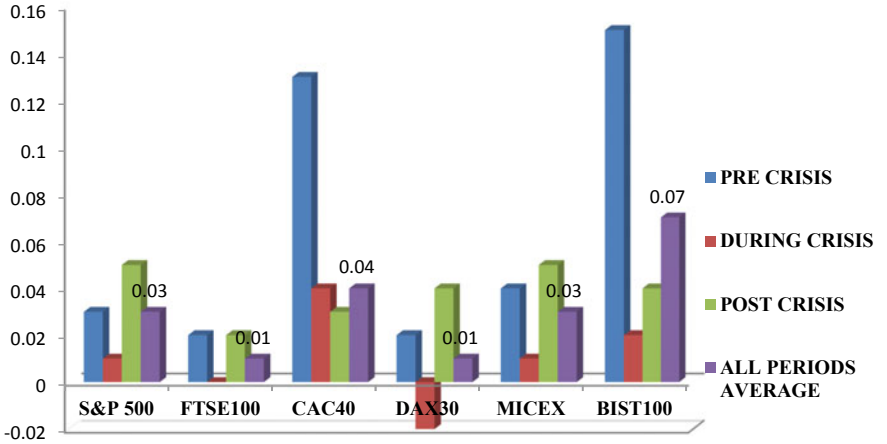

Fig. 4 Average daily percentage stock returns on international stock indexes from 2002 to 2017. *Source* Authors own

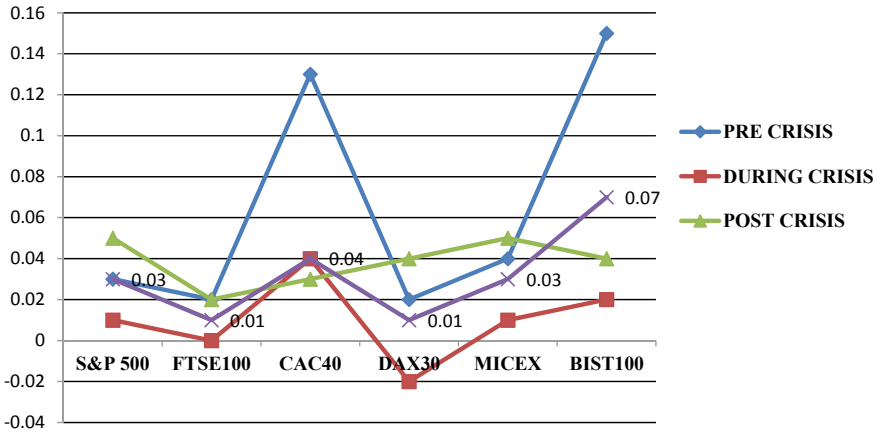

Fig. 5 Average daily percentage stock returns on international stock indexes from 2002 to 2017. *Source* Authors own

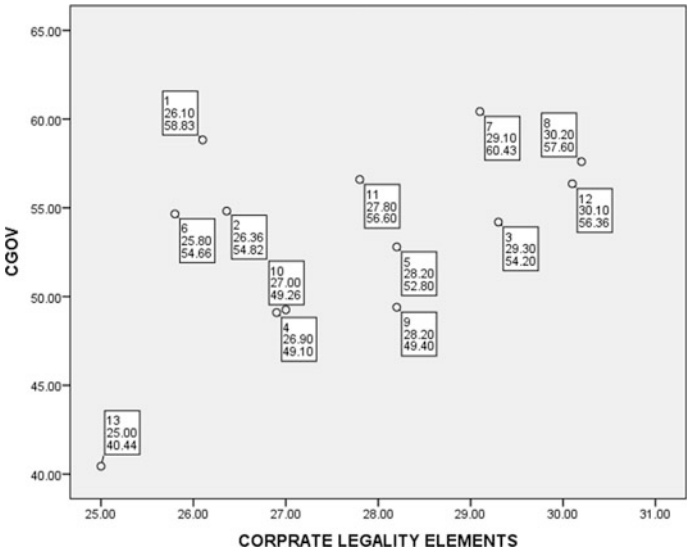

Fig. 6 External governance performance before improvements. *Source* Authors own

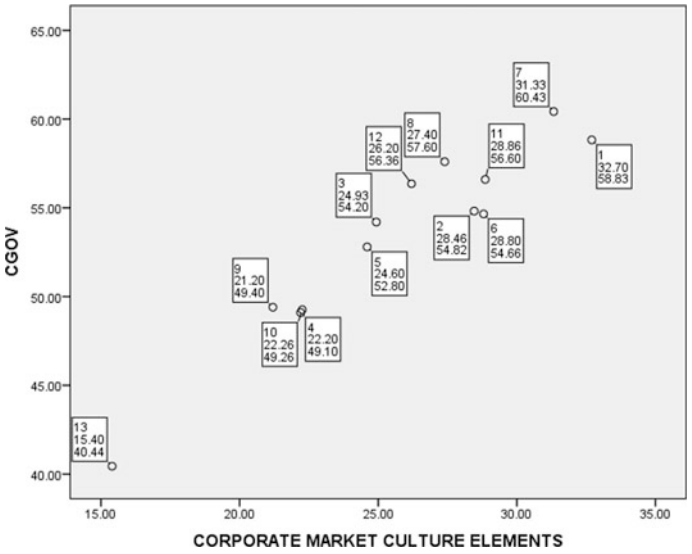

Fig. 7 Internal governance performance before improvements. *Source* Authors own

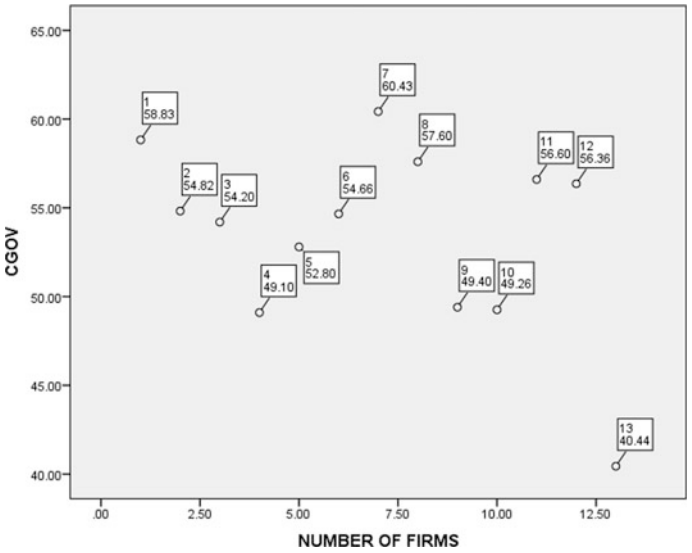

Fig. 8 Corporate governance performance of all firms before improvements. *Source* Authors own

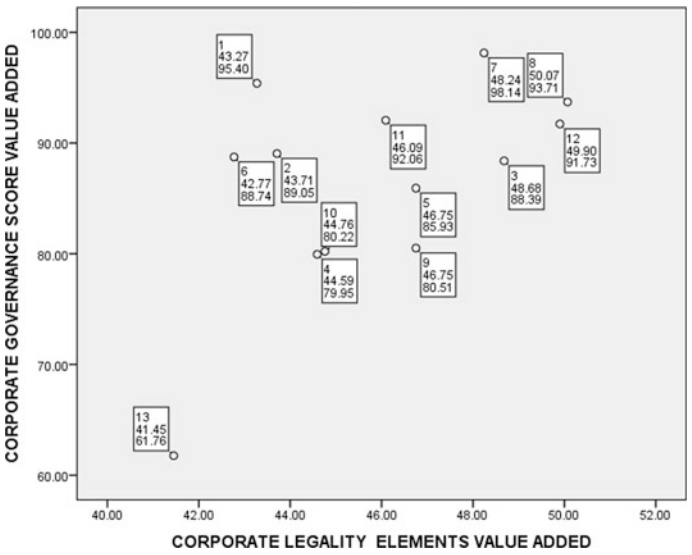

Fig. 9 External governance performance after improvements. *Source* Authors own

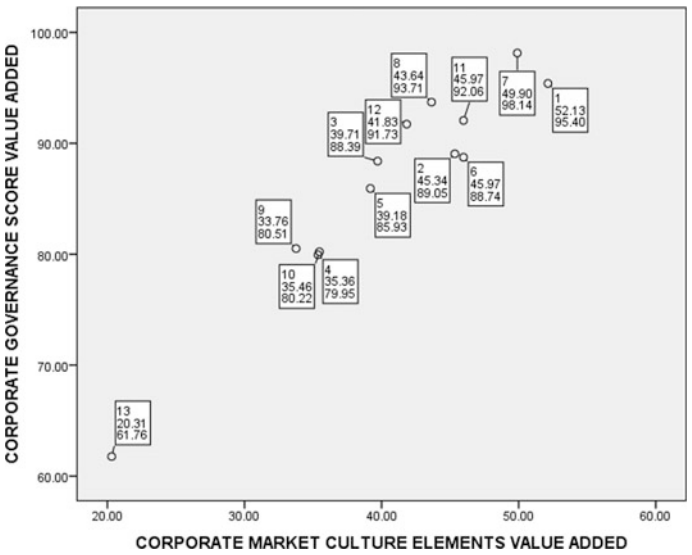

Fig. 10 Internal governance performance after improvements. *Source* Authors own

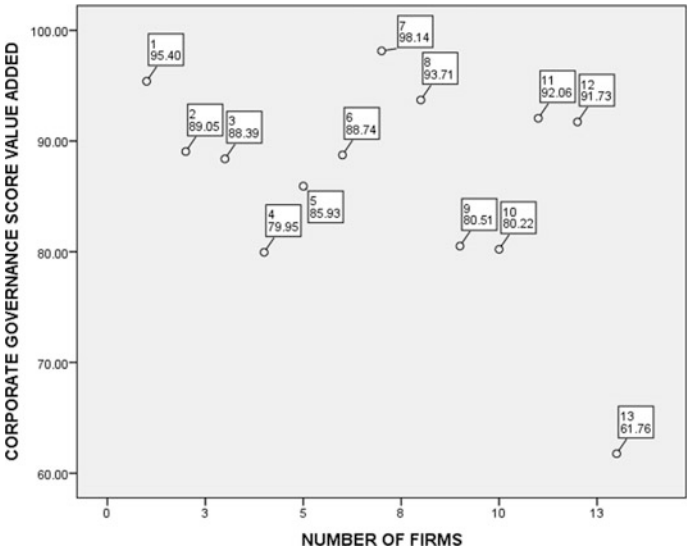

Fig. 11 Overall corporate governance performance of all firms after improvements. *Source* Authors own

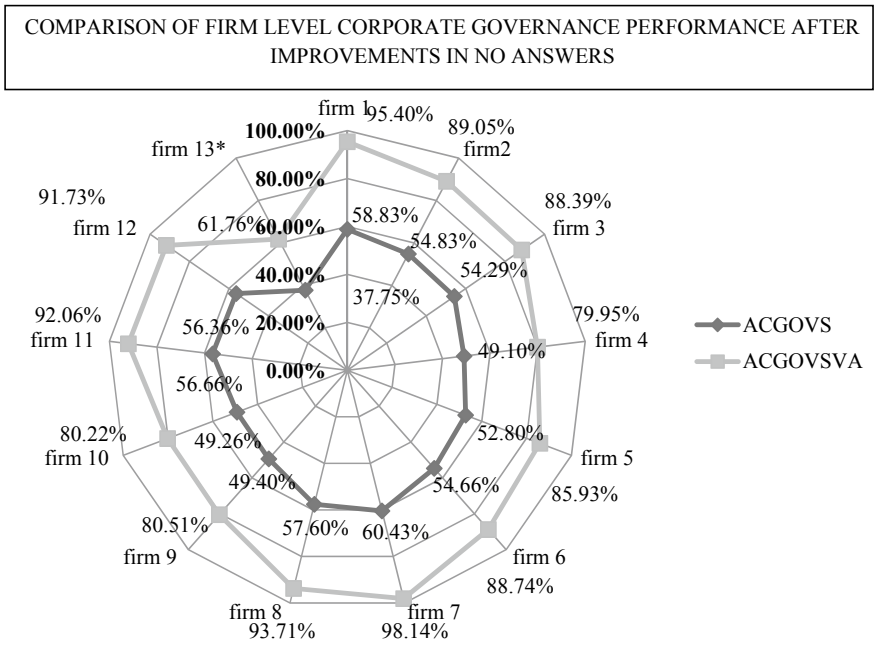

Fig. 12 Comparison of firm level corporate governance performance after improvements in no answers. *Source* Authors own

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Spillover Effect of Interest Rate Volatility on Banking Sector Development in Nigeria: Dynamic ARDL Bound Test Approach

Alimshan Faizulayev and Isah Wada

Abstract This study investigates the dynamic spillover effect in the United States (US) interest rate volatility on the Nigerian banking sector development. The study adopts the bounds test approach in the context of the dynamic autoregressive distributed lag model (ARDL) and the modified Granger causality test. Empirical results support the dynamic impact in the spillover effect of US interest rate volatility on the banking sector development in Nigeria—over the short and long run time horizons. The research reveals that the spillover in the US interest rate volatility affects the development of the Nigerian banking sector through numerous channels—most significantly—via the real interest rate channel. Thus, the empirical results in the current research confirm the spillover impacts of US interest rate volatility consistent with other empirical studies—and is of interest to central bank monetary policy decisions.

Keywords Autoregressive distributed lag model (ARDL) · Banking sector development · Interest rate volatility · Modified Granger causality · Nigeria

1 Introduction

Economic growth process is inextricably linked with the development in the banking sector. It is well documented in existing literature that economies with established and highly developed banking system attract significantly positive economic growth (see Demirguc-Kunt and Levine 2001; Ho 2013; Were and Wambua 2014). Authors agree that economic growth can be severely halted by macroeconomic instability that affects the banking sector development (see Hawkins and Mihaljek 2001;

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Singh et al. 2008; Monnin and Jokipii 2010). Several macroeconomic factors combines together including the dynamic fluctuation in interest rate movement are specifically identified as significant hindrance to banking sector growth in emerging countries (Were et al. 2014; Borio et al. 2015; Hajilee et al. 2015). For instance, studies shows that the uncertainty in interest rate movements and structural rigidities in the economic system affects banking sector performance in developing countries. The transmission channels of the macro economic impact on banking sector performance is also well documented in the extant literature (see Blank and Dovern 2009; Altunbas et al. 2014). Studies have empirically tested and report the significance of stock market and stock price transmission channels in accounting for interest volatility impact on the banking sector development (Ibrahim and Shah 2012; Dungey and Gajural 2015; Ellinhton 2018). The internationalization and liberalization of the global financial system means that external interest rate movements in addition to the domestic rates are both of equal importance—in analyzing the spillover effects of interest rates changes in emerging countries. Hence, the non-domestic interest rate fluctuation notably the external rate from the United Stated (US) have significant spillover impacts on banking sector performance and development around the World (Lacoviello and Navaro 2018). A plethora of academic research has examined the dynamic spillover of the US interest rate changes on banking sector development in emerging countries (see Georgiadis 2015; Hajilee et al. 2015; Kose et al. 2017; Avdjiev and Hale 2018; Gajewski et al. 2019). These studies have mostly reported inverse relationship between the US interest rates and banking sector development in their study samples. The evidence gives negative spillover in the US rate changes on the development of banking sectors examined, respectively (see Lacoviello and Navaro 2018).

For the current study, the spillover effect of interest rate volatility on banking sector development in Nigeria is examined. Various factors combined together make the choice of Nigeria interesting for the current studies. Nigeria is the biggest emerging market in Africa with an estimated gross domestic product of 375 billion Unites States dollar (USD). Beginning from the 1980's, Nigeria has implemented significant financial sector reforms in the past mostly supervised by the International monetary funds (IMF) and the World Bank. Thus, the Nigerian financial system is highly deregulated exposing the country to significant risk pose by interest rate fluctuation. In 2008/2009, the global financial crisis triggered a banking crisis in Nigeria—forcing the Nigeria Central Bank (CBN) to undertake severe measures to stabilize the banking system—injecting significant liquidity into the system about 620 Billion Nigeria naira (NGN). Thus, the Nigerian financial system witnessed significant volatility due to its exposures to the global financial system leading to massive withdrawal of portfolio investment from the country. Finally, the size of Nigeria GDP, comparative stable growth of the domestic financial market and high interest rate has help attract foreign investment of all class to the country. However, the lingering internal instability in the country, poor infrastructural development and corruption continue to discourage foreign investor from the choice of Nigeria as safe investment hub in Africa. In spite of the above, the significant growth in emerging market and the appetite of foreign investors for

good returns makes Nigeria more attractive putting significant pressure on the volatile domestic interest rate.

This study is unique been the first in our best opinion to examine the spillover effect of interest rate volatility on banking sector development in Nigeria within the ARDL framework. Thus, we investigate the impact of external and domestic interest rate volatility on the development of the Nigerian banking sector. By adopting, the ARDL bounds testing approach, we are able to decompose the impact of interest spillover for the Nigerian banking system according to its short-term and long-term effects. Finally, by employing the Granger causality technique within the context of the error correction methodology, we are able to observe the causalities amongst the adopted variables in the estimated model. Hence, our findings have significant ramifcations for the banking sector development in Nigeria.

For the reminder of the study, Sect. 2 give the theoretical setting. Section 3 highlights the data and methodology. Section 4 present the empirical finding and Sect. 5 concludes the paper.

2 Theoretical Setting

As elucidated in Sect. 1, interest rate volatility in developing economies is reported to impact banking sector development adversely (see Alam and Uddin 2009; Kasman et al. 2011; Hajilee et al. 2015). Existing studies also found that domestic interest are in developing economies are significantly impacted by movements in the US monetary policy rate causing dynamic spillover effects (Lacoviello and Navaro 2018). For our study, we hypothesize that change in the US federal fund rate (F) and domestic interest rate affect the banking sector development in Nigeria. Therefore, to model the spillover effect of US monetary policy rate on the development of the Nigerian banking sector, the following theoretical model is proposed.

$$D_t = F(R_t, H_t, F_t, G_t, B_t) \tag{1}$$

where D is a measure of financial sector intermediation adopted as proxy for the banking sector development. It is define as the domestic credit by the banks to the private sector expressed as percentage of gross domestic product (GDP). R gives the domestic real interest rates percent adjusted for inflation in Nigeria. H is the historical volatility derived from the annualized mean absolute deviation of the real interest rate. It is adopted to capture the volatility of domestic interest rate in Nigeria. F gives the United States (US) federal fund rate in percentage. It is adopted to examine the dynamic spillover effect of the US monetary policy rates on the Nigeria banking sector. In line with literature, G and B are adopted as control variables in the estimated model. G gives the annual percentage of the real per capita GDP growth rate in Nigeria whilst B is adopted as proxy for the development of the banking sector. It gives the percentage of the total annual bank deposit to GDP in the country. Thus, bank deposit impacts the banking sector propensity to

lend and magnitude of credit allocated to the private sector. This is crucial for the overall development of the banking sector necessary for economic growth. Hence, according to Demirguc-kunt and Levine (2001) banking sector development and the real GDP growth rate per capita moves in similar direction with significantly positive correlation. Thus, the per capita GDP growth rate gives a good indicator of banking sector led economics growth development.

An econometric model that captures the functional relationship in Eq. (1) is expressed as follows;

$$D_t = \omega_0 + \omega_1 R_t + \omega_2 H_t + \omega_3 F_t + \omega_4 \beta G_t + \omega_5 B_t + \varepsilon_t \quad (2)$$

a priori, ω_1 is expected to be negative as low real interest rate encourages more private sector driven domestic investment. The coefficient of *HVR*—ω_2 is expected to be inversely related to banking sector development. Furthermore, the estimated coefficient of H is equally expected to be negative a spillover of the US federal fund rate adversely impact developing economies (Lacoviello and Navaro 2018).

3 Data and Methodology

The data employed for the current study are annual time series from 1970 to 2016. The time period chosen is motivated by data availability covering important milestones including the impact of the recent global financial crisis on the Nigerian banking sector. Thus, the data on banking sector development (D), real interest rate (R) and real per capita GDP growth rate (G) are derived from the World Bank Indicator data base. Conversely, the bank deposit (B) data is obtained from the World Bank Global financial data bank whilst the US federal fund rate (F) data is sourced from Data stream.

The ADRL bounds test methodological approach followed is due to Pesaran et al. (2001). This approach allows us to investigate the dynamic short-run interaction and long-term stable equilibrium relationship amongst the selected variables. This approach is admissible devoid of the order on integration—whether zero order I(0), order one I(1) or fractionally integration (Wada 2017). Thus, the ARDL methodology can be applied without pre-testing as with other empirical technique and is preferred even if the study variables are integrated of mixed order. This ARDL technique is empirically more widely employed when confronted with either small sample or finite data set. Thus, unlike other techniques it deals easily with endogeneity issues, hypothesis testing regarding the long-run stable long-run equilibrium relationship and associated simultaneous equation bias (see Pesaran et al. (2001). Hence, the following unrestricted model for the conditional error correction equation is specified in modeling the ARDL;

$$\Delta D_t = \alpha_0 + \alpha_1 C_t + \omega_1 D_{t-1} + \omega_2 R_{t-2} + \omega_3 H_{t-3} + \omega_4 F_{t-4} + \omega_5 G_{t-5} + \omega_6 B_{t-6} + \sum_{i=1}^{p} \beta_1 \Delta D_{t-i} + \sum_{i=0}^{q} \beta_2 \Delta R_{t-i} + \sum_{i=0}^{q} \beta_3 \Delta H_{t-i} + \sum_{i=0}^{q} \beta_4 \Delta F_{t-i} + \sum_{i=0}^{q} \beta_5 \Delta G_{t-i} + \sum_{i=0}^{q} \beta_6 \Delta B_{t-i} + \beta_7 \varepsilon_{t-i} + u_t \quad (3)$$

where Δ gives the changes in the estimated variables. The drift term is α_0 and the coefficients of the model to be estimated lagged one period at level are ω_1, ω_2, ω_3, ω_4, ω_5, and ω_6, respectively. u_t gives the zero mean serial independent random error term with finite covariance matrix (Narayan and Smyth 2004). C_t captures the impact of the global financial crisis in the estimated sector, hence adopted as the crisis dummy for the recent global financial crisis on the Nigerian banking sector.

Thus, $C_t = 1$, in 2009, 0 otherwise.

The existence of a long-run stable equilibrium relationship in the estimated model is verified considering Narayan (2005) F-statistic critical value and the Pesaran et al. (2001) t-statistic critical values. The calculated value from the statistic is compared with the upper bounds—for order one (1) and the lower bounds—for order zero I(0). Thus from Eq. (1), the null hypothesis $H_0 = \omega_1 = \omega_2 = \omega_3 = \omega_4 = \omega_5 = 0$ is tested against the alternate $H_1 = \omega_1 \neq \omega_2 \neq \omega_3 \neq \omega_4 \neq \omega_5 \neq 0$. Hence the evidence of a stable–level–long-run equilibrium relationship is revealed from the test joint significance. The model is estimated using the appropriate level order selected on the basis of the information criteria.

Going forward, with long-term level relationship established in the estimated model, a conditional error correction of the form specified below is estimated as thus;

$$\Delta D_t = \alpha_0 + \alpha_1 C_t + \sum_{i=1}^{p} \omega_1 \Delta D_{t-i} + \sum_{i=0}^{q} \omega_2 \Delta R_{t-i} + \sum_{i=0}^{q} \omega_3 H_{t-i} + \sum_{i=0}^{q} \omega_4 \Delta F_{t-i} + \sum_{i=0}^{q} \omega_5 \Delta G_{t-i} + \sum_{i=0}^{q} \omega_6 \Delta B_{t-i} + \omega_5 u_{t-1} + \varepsilon_t \quad (4)$$

in Eq. (3), Δ is the change in the estimated regressors and D_t whilst u_{t-1} gives the lagged error correction term.

3.1 Condition Granger Causality

The existence of a stable long-run equilibrium relationship among the estimated variable is indicative of Granger causality in a significant direction, yet unknown (Narayan and Smyth 2004). Hence, the coefficient of the estimated ECT is lagged one period to validate the significant long-run effect in the estimated model. It also

reveals the direction of the long-run causality. Thus, the condition Granger causality under ECM is examined in the framework of a multivariate k order vector error correction model (VECM) as follows;

$$(1-L)\begin{bmatrix} lD_t \\ R_t \\ H_t \\ F_t \\ G_t \\ lB_t \end{bmatrix} = \begin{bmatrix} \tau_1 \\ \tau_2 \\ \tau_3 \\ \tau_4 \\ \tau_5 \\ \tau_6 \end{bmatrix} + \sum_{i=1}^{k} \begin{bmatrix} \tau_{11i} & \tau_{12i} & \tau_{13i} & \tau_{14i} & \tau_{15i} & \tau_{16i} \\ \tau_{21i} & \tau_{22i} & \tau_{23i} & \tau_{24i} & \tau_{25i} & \tau_{26i} \\ \tau_{31i} & \tau_{32r} & \tau_{33i} & \tau_{34i} & \tau_{35i} & \tau_{36i} \\ \tau_{41i} & \tau_{42i} & \tau_{43i} & \tau_{44i} & \tau_{45i} & \tau_{46i} \\ \tau_{51i} & \tau_{52i} & \tau_{53i} & \tau_{54i} & \tau_{55i} & \tau_{66i} \\ \tau_{61i} & \tau_{62i} & \tau_{63i} & \tau_{64i} & \tau_{65i} & \tau_{66i} \end{bmatrix} \begin{bmatrix} lD_{t-i} \\ R_{t-i} \\ H_{t-i} \\ F_{t-i} \\ G_{t-i} \\ lB_{t-i} \end{bmatrix} + \begin{bmatrix} \gamma_1 \\ \gamma_2 \\ \gamma_3 \\ \gamma_4 \\ \gamma_5 \\ \gamma_6 \end{bmatrix} ECT_{t-1} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \\ \varepsilon_{5t} \\ \varepsilon_{6t} \end{bmatrix} \tag{5}$$

where $(1-L)$ is the operator lag and ECT_{t-1} is the one period lagged error correction term calculated from the co integration equilibrium model. ε_{1t}, $\varepsilon_{2t}, \varepsilon_{3t}, \varepsilon_{4t}, \varepsilon_{5t}$, and ε_{6t} are the serial independent uncorrelated random errors. Hence, in the estimated VECM, the F-statistic on the regressors gives significant short-term effects whilst statistically significant ECT term implies significant long-run causalities (Table 1).

4 Empirical Results

Beginning with Fig. 1, the line plot of the variables under study indicates structural break in the selected series. Hence the Zivot and Andrew (1992) test incorporating single structural break is followed for test of unit root in the series. This test procedure is adopted to circumvent potentially severe problems associated with the traditional unit root test. Thus, with the exception of the bank deposit variable (B)—which became stationary only after first differencing I(1), the remainder of the study variable are found to be stationary at level I(0) and at their first differences I(1), respectively. Therefore we ascertain that none of our study variables is integrated of order two—I(2) which makes the ARDL approach admissible. In applying the ARDL technique, the UCEM in Eq. (2) is estimated for the level relationship amongst the adopted variables. The result of the bounds test is presented in Table 2 whilst Table 3 gives the test critical value for the F-statistic and t-ratio, respectively. The test decision criterion is reject H_o if the test critical is above the test upper bound and do not reject for critical value below the test lower bound. For test

Table 1 Zivot-Andrews unit root test with structural break

	Level statistics			Differenced (Δ) statistics			
	Z_B	Z_T	Z_I	Z_B	Z_T	Z_I	Decision
D	−4.9058***	−4.2339*	−5.3325**	−6.5452*	−5.8073*	−6.1347*	I(0)
Lag length	3	1	3	2	2	2	
Break date	2007	1996	2007	2007	1982	1981	
R	−6.9442*	−6.4666*	−6.6089*	−5.3922**	−5.0855*	−5.4682*	I(0)
Lag length	0	0	0	4	4	4	
Break date	1983	1982	1997	1997	1985	1997	
H	−6.1135*	−5.6004*	−5.5481*	−5.9248*	−5.4744*	−5.7767*	I(0)
Lag length	1	0	0	3	3	3	
Break date	2000	2007	2007	1983	2002	1998	
F	*NA*	−4.2366*	−4.6113***	−8.9871*	−6.1729*	−7.0338*	I(0)
Lag length		0	0	3	3	3	
Break date		1980	1978	1981	1988	1981	
G	−7.0115*	−5.8276*	−5.9941*	−6.3247*	−5.0894	−6.3553*	I(0)
Lag length	0	0	0	4	4	4	
Break date	1984	1982	1978	1984	1989	1984	
B	−4.2128	−2.3741	−4.4626	−5.9064*	−5.0134*	−5.7696*	I(1)
Lag length	1	1	1	0	0	0	
Break date	1989	1999	1989	1999	1994	1999	

Note *D* is Domestic credit to private sector by banks (% of GDP); *R*—Real interest rate (%); *F*—Federal Funds Rate (%); *G*—GDP per capita growth (annual %) and *B*—Bank deposits to GDP (%). Probability values are calculated from standard t-distribution and do not take into account the breakpoint selection process. *, **, and *** denotes null hypothesis rejection at 1%, 5%, and 10% levels of the test critical value, respectively

critical value falling between the upper and lower bound, a non-conclusive result is reported. In this case integration order is necessary to reach a definite decision (see detail in Pesaran et al. 2001). Therefore from Table 3, the Narayan (2005) F-statistic application suggests stable long-run equilibrium relationship amongst the selected variables. Thus, the null hypothesis (H_o) of no level relationship is rejected. This conclusion is reached by estimating the UCEM specified in Eq. (2) under three different scenarios—with unrestricted intercept and restricted trend F_{IV}; unrestricted intercept and trend F_V and unrestricted intercept and no trend F_{III}, respectively. The model is estimated using appropriately selected information

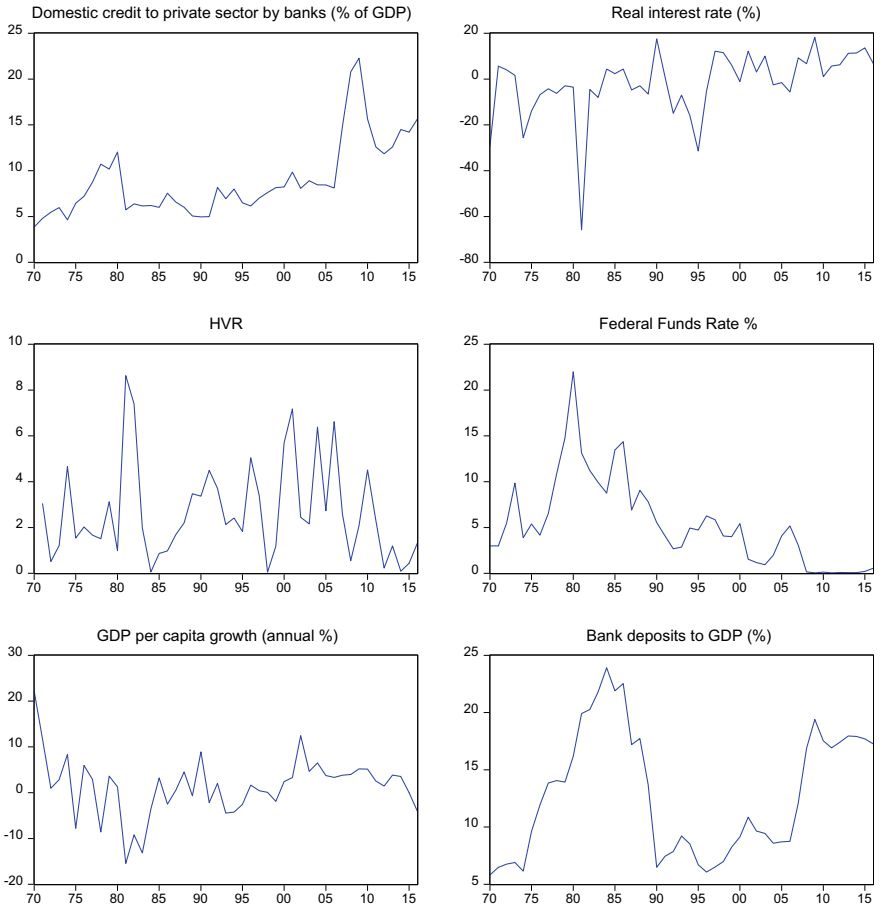

Fig. 1 Line plot of the series

Table 2 Bounds test for level relationships

	With deterministic trend		Without deterministic trend		
P	F_{IV}	F_V	t_V	F_{III}	t_{III}
2	5.3237^{x}	6.1801^{x}	-3.5032^{y}	5.3595^{x}	-2.7908^{y}
3	4.4914^{x}	5.2313^{x}	-3.1111^{z}	4.8174^{x}	-3.3376^{y}
4	6.8186^{x}	7.9370^{x}	-3.3453^{y}	6.5844^{x}	-2.5302^{z}

Note P denotes the optimal lag selected on the basis of the appropriate information criteria. F_{IV}, F_V, F_{III} give the F-statistic of the model with unrestricted intercept and restricted trend, unrestricted intercept and trend, and unrestricted intercept and no trend, respectively. t_V and t_{III} are respective t-ratio with and without deterministic trend to test $\omega_1 = 0$ specified in Eq. (2). $^{x, y, z}$gives the test statistic value above the upper bounds; between the bounds and below the lower bounds of the test

Table 3 Bounds test F-statistics and t-ratio critical value

	1%		5%		10%	
$K = 5$	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F_{IV}	4.850	6.473	3.504	4.747	2.907	4.010
F_V	5.347	7.242	3.818	5.253	3.157	4.412
F_{III}	4.537	6.370	3.125	4.608	2.578	3.858
t_V	−3.96	−5.13	−3.41	−4.52	−3.13	−4.21
t_{III}	−3.43	−4.79	−2.87	−4.19	−2.57	−3.86

Source *F-statistic* culled from Narayan (2005) whilst t-*ratio* from Pesaran et al. (2001). *K* gives the numbers of estimated regressors for the dependent variable

criteria at various lag order ($P = 2$, 3 and 4). Thus, the rejection of the null hypothesis implies that the estimated F-test statistic under F_{IV}, F_V and F_{III} lies above the test critical values for the specified significant levels, respectively.[1]

Hence, the Nigerian banking sector development indicator (D) is in stable long-run equilibrium relationship with the selected endogenous variables in the estimated model. With the long-run level association established for the selected variables, the Pesaran et al. (2001) ARDL approach is employed to estimate the functional relationship in Eq. (1) amongst the adopted variables. The coefficient estimates for the equilibrium long-run relationship is given below[2];

$$\underset{[0.000]}{LD_t} = \underset{[0.000]}{0.320C_t} - \underset{[0.000]}{0.013R_t} - \underset{[0.000]}{0.110H_t} - \underset{[0.000]}{0.023F_t} + \underset{[0.000]}{0.086G_t} + \underset{[0.000]}{0.187LB_t} + \underset{[0.000]}{2.107} + u_t$$

where the p-values of estimated coefficients are in brackets. The estimated coefficients are generally found to be statistically significant. The estimated result yield long-run positive response for the impact of the global financial crisis $(C_t = 0.320)$ on the banking sector development in Nigeria. This could be attributable to the efforts of the Nigerian CBN to curtail the immediate effect of the crisis on the system. This was achieved through injecting liquidity into the system, adequate risk assessment as well as promoting sound corporate governance practices—in line with global best practice. Furthermore, the result obtained gives significant evidence for the adverse effect of real interest rate fluctuation $(R_t = -0.013)$ and its historical volatility $(H_t = 0.110)$ as well as the dynamic spillover impact of the US federal fund rate on the Nigerian banking sector development. Specially, the result implies that 1% change in real interest rate decreases growth in the banking sector by 0.013% in the long-run. And 1% change in interest rate historical volatility negatively affects the growth of the banking sector by 0.110% overtime. For the spillover effect of the federal fund rate, the estimated coefficient also indicates that

[1]Following the approach in Pesaran et al. (2001), the results in Table 2 for the bounds level relationships indicates whether to include or not to allow trend restrictions.

[2]

D_t and B_t are estimating in their natural logarithm.

increase in the federal fund rate by 100 basis points adversely affect the banking sector development in Nigeria by 0.023%. The result confirms the evidence in existing studies that US federal fund rate spillover significantly affect banking sector development in emerging countries. As expected the estimated coefficient of per capita GDP growth rate ($G_t = 0.086$) and bank deposit ($B_t = 0.187$) are significantly positive in the long-run. The result shows that real GDP per growth rate and the bank deposit (%GDP) moves in positive direction with the development in the domestic banking sector. Thus 1% increase in real GDP per capita is associated with 0.086% growth in the banking sector development. Whilst a 1% growth in bank deposit (% GDP) stimulate growth for the banking sector development by 0.187% in the long-run.

For the short-run model, the CECM specified in Eq. (3) is estimated. The result is presented in Table 4. The estimated coefficient of the short-run dynamic interactions follows mix pattern in the estimated CECM model responding highly inelastic to development in the banking sector. Thus the impact of crisis dummy and the historical volatility of interest rate changes are found to be statistically insignificant in the short-run. The real interest rate (ΔR_t and ΔR_{t-1}) and the US federal fund rate (ΔF_{t-1}) have significantly inelastic impact on the banking sector development in the short-run, generally. Short-run GDP per capita growth rate give mixed result with positive impact at ΔG_t and a significant negative inelastic effect at ΔG_{t-1}. Finally, the short-run bank deposit variable exert same impact on the banking sector development in the short-run and long-run—with significant positive impact of the banking sector development in the estimated model. Expectedly, the estimated ECT (−0.3725) is negative and statistical significant. It gives clear evidence for the existence of stable long-run nexus in the estimated model. The result implies that on

Table 4 Dependent variable: D_t ARDL conditional error correction regression

Variable	Coefficient	S.E	t-statistic	p-value
$\widehat{U}_{t-1}$	−0.3725	0.0667	−5.5834	0.0000
$\Delta \ln D_{t-1}$	−0.2210	0.1338	−1.6523	0.1149
$\Delta \ln D_{t-2}$	0.0684	0.1196	0.5719	0.5741
$\Delta \ln D_{t-3}$	0.0546	0.1205	0.4530	0.6557
$\Delta \ln D_{t-4}$	−0.2247	0.1067	−2.1061	0.0487
$\Delta \ln D_{t-5}$	−0.1872	0.1023	−1.8304	0.0829
$\Delta \ln D_{t-6}$	−0.1123	0.1042	−1.0778	0.2946
ΔR_t	0.0050	0.0018	2.7912	0.0116
ΔR_{t-1}	0.0051	0.0019	2.7733	0.0121
ΔF_t	−0.0036	0.0097	−0.3727	0.7135
ΔF_{t-1}	0.0229	0.0097	2.3627	0.0290
ΔG	0.0154	0.0059	2.6189	0.0169
ΔG_{t-1}	−0.021546	0.005224	−4.124082	0.0006
$\Delta \ln B$	0.927393	0.160089	5.792974	0.0000

Note SE is the estimated coefficient standard error. R-Squared = 0.78. *Adj* $R^2 = 0.67$. Durbin Watson Statistic = 2.2. Log likelihood = 34.01972

average the banking sector development converge to it long-run equilibrium 37.25% annually via the channels of the adopted exogenous variable of the estimated model.

The conditional Granger causality test reveals 3 significant uni-directional long-run causalities in the estimated model. This is shown by the significant test statistic for the one period lagged error correction term (ECT_{t-1}). The result is given by causal nexus of the selected exogenous variables significant for the growth and development of the Nigerian banking sector to annual historical volatility of real interest rate $((D, R, H, F, B) \gg H)$. Secondly, form the specified explanatory variables in the estimated model to the real per capita GDP growth rate $((R, H, F, D, B) \gg G)$. Thirdly, from the key factors of banking sector development in the adopted model to bank deposit (%GDP) $(F, R, G, D, H) \gg B)$. The F-test statistic for the conditional causality also indicates the presence of 4 significant short-run unidirectional causalities in the model. These are given by the nexus from domestic real interest rate to the real per capita GDP growth rate $(R \gg G)$; US federal fund rate to domestic real interest rate $(F \gg R)$; US federal fund rate to domestic credit by banks to the private sector $(F \gg D)$; and US federal fund rate to GDP per capita growth rate $(F \gg G)$. Therefore, the result obtain pertaining to the long-term Granger causality confirms the stable equilibrium relationship in the estimated model. More so, the dynamic causality in the short-run validates the spillover effects of the US monetary policy rates on the growth and development of the Nigerian banking sector. Thus, the spillover of the US federal fund rate on the domestic real interest rate impacts the domestic credit to the private sector and also impact the real GDP per growth rate in the country via its causal effects. Interestingly, the condition Granger causality test shows that none of the estimated variables Granger causes the US federal fund rate (Table 5).

The diagnostic test for the specified model is given in Table 6. The result yield robust coefficient estimates for the estimated model for various test considered.

Table 5 Conditional Granger causality

(q \x)	*lD*	*R*	*H*	*F*	*G*	*B*	ECT_{t-1}
lD	–	1.2541 [0.296]	0.1267 [0.8814]	0.7640 [0.473]	0.3335 [0.718]	0.5082 [0.6054]	0.8459 [0.439]
R	0.1728 [0.842]	–	0.7036 [0.5010]	0.7761 [0.467]	2.6956 [0.080]***	0.0095 [0.991]	1.2110 [0.311]
H	0.6379 [0.534]	0.8707 [0.427]	–	0.5251 [0.596]	0.08536 [0.918]	0.3512 [0.706]	4.2654 [0.023]**
F	3.761 [0.019]**	8.3200 [0.001]*	1.8587 [0.169]	–	3.3808 [0.044]*	0.6229 [0.542]	0.9944 [0.381]
G	0.3518 [0.706]	0.0176 [0.983]	1.3075 [0.282]	0.7405 [0.483]	–	2.3159 [0.112]	14.650 [0.00]*
lB	1.6623 [0.203]	0.2873 [0.752]	0.7753 [0.468]	0.1116 [0.895]	0.1217 [0.886]	–	6.9683 [0.003]*

Note *, **, *** denotes significant at 1%, 5%, and 10%, respectively. Null hypothesis—H_0 = q does not Granger cause x

Table 6 Model diagnostic test

	Test-statistic	p-value
Breusch-Pagan-Godfrey	0.3001	0.9949
Glejser	0.4518	0.9572
ARCH	0.1066	0.7459
White	0.4206	0.9692
Jarque-Bera	2.3412	0.3102
Correlogram-Q-statistic (P = 20)	18.659	0.544
Correlogram squared (P = 20)	10.091	0.967

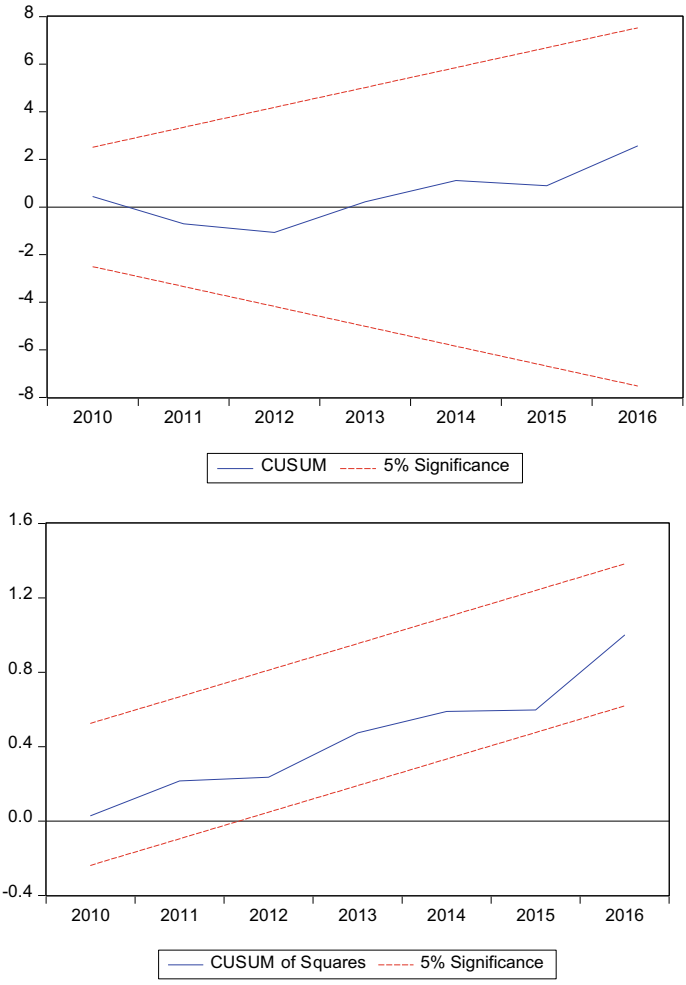

Fig. 2 Plot of cusum and cusumSQ

Finally, the plot of the cumulative (CUSUM) and cumulative sum square (CUSUMSQ) credited to Brown et al. (1975) at a critical bound of 5% confirms the stability of the long-run coefficients in the estimated model (Fig. 2).

5 Concluding Remark

The study empirically examined the impact of Nigerian real interest rate and its historical volatility as well as the spillover effect of US federal fund rate on the banking sector development in the country. Annual time series data from 1970 to 2016 was utilized for the study. The ARDL bounds test methodological approach and the conditional Granger causality within the frame work of VECM was followed in the empirical estimations. Bounds testing confirm the presence of stable long-run equilibrium relationship amongst the adopted variable of study. The estimation of the ARDL model for the banking sector development in Nigeria validate the long-run spillover effect of the US monetary policy rate on the Nigerian banking sector. Furthermore, domestics real interest rate and its volatility is found to negatively impact the growth of the banking sector development in Nigeria. The estimated result also shows that the Nigerian banking sector development move in significant positive direction with the real GDP per capita growth rate and the growth rate in bank deposit (% GDP). Moreover, the estimated ECT term is found to be highly statistically significantly negative. The result shows that on average banking sector development in Nigeria converge to its long-run equilibrium by 37.25% annually. The result gives slow convergence in the model from the short-run to the long-run and signifies positive feedback amongst the adopted variable. The estimated result of the short-run CECM indicates mix result for the short-run model with generally inelastic responses. For instance, the short-run impact of real interest is highly inelastic— almost non-responsive at ΔR (0.005) and ΔR_{t-1} (0.005). The estimated coefficient of the short-run US federal fund was found to be inelastic at ΔF_{t-1} in the short-run. This might be attributable to portfolio rebalancing effects minimizing the short-term risk pose by the spillover in US monetary policy rate—with the banking responding positively in the short-run. However in the long-run, the spillover effect was significantly negative affecting the banking sector development.

For the control variables, the short-run impact of real GDP per capita growth rate was positive at ΔG and negative at ΔG_{t-1}. Short-run negative coefficient might be attributable to high domestic interest rate and unfavourable lending policy slowing investment critical for real economic growth. And the sluggish real economic growth affect the growth rate of the real GDP per capita which in turn affects banking sector growth and development. The coefficient of bank deposit was estimated to be positive in the short-run. Thus other factors held constant, short-run growth of bank deposit leads to positive development in the banking sector.

Furthermore, the conditional Granger causality test reveals significant long-term unidirectional causality for the banking sector model examined. The results showed

that spillover effect in the US federal fund rate have significant repercussion for the Nigerian banking sector development in the long-run. This was further collaborated by the dynamic short-run causalities in the US federal fund rate with real interest rate; domestic credit to the private sector and the real GDP per capita growth rate.

Finally, with rapid financialization and globalization, the managers of the Nigerian banking system must ensure adequate measure to curb the long-run spillover effect of the US monetary policy rate—on the banking sector development in the country. Hence, with US foreign direct investment (FDI) in excess of USD 5.8 billion in the Nigerian stock exchange and USD 6.8 million of Nigerian FDI in the US capital market in 2017—uncertainty about future policy direction poses threat to capital outflows from Nigeria. Thus, the Nigerian financial sector stability framework must incorporate robust policies to also address external shocks and spillover from abroad to prevent capital flight form the Nigeria economy.

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Detecting Price Explosivity (Bubble) in Turkey's Stock Prices: Evidence from an Radf Technique

Kelvin Onyibor and Okan Şafakli

Abstract Most of the historic economic and financial crises have resulted from the negligence of financial asset bubbles (overpricing of an asset above its fundamental value). Hence, this has drawn much attention to the need for bubble detection in these financial asset prices in order to avert a future financial crisis. This study would employ the second-generation base Right-tailed Augmented Dickey-Fuller test technique (Standard ADF, Sup ADF, Rolling ADF, and the Generalized Sup ADF) to detect the presence of price explosivity in Turkey's stock market prices. Employing the entire RADF would help date stamp both single and multiple price bubble periods in stock prices. This study covers weekly data of Turkey's BIST 100 from 200W1 to 2019W4 in order to capture the before and after periods of the 2008 financial crisis. A presence of multiple bubbles is expected in the series since the data covers a range of financial crisis period associated with the stock market. If the null hypothesis of no bubble is significantly rejected, expansionary monetary policies, transparency in the economic agents and prudential macro policy would be possible recommendations for policymakers to deflate the existing bubble.

Keywords RADF · GSADF · Sup ADF · Rolling ADF · Bubble · Stock price · Turkey

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1 Introduction

The stock markets share of emerging economies has no doubt provided significant financial benefits to the world at large. All markets in developing countries has been categorized by the International Financial Corporation as emerging markets. According to the World bank statistics, countries with a GNP per capita below $7620 in 1990 prices are considered as developing economies. Based on this statistics, Turkey is considered as a developing country and as such its stock Exchange Market (Istanbul Stock Exchange Market) is categorized under world emerging financial markets. The Istanbul Stock Exchange (ISE henceforth) is the only stock exchange market in Turkey, equipped with the legal rights to trade on domestic financial instruments as well as international securities.

In 1982 the legal compliance and formalities for the creation of the ISE was completed. However official opening of the ISE was in 1986, initially having 42 listed companies. Trading on the ISE was restricted to licensed brokers on the trade floor up until the late 1987 when a manual trading system was established and individual investors were allowed to directly execute their orders. Finally, in 1989, the Turkish stock Exchange Market was liberalized and this gave access for foreign investors to trade and hold financial securities in the ISE market. Currently the ISE is the 87th largest stock exchange market in the world, which houses 371 prestigious companies and a market capitalization of approximately 220 billion dollars which drags its trade volume to approximately 2.92 trillion dollars.

However, the Turkish stock market is highly influenced by several economical, financial and social factors which results to a high level of fluctuations in the stock prices. Over the years, stock prices of the ISE has witnessed a high level of volatility with a persistent and sharp increase in its prices. This has drawn a considerable attention by researchers to look into the price behavior of this emerging market.

This study aims to determine the existence of a stock price bubble in the Istanbul Stock Exchange markets. According to Cochrane (2001) Bubbles are considered as both financial and economic situations which is characterized by a continuous rise in the price of a assets above its fundamental value leading to overvaluation of an asset and which would subsequently result in the collapse of the market. The fundamental value of an asset consist of both the expected dividend and its future selling price, Hence the difference between the currently selling price of an asset and its fundamental value is considered as an asset price bubble. Cochrane (2001) stressed the fact that, a price bubble would naturally grow bigger as a rational investor would attach more value to an asset with an increasing currently market price and hence, would prefer to hold such assets with a persistent rising market prices.

The major base references for this study was drawn from 2 important empirical work which includes; Phillips et al. (2015) were they created the generalized supremum ADF test to capture the dynamics in historic dataset in an attempt to detect stock price bubble in NASDAQ. Also, Bouchaud and Challet (2017) they

tested the presence of stock price bubble using price dispersion among similar listed firms.

Many studies has contributed to the literature of assets price bubbles, however, no study have attempted to detect stock price bubble in the Turkish stock market (Istanbul Stock Exchange), hence this paper seeks to fill this gap in the literature by focusing our attention on analyzing the ISE market in an attempt to investigate the intrinsic price behaviors by employing the Right tailed Augmented Dickey Fuller Test which includes the Standard ADF (Dolado et al. 2002), Supremum ADF (Phillips et al. 2015), Rolling ADF (Phillips et al. 2015) and Generalized Supremum ADF (Phillips et al. 2015) test. The dynamic structure of the Right tailed ADF test holds on the fact that it detects both single and multiple bubble periods.

2 Literature Review

The field of bubble detection has been extensively been studied in the literature covering a wide range of asset prices. The rational bubble and present value models are the most commonly used techniques for bubble detection. According to Blanchard and Watson (1982), the current price of an asset is an equivalent of its future discounted incomes in the absence of bubble and arbitrage. This price is considered as the fundamental price of the asset Gurkaynak (2008). When investors shows willingness to purchase assets above its fundamental price with the hope that the future price of the assets would exceed its fundamental value in the future, this would lead to the creation of a price bubble in the market. Hence, an asset price with rational bubble would consist of the fundamental value of the assets and bubble components.

The variance bound test proposed by Shiller (1981) was one of the earliest test for rational bubble detection. The technique holds such that, when the observed variance of the asset price exceeds the fundamental price imposed bound, a rational bubble exist. However, the power of the variance bound test was criticized since it lacks a significant structure for bubble detection and the fact that, bubble indications derived from the test can be caused by other factors. West (1987) the two-step test was another earlier alternative test for bubble detection which involve specifications for asset price underlying equilibrium model. This test involve the comparison between the impact of the estimated fundamental asset prices respectively in the underlying equilibrium model within a simple linear model context which takes into account the absence of price bubble. Hence any difference between both models would be considered as a presence of price bubble. However the significance of this model lies on the strength of the equilibrium model.

In other to eliminate the shortcomings and bias posed by west's two-step model and the equilibrium model proposed by West (1987), Campbell and Shiller (1987) developed an alternative bubble technique which shows that, the difference between an asset price and its fundamental value would directly reflect evidence of

explosivity during a bubble development phase. Campbell and Shiller (1987) employed a unit root estimation to test for the presence of bubble in an asset price. If the null hypothesis of bubble is rejected then the fundamental value and asset price can be characterized in two cases. Firstly, the fundamental value and the asset price are stationary and non-stationary respectively while in the second case, both the fundamental value and the asset price are non-stationary. However the second case those not provide enough evidence to justify the present of price bubble.

Over the past 2 decades, unit root and co-integration tests have been widely employed in the bubble detection estimations in property market of several economies. Drake (1993) used the unit root technique to test for price bubble in the UK property market in the mid-1980s. On the other hand, Arshanapalli and Nelson (2008) studied the US housing market by employing the co-integration technique to test for price bubble.

Also Peng (2002) also employed the co-integration test in the case of Hong Kong's real estate market which detected the residential property market bubble in 1977. Over the years this tests have been further developed and advanced such that, regime switching and panel data techniques are been developed and employed in the test for price explosivity.

The shortcomings of the unit root and co-integration techniques were comprehensively pointed out by Evans (1991) who argued that both tests fails to capture price bubbles in time series data with traces of collapsing bubbles in the samples. Blanchard (1979) adds that, the linearity in the dynamic structure is been broken by the collapsing bubble, hence leading to the decrease in the significance and strength of the test. Evans evaluated the strength of the co-integration and unit root tests using simulated data to support his findings.

Furthermore, Phillips and Yu (2009) demonstrated that, when Dickey Fuller statistics are obtained from the whole sample, it diverge to negative infinity in a mildly explosive environment. His findings provided empirical evidence to the failure of both the unit root and co-integration techniques in detecting explosivity in the collected sample where the bubble collapses. Hence, this shortcomings in Evans (1991), has given rise to other recent techniques in an attempt to detect periodic collapsing bubble.

Phillips et al. (2011) developed the sup ADF test which is a right tailed DF test. According to PWY, the right tailed ADF technique should be implemented repeatedly on a forward expanding sample sequence drawing conclusions based on the corresponding DF statistics' sup value. They argued that, compared to earlier developed techniques, the SADF possess more strength in detecting an existence of bubble. Also the SADF outperforms the conventional techniques in that, it date stamps the start and end points of a bubble. The SADF was successfully employed by PWY in several studies to detect price bubble in financial assets both before and after the 2008 global financial crisis.

Homm and Breitung (2012) supported the SADF test technique developed by Phillips et al. (2011) by running extensive Monte-Carlo simulations and statistically

suggests that the SADF performs better than earlier techniques in detecting price bubble in real time. However, the major limitation observed in the SADF technique was the fact that, it can only be used to detect single bubble phase. According to Phillips et al. (2015) argues that the start and end point of a bubble in PWY technique cannot be consistently detected if there exist two bubble periods of which the start period of the second bubble is less than that of the first. This assumption applies to multiple bubble scenarios as well. Economic and financial datasets commonly exhibit single bubble phases. However, the presence of multiple bubbles is inevitable in cases involving a much longer time series data.

As a corrective measure for the PWY, Phillips et al. (2015) developed the supsup ADF test which is still based on the SADF technique but rather than using a fixed starting point, PSY allowed both the starting and end points to vary across a feasible range of flexible windows within the sample size. Furthermore, PSY out performs the PWY since it covers a variety of sub samples and possess the potential of selecting the sub samples which contains a bubble period.

Following the stock market crisis, the need for asset price bubble detection grows rapidly, the number of studies associated with stock prices grows as well. This is as a result of the importance and popularity of stocks as a means of accumulating and liquefying wealth around the globally. The most popular method of comprehending the dynamics of the stock market is by developing a model with the potential of utilizing short- term factors as well as economic fundamentals. Glindro et al. (2008) examined the stock market of 9 Asian countries in an attempt to investigate the determinants of the short-term factors and economic fundamentals. In addition Ahuja et al. (2010) investigated the causes of a rapid and persistent rise in China's stock market by employed the fundamental model.

3 Methodology

In detecting price bubble, the study employed a robust techniques of the Right tailed Augmented Dickey-Fuller (RtADF). It comprises of 4 different sub techniques which includes; right tailed of the ordinary standard Augmented Dickey-Fuller (ADF), the rolling ADF (RADF) test of Phillips et al., the supremum ADF (SADF) test of Phillips et al. (2011), the generalised supremum ADF (GSADF) test of Phillips et al. (2015).

Generating the equational form of the test, we first express the stock price as:

$$\mathrm{P}_t = P_i(1+\mathrm{r})^n + P_i \tag{1}$$

where: $\mathrm{P_t}$ represent Price after dividend, $\mathrm{P_i}$ represents Price before dividend, r represents interest rate.

3.1 Standard ADF

From the stock price equation in Eq. (1) we construct the ADF test using by comparing the lagged coefficient's t-statistic of the dependent variable against the critical values, in order to reject the null hypothesis of the series containing a unit root as shown in Eq. (2)

$$\Delta P_t = \mu_1 + \delta P_{t-1} + \sum_{i=1}^{M} a_i \Delta P_{t-1} + \varepsilon_t \tag{2}$$

where; Δ represents first difference, P_t represents price, t represents the variable's time trend, M represents the model's number of lags added, ε represents error term. The differenced lagged values of the dependent variable ($\sum_{i=1}^{M} a_i \Delta P_{t-1}$) is added to the estimation until they are significant and the problem of serial correlation is not present in the error term. Since the right tailed ADF[1] test is employed, the null hypothesis guiding unit root test will be defined as;

$$\mathrm{H}_0 : \delta = 1\{\text{There is no price bubbles}\}$$
$$\mathrm{H}_1 : \delta > 1\{\text{There is price bubbles}\}$$

After the standard ADF is carried out, we proceed with the rolling ADF test to detect price bubbles, as shown below.

3.2 Rolling ADF (RADF)

Furthermore, we employ the rolling ADF (RADF) test which is the second right-tailed test, this includes the rolling version of the standard[2] ADF test. In the RADF test implementation, it starts with the total sample size (T)'s of the r_1th fraction and end with the sample size's r_2th fraction which increases by one observation at a time. This is clearly shown in Fig. 1. Equation (3) shows the RADF[3] regression model:

$$\Delta P_t = \mu_{r_1 r_2} + \delta_{r_1 r_2} P_{t-1} + \sum_{i=1}^{M} a_{r_1 r_2} \Delta P_{t-1} + \varepsilon_t \tag{3}$$

[1]Classical ADF unit root test is based on the null hypothesis ($\delta = 1$) against its alternative hypothesis ($\delta < 1$). The right-tailed ADF statistic is calculated using the recursive regressions.

[2]It should be noted that in the standard ADF, the widow size is usually fixed. i.e., $r_w = r_0$. Window size (r_w) can be simply be denoted as $r_w = r_2 - r_1$.

[3]In the RADF. procedure, the windows are always overlapping.

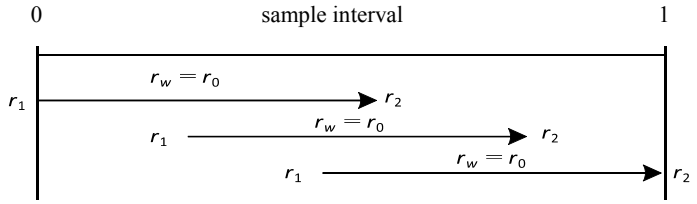

Fig. 1 RADF implementation

where $r_2 = r_1 + r_w$ and $r_w > 0$ is the regression window size. Based on the regression of the ADF statistics, it will be denoted as $ADF_{r_1}^{r_2}$.

After the RADF has been estimated, we can now briefly review the SADF test procedure that was developed by PWY.

3.3 Supremum ADF (SADF) Test

Phillips et al. (2011) developed the third RtADF. PWY test is based mainly on recursive ADF statistics estimations. This is carried out by establishing a starting point[4] which is fixed on a sample sequence that is expanding. In the estimation of the SADF test, the sample starting point which is denoted as r_1 will be fixed as 0 i.e. $(r_1 = 0)$ whereby each samples endpoint will be denoted as r_2 which is equal to r_w causing an expansion from the small window (r_0) to the recursion largest window (1). Figure 2 gives a graphical representation of the SADF implementation. The whole sample is based on the estimation i.e. $(r_2 = 1)$, which denotes the sample of the ADF statistics as $ADF_0^{r_2}$. Based on the forward recursive regression model, the regression will be a supremum value of $ADF_0^{r_2}$ and it is clearly defined in the Eq. (4) below:

$$SADF(r_0) = \sup_{r_2 \in [r_0, 1]} \left\{ ADF_0^{r_2} \right\} \tag{4}$$

3.4 Generalized SADF (GSADF) Test

Phillips et al. (2015) proposed the GSADF, so as to address SADF's sensitivity potential which is caused by the sample's fixed starting point. PSY test allows for flexibility whereby the regression starting point (r_1) changes within a range which is from 0 to $(r_2 - r_0)$ while the regression endpoint (r_2) also changes from the

[4]The user sets the initial window size.

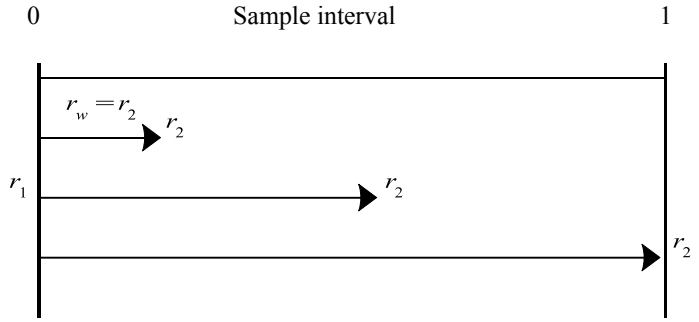

Fig. 2 SADF implementation

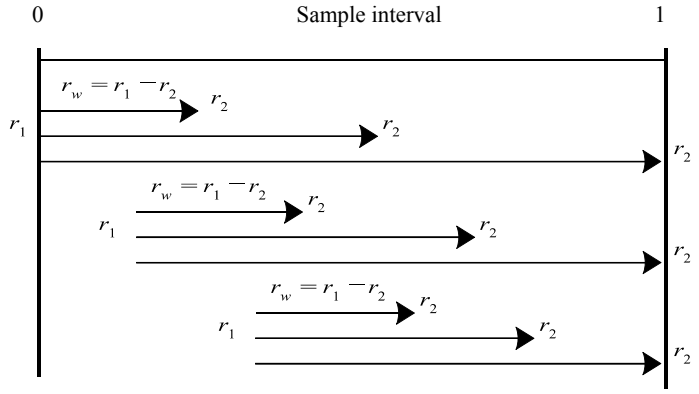

Fig. 3 GSADF implementation

minimal window width (r_0) to 1. Implementation of the GSADF is shown graphically in Fig. 3. Equation (5) defined the test statistic as:

$$\mathrm{GSADF}(r_0) = \sup_{\substack{r_2 \in [r_0, 1] \\ r_1 \in [0, r_2 - r_0}} \left\{ \mathrm{ADF}_{r_1}^{r_2} \right\} \tag{5}$$

Once the RtADF tests as proven to be statistically significant (rejecting null hypothesis of no price bubbles) meaning there is a presence of price bubble. The price bubble starting point and it ending point can be date stamped, this is known as the date stamping strategy. The date[5] stamping strategy is only done with the SADF, RADF, and GSADF procedures. The date stamping strategy is done via the backward SADF test. For the observation explosiveness to be identified at time

[5]See Phillips et al. (2011) and Phillips et al. (2015) for a more and detailed explanation.

(T_{r_2}). PSY proposed that the estimated ADF_{r_2} to be compared with its corresponding critical value of the standard right-tailed ADF statistic. The bubble starting period is denoted as $T\widehat{r}_e$, which is estimated as the first chronological observation, whereby the ADF statistic outweighs the critical value. The estimated bubble start and end period are denoted as $T\widehat{r}_e$ and $T\widehat{r}_f$ respectively. Employing the crossing time formulas, Eqs. (6) and (7) defined the dating estimates as:

$$\widehat{r_e} = \inf_{r_2 \in [r_0,1]} \left\{ r_2 : ADF_{r_2} > CV_{r_2}^{\beta_T} \right\} \tag{6}$$

$$\widehat{r}_f = \inf_{r_2 \in \left[\widehat{r}_e,1\right]} \left\{ r_2 : ADF_{r_2} < CV_{r_2}^{\beta_T} \right\} \tag{7}$$

where: $CV_{r_2}^{\beta_T}$ is the $100(1 - \beta_T)\%$ critical value of the standard ADF test which based on the observations (T_{r_2}). For type I errors to be eliminated, we assume $\beta_T \to 0$ as $T \to \infty$. For convenience, we set β_T to be constant at 5%.

From Eqs. (6) and (7), we generate Eq. (8) which defined the backward SADF (BSADF) test:

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} \left\{ ADF_{r_1}^{r_2} \right\} \tag{8}$$

From the Eq. (8), the end of the sample window interval is constant at r_2 while the starting point changes from 0 to $(r_0 - r_2)$.

Based on the GSADF bubble date stamping, Eqs. (9) and (10) defined the estimates as:

$$\widehat{r}_e = \inf_{r_2 \in [r_0,1]} \left\{ r_2 : BSADF_{r_2} > SCV_{r_2}^{\beta_T} \right\} \tag{9}$$

$$\widehat{r}_f = \inf_{r_2 \in \left[\widehat{r}_e,1\right]} \left\{ r_2 : BSADF_{r_2} < SCV_{r_2}^{\beta_T} \right\} \tag{10}$$

where: $CV_{r_2}^{\beta_T}$ is the $100(1 - \beta_T)\%$ critical value of the sup ADF test which is based on the observations (T_{r_2}). It follows BSADF procedure but here, the estimated supremum ADF_{r_2} is compared with its corresponding critical value of the supremum right-tailed ADF statistic.

Implementing Eqs. (8) and (9) repeatedly, will defined the GSADF[6] in Eq. (11) as:

$$\mathrm{GSADF}(r_0) = \sup_{r_2 \in [r_0,\ 1]} \{ BSADF_{r_2}(r_0) \} \tag{11}$$

[6]In deriving the initial sample size, we use this formula $r_0 = 0.01 + 1.8/\sqrt{T}$ (Phillips et al. 2015).

4 Results and Findings

4.1 Conventional ADF Analysis

We begin by running the conventional ADF test which is sometimes referred to as Standard ADF test before launching the Supreme ADF (SADF), Rolling ADF (RADF), and General SADF ADF (GSADF). The Table 1 display the outcome of the conventional ADF test.

When looking at the stationary nature of this time series, we will deduce that the model is non-stationary, the ADF is higher than the 5% critical value of which we cannot refuse the zero hypothesis of non-stationary (P = 1) in relation to the alternative stationary (p < 1) hypotheses.

As stated before, though, distribution is skewed to the left and our aim is not to test for stationarity but rather, the existence of bubbles in the market. to do this, the conventional ADF test will be used for the full sample (2000W1–2019W4), at 5% significance level, the unit root will fail to accept he the Zero hypothesis of a right-tailed alternative volatile behavior. Nevertheless, Evans (1991) criticizes the fact that conventional unit root tests for the complete sample have problems in the identification of bubble that collapses regularly, which means that we move rolling and recursive tests.

4.2 Sup ADF (SADF) Test

The ADF statistics for each recursive sub-sample are estimated in Sup ADF tests. The observations from the first to the 25th observation are included in the first sup sample The size of the first subsample can be arbitrarily selected as previously stated, provided that only the results of the later part of the data are taken into consideration. the Sup ADF tests of the Zero-unit root test hypothesis against the alternate explosive-root, the Sup ADF stats are the maximal ADF statistics calculated among all probable windows and the critical values for the SADF are similar with the previous one used (Table 2).

The SADF test gives substantial proof that the price data are volatile at every level of confidence, affirming the rolling assertion that price exuberance is present in the Turkish stock market (Fig. 4).

Table 1 Conventional ADF test result

Interpolated dickey fuller			
Test statistics	Critical values		
	99%	95%	90%
−0.772 (0.193)	0.652	−0.007	−0.431

Notes *Indicate statistical significance at the 1%
Critical values are based on a Monte Carlo simulation

Table 2 Sup ADF test result

SADF			
Test statistics	Critical values		
	99%	95%	90%
2.861 (0.000)	2.049	1.516	1.276

Notes *Indicate statistical significance at the 1%
Critical values are based on a Monte Carlo simulation

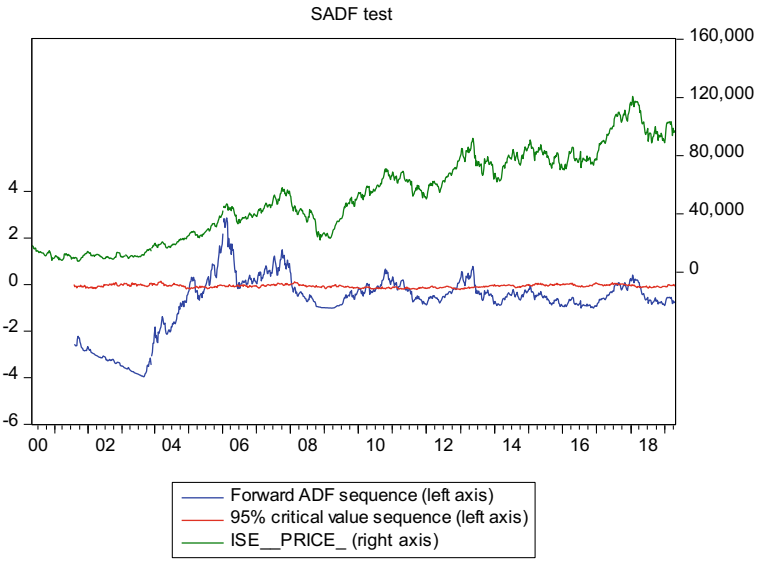

Fig. 4 Date stamping SADF test result

Many inferences have been carved out from the curve of SADF, first it is obvious that the outcomes of SADF are far from being coherence with the rolling ADF. The SADF test identifies a second bubble, before the financial crisis that circulate round the globe in 2008, there is existence of bubble in 2007 and the other that collapsed in late 2010 at the beginning of 2011. Furthermore, bubble surface in 2012 and 2018. However, the existence of bubble in 2018 may be as a result of weak lira, and rise in several macroeconomic indicators. In addition, the recursive curve confirms that the Turkish stock market show exuberance from 2005 to 2018. this finding is in line with the RADF test. In this scenario, we can deduce that the SADF test is far more precise and allows bubbles to be detected more accurately.

4.3 Rolling ADF (RADF) Test Analysis

With regard to the rolling ADF version, we will test the Zero hypothesis against the alternative hypothesis of volatile unit root hypothesis. The central question is how to identify the most appropriate sample size of the window length employed in rolling regressions estimation, and the way to use it before rolling ADF tests are carried out. Indeed, sub-sample data may not be too small, that is, estimators' statistical attributes will be poor and coefficient distortions will be severe. Phillips et al. (2011) employed the rolling regressions in their empirical analysis with 77 findings out of total 380 NASDAQ stock index observations.

The rolling data windows here have a restricted length of 25 observations, which is around 20% of the total sample to give indicators that can provide a trustworthy and timely signal. In which a rolling window of 25 observations is computed for the ADF statistics. Windows starting and ending point are increased one step at a time throughout this specific procedure and the ADF rolling statistics are the maximum ADF statistic calculated for all possible windows. The outcome is shown in Table 3. A Monte-Carlo simulation with 1000 replications extracted the critical value (CV). The procedures are taken from the article "Rolling ADF Test: detection of rational bubbles within the Chinese Stock Market" are as follows: For the sample size 25, we are using a DF test to calculate the subsequent ADF statistics on each of the stimulated samples, where the null hypothesis is that there is constant term, but no trend. In the end, we are looking at the percentiles mentioned in the table sampling size which are 1000 AR (1) root time series each of the units with a fixed constant term, and step 1–3 are re-run for dissimilar sample size (Fig. 5).

The very first point to note is that the stock market in Turkey has multiple bubbles. Rather than following a clear trend the ADF line will drop drastically when the bubble bursts, they will go up and down, then go up and down again and again, though in varying degrees each time. The first price exuberance in data occurrence is at the end of 2001. The second occur in late 2002 with subsequent bubbles that collapsed regularly and last for one month or less in late 2002.

The first burst occurred at the end of 2005, in line with the famous 2008 financial crisis. What is noteworthy is that the market was able to bounce back, including after the 2008 crisis, and that prices were rising again, which brought exuberance into Turkish stock market. However, subsequently in the end of 2012 the bubble reappeared and this could come about as a result of a careful market, because the concerns in investors were fostered by an overwhelming environment of insecurity

Table 3 Rolling ADF test result

RADF			
Test statistics (prob.)	Critical values		
	99%	95%	90%
2.117 (0.042)	0.662	−0.043	−0.407

Notes *Indicate statistical significance at the 1%
Critical values are based on a Monte Carlo simulation

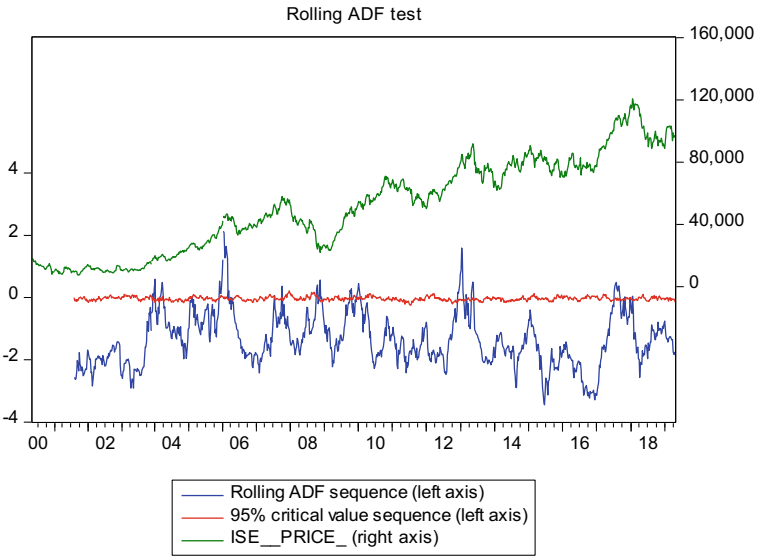

Fig. 5 Date stamping Rolling ADF test result

and nobody would want to invest or to gamble during this critical time. Another noticeable fact was, regardless of the fact that there was a coup de ta in the country, bubble did not appear in 2016. Bubbles reemerged in 2017, this may be as a result of a fall in Turkish lira, which was especially high in 2017, for many investors.

4.4 Generalized SADF (GSADF)

The SADF test may be lowered and contradictory, failing to disclose bubbles, if multiple episode of exuberance and collapses occur during the sample period. The vulnerability is a specific inconvenience in the analysis of long-term data or volatile market data quickly, where several exuberance episodes are presumed. We suggest an alternate method called the generalized sup ADF (GSADF) test in order to address this shortcoming. The GSADF test is premised on the notion that a right-tailed ADF test is continuously carried out, but somehow it expands the sampling series to a wider and more adaptable range.

The GSADF test stretches the sample sequence by altering the start and endpoint of the sample over a range of flexible windows rather than fixing the beginning of the sample (in particular the first sample observation). In SADF and GSADF tests, sample sequences are intended to track any volatile behavior inside the general sample and make adequate observations for initiating the recursion are made.

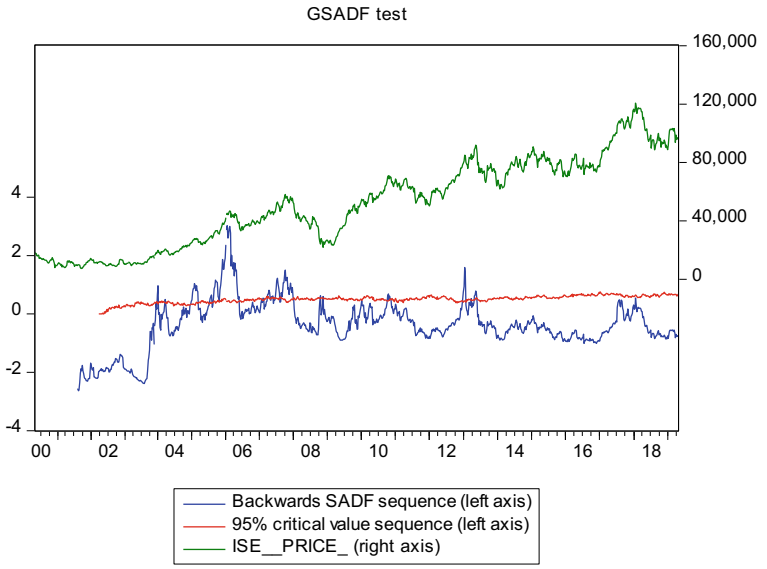

Fig. 6 Date stamping GSADF test result

Table 4 Generalized Sup ADF test result

GSADF			
Test statistics (prob.)	Critical values		
	99%	95%	90%
3.020 (0.002)	2.589	2.179	1.960

Notes *Indicate statistical significance at the 1%
Critical values are based on a Monte Carlo simulation

Although the GSADF test encompasses further sub samples of data and increased flexibility in the window, the SADF test is predicted to be superior when explosive actions are detected in multiple episodes. Simulations show this performance increase via the GSADF test comparing the size and power of both tests in bubble identification (Fig. 6; Table 4).

Finally, the Turkish stock market, with the t-stat logarithm of 3.02 which is more than the 1% critical value of the eruptive alternative of 2.59. This denotes that Turkey stock market is volatile as shown by the GSADF. the first bubble shows up in late 2003 followed by mid-2004, and 2006. Furthermore, bubble surface in late 2007, and late 2008. This may be attributed to the global financial crisis that hit the world in 2007. Finally, in early 2012, and 2013 bubble show up. However, from 2014 to 2018, there is no sign of bubble(s) in the turkey stock market.

5 Conclusion

In recent years, speculative activity has grown unprecedentedly. Even though the precise instruments stay controversial, there is no doubt about the adverse effect. This article seeks to shed light on what speculation is. True, speculation is of use to provide market liquidity, the problem is that excessive speculation does not help the public. Not only can speculation not be confused with hedging or investment, it can play a significant role in the market destabilization, but also promote the growth of added value and the development of the economy by pushing the price upwards and downward and boosting the volatility of the market more than it has been and hence, establishing bubbles. Every bubble is dissimilar, but the outcome is still the same: speculation, boom, more speculation, crashing and the financial pain. The empirical objective of the paper includes testing for bubbles in the Turkish Stock Market (ISE), which tends to lead us to acknowledging the presence of bubbles through the drastic volatility in stock prices. We take conventional ADF, a standard ADF, a rolling ADF, and a generalized SADF test to examine such behavior in the Turkish stock market and the results prove the presence of exuberance in the Turkish Stock Market.

The outcome indicates how explosivity in prices can be backed by explosiveness of dividend in these cases, thus demonstrating no indication of bubble when looking at specific listed companies in the Turkish stock market. The work has not sought to distinguish explicit sources of the exuberance found, nor has the exact origin and collapse of the bubbles spotted stunned. Finally, and not the least, it is vital to say that it would be ridiculous to try to ban it, notwithstanding the damage caused by speculation. However, market regulation can relieve its negative impact. This involves making market opportunities less appealing to short-sellers and avaricious investors via lower expected returns, increased access costs, easy access to debt and financial innovation and short selling taxation.

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Nonlinearity in Emerging European Markets: Pre and Post Crisis Periods

Ceyda Aktan and Tolga Omay

Abstract Investigating the efficiency of emerging markets has been a popular research trend in the past decade, showing implications on both the economy and the policies of the countries in question. Market efficiency, in other words, informational efficiency, states that if markets are fully efficient, then all information is instantly reflected the prices of stocks. However, there are many arguments for and against this theory, especially on the discussions of the 2008 Global Financial Crisis. These past studies are seen to be showing mixed results. It is important the note that there is a nonlinear movement among the stock prices within stock markets and this needs to be incorporated in the tests that are used to measure their efficiency in order to obtain more accurate results. Therefore, in this study, we have tested the weak form efficiency of the emerging markets located in Europe, namely, Czech Republic, Greece, Hungary, Poland, Turkey, and Russia. Effects of the 2008 Global Financial Crisis were put forward by taking two different time periods (Pre: November 2005–September 2008 and Post: October 2008–February 2019—Crisis) and applying newly developed nonlinear unit root tests. Results of the study supported previous research and showed that the efficiency of most markets changed in the post-crisis period from efficient to inefficient.

Keywords Market efficiency · Emerging markets · Nonlinear unit root tests · Nonlinearity

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1 Introduction

During the past couple of decades there has been growing interest on emerging markets from researchers around the globe. These markets provide investors with high rates of return have high volatility and create an opportunity for diversifying portfolios (Antoniou et al. 1997a). The growing interest is said to be attributed to a couple of factors. First of all, countries with emerging markets tend to be highly populated making up most of the world's population. Second point is that the rates of growth in these markets are much greater when compared to developed markets (Kearney 2012). But high profitability from these markets brings about the question as to whether these markets are actually efficient.

Emerging markets research also shows that there are push and pull factors affecting these markets and, hence, their efficiencies. As previously mentioned, developed countries offer lower returns and opportunities for investors, which then causes a push toward emerging markets. On top of this, emerging markets also offer different benefits such as higher returns to investors, and constantly undergoes structural reforms and takes on exchange rate stabilization programs which in turn makes up the pull factors. Investments are pulled towards these markets (Fountas and Segredakis 2002). There are many more issues that still need to be analyzed, interpreted and implemented in order to get more benefit from the emerging markets. Looking into their market efficiency is one of them. Efficiency is an important area to consider when it comes to taking decisions to invest in a particular market, especially when the resources are limited (Antoniou et al. 1997a).

Although the idea behind market efficiency goes back all the way to the beginning of 1900s, market efficiency, as we know, is a concept that was first defined by Fama (1970). The theory behind it is referred to as the Efficient Market Hypothesis (EMH hereafter). According to the EMH, all information will be immediately reflected in the prices of stocks as it comes. In other words, if a market is said to be efficient, then one can expect that all stock prices have incorporated the new information that came to the market (Rizvi and Arshad 2016). All investors will be subjected to the same amount of information and prices as one another (Antoniou et al. 1997b). However, it gets confusing when there are different types of information. Thus, Fama (1970) has classified market efficiency into 3 different levels according to the type of information absorbed: weak form, semi-strong form and strong form. Weak form of market efficiency is the basic form of efficiency where only the historical information is considered. Obtaining historical information is relatively easier and therefore this form of efficiency is termed as 'weak'. If a market is weak form efficient then the prices of stock reflects upon past prices. Investors cannot then use past information to predict future prices and gain an advantage (Bodie et al. 2003). However, if a market is efficient in the semi-strong form, then not only past information is reflected in the prices of stocks but all publicly available information is also taken into account (Jensen 1978). The third form of market efficiency is the strong form, which Fama (1970) states that all available information is reflected onto the prices. All available information includes

past, publicly available and the relevant private information. It is the strictest level of efficiency on which debates exit as to its existence (Finnerty 1976).

EMH has been and still is a widely used and accepted model. However, although there are arguments for the theory, there are also arguments against it. Studies indicate that investors are not always rational and together with stock prices they may over or under-react to information. In other words, a person may either underestimate or over estimate the value of the new information (Malkiel 2011). Study by Jegadeesh and Titman (1993) concludes that employing a particular trading strategy generates positive returns: this strategy is buying past winners and selling past losers. Winners are expressed as stocks that have a higher current price than its average price whereas losers are stocks with a lower current price.

Another argument that is against the EMH is the bubbles that are experienced within the stock markets (Lei and Vesely 2009). Bubbles, or asset bubbles, are the overly-inflated asset prices that exist within particular markets. For example in the 90 s the Internet Bubble was experienced which became a disaster when the bubble popped in short time. Stocks of companies that were related to Internet dropped instantly by around 90%. Investors were observed to react favorable to stocks with increasing prices as much as that even knowing that the stock might quickly lose value in the future, they still expect an increase in the price of those stocks (Malkiel 2011). However, if markets were efficient and arbitrage opportunities existed as the EMH suggests, how was it that these bubbles were not identified and eliminated? These bubbles that were observed in prices of assets were used against market efficiency theories by many and were held as evidence. This was also the case in the housing bubble of 2007–2008, which brought about the famous Global Financial Crisis.

The crisis of 2008 started with the bankruptcy announcement of Lehman Brothers and rapidly spread to markets from all around the world (Ali and Afzal 2012). Both the developed and emerging markets were severely affected, their economies weakened, economic growth declined and unemployment rates increased (Anagnostidis et al. 2016). The interesting part was that, during the financial crisis, majority of the markets that were known to be informationally efficient severely suffered losses (Ball 2009). This pointed out that not all information was instantly reflected in the market and then brought about the development of newer theories that focused on the behavioral aspects of finance opposing the general principles of EMH (Mynhardt et al. 2014). There is supporting evidence from previous literature that people do not instantaneously react to new information and their delayed response creates nonlinear dynamics where information is incorporated into the stock prices in a nonlinear fashion (Antoniou et al. 1997a). The Global Financial Crisis of 2008 is said to have caused a panic and chaos among investors, which led to a decrease in the efficiency of these markets through the creation of nonlinear dynamics (Todea and Lazar 2012). Ball (2009) and Malkiel (2011) mention in their studies that there is a group that even considers that EMH is responsible for the crisis itself.

Financial crises are events when value of assets suddenly decreases causing panic in the market (Anagnostidis et al. 2016). Evaluating the reaction of these stock markets under chaos and stress provides important areas for future research.

Taking the 2008 Global Financial Crisis into account, time before the crisis and its aftermath provides a good ground for analyzing the efficiencies of markets and to discuss its implications. We therefore, aim to investigate the effects of the 2008 Global Financial Crisis on the efficiency of the emerging markets located in Europe.

Fama (1991) has quoted "…evidence of predictability should always be met with a healthy dose of skepticism…" meaning that results of studies, all different kinds of information need to be questioned. With different time frames and tests, results can show variations amongst one another. We should be skeptical about the predictability of stock prices and should not tell with great certainty if the market is efficient or inefficient. In this study we have tested the weak form efficiency of 6 emerging markets located in Europe, namely, Czech Republic, Greece, Hungary, Poland, Turkey, and Russia using 5 different nonlinear unit root tests. Two different time periods were taken to observe the differences in the efficiency of these markets before the crisis and secondly, after the crisis. Pre crisis period is taken as from November 2005 until September 2008. Post crisis period starts from October 2008, includes the time of the crisis and ends on February 2019.

Contribution of this paper to the market efficiency literature will be great as first of all there are not many studies focusing on the emerging markets in Europe. Secondly, as opposed to the conventional unit root tests, such as Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) tests, this study takes into account the nonlinear nature of these markets and 5 different nonlinear unit root tests were chosen to be used to assess market efficiency. Thirdly, there are no studies yet with a time period as recent as this study. Taking data all the way until February 2019 provides a larger sample to make an analysis.

The rest of the study is organized as follows: In Sect. 2 a brief literature review is given. Section 3 presents the data and methodology. Section 4 discusses the results and Sect. 5 concludes.

2 Literature Review

Looking at previous literature on market efficiency, it could be seen that there are vast amount of information and many different types of studies. Some of these studies focus their attention on the markets being studied, some on the method and some on the particular time frame. However, all of these factors cause variations in the results of the studies. In this particular study, it would be correct to look at past literature on the basis of emerging markets and the global financial crisis.

Studies focusing on the market efficiency of emerging markets are still at its infancy when compared to the amount of studies conducted on the developing markets from around the world. There is a general assumption that developed markets will be much more efficient than emerging markets (Griffin et al. 2010). However, a common mistake here is that the lack of financial development in emerging markets are as a result of imperfections in the market, not necessarily about the uninformed or irrational investor within these markets compared to its

developed counterparts (Mobarek and Keasey 2000). On the other hand, open policy of emerging markets is said to provide big investors an opportunity to make speculations on the market. If a market is not well organized and does not have timely information, it creates possibilities for insider trading and generating above normal returns. Hence, indicating inefficiency in the stock market (Mobarek and Keasey 2000). Therefore, studies on emerging market efficiency have been divided into two: ones with results that support the inefficiency of these markets, and ones with results indicating that these markets are efficient.

Ojah and Karemera (1999) have looked at the random walk properties of the equity markets of Argentine, Brazil, Chile and Mexico using 2 different tests: the auto-regressive fractionally integrated moving-average test of Geweke and Porter-Hudak (1983) (GPH) and the multiple variance ratio test of Chow and Denning (1993). Data was taken monthly and from time period between December 1987 and May 1997. Results obtained from both tests indicated that all of the above markets showed random walk properties and hence, were weak form efficient.

Although Ojah and Karemera (1999)'s results showed efficiency in these 4 market, 4 years previously Urrutia (1995) had also conducted tests to measure the weak form efficiency of the same Latin American markets using monthly data taken from December 1975 to March 1991. He used a single variance-ratio test which showed that the dynamics of these markets were inconsistent with the random walk hypothesis.

A supporting study was conducted by Worthington and Higgs in 2003 where they have tested the weak form market efficiency of 7 Latin American markets; namely, Argentina, Brazil, Chile, Columbia, Mexico, Peru and Venezuela. Different than the two studies mentioned above, daily instead of monthly data was used and number of tests applied was much greater. Tests used in the study were serial correlation coefficient, runs, multiple variance ratio (MVR), and unit root tests such as Augmented Dickey-Fuller (ADF), Phillips-Perron (PP) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) tests. Results of the study pointed that none of these markets were efficient in the weak form (Worthington and Higgs 2003).

Study conducted by Kawakatsu and Morey (1999) focused on the liberalization of the equity markets in emerging economies. They have suggested that as equity markets are liberalized, they will be more open to public and therefore prices of equity will reflect the available information and be more efficiently priced. In other words, their aim was to show that with liberalization markets will become more efficient. 9 countries with emerging economies were used in the study (Argentina, Brazil, Chile, Mexico, Colombia, India, Korea, Thailand, and Venezuela). However, although theoretically valid, their results showed that these countries were already efficient to begin with.

There are few studies that specifically focus on the emerging markets that are located in Europe. One of these studies is by Guidi et al. (2011). Central and Eastern European (CEE) markets (Poland, Czech Republic, Hungary, Slovakia, Slovenia, Romania and Bulgaria) were tested for the weak-form market efficiency using daily data obtained between 1999 and 2009. Autocorrelation analysis together with runs and variance ratio tests were used on the data. The findings show that

after CEE countries joined the EU, the autocorrelation analysis indicated there's no random walk whereas the runs test indicated that the efficiency of these markets improved. Within the same time period, the variance ratio tests resulted in the rejection of random walk for Slovakia and Bulgaria.

Smith and Ryoo (2003) conducted multiple variance ratio tests on the stock markets of Greece, Hungary, Poland, Portugal, and Turkey, all which are classified as emerging markets. Only the Turkish stock market was found to be weak form efficient whereas the other 4 markets were found to be inefficient for the time period between 1991 and 1998.

In his study, Smith (2012) focused on a larger number of markets in Europe which he expresses as emerging. These markets are: Croatia, Czech Republic, Estonia, Hungary, Iceland, Latvia, Lithuania, Malta, Poland, Romania, Russia, Slovakia, Slovenia, Turkey, and Ukraine. Daily data from February 2000 to December 2009 was used on variance ratio tests. Their results showed that markets of Turkey, UK, Hungary and Poland were the most efficient whereas the markets in Ukraine, Malta and Estonia were the least efficient. The study also looked at the effect of the 2008 financial crisis on the weak form efficiency of these markets. Out of all the markets analyzed the crisis affected the markets of Latvia, Romania, Russia and Turkey the least.

Aktan et al. (2019) used nonlinear panel unit root tests to observe the efficiencies of 32 European markets. These markets were classified as frontier, emerging and developed. Under the emerging markets were the Czech, Greek, Hungarian, Icelandic, Polish Russian, Turkish, and Ukrainian markets. Data was obtained monthly and from June 2006 to June 2017. Results showed that within this period the European emerging markets were efficient. However, a sub-period was also tested to observe the effects of the crisis, from January 2011 to June 2017. In this period stationarity was observed in the European emerging markets.

Another focus of this study is the Global Financial Crisis of 2008 and how it affected the efficiency of emerging markets in Europe. Looking at past literature, it could be understood that there has not been many studies on the topic. Literature on the effects of financial crises on stock markets focuses more on the 1997 Asian stock market crisis (Anagnostidis et al. 2016). It is important to see if there have been any changes in the efficiencies of markets after the 2008 crisis as it brings out the question of whether these markets were actually efficient from the beginning. Some of the studies that analyze the effects of the crisis on the efficiency of markets are given below.

Mishra et al. (2009) used the classic KPSS and PP unit root tests to data obtained daily from the Indian stock market to test the weak form market efficiency. The data span of the study was limited as it just took the time of crisis into question. Data was from January 2007 to July 2009. The results of the study showed that the Indian stock market was not weak form efficient during the crisis.

Chen and Jarrett (2011) studied the Chinese equity market to test whether this market is weak form efficient or not. The data was gathered as daily and monthly from January 2002 to December 2008. To compare the market: pre-crisis period

was taken as 2002–2006 and the crisis period as 2007–2008 and variance ratio tests applied. Results of the monthly index data were that these markets were inefficient before the crisis but became efficient during the crisis.

A study of interest has been conducted by Anagnostidis et al. (2016) to test the relative efficiency of the European stock markets and show the implications of the Global Financial Crisis on these markets. 12 stock markets; namely, Austria, Belgium, Finland, France, Germany, Greece, Netherlands, Ireland, Italy, Luxembourg, Portugal and Spain was tested using the generalized hurst exponent algorithm (GHE). Daily closing prices between 24.08.2004 and 15.09.2014 were taken. Results of the study support the above-mentioned literature and show that mean-reverting patterns in stock price movements was detected.

Literature on the Global Financial Crisis and its effects on efficiencies of markets is still a new area and therefore, not many studies exist on the topic. This study will greatly contribute to existing literature.

3 Data and Methodology

3.1 Data

As previously mentioned, weak form of market efficiency deals with historical information and is often tested by analyzing whether the past prices of stocks show patterns which allows for future prices to be predicted. Therefore, in this study weak form of market efficiency was tested using data obtained from 6 different emerging markets located within Europe, namely, Czech Republic, Greece, Hungary, Poland, Turkey, and Russia. In order to determine which markets to include in the study, FTSE 'Country Classification' (as at March 2018) found within the "FTSE Country Classification Process" (2018) report was considered. According to the report 5 European countries (Czech Republic, Greece, Hungary, Poland, and Turkey) were listed as Advanced Emerging and one European country (Russia) was listed as Secondary Emerging.

Data used consists of the monthly closing prices of major indices within those markets, which are listed below in Table 1. Natural logarithms of the data are taken to make the series more stationary for the purpose of the study. An important element of the study is to observe whether the efficiency of these markets show differences before and after the crisis. Therefore, it is very difficult but crucial to identify a date that separates the two periods. There are vast amount of studies taking different time periods relative to the crisis. However, study by Hsu et al. (2013) was taken as reference and the two periods to analyze were identified as November 2005–September 2008 (Pre-Crisis) and October 2008–February 2019 (Post-Crisis).

Table 1 Markets, indices, and codes used in the study

Market	Index	Code
Czech Republic	PX	PX
Greece	Athens General Composite	ATG
Hungary	Budapest SE	BUX
Poland	WIG20	WIG20
Turkey	BIST 100	XU100
Russia	MOEX Russia	IMOEX

3.2 Methodology

It is generally assumed that markets are liquid, the investors are highly educated and reaching reliable information is possible. However, in emerging markets nearly the opposite of this statement is true as these markets are highly volatile with a rapid economic and political change. Also, one of the principals behind market efficiency states that investors are rational. As soon as new information arrives in the market, investors will react instantaneously and this information will immediately be incorporated in the prices of stocks. As a result of this rational behavior, there will be linear reaction of stock prices to the coming information (Antoniou et al. 1997a).

Once again, studies show that investors are not always rational and anomalies exist within the markets (Schwert 2003). Some investors can be classified as loss averse, as in being more susceptible to loss, or they can be uninformed and bias. This becomes more evident in emerging markets due to information asymmetry and lack of access to sources (Griffin et al. 2010; Antoniou et al. 1997a). Price and information movement becomes non-linear. Therefore, when there is a non-linear behavior within the market and stock prices, using non-linear unit root tests to measure weak form market efficiency will yield better results than the conventional linear tests.

Taking the non-linear nature of price movements within stock markets into consideration, in this study we employ 5 recent non-linear unit root tests: Leybourne, Newbold, and Vougas (LNV) Test; Kapetanios, Shin, and Snell (KSS) Test; KSS–LNV Test developed by Omay and Yildirim (2014); Sollis Test; and LNV–Sollis Test developed by Omay et al. (2018). Brief descriptions of the tests are provided below.

The null and alternative hypotheses of the study are:

H_0: contains unit root (efficient market) (i.e. H_0: $\phi = 0$)
H_1: stationary (inefficient market) (i.e. H_1: $\phi < 0$)

3.2.1 Leybourne, Newbold, and Vougas (LNV) Test

In their study Leybourne et al. (1998) looked at different regimes for a smooth transition in order to show a deterministic structural change. Regression models used in their test are as shown:

$$\begin{aligned}
&\textit{Model A} \quad y_t = \alpha_1 + \alpha_2 S_t(\gamma, \tau) + v_t \\
&\textit{Model B} \quad y_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\gamma, \tau) + v_t \\
&\textit{Model C} \quad y_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\gamma, \tau) + \beta_2 t S_t(\gamma, \tau) + v_t
\end{aligned}$$

In the equations, v_t represents the zero-mean $I(0)$ process, whereas, $S_t(\gamma, \tau)$ represents the logistic smooth transition function with a sample size T and

$$S_t(\gamma, \tau) = [1 + exp\{-\gamma(t - \tau T)\}]^{-1} \quad \gamma > 0$$

The extreme values of the logistic transition function given above lies between 0 and 1. It is a continuous function and generally referred to as a regime-switching model with a gradual transition between regimes. The parameter γ represents the speed of this transition between two regimes and can be said as the determinant for the smoothness of the transition.

Each regression model has its own structure. In Model A, y_t is stationary around the mean. Model B is similar to Model A, but it also includes a fixed slope term. Lastly, in Model C, besides a change in intercept, there is also a change in slope.

The null and the alternative hypotheses proposed by the LNV test are:

Null hypothesis (H_0)	$y_t = \mu_t, \mu_t = \mu_{t-1} + \varepsilon_t, \mu_0 = \psi$
Alternative hypothesis (H_a)	Model A, Model B or Model C
Null hypothesis (H_0)	$y_t = \mu_t, \mu_t = \kappa + \mu_{t-1} + \varepsilon_t, \mu_0 = \psi$
Alternative hypothesis (H_a)	Model B or Model C

ε_t and υ_t are both assumed to be a stationary process with a zero mean.

There are two steps involved in the calculation of the test statistics:

1st Step: Nonlinear Least Squares (NLS) method is used and the deterministic component is calculated, residuals found.

$$\begin{aligned}
&\textit{Model A} \quad \hat{\upsilon}_t = y_t - \hat{\alpha}_1 - \hat{\alpha}_2 S_t(\hat{\gamma}, \hat{\tau}) \\
&\textit{Model B} \quad \hat{\upsilon}_t = y_t - \hat{\alpha}_1 t - \hat{\beta}_1 - \hat{\alpha}_2 S_t(\hat{\gamma}, \hat{\tau}) \\
&\textit{Model C} \quad \hat{\upsilon}_t = y_t - \hat{\alpha}_1 t - \hat{\beta}_1 - \hat{\alpha}_2 S_t(\hat{\gamma}, \hat{\tau}) - \hat{\beta}_2 t S_t(\hat{\gamma}, \hat{\tau})
\end{aligned}$$

2nd Step: ADF statistic and the t ratio are calculated:

$$\Delta\hat{v}_t = \hat{\rho}\hat{\upsilon}_{t-1} + \sum_{i=1}^{k} \hat{\delta}_i \Delta\hat{v}_{t-i} + \hat{\eta}_t$$

3.2.2 Kapetanios, Shin and Snell (KSS) Test

In their study, Kapetanios et al. (2003) looked at the possible implications of nonlinear unit root testing and showed an alternative method of how to test for a possible unit root. The existence of unit root was taken as the null hypothesis whereas the nonlinear exponential smooth transition autoregressive (ESTAR) process, which shows stationarity, was taken as the alternative hypothesis.

Development of the test began by re-parameterizing the ESTAR model:

$$y_t = \beta y_{t-1} + \gamma y_{t-1}\left[1 - \exp\left(-\theta y_{t-d}^2\right)\right] + \varepsilon_t$$

Which, after inserting ϕ for $\beta - 1$, becomes:

$$\Delta y_t = \phi y_{t-1} + \gamma y_{t-1}\left[1 - \exp\left(-\theta y_{t-d}^2\right)\right] + \varepsilon_t$$

The parameter θ relates to the speed of the mean reversion and also forms the base of the hypotheses of the KSS test. Stationarity of the y_t process can be tested with the following hypotheses:

Null Hypothesis $(H_0) : \theta = 0$
Alternative Hypthesis $(H_a) : \theta > 0$

But, the null hypothesis cannot directly be tested, as the γ parameter is not identified under null hypothesis. In their study, Kapetanios et al. (2003) came up with a solution for this situation and replaced the transition function with the first-order Taylor approximation. The final extended regression model became:

$$\Delta y_t = \sum_{j-1}^{p} \rho_j \Delta y_{t-j} + \delta y_{t-j}^3 + error$$

3.2.3 KSS-LNV Test

Omay and Yildirim (2014) proposed, in their study, a new test, which is considered to be an extension of the previously mentioned KSS Test. They have employed a nonlinear attractor with a gradual break in order to improve the alternative hypothesis of the KSS Test.

Following from the work of Leybourne et al. (1998), Omay and Yildirim (2014) started with the 3 regression models (Model A, Model B and Model C) and came up with the following null and alternative hypotheses:

$$H_0: Unit\ Root, (\text{Linear Nonstationary})$$
$$H_a: Nonlinear\ Stationary$$

Lastly, the test statistics were then calculated with the similar two steps as the LNV Test. In the first step, NLS algorithm was used, the deterministic component was estimated and the residuals were calculated.

$$\begin{aligned}
&\textit{Model}\,1: \quad \hat{\varepsilon}_t = y_t - \hat{\alpha}_1 - \hat{\alpha}_2 S_t(\gamma, \tau) \\
&\textit{Model}\,2: \quad \hat{\varepsilon}_t = y_t - \hat{\alpha}_1 - \hat{\beta}_1 t - \hat{\alpha}_2 S_t(\gamma, \tau) \\
&\textit{Model}\,3: \quad \hat{\varepsilon}_t = y_t - \hat{\alpha}_1 + \hat{\beta}_1 t + \hat{\alpha}_2 S_t(\gamma, \tau) + \hat{\beta}_2 t S_t(\gamma, \tau)
\end{aligned}$$

In step 2, Ordinary Least Squares (OLS) regression was used to compute the KSS statistic and the t-ratio related to $\hat{\rho}_i$.

$$\Delta\hat{\varepsilon}_t = \hat{\rho}\hat{\varepsilon}_t^3 + \sum_{j=1}^{k} \hat{\delta}_j \Delta\hat{\varepsilon}_{t-j} + \hat{\eta}_t$$

3.2.4 Sollis Test

Sollis (2009), in his study, extended the ESTAR model and proposed a unit root test. This proposed model provided for the symmetric or asymmetric nonlinear adjustment of the proposed alternative hypothesis. This was named as the asymmetric ESTAR or AESTAR model. It contains in it both an exponential and a logistic function:

$$\begin{aligned}
\Delta y_t &= G_t(\gamma_1, y_{t-1})\{S_t(\gamma_2, y_{t-1})\rho_1 + (1 - S_t(\gamma_2, y_{t-1}))\rho_2\}y_{t-1} + \varepsilon_t \\
G_t(\gamma_1, y_{t-1}) &= 1 - \exp\left(-\gamma_1\left(y_{t-1}^2\right)\right) \quad \gamma_1 \geq 0 \\
S_t(\gamma_2, y_{t-1}) &= [1 + \exp(-\gamma_2 y_{t-1})]^{-1} \quad \gamma_2 \geq 0
\end{aligned}$$

where y_{t-1} is the transition variable.

However, like the KSS Test, same problem exists in the Sollis Test where the null hypothesis becomes unidentifiable due to the parameters: $\gamma_{2,}\rho_1$ and ρ_2. To overcome the problem, the function was adjusted twice: firstly by the first order Taylor expansion of the exponential function, then lastly by expanding the logistic function. The resulting augmented regression function can be shown as:

$$\Delta y_t = \phi_1 y_{t-1}^3 + \phi_2 y_{t-1}^4 + \sum_{i=1}^{k} \kappa_i \Delta y_{t-i} + \eta_t$$

where; H_0: $\phi_1 = \phi_2 = 0$.

3.2.5 LNV-Sollis Test

The use of logistic functions within studies has proven to be efficient in capturing the structural breaks and, hence, is popular among many researchers to use within their models. This also applies for the test developed by Omay et al. (2018). In their test, adjustment towards the equilibrium is nonlinear and asymmetric while allowing for the simultaneous structural changes.

This newly developed test is a combination of the LNV and Sollis Tests. Starting from the 3 regression models proposed by the LNV Test:

$$\begin{aligned} &\textit{Model A} \quad y_t = \alpha_1 + \alpha_2 S_t(\gamma, \tau) + v_t \\ &\textit{Model B} \quad y_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\gamma, \tau) + v_t \\ &\textit{Model C} \quad y_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\gamma, \tau) + \beta_2 t S_t(\gamma, \tau) + v_t \end{aligned}$$

the logistic smooth transition function with sample size T was represented as:

$$S_t(\gamma, \tau) = [1 + \exp\{-\gamma(t - \tau T)\}]^{-1} \quad \gamma > 0$$

This particular test developed by Leybourne et al. (1998) used a linear model for the adjustment whereas; Sollis (2009) had a different approach as previously mentioned. In this LNV-Sollis model, approach of Sollis (2009), AESTAR, was used for the adjustment towards the equilibrium:

$$\begin{aligned} \Delta u_t &= G_t(\theta_1, u_{t-1})\{F_t(\theta_2, u_{t-1})\rho_1 + (1 - F_t(\theta_2, u_{t-1}))\rho_2\}u_{t-1} + \varepsilon_t \\ G_t(\theta_1, u_{t-1}) &= 1 - \exp\left(-\theta_1\left(u_{t-1}^2\right)\right) \quad u_1 > 0 \\ F_t(\theta_2, u_{t-1}) &= [1 + \exp(-\theta_2 u_{t-1})]^{-1} \quad u_2 > 0 \end{aligned}$$

where u_{t-1} is the transition variable and $\varepsilon_t \sim iid(0, \sigma^2)$.

Steps afterwards follow the similar path as to the Sollis Test where the unidentifiable parameters were corrected using the Taylor expansion. The resulting regression function is augmented and can be shown as:

$$\begin{aligned} \Delta u_t = {} & G_t(\theta_1, u_{t-1})\{F_t(\theta_2, u_{t-1})\rho_1 + (1 - F_t(\theta_2, u_{t-1}))\rho_2\}u_{t-1} \\ & + \sum_{j=1}^{p} \delta_j \Delta u_{t-j} + \varepsilon_t \text{ and } \varepsilon_t \sim iid(0, \sigma^2). \end{aligned}$$

4 Results

The above tests were conducted using the WinRats software. We have used the demeaned and de-trended series for these nonlinear tests, as it is clear that a time trend exists within the stock prices. This makes it difficult to observe the stock

prices when they deviate away from the trend in the case where the market is actually efficient. Therefore, by regressing the natural logarithms of index series against a constant and time trend, these demeaned and de-trended series were obtained (Hasanov and Omay 2007).

Table 2 summarizes the results obtained from performing the non-linear unit root tests on the data collected. The results indicate whether the markets are efficient or not between November 2005 and September 2008, or the pre-crisis period. It can be seen that only in the case of the Czech market that the null hypothesis of a unit root was rejected and the alternative hypothesis held. All of the other markets are seen to contain a unit root and hence, are efficient. Stationarity of the Czech market was detected through the KSS-LNV, Sollis, and LNV-Sollis tests. KSS-LNV test involves a model that allows for time dependent, multiple smooth structural break exponential smooth transition autoregressive (ESTAR) nonlinearity. Whereas the Sollis test allows for state dependent, symmetric or asymmetric stationary ESTAR nonlinearity and the LNV-Sollis test allows for both smooth structural break and asymmetric nonlinear adjustment towards the equilibrium level. Results of the pre-crisis period can be interpreted as that the Czech market contains both structural breaks and has a state dependent nonlinearity. However the market was found to be efficient when both the LNV and KSS tests are applied separately which indicates that the stationarity was captured when these features were embedded in the same test.

Table 2 Results of non-linear unit root tests for the pre-crisis period

	Czech Republic	Greece	Hungary	Poland	Turkey	Russia
LNV test						
Model A	–2.568	–2.456	–2.186	–1.880	–1.927	0.229
Model B	–2.537	–3.934	–2.948	–2.642	–1.808	–1.018
Model C	–3.256	–3.821	–4.030	–4.462	–2.165	–3.972
KSS test						
Demeaned	–1.467	–1.827	–1.316	–1.483	–2.381	0.229
Detrended	–1.721	–1.854	–1.432	–1.566	–2.454	–1.018
KSS–LNV test						
Model A	–2.612	–2.078	–1.996	–0.775	0.538	–2.933
Model B	–2.337	–2.080	–1.946	–2.319	0.260	–3.166
Model C	**–4.738**	–0.644	–0.965	0.591	0.208	–3.744
Sollis test						
Demeaned	1.540	1.671	2.847	0.732	2.877	1.794
Detrended	**8.092**	1.705	3.081	0.697	2.682	1.552
LNV-Sollis test						
Model A	1.148	0.474	0.877	0.544	3.504	4.483
Model B	**11.317**	4.220	1.969	3.392	2.840	1.552
Model C	**11.618**	6.673	3.727	0.471	0.068	6.197

Note Values in bold indicate stationarity

After analyzing the results of the pre-crisis period, Table 3 above shows the results obtained from applying the same 5 nonlinear unit root tests to the post-crisis period, from October 2008 to February 2019. There are many differences in the results of the post-crisis period when compared to pre-crisis as now out of the 6 emerging markets identified 5 of them were found to be inefficient. The Czech market was found stationary through applying the KSS and Sollis tests. Pre-Crisis period showed the Czech market had both structural breaks and state dependent nonlinearity. However post-crisis there are no structural breaks observed from the tests. Both the Turkish and the Hungarian markets rejected the null hypothesis in the KSS-LNV and the LNV-Sollis tests. Russian stock market was the most interesting case as pre-crisis none of the tests showed stationarity but the results of the post crisis data pointed out that the Russian market was inefficient according to the LNV, KSS-LNV and the LNV-Sollis tests. Polish market was found efficient in 4 of the tests but stationarity within the series was captured through the application of the KSS-LNV test. Altogether in the Hungarian, Russian, Polish and Turkish stock markets it can be said that there are both structural breaks and also state dependent nonlinearity. Only the Greek market was efficient in both periods.

Table 3 Results of non-linear unit root tests for the post-crisis period

	Czech Republic	Greece	Hungary	Poland	Turkey	Russia
LNV test						
Model A	–2.797	–1.338	–2.572	–2.232	–2.741	–1.967
Model B	–2.759	–2.424	–3.555	–3.341	–3.478	–2.266
Model C	–3.101	–2.500	–4.238	–3.278	–3.465	**–5.309**
KSS test						
Demeaned	**–4.275**	–1.202	–1.948	–2.467	–0.679	–0.545
Detrended	**–4.214**	–2.725	–2.917	–2.459	–1.337	–1.331
KSS–LNV test						
Model A	–3.421	–2.109	–1.766	–2.116	**–3.524**	–1.742
Model B	–3.396	–3.448	–3.212	**–4.177**	–3.550	–1.410
Model C	–3.818	–3.736	**–4.392**	**–4.127**	–2.559	**–4.766**
Sollis test						
Demeaned	**9.109**	2.423	1.936	3.034	0.236	0.155
Detrended	**8.887**	3.686	4.278	3.015	1.248	0.884
LNV-Sollis test						
Model A	3.854	3.434	5.011	4.986	**7.439**	2.468
Model B	6.649	5.982	4.277	2.439	6.266	1.045
Model C	7.253	6.916	**9.963**	8.193	3.782	**11.275**

Note Values in bold indicate stationarity

5 Conclusion

The concept of market activity is one of the most widely researched and important issues in the field of finance. Whether or not the markets are efficient affects both investor decisions and, accordingly, contributes to the development of those countries. However, there are fluctuations in the markets within the framework of financial, economic and political events in the world and it is discussed in the literature that these fluctuations affect market efficiency either positively or negatively. The Global Financial Crisis that took place in mid-2008 is said to be one of those major events that affected the efficiency of stock markets.

During the past couple of decades there has also been a growing interest on the studies of emerging markets. These markets provide investors with high rates of return, have high volatility and create an opportunity for diversifying portfolios (Antoniou et al. 1997a). According to the Efficient Market Hypothesis, proposed by Fama (1970), if a market is efficient then all new information will be instantly reflected in the prices of stocks and no investor then will be able to gain above normal returns. But is a market is inefficient, the opposite holds. Investors can earn greater profits by trading in such markets and there will be room for insider trading. Hence, this situation will create the opportunity for portfolio diversification within these inefficient markets.

Therefore, considering the implications of the Efficient Market Hypothesis, the increasing interest on the emerging markets and the effects of the 2008 Global Financial Crisis, this study was conducted. The aim of the study is to investigate the effects of the 2008 Global Financial Crisis on the weak form efficiency of the emerging markets located in Europe using recently developed non-linear unit root tests. Markets included in the study were the major indices of the Czech Republic, Greece, Hungary, Poland, Turkey, and Russia. Effects of the crisis were put forward by taking two different time periods: Pre (November 2005–September 2008) and Post (October 2008–February 2019)—Crisis.

The results of the study showed that in the pre-crisis period only the Czech market was seen to be inefficient (hence, stationary). Stationarity of the Czech market was detected through the KSS-LNV, Sollis, and LNV-Sollis tests, which can be interpreted as that the Czech market contains both structural breaks and has a state dependent nonlinearity. Looking at the post-crisis period, only the Greek market seemed to have stayed weak form efficient but rest of the 5 markets were inefficient. It was mainly the KSS-LNV, LNV- Sollis tests that were efficient in capturing the stationarity of the series and it would be correct to say that there are structural breaks and also state dependent nonlinearity within these markets as well (exception being the Greek market).

These results do lead to some different concerns about the European emerging markets. First of all the either the effects of the 2008 Global Financial Crisis were so severe that within a short period of time there were many changes in the stock markets of these countries and caused them to be inefficient or there were problems in the pre-crisis period but somehow the information was not properly absorbed by the

market, which actually means that the market was not efficient anyway. So how can the market be inefficient when the results say they are actually are? Secondly how are policy makers going to react in the future if markets are losing their efficiencies? There is a greater focus on the behavioral aspects of markets and the possible deviations from the efficient market hypothesis in recent years. More research needs to be conducted in order to understand the reasoning behind these results and to provide solutions for the rapidly changing nature of the emerging markets. This study is important to indicate the situation of the European emerging markets before the 2008 crisis took place and how it has changed straight after the crisis. The nature of the tests used provides a detailed understanding of the inefficiencies within the series.

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The Firm-Specific Determinants of Capital Structure in Beverage Industry in Europe

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Abstract This study investigates the firm-specific capital structure determinants for the listed firms operating in the beverage industry in Europe. The financial data related to the period 2010–2018 are obtained from Orbis. A total of 83 companies with 747 observations are used. According to the results, profitability is negatively correlated with total debt ratio, long-term debt ratio, and short-term debt ratio. Tangibility and liquidity are also negatively correlated with both total debt ratio and short-term debt ratio. Also, it is found that growth has a statistically significant negative impact on both total debt ratio and long-term debt ratio. On the other hand, the results underline that non-debt tax-shield is positively correlated with total debt ratio and short-term debt ratio. Similarly, size is positively correlated with both total debt ratio and long-term debt ratio. To sum up, growth, tangibility, liquidity, profitability, size, and non-debt tax shield have statistically significant influences on debt ratios. This study may help managers and policy makers interested in capital structure determinants to make accurate decisions. Creditors may also utilize this study to analyze the capital structure of borrowers while they are considering the issues related to lending money.

Keywords Beverage industry · Capital structure · Debt · Profitability

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1 Introduction

Capital structure decisions necessitate a choice between external debt and equity. Finding the optimal balance between external debt and capital structure is an important issue for the survival of a firm because composition of capital structure has the potential to influence profitability of a firm (Modigliani and Miller 1963; Myers 1984; Jensen and Meckling 1976). In addition, incorrect capital structure decisions may cause financial distress which may finally lead to bankruptcy of a firm (Modigliani and Miller 1963). Considering the importance of finding optimal amount of debt in capital structure, understanding the factors showing how a firm can find debt is an important issue to be analyzed.

The prior literature reveals mixed results regarding the determinants of capital structure (Rajan and Zingales 1995; Booth et al. 2001; Suto 2003). Due to inconclusive contradictory results regarding the factors influencing capital structure, how these factors affect the choice between debt and equity in the capital structure deserves further attention. Apart from these considerations, the firm-specific factors affecting capital structure may both depend on the economic environment of the firm and the industry in which the firm operates (Kumar et al. 2017). Prior studies also reveal that majority of researchers (e.g. Li and Islam 2019; Moradi and Paulet 2019) are focused on all firms from all sectors and there is a very limited industry-specific studies (e.g. Upneja and Dalbor 2001; Kaur and Rao 2009) investigating capital structure determinants (Kumar et al. 2017). Inspired from these arguments this study investigates firm-specific capital structure determinants for the listed firms operating in the beverage industry in Europe.

The beverage industry is an important industry and has grown dramatically in the last two centuries. There are a large number of local and international firms in the industry. Several million people work in all these firms worldwide. Competition is very intense in the beverage industry. The beverage industry consists of two major categories which are nonalcoholic and alcoholic beverages. There are eight sub categories under these two major categories such as drink syrup manufacture fruit juices bottling, the coffee industry, distilled spirits, wine and brewing.

Cost of capital is an important aspect in competitive advantage therefore the purpose of this paper is to explain the capital structure of European based listed beverage companies. To the best of the authors' knowledge, there are only two studies (Viviani 2008; Kariuki and Kamau 2014) investigating the factors influencing the capital structure. In this regard, Viviani (2008) researched the capital structure of French companies in the wine industry. Kariuki and Kamau (2014), on the other hand, investigated the capital structure of the private firms in the food and beverage industry in Kenya. Since there are a few studies in the field, this study is expected to contribute to the capital structure studies in general and the beverage industry in particular.

Accordingly, by taking a larger sample of beverage industry in the whole Europe, the current study contributes to the existing literature and is expected to

provide important implications to the managers of the sample firms in understanding the factors which influence the amount of debt in their capital structure.

The remaining part of the paper flows as follows. The second part outlines the theoretical framework. This is followed by the research methodology in the third section. Section four presents the results. Finally, section five outlines the conclusions.

2 Factors Influencing the Debt and Equity Choices of a Company

The capital structure theories, which are pecking-order theory, trade-off theory, agency theory, and bankruptcy theory, suggest that capital structure determinants shaped by the costs and benefits are associated with debt and equity (Myers 1977, 1984; Myers and Majluf 1984; Eldomiaty and Azim 2008). In light of these theories, previous studies (e.g. Bancel and Mitto 2004; Chakraborty 2010; Moosa et al. 2011) generally demonstrate that, such firm-specific factors as profitability, tangibility, size, growth, liquidity, risk and non-debt tax shield affect the amount of debt in the capital structure. Following is a brief review of how these factors influence the level of debt in the capital structure:

Profitability (PROF): Prior studies reveal mixed results regarding how profitability influences the amount of debt in capital structure. Some of the studies show that profitable firms are better able to cope with interest cost of using more of debt and benefit from tax shield (Fama and French 2002). Some of the other studies (e.g. Bhaduri 2002; Moradi and Paulet 2019), on the other hand, show that profitability is negatively related to indebtedness because profitable firms do not need external debt.

Tangibility (TANG): Previous research (e.g. Booth et al. 2001) generally finds the tangibility affects leverage positively because firms having more tangible assets are able to find more collateral for the debt financing.

Size (SIZE): Literature review shows mixed results regarding the impact of firm size on profitability. Some of the authors show that firm size is positively related to capital structure because larger firms can borrow at lower interest rates, have better access to capital markets, and have lower information asymmetry (Rajagopal 2010). Some of the authors (Titman and Wessels 1988), on the other hand, note that firm size is negatively related to debt ratio because larger firms issue more equity than smaller ones because large firms have less information asymmetry between insiders and capital markets.

Growth (GROW): Prior studies (e.g. Zou and Xiao 2006; Eriotis et al. 2007) generally indicate a negative relationship between growth opportunities and capital structure. This is due to the agency conflict between lenders and shareholders created by growth opportunities, which in turn discourage firms from borrowing more in order to mitigate the agency conflict (Myers 1977).

Liquidity (LIQID): Liquidity has been generally found to have a negative relationship with the level of debt in the capital structure because firms with adequate working capital do not need external funds to finance long term investments (Mazur 2007; Alom 2013).

Risk (RISK): Most of the previous studies (e.g. Chen et al. 2009) demonstrate that business risk reduces the amount of debt in the capital structure because it increases financial risk of a firm.

Non-debt tax shield (NDSHLD):

Previous studies (e.g. Sogorb-Mira 2005; Cortez and Susanto 2012) generally find that the non-debt tax shields such as depreciation and depletion deductions have negative relationship with the amount of debt. In other words, as non-debt tax shield increases, the need for external debt decreases. Some of the studies (e.g. Bradley et al. 1984) find that NDSHLD influences debt ratio positively.

Tax shield (TSHLD): The Trade-off Theory (Modigliani and Miller 1963) suggests that companies borrow in order to benefit from interest tax shield until the tax shield benefits balance the cost of borrowing. Therefore, tax shield is expected to have a positive effect on debt ratio.

Based on this background, the following hypotheses are formulated in this study:

H1: PROF influences the amount of debt in capital structure
H2: TANG influences the amount of debt in capital structure
H3: SIZE influences the amount of debt in capital structure
H4: GROW influences the amount of debt in capital structure
H5: LIQID influences the amount of debt in capital structure
H6: RISK influences the amount of debt in capital structure
H7: NDSHLD influences the amount of debt in capital structure
H8: TSHLD influences the amount of debt in capital structure.

3 Data and Methodology

3.1 Data

This study includes listed beverage companies operated in Europe. The financial data, such as total assets, total liabilities, long-term debt, short-term debt, fixed assets, ROA, Earnings before tax, and net sales, related to the period 2010–2018 are obtained from Orbis. After eliminating the companies having missing data, a total of 83 companies with 747 observations are used. Accordingly, Table 1 shows both the countries included in this study and the number of beverage companies in each country.

Table 1 Countries of beverage companies and numbers of observations

Country	Number of beverage companies	Number of observations
Czech Republic	1	9
Finland	1	9
Ireland	1	9
Italy	1	9
Latvia	1	9
Malta	1	9
Portugal	1	9
Slovakia	1	9
Bulgaria	2	18
Spain	2	18
Hungary	2	18
Lithuania	2	18
Sweden	2	18
Austria	3	27
Belgium	3	27
Croatia	3	27
Cyprus	3	27
Greece	3	27
Denmark	3	27
Netherlands	3	27
Poland	3	27
Romania	4	36
France	10	90
Germany	11	99
United Kingdom	16	144
Total	83	747

3.2 Variables

As dependent variables, in line with some of the prior studies (e.g. Rajan and Zingales 1995; Vo 2017); ratios of long-term, short-term, and total debt to total assets are used as measures of capital structure. PROF is measured by return on assets which is a ratio of profit before tax to total assets (Sheikh and Wang 2011). Growth opportunity is measured as a ratio of sales growth to total assets growth in line with Sheikh and Wang (2011). TANG is measured as a ratio of fixed assets to total assets (Deesomsak et al. 2004). LIQID is represented by the ratio of current assets to current liabilities (Khan 2012). Natural logarithm of total assets measures the SIZE (Li and Stathis 2017). RISK is measured as a percentage change in the ratio of profit before tax to total assets (Ahsan et al. 2016). TSHLD is a ratio of tax

payments to total asset (Ahsan et al. 2016), while NDSHLD is represented by the ratio of depreciation expenses to total assets (Memon et al. 2015).

3.3 Data Analysis

In this study, Ordinary Least Squares (OLS) is used to test the hypotheses. Macroeconomic conditions specific to each country are likely to influence capital structure decisions (Bokpin 2009; Frank and Goyal 2009). Accordingly, in order to control for country differences, country dummies are used in this study by means of country-fixed effects. In order to get rid of potential heteroscedasticity problem in OLS, we used robust standard error (Baltagi 2005). Robust standard errors are clustered by firms.

4 Results

4.1 Descriptive Statistics and Correlation Analysis

Table 2 shows descriptive statistics and correlations among the variables. According to the Table 2, the mean value of ROA is 3.384. The standard deviation of ROA, on the other hand, is 8.762. The mean value of total debt ratio (TDR), which is 0.468, is higher than the mean values of both long-term debt ratio (LTDR) and short-term debt ratio (STDR).

Table 2 also shows correlations among variables. When the results of correlations are mainly analyzed, it can be concluded that ROA has a statistically significant relationships with TDR, LTDR, and STDR and this relationship is negative. It can also be concluded that TANG, SIZE, and NDSHLD are positively correlated with TDR, LTDR, and STDR.

4.2 Results of OLS

Table 3 presents the OLS results. According to the results, GROW has statistically significant negative impact on both TDR ($\beta = -0.0000664$, $p < 0.05$) and LTDR ($\beta = -0.0000577$, $p < 0.05$). This finding is consistent with the fact that companies experiencing high growth opportunities refrain from borrowing more in order to avoid agency conflict. This result is in line with some of the prior studies (e.g. Zhang 2010).

On the other hand, NDSHLD influence TDR ($\beta = 1.7582$, $p < 0.01$) and STDR ($\beta = 1.1767$, $p < 0.01$) positively, and this influence is significant at 1%. The

Table 2 Descriptive statistics and correlations

	Mean	Std. dev.	ROA	TDR	LTDR	STDR	CR	TANG	SIZE	Non-debt-shield	Tax shield	Bus risk	GROWTH OPP.
ROA	3.384	8.762	1	−0.310*	−0.200*	−0.179*	−0.005	−0.106*	0.281*	0.119*	0.340*	0.005	−0.063
TDR	0.468	0.302		1	0.700*	0.714*	−149*	0.423*	0.602*	0.342*	−0.022	−0.042	−0.022
LTDR	0.230	0.212			1	0.000	−0.071	0.418*	0.542*	0.189*	0.019	−0.020	−0.028
STDR	0.238	0.216				1	−0.140*	0.182*	0.312*	0.293*	−0.050	−0.039	−0.004
CR	6.462	40.926					1	−0.050	0.006	−0.102*	0.130*	0.004	0.006
TANG	0.554	0.299						1	0.701*	0.306*	0.026	0.022	−0.030
SIZE	10.556	4.823							1	0.270*	0.113*	0.003	−0.004
NDSHLD	0.026	0.030								1	0.028	−0.003	−0.096*
TAX SHIELD	0.040	0.141									1	0.033	−0.040
BUS RISK	0.390	13.313										1	0.001
GROWTH OPP	−3.663	112.931											1

ROA—represents return on assets; TDR—the total debt ratio; LTDR—the long term debt ratio; STDR—the short term debt ratio; CR—the current ratio; TANG—the tangibility; SIZE—the firm size; NDSHLD—the non-debt tax shield; GROWTH OPP.—the growth opportunities

*Correlation is significant at 1% level

Table 3 OLS results

	TDR			LTDR			STDR		
	β	t	VIF	β	t	VIF	β	t	VIF
GROW	−0.0000664**	−2.27	1.02	−0.0000577**	−2.18	1.02	−8.70e−06	−0.36	1.02
NDSHLD	1.758236***	3.42	1.51	0.5814517	1.31	1.51	1.176785***	2.81	1.51
SIZE	0.0430182***	4.29	2.41	0.0373137***	4.03	2.41	.0057045	0.92	2.41
TANG	−0.4040183***	−3.77	1.83	−0.0273429	−0.29	1.83	−0.3766755***	−4.54	1.83
LIQID	−0.0007442***	−3.23	1.56	−0.0000632	−0.52	1.56	−0.000681***	−4.02	1.56
PROF	−0.0135503***	−2.89	1.60	−010312**	−2.53	1.60	−0.0032384**	−2.16	1.60
RISK	−0.0007245	−1.22	1.04	−0.0000631	−0.18	1.04	−0.0006614	−1.35	1.04
TSHLD	0.0666433	0.56	1.42	0.1323025*	1.88	1.42	−0.0656592	−0.90	1.42
R^2	0.4644			0.4488			0.4214		
Country-fixed effects	Yes			Yes			Yes		

***Represents significance at 1%
**Represents significance at 5%
*Represents significance at 10%

positive impact of NDSHLD on debt ratios is not expected and it is contradictory to majority of the prior studies and trade-off theory. Nevertheless, this result is in line with Chakraborty (2010) who implies that NDSHLD may influence capital structure positively due to tax shield benefit obtained from interest deductibility. This positive relationship can also be due to the fact that as securable assets increase, debt ratio also increases (see Bradley et al. 1984).

SIZE is found to influence TDR ($\beta = 0.0430$, $p < 0.01$) and LTDR ($\beta = 0.0373$, $p < 0.01$) positively. This result can be supported by the assumption that large firms can borrow at lower interest rates, have better access to capital markets, and have lower information asymmetry. This finding is consistent with some of the previous studies (e.g. Michaelas et al. 1999).

According to the results, TANG has a statistically significant negative influence on TDR ($\beta = -0.4040$, $p < 0.01$) and STDR ($\beta = -0.3766$, $p < 0.01$). Although the findings of extant literature (e.g. Rajan and Zingales 1995; Frank and Goyal 2003) indicate a positive relationship between TANG and leverage, this finding is consistent with some of the prior research (e.g. Booth et al. 2001; Mazur 2007). This negative relationship can be explained by the assertion that firms having less TANG are likely to borrow more to prevent managers from using perquisites more than optimal level (see Sheikh and Wang 2011). In addition to this, firms owning more tangible assets are less likely to asymmetric information problems and are less motivated to issue more of debt to mitigate the information asymmetry (Mazur 2007).

The results further reveal that LIQID influence TDR ($\beta = -0.0007$, $p < 0.01$) and STDR ($\beta = -0.0006$, $p < 0.01$) negatively. According to Pecking-order theory, firms prefer internal finance to external debt. Therefore, as LIQID increases, company's internal source of finance also increases and the need for external debt falls down.

PROF is found to have a statistically significant negative influence on TDR ($\beta = -0.0135$, $p < 0.01$), LTDR ($\beta = -0.0103$, $p < 0.01$), and STDR ($\beta = -0.0032$, $p < 0.05$). This finding supports the majority of empirical studies (e.g. Rajan and Zingales 1995; Booth et al. 2001; Bevan and Danbolt 2002) finding a negative profitability-debt ratio relationship. To sum up, GROW, TANG, LIQID, PROF, SIZE, and NDSHLD have statistically significant influences on debt ratios therefore H1, H2, H3, H4, H5 and H7 are accepted.

On the other hand, RISK and TSHLD, do not have any statistically significant influence on debt ratios. Based on these findings, H6 and H8 are rejected. The other hypotheses are accepted.

5 Conclusion

The paper investigates the capital structure of the listed European Beverage companies. It is essential to assess the optimal balance between external debt and capital structure. The optimal balance helps the survival of a firm because it is closely

related to the capital structure and its influence on the profitability. The results of the analysis showed that PROF is negatively correlated with TDR, LTDR, and STDR. TANG and LIQID are also negatively correlated with TDR and STDR. In addition, GROW has statistically significant negative impact on both TDR and LTDR. On the other hand, NDSHLD is positively correlated with TDR and STDR. Similarly, SIZE is positively correlated with TDR and LTDR. To sum up, GROW, TANG, LIQID, PROF, SIZE, and NDSHLD have statistically significant influences on debt ratios. RISK and TSHLD, on the other hand, do not have any statistically significant influence on debt ratios. In this regard, since it is essential to assess the optimal balance between external debt and capital structure this paper is believed to contribute to the capital structure literature. This study may also help managers and policy makers who are interested in capital structure determinants to make accurate decisions. Finally, creditors, which can be organizations or individuals, may also utilize this study to analyze the capital structure of borrowers while they are considering the issues related to lending money.

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Does the Financial Performance of Banks Change During the Global Financial Crisis? The Case of Palestine

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Abstract The main goal of this study is empirically evaluating the financial performance of Palestinian banks during the period 2005–2011. The main purpose of these selected periods is to the capture the global financial crisis time effect fully. Both bank-specific and macroeconomic variables are used to investigate the financial performance of banks during the global financial crisis. Fixed-effects and Random-effects methodologies are used to do empirical analysis. The study concluded that the macroeconomic factors have more impact on the profitability of the banks in Palestine, in contrast with bank-specific profitability determinants.

Keywords Banks · Inflation · Profitability · Global financial crisis

1 Introduction

Recently, the banking system plays an undeniable role in each country's economy. One of the main roles of banks is helping to develop the economy quickly, therefore, many of the financial activities are depending on them. Banks are the financial institutions that stand alongside with other investment banks and institutions that get profits from the investment of money. As financial intermediaries, banks are standing between borrowers who demand the capital and depositors who supply the capital.

In the last 20 years in Palestine, the banking system has begun to grow and form as a real financial institution. Therefore, the goal of this research is to evaluate the profitability and proficiency performance in Palestinian banks.

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Nowadays, Palestine banking system is on the stand of improvements. So, it is essential to control and improve this banking sector. Then, it is decided to consider this research.

The paper aims to analyze bank profitability determinants. As profitability indicators, we used return on equity (ROE) and return on Assets (ROA).

Additionally, by the last researches it is essential to check the effects of the squeezes on Palestine banking sector as well and here in the study there are numerous amounts of previous researches that have resulted in the same scope like the study of Dietrich and Wanzenried (2009), which investigated profitability of different commercial banks in Swiss during period of time from 1999 to 2006.

Athanasoglou et al. (2008), investigated profitability measurements of banks in Greece by depending on industry specific, bank specific and macroeconomic measurements during a period from 1985 to 2001.

2 Literature Review

Nowadays banks are contributing by a main role in the growth of each country's economy. Various studies found which focus on profitability of banks. Various researches employed various characteristics to analyze the bank system across countries. This research follows the last researches in evaluating the profitability of banks in different studies that focused on single countries. These are as follow: (Claessens and Laeven 2004; Gul et al. 2011; Dietrich and Wanzenried 2014), Albertazzi and Gambacorta (2008), Alper and Anbar (2011), Anwar and Herwanay (2006), Aysan and Ceyhan (2007), Bader and Malawi (2007), Dietrich and Wanzenried (2009), Lee and Hsieh (2012), Bapat (2018).

Different researchers have focused on the management of liabilities and assets in the financial banking system (Tektas et al. 2005), explaining the management of assets and liabilities in financial problems. Tektas and Gunay found that if any bank working on maximizing its profit and controlling the various risks that they face by decreasing them, so the bank's asset-liability management will be an efficient. Also their research showed how if the market perceptions changing, so it can create some crisis.

Smadi (2010) evaluated how the bank specific and macroeconomic measurements in 23 Jordanian banks over the period (1995–2008) are interrelated. He found that the strong capital and profit should be indicated by higher risk index level of the banking system. Smadi, showed also that during a high risk in 1997 and also the low economic performance, there will be low risk index of the sample.

Albertazzi and Gambacorta (2008), used the independent variables in their analysis such as the operating cost, non-interest income, net interest income, and profit before tax and another dependent variable as profitability of banking system. They found that the independent variables affected the bank profitability to become decreased during the period 1990–2001.

Alper and Anbar (2011), evaluated the bank-specific indicators to test the profitability performance of some commercial banks through a time from 2002 to

2010 for the case of Turkey. They found that the non interest income and the bank size have both a positive influence on the profitability of the banks. It means any bank having the largest size, will have the highest profitability. He also found that the bank's profitability is negatively affected by the size of the credit portfolio. In other words, increasing in the interest rate has a positive influence on the profitability and this result matches with our statistical analysis case study.

Another case for Indonesia, Anwar and Herwanay (2006), focused on Private Non-foreign Exchange banks and Provincial Government's banks during the period of 1993–2000. They used ROE and ROA as dependent indicators to evaluate the bank's profitability and they found that there is positive impact on the profitability from the CRTA and LIQ.

A study on the performance of Turkish banks is also been achieved by Aysan and Ceyhan (2007). They suggested that large size banks are less efficient than medium size banks. Also a significant positive relationship between loan ratio and the performance had existed. Also return on equity does not have statistical significant relationship with any factor of efficiency.

Another case for Jordan, Bader and Malawi (2007), investigated the influence of real interest rate in the Jordanian economy by using the co-integration analysis. They planned to explore the influence of the real interest rate on Jordanian investment during 1990–2005. Bader and Malawi concluded that there is a negative significant sign between the real interest rate and the level of investment.

Fungáčová et al. (2010), investigated the bank profitability during 2001–2006 in Russian banking system. They found that the Ukrainian banking system suffered on the loans quality and will not able to reconstruct the flow of money by depending on the increasing flow of deposits. Also there is a negative influence on profitability from liquidity, foreign ownership inflation, and credit risk. Also, he found in his study that there is a positive effect of capital, concentration rate, depreciation, exchange rate, and bank size.

Dietrich and Wanzenried (2009), investigated the determinants like industry-specific, macroeconomic, and bank-specific factors for 453 Swiss commercial Banks during the period 1999–2006. They found a positive influence on profitability from industry-specific and macroeconomic factors.

Lee and Hsieh (2012), investigated the macroeconomic and bank specific factors and how they affect the profitability in 42 countries during the period (1994–2008). They found a positive relationship between the risk of profit and the capital of the bank. Also Lee and Hsieh concluded that they should develop the Asian countries banking system by supporting the investing banks by the financial efficiency.

3 Data and Methodology

This section presents the banks specific and macroeconomic indicators that exert influence on Palestine banking sector financial performance during the period 2005–2011. The data for 7 commercial banks in Palestine were collected with

similar bank size from financial statements. Panel data employed to conduct analysis.

We used the standard model which used by Faizulayev and Bektas (2018), and Dietrich and Wanzenried (2009), to evaluate the determinants of profitability of banks in Palestine.

In this study, we used two dependent indicators, as proxy of financial performance, like, return on equity (ROE) and return on assets (ROA). Furthermore, FE/RE effects approaches used to evaluate the bank's profitability.

To test the hypothesis, the regression analysis will be investigated to do the test of unit root to decide if our data can change or not change with time and also the panel data that determine the cross sectional data and time series data because it will be used to investigate the various years with the various banks. In the unit root test of our study, the null hypothesis is suggested to be non-stationary and the alternative is suggested to be stationary. Therefore, our results showed that all our variables are stationary.

Our model is specified as Eq. 1 describes as follow:

$$\prod_{bct} = \alpha + \sum_{j=1}^{j} \beta_j X_{bct}^{j} + \sum_{m=1}^{m} \beta_m Z_{bct}^{m} + \varepsilon_{bct} \qquad \varepsilon_{bct} = v_t + u_t \tag{1}$$

where Π_{bct} is proxied as measure of financial performance for Palestine banks, X_{bct}^{j} stand for bank specific and macroeconomic indicators are grouped into Z_{bct}^{m}. Moreover, α denotes a constant term ε_{bct} stands for error term, with v_t refers to the unobserved individual specific effect and u_t is disturbance component.

The variables consist of two categories as dependent variables, we will use (Return on Equity (ROE) and Return on Asset (ROA)) and the independent variables consisting of two groups as bank-specific based on CAMEL approach (Capital Adequacy Ratio (CAR), Asset Quality Ratio (ASQ), Management Quality Ratio (EFF) and liquidity Ratio (LQ)) and as macroeconomic measurements (Real interest rate and Inflation rate) (Table 1).

4 Empirical Results

Correlation analysis evaluates the linear relationship between the dependent and independent variables. The relationship between each independent variable with the dependent variable will be discussed according to the results that obtained from the e-views program (Table 2).

According to the table above it can be seen that the variables are negatively and positively correlated.

Table 1 Describes the study variables (https://www.investopedia.com/)

Variable	Measure	Notation	Impact
Dependent variables			
Profitability	Net income before taxes over total assets	ROA	
	Net income before taxes over total equity	ROE	
Independent variables			
Bank specific			
Capital adequacy	Total equity to total assets	CAR	+
Asset quality	Total loans to total assets	ASQ	−
Efficiency management	Cost to income ratio	EFF	−
Liquidity	Cash to total assets	LQR	±
Macroeconomic			
Inflation	GDP growth	INF	−
Interest rate	Deposit rate is used due to absence of total rate of interest	IR	+

Return on asset (ROA) has a positive correlation with CAR by 0.127 and which shows if the return on asset increase, the capital adequacy will increase. But then, Return on Equity (ROE) has a negative correlation with CAR by −0.627 and that shows capital adequacy will decline when the return on equity increase in the Palestinian banks.

Return on asset (ROA) has a positive correlation with ASQ by 0.189 and that means if the return on asset increase, the assets quality will increase. Also, Return on Equity (ROE) has a positive correlation with ASQ by 0.229 and that means when the return on equity increase, the asset quality will increase as a result in the Palestinian banks.

Return on asset (ROA) has a negative correlation with EFF by −0.349 and that means if the return on asset increase, the management efficiency will decrease. Also, Return on Equity (ROE) has a negative correlation with EFF by −0.101 and

Table 2 Describes the correlation of dependent and independent variables (https://www.investopedia.com/)

	LROA	LROE	LCAR	LASQ	LEFF	LLQR	LIR	LINF
LROA	1.000							
LROE	0.692	1.000						
LCAR	0.127	−0.627	1.000					
LASQ	0.189	0.229	−0.110	1.000				
LEFF	−0.349	−0.101	−0.236	−0.243	1.000			
LLQR	−0.103	0.017	−0.134	−0.472	0.339	1.000		
LIR	0.367	0.160	0.175	−0.100	−0.478	−0.244	1.000	
LINF	0.183	0.129	0.019	0.038	−0.146	0.001	−0.111	1.000

that means when the return on equity increase, the efficiency of management will decrease as a result in the Palestinian banks and it will be a lower decrease if the return on asset increases.

Return on asset (ROA) has a negative correlation with LQR by −0.103 and that means if the return on asset increase, the liquidity ratio will decrease. But then, Return on Equity (ROE) has a positive significant correlation with LQR by 0.017 and that means when the return on equity increase, the liquidity ratio will increase accordingly.

For the macroeconomic factors interest rate and inflation rate, it is found that Return on asset (ROA) has a positive correlation with the interest rate by 0.367 and also a positive significant correlation with the inflation rate by 0.183. However, Return on Equity (ROE) has a lower positive significant correlation with the interest rate by 0.160 and also a lower positive significant correlation with the inflation rate by 0.129.

Finally, if the correlation between the independent variables is high and more than 50%, so multicollinearity problem will occur. According to the analysis, this problem wasn't found in the independent variables; therefore, there is no multicollinearity problem between the independent measurements of this research.

If the correlation between the independent variables is high and Durbin Watson (d) value is lower than rate of 1.50, so there will be autocorrelation problems in the data. According to the results, it can be observed that the Durbin Watson (d) value is 2.01; higher than rate of 1.50. Therefore, we don't have any autocorrelation problem in our study.

The coefficient of determination (r2), R-Squared is the proportion of the total variation in the regressand variable (ROE and ROA) that is accounted by the variation in the regressor variable (CAR, ASQ, EFF, and LQR). In the analysis, R-Squared is equal to 0.571212 in the simple regression result for LROA and it increased to 0.921331 in the simple regression result for LROE. It can be said that 57.1% of ROA variation is accounted by the variation in the independent variable (CAR, ASQ, EFF, and LQR). And 92.1% of ROE variation is accounted by the variation in the independent variable (CAR, ASQ, EFF, and LQR).

Tables 3 and 4 show the results of simple regression for LROA and LROE respectively and (L) means the logarithm and the logarithm was used because a better behaved distribution for the independent variables was aimed and also to reduce the effect of outliers.

According to the results above, our data is stationary and that shows the average, variance and covariance are moving in the same direction. Therefore, the formula of the simple regression will be tested by using the E-views program in order to explain the significant statistically relationship between our variables (dependent and independent).

Table 3 Results of simple regression for LROA

Variable	Coefficients	STD. error	T-statistic	Probability
C	−1.387116	0.598005	−2.319573	0.0257
LCAR	0.086919	0.040202	2.162071	0.0368
LASQ	0.028819	0.009927	2.903113	0.0061
LEFF	0.134471	0.087650	1.534174	0.1331
LLQR	0.208811	0.020347	10.26230	0.0000
LIR	0.267850	0.045450	5.893320	0.0000
LINF	0.361662	0.110054	3.286226	0.0022
R-squared	0.571212			
F-statistics	8.659012			0.000005
Durbin-Watson	**2.014070**			

Table 4 Results of simple regression for LROE

Variable	Coefficients	STD. error	T-statistic	Probability
C	−1.389623	0.598229	−2.322894	0.0255
LCAR	−0.913250	0.040116	−22.76534	0.0000
LASQ	0.028821	0.009926	2.903502	0.0060
LEFF	0.135535	0.087626	1.546743	0.1300
LLQR	0.208978	0.020314	10.28757	0.0000
LIR	0.267656	0.045464	5.887140	0.0000
LINF	0.361460	0.110031	3.285083	0.0022
R-squared	0.921331			
F-statistics	76.12488			0.000000
Durbin-Watson	**2.014915**			

According to the study, our hypothesis will be suggested to check if the intercept has a statistically significant influence or not.

H0: **Estimated Intercept (B0) is not statistically significant**
H1: **Estimated Intercept (B0) is statistically significant**

After the analysis was done and according to the results that were found, the probability value of the intercept (β0) equals 0.0257, by using the P-value approach the null hypothesis was rejected when the level of significant equals to 5% and it means the estimated intercept is statistically significant with 95% level of confidence.

In any analysis, if the investor wants to measure the impact on the profitability ratio according to different years he will use the interest rate and according to this

study we found the coefficient IR probability value equal to 0.0000. By using the P-value approach the null hypothesis will be rejected when the level of significant equals to 1% and it means the coefficient IR is statistically significant with 99% level of confidence. This result agrees with the statistical result of Alper and Anbar (2011) study for the case of Turkey that was explained previously in the literature review.

According to the study, we found that coefficient INF probability value equal to 0.0022. By using the P-value approach the null hypothesis will be rejected when level of significant equals to 1% and it means the coefficient INF is statistically significant with 99% level of confidence.

Asset quality ratio was used to discuss the balance sheet left side that explained the performance of loans in financial institutions. Since t- computed value is larger than t-critical value at alpha = 0.01 level, so, H0 was rejected and H1 was accepted that the estimated coefficient of ASQ was statistically significant at 99% confidence interval. The same conclusion was reached by p-value approach where t-prob value (p = 0.0060) was less than alpha = 0.01 level.

Liquidity ratio was used to evaluate if the liquidity of the banks is able cover the short-term debts or not. Since t-computed value is greater than t-critical value at alpha = 0.01 level, therefore, H0 was rejected and H1 was accepted that the estimated coefficient of LQ is statistically significant at 99% confidence interval. The same conclusion was reached by p-value approach where t-prob value (p = 0.0000) is less than alpha = 0.01 level.

Management efficiency ratios were used to measure how banks use their liabilities and assets. Since t-computed value was less than t-critical value at alpha = 0.10 level, so, H0 could not be rejected and H1 was rejected that the estimated coefficient of EFF was not statistically significant. The researcher reached the same conclusion by p-value approach where t-prob value (p = 0.1331) was greater than alpha = 0.10 level.

Capital Adequacy is used to check if the banks are able to cover the financial obligation. Since t-computed value was greater than t-critical value at alpha = 0.05 level, therefore, the researcher rejected H0 and accepted H1 that the coefficient CAR is statistically significant at 95% confidence interval. We reach the same conclusion by p-value approach where t-prob value (p = 0.0368) was less than alpha = 0.05 level.

5 Conclusion and Recommendation

The banking system is connected to the economy's system. In short, a well-banking system is one of the main points behind the growth of any economy. So it was found that the Palestinian banks determinants of profitability can be done by an analysis of 7 commercial banks for the period 2005–2011.

Palestine banking system is on the stand of improvement. So, it is essentially to control and improve this banking sector. In this regard, the researcher decided to consider this theme.

Following the results that were obtained from the analysis and in the light of the interpreted results, one of the surprising results is the direct relationship between return on assets and capital adequacy ratio. Furthermore, return on equity has a negative relationship with capital adequacy ratio. We recommend that banks in Palestine should support the reserve accounts in order to rise up the capital adequacy ratio which will enhance more safety to the banking systems.

Moreover, the paper found a direct relationship between the ratio of liquidity and both return on equity and return on asset variables. By that result, we became sure that Palestinian banks are able to cover their short term obligations they are able to continue and grow more in the future.

According to the analysis results, it was found a positive significant relationship between both return on equity and return on asset and management efficiency ratio. This result proves that managements have been successful in controlling their assets and liabilities and this result encourages the Palestinian investors to invest more in the coming years even they know that Palestine banking sector and economy are under development.

Also, we found a positive significant relationship between return on equity and return on asset and our independent factor asset quality ratio. This result can prove that Palestinian banks financial managers are concentrating on the quality of the loans in order to gain more earnings for the bank.

One can understand the positive inflation rate might be good for the Palestinian economy under all circumstances because Palestine depends on three currencies, the Jordanian dinar, US dollar and Israeli shekel (JOD, USD and NIS).

A positive interest rate in this situation means that the nominal interest rate is close to zero and it makes the interest rate to be as high as the rate of deflation.

In short, the research concludes bank specific determinants have less impact on the banks profitability system in Palestine, in contrast with macroeconomic indicators and the reason behind that is the special structure of each bank.

In further research, we will try to expand the number of observations, banks, and independent indicators to get more accurate results.

Appendices

Appendix 1: Panel Unit Root Tests for Palestinian Banks

Variables		Levels		
		LLC	IPS	M-W
LROE	τ_T	−6.49*	0.069	33.68*
	τ_μ	−5.84*	−1.03	33.91*
	τ	−4.19*	–	44.99*
LROA	τ_T	−9.58*	−0.340	38.48*
	τ_μ	−8.25*	−3.01*	44.14*
	τ	−2.15	–	28.28
LCAR	τ_T	−9.59*	−0.547	38.56*
	τ_μ	−5.47*	−1.634**	37.34*
	τ	−0.313	–	9.34
LLQR	τ_T	−6.117*	−0.1434	22.04***
	τ_μ	−3.84*	−1.02	28.68*
	τ	−16.30*	–	20.68
LASQ	τ_T	−8.13*	−0.0894	24.23**
	τ_μ	−1.57***	0.6591	10.66
	τ	−2.369***	–	31.29*
LEFF	τ_T	−5.86*	−0.378	41.10*
	τ_μ	−3.25*	−1.73**	33.17*
	τ	−0.0612	–	12.35
LINF	τ_T	−8.65*	−0.7026	51.88*
	τ_μ	−5.41*	−3.32*	52.78*
	τ	−1.89**	–	26.89**
LIR	τ_T	−15.16*	−2.13**	87.62*
	τ_μ	−14.75*	−6.37*	87.41*
	τ	−14.82*	–	107.4*

Notes ROE represents the liquidity. τ_T represents the most general model with a drift and trend; τ_T is the model with a drift and without trend; τ is the most restricted model without a drift and trend. Optimum lag lengths are selected based on Schwartz Criterion. *, **, *** denote rejection of the null hypothesis at the 1, 5, 10% levels. Tests for unit roots have been carried out in E-VIEWS 6.0

Appendix 2: Panel Unit Root Tests for Palestinian Banks

Variables		1st differences		
		LLC	IPS	M-W
LROE	τ_T	−4.39*	0.538	13.59
	τ_μ	−5.91*	−1.204	34.51*
	τ	−6.801*	–	52.66*
LROA	τ_T	−6.39*	0.006	27.53*
	τ_μ	−7.65*	−2.104**	37.26*
	τ	−9.047*	–	76.42*
LCAR	τ_T	−12.24	−1.215	62.61*
	τ_μ	−9.56*	−3.21*	53.51*
	τ	−9.08*	–	74.47*
LLQR	τ_T	−33.012*	−4.71*	48.45*
	τ_μ	−11.55*	−3.37*	42.26*
	τ	−7.97*	–	65.64*
LASQ	τ_T	14.42*	−1.028	47.03*
	τ_μ	−12.06	−3.017*	43.26*
	τ	−7.28*	–	49.61*
LEFF	τ_T	−5.06*	0.368	30.93*
	τ_μ	−4.502*	−1.767	30.90***
	τ	−6.38*	–	66.13*
LINF	τ_T	−8.041*	−0.942	59.58*
	τ_μ	−10.02*	−4.74*	84.08*
	τ	14.59*	–	130.67*
LIR	τ_T	−18.34*	−1.97	87.62*
	τ_μ	−14.75*	−6.37*	83.07*
	τ	−21.22*	–	128.95*

Note ROE represents return on equity; CAR is a capital adequacy; EFF is a management quality; LQR represents the liquidity. τ_T represents the most general model with a drift and trend; τ_μ is the model with a drift and without trend; τ is the most restricted model without a drift and trend. Optimum lag lengths are selected based on Schwartz Criterion. *, **, *** denote rejection of the null hypothesis at the 1, 5, 10% levels. Tests for unit roots have been carried out in E-VIEWS 6.0

Appendix 3: Simple Regression Results for ROE

Dependent variable: LROE				
Method: panel EGLS (period SUR)				
Date: 12/10/13 Time: 21:12				
Sample: 2005 2011				
Periods included: 7				
Cross-sections included: 7				
Total panel (unbalanced) observations: 46				
Linear estimation after one-step weighting matrix				
White period standard errors and covariance (no d.f. correction)				
WARNING: estimated coefficient covariance matrix is of reduced rank				
Variable	Coefficient	Std. error	t-statistic	Prob.
C	−1.389623	0.598229	−2.322894	0.0255
LCAR	−0.913250	0.040116	−22.76534	0.0000
LASQ	0.028821	0.009926	2.903502	0.0060
LEFF	0.135535	0.087626	1.546743	0.1300
LLQR	0.208978	0.020314	10.28757	0.0000
LIR	0.267656	0.045464	5.887140	0.0000
LINF	0.361460	0.110031	3.285083	0.0022
Weighted statistics				
R-squared	0.921331	Mean dependent var		−2.181822
Adjusted R-squared	0.909228	S.D. dependent var		5.392973
S.E. of regression	0.831023	Sum squared resid		26.93338
F-statistic	76.12488	Durbin-Watson stat		**2.014915**
Prob (F-statistic)	0.000000			
Unweighted statistics				
R-squared	0.480311	Mean dependent var		−2.529507
Sum squared resid	17.61176	Durbin-Watson stat		0.970266

Appendix 4: Simple Regression Results for ROA

Dependent variable: LROA				
Method: panel EGLS (period SUR)				
Date: 12/10/13 Time: 21:10				
Sample: 2005 2011				
Periods included: 7				
Cross-sections included: 7				
Total panel (unbalanced) observations: 46				
Linear estimation after one-step weighting matrix				
White period standard errors and covariance (no d.f. correction)				
WARNING: estimated coefficient covariance matrix is of reduced rank				
Variable	Coefficient	Std. error	t-statistic	Prob.
C	−1.387116	0.598005	−2.319573	0.0257
LCAR	0.086919	0.040202	2.162071	0.0368
LASQ	0.028819	0.009927	2.903113	0.0061
LEFF	0.134471	0.087650	1.534174	0.1331
LLQR	0.208811	0.020347	10.26230	0.0000
LIR	0.267850	0.045450	5.893320	0.0000
LINF	0.361662	0.110054	3.286226	0.0022
Weighted statistics				
R-squared	0.571212	Mean dependent var		−3.802245
Adjusted R-squared	0.505245	S.D. dependent var		8.318261
S.E. of regression	0.831325	Sum squared resid		26.95297
F-statistic	8.659012	Durbin-Watson stat		**2.014070**
Prob (F-statistic)	0.000005			
Unweighted statistics				
R-squared	0.157817	Mean dependent var		−4.333463
Sum squared resid	17.58328	Durbin-Watson stat		0.970544

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