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Research article

Banking system stability and economic sustainability: A panel data analysis of the effect of banking system stability on sustainability of some selected developing countries

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Abstract: The study investigated the effects of banking system stability on economic sustainability from the perspective of 37 developing economies for the period 2000–2016. The study applied panel data models precisely fixed effects and random effects models. Hausman test of endogeneity revealed fixed effects model as the most appropriate in all estimations. Our empirical analysis revealed the following key findings: First, the study revealed that banking system z-scores has positive effect on economic sustainability of developing economies while banking system regulatory capital and bank credit have negative effects on economic sustainability among selected developing economies. Second, while banking system z-scores, bank liquid assets and bank credit have positive effects on economic sustainability of BRICS economies, bank liquid assets and bank credit have negative effects on economic sustainability of non-BRICS economies except banking system z-scores, which has a positive effect. In addition, banking system z-scores has positive effect on economic sustainability of Asian and non-Asian economies. However, non-performing loans and bank credit has negative effects on economic sustainability of Asian economies while banking system regulatory capital has negative effect on economic sustainability of non-Asian economies. We conclude that banking system stability play a role in economic sustainability developing economies. However, banking system stability has differing effects on economic sustainability of BRICS and non-BRICS economies; and Asian and non-Asian economies.

Keywords: economic sustainability; Adjusted Net Savings rate; GDP per capita; banking system stability; developing economies

JEL Codes: O5

1. Introduction

The global financial crisis in 2008 has exposed systemic vulnerabilities in the banking system that are unfavorable to the wider economy. After this peaked financial crises, there has been the inception of several regulatory initiatives to reshape the rules that govern the financial system and the major institutions (Wyman, 2015). The changes in regulation and deregulation are part of a broad policymaking effort to increase financial stability (Wyman, 2015). The Banking System Stability (BSS) is an integral part of future growth and sustainability (Monnin and Jokipii, 2013). The role of the banking system in the economy and broader society is to provide the necessary financing and liquidity for human and economic activity to thrive—not only today but also tomorrow. Its role is to fund a stable and sustainable economy (CISL and UNEP FI, 2014). Therefore, financial regulators play a key role in ensuring that excessive risks that threaten the stability of the financial system—and hence imperil the stability and sustainability of the economy are minimized (CISL and UNEP FI, 2014).

With the influx of initiatives in the banking system in recent years, most researchers have channeled their efforts to understand the interaction between stability in the banking system and economic growth. While some researches focus on the effects of BSS on economic growth (Jayakumar et al., 2018; Azeez and Oke, 2012), others concentrated on the reverse or double edge effects (Tongurai and Vithessonthi, 2018; Aluko and Ajayi, 2017; Jiang, 2014). For instance, Jayakumar et al. (2018) revealed that banking stability is a significant driver of economic growth in European countries. Tongurai and Vithessonthi (2018) found a bidirectional relationship between agricultural sector development and banking sector development but a unidirectional effect of industrial sector development on banking sector development. Thus, the study revealed that banking sector development have significant effect on industrial sector development but not the reverse. Regardless of the efforts made by researchers to establish the effect of banking stability on macroeconomic stability indicators, the literature is far less clear regarding whether or not the BSS is the main trigger of the economic growth or slowdown. Thus, it is difficult to separate cause and effect in the financial sector real economy nexus (Kaminsky and Reinhart, 1999; Demirgüç-Kunt and Detragiache, 1999, 2005; Hilbers et al., 2005). These studies make it clear that the link between BSS and economic activity is of particular interest to policy makers as it is one of their basis for making monetary policy decisions on economic forecasts.

On the argument of economic sustainability and financial stability, Schmidt-Traub and Shah (2015) maintain that the global financial sector will be at the center of humanity's attempt to accomplish the Sustainable Development Goals (SDGs). Recent estimates point out that the SDGs will need an extra US$2.4 trillion of annual investment (public and private) into the health, energy, agriculture, education, low-carbon infrastructure and other sustainability sectors globally. The financial system (especially the banking system) has the responsibility to mobilize this capital for the SDG agenda (Murphy et al., 2017). To achieve the global SDGs, each country has significant role to play. It therefore implies that countries are to ensure stability in the financial system to be able to finance the SDGs at the country level.

However, literature that link BSS to economic sustainability is very scarce. The limited number of studies on BSS and sustainability can be attributed to one key common limitation-how to measure sustainability. Most policy makers and researchers rely on macroeconomic stability indicators like GDP, real output growth, etc as a measure of sustainability. However, these indicators fail to offer a comprehensive viewpoint of the true meaning of sustainability. Hence, most of the findings seem inconclusive. To this end, our study employs the Adjusted Net Savings rate as a measure of economic sustainability of the economies. The World Bank group developed the Adjusted Net Savings rate (ANS) as a comprehensive indicator for measuring economic sustainability (Pardi et al., 2015; World Bank, 2012; Hamilton, 2006). The ANS approach is superior to other approaches for the following reasons: (1) it presents environmental issues and resource in a context of a framework that development planning ministries and finance can understand. (2) It makes available relatively simple and clearer sustainability indicator to national-level decision makers on how sustainable a country's investment policies are. (3) It extends the net national saving rate calculation by adding human capital development (public expenditures on education) and subtracting depletion on natural resources in addition to environmental degradation (pollution). Indeed, the ANS is a useful measure of economic sustainability.

It is clear from literature that banking sector stability is an integral part of growth and sustainability. Monnin and Jokipii (2013) revealed that periods of stability are generally followed by an increase in real output growth and while period of instability is associated with a decrease in real output growth. It is therefore, undeniable that instability in the banking system affects economic growth due to financial constraints for government, firms and individuals with direct long-term consequences on the country. Additionally, Pradhan et al. (2019) revealed that bank stability is linked with stock market development indicating that banking system is linked to other aspects of the economy. Our study seeks to examine the effects stability in the banking system has on economic sustainability in some selected developing countries. Our paper differs from previous studies in a number of ways. First, our study extends current knowledge by investigating the effects of BSS on economic sustainability whilst employing a more reliable and comprehensive indicator (Adjusted Net Savings rate). Secondly, our study seeks to provide the clear direction of the interaction between BSS on economic sustainability from the perspective of traditional sustainability indicator, GDP per capita. Thirdly, unlike most studies, our study used six key banking stability indicators to examine their effects on long-term economic growth in greater depth. For each of the three levels of investigation by this current study, we compared and contrasted the effects of banking system stability on GDP per capita or ANS (or effects of GDP per capita on ANS) between the BRICS countries; non-BRICS countries; and) between the Asian countries and non-Asian countries.

Our study has a number of intended contributions to literature: First, it adds to literature by providing empirical evidence of whether stability in the banking system positively affects long-term economic growth. This helps to clarify the inconsistent results reported by some researchers like Azeez and Oke (2012) as banking system not positively and adequately affecting Nigeria's economic growth and Jayakumar et al. (2018) that banking stability is the main driver of economic growth. Secondly, it provides an extended form by linking banking stability to economic sustainability of the economies by using Adjusted net savings rate as a proxy. Most studies has attempted to find this but proxied by microeconomic variables such as GDP growth rate, unemployment rate, money supply, and industrial sector development (Tongurai and Vithessonthi, 2018; Aluko and Ajayi, 2017; Jiang, 2014). Furthermore, this paper provides empirical support to show the increase in GDP growth rate increases a countries sustainability. Finally, the findings is intended to provide a clear picture of how the effects of banking system stability on sustainability differ between (1) BRICS and non-BRICS countries; and (2) Asian and non-Asian countries.

The rest of the paper is organized as follows: section 2 reviews literature on measurement indicator for sustainability; the empirical studies on the effects of stability in the banking system and sustainability; and the relationship that exist among banking system stability indicators, GDP growth rate and ANS. Section 3 deals with the methodology. It covers data sources and description; explanation of the variables; econometric modelling; and robustness tests. Section 4 deals with results and discussions. It presents the results based on the objectives of the study. Finally, section 5 present the conclusion and key policy implications.

2. Literature

2.1. Adjusted Net Savings rate (ANS) as economic sustainability indicator

Over the years, individuals, groups and countries are concerned with identifying a useful indicator for measuring sustainability. Adjusted Net Savings rate (ANS) also known as Genuine Savings (GS) developed by World Bank group in the 1990s has emerged as a leading indicator for measuring sustainability (Pardi et al., 2015; World Bank, 2012; Hamilton, 2006). In its simplest form, the World Bank group calculates ANS as:

$$ANS = \frac{GNS - DPC + CEE - \sum RDN_i - DCD}{GNI} \tag{1}$$

where *ANS* is Adjusted Net Savings rate; *GNS* is Gross National Savings; *DPC* is Depreciation of Produced Capital; *CEE* is Current Expenditure on Education; *RDN* is Rent from Depletion of Natural Capital, *i*; *DCD* is Damages from Carbon Dioxide emissions; and *GNI* is Gross National Income at market prices. With this formula, ANS can be positive or negative. Where ANS is positive, it means that the nation is operating at sustainable path, and hence, accumulating the assets needed to build up wealth to ensure her growth over a long period. However, a negative ANS means that the nation is operating at unsustainable path, and hence, running down her capital stock.

Researches on ANS mostly focus on its validity. While several studies identified the strengths of this measure as a very useful measure of sustainability (Pardi et al., 2015; Hanley et al., 2015; World Bank, 2012; Hamilton, 2006; Bolt et al., 2002; Pearce and Atkinson, 1993), others questioned its validity and suggested limitations to ANS (Ferreira et al., 2008; Pillarisetti, 2005; Ferreira and Vincent, 2005). With the former, the World Bank (2012) explains that ANS has a number of benefits as a policy indicator in addition to its being a useful sustainability indicator. It presents environmental issues and resource in a context of a framework that development planning ministries and finance can understand. Bolt et al., (2002) argued that ANS pursues to make available relatively simple and clearer sustainability indicator to national-level decision makers on how sustainable a country’s investment policies are. Pearce and Atkinson (1993), point out that ANS is one of the most frequently preferred sustainability indicators by economists; due to its exclusive feature of extending the net national saving rate calculation by adding human capital development (public expenditures on education) and subtracting depletion on natural resources in addition to environmental degradation (pollution).

On the contrary, critiques describe ANS measure as a "weak sustainability" (Ferreira et al., 2008; Pillarisetti, 2005; Ferreira and Vincent, 2005). The basic argument is that ANS thrives on a popular assumption of "perfect substitutability between different types of capital and that natural capital can be valued using monetary values" is not valid. Thus, these researchers are of the view that natural, physical and human capital are not substitutable and must be treated independently (Pillarisetti, 2005, Ferreira and Vincent, 2005) and hence must be viewed as economic sustainability indicator but not a general indicator for measuring overall sustainable development.

Regardless of these limitations, almost all the researchers agree that ANS is an important indicator for measuring sustainability. The consensus is that whether ANS is a weak sustainability or not, countries need to pass the test of "weak sustainability" before proceeding to "strong sustainability" test. This has shifted the attention of researchers in a new area of identifying which variables affect sustainability as measured by ANS (Pardi et al., 2015). The study therefore envisage to reveal the true effects of banking system stability (BSS) on sustainability from the perspective of selected developing countries.

2.2. Empirical studies on the effects of banking system stability and economic sustainability

Even though, studies linking BSS and sustainability is limited in literature, several attempts has be made by researchers across the globe. In Nigeria, Azeez and Oke (2012), moved by the fact that banking system reforms in Nigeria steered stability and efficiency in the banking system explored the influence of banking sector reforms on Nigeria's economic growth. They employed time series analysis. They concluded that there seem to be the existence of long run relationship between the banking sector reforms and Nigeria's economic growth. The overall findings revealed that banking reforms do not positively and adequately influence the economy. Similarly, Monnin and Jokipii (2013) studied the effects of banking sector stability on real output growth. They used panel vector auto regression methodology. They study concluded that banking sector stability is an important driver of GDP growth and that eras of stability increases real output growth, while eras of instability reduces real output growth. Equally, Tripathy (2019) investigated the impact of financial development on India's economic growth using auto-regressive distributed lag model. The study revealed that financial development has positive impact on India's economic growth.

Apart from the individual country studies, a significant number of studies (Jayakumar et al., 2018; Tongurai and Vithessonthi, 2018; Demetriades and Rousseau, 2016; Mhadhbi, 2014; Narayan & Narayan, 2013) examined the effects of banking system on long-term economic growth using cross-country data, yet the results has been inconclusive. While some studies (Jayakumar et al., 2018; Younsi and Bechtini, 2018; Pradhan et al., 2016) found positive relationship among the variables, others (Tongurai and Vithessonthi, 2018; Demetriades and Rousseau, 2016; Mhadhbi, 2014; Narayan & Narayan, 2013) found negative or no relationship among the variables. For instance, Jayakumar et al. (2018) used panel vector error-correction model (VECM) to analyze a panel from 32 European countries over the period 1996–2014. The finding revealed that both banking competition and banking stability are significant long-term drivers of economic growth in the European countries. On the other hand, Tongurai and Vithessonthi (2018) studied the influence of development in the banking sector on variations in economic structure and growth. They constructed data for panel sample of all countries in the world during 1960–2016. The finding reveal that banking sector development has a negative influence on agricultural sector development and no influence on industrial sector development. It is very clear from the findings of Jayakumar et al. and Tongurai and

Vithessonthi the impact of banking system on economy wide is inconclusive. These studies used varied methodological approaches yet inconclusive results. In addition, most of these studies examined the relationship between financial development and long-term economic growth but not banking system stability and economic sustainability. Therefore, a new strand of research is needed to extend the relationship to economic sustainability. Hence, the need for the current study.

2.3. The Relationship between Banking System Stability Indicators, Economic Growth and Adjusted Net Savings rate (ANS)

This subsection focuses on the relationships between banking system stability indicators[1], economic growth and ANS of selected developing countries. To enhance the understanding of the existing relationship among the variables of interest, our study shows the trend graph (Figures 1a–1f) for the period 2000 to 2016 based the availability of the data from the World Bank. Figures 1a–1f show graphically illustration of the relationships among ANS, GDPG and BSS indicators. It is clear from the figures that there is a positive relationship between ANS and GDPG. In generally, the figures depict a positive relationship among ANS, GDPG and BSS indicators except for bank liquid assets (see Figures 1b) and non-performing loans (see Figure 1d) which exhibit negative relationship.

The relationship between banking system stability indicators, GDPG and ANS illustrated above, however, does not necessarily imply causation, because of the difficulties in identification of the direction of causalities. It must be emphasized that a mere graphical representation of the relationship among the variables may not provide enough justification for causality. Hence, it is crucial to identify the direction of causation, so that policymakers could adopt and implement the most appropriate public policies to strengthen financial stability and increase sustainability.

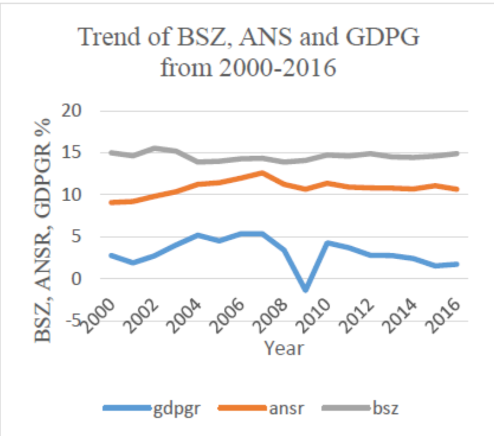

Figure 1a. The relationship between Banking System Z-scores, GDP growth rate and Adjusted Net.

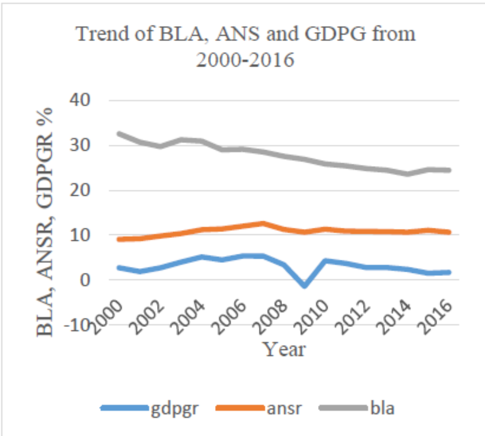

Figure 1b. The relationship between Bank liquid assets, GDP growth rate and Adjusted Net Savings.

[1] Non-performing loans as percent of all bank loans (NPL), Bank credit as percent of bank deposits (BCD), Banking system z-scores (BSZ), bank liquid assets to deposits and short-term funding (BLA), banking system capital percent of assets (BSC), Banking system regulatory capital to risk-weighted assets (BSR).

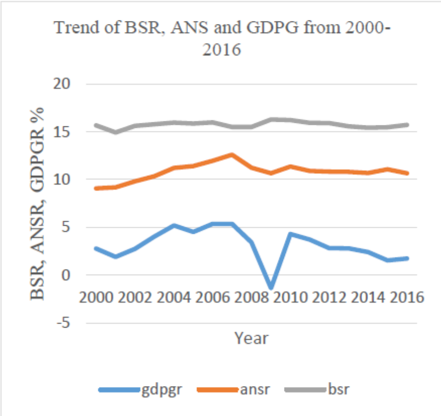

Figure 1c: The relationship among banking system regulatory capital, GDP growth rate and Adjusted Net Savings rate.

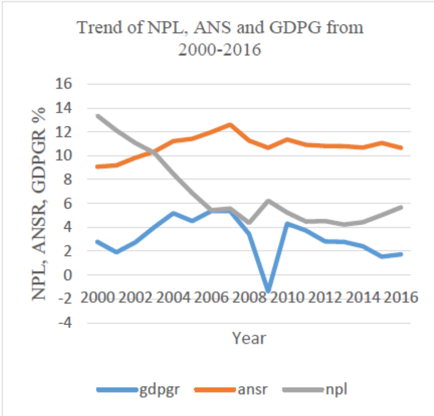

Figure 1d: The relationship among non-performing loans, GDP growth rate and Adjusted Net Savings rate.

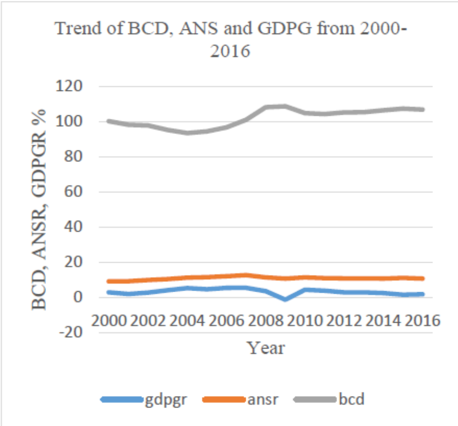

Figure 1e: The relationship between bank credit, GDP growth rate and Adjusted Net Savings rate.

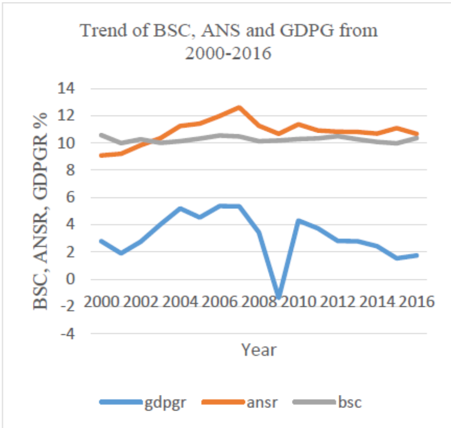

Figure 1f: The relationship between banking system capital, GDP growth rate and Adjusted Net Savings rate.

Figures 1a–1f. The relationship among banking system stability, economic growth (GDP growth rate) and Adjusted Net Savings rate of the countries selected for this study. Source: Author construction based on data from World Bank (2019).

2.4. Stability in banking system: BRICS in focus

It is important to note that BRICS members have been quite successful in organizing alternative sources of credit flows geared towards financial stability, growth and development (Kregel, 2009). According to Sen (2016), the BRICS has her own Financial Institutions established purposely to strengthen their financial sector. Among these financial institutions are: the BRICS (or New) Development Bank (NDB), Asian Infrastructure Investment Bank (AIIB), the BRICS-led Contingency Reserve Fund (CRF) and the Silk Road projects. With these BRICS banks, members can settle the bilateral trade surpluses and deficits among themselves using their own currencies without using of non-BRICS (US dollar and Euro) currencies. The usual cross exchange rates of currencies for different countries within the BRICS can be used to settle the two-way transactions in local currencies, say the deficit country paying back the surplus in the local currency of the same country. However, when dealing with non-BRICS countries, there is likely to encounter problems in settling the trade balances. When this arises, the use of cross rates of currencies are required. To avoid volatility in exchange rates under uncertainty, those cross rates can even be frozen by having forward contracts in order that those are not affected by exchange rate variations in terms of each other non–BRICS currencies like US dollar (Sen, 2016). Net balances in intra-BRICS trade can remain within the BRICS and deposited with the NDB (BRICS Bank).

The BRICS countries seem well placed to respond to any financial crisis and instability in financial sector, given that their financial systems have been relatively untouched by the global financial crisis and have maintained high levels of foreign reserves to cover temporary external deficits caused by the decline in global trade (Kregel, 2009). According to Rahman et al. (2017) during the global financial crisis period (2007–2009), bank net interest margins and bank equity ratios in BRICS countries did not deteriorate. This support the revelation of Jacobs and Rossem (2014) that BRICS block banking sectors had minimal adverse effects during the global financial crisis of 2007–2009 suggesting that the crisis had less impact on bank capital in these countries. This implies that the BRICS has stable financial system than many other countries during the crisis period. It is therefore, necessary to identify whether this stability in the banking system influence their economic sustainability.

2.5. Stability in banking system: Asia in focus

Since the 1997 crisis, Asian countries started engaging in active deliberations on regional financial cooperation. After putting much effort to come up with means of stopping and effectively coping with financial crises in the region, Asian countries have achieved visible results (Genberg, 2017). The countries' financial crisis was attributed to regional countries' increasing dependence upon foreign capital and bank loans, due to their relatively underdeveloped financial markets. In addition, the maturity mismatches in overseas markets, such as long-term lending and short-term borrowing also contributed to financial crisis. In recognition to this fact, Asian countries have focused on techniques of developing regional financial markets such as implementing regional bond markets. It must be noted that Asian emerging market economies have recovered relatively well from the Great Recession of 2008–2009. For instance, emerging Asian countries have been quite successful in maintaining both macroeconomic stability including financial stability in a unstable global environment. Based on the lessons learnt from the Asian Financial Crisis, the region adapted policy frameworks and governance structures suitable for their economies. In fact, policy makers have not been afraid to adopt varied approaches to achieving monetary and financial stability using more than a single policy instruments to reach their objectives (Genberg, 2017).

Two main bodies are presently leading regional financial cooperation in Asia: Association of Southeast Asian Nations plus three countries (ASEAN+3) and the Executives' Meeting of East Asia Pacific (EMEAP) central banks. These bodies play central roles in the contemporary regional financial cooperation projects. For instance, countries under ASEAN+3 have established a system of regional emergency liquidity provision through Bilateral Swap Arrangements (BSAs) under the Chiang Mai Initiative (CMI) as well as developing regional bond markets through the Asian Bond Market Initiative (ABMI). Similarly, countries under EMEAP have come up and operating the Asian Bond Fund (ABF) to foster regional bond markets. In addition, they are strengthening financial and economic monitoring and risk management within the region through the Monetary Financial Stability Committee (MFSC) (Jung, 2008). Apart from the ASEAN+3 and EMEAP, other bodies and organizations such as the South East Asian Central Banks (SEACEN) Research and Training Centre, Association of Southeast Asian Nations (ASEAN), the Asia-Europe Meeting (ASEM), Asia-Pacific Economic Cooperation (APEC), and the Southeast Asia, New Zealand and Australia (SEANZA) countries (Jung, 2008).

Even though literature does not specifically point a clear direction as to whether banking system stability influence economic sustainability (specifically macroeconomic stability indicators) or not, it must be emphasized that effort has been made by several researchers regarding banking system stability and macroeconomic stability nexus. The main gap in literature is identifying a reliable indicator for measuring economic sustainability and thus, examining how this indicator is influenced by stability in the banking system. Because ANS has emerged as a more accurate and comprehensive indicator for economic sustainability than most macroeconomic stability indicators, it is prudent to investigates the effects of stability in the banking system on economic sustainability proxied by ANS. In addition, further examination on this topic could help provide a clearer direction and clarify inconclusive results presented in literature. To add literature, the study first examine the effects of banking system stability on economic sustainability proxied by GDP per capita as a traditional and widely used economic sustainability indicator. Second, we examine the effects of BSS on economic sustainability proxied by ANS (as a more comprehensive and reliable sustainability indicator). Finally, we find out whether GDP per capita affects ANS. For each level of analysis, we try to compare BRICS and non-BRICS countries; and Asian and non-Asian countries.

3. Materials and methods

3.1. Data sources and description

We used annual data of Adjusted Net Savings rate (ANS), GDP per capita (GDPpc) and BSS indicators from the World Bank through two databases: (1) World Development Indicators (WDI) database; and (2) the St. Louis Federal Reserve Bank database. These sources are well known for providing high quality, credible and reliable data for drawing statistical inferences for making policy decisions. These sources work with experienced researchers and organizations who have developed control procedures to control the quality of the emerging data which ordinary researchers may not be able to do (Bryman and Bell, 2007). Finally, our assessment also revealed that data from the two sources are similar and consistent. We can conclude based on our assessment that the two sources give the same results.

We obtained ANS and GDPpc data from the World Bank through WDI database while we retrieved BSS indicators from the St. Louis Federal Reserve Bank database (World Bank group, 2019). We measured BSS using six main indicators (World Bank, 2019; The GlobalEconomy.com, 2019; Stewart and Chowdhury, 2019). They are Non-performing loans as percent of all bank loans (NPL), Bank credit as percent of bank deposits (BCD), Banking system z-scores (BSZ), Bank liquid assets to deposits and short-term funding (BLA), Banking system capital percent of assets (BSC), Banking system regulatory capital to risk-weighted assets (BSR). For the purpose of statistical accuracy and minimizing potential endogeneity problem, we control for other economic sustainability determinants such as government expenditure, foreign direct investment, trade openness and secondary education (Al-Moulani &

Constantinos, 2017; Arcand, et al., 2012). We retrieve data from 37 developing countries[2] from the period 2000-2016. Some developing countries do not have adequate data for analysis. Hence, these countries were not included in the study. As a normal practice in econometrics to minimize heteroscedasticity, we transformed all the variables into their natural log (Charfeddine and Ben Khediri, 2016). Table 1 summarizes the data used in the study. Descriptive Statistics for the various Panels.

Table 1a. Panel A: All countries.

Variable	Obs	Mean	Std. Dev.	Min	Max
lnANS	582	2.187	0.999	−4.605	3.481
lnBSZ	629	2.502	0.658	0.122	3.984
lnBSR	629	2.748	0.266	0.775	3.884
lnBLA	629	3.230	0.485	1.694	4.309
lnNPL	628	1.558	0.895	−0.892	3.874
lnBSC	629	2.296	0.338	0.399	3.421
lnBCD	629	4.590	0.342	3.677	5.736
lnTRADE	629	4.225	0.456	3.031	5.395
lnSEC	629	4.312	0.336	2.492	4.835
lnGFE	629	2.587	0.335	−0.051	3.267
lnFDI	614	0.847	0.995	−4.605	2.917
lnGDPpc	629	9.103	0.708	7.653	11.481

Table 1b. Panel B: BRICS and Non-BRICS countries.

Variable	BRICS					Non-BRICS				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
lnANS	81	2.116	1.297	−3.912	3.481	501	2.199	0.943	−4.605	3.462
lnBSZ	85	2.624	0.356	1.716	3.706	544	2.483	0.691	0.122	3.984
lnBSR	85	2.562	0.395	0.775	3.040	544	2.778	0.227	2.140	3.884
lnBLA	85	3.194	0.690	1.694	4.167	544	3.235	0.445	1.875	4.309
lnNPL	85	1.418	0.731	−0.051	3.395	543	1.580	0.916	−0.892	3.874
lnBSC	85	2.087	0.305	1.335	2.681	544	2.329	0.331	0.399	3.421
lnBCD	85	4.720	0.436	4.083	5.736	544	4.570	0.321	3.677	5.354
lnTRADE	85	3.780	0.331	3.096	4.289	544	4.295	0.433	3.031	5.395
lnSEC	85	4.412	0.224	3.808	4.650	544	4.296	0.348	2.492	4.835
lnGFE	85	2.764	0.229	2.304	3.035	544	2.559	0.341	−0.051	3.267
lnFDI	85	0.709	0.686	−1.470	1.788	529	0.869	1.035	−4.605	2.917
lnGDPpc	85	9.198	0.618	7.908	10.148	544	9.088	0.720	7.653	11.481

[2] Armenia; Belarus; Brazil; Chile; China; Colombia; Costa Rica; Dominican Republic; Ecuador; Egypt, Arab Rep.; El Salvador; Georgia; Guatemala; Honduras; India; Indonesia; Kenya; Korea, Rep.; Kuwait; Malaysia; Mauritius; Mexico; Moldova; Morocco; Namibia; Nigeria; Pakistan; Panama; Paraguay; Peru; Philippines; Russian Federation; Senegal; South Africa; Thailand; Ukraine; Uruguay.

Table 1c. Panel C: Asia and Non-Asian countries.

Variable	Asia					Non Asia				
	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
lnANS	172	2.725	0.669	−0.041	3.481	410	1.962	1.029	−4.605	3.462
lnBSZ	187	2.327	0.539	0.912	3.518	442	2.576	0.689	0.122	3.984
lnBSR	187	2.724	0.379	0.775	3.552	442	2.759	0.199	2.186	3.884
lnBLA	187	3.041	0.520	1.879	4.309	442	3.309	0.447	1.694	4.304
lnNPL	187	1.537	0.964	−0.777	3.538	441	1.566	0.864	−0.892	3.874
lnBSC	187	2.275	0.419	1.335	3.320	442	2.305	0.297	0.399	3.421
lnBCD	187	4.586	0.423	3.677	5.736	442	4.592	0.302	3.699	5.354
lnTRADE	187	4.278	0.497	3.231	5.395	442	4.203	0.436	3.031	5.116
lnSEC	187	4.319	0.337	3.002	4.706	442	4.309	0.336	2.492	4.835
lnGFE	187	2.520	0.266	1.876	3.255	442	2.615	0.357	−0.051	3.267
lnFDI	181	0.606	1.138	−4.605	2.917	433	0.947	0.911	−3.219	2.787
lnGDPpc	187	9.211	0.916	7.908	11.481	442	9.057	0.593	7.653	10.148

Note: Observation (Obs), Adjusted Net Savings rate (lnANS), Non-performing loans as percent of all bank loans (lnNPL), Banking system z-scores (lnBSZ), Banking system capital percent of assets (lnBSC), Bank credit as percent of bank deposits (lnBCD), Bank liquid assets to deposits and short-term funding (lnBLA), Banking system regulatory capital to risk-weighted assets (lnBSR) and GDP per capita (lnGDPpc). Trade openness (lnTRADE), secondary education (lnSEC), government final expenditure (lnGFE) and foreign direct investment (lnFDI).

3.2. Description of variables

3.2.1. Economic sustainability indicators

By economic sustainability, we mean the ability of economies to accumulate the assets needed to build up wealth to ensure her growth over a long period. In short, the economies are working towards economically sustainable economy. As indicated earlier, we measured sustainability using ANS (as a comprehensive and more accurate indicator) and GDPpc (as a traditional and simple but frequently used indicator). Even though, GDPpc is a strong macroeconomic indicator but weak sustainability indicator as established in the literature, we include this indicator in our economic sustainability indicators because it (1) is widely used in predicting a sustainability, and (2) might be useful in clarifying the contribution of banking system stability to the entire economy as debated in literature. The explanation of the two variables are below:

i. *Adjusted Net Savings rate (ANS):* ANS is a dependent variable in our study. As explained earlier, the World Bank group developed ANS as a useful measure of sustainability. It make available a useful measure of sustainability by determining the change in comprehensive wealth for a specified period.

ii. *GDP per capita (GDPpc):* GDPpc is our second dependent variable. It is simply gross domestic product divided by midyear population. It is measured in constant 2010 U.S. dollars. Traditionally, economic theory suggest that countries with high GDP per capita growth are on economically sustainable path.

3.2.2. Banking System Stability (BSS) indicators

The GlobalEconomy.com measures BSS using six indicators. The explanations of these indicators are as follows:

i. *Non-performing loans as percent of all bank loans (NPL):* NPL may refers to a loan on which the borrower is not making any interest payments or repaying any principal. The calculation of NPL is simply the value of non-performing loans divided by the total value of the loan portfolio. Declaring a loan as non-performing is dependent on the local regulations.

ii. *Banking system z-scores (BSZ):* BSZ captures the probability of default of a country's banking system. It compares the buffer of a country's banking system with the volatility of those returns. It is estimated as (ROA+ (equity/assets))/sd(ROA); sd(ROA) is the standard deviation of Return on Assets (ROA).

iii. *Banking system capital, percent of assets (BSC):* It is the ratio of bank capital and reserves to total assets. Capital and reserves comprise funds contributed by owners, retained earnings, general and special reserves, provisions, and valuation adjustments. Capital comprises tier 1 capital, which is a common feature in all countries' banking systems, and total regulatory capital, which comprises several specified types of subordinated debt instruments which require no repayment if the funds are required to maintain minimum capital levels. Total assets comprise all nonfinancial and financial assets.

iv. *Bank credit as percent of bank deposits (BCD):* It includes the financial resources given to the private sector by domestic money banks as a share of total deposits. Domestic money banks include commercial banks and other financial institutions that receive transferable deposits like demand deposits. Total deposits comprise demand, time and saving deposits in deposit money banks.

v. *Bank liquid assets to deposits and short-term funding (BLA):* BLA refers the ratio of the value of liquid assets (easily altered to cash) to total deposits and short-term funding. Liquid assets comprise cash and due from banks, trading securities and at fair value through income, loans and advances to banks, reverse repos and cash collaterals. Deposits and short term funding comprises total customer deposits and short-term borrowing.

vi. *Banking system regulatory capital to risk-weighted assets (BSR):* BSR is simply the capital adequacy of deposit takers. It is the ratio of total regulatory capital to its assets held, weighted according to the risk of those assets.

3.3. Econometric modelling

3.3.1. Economic growth model

The economic growth model used for the study is Solow growth model (Solow, 1956). It is a model of long-run economic growth that overcome the Harrod-Domar economic growth model, which uses simple fixed coefficient production function. Solow combined flexible factors and variable factor proportions to show that growth path of output was essentially stable. The model assumes a production function with property of diminishing returns and perceived technological progress as increasing productivity. Thus, Solow's model provides a good basis for modeling economic growth (Pardi, et al., 2015). We use the Cobb-Douglas production function, which is the main pillar of economic growth theory to develop the growth model. Using the production function, we can write the level of national output as follows:

$$Y = f\left(\underline{K}, \underline{L}, \underline{R}\right) \tag{2}$$

where Y represent the real national output, K represent capital, L is labor and R is the natural resources. K, L and R are the main factors of production of a given country. Equation (2) assumes that real national output is a function of capital, labor and natural resources. It is also assumed that the factors of production grow exogenously at rates designated by v, w, and q for capital, labor and national resources respectively. To modify Equation (2), there is the need to introduce an index of technological progress (A). "A" is assumed to be growing at the exogenous rate denoted by g. Thus, Equation (2) can be re-written as:

$$Y_t = A_t\,[\underline{K}_t]^{\alpha}\,[\underline{L}_t]^{\beta}\,[\underline{R}_t]^{\gamma} \tag{3}$$

where $A = A_0 e^{gt}$, $\underline{K}_t = e^{vt}\underline{K}_t$ $\underline{L}_t = e^{wt}\underline{L}_t$ $\underline{R}_t = e^{qt}\underline{R}_t$ α, β and γ represent the measures of the elasticities of output with respect to capital, labor and natural resources. When the growth rate for quality of capital is positive (v > 0), it suggests new technology applied in new capital goods. Similarly, improvements in the quality of labor (w > 0), signifies progress in human capital formation with investment in education, health and nutrition. Per assumption, the growth rate of natural resources can be in both ways, either positive (q > 0), or negative (q < 0). For instance, land fertility could decline by logging activities but it somehow could be offset by applying an efficient fertilization activity. By extracting the best and most accessible natural resources, quality of remaining natural resources maybe reasonably declined afterwards.

In a closed economy, equilibrium is achieved when net domestic saving equals net domestic investment. At this point, it is assumed that labor force volume is to grow at rate t and natural resources is to deplete at rate z. Stocks of non-renewable natural resources diminishes when used and renewable natural resources can be maintained, if not utilized beyond regeneration capacities. Based on these assumptions, we can derive the growth rate of productivity as follows:

$$\frac{dy}{y} = \theta + \alpha.\left[\frac{\left(sy - nk\right)}{k}\right] - \left(1 - \alpha - \beta\right).t - \gamma z \tag{4}$$

whereby $\theta = g + \alpha v + \beta w + \gamma q$ reflects the comprehensive growth rate all factors, $y = \frac{Y}{L}$ is output per unit of labour, $k = \frac{K}{L}$ is the ratio of capital per unit labor and s denotes domestic saving rate. Therefore, economic growth can be written as the sum of growth rate in productivity of labor, $\frac{dy}{y}$ and aggregate labor force participation rate, $n - p(p\ is\ population\ growth\ rate)$. Extending the model above, we can write economic growth rate as:

$$\frac{dy*}{y*} = \theta + \alpha.\left(\frac{sy}{k}\right) + \beta n - \gamma u - p \tag{5}$$

where y* is the output per capita. In summary, economic growth rate is defined as directly related to net saving rate (s), rate of technological progress (g) and growth rate of factors of production K, L and R (v, w and q) and also with growth rate of labor force (t). However, it would be negatively related with natural resources depletion (z) and population growth rate (p).

3.3.2. Adjusted net savings rate model

The derivation of Equation (5) clearly showed that saving as a function of increasing output. Hence, crucial to policymakers to determine the factors influencing national saving to enable them forecast and achieve targeted economic growth rate. Equation (5) also demonstrates a model for economic sustainability represented in per capita terms. This is because the proposed saving model includes natural resources depletion, demonstrating how natural capital reduction may affect level of saving for future generation.

We can derive the Equation (6) from Equation (5) to obtain the relationship of saving with its respective determinants.

$$\frac{sy}{k} = \theta + \alpha . \left(\frac{dy^*}{y^*} \right) - \beta n + \gamma u + p \tag{6}$$

In addition to these determinants, several studies have shown that there are other key determinants of economic sustainability such as banking system stability (Jayakumar et al., 2018; Younsi and Bechtini, 2018; Pradhan et al., 2016; Tongurai and Vithessonthi, 2018) which has renewed researchers interest in establishing the relationship between the variables. Nevertheless, these studies have not reached consensus in terms of the true impact of banking system stability on sustainability. Thus, this study seeks to establish the impact of banking system stability on economic sustainability of developing countries.

3.3.3. Model specification

We propose two variables (ANS and lnGDPpc) to measure economic sustainability as the dependent variable and six variables (BSZ, BSR, BLA, NPL, BSC, BCD) to measure banking system stability and lnGDPpc as the independent variables. Therefore, the general equation is hypothesized to reflect the three levels of objectives for the study:

$$GDPPC = f\left(BSZ, BSR, BLA, NPL, BSC, BCD\right) \tag{7}$$

$$ANS = f\left(BSZ, BSR, BLA, NPL, BSC, BCD\right) \tag{8}$$

$$ANS = f\left(GDPPC\right) \tag{9}$$

In Equations (7) and (8), GDP per capita (lnGDPpc) and Adjusted Net Savings rate (ANS) are assumed to be functions of banking system stability indicators (as explained earlier). In Equation (9), ANS is assumed to be a function of GDPpc.

We employed the most commonly used models in short panel data analysis: fixed effects (FE) and random effects (RE) regressors in linear regression using ordinary least squares (OLS). Therefore, we modeled both FE and RE from a classical linear regression model to examine (1) the effects of BSS indicators on lnGDPpc and ANS; and (2) lnGDPpc on ANS. In order to minimize potential endogeneity arising from omitted biases, we control for other economic sustainability determinants in our model. Based on Equations (7)–(9), we derived the classical linear regression model as:

$$Y_{it} = \alpha_0 + \beta_i X_{it} + \delta_i Z + \mu_{it} \qquad for\; i = 1,2,...,N \text{ and } t = 1,2,...,T \tag{10}$$

where Y_{it} is the dependent variables for the *ith* unit and *tth* time period; α_0 is the intercept; β_i represents the coefficients of the independent variables ($\beta_i \neq 0$) and δ_i represents the coefficients of the control variables ($\delta_i \neq 0$). X_{it} represents the vector of independent variables for the *ith* unit and *tth* time period, Z_{it} represents vector of control variables for the *ith* unit and *tth* time period, and μ_{it} is the error for the *ith* unit and the *tth* time period. We assume that μ_{it} satisfies the assumptions of the classical model. We can therefore specify the pooled OLS model in Equation (10) to capture the variables in their logarithm form as:

$$\begin{aligned} \ln GDPPC_{it} &= \alpha_0 + \beta_1 \ln BSZ_{it} + \beta_2 \ln BSR_{it} + \beta_3 \ln BLA_{it} + \beta_4 \ln NPL_{it} + \beta_5 \ln BSC_{it} \\ &+ \beta_6 \ln BCD_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \mu_{it} \end{aligned} \tag{11}$$

$$\begin{aligned} \ln ANS_{it} &= \alpha_0 + \beta_1 \ln BSZ_{it} + \beta_2 \ln BSR_{it} + \beta_3 \ln BLA_{it} + \beta_4 \ln NPL_{it} + \beta_5 \ln BSC_{it} \\ &+ \beta_6 \ln BCD_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \mu_{it} \end{aligned} \tag{12}$$

$$\ln ANS_{it} = \alpha_0 + \beta_1 \ln GDPPC_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \mu_{it} \tag{13}$$

$$for\; i = 1,2,...,N \qquad t = 1,2,...,T \qquad \beta_1 - \beta_6 \neq 0 \; and \; \delta_1 - \delta_4 \neq 0$$

where all variables are explained above. We estimates the FE regression model, which is an extension of the classical linear regression model in Equation (10) as:

$$Y_{it} = \beta_i X_{it} + \delta_i Z_{it} + \alpha_i + \mu_{it} \tag{14}$$

where the component α_i represents all the stable characteristics of the countries used in the study; the component μ_{it} represents all unobserved factors that vary across country and time. All other variables are explained above. It is assumed that the net effect on Y of unobservable factors for the *ith* unit that are constant over time is a fixed parameter, designated α_i. Specifying Equation (14), we derived the following equations based on Equations (7), (8) and (9) respectively.

$$\begin{aligned} \ln GDPPC_{it} &= \beta_1 \ln BSZ_{it} + \beta_2 \ln BSR_{it} + \beta_3 \ln BLA_{it} + \beta_4 \ln NPL_{it} + \beta_5 \ln BSC_{it} \\ &+ \beta_6 \ln BCD_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \alpha_i + \mu_{it} \end{aligned} \tag{15}$$

$$\ln ANS_{it} = \beta_1 \ln BSZ_{it} + \beta_2 \ln BSR_{it} + \beta_3 \ln BLA_{it} + \beta_4 \ln NPL_{it} + \beta_5 \ln BSC_{it} + \beta_6 \ln BCD_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \alpha_i + \mu_{it} \quad (16)$$

$$\ln ANS_{it} = \beta_1 \ln GDPPC_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \alpha_i + \mu_{it} \quad (17)$$

$for\, i = 1, 2, ..., N \quad t = 1, 2, ..., T \quad \beta_1 - \beta_6 \neq 0 \; and \; \delta_1 - \delta_4 \neq 0$

On the other hand, we estimates RE model from equation (10) as:

$$Y_{it} = \alpha_0 + \beta_i X_{it} + \delta_i Z_{it} + \varepsilon_{it} \qquad \varepsilon_{it} = \mu_i + e_{it} \quad (18)$$

where the classical error term ε_{it} is decomposed into two components: μ_i represents between-entity errors; e_{it} is the within-entity error. All other variables are explained earlier.

$$\ln GDPPC_{it} = \alpha_0 + \beta_1 \ln BSZ_{it} + \beta_2 \ln BSR_{it} + \beta_3 \ln BLA_{it} + \beta_4 \ln NPL_{it} + \beta_5 \ln BSC_{it} + \beta_6 \ln BCD_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \varepsilon_{it} \quad (19)$$

$$\ln ANS_{it} = \alpha_0 + \beta_1 \ln BSZ_{it} + \beta_2 \ln BSR_{it} + \beta_3 \ln BLA_{it} + \beta_4 \ln NPL_{it} + \beta_5 \ln BSC_{it} + \beta_6 \ln BCD_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \varepsilon_{it} \quad (20)$$

$$\ln ANS_{it} = \alpha_0 + \beta_1 GDPPC_{it} + \delta_1 \ln TR_{it} + \delta_2 \ln SEC_{it} + \delta_3 \ln GFE_{it} + \delta_4 \ln FDI_{it} + \varepsilon_{it} \quad (21)$$

$for\, i = 1, 2, ..., N \quad t = 1, 2, ..., T \quad \beta_1 - \beta_6 \neq 0 \; and \; \delta_1 - \delta_4 \neq 0$

3.4. Robustness tests

Selecting appropriate panel data model depends on a series of test performed on the data. We performed the following test: F-test, LM test for RE; and Hausman test $\chi 2$ for testing endogeneity to select the best model for the data. In addition, we corrected for presence of heteroscedasticity and autocorrelation in the data using the Wald test for heteroscedasticity and Wooldridge test for autocorrelation. Table 2 summarizes the steps followed to choose appropriate model for the study.

According to Table 2, we followed series of steps to choose appropriate panel data model at each point in time for the study. First, we tested the hypotheses that Pooled OLS is more appropriate than FE and RE using F or Wald Test and Breusch-Pagan Test for the two models respectively. Step 1 shows that if H0 is not rejected for both FE and RE models, then Pooled OLS is appropriate. However, at the step 2, FE model is chosen as appropriate for the data if the hypotheses for FE vs Pooled OLS is rejected and that of RE vs Pooled OLS is not rejected. On the other hand, RE model is chosen as appropriate for the data if the hypotheses for FE vs Pooled OLS is not rejected and that of RE vs Pooled OLS is rejected. However, if both hypotheses are rejected and the two models FE and RE accepted, the choice for appropriate model is based on Hausman test. Where the Hausman test shows significant ($p < 0.05$), FE model is preferred, otherwise RE model is appropriate.

Table 2. Steps in selecting appropriate panel data model.

STEPS	FE vs. Pooled OLS	RE vs. Pooled OLS	DECISION
Hypothesis	$H_0 = \mu_1 = \mu_2 = \ldots = \mu$	$H_0 = Var(\mu_i) = 0$	Model
Recommended Test	F or Wald Test	Breusch-Pagan Test	
Step 1	H_0 not rejected ⇒ No FE	H_0 not rejected ⇒ No RE	Pooled OLS
Step 2	H_0 rejected ⇒ FE	H_0 not rejected ⇒ No RE	FE Model
Step 3	H_0 not rejected ⇒ No FE	H_0 rejected ⇒ RE	RE Model
Step 4	H_0 rejected ⇒FE	H_0 rejected ⇒ RE	Choose one based on Hausman test

The panel data model employed in our study makes assumptions such as homoscedasticity, normal distribution, and no autocorrelation (Baltagi, 2005; Yaffee, 2005). However, our data did not meet these assumptions. Hence, we applied suggested techniques for correcting heteroscedasticity and autocorrelation in short panels (number of countries is greater than time period). Where the data showed presence of heteroscedasticity only, we used robust standard errors approach. However, where both heteroscedasticity and autocorrelation are present, we used cluster standard errors.

4. Results and discussions

4.1. The effects of banking system stability on economic sustainability

4.1.1. The Effects of banking system stability on GDP per capita

As indicated earlier, we used panel data models to estimate the effects of banking system stability on GDP per capita. We compared the most common panel data models—Pooled OLS, Fixed Effects (FE) and Random Effects (RE). The choice for the appropriate model was based on the steps outlined in Table 2. Our analysis first, examined the effects based on the full sample. Second, we compared the effects based on non-BRICS and BRICS countries. Finally, we compare the effects based on non-Asian and Asian countries. Table 3 summarizes the result of the effects of banking system stability on GDP per capita for the full sample as well as comparing non-BRICS and BRICS countries. Based on the robustness tests, the FE model was found appropriate, hence we interpret our results based on the FE model.

Table 3. The effects of banking system stability on GDP per capita for all countries, non-BRICS and BRICS countries.

Variable	All Countries			BRICS			NON-BRICS		
	OLS	FE	RE	OLS	FE	RE	OLS	FE	RE
lnBSZ	−0.073**	0.009	−0.001	−0.402***	0.078*	−0.402***	−0.057*	0.021	0.009
	(0.029)	(0.034)	(0.032)	(0.074)	(0.031)	(0.108)	(0.030)	(0.027)	(0.027)
lnBSR	−0.367**	0.046	0.037	0.186**	0.099***	0.186**	−0.646***	−0.175**	−0.177***
	(0.144)	(0.133)	(0.131)	(0.076)	(0.008)	(0.080)	(0.124)	(0.064)	(0.066)
lnBLA	0.286***	−0.050	−0.046	0.111***	0.009	0.111*	0.143***	−0.031	−0.031
	(0.047)	(0.032)	(0.032)	(0.041)	(0.009)	(0.067)	(0.054)	(0.032)	(0.032)
lnNPL	−0.250***	−0.037*	−0.042**	0.015	−0.013	0.015	−0.225***	−0.013	−0.021
	(0.027)	(0.020)	(0.020)	(0.027)	(0.007)	(0.053)	(0.027)	(0.013)	(0.014)
lnBSC	−0.363***	−0.052	−0.053	0.680***	−0.076	0.680***	−0.396***	−0.008	−0.012
	(0.084)	(0.048)	(0.048)	(0.090)	(0.047)	(0.128)	(0.081)	(0.037)	(0.037)
lnBCD	0.147**	0.159**	0.167***	0.350***	0.277***	0.350***	0.268***	0.078**	0.091**
	(0.060)	(0.064)	(0.062)	(0.042)	(0.027)	(0.080)	(0.070)	(0.037)	(0.038)
lnTRADE	0.284***	−0.025	−0.008	0.145***	−0.335***	0.145**	0.325***	−0.065	−0.035
	(0.043)	(0.067)	(0.063)	(0.054)	(0.018)	(0.069)	(0.046)	(0.066)	(0.062)
lnSEC	1.046***	−0.017	0.037	1.248***	1.301***	1.248***	1.102***	−0.095	−0.033
	(0.083)	(0.130)	(0.127)	(0.185)	(0.092)	(0.272)	(0.087)	(0.114)	(0.112)
lnGFE	−0.082	−0.054	−0.054	0.116	−0.062	0.116	−0.235***	−0.022	−0.026
	(0.056)	(0.067)	(0.066)	(0.123)	(0.079)	(0.166)	(0.064)	(0.053)	(0.053)
LnFDI	−0.167***	−0.010	−0.012	−0.027	0.013**	−0.027	−0.184***	−0.008	−0.009
	(0.035)	(0.014)	(0.014)	(0.026)	(0.005)	(0.023)	(0.039)	(0.014)	(0.015)
Cons	4.541***	8.633***	8.360***	−0.030	3.156***	−0.030	5.224***	9.766***	9.408***
	(0.610)	(0.782)	(0.778)	(0.401)	(0.446)	(0.625)	(0.662)	(0.541)	(0.548)
R2	0.7632	0.786	0.785	0.8813	0.8919	0.8995	0.7102	0.8093	0.8074
F test	36.07***	19.89***		228.29***	22.01***		45.77***	129.19***	
Wald 2			587.94***			168.25***			702.62***
F Test (u_i=0)		197.09			82.97			187.71	
		[0.000]			[0.000]			[0.000]	
Serial Correlation	383.355			31.829			349.631		
	[0.000]			[0.000]			[0.000]		
Hettero-scedasiticity		15921.58			17.09			20970.45	
		[0.000]			[0.004]			[0.000]	
Hausman test		68.39			212.27			53.79	
		[0.000]			[0.000]			[0.000]	
LM test			2664.63			548.62			2026.01
			[0.000]			[0.000]			[0.000]
Obs	613	613	613	85	85	85	528	528	528

Note: ***, **, * Significant at 1%, 5% and 10% respectively. *Robust standard errors are in ( ) and p-values are in [ ].*

According to Table 3, non-performing loans significantly and negatively influence GDP per capita at 10% significance level while bank credit significantly and positively influence GDP per capita among the selected developing countries at 5% significance level, controlling for other economic sustainability determinants. Thus, holding other factors constant, GDP per capita will decrease by 0.037% as a result of a 1% increase in non-performing loans but increase by 0.159% resulting from a 1% increasing in bank credit. The result implies that lower non-performing loans is necessary to put developing countries on economically sustainable path as viewed from the perspective of traditional economic sustainability indicator. Furthermore, the result indicates that additional bank credit to the private sector is useful to improve economic sustainability of developing countries. This finding is consistent with the finding of Jayakumar et al. (2018) who found that bank stability is a significant driver of economic growth.

While banking system regulatory capital significantly and positively influence the GDP per capita of BRICS economies, it negatively influence on GDP per capita of non-BRICS economies suggesting that capital adequacy to deposit takers is a contributing factor to BRICS economic sustainability but adversely affects the economic sustainability of non-BRICS economies. Therefore, a 1% increase in banking system regulatory capital will lead to 0.099% increase in GDP per capita of BRICS economies but 0.175% decrease in GDP per capita of non-BRICS economies, other factors held constant. Besides, bank credit significantly and positively influence GDP per capita of both BRICS and non-BRICS economies. However, the impact is stronger among BRICS economies than non-BRICS economies. Thus, a 1% increase in bank credit will increase GDP per capita of BRICS and non-BRICS economies by 0.277% and 0.078% respectively. This finding further confirms that the BRICS banking system in general is well placed compared with other developing countries and emerging economies (Kregel, 2009).

In addition, we compare the non-Asian and Asian countries to examine the effects. Table 4 illustrates the effects of Banking System Stability on GDP per capita for non-Asian and Asian countries. Similarly, the robustness tests shows that FE model is appropriate. Hence, our interpretation of this result uses FE model.

The results in Table 4 show that conditioning on other economic sustainability determinants, banking system regulatory capital and bank credit significantly and positively influence GDP per capita of Asian economies while banking system capital significantly and negatively influence GDP per capita of Asian economies. The results implies that, GDP per capita of Asian economies will increase by 0.149% and 0.434% as a result of a 1% increase in banking system regulatory capital and bank credit respectively but decrease by 0.298% resulting from a 1% increase in banking system capital, holding other factors constant. In contrast, banking system regulatory capital and bank liquid assets significantly and negatively influence GDP per capita of non-Asian economies while bank credit significantly and positively influence GDP per capita of the same economies. This suggests that, holding other factors constant, GDP per capita of non-Asian economies will decrease by 0.197% and 0.137% as a result of a 1% increase in banking system regulatory capital and bank liquid assets respectively but increase by 0.139% resulting from a 1% increase in bank credit. A critical examination of the results show that even though both countries are adversely affected by one (in the case of Asian economies) or more (non-Asian economies), the Asian economies seem relatively stronger in linking banking system stability with economic sustainability than the non-Asian economies (Genberg, 2017). The marginal impact of a common BSS variable—bank credit can further confirm this claim since the positive impact of bank credit on GDP per capita is stronger among the Asian economies.

Table 4. Effects of Banking System Stability on GDP per capita among non-Asian and Asian countries.

lngdppc	ASIA			NON-ASIAN		
	OLS	FE	RE	OLS	FE	RE
lnBSZ	−0.015	0.132	−0.015	−0.107***	−0.009	−0.021
	(0.068)	(0.087)	(0.180)	(0.029)	(0.019)	(0.020)
lnBSR	0.145	0.149**	0.145	−0.760***	−0.197***	−0.205***
	(0.137)	(0.055)	(0.263)	(0.128)	(0.064)	(0.068)
lnBLA	0.002	−0.002	0.002	0.353***	−0.137***	−0.131***
	(0.095)	(0.064)	(0.172)	(0.051)	(0.022)	(0.023)
lnNPL	−0.141**	−0.016	−0.141	−0.246***	−0.011	−0.018
	(0.069)	(0.032)	(0.139)	(0.021)	(0.014)	(0.015)
lnBSC	−0.123	−0.298**	−0.123	−0.233***	−0.001	−0.002
	(0.161)	(0.130)	(0.314)	(0.060)	(0.032)	(0.033)
lnBCD	0.486***	0.434***	0.486**	0.205***	0.139**	0.136**
	(0.099)	(0.088)	(0.228)	(0.058)	(0.052)	(0.051)
lnTRADE	0.813***	−0.090	0.813***	0.042	−0.096	−0.095
	(0.117)	(0.109)	(0.188)	(0.040)	(0.062)	(0.061)
lnSEC	0.104	0.329	0.104	0.979***	−0.137	−0.085
	(0.225)	(0.325)	(0.493)	(0.082)	(0.091)	(0.086)
lnGFE	0.655***	−0.030	0.655	−0.143***	−0.021	−0.025
	(0.213)	(0.107)	(0.446)	(0.050)	(0.055)	(0.059)
LnFDI	−0.431***	−0.034*	−0.431***	0.010	0.015*	0.016*
	(0.049)	(0.018)	(0.096)	(0.019)	(0.008)	(0.008)
Cons	1.592*	5.959***	1.592	6.191***	10.203***	10.203***
	(0.936)	(1.447)	(2.440)	(0.557)	(0.603)	(0.603)
R2	0.7332	0.8481	0.7332	0.719	0.8585	0.8571
F test	23.84***	21.66***		42.62***	29.17***	
Wald 2			251.44***			615.08***
F Test (u_i=0)		263.64			101.31	
		[0.000]			[0.000]	
Serial Correlation	124.992			238.865		
	[0.000]			[0.000]		
Hettero		455.09			17025.99	
scedasiticity		[0.000]			[0.000]	
Hausman		110.71			147.66	
test		[0.000]			[0.000]	
LM test			775.48			1385.15
			[0.000]			[0.000]
Obs	181	181	181	432	432	432

Note: ***, **, * Significant at 1%, 5% and 10% respectively. *Robust standard errors are in ( ) and p-values are in [ ].*

4.1.2. Effects of banking system stability on Adjusted Net Savings rate

Our second objective examined the effects of BSS on ANS. Based on the robustness tests outlined in Table 2; we found the FE model appropriate for all countries, non-BRICS countries and BRICS countries. Therefore, we interpret our data based on the appropriateness of the model for the group. Table 5 summarizes the results for all countries, non-BRICS and BRICS countries.

For all countries sampled, the results in Table 5 show that conditioning on other economic sustainability determinants, banking system regulatory capital and bank credit had significantly negative impacts on ANS at 5% significance level while banking system z-scores had a significantly positive impact on ANS at 10% significance level. This implies that, a 1% increase in banking system regulatory capital and bank credit will lead to 0.185% and 0.214% decrease in ANS respectively while the same increase in banking system z-scores will lead to 0.097% increase in ANS of developing countries but only at 10% significant level, all other factors held constant. This finding contradicts the findings of Younsi and Bechtini (2018) and Pradhan et al. (2016) who revealed positive impacts of financial sector development on long-term economic growth. The result could mean that stability in the banking system of developing countries is not well aligned with the future growth and sustainability.

Concerning the impacts of banking system stability on ANS among BRICS and non-BRICS, Table 5 shows that controlling for other variables, banking system stability variables such as banking system z-scores, bank liquid assets and bank credit significantly affected ANS for both groups. While these variables positively influenced the ANS of BRICS economies, the variables negatively influenced ANS of non-BRICS economies except for banking system z-scores, which had positive influence. This implies that holding other factors constant, a 1% increase in banking system z-scores, bank liquid assets and bank credit will lead to 1.447%, 0.416% and 0.214% increase in ANS of BRICS economies respectively. On the contrary, while a 1% increase in banking system z-scores will lead to a 0.183% increase in ANS of non-BRICS economics, a percentage increase in bank liquid assets and bank credit will lead to 0.240% and 0.447% decrease in ANS of non-BRICS economies respectively, holding other factors constant. The differences in the results among the two groups in favor of BRICS economies is expected since the BRICS has made huge investment and introduced initiatives in their banking system (Sen, 2016) to put them ahead of other emerging economies (Kregel, 2009).

Shifting the attention to Asian and non-Asian countries, the robustness tests shows that the FE model is appropriate for the two groups. Hence, we interpret our results based on FE model.

Table 5. Effects of banking system stability on Adjusted Net Savings rate for all countries, non-BRICS and BRICS countries.

lnANSR	ALL			BRICS			NON-BRICS		
	OLS	FE	RE	OLS	FE	RE	OLS	FE	RE
lnBSZ	0.215*** (0.056)	0.097* (0.050)	0.211*** (0.041)	0.042 (0.427)	1.447** (0.697)	0.042 (0.516)	0.251*** (0.059)	0.183*** (0.048)	0.238*** (0.047)
lnBSR	−0.629*** (0.023)	−0.185** (0.064)	−0.263*** (0.061)	−0.528* (0.278)	−0.432* (0.169)	−0.528* (0.295)	0.039 (0.270)	−0.110 (0.445)	0.026 (0.361)
lnBLA	−0.122 (0.101)	−0.116 (0.143)	−0.159 (0.161)	0.495** (0.221)	−0.416** (0.125)	0.495** (0.218)	−0.304*** (0.112)	−0.240*** (0.075)	−0.280*** (0.092)
lnNPL	−0.134* (0.076)	0.006 (0.077)	−0.040 (0.096)	0.584* (0.332)	0.256 (0.234)	0.584 (0.467)	−0.228*** (0.078)	−0.041 (0.088)	−0.143 (0.136)
lnBSC	−0.037 (0.172)	−0.190 (0.169)	−0.190 (0.210)	1.223** (0.575)	−1.592 (0.897)	1.223 (0.817)	−0.164 (0.169)	−0.181 (0.174)	−0.226 (0.253)
lnBCD	−0.344*** (0.048)	−0.214** (0.073)	−0.204*** (0.043)	1.356*** (0.393)	0.960** (0.325)	1.356*** (0.349)	−0.639*** (0.169)	−0.447* (0.223)	−0.578** (0.257)
lnTRADE	0.538*** (0.078)	−0.196 (0.307)	0.349* (0.186)	−1.432*** (0.363)	−1.571** (0.501)	−1.432 (0.547)	0.580*** (0.093)	0.010 (0.334)	0.543*** (0.208)
lnSEC	0.162 (0.135)	0.833* (0.422)	0.494** (0.225)	0.261 (0.861)	0.778 (1.206)	0.261 (0.533)	0.187 (0.137)	0.966** (0.439)	0.395 (0.245)
lnGFE	−0.367** (0.154)	−0.964** (0.385)	−0.636* (0.354)	−5.953*** (0.876)	0.508 (2.208)	−5.953 (0.847)	−0.135 (0.146)	−1.021** (0.448)	−0.354 (0.370)
LnFDI	−0.023 (0.043)	−0.086* (0.045)	−0.055 (0.050)	0.001 (0.153)	−0.141 (0.260)	0.001 (0.167)	−0.072** (0.034)	−0.082* (0.047)	−0.068 (0.056)
Cons	3.710*** (1.224)	4.084*** (1.096)	3.414** (1.434)	11.782*** (2.730)	−6.302*** (1.974)	11.782*** (3.432)	3.501*** (1.321)	3.479** (1.548)	2.502** (1.070)
R2	0.7494	0.6535	0.7213	0.7967	0.6887	0.7967	0.7220	0.6333	0.7104
F test	6.79***	6.89***		17.99***	16.52***		7.68***	7.44***	
Wald 2			347.55***			94.06***			148.50***
F Test (u_i=0)		29.13 [0.000]			7.53 [0.000]			23.28 [0.000]	
Serial Correlation	11.164 [0.001]			8.898 [0.040]			8.872 [0.005]		
Hettero−scedasiticity		92905.61 [0.000]			1724.33 [0.000]			61742.55 [0.000]	
Hausman test		170.37 [0.000]			87.88 [0.000]			81.96 [0.000]	
LM test			1128.27 [0.000]			382.34 [0.000]			683.93 [0.000]
Obs	569	569	569	81	81	81	488	488	488

Note: ***, **, * Significant at 1%, 5% and 10% respectively. *Robust standard errors are in ( ) and p-values are in [ ].*

Table 6. Effects of banking system stability on Adjusted Net Savings rate of non-Asian and Asian Countries.

lnansr	ASIA			NON-ASIA		
	OLS	FE	RE	OLS	FE	RE
lnBSZ	0.557***	0.301**	0.557***	0.212***	0.167*	0.214**
	(0.083)	(0.106)	(0.125)	(0.072)	(0.085)	(0.077)
lnBSR	−0.260	0.083	−0.260	−0.321	−0.975*	−0.330
	(0.200)	(0.203)	(0.182)	(0.312)	(0.568)	(0.687)
lnBLA	−0.114	−0.302	−0.114	0.307**	−0.150	0.286
	(0.100)	(0.248)	(0.191)	(0.145)	(0.186)	(0.297)
lnNPL	−0.096	−0.148**	−0.096	−0.131	0.064	−0.121
	(0.064)	(0.060)	(0.123)	(0.101)	(0.110)	(0.242)
lnBSC	−0.402*	0.163	−0.402	0.016	−0.206	0.004
	(0.211)	(0.204)	(0.281)	(0.227)	(0.227)	(0.457)
lnBCD	−0.290*	−0.819***	−0.290	−0.294	−0.051	−0.282
	(0.154)	(0.222)	(0.310)	(0.206)	(0.501)	(0.453)
lnTRADE	−0.080	−0.230	−0.080	0.637***	0.182***	0.631***
	(0.086)	(0.509)	(0.168)	(0.110)	(0.041)	(0.138)
lnSEC	0.588***	−0.102	0.588**	−0.136	1.073**	−0.099
	(0.179)	(0.371)	(0.271)	(0.179)	(0.495)	(0.391)
lnGFE	0.114	−0.647	0.114	−0.088	−0.877	−0.107
	(0.312)	(0.462)	(0.533)	(0.182)	(0.608)	(0.446)
LnFDI	−0.108**	−0.017	−0.108***	0.187***	−0.134**	0.177
	(0.044)	(0.032)	(0.035)	(0.057)	(0.055)	(0.131)
Cons	2.610***	9.548***	2.610***	1.780**	3.073***	0.741*
	(0.606)	(3.009)	(0.787)	(0.835)	(0.878)	(0.871)
R2	0.7443	0.6479	0.7443	0.7784	0.6264	0.7747
F test	8.94***	8.06***		5.55***	4.99***	
Wald 2			101.28***			135.42***
F Test (u_i=0)		14.76			24.81	
		[0.000]			[0.000]	
Serial Correlation	208.886			5.833		
	[0.000]			[0.023]		
Hettero-		1703.36			42932.02	
scedasiticity		[0.000]			[0.000]	
Hausman		20.96			165.38	
test		[0.000]			[0.000]	
LM test			416.82			525.45
			[0.000]			[0.000]
Obs	168	168	168	401	401	401

Note: ***, **, * Significant at 1%, 5% and 10% respectively. *Robust standard errors are in ( ) and p-values are in [ ].*

Among the Asian economies, banking system z-scores had significantly positive impact on ANS while non-performing loans and bank credit had significantly negative impacts on ANS (see Table 6). Thus, holding other factors constant, a 1% increase in banking system z-scores will increase ANS of

Asian economies by 0.301% while in non-performing loans and bank credit, the same increase will decrease ANS by 0.148% and 0.818% respectively. In contrast, only banking system z-scores and banking system regulatory capital significantly influenced ANS of non-Asian economies with banking system z-scores having a positive impact while banking system regulatory capital having a negative impact. Thus, a 1% increase in banking system z-scores will increase ANS of non-Asian economies by 0.167% while ANS of these economies will decrease by 0.975% resulting from a percentage increase in banking system regulatory capital, , holding other factors constant. Comparatively, the marginal impacts of banking system stability variables – banking system regulatory capital and banking system z-scores is in favor of Asian economies indicating that Asian banking system is relatively aligned with their future growth and sustainability (Genberg, 2017).

4.2. Effects of GDP per capita on Adjusted Net Savings rate

With regards to the effects of GDP per capita on Adjusted Net Savings rate, the robustness tests revealed that FE model is appropriate for all the panels. Therefore, we interpret the results of all panels based on FE model. Table 7 summarizes the results of the effects of GDP per capita on Adjusted Net Savings rate for all countries, non-BRICS and BRICS countries.

The results in Table 7 show that GDP per capita of the selected developing economies significantly and positively influence ANS at 1% significant level. Thus, holding other factors constant, a 1% increase in GDP per capita will increase ANS by 0.037%, holding other factors constant. This means that if developing countries put in effective mechanism to ensure continuous increase in GDP per capita, they are working towards a more economically sustainable path. This suggests that higher GDP per capita among developing countries is an indication of accumulating assets needed to build up wealth to ensure growth over a long period. This finding is consistent with economic theory that suggest that higher GDP per capita suggest economically sustainable economy.

Compared with BRICS and non-BRICS economies, the results show that GDP per capita significantly and positively influence both economies but the impact is stronger for BRICS economies. Thus, holding other factors constant, a 1% increase in GDP per capita will lead to 0.903% and 0.617% increase in ANS of BRICS and non-BRICS economies respectively. This seems to suggest the long-term economic growth of BRICS economies are more aligned with their future growth and sustainability compared with non-BRICS economies.

Table 8 compares the results the effects of GDP per capita on Adjusted Net Savings rate of non-Asian and Asian countries.

Table 7. Effects of GDP growth rate and Adjusted Net Savings rate for all countries, non-BRICS and BRICS countries.

ANS	ALL			BRICS			NON-BRICS		
	OLS	FE	RE	OLS	FE	RE	OLS	FE	RE
lnGDPPC	0.335***	0.241***	0.327***	1.034***	0.903**	1.034**	0.417***	0.617***	0.357***
	(0.071)	(0.092)	(0.095)	(0.361)	(0.431)	(0.473)	(0.071)	(0.082)	(0.089)
lnTRADE	0.485***	−0.067	0.213	−0.945**	−0.761	−0.945	0.638***	0.048	0.396*
	(0.070)	(0.242)	(0.179)	(0.374)	(0.805)	(0.684)	(0.088)	(0.328)	(0.226)
lnSEC	−0.527**	0.613*	0.254	−2.159**	−0.603	−2.159**	−0.541**	1.099**	0.216
	* (0.159)	(0.343)	(0.277)	(0.867)	(1.428)	* (0.605)	* (0.160)	(0.440)	(0.280)
lnGFE	−0.419**	−1.085**	−0.721**	−4.532**	−0.724	−4.532**	−0.205	−1.000**	−0.596
	* (0.159)	* (0.341)	(0.337)	* (0.972)	(1.470)	* (1.104)	(0.175)	(0.437)	(0.415)
lnFDI	0.020	−0.084*	−0.061	0.696***	−0.084	0.696*	−0.033	−0.082	−0.069
	(0.037)	(0.048)	(0.039)	(0.140)	(0.173)	(0.355)	(0.033)	(0.051)	(0.044)
Cons	2.491***	2.345***	−2.349**	17.510**	11.045**	17.510**	−1.357**	−8.980**	−2.022**
	(0.652)	(0.218)	* (0.716)	* (2.558)	* (3.454)	* (3.715)	(0.614)	* (0.761)	* (0.603)
R2	0.6106	0.6552	0.6277	0.6779	0.6396	0.6779	0.6664	0.6382	0.6145
F test	4.82***	2.88**		9.51***	3.72**		8.35***	2.98***	
Wald 2			37.02**			29.69**			48.04***
F Test (u_i=0)		31.55 [0.000]			15.38 [0.000]			25.38 [0.000]	
Serial Correlation	10.904 [0.002]			8.152 [0.000]			8.723 [0.005]		
Hettero-scedasiticity		58385.71 [0.000]			962.59 [0.000]			78321.53 [0.000]	
Hausman test		106.93 [0.000]			29.72 [0.000]			81.21 [0.000]	
LM test			1361.32 [0.000]			185.36 [0.000]			901.68 [0.000]
OBS	570	570	570	81	81	81	489	489	489

Note: ***, **, * Significant at 1%, 5% and 10% respectively. *Robust standard errors are in ( ) and p-values are in [ ].*

Table 8. Effects of GDP per capita on Adjusted Net Savings rate of non-Asian and Asian countries.

ANS	ASIA			NON-ASIA		
	OLS	FE	RE	OLS	FE	RE
lnGDPPC	0.189**	0.240***	0.296**	0.466***	2.244**	0.379
	(0.086)	(0.032)	(0.124)	(0.110)	(0.766)	(0.307)
lnTRADE	−0.165	−0.301	−0.165	0.631***	0.169	0.519**
	(0.100)	(0.475)	(0.300)	(0.096)	(0.409)	(0.230)
lnSEC	0.332*	0.553*	0.332	−0.757***	1.330**	0.057
	(0.196)	(0.281)	(0.549)	(0.214)	(0.534)	(0.372)
lnGFE	−0.185	−0.767*	−0.185	−0.064	−0.678	−0.438
	(0.311)	(0.416)	(0.682)	(0.182)	(0.571)	(0.473)
lnFDI	−0.200***	−0.020	−0.200	0.182***	−0.170***	−0.030
	(0.044)	(0.056)	(0.123)	(0.051)	(0.052)	(0.061)
Cons	1.844***	5.698**	1.844	−1.604	−22.289**	−2.705
	(0.552)	(2.328)	(1.358)	(1.106)	(8.876)	(2.706)
R2	0.6167	0.6220	0.6217	0.6057	0.6181	0.6113
F test	4.10***	4.83***		5.52***	6.53***	
Wald 2			26.01**			54.95***
F Test		24.85			24.88	
(u_i= 0)		[0.000]			[0.000]	
Serial	170.605			5.910		
Correlation	[0.000]			[0.022]		
Hettero-		4239.36			62145.59	
scedasiticity		[0.000]			[0.000]	
Hausman		92.34			98.89	
test		[0.000]			[0.000]	
LM test			274.28			625.61
			[0.000]			[0.000]
OBS	168	168	168	402	402	402

Note: ***, **, * Significant at 1%, 5% and 10% respectively. *Robust standard errors are in ( ) and p-values are in [ ].*

This study revealed a significant and positive impact of GDP per capita on ANS in both Asian and non-Asian economies but the impact is stronger in non-Asian economies suggesting that GDP per capita has a key role in economic sustainability of non-Asian economies than Asian economies, controlling other determinants. Thus, a 1% increase in GDP per capita will increase Asian and non-Asian Economies by 0.240% and 2.244% respectively, holding other factors constant. This is quite surprising since according to the literature emerging Asian countries have been quite successful in maintaining macroeconomic stability for a long period of time (Genberg, 2017). It seems to suggest Asian economic sustainability is much affected by other factors apart from GDP per capita.

5. Conclusion and policy implications

We investigated the effects of banking system stability on economic sustainability of developing economies. We investigated this on three levels. First, we examined the effects of banking system stability on GDP per capita (as a traditional proxy of economic sustainability). Second, we examined the effects of banking system stability on Adjusted Net Savings rate (as modern and comprehensive indicator of economic sustainability) and finally, we examined the effects of GDP per capita on Adjusted Net Savings rate. For each level of analysis, we compared BRICS and non-BRICS countries; and Asian and non-Asian countries to find out if the effects are the same for these subgroups. We measured banking system stability using six indicators: non-performing loans as percent of all bank loans (NPL), banking system z-scores (BSZ), banking system capital percent of assets (BSC), bank credit as percent of bank deposits (BCD), bank liquid assets to deposits and short-term funding (BLA), and banking system regulatory capital to risk-weighted assets (BSR). We analyzed data from 37 developing economies using panel data models specifically fixed effects and random effects models.

We found out that banking system z-scores has positive effect on ANS of developing economies while banking system regulatory capital and bank credit have negative effects on ANS. Furthermore, we revealed that while banking system z-scores, bank liquid assets and bank credit have positive effects on ANS of BRICS economies, bank liquid assets and bank credit have negative effects on ANS of non-BRICS economies except banking system z-scores, which has a positive effect. In addition, banking system z-scores has positive effect on ANS of Asian and non-Asian economies. However, non-performing loans and bank credit has negative effects on ANS of Asian economies while banking system regulatory capital has negative effect on ANS of non-Asian economies.

This study also revealed that non-performing loans reduces GDP per capita of developing economies while bank credit increases to GDP per capita. Comparatively, banking system regulatory capital increases GDP per capita of BRICS economies but reduces GDP per capita of non-BRICS economies. In addition, bank credit contributes positively to GDP per capita of both BRICS non-BRICS economies but the impact is stronger among BRICS economies. Banking system regulatory capital and bank credit have positive effects on GDP per capita of Asian economies while banking system regulatory capital and bank liquid assets have negative influence GDP per capita of non-Asian economies.

Finally, this study revealed that GDP per capita has positive effect on ANS of the selected developing economies. Compared with BRICS and non-BRICS economies, we revealed that GDP per capita has positive effect on ANS for both economies but the effect is stronger for BRICS economies. Similarly, GDP per capita has positive effect on ANS for both Asian and non-Asian economies but the marginal effect is stronger in non-Asian economies.

The findings of this study has policy implications. First, the findings show that banking system stability is a critical component of economic sustainability among developing countries. It is important for policy makers in developing countries to collaborate with banking regulators to revise the existing banking system stability models to positively align with their economic sustainability. Thus, the new models should place the banking system at the heart of every aspect of their economy. Stabilization policies and initiatives in the banking should be encouraged to achieve a stable banking system that can fund many economically sustainable projects. The findings of this study also encourages other emerging markets and groups to emulate the BRICS by developing strong banking system that will back their group level and international co-operations. These emerging economies should aim at establishing common banking institutions to back their group level activities as well as supporting the economies of individual countries within the groups. The findings also suggest that even though Asian economies in general have taken step to improve their financial sector, this improvement is not directly linked to economic sustainability of developing economies in Asia.

Therefore, developing economies in Asia especially the least developed economies should not shy away from using varied country level bank stabilization policies (aside the regional policies) suitable for their individual economy.

Even though this study provide insights into the role of banking system stability in economy wide, it does not fully capture all aspect of sustainable economy. Therefore, further research needs to examine the effects of banking system stability on other areas of sustainability such as environmental sustainability.

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Conflict of interest

All authors declare no conflicts of interest in this paper.

References

Al-Moulani A, Constantinos A (2017) Banking sector depth and economic growth nexus: a comparative study between the natural resource-based and the rest of the world's economies, International. *Rev Appl Econ* 31: 625–650. DOI:10.1080/02692171.2017.1299115

Alexander K (2014) Stability and Sustainability in Banking Reform: are environmental risks missing in Basel III. *CISL & UNEPFI: Cambridge and Geneva*.

Aluko OA, Ajayi MA (2018) Determinants of banking sector development: Evidence from Sub-Saharan African countries. *Borsa Istanbul Rev* 18: 122–139.

Arcand JL, Berkes E, Panizza U (2012) Too much finance? IMF Working Paper, No. 12/161, Washington DC: IMF.

Azeez BA, Oke MO (2012) A Time Series Analysis on the Effect of Banking Reforms on Nigeria's Economic Growth. *Int J Econ Res* 3: 26–37.

Baltagi BH (2005) *Econometric Analysis of Data Panel*, *England: John Wiley & Sons Ltd*.

Bolt K, Matete M, Clemens M (2002) Manual for calculating adjusted net savings. *Environ Department World Bank*, 1–23.

Bryman A, Bell E (2015) *Business research methods*, Oxford University Press, USA.

Demetriades PO, Rousseau PL (2016) The changing face of financial development. *Econ Lett* 141: 87–90.

Charfeddine L, Ben Khediri K (2016) Financial development and environmental quality in UAE: Cointegration with structural breaks. *Renew Sust Energy Rev* 55: 1322–1335.

Demirgüç-Kunt A, Detragiache E (1999) *The determinants of banking crises: evidence from industrial and developing countries*, The World Bank.

Demirgüç-Kunt A, Detragiache E (2005) *Cross-country empirical studies of systemic bank distress: a survey*, The World Bank.

Ferreira S, Vincent JR (2005) Genuine savings: leading indicator of sustainable development?. *Econ Dev Cult Change* 53: 737–754.

Ferreira S, Hamilton K, Vincent JR (2008) Comprehensive wealth and future consumption: accounting for population growth. *World Bank Econ Rev* 22: 233–248.

Genberg H (2017) Global shocks and risk to financial stability in Asia (No. 709). ADBI Working Paper Series.

Hamilton K (2006) *Where is the wealth of nations?: measuring capital for the 21st century*, World Bank Publications.

Hanley N, Dupuy L, McLaughlin E (2015) Genuine savings and sustainability. *J Econ Surv* 29: 779–806.

Jacobs LM, Van Rossem R (2014) The BRIC Phantom: A comparative analysis of the BRICs as a category of rising powers. *J Policy Model* 36: S47–S66.

Jayakumar M, Pradhan RP, Dash S, et al. (2018) Banking competition, banking stability, and economic growth: Are feedback effects at work? *J Econ Bus* 96: 15–41.

Jiang B (2014) Financial stability of banking system in China, Doctoral dissertation, Nottingham Trent University.

Jokipii T, Monnin P (2013) The impact of banking sector stability on the real economy. *J Int Money Financ* 32: 1–16.

Jung JY (2008) Regional financial cooperation in Asia: challenges and path to development. *Press & Commun CH 4002 Basel Switzerland*, 120.

Kaminsky GL, Reinhart CM (1999) The twin crises: the causes of banking and balance-of-payments problems. *Am Econ Rev* 89: 473–500.

Kregel J (2009) The global crisis and the implications for developing countries and the BRICs: Is the "B" really justified? *Braz J Polit Econ* 29: 341–356.

Moundigbaye M, Rea WS, Reed WR (2017) Which panel data estimator should I use?: A corrigendum and extension. Economics Discussion Papers, No 2017–58. *Kiel Inst World Econ* 2.

Mhadhbi K (2014) Financial development and economic growth: A dynamic panel data analysis. *Int J Econ Financ Manage* 2: 48–58.

Murphy P, Waygood S, Wilson G (2017) Ideas for Action for a Long-Term and Sustainable Financial System. *Bus Sustainable Dev Comm*.

Narayan PK, Narayan S (2013) The short-run relationship between the financial system and economic growth: New evidence from regional panels. *Int Rev Financ Anal* 29: 70–78.

Pardi F, Salleh AM, Nawi AS (2015) Determinants of Sustainable Development in Malaysia: A VECM Approach of Short-Run and Long-Run Relationships. *Am J Econ* 5: 269–277.

Pazarbasioglu C, Johnsen G, Hilbers MPLC, et al. (2005) *Assessing and managing rapid credit growth and the role of supervisory and prudential policies* (No. 5–151), International Monetary Fund.

Pearce DW, Atkinson GD (1993) Capital theory and the measurement of sustainable development: an indicator of "weak" sustainability. *Ecol Econ* 8: 103.

Pillarisetti JR (2005) The World Bank's 'genuine savings' measure and sustainability. *Ecol Econ* 55: 599–609.

Pradhan RP, Arvin MB, Nair M, et al. (2019) Inter-linkages between competition and stabilisation policies in the banking sector and stock market development in Europe. *Appl Econ* 51: 4313–4324.

Rahman MM, Ashraf BN, Zheng C, et al. (2017) Impact of Cost Efficiency on Bank Capital and the Cost of Financial Intermediation: Evidence from BRICS Countries. *Int J Financ Stud* 5: 32.

Schmidt-Traub G, Shah A (2015) Investment needs to achieve the Sustainable Development Goals. *Paris New York Sustainable Dev Solutions Network.*

Sen S (2016) The BRICS Initiatives Towards a New Financial Architecture: An Assessment with Some Proposals (No. 205). RIS Discussion Paper.

Solow RM (1956) A Contribution to the Theory of Economic Growth. *Q J Econ* 70: 65–94.

Stewart R, Chowdhury M (2019) Does Bank Stability Promote Economic Resilience?: Evidence From Panel Data. *Evidence From Panel Data*.

TheGlobalEconomy.com (2019) *Business and economic data for 200 countries.* Available from https://www.theglobaleconomy.com/indicators_list.php.

Tongurai J, Vithessonthi C (2018) The impact of the banking sector on economic structure and growth. *Int Rev Financ Anal* 56: 193–207.

Tripathy R (2019) Doe measure of financial development matter for economic growth in India? *Quant Financ Econ* 3: 508–525.

World Bank (2012) *Contribution to Beyond GDP, "Virtual Indicator Expo"*, Washington DC: World Bank.

World Bank (2019) Economic research data. Retrieved from FRED, Federal Reserve Bank of St. Louis. [dataset for banking system stability] Available from: https://fred.stlouisfed.org/series.

World Bank Group (2019) *World Development Indicators 2019*, Washington DC: World Bank. [dataset for economic sustainability and other determinants].

Wyman O (2015) *Post–Crisis Changes in the Stability of the US Banking System Evidence from US Bank Holding Companies from 2004 to 2014,* NY 10036: New York.

Yaffee R (2003) A primer for panel data analysis. *Connect: Information Technology at NYU*, 1–11.

Younsi M, Bechtini M (2018) Economic Growth, Financial Development and Income Inequality in BRICS Countries: Evidence from Panel Granger Causality Tests. Available from: https://mpra.ub.uni–muenchen.de/85182/.