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2019
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The Impact of Financial Institution and Market Development on Economic Growth in BRICS

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0504473K

A research article submitted to the Faculty of Commerce, Law and Management, University of the Witwatersrand, in partial fulfilment of the requirements for the degree of Master of Business Administration

Johannesburg, 2019

Protocol number: WBS/BA0504473k/375

DECLARATION

I, Joseph Mundu Mwakio, declare that this research article is my own work except as indicated in the references and acknowledgements. It is submitted in partial fulfilment of the requirements for the degree of Master of Business Administration in the Graduate School of Business Administration, University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination in this or any other university.



Joseph Mundu Mwakio

Signed at ….Armstrong Building, McGill University, Canada.…

On the ….21th…. day of ….March…. 2019….

DEDICATION

I dedicate this research article to my family. Special gratitude goes specifically to my mother, Voulstan M. Mwakio who has been a part of this journey from its inception and without whose encouragement I would not have taken the first step in a journey of a thousand miles. To my sisters Perice, Mary, Rodah and Joy thank you for always availing your ears, hearts and minds to me. Words cannot eloquently express how much you all mean to me. To my father Ayub M. Mundu, you deservedly receive the utmost thanks for supporting me in more ways than I could ever enumerate.

ACKNOWLEDGEMENTS

To my supervisor, Kgabo Molabe, thank you for your excellent supervisory qualities and for the commitment you displayed towards the research. Your unfailing belief and mentorship allowed me to perform research that is outside the realm of my expertise.

To Wycliffe Ouma, thank you for the assistance you afforded me in critiquing my preliminary models and your instruction in the interpretation of the results.

To Sayed Hossain, the tutorials you posted on your YouTube channel assisted me immensely in understanding econometric modelling using EViews.

SUPPLEMENTARY INFORMATION

Nominated journal:	African Review of Economics and Finance
Supervisor / Co-author:	Kgabo Molabe
Word count †:	14097
Supplementary files:	Excel Files: Panel economic and financial data
	EViews® 8 modelling files including OLS regression and causality model results

† Including abstract, references, etc.

ABSTRACT

This research investigated the causal relationship between financial development and economic growth in Brazil, Russia, India, China and South Africa (henceforth BRICS) from 1990 to 2015. Panel studies were conducted using Panel Vector Error Correction (VEC) Modelling and Granger causality tests. The research found that bank development exhibited bidirectional causality, which transitioned to reverse causality from 1995 to 2015. Bond and stock market development exhibited unidirectional Granger causality with economic growth. Private debt issued through bond markets was consistently shown to Granger cause economic growth, unlike private credit issued by banks. On the basis these research findings, it is recommended that BRICS member states control the level and growth of private credit. Failure to do so could give rise to speculation, asset bubbles, financial crises and recessions. More critically, BRICS should promote the development of financial markets, especially bond markets, which would promote private debt as a productive alternative to the private credit issued by banks.

Keywords: financial development, economic growth, BRICS, panel VECM, Granger causality

1. INTRODUCTION

What is the nature of the causal link between the development of banks, bond markets and stock markets (henceforth financial development or finance) and economic growth?

Notable proponents of finance such as Adam Smith, Walter Bagehot, and Joseph Schumpeter have argued that financial development leads to economic growth. They contend that finance does this by facilitating the easy exchange of goods and services (Smith, 1776) and by banks mobilising savings and efficiently allocating capital to entrepreneurs and innovators (Bagehot 1873; Schumpeter 1934). These functions of finance have been shown to promote growth in obvious ways (Miller, 1998). These early proponents of finance are also supported by numerous empirical studies, which have demonstrated that financial development has a causal effect on economic growth (Levine, 2005).

However, critics of finance, such as Joan Robinson (1953), have contended that finance follows the lead of enterprises. Lucas (1988), similarly, was of the opinion that finance's role in the economy was badly overstressed. Meier and Seers (1984), for their part, excluded financial development from their seminal discussion of developmental economics. These critics are of the opinion that finance does not offer real services that can spur economic growth; in their view, it is rather economic growth that causes financial development to occur.

In either case, finance's role is not all beneficial. Whereas credit has the ability to promote growth (Juglar, 1862; 1863) (as cited in Besomi, 2010), excess credit in times of prosperity has the capacity to drive up overconfidence (Akerlof & Shiller, 2010; Johnson & Fowler, 2011) as well as reckless and speculative behaviours in financial institutions and markets (Knell, 2015; Leathers & Raines, 2004). Speculative investments bid up asset prices that can plunge the economy into recession when market corrections occur.

Juglar (1862; 1863) (as cited in Besomi, 2010) and Minsky (1992) subscribed to similar views on the negative effects that credit could have on economic growth. Minsky's (1992) financial instability hypothesis postulated that booms in credit and asset prices sowed the seeds for busts, which in turn negatively affected economic

growth (Borio, 2014; Minsky, 1992; Schularick & Taylor, 2012). Juglar (1862; 1863) also recognised that credit could precipitate financial and economic crises. Empirical studies have corroborated Juglar (1862; 1863) and have shown that excessive bank credit in an economy can adversely affect financial stability and economic growth (Arcand, Berkes, & Panizza, 2015; Law & Singh, 2014). For example, Chen and Kang (2018) found that credit growth rates of greater than 30% over five years had an 88% chance of causing a recession or financial crisis. Such issues are what led Minsky (1992) to advocate for the use of public policy, regulation and interventions to maximise finance's benefits for the economy and curtail its excesses (Knell, 2015).

According to Juglar (1862; 1863) (as cited in Besomi, 2010), however, financial and economic crises are necessary as they purge bad actors from the economy and allow only sound firms and banks to emerge from crises. Hence, boom and bust cycles enable economic adaptation, evolution and resilience. Unfortunately, the elimination of bad lenders and borrowers during economic downturns, as envisaged by Juglar, has not been altogether borne out in modern financialised economies. The aftermath of the Global Financial Crisis of 2008, for instance, has shown that some financial institutions are systemically important—colloquially referred to as "too big to fail" (Bernanke, 2010). By bailing out too big to fail institutions central banks have set the precedent of being a lender of last resort. This has had the effect of shielding banks, other financial institutions and firms from the economic Darwinism envisioned by Juglar.

Financial crises will continue to occur solely due to the central role that banks and financial markets play in national economies and the global economy. In the first half of 2018, there was talk of U.S. corporate credit bubbles, bond bubbles and stock bubbles. At the very least, these pending crises are expected to cause stagflation in the U.S. economy (Greenspan, 2018; Pearlstein, 2018). In China, concerns have emerged of a corporate credit bubble amid a slowdown in economic growth (Chen & Kang, 2018). It is unclear if financial contagions will develop from the aforementioned bubbles and how they will affect the global economy.

Cautious proponents of finance have emerged over the years. They acknowledge the positive and negative impacts that financial development can have on the

economy. They often propose regulation and policies to maximise finance's beneficial aspects and control destructive behaviours (Knell, 2015; Minsky, 1992).

The views of fervent proponents remain unaltered despite the evidence of financially induced recessions. According to Miller (1998), finance should not be blamed for market crashes as they are primarily caused by inept management of policy and occur equally in other sectors such as commodities.

The ambivalent role of finance in its capacity to induce economic growth but also crises and recession leads one to question whether modern financial development promotes or retards economic growth. In this paper, this line of enquiry is directed toward analysing the role of financial development in developing countries, specifically Brazil, Russia, India, China and South Africa (henceforth BRICS).

The research problem and research objectives are clarified in Section 1.1 and Section 1.2, respectively. Section 1.3 lists the three research questions, and Section 1.4 discusses the research contributions.

1.1 Problem Statement

Financial institutions and financial markets provide essential functions necessary for economic growth. These functions include the production of information, allocation of capital, monitoring of firms, exertion of corporate governance, amelioration of risks, pooling of savings and easing of exchange (Levine, 2005). These functions have a demonstrable impact on investment and the funding of entrepreneurs, firms and innovations, all of which spur economic growth. However, finance can also exhibit excesses, which can be detrimental to the economy (Zingales, 2015). For example, financial innovation, poor regulation, easy credit and speculation exacerbate risks posed to the economy by financial instability, crises, crashes and recessions (Borio, 2014; Minsky, 1992; Vogel; 2009).

Finance's ability to provide services necessary for growth while at the same time being prone to excesses that can be detrimental to growth lead us to question whether the development of domestic financial institutions and financial markets benefits the economy. Universally speaking, the question may never receive an adequate answer, for banks and financial markets develop and evolve over time in

unique ways in different countries based on endogenous factors (i.e. initial endowments, political history, legal origin, institutional quality, and tax systems) (Levine, 2005). Indeed, the econometric and statistical challenges necessary to pool all 195 unique countries in the world into one analysis are such that any answer would be disputed and debated. For this reason, the present research eschews such an approach and rather addresses the question in a more focussed way by investigating the emerging economies that constitute BRICS.

1.2 Research Objectives

The research has two objectives. First, it aims to determine the causal relationship between economic growth and the development of banks, bond markets and stock markets in BRICS. Second, it aims to compare private credit against private debt securities to determine correlation and causality with economic growth.

1.3 Research Questions

1. Is there a causal link between economic growth and the development of banks, bond markets and stock markets in BRICS?
    a. If so, does the nature of the causal relationship between financial development and economic growth change over time?
2. Does the causal link between economic growth and financial variables differ between countries that started the 1990s as either upper middle income or low income?
3. Do private debt securities affect economic growth more than private credit?

1.4 Research Contribution

The research contributes to the formulation and prioritisation of financial development policies by the BRICS governments, their finance ministers and the New Development Bank (NDB). Further, it raises awareness about the extent to which credit and debt expansions drive economic growth in BRICS countries. Governments could act on this information by, for example, curtailing the growth of lending when private credit is shown not to cause economic growth and when its levels risk exposing the economy to financially induced crises.

The research also contributes to the empirical literature on financial development and economic growth that has thus far overlooked the importance of developing domestic bond markets. As Herring and Chatusripitak (2007) point out, the need for deep and liquid domestic bond markets is critical to promoting stable monetary policy and attracting institutional investors while limiting borrowers' exposure to foreign exchange risk.

2. THEORETICAL AND EMPIRICAL LITERATURE REVIEW

The literature review that follows aims to elucidate how financial development can both spur and depress economic growth. Section 2.1 addresses the functions that banks and financial markets provide in the economy. Section 2.2 discusses the negative effects that finance can have on economic growth. Empirical studies of financial development and economic growth are presented in Section 2.3.

2.1 Finance's Function in Spurring Economic Growth

The sections that follow highlight how banks and financial markets affect economic growth by providing the five functions listed below (Levine, 2005).

(i) production of information and capital allocation,
(ii) monitoring of firms and exertion of corporate governance,
(iii) amelioration of risk,
(iv) pooling of savings, and
(v) easing of exchange.

2.1.1 Banks

Through deposits, banks can pool savings from disparate households and enterprises. This has two effects. First, it reduces the number of lending agents that entrepreneurs and households have to seek in order to raise funding. This improves a borrower's chances of finding cost-effective capital to fund their endeavours (Levine, 2005). Second, "efficient pooling can profoundly affect economic growth by increasing savings, exploiting economies of scale and overcoming investment indivisibilities" (Levine, 2005, pp. 879-880).

Bagehot (1873) credited England's industrialisation to banking's ability to mobilise and allocate capital. Banks effectively pool savings; Keynes (1936) (as cited in Werner, 2016) identified this as a necessary precondition to investment in productive enterprises and technological innovations which drive economic growth.

In addition to deposits and credit, modern banks provide additional services, including chequing accounts, demand deposits, payment services, fund transfers, forex transactions, investment services, payroll services, and advisory services.

These services facilitate the easy exchange of goods and services and expand the information that banks can generate from their customers (Boot, 2000).

Banks also collect and produce proprietary insider information by originating and pricing loans and by monitoring borrowers (Boot, 2000). This information facilitates investment evaluations and the efficient allocation of credit to endeavours that have the best chances of success. This can boost credit extensions to entrepreneurs to fund investments that drive economic growth (Levine, 2005).

By accepting short term liquid deposits and giving borrowers long term illiquid loans, banks engage in maturity transformation and qualitative asset transformation (Noeth & Sengupta, 2011). Banks thus ameliorate liquidity and credit risks and, in so doing, are capable of providing long term funding to entrepreneurs and innovations from liquid instruments (Levine, 2005). According to Bagehot (1873) and Schumpeter (1934), this is a necessary precondition for economic growth.

2.1.2 Financial Markets

2.1.2.1 Bond Markets

Bond markets facilitate the buying and selling of debt claims. The primary market for bonds allows disparate savers to invest in a firm's debt, thereby pooling funds from numerous economic agents to fund productive endeavours (Herring & Chatusripitak, 2007). Debt claims can be traded by impersonal agents in secondary markets, thus improving the liquidity risks of purchasing a firm's debt (Fabozzi, 2008; Herring & Chatusripitak, 2007).

Bond prices reflect the market consensus on a variety of risks, such as interest rate, prepayment, credit, liquidity and inflation or purchasing power risks (Fabozzi, 2008). The market pricing of corporate bonds generates information that determines capital allocation by investors to firms (Herring & Chatusripitak, 2007).

Banks tend to provide firms with short-term credit, which can bias capital allocation towards short-term assets with minimal investment in long-term illiquid assets such as infrastructure and utilities (Herring & Chatusripitak, 2007). The bond market allows firms to match the duration of their debts to returns from their productive

assets. This allows for the financing of long-term illiquid assets with long-term debt instruments (Hawkins, 2002). Furthermore, the bond market allows insurance companies and pension funds to purchase long-term assets that match the maturity of their long-term liabilities (Hawkins, 2002). In this way, the bond market can ameliorate intertemporal risks (Herring & Chatusripitak, 2007).

The bond market provides the economy with a market determined term structure of interest rates, which reflect the opportunity cost of funds at each maturity (Hawkins, 2002; Herring & Chatusripitak, 2007). The development of efficient derivatives markets requires the term structure of interest rates to provide investors with the means of ameliorating financial risks. Without a well-functioning bond market, risk management would be hampered, as it might not be possible to structure forwards, swaps and options contracts at competitive prices (Herring & Chatusripitak, 2007).

The government bond market establishes a risk-free rate at critical maturities, which is a precondition for the development of the corporate bond market and information production for investors (Fabozzi, 2008; Herring & Chatusripitak, 2007). For example, the risk-free term structure of interest rates informs the pricing of credit risk and can be used to competitively price bank credit. The difference in yield between a risky and risk-free bond of similar characteristics reflects credit risk and liquidity risk premiums demanded by investors and informs capital allocation decisions (Herring & Chatusripitak, 2007).

Domestic bond markets provide firms and the government with the ability to issue local currency debt. The currency matching of revenues with debt obligations insulates the economy, governments and firms from exposure to foreign currency risks (Burger & Warnock, 2006; Hawkins, 2002). By disintermediating bank credit, bond markets insulate the economy from suffering recessions and downturns when banking crises and their associated liquidity crises occur (Burger & Warnock, 2006; Herring & Chatusripitak, 2007).

However, banks can degenerate into rent seeking activities (Zingales, 2015). Therefore, bond markets provide entrepreneurs with alternative sources of debt financing which encourage entrepreneurial activity. Weakly capitalised banks are restricted in their ability to write off loans as they could violate capital adequacy

standards. Rather than write off non-performing loans, weakly capitalised banks may allow firms to continue with negative present value projects to the detriment of both firm value and economic growth. Yet bondholders would have no interest in sustaining any uneconomic activity; firm monitoring and corporate governance exertion are thus preferable with bondholders (Herring & Chatusripitak, 2007).

2.1.2.2 Stock Markets

Stock markets facilitate the buying and selling of equity claims. Equity claims can be traded by impersonal savers in secondary markets, while firms and entrepreneurs permanently access the capital raised in primary markets. The capital raised can be used to fund long-term illiquid projects and innovations (Fabozzi, 2008; Herring & Chatusripitak, 2007).

The primary market allows entrepreneurs and firms to raise capital through equity issues and offers entrepreneurs an avenue to exit their investments through initial public offerings (Rousseau and Wachtel, 2000 as cited in Levine, 2005). Equity claims issued by firms offer buyers theoretically unlimited dividend yields and capital gains, which compensate investors for bearing the investments' idiosyncratic risk (Herring & Chatusripitak, 2007).

Capital allocation to firms in primary markets depends on the risk-return appetites of investors. This takes place through the price discovery process (Fabozzi, 2008). In an efficient market, prices reflect the aggregate public information collected by all market participants. This allows investors to accurately judge the merits of investing in each firm's stock, which thereby steers capital allocation.

In purchasing equity claims, shareholders usually receive a proportionate vote in corporate governance matters (Herring & Chatusripitak, 2007). These votes can be exercised to exert influence over corporate managers to minimise agency costs. For instance, many publicly listed companies have linked managerial compensation and bonuses to the firm's share price, although this practice is subject to numerous debates. The effect of this has been to align the interests of shareholders and managers around increasing the worth of the firm and reducing agency costs (Rousseau and Wachtel, 2000 as cited in Levine, 2005). Easily discoverable market

prices and sentiments allow savers to monitor and exert corporate governance through the market system (Levine, 2005).

The range of shares available to investors allows for cross-sectional diversification (Fabozzi, 2008). A fully diversified investor would be exposed only to the systematic risk and not the idiosyncratic risk of an investment (Fabozzi, 2008). Cross-sectional risk diversification allows for the allocation of capital to a diversified portfolio of “safe” and “risky” projects and technological innovations. With this market function, both safe and risky investments may obtain funding, generate economic activity and drive growth (Levine, 2005).

Secondary markets offer easy exchange of equity claims for money by impersonal savers. This provides savers with access to liquid assets while their funds are used to fund long-term illiquid assets (Rousseau and Wachtel, 2000) (as cited in Levine, 2005). Without this amelioration of liquidity risk, the economy would be biased to short-term liquid investments and would stifle the financing of long-term illiquid projects (Levine, 2005). An efficient secondary market reduces explicit and implicit search costs; buyers and sellers can efficiently exchange claims at low costs thereby increasing the liquidity of financial instruments (Fabozzi, 2008).

The stock market also provides numerous other products, some of which are used for hedging and speculating. Futures, options, swaps and other derivatives allow for the amelioration of intertemporal risks through hedging (Fabozzi, 2008). Sale prices are agreed upon upfront for a future date; this allows for investments in the economy today even in the midst of an uncertain future (Levine, 2005).

2.1.3 Banks or Financial Markets: Is one better than the other?

As countries become richer, their financial systems tend to adopt a market-based structure with higher stock market participation and efficiency relative to banks (Demirgüç-Kunt, Feyen, & Levine, 2012; Gambacorta, Yang, & Tsatsaronis, 2014). Tadesse (2002) contended that even though market-based systems outperform bank-based systems in financially developed countries, banks are still much better performers in countries with underdeveloped financial markets. Beck and Levine (2004) found that both bank and stock market development independently contributed to growth in significant ways. Chakraborty and Ray (2006), however,

showed that there was no evidence of either bank-based or market-based financial structures being singularly better suited to drive economic growth.

It is conceivable that banks and financial markets could offer complimentary services, rather than compete. This would effectively make institutional decomposition of secondary importance to understanding the relationship between financial development and economic growth (Levine, 2005). Rather than deny the importance of financial structure, studies show that the optimal financial structure that maximises economic growth varies from country to country and over time (Demirgüç-Kunt et al., 2012; Lee, 2012; Levine, 2005).

2.2 Finance's Role in Financial Instability and Economic Recessions

Section 2.1 discussed the positive effects that finance has on economic growth. However, these effects are counteracted by finance's ability to increase financial instability and induce economic recessions. The first avenue through which finance can have deleterious effects on economic growth is credit. This is discussed in section 2.2.1. Section 2.2.2 describes the second deleterious aspect of finance, which is the role that asset price bubbles and busts play in inducing economic recession.

2.2.1 Credit Booms & Financial Instability

Juglar (1862; 1863; 1889) (as cited in Besomi, 2010; Legrand & Hagemann, 2007) was the first to propose that credit permitted people to speculate beyond their means and was the cause of the alternating cyclical periods of prosperity, crisis and recession. Similar to Juglar's theory of credit and business cycles is Minsky's (1992) financial instability hypothesis. This hypothesis demonstrated that transitions from hedged credit to speculative and Ponzi credit can induce financial instability and precipitate boom and bust cycles to the detriment of the economy (Knell, 2015).

Juglar (1862) (as cited in Besomi, 2010; Legrand & Hagemann, 2007) and Minsky (1992) identified three business cycle phases, namely prosperity, crisis and liquidation. In their view, each phase is the product of the preceding one and causes the next phase. Sections 2.2.1.1 to 2.2.1.3 briefly describe the interactions between the credit cycle and business cycle and their impacts in each phase.

2.2.1.1 Prosperity Phase

In a prosperity phase, the economy is stable, and credit is predominantly allocated to assets that can repay obligations through cash flows or liquidation. As the economy continues to prosper, economic agents begin to believe that the future will be as or more prosperous, which naturally leads to overconfidence and speculation (Besomi, 2010; Johnson & Fowler, 2011). Credit and overconfidence lead investors to speculate in projects with marginal to zero chances of success. Thus the economy transitions from one of hedged credit to speculative credit or worse, Ponzi credit (Minsky, 1992).

As profit seeking enterprises, banks must continually innovate their loan and deposit products to maximise profits. Therefore, much like economic prosperity, unfettered financial innovation in banks and other financial institutions can shift the economy from one of hedged credit to speculative credit and Ponzi credit (Minsky, 1992).

The shift to riskier unsecured loans introduces financial instability in two ways. First, credit is used with diminishing efficiency increasing default and bank failure risks (Minsky, 1992). Second, as speculation increases, agents' investment decisions are increasingly based on hopeful outcomes, not by the nominal expected value of capital and not by outcome or wealth. This serves to bid up asset prices creating credit and asset bubbles. Asset bubbles are discussed in further detail in Section 2.2.2.

2.2.1.2 Crisis & Liquidation Phases

The crisis phase can be precipitated in one of two ways. The first is when speculative investors realise that there are no new buyers in the market who are willing to buy their investments. As a result, asset prices reach their peak, and the speculative asset bubble bursts forcing investors to confront the worthlessness of their investments (Besomi, 2010).

Rising rates is the second way that a crisis can be precipitated. This occurs whether it is the central bank that raises interest rates to curb rising inflation or the commercial banks that raise lending rates to cover high default risks and tighten

lending (Minsky, 1992). Rising rates cause the level cheap credit to shrink or even disappear, making the repayment of loans more costly.

Regardless of how a crisis is precipitated, speculative borrowers are forced to reckon with the fact that they cannot repay their obligations. Speculative and Ponzi credit become worthless thereby exposing banks to losses and even collapse. In this climate, borrowers deleverage their balance sheets, which can lead to the mass liquidation of assets, a crash in asset prices, the disappearance of confidence and economic recession (Legrand & Hagemann, 2007).

2.2.1.3 Recovery Phase

Crisis and liquidation phases do not last forever. A combination of low asset prices and expansionary monetary and fiscal policies will spur the economy to recovery (Legrand & Hagemann, 2007). Although Juglar (1862) (as cited in Besomi, 2010; Legrand & Hagemann, 2007) and Minsky (1992) did not discuss the economic recovery phase or its necessary preconditions, the recovery phase is necessary to complete a full business and credit cycle. In the recovery phase, the economy grows, investors return to prudence, banks return to issuing hedged credit and asset prices recover. Eventually, the economy returns to prosperity and a regime of financial stability, and the cycle repeats again (Knell, 2015; Minsky, 1992).

2.2.2 Asset Bubbles & Busts

Bubbles refer to the large and sustained mispricing of either financial or real assets (Brunnermeier & Oehmke, 2013). This is typically followed by a sudden, sharp asset devaluation and deleveraging (Chappe, Nell, & Semmler, 2015). Asset mispricing is either due to explosive asset valuations (Brunnermeier & Oehmke, 2013) or to when asset prices far exceed their fundamental value (Vogel, 2010). This mispricing can lead to capital misallocation towards speculative investments (Brunnermeier, 2016).

During a bubble, speculators anticipate profiting from selling assets at higher prices in the future rather than from the assets' future earning capacities or their true value (Brunnermeier, 2016; Vogel, 2010). The mere presence of speculators is not sufficient to cause an asset bubble; however, bubbles cannot form without the participation of speculators (Vogel, 2010).

Economic analysis has largely focussed on rational and quantifiable facts (Akerlof & Shiller, 2010). However, economic agents are often known to make irrational economic decisions based on intuition, emotions, positive psychology, crowd psychology, overconfidence and animal spirits (Chappe et al., 2015). Such irrational economic decisions are a necessary precondition for the formation and growth of asset bubbles (Vogel, 2010). Psychologists Furnham and Argyle (1998) (as cited in Vogel, 2009) showed that money can confer a sense of empowerment and worthiness; such feelings are also principal components of bubbles (Chappe et al., 2015). Likewise, credit has been shown to be capable of stimulating enthusiasm, prompting people to speculate beyond their financial means (Besomi, 2010).

Bubbles cannot grow indefinitely, however; at some point, crises of confidence destabilize asset prices, leading to a crash. Crashes often happen faster than the rate at which investors can liquidate their portfolios. Furthermore, assets in a crash exhibit high levels of correlations thereby eliminating cross-sectional risk diversification (Vogel, 2010). Crashes lead to panic, whereupon the two mutually reinforce each other; the collapse of financial institutions can dramatically exacerbate panics and crashes (Vogel, 2010).

Crashes inflict major losses on investors leading to balance sheet impairment for households, banks and enterprises (Brunnermeier & Oehmke, 2013). Apart from inflicting losses on investors, crashes can have direct and indirect spillovers into the real economy (Brunnermeier & Oehmke, 2013); large amplifications are typically influenced by credit financed asset bubbles (Jordà, Schularick, & Taylor, 2015).

Jordà et al. (2015), the IMF (2003) and Siegel (2008) (as cited in Vogel, 2010) found that the most economically damaging bubbles in history were fuelled by credit booms. With credit, asset price bubbles increase the risk of financial crisis. When asset prices collapse, hedged credit becomes worthless, and the economy is plunged into deep recessions accompanied by slow recoveries. The Global Financial Crisis and the Great Depression exemplify the deleterious role of credit in asset price bubbles; the Global Financial Crisis heralded the rise of the more dangerous house prices bubbles that are credit financed (Jordà et al., 2015). By contrast, in the 2001 Dot-com Crash, stock purchases were not financed by credit, hence the crash had

minimal negative effects on the U.S. economy despite inflicting severe losses on investors (Brunnermeier & Oehmke, 2013).

2.3 Empirical Literature

This section surveys the empirical studies that demonstrate the positive and negative theoretical concepts of financial development discussed in Section 2.2. Section 2.3.1 examines several seminal cross-country, panel and time series empirical studies that investigated the causal relationship between financial development and economic growth. Section 2.3.2 looks at empirical findings on how the dynamics of credit and asset prices actually affect the real economy.

2.3.1 Financial Development and Economic Growth

2.3.1.1 Cross-Country Studies

Atje and Jovanovic (1993), Demirgüç-Kunt and Levine (1996, 2001), Goldsmith (1969), Hicks (1969), King and Levine (1993a, 1993b), Levine (1997, 2002); Levine and Zervos (1998), McKinnon (1973) and Shaw (1973) (as cited in Levine, 2005) were early seminal contributors in the cross-country analysis of financial development and economic growth. These researchers observed significant association between both bank and stock market development and economic growth. Furthermore, they demonstrated that future growth rates were inexorably linked to initial levels of financial development. Despite their seminal contributions, the researchers failed to prove that financial development causes economic growth.

Cross-country studies have inherent statistical and econometric shortcomings. Accounting and controlling for all economic growth determinants often leads to omitted variable bias (Beck, 2009; Levine, 2005). It is also difficult to account for reverse causality where economic growth causes financial development. Furthermore, the analysis pools vastly diverse countries into one statistical analysis introducing concerns of parameter heterogeneity (Beck, 2009; Levine, 2005).

2.3.1.2 Panel Studies

Seminal panel studies by Beck and Levine (2004), Beck, Levine, and Loayza (2000), Christopoulos and Tsionas (2004) and Levine, Loayza, and Beck (2000) improved

on the econometric and statistical shortcomings of cross-country studies. Panel studies use both the time series and cross-sectional dimensions of the data.

Beck et al. (2000) and Levine et al. (2000) showed that financial development was positively and robustly linked to growth with unidirectional causality for a panel of 77 countries from 1960 to 1995. In a panel study of 109 countries from 1960 to 1994, Calderón and Liu (2003) found bidirectional causality between financial development and economic growth. Calderón and Liu (2003) also found that financial development's effect on growth increased with time.

Beck and Levine (2004) measured bank and stock market development with bank credit and the turnover ratio, respectively. They found that stock market development and bank development positively influenced economic growth in a panel of 40 countries from 1976 to 1998. Their study controlled for simultaneity and reverse causality as well as country specific and endogenous effects.

In examining 10 developing countries from 1970 to 2000, Christopoulos and Tsionas (2004) found compelling evidence of long-run unidirectional causality from financial development to economic growth. Furthermore, they found that financial development and economic growth are uniquely cointegrated, which bolstered their case for a long-run relationship. Their study found no evidence of the bidirectional causality observed by Calderón and Liu (2003). Of course, this could be due to differences in panel sizes, countries investigated and measures of financial development.

Rousseau and Wachtel (2011) found that in 84 countries studied from 1960 to 2004 the effect of financial development on economic growth diminished over time, thereby contradicting Calderón and Liu (2003). Rousseau and Wachtel (2011) noted that the effect was significant from 1960 to 1989 but insignificant from 1990 to 2004. They attributed the diminishing effect of financial development on economic growth to financial and banking crises. According to Rousseau and Wachtel (2011), financial liberalisation and stock market development did not induce this effect.

Hassan, Sanchez, and Yu (2011) advanced panel studies by focusing on income groups and introducing gross domestic savings as an alternative measure of financial development. They found domestic gross savings to be positively correlated

to growth, especially in high saving countries. Credit to the private sector was found to be positively correlated to growth in East Asia & Pacific and Latin America & Caribbean. However, an inverse correlation was observed in high income countries.

In Granger causality tests, Hassan et al. (2011) found bidirectional causality in Europe & Central Asia, Latin America and Caribbean, Middle East & North Africa, South Asia and High-income OECD. Countries in Sub-Saharan Africa and East Asia & Pacific panels were observed to exhibit reverse causality, i.e. that economic growth caused financial development. Hassan et al. (2011) found that savings correlated with growth. They attributed this to large pools of savings that could fund more investments and increase growth.

In a recent study of 52 middle income countries from 1980 to 2008, a non-monotonic inverted U-shaped relationship between financial development and growth was found by Samargandi, Fidrmuc, and Ghosh (2015). According to Samargandi et al. (2015), there is a threshold level of financial development above which too much finance can negatively influence economic growth. Their findings are corroborated by Arcand et al. (2015) and Law and Singh (2014).

In 2017, the global bond market was valued at U.S. $100 trillion. Despite this, studies that investigate bond market development and economic growth are scarce, a point noted by Herring and Chatusripitak (2007). A search of prior work on bond market development and economic growth yielded four non-seminal studies: Fink, Haiss, and Hristoforova (2003, 2006); Pradhan, Arvin, Bennett, Nair, and Hall (2016); and Thumrongvit, Kim, and Pyun (2013). The studies by Fink et al. (2003, 2006) are analysed in Section 2.3.1.3.

In studying a panel of 38 countries from 1989 to 2010, Thumrongvit et al. (2013) found a significant positive correlation between government bonds and economic growth. Thumrongvit et al. (2013) also observed bidirectional relationships between bank credit, bond markets and economic growth. Corporate bonds correlated negatively with growth from 1989 to 2003 and positively from 1989 to 2010.

Pradhan et al. (2016) utilised Granger causality tests to examine bond market development and economic growth in a panel of 35 high-income countries and middle-income countries from 1993 to 2011. They found that bond market

development Granger caused economic growth in the long run. However, bidirectional causality was observed in the short run.

Although panel studies improve on cross-country studies, they still do not correct for differences in financial development and growth within a country. Cross-country panel regressions of vastly different countries could lead to erroneous inferences on causality (Wachtel, 2011). Furthermore, the panel studies are typically defined for steady-state growth where the collected data are averaged over five or seven non-overlapping year periods. If the non-overlapping period does not adequately describe long-run relationships, panel models may imprecisely assess the link between finance and growth (Levine, 2005).

2.3.1.3 Time Series Studies

Considerable attention has shifted from panel studies to country specific time series studies (Levine, 2005). This relaxes the restrictive assumption that the link between financial development and growth is the same across all countries. Furthermore, time series studies introduce a lag structure to capture omitted variables without the need to include other variables or control for instrumental variables (Beck, 2009).

Christopoulos and Tsionas (2004) and Beck (2009) have cautioned that time series studies may be limited by the low econometric power of unit root tests. Time series techniques require high frequency yearly or quarterly data, which is only available for a few developed countries. In studying developing countries, some seminal researchers have conducted time series studies with at least 27 annual data points.

Seminal contributions in time series studies have been made by Arestis and Demetriades (1997), Arestis, Demetriades, and Luintel (2001), Demetriades and Hussein (1996) and Rousseau and Wachtel (1998) (as cited in Levine, 2005). Demetriades and Hussein (1996) (as cited in Levine, 2005) found a predominantly bidirectional relationship between bank development and economic growth in a sample of developing countries. Arestis et al. (2001) (as cited in Levine, 2005) investigated five developed economies and found vastly different causal patterns among them.

Fink et al. (2003) examined the relationship between the development of aggregate bond markets and real GDP in 13 developed countries from 1950 to 2000. The authors found that the U.S., Great Britain, Germany, Austria, Switzerland, the Netherlands and Spain exhibited unidirectional causality from bond market development to economic growth. Japan, Finland and Italy showed bidirectional causality. No country investigated showed reverse causality between bond market development and economic growth (Fink et al., 2003).

Fink et al. (2006) limited their investigation to seven developed countries from 1950 to 2001. The authors found that causality patterns were unique in each country due to heterogeneous market structures and differing degrees of openness and international integration of markets. All countries except Germany exhibited unidirectional causality from financial development to economic growth. Reverse causality was observed in Germany, Japan and the Netherlands (Fink et al., 2006).

In a recent study, Lee (2012) investigated six developed economies over varying time periods of 20 to 40 years. The author found that stock market development was more prominent in causing economic growth in the U.S., the U.K. and Japan. In contrast, bank development featured more prominently in Germany, France and Korea. Furthermore, Lee (2012) showed that for all countries bank development played an important role in early years of economic growth. Only in later years did some economies diverge to exhibit greater dominance of the stock market on economic growth. Financial development was observed to cause economic growth in all countries except Korea where reverse causality was observed (Lee, 2012).

Peia and Roszbach (2015) studied the times series properties of economic and financial development for 22 advanced economies over a period of 20 to 45 years. Peia and Roszbach (2015) found unidirectional causality between stock market development and economic growth in 11 countries, while in 16 countries reverse causality between bank development and economic growth was observed.

These time series studies empirically demonstrate that exploring the role of financial development on economic growth for a specific country, over time, may reveal causality patterns that cannot be inferred from pooled cross-sectional studies (Lee,

2012; Levine, 2005; Peia & Roszbach, 2015). The average view provided by cross-country or panel studies is useful but misses many important details.

None of the studies surveyed above investigated BRICS countries over the same time period. It was elected not to cite single BRICS country studies, as differing time periods can profoundly affect the direction of causality between financial development and economic growth.

2.3.2 Financial Cycles and Economic Growth

The dynamics of credit and asset prices are termed financial cycles and have cyclic features similar to those of the business/economic cycle (Claessens, Kose, & Terrones, 2012). Financial downturns (contractions) can be likened to business cycle recessions. Financial upturns (expansions) mirror business cycle recoveries. Both financial and business cycles are characterised by cyclical durations, amplitudes and the slope of the cyclical phase (Claessens et al., 2012).

Drehmann, Borio, and Tsatsaronis (2012) and Borio (2014) favoured house prices over equity prices in their definition of the financial cycle; however, Claessens et al. (2012) found that both these measures of asset prices should be considered.

Drehmann et al. (2012) determined that among developed economies the financial cycle has lower frequencies of approximately 16 years compared to the much shorter business cycle frequency of one to eight years. Claessens et al. (2012) observed that, apart from lower frequencies, financial cycles, have deeper troughs and sharper declines compared to business cycles. Furthermore, emerging markets exhibit these cyclical features more severely than advanced economies.

Borio (2014) and Drehmann et al. (2012) found an association between the peak of a financial cycle and a financial crisis; therefore, credit booms can act as indicators of a financial crisis. Jordà, Schularick, and Taylor (2013) defined credit booms as the level of credit and the year-on-year growth rate of credit. However, credit booms or financial cycle peaks do not necessarily lead to a financial crisis (Jordà et al., 2013; Schularick & Taylor, 2012).

In the absence of a crisis, normal business cycle recessions that coincide with a contracting financial cycle are longer and deeper. The drying up of credit and minimal investment spending tend to deepen the recession. These are especially worse in highly levered contractions. Recessions induced by financial crises are more severe compared to normal recessions. The severity is more pronounced when the recession is highly levered with a high rate of credit growth (Jordà et al., 2013). Claessens et al. (2012) found similar results with asset price busts; such recessions tend to be longer and deeper with weak recoveries.

Arcand et al. (2015) showed that the relationship between credit and growth is quadratic for private credit and household credit and monotonic for firm credit. In the quadratic relationship, certain threshold values of credit can exhibit a positive correlation, no correlation and a negative correlation with growth.

Statistically significant positive relationships between finance and growth were observed for private credit below 42% of GDP, household credit below 50% and firm credit below 80% of GDP (Arcand et al., 2015). Negative marginal effects on growth were noted when private credit exceeded 100% of GDP (Arcand et al., 2015). These findings were corroborated by Cecchetti and Kharroubi (2012) who reported a 90% threshold. Law and Singh (2014) reported thresholds for private sector credit, liquid liabilities and domestic credit at 94%, 97% and 100%, respectively.

Private credit is made up of household credit and enterprise credit. Credit extended to households is often perceived to be unproductive with banks exposed to default risk due to loss of income. On the other hand, enterprise credit is perceived to be efficient as credit is directed to productive projects which generate income (Büyükkarabacak & Valev, 2010).

Household credit booms were shown by Büyükkarabacak and Valev (2010) to heighten the risks of banking crises and were more commonly associated with such crises. Enterprise credit booms had weaker, less robust effects, presumably due to the income generating capacity of enterprise credit. Schularick and Taylor (2012) cautioned against disaggregating private credit. They observed that in the long-run crises were as likely to occur after investment booms as with any other activity.

In a study of equity and housing market bubbles in 17 countries over 140 years, Jordà et al. (2015) found that not all bubbles threaten financial stability or the real economy. They found that equity and housing bubbles that were fuelled by credit booms posed the greatest dangers to financial stability and the economy; when asset prices fall and deleveraging ensues, credit bubbles burst. The bursting of credit bubbles destabilises the financial sector and plunges the economy into deep recessions after which economic recovery is typically very slow. They also found the effect of credit to be more severe in housing bubble recessions than in equity bubble recessions. Housing bubbles were associated with deeper recessions and much slower recoveries. In comparison, equity bubbles inflict much less severe economic downturns even when fuelled by credit booms.

3. RESEARCH METHODOLOGY

3.1 Country Sample

The research focused on the five emerging economies that constitute BRICS, namely Brazil, Russia, India, China and South Africa.

3.2 Proxy Measures of Economic and Financial Variables

3.2.1 The Dependent Variable: Economic Growth

Economic growth henceforth GDP was measured as real GDP per capita in line with previous studies conducted by Hassan et al. (2011), Lee (2012), and Peia and Roszbach (2015). The rationale is that mistakes made when measuring GDP are the same as those in a census; hence, real GDP per capita is a more reliable measure.

3.2.2 The Explanatory Variables: Financial Development

The Global Financial Development Database presented by Čihák, Demirgüç-Kunt, Feyen, and Levine (2012) has four categories with a total of 109 empirical measures of financial development. The number and variety of proxy measures has led researchers to choose wildly different indicators to describe financial development resulting in vastly different causal relationships and conclusions.

In this research article, private credit by deposit money banks and other financial institutions divided by GDP, henceforth PC, was used as the single proxy measure for bank development. This measure is consistent with previous studies by Arcand et al. (2015), Beck et al. (2000), Büyükkarabacak and Valev (2010), Peia and Roszbach (2015), and Thumrongvit et al. (2013).

In order to measure bond market development, the research follows the example of Pradhan et al. (2016) who decomposed the bond market into its three constituents. The research deviated from Pradhan et al. (2016) by disregarding both international bonds and public debt securities. The research only uses outstanding domestic private debt securities relative to GDP, henceforth PD, as a size indicator for bond market development. Outstanding domestic private debt securities include bills, commercial paper, notes and bonds.

For the measurement of stock market development, three measures were used as exemplified by Beck and Levine (2004), Beck et al. (2000), Levine et al. (2000), and Peia and Roszbach (2015). The first measure was stock market capitalisation relative to GDP henceforth SMC. Secondly, stock market liquidity was measured by stock market total value traded divided by GDP, henceforth SMTVT. Lastly, the stock market turnover ratio, henceforth SMTR was used as a measure of stock market liquidity relative to the stock market capitalisation.

Following Beck and Levine (2004), Beck et al. (2000), and Levine et al. (2000) the research addresses the potential stock flow problem of financial variables in the following manner. The stock flow problem refers to the fact that financial balance sheet items are measured at the end of the year, whereas GDP as a stock variable is measured throughout the year. The end-of-year financial balance sheet items are deflated by the end-of-year consumer price-index (CPI) and the GDP by the annual CPI. Then the average of the real financial balance sheet items in year t and year t-1 is divided by the real GDP measured in year t.

3.3 Data Sources

The Federal Reserve Economic Database (FRED®) was used as the single data source for all the proxy measures for financial development and economic growth.

3.4 Ethical Consideration

Ethical clearances were not required due to the data's public and secondary nature.

3.5 Data Analysis

EViews® 8 was used in the analysis of the data and econometric modelling.

3.6 Data Constraints and Limitations

A quarter of a century was selected as the period of interest. Table 1 presents the economic and financial data for BRICS that was reported from 1990 to 2015. Sections 3.6.1 to 3.6.2 describe the data constraints and limitations that were identified and how the research dealt with the shortcomings in the data.

Table 1: Availability of Economic and Financial Data from FRED®

	Country				
Variable	Brazil	Russia	India	China	South Africa
GDP	1990 - 2015	1990 - 2015	1990 - 2015	1990 - 2015	1990 - 2015
PC	1990 - 2015	1993 - 2015	1990 - 2015	1990 - 2015	1990 - 2015
PD	1993 - 2014	Missing	1990 - 2011	1990 - 2015	1990 - 2015
SMC	1990 - 2015	1993 - 2015	1990 - 2015	1992 - 2015	1990 - 2015
SMTVT	1990 - 2015	1995 - 2015	1990 - 2015	1992 - 2015	1990 - 2015
SMTR	1990 - 2015	1994 - 2015	1990 - 2015	1992 - 2015	1990 - 2015

where:

GDP	real GDP per capita
PC	private credit as a % of GDP
PD	private debt securities as a % of GDP
SMC	stock market capitalisation as a % of GDP
SMTVT	stock market total value traded as a % of GDP
SMTR	stock market turnover ratio

3.6.1 Limited and missing data

Brazil, India and China were observed to have unreported data on some financial variables. The variables went unreported for a minimum of two to a maximum of four years. Due to the limited data set, the research could not afford to disregard years or variables with missing data. Hence, the EViews® Interpolate function was used to generate the missing data in the yellow highlighted financial variables; simple linear interpolation was used using at least four lead or lag data points.

Russia's data presented two challenges. Firstly, the financial variables were only consistently reported from either 1993, 1994 or 1995. The first reported data were either near zero or very high in value. In this case, the use of the EViews® Interpolate function could not be relied up because the interpolation required the use of reliable and realistic data. The research therefore elected not to interpolate Russia's missing data and instead restricted any analysis with Russia to a time period that ranged from 1995 to 2015. The data collected during this period was considered to be more reliable.

The second issue in Russia arises from missing PD data as highlighted in red in Table 1. This omission restricts the analysis of financial development in Russia to the bank and stock market development.

3.6.2 Low frequency data

The data collected from FRED® was limited to annual frequency. From Table 1, the overall minimum and maximum data points were 21 and 26, respectively. Time series techniques require high-frequency monthly or quarterly data. In studying developing countries some seminal researchers have conducted time series studies with at least 27 annual data points. However, Christopoulos and Tsionas (2004) and Beck (2009) warned that such time series studies may be limited by the low econometric power of unit root tests.

In an attempt to increase the number of data points frequency conversion methods such as EViews® Frequency Converter were considered to convert the data from annual to quarterly frequency. Unfortunately preliminary evaluation of such transformations yielded quarterly data with vastly different unit root characteristics to the annual data.

Bloomberg, Bank of International Settlements (BIS) and Datastream were investigated as possible alternative data sources of high frequency data. Unfortunately the data derived from these sources required conversions that yielded vastly different values for the same variable sourced from FRED® increasing the risk of data inconsistencies.

The research elected to proceed with annual data sourced from FRED® to avoid erroneous findings caused by conversion inconsistencies or by using artificially generated quarterly data in models that require real quarterly data.

3.7 Research Design

3.7.1 Panel Data

The low frequency and the few data points, which were highlighted by Christopoulos and Tsionas (2004) and Beck (2009), warn that the low econometric power of time series studies could lead to spurious analyses and results. On this basis, the

research disregarded the analysis of the BRICS country data with times series econometric models. Instead, the research elected to utilise panel studies to maximize the use of the time series and cross-sectional variation of the data. Furthermore, the panel study would eliminate omitted variable bias associated with unobserved country-specific time-invariant factors, which are prevalent in cross-country studies.

Levine (2005) observed that panel studies typically used “steady state data,” i.e. data averaged over five or seven non-overlapping year periods. The steady state data aims to remove business cycle effects. However, should the chosen steady-state time span be erroneous, panel models may imprecisely assess the link between finance and growth. The research deviates from Levine’s (2005) aforementioned observations by including the business and financial cycle effects into the panel models. This is achieved by using the economic and financial panel data as is in the econometric modelling. Table 2 presents the panels that were developed and investigated in this research.

Table 2: Panels Developed for Econometric Modelling

	Panel			
Variable	BRICS	BICS	BS	IC
GDP	1995 - 2015	1990 - 2015	1990 - 2015	1990 - 2015
PC	1995 - 2015	1990 - 2015	1990 - 2015	1990 - 2015
PD	Excluded	1990 - 2015	1990 - 2015	1990 - 2015
SMC	1995 - 2015	1990 - 2015	1990 - 2015	1990 - 2015
SMTVT	1995 - 2015	1990 - 2015	1990 - 2015	1990 - 2015
SMTR	1995 - 2015	1990 - 2015	1990 - 2015	1990 - 2015

3.7.2 Research Process

Firstly, the research determined the descriptive statistics, correlation and nature of stationarity of each variable in each panel. In anticipating data stationarity at first

difference the research evaluated the data using Panel Vector Error Correction Model (VECM) or Vector Auto Regression (VAR) models as described in Section 3.8

Secondly, using the BRICS and BICS panels, the research determined the nature of causality between economic growth (GDP) and the three stock market development variables (SMC, SMTVT and SMTR). The research went on to eliminate from further consideration the stock market development measures that were observed not to cause economic growth.

Finally, using the Panel VECM, the research performed regression analysis and causality tests between the financial variables and economic growth in each panel described in Table 2. The econometric modelling aimed to elucidate the following:

1. What causal links does financial development exhibit with economic growth in BRICS and BICS?
    a. Does the causal link between financial development and economic growth change over time?
2. In comparing the BS panel with the IC panel does the causal link between economic growth and financial variables differ between countries that started the 1990s as either upper middle income or low income?
3. Do private debt securities affect economic growth more than private credit?

3.8 Econometric Modelling

The research relied on the econometric techniques used in past empirical studies. Sections 3.8.1 to 3.8.4 briefly discuss the quantitative methods that were used in regression modelling and causality testing.

3.8.1 Stationarity/Unit Root

The variables used in this research as described in Section 3.2 were checked for non-stationarity using the Augmented Dickey-Fuller (ADF) unit root test (Brooks, 2014). According to Beck (2009), financial variables and GDP per capita are non-stationary at level in most countries; stationarity in these variables is typically

induced by using the first difference (Beck, 2009; Brooks, 2014). The first difference Augmented Dickey-Fuller (ADF) unit root test is given by Equation 1 (Brooks, 2014).

$$\Delta y_t = \psi y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + u_t \quad \text{where } \Delta y_{t-1} = y_t - y_{t-1} \tag{1}$$

Stationarity of the data at first difference eliminates the use of simple regressions and necessitates econometric modelling using either VECM or VAR depending on whether the variables are cointegrated or not.

The EViews® Panel Unit Root Test was used to determine data stationarity. The test type used was consistently set to Summary with lag length selected automatically by the Schwarz Info Criterion. A variety of test equations were used to determine the specific form of the unit root.

3.8.2 Cointegration Test

A cointegration test was used to determine whether the relationship between variables over time displays equilibrium stability (Beck, 2009). Consistent with Arestis et al. (2001) (as cited in Levine, 2005), Christopoulos and Tsionas (2004) and Peia and Roszbach (2015) this research used the Johansen Technique. The VECM form of the Johansen Technique is depicted by Equation 2 (Brooks, 2014).

$$\Delta y = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + \Gamma_2 \Delta y_{t-2} + \cdots + \Gamma_{k-1} \Delta y_{t-(k-1)} + u_t \quad \text{where } \Pi = \left(\sum_{i=1}^{k} \beta_i\right) - I_g \text{ and } \Gamma_i = \left(\sum_{j=1}^{i} \beta_j\right) - I_g \tag{2}$$

The research used the EViews® Fisher Combined Johansen Panel Cointegration Test with a deterministic linear trend in data with intercept in Cointegrated Equations (CE) and VAR without a trend in the data. All variables of interest as shown in Equation 3 and Equation 4 were analysed for cointegration at one go.

In order to determine preliminary cointegration, the default 1 2 lag interval was specified for different endogenous variables in all tests. The level of cointegration was rechecked once the optimal lag structure was determined in the regression

model. Panel VECM regression was conducted if cointegration was observed in variables that were stationary at first difference.

3.8.3 Regression Models

This research aimed to use the regression of panel data to characterise the relationship between economic growth and financial development. Regression analysis for each panel was undertaken using the cross-country regression proposed by Beck et al. (2000). However, the research deviated from Beck et al. (2000) by excluding control and dummy variables as the aim was to only study economic growth in relation to financial development. The research also included the variations of the business cycles, financial cycles and other endogenous factors.

Equation 3 and Equation 4 represent the level regression models that were used in the panel analysis. Equation 3 was used to analyse the regression and causality of stock market variables on economic growth in the only the BRICS and BICS panels. Any of the stock market variables in Equation 3 that were observed not to cause economic growth were eliminated from further consideration in Equation 4.

Equation 4 represents the regression and causality model used to test for the influence of each financial variable on economic growth. Equation 4 is used as an exemplar with SMC identified as having causal relationship to growth from Equation 3. The BS and IC panels were analysed only with Equation 4.

Depending on the stationarity of the data Equation 3 and Equation 4 were modified in EViews® to suit either VECM or VAR; both of which are first difference stationary models. In the event that the variables were not cointegrated, the VAR regressions were used otherwise VECM modelling was performed. The time series component of the data required the use of lagged variables. The optimal lag structure was selected in each regression to be one that had the lowest Akaike Information Criterion, henceforth, AIC for the regression system. Ordinary Least Squares regression was performed to determine the regression constants and their significance. Wald tests were performed on the regression constants to ascertain the validity of the regressions and their associated constants.

The soundness of the regression model was checked using residuals serial autocorrelation and heteroscedasticity. The results of these checks were merely reported as correcting for residual autocorrelation and heteroscedasticity was beyond the scope of the research.

$$GDP = \beta_0 + \beta_1 SMC + \beta_2 SMTVT + \beta_3 SMTR + u_0 \quad (3)$$

$$GDP = \beta_4 + \beta_5 PC + \beta_6 PD + \beta_7 SMC + u_1 \quad (4)$$

Where:

$\beta_0, \beta_1, \beta_2 \ldots \beta_7$	are regression constants
GDP	real GDP per capita
PC	private credit by deposit money banks and other financial institutions divided by GDP
PD	outstanding domestic private debt securities relative to GDP
SMC	stock market capitalisation relative to GDP
$SMTVT$	stock market total value traded divided by GDP
$SMTR$	stock market liquidity relative to stock market capitalisation
u_0, u_1	are error terms

3.8.4 Granger causality

The Granger causality test was used to check for unidirectional, bidirectional and non-causal patterns. Granger causality testing for cointegrated variables requires the use of an Error Correction Model (ECM). Equation 5 and Equation 6 depict Granger causality testing in a two variable scenario (Türsoy, 2017).

$$\Delta y_t = \phi + \lambda_1 e_{t-1} + \sum_{i=1}^{p} \gamma_{1i} \Delta y_{t-i} + \sum_{j=1}^{q} \omega_{1j} \Delta x_{t-j} + u_{1t} \quad (5)$$

$$\Delta x_t = \phi + \lambda_2 e_{t-1} + \sum_{j=1}^{q} \omega_{2j} \Delta x_{t-j} + \sum_{i=1}^{p} \gamma_{2i} \Delta x_{t-i} + u_{2t} \quad (6)$$

Where $e_{t-1} = y_{t-1} - \alpha - \beta x_{t-1}$

Granger causality tests seek to determine if changes in y cause changes in x by analysing if lags of y feature significantly the x model (Brooks, 2014). In the y model past values of the x variable appear in e_{t-1} and in $\sum_{j=1}^{q} \omega_{1j} \Delta x_{t-j}$ and in the x model past y variables appear in e_{t-1} and $\sum_{i=1}^{p} \gamma_{2i} \Delta x_{t-i}$. In this research x does not Granger cause y if $\omega_{11} = \cdots = \omega_{1q} = \lambda_1 = 0$ and in turn y does not Granger cause x if $\gamma_{21} = \cdots = \gamma_{2p} = \lambda_2 = 0$. Short-run causality is observed if $\omega_{11} = \cdots = \omega_{1q} \neq 0$ or if $\gamma_{21} = \cdots = \gamma_{2p} \neq 0$ while long-run causality is observed if $\lambda_1 \neq 0$ or if $\lambda_2 \neq 0$ (Türsoy, 2017).

Using EViews® Granger Causality/Block Exogeneity Tests the research investigated unidirectional and bidirectional causality between financial variables and economic growth in Equation 3 and Equation 4. The causal relationships between explanatory variables was not pertinent to this research therefore although they are reported they are not discussed.

4. RESULTS AND DISCUSSION

4.1 BRICS and BICS Panels

4.1.1 Descriptive Statistics and Correlations

Table 3 and Table 4 present the descriptive statistics and correlations for the BRICS and BICS panels, respectively. There was a wide variation in the data series starting point and change in economic and financial development in the countries that constitute BRICS. Brazil and South Africa started the 1900s as upper middle income countries with a GDP per capita of 100 times larger than in India and China. Despite their low income label, India and China showed robust bank development by 1990 with PC approximately 24% and 76% in each respective country. In 1990, all countries except South Africa displayed low bond and stock market development.

In the BRICS panel, Russia started out the mid-1990s as an upper middle income country; however, banks and financial markets were underdeveloped. Russia's starting position of economic development resembled that of Brazil and South Africa; however, its financial development resembled that of India and China. In less than a decade, Russia transformed itself to become the single high income country in BRICS with a GDP per capita of U.S. $ 16,007. Financial development had also risen modestly with bank development and stock market capitalisation reaching 50% and 35%, respectively. In the mid-2000s, external factors such as sanctions reduced Russia's economic growth and lowered its stock market capitalisation.

The Jarque-Bera statistic was significant in both Table 3 and Table 4; therefore, the null hypothesis that the data was not normally distrusted cannot be rejected. In Table 3, none of the financial variables in BRICS showed any statistically significant correlation with economic growth. Table 4 shows that in the BICS panel there were strong and statistically significant correlations between financial variables and economic growth with the exception of SMTR.

In both the BRICS and BICS panels, there were statistically significant inter-correlations between financial variables. Fortunately, none of the correlations were high enough to suggest that financial variables were identically describing the same phenomena. SMTR was the only exception to the aforementioned observation as it

was shown to be consistently uncorrelated with PC in both panels and PD in the BICS panel. The correlations show that economic and financial variables show linear relationships with one another, however, it neither implies cointegration or causation.

4.1.2 Stationarity/Unit Root

Table 5 and Table 6 present the unit root test at first difference for BRICS and BICS respectively. The Augmented Dickey-Fuller (ADF) test and all other tests showed that data stationarity consistently appeared at first difference with all the results being statistically significant at the 5% level. These findings concur with Beck's (2009) observation that many countries displayed first difference stationarity in financial variables and GDP per capita. Panel VECM and VAR models were considered in each panel model depending on whether the panel variables exhibited cointegration or not.

4.1.3 Stock Market Development and Economic Growth

There were three proxy measures for stock market development, namely SMC, SMTVT and SMTR. In order to make the regression modelling more manageable it was necessary early on to eliminate any stock market development measures that were observed not to cause economic growth in the BRICS and BICS panels.

4.1.3.1 Cointegration

Table 7 and Table 8 show the results of the Johansen Fisher Panel Cointegration test for the BRICS and BICS panels respectively. Fisher Statistics from trace tests that were statistically significant at the 5% level were considered as indicative determinants of cointegrating equations. Using the unrestricted cointegration rank tests, three and two cointegrating equations were observed in the BRICS and BICS panels, respectively. Different cointegration characteristics were exhibited in the cross-section results; however, these were not deemed to be pertinent to the panel study. From the tests there appears to be a long-term equilibrium relationship between stock market development and economic growth.

The cointegration of variables in BRICS and BICS ceased when the lag interval increased from two to three and four, respectively. This variation in the lag structure

induced regression model changes from VEC to VAR and affected the lag length used in Granger Causality tests. Furthermore, spurious near prefect regression fits were observed when VAR models were used to model stock market development and economic growth in BRICS and BICS. Due to these reasons, two lags were used in the VECM Granger Causality Tests.

4.1.4 Granger Causality

Table 9 and Table 10 show that in BRICS and BICS there was statistically significant unidirectional Granger causality from D(SMC) to D(GDP). The other stock market variables did not exhibit any form of Granger causality with economic growth. For this reason, SMC was selected as the preferred proxy measure for stock market development in further econometric modelling. For this reason, SMTVT and SMTR were excluded from further consideration.

4.1.5 Financial Development and Economic Growth

4.1.5.1 BRICS Panel: VECM Regression

There are no more than two cointegrated equations between the financial and economic variables in BRICS as shown in Table 11. Table 12 presents the VECM model developed from the cointegration results with the minimum system Akaike Information criterion. The regression of D(GDP) with lagged D(GDP), D(PC) and D(SMC) showed a reasonable regression fit with a R^2 and a adj. R^2 of 29.4% and 22.4%, respectively.

Table 13 presents the Ordinary Least Square (OLS) estimation of the VECM model presented in Table 12. For the purposes of the research, only the statistical significance of coefficients and their corresponding magnitudes were considered. The observations that follow were made from Table 12 and Table 13.

D(GDP) and D(SMC) both entered the first cointegration equation in a statistically significantly manner as shown in their corresponding t-statistics. On the other hand, D(PC) was not statistically significant in the first cointegrating equation. The finding shows the presence of a long run equilibrium relationship between economic growth and stock market development whilst none was observed with bank development.

Furthermore, the cointegration of all explanatory variables was not statistically significant in the second cointegrating equation.

From Table 13 the error correction term C(1) was negative and significant indicating long run causality from lagged GDP and lagged SMC to D(GDP). C(1)'s magnitude and sign also indicated the speed of adjustment, which in this case showed that a 9.89% adjustment occurred from the previous period to the equilibrium, thereby validating that the model converges. Similarly, the statistical significance of the coefficient C(3) revealed short run causality from lagged D(GDP(-1)) to D(GDP). The regression model shows that past D(GDP) can significantly explain present D(GDP); thereby indicating that today's high economic growth can spur on higher economic growth in the following year with the opposite also being similarly true.

Lagged D(PC) coefficients C(5) and C(6) were not statistically significant therefore no short run causality with D(GDP) could be inferred. Overall private credit or bank development was shown to be poor explanatory regressor of economic growth.

At the 10% significance level both lagged D(SMC) coefficients C(7) and C(8) showed short run causality with D(GDP). At the 5% significance level only D(SMC(-2)) showed short run causality with D(GDP). Lagged stock market variables were thus shown to be statistically significant regressors of economic growth.

Table 14 presents the tests for residual serial autocorrelation and heteroscedasticity to validate the VECM model. Table 15 shows the results of the Wald Test which confirms the non-zero value of the significant coefficients fitted in the OLS regression presented in Table 13. Table 15 also shows that all OLS coefficients in Table 13 that were not statistically significant could be considered to be zero.

4.1.5.2 BRICS Panel: Granger Causality

The results of VEC Granger causality tests are shown in Table 16. There was unidirectional Granger causality from D(SMC) to D(GDP), which corroborates the long-run and short-run causalities observed in the OLS regression model. Reverse Granger causality was observed from D(GDP) to D(PC). In summary, the OLS regression and Granger causality tests showed that stock market capitalisation

Granger caused economic growth while economic growth Ganger caused private credit.

4.1.5.3 BICS Panel: VECM Regression

There are no more than two cointegrated equations between the financial and economic variables in BICS as shown in Table 17. The VEC model developed from the cointegration results with the minimum system Akaike Information criterion for BICS is presented in Table 18. The regression of D(GDP) with lagged D(GDP), D(PC), D(PD) and D(SMC) shows reasonable regression fit of R^2 and adj. R^2 of 47.1% and 40.6%, respectively.

Table 19 presents the Ordinary Least Square (OLS) estimation of the VEC model presented in Table 18. For the purposes of this study, only the statistical significance of coefficients and their corresponding magnitudes were considered. The observations that follow were made from Table 18 and Table 19.

Both D(GDP) and D(PD) were observed to enter the first and second cointegration equations in a statistically significantly manner, as shown in their corresponding t-statistics. By contrast, D(PC) and D(SMC) were not statistically significant in the first and second cointegrating equations. The finding shows that there was a long-run equilibrium relationship between economic growth and bond market development while no such relationship was observed with bank and stock development.

From Table 19 the error correction term C(1) was negative and significant showing long-run causality from lagged GDP and lagged PD to D(GDP). C(1)'s magnitude and sign also indicated the speed of adjustment to equilibrium, which in this case showed that a 12.37% adjustment occurred from the previous period to the equilibrium, which validated the convergence of the model. C(2) the coefficient of the second cointegrating equation was observed to be statistically significant indicating short run causality between lagged financial development variables and D(GDP). Coefficient C(3) showed short-run causality from lagged D(GDP(-1)) to D(GDP). The regression model shows that past D(GDP) can significantly explain present D(GDP), thereby indicating that today's high economic growth can spur higher economic growth in the following year with the opposite also being similarly true.

Lagged D(PC) coefficients C(5) and C(6) were not statistically significant showing no short-run causality with D(GDP). They are thus shown to be poor explanatory regressors of economic growth. The finding shows that bank development as described by private credit levels was a poor explanatory regressor of economic growth in BICS.

The inclusion of PD into the BICS panels showed there was statistically significant short-run causality from both the first and second lags of D(PD) to D(GDP). Furthermore, the magnitude of the D(PD) regressor coefficients C(7) and C(8) were the largest in the regression model suggesting that a small change in D(PD) can have a significant contribution to D(GDP).

The second lagged coefficient of stock market capitalisation C(10) was shown to be statistically significant, which is indicative of short-run causality between D(SMC(-2)) and D(GDP). The result indicates that stock market development was a statistically significant regressor of economic growth.

Table 20 presents the tests for residual serial autocorrelation and heteroscedasticity to validate the VECM model. Table 21 shows the results of the Wald Test, which confirms the non-zero value of the significant coefficients fitted in the OLS regression presented in Table 19. Table 21 also shows that all OLS coefficients in Table 19 that were not statistically significant could be considered to be zero.

4.1.5.4 BICS Panel: Granger Causality

The results of VEC Granger causality tests are presented in Table 22. Bidirectional Granger causality from D(PC) to D(GDP) was observed. The bidirectional nature of the causality relationship might be the reason why the OLS regression model did not show C(5) and C(6) as being statistically significant coefficients.

The bidirectional causality between D(PC) and D(GDP) observed in the BICS panel seems to contradict the reverse causality observed in the BRICS panel, as shown in Table 16. However, the longer time span considered in the BICS panel was observed to be the cause of the bidirectional causality. Table 23 shows the Granger causality in the BICS panel analysed for the same period as in the BRICS panel, i.e. from 1995 to 2015. The results confirm the reverse Granger causality relationship

between D(PC) and D(GDP) in Table 16. Thus, D(GDP) Granger causes D(PC) in both BRICS and BICS from 1995 onwards. In the early years, D(PC) Granger caused D(GDP); however, this causal direction diminished over time.

Table 22 showed the presence of unidirectional Granger causality from D(PD) to D(GDP) and from D(SMC) to D(GDP). The OLS regression and the Granger causality tests show that both bond and stock market development Granger cause economic growth. In Table 23, the stock market causal relationship is shown to persist over time, unlike with private credit. Furthermore, stock market development was consistently shown to Granger cause economic growth irrespective of whether the BRICS or BICS panel was considered.

4.2 BS and IC Panels: Granger Causality

The BS and IC panels were developed to investigate how the causal link between economic growth and financial development in countries that started the 1990s as upper middle income and low income changed between 1990 and 1995. The countries in each panel evolved very differently both economically and financially. For example, by 2015 China was ranked as an upper middle income country while India remained a lower middle income country. In addition, China showed considerably more financial development than India.

Table 24 shows that in the BS panel, D(PC) had bidirectional causality with D(GDP) for the period 1990 to 2015. In Table 25, when the 1995 to 2015 time period was considered, only reverse Granger causality was observed between D(PC) and D(GDP). This indicates that the influence of bank development on economic growth in the Brazil and South Africa panel waned and disappeared between 1990 and 1995, such that economic growth spurred bank development.

In both Table 24 and Table 25, the unidirectional Granger causality from D(PD) to D(GDP) and from D(SMC) to D(GDP) persisted. This indicates that the development of financial markets drove economic growth irrespective of the time period investigated.

D(PC) did not Granger cause D(GDP) in the IC panel as shown in Table 26 and Table 27. Instead, D(GDP) was consistently shown to Granger cause D(GDP),

irrespective of the time period investigated. Similar to the BS panel, the IC panel showed that D(PD) and D(SMC) both Granger caused D(GDP) with no reverse causality.

These results show that, as countries develop, market-based systems spur economic growth. In turn, as economics growth increases, bank development occurs through an increase in credit issuance without it being causally linked to economic growth.

5. CONCLUSIONS

The research has examined the nature of the causal link between economic growth and the development of banks, bond markets and stock markets with a specific focus on BRICS countries. Through Panel VEC modelling, OLS regression and VEC Granger causality, the research was able to determine the following findings.

Bank development as proxied by private credit as a percentage of GDP exhibited bidirectional causality in the BICS and BS panels. The bidirectional causal link was time dependent; it was observed to become reverse causality when the time period of investigation was restricted from 1995 to 2015. Economic growth was therefore shown to cause bank development in all panels for the 1995 to 2015 period.

Bond market development as proxied by outstanding domestic private debts as a percentage of GDP was shown to exhibit unidirectional Granger causality with economic growth irrespective of the panel investigated or time period. Furthermore, OLS coefficients of bond market development were found to be the largest in the BICS panel, indicating that further bond market development could lead to multiplicative rises in economic growth. Bond market private debt was consistently shown to promote economic growth more than bank issued private credit.

In the BRICS and BICS panels, stock market capitalisation was the best variable to describe stock market development in the econometric models. Furthermore, stock market development was shown to consistently Granger cause economic growth irrespective of the panel investigated or time period. The time invariant unidirectional causal link suggests that further stock market development in all panels considered could continue to spur economic growth.

These findings lend weight to the position of cautious proponents of finance. Moreover, it adds to the empirical body of knowledge that supports the view that financial market development facilitates economic growth by facilitating the easy exchange of goods and services, mobilising savings and efficiently allocating capital to entrepreneurs and firms.

6. RECOMMENDATIONS

With regard to bank development, it is recommended that BRICS member states curtail the growth of private credit, as it does not cause economic growth. The level of private credit should be below 80%, which was reported as being the threshold limit above which the relationship between credit and economic growth turns negative (Arcand et al., 2015; Cecchetti and Kharroubi, 2012; Law and Singh, 2014).

For bond market development, the research recommends that BRICS governments devise targeted polices that promote the substitution of private credit with private debt. Even at low levels, bond markets have been shown to cause economic growth; therefore, their further development requires urgent attention.

In order to sustain stock market development, the research recommends that BRICS member states relax listing and reporting requirements to allow more companies to list and seek financing through share issues.

The financial development measures used in the research were similar to those used in past research. Alternative measures such those recommend by Čihák, Demirgüç-Kunt, Feyen, and Levine (2012) could be more appropriate measures of financial development. The use of such alternative measures could present interesting results and expand the debate. Furthermore, research into the relationship between the informal financial sectors, shadow banking financial development and formal/informal economic growth could also offer interesting perspectives that add to the debate.

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8. APPENDIX

Table 3: Descriptive Statistics and Correlations in BRICS

Date: 12/14/18 Time: 19:45
Sample: 1995 2015

	GDP	PC	SMC	SMTVT	SMTR
Mean	4528.228	69.81829	72.74952	38.37724	81.99152
Median	3469.504	49.87	46.78	31.01	57.12
Maximum	16007.09	150.21	255.62	231.62	557.04
Minimum	370.1014	7.75	1.57	0.07	5.94
Std. Dev.	3848.014	44.88651	65.38177	34.51589	81.11467
Skewness	1.105955	0.373942	1.465521	2.261672	2.786199
Kurtosis	3.555572	1.637921	4.036508	11.43279	13.85394
Jarque-Bera	22.75528	10.56384	42.28594	400.6298	651.2612
Probability	0.000011	0.005083	0	0	0
Sum	475463.9	7330.92	7638.7	4029.61	8609.11
Sum Sq. Dev.	1.54E+09	209539.1	444576.6	123900.1	684277.3
Observations	105	105	105	105	105

Covariance Analysis: Ordinary
Date: 12/14/18 Time: 19:42
Sample: 1995 2015
Included observations: 105

Correlation *Probability*	GDP	PC	SMC	SMTVT	SMTR
GDP	1 -----				
PC	0.120993 *0.2189*	1 -----			
SMC	0.142477 *0.1471*	0.677802 *0.0000*	1 -----		
SMTVT	0.150894 *0.1244*	0.525207 *0.0000*	0.353036 *0.0002*	1 -----	
SMTR	-0.14727 *0.1338*	0.13979 *0.1549*	-0.29563 *0.0022*	0.527575 *0.0000*	1 -----

Table 4: Descriptive Statistics and Correlations in BICS

Date: 12/14/18 Time: 18:23
Sample: 1990 2015

	GDP	PC	PD	SMC	SMTVT	SMTR
Mean	3512.718	75.19144	12.93179	73.52553	35.49684	90.522
Median	3068.021	71.245	11.06	46.505	28.265	68.38
Maximum	13167.47	150.21	46.57	255.62	231.62	557.04
Minimum	298.2177	21.48	0.27	1.144	0.47	4.16
Std. Dev.	3088.913	42.30994	11.21345	68.69762	35.32396	84.0432
Skewness	1.148394	0.260645	0.766786	1.222423	2.285082	2.328223
Kurtosis	3.923419	1.604548	2.713083	3.399549	11.28028	11.30304
Jarque-Bera	26.55441	9.615796	10.54804	26.59327	387.6142	392.6994
Probability	0.000002	0.008165	0.005123	0.000002	0	0
Sum	365322.7	7819.91	1344.906	7646.655	3691.671	9414.288
Sum Sq. Dev.	9.83E+08	184383.5	12951.37	486094.3	128521.5	727515.7
Observations	104	104	104	104	104	104

Covariance Analysis: Ordinary
Date: 12/14/18 Time: 19:48
Sample: 1990 2015
Included observations: 104

Correlation *Probability*	GDP	PC	PD	SMC	SMTVT	SMTR
GDP	1 -----					
PC	0.324354 *0.0008*	1 -----				
PD	0.764842 *0.0000*	0.546809 *0.0000*	1 -----			
SMC	0.32948 *0.0006*	0.6676 *0.0000*	0.277238 *0.0044*	1 -----		
SMTVT	0.308116 *0.0015*	0.510725 *0.0000*	0.588702 *0.0000*	0.332812 *0.0006*	1 -----	
SMTR	-0.11315 *0.2528*	0.018783 *0.8499*	0.138977 *0.1594*	-0.42468 *0.0000*	0.437131 *0.0000*	1 -----

Table 5: Variables Stationarity Tests in BRICS

Panel unit root test: Summary
Series: D(GDP)
Date: 12/18/18 Time: 21:19
Sample: 1995 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-2.63037	0.0043	5	94
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.15115	0.0157	5	94
ADF - Fisher Chi-square	20.2723	0.0268	5	94
PP - Fisher Chi-square	18.4996	0.0471	5	95

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(PC)
Date: 12/18/18 Time: 21:20
Sample: 1995 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.45846	0	5	94
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.89901	0	5	94
ADF - Fisher Chi-square	33.5806	0.0002	5	94
PP - Fisher Chi-square	29.6154	0.001	5	95

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(SMC)
Date: 12/18/18 Time: 21:22
Sample: 1995 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.20596	0	5	94
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.88429	0	5	94
ADF - Fisher Chi-square	49.2438	0	5	94
PP - Fisher Chi-square	57.924	0	5	95

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(SMTVT)
Date: 12/18/18 Time: 21:24
Sample: 1995 2015
Exogenous variables: None
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 4
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.04617	0	5	89
Null: Unit root (assumes individual unit root process)				
ADF - Fisher Chi-square	35.3913	0.0001	5	89
PP - Fisher Chi-square	33.4705	0.0002	5	95

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(SMTR)
Date: 12/18/18 Time: 21:24
Sample: 1995 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.20263	0	5	92
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-6.31142	0	5	92
ADF - Fisher Chi-square	54.3239	0	5	92
PP - Fisher Chi-square	62.058	0	5	95

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table 6: Variables Stationarity Tests in BICS

Panel unit root test: Summary
Series: D(GDP)
Date: 12/18/18 Time: 21:16
Sample: 1990 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.2159	0.0007	4	96
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-2.80753	0.0025	4	96
ADF - Fisher Chi-square	22.3281	0.0043	4	96
PP - Fisher Chi-square	21.9176	0.0051	4	96

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(PC)
Date: 12/18/18 Time: 21:45
Sample: 1990 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-4.51159	0	4	94
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.78299	0	4	94
ADF - Fisher Chi-square	36.4508	0	4	94
PP - Fisher Chi-square	31.9101	0.0001	4	96

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(PD)
Date: 12/18/18 Time: 21:46
Sample: 1990 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 4
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-3.59185	0.0002	4	92
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-5.24419	0	4	92
ADF - Fisher Chi-square	42.343	0	4	92
PP - Fisher Chi-square	41.8614	0	4	96

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(SMC)
Date: 12/18/18 Time: 21:46
Sample: 1990 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.49352	0	4	92
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-4.89119	0	4	92
ADF - Fisher Chi-square	40.828	0	4	92
PP - Fisher Chi-square	62.2486	0	4	96

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(SMTVT)
Date: 12/18/18 Time: 21:47
Sample: 1990 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 3
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-1.45873	0.0723	4	90
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-3.84271	0.0001	4	90
ADF - Fisher Chi-square	29.4828	0.0003	4	90
PP - Fisher Chi-square	15.5041	0.0501	4	96

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Panel unit root test: Summary
Series: D(SMTR)
Date: 12/18/18 Time: 21:47
Sample: 1990 2015
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 1
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-5.96069	0	4	95
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-7.26251	0	4	95
ADF - Fisher Chi-square	57.196	0	4	95
PP - Fisher Chi-square	76.5536	0	4	96

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

Table 7: Cointegration of Stock Market Development and Economic Growth Variables in BRICS

Johansen Fisher Panel Cointegration Test
Series: GDP SMC SMTVT SMTR
Date: 12/19/18 Time: 08:48
Sample: 1995 2015
Included observations: 105
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 2

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace	Prob.	Fisher Stat.* (from max	Prob.
None	188.9	0	132.8	0
At most 1	90.54	0	54.34	0
At most 2	52.91	0	42.87	0
At most 3	27.81	0.0019	27.81	0.0019

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
Brazil	112.2049	0	40.413	0.0007
Russia	120.7321	0	75.6572	0
India	66.4367	0.0004	41.2733	0.0005
China	105.504	0	59.9844	0
South Africa	126.7415	0	69.1641	0
Hypothesis of at most 1 cointegration relationship				
Brazil	71.7919	0	33.7847	0.0005
Russia	45.0749	0.0004	28.996	0.0032
India	25.1633	0.1557	16.1122	0.2184
China	45.5195	0.0004	26.8217	0.0071
South Africa	57.5774	0	33.3099	0.0006
Hypothesis of at most 2 cointegration relationship				
Brazil	38.0072	0	23.2919	0.0015
Russia	16.0789	0.0408	15.0161	0.038
India	9.0511	0.3607	7.9809	0.3807
China	18.6978	0.0159	18.5375	0.0099
South Africa	24.2675	0.0019	22.1493	0.0023
Hypothesis of at most 3 cointegration relationship				
Brazil	14.7154	0.0001	14.7154	0.0001
Russia	1.0629	0.3026	1.0629	0.3026
India	1.0703	0.3009	1.0703	0.3009
China	0.1603	0.6889	0.1603	0.6889
South Africa	2.1181	0.1456	2.1181	0.1456

**MacKinnon-Haug-Michelis (1999) p-values

Table 8: Cointegration of Stock Market Development and Economic Growth Variables in BICS

Johansen Fisher Panel Cointegration Test
Series: GDP SMC SMTVT SMTR
Date: 12/19/18 Time: 08:48
Sample: 1990 2015
Included observations: 104
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 2

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace	Prob.	Fisher Stat.* (from max	Prob.
None	72.6	0	41.34	0
At most 1	38.21	0	25.5	0.0013
At most 2	21.94	0.005	20.83	0.0076
At most 3	11.04	0.1993	11.04	0.1993

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
Brazil	74.9354	0	37.5709	0.0019
India	46.3811	0.0683	22.9732	0.1746
China	77.4176	0	38.3426	0.0014
South Africa	79.1239	0	37.1147	0.0022
Hypothesis of at most 1 cointegration relationship				
Brazil	37.3645	0.0056	29.6319	0.0025
India	23.4079	0.2266	12.4856	0.5005
China	39.075	0.0032	20.8221	0.0552
South Africa	42.0092	0.0012	21.6791	0.0419
Hypothesis of at most 2 cointegration relationship				
Brazil	7.7326	0.4944	6.795	0.5137
India	10.9223	0.2163	10.8984	0.1594
China	18.2529	0.0187	14.8671	0.0401
South Africa	20.3301	0.0086	18.7469	0.0091
Hypothesis of at most 3 cointegration relationship				
Brazil	0.9376	0.3329	0.9376	0.3329
India	0.0239	0.8772	0.0239	0.8772
China	3.3858	0.0658	3.3858	0.0658
South Africa	1.5831	0.2083	1.5831	0.2083

**MacKinnon-Haug-Michelis (1999) p-values

Table 9: Granger Causality between Stock Market Development and Economic Growth Variables in BRICS

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/19/18 Time: 11:59
Sample: 1995 2015
Included observations: 90

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(SMC)	11.73931	2	0.0028
D(SMTVT)	2.371024	2	0.3056
D(SMTR)	1.713959	2	0.4244
All	16.69812	6	0.0105

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	2.046107	2	0.3595
D(SMTVT)	1.358798	2	0.5069
D(SMTR)	4.438642	2	0.1087
All	7.690241	6	0.2617

Dependent variable: D(SMTVT)

Excluded	Chi-sq	df	Prob.
D(GDP)	0.051614	2	0.9745
D(SMC)	0.050186	2	0.9752
D(SMTR)	7.117718	2	0.0285
All	7.323553	6	0.292

Dependent variable: D(SMTR)

Excluded	Chi-sq	df	Prob.
D(GDP)	0.044216	2	0.9781
D(SMC)	1.08929	2	0.58
D(SMTVT)	0.264434	2	0.8762
All	1.563089	6	0.9552

Table 10: Granger Causality between Stock Market Developmen and Economic Growth Variables in BICS

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/19/18 Time: 12:04
Sample: 1990 2015
Included observations: 92

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(SMC)	11.89211	2	0.0026
D(SMTVT)	1.534475	2	0.4643
D(SMTR)	1.182679	2	0.5536
All	14.17254	6	0.0278

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	2.900358	2	0.2345
D(SMTVT)	0.42488	2	0.8086
D(SMTR)	3.49191	2	0.1745
All	6.943048	6	0.3261

Dependent variable: D(SMTVT)

Excluded	Chi-sq	df	Prob.
D(GDP)	0.604676	2	0.7391
D(SMC)	0.135892	2	0.9343
D(SMTR)	2.835368	2	0.2423
All	4.00231	6	0.6764

Dependent variable: D(SMTR)

Excluded	Chi-sq	df	Prob.
D(GDP)	1.234588	2	0.5394
D(SMC)	0.783064	2	0.676
D(SMTVT)	0.183066	2	0.9125
All	2.621377	6	0.8546

Table 11: Cointegration of Financial and Economic Variables in BRICS

Johansen Fisher Panel Cointegration Test
Series: GDP PC SMC
Date: 12/19/18 Time: 15:09
Sample: 1995 2015
Included observations: 105
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 2

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	89.57	0	66.23	0
At most 1	37.4	0	33.73	0.0002
At most 2	19.26	0.037	19.26	0.037

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
Brazil	47.654	0.0002	26.8577	0.007
Russia	48.554	0.0001	25.4799	0.0115
India	35.9023	0.0087	25.5778	0.0111
China	70.2063	0	51.2122	0
South Africa	42.0833	0.0012	28.5381	0.0038
Hypothesis of at most 1 cointegration relationship				
Brazil	20.7963	0.0072	20.6734	0.0042
Russia	23.0741	0.003	16.233	0.0241
India	10.3245	0.2566	7.1613	0.4702
China	18.9942	0.0142	18.5904	0.0097
South Africa	13.5452	0.0963	12.2586	0.1013
Hypothesis of at most 2 cointegration relationship				
Brazil	0.123	0.7258	0.123	0.7258
Russia	6.8411	0.0089	6.8411	0.0089
India	3.1631	0.0753	3.1631	0.0753
China	0.4037	0.5252	0.4037	0.5252
South Africa	1.2866	0.2567	1.2866	0.2567

**MacKinnon-Haug-Michelis (1999) p-values

Table 12: Vector Error Correction (VEC) Model in BRICS

Vector Error Correction Estimates
Date: 12/20/18 Time: 08:12
Sample (adjusted): 1998 2015
Included observations: 90 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2
GDP(-1)	1	0
PC(-1)	0	1
SMC(-1)	-15.1587	-0.49775
	-16.8655	-0.5891
	[-0.89880]	[-0.84493]
C	-3502.86	-33.2209

Error Correction:	D(GDP)	D(PC)	D(SMC)
CointEq1	-0.09895	2.79E-05	-0.00095
	-0.03383	-0.00012	-0.00052
	[-2.92488]	[0.24170]	[-1.83641]
CointEq2	-2.77365	0.004398	0.024471
	-3.28327	-0.01121	-0.05027
	[-0.84478]	[0.39221]	[0.48680]
D(GDP(-1))	0.587144	0.0014	-0.00048
	-0.13188	-0.00045	-0.00202
	[4.45209]	[3.10837]	[-0.23908]
D(GDP(-2))	0.145417	0.000275	0.002018
	-0.1543	-0.00053	-0.00236
	[0.94245]	[0.52246]	[0.85418]
D(PC(-1))	-13.9279	0.53757	0.31211
	-32.2475	-0.11012	-0.49374
	[-0.43191]	[4.88154]	[0.63213]
D(PC(-2))	42.38564	-0.27545	-1.00105
	-30.3006	-0.10347	-0.46393
	[1.39884]	[-2.66203]	[-2.15775]
D(SMC(-1))	13.80167	0.008332	-0.00228
	-7.1037	-0.02426	-0.10876
	[1.94289]	[0.34347]	[-0.02100]
D(SMC(-2))	-22.7216	0.038852	-0.30981
	-7.21048	-0.02462	-0.1104
	[-3.15119]	[1.57786]	[-2.80626]
C	-53.9956	0.872513	3.615725
	-136.857	-0.46736	-2.0954
	[-0.39454]	[1.86691]	[1.72555]
R-squared	0.293762	0.418631	0.209877
Adj. R-squared	0.22401	0.361212	0.13184
Sum sq. resids	80521796	939.0272	18876.34
S.E. equation	997.0438	3.404839	15.26569
F-statistic	4.211529	7.290785	2.689462
Log likelihood	-744.395	-233.231	-368.268
Akaike AIC	16.74211	5.382912	8.383732
Schwarz SC	16.99209	5.632893	8.633713
Mean dependent	231.1033	2.099333	2.150556
S.D. dependent	1131.843	4.260083	16.38387

Determinant resid covariance (dof adj.)	2.45E+09
Determinant resid covariance	1.78E+09
Log likelihood	-1341.73
Akaike information criterion	30.54948
Schwarz criterion	31.46607

Table 13: BRICS Ordinary Least Squares (OLS) Regression Model

Dependent Variable: D(GDP)
Method: Panel Least Squares
Date: 12/19/18 Time: 15:26
Sample (adjusted): 1998 2015
Periods included: 18
Cross-sections included: 5
Total panel (balanced) observations: 90

D(GDP) = C(1)*(GDP(-1) - 15.1586874971*SMC(-1) - 3502.85644092) + C(2)*(PC(-1) - 0.497751531574*SMC(-1) - 33.2209080366) + C(3) *D(GDP(-1)) + C(4)*D(GDP(-2)) + C(5)*D(PC(-1)) + C(6)*D(PC(-2)) + C(7)*D(SMC(-1)) + C(8)*D(SMC(-2)) + C(9)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.09895	0.033829	-2.924876	0.0045
C(2)	-2.77365	3.283266	-0.844783	0.4007
C(3)	0.587144	0.131881	4.45209	0
C(4)	0.145417	0.154298	0.942446	0.3488
C(5)	-13.9279	32.24749	-0.431907	0.667
C(6)	42.38564	30.30061	1.398838	0.1657
C(7)	13.80167	7.103698	1.942885	0.0555
C(8)	-22.7216	7.21048	-3.151189	0.0023
C(9)	-53.9956	136.8566	-0.394541	0.6942

R-squared	0.293762	Mean dependent var	231.1033
Adjusted R-squared	0.22401	S.D. dependent var	1131.843
S.E. of regression	997.0438	Akaike info criterion	16.74211
Sum squared resid	80521796	Schwarz criterion	16.99209
Log likelihood	-744.395	Hannan-Quinn criter.	16.84291
F-statistic	4.211529	Durbin-Watson stat	1.921539
Prob(F-statistic)	0.000295		

Table 14: BRICS VEC Model Autocorrelation and Heteroscedasticity

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 12/19/18 Time: 15:33
Sample: 1995 2015
Included observations: 90

Lags	LM-Stat	Prob
1	15.10446	0.0881
2	14.61783	0.102
3	10.98524	0.2767
4	6.585109	0.6802
5	11.57546	0.2383
6	20.39182	0.0156
7	2.781997	0.9723
8	7.331941	0.6026
9	15.94605	0.068
10	10.16763	0.3371
11	8.900814	0.4465
12	7.9759	0.5366

Probs from chi-square with 9 df.

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 12/19/18 Time: 15:35
Sample: 1995 2015
Included observations: 90

Joint test:

Chi-sq	df	Prob.
178.6354	96	0

Individual components:

Dependent	R-squared	F(16,73)	Prob.	Chi-sq(16)	Prob.
res1*res1	0.521348	4.969478	0	46.92132	0.0001
res2*res2	0.187971	1.056138	0.4116	16.91735	0.391
res3*res3	0.247959	1.504322	0.1216	22.31629	0.1333
res2*res1	0.468972	4.029328	0	42.20749	0.0004
res3*res1	0.434484	3.50536	0.0001	39.1036	0.0011
res3*res2	0.220841	1.293171	0.225	19.87567	0.2259

Table 15: WALD Test of BRICS OLS Coefficients

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-2.924876	81	0.0045
F-statistic	8.5549	(1, 81)	0.0045
Chi-square	8.5549	1	0.0034

Null Hypothesis: C(1)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(1)	-0.09895	0.033829

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.844783	81	0.4007
F-statistic	0.713658	(1, 81)	0.4007
Chi-square	0.713658	1	0.3982

Null Hypothesis: C(2)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(2)	-2.77365	3.283266

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	10.8488	(2, 81)	0.0001
Chi-square	21.69761	2	0

Null Hypothesis: C(3)=C(4)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(3)	0.587144	0.131881
C(4)	0.145417	0.154298

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	1.025241	(2, 81)	0.3633
Chi-square	2.050483	2	0.3587

Null Hypothesis: C(5)=C(6)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5)	-13.9279	32.24749
C(6)	42.38564	30.30061

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	7.218102	(2, 81)	0.0013
Chi-square	14.4362	2	0.0007

Null Hypothesis: C(7)=C(8)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(7)	13.80167	7.103698
C(8)	-22.7216	7.21048

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
t-statistic	-0.394541	81	0.6942
F-statistic	0.155663	(1, 81)	0.6942
Chi-square	0.155663	1	0.6932

Null Hypothesis: C(9)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(9)	-53.9956	136.8566

Restrictions are linear in coefficients.

Table 16: BRICS VEC Granger Causality

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/19/18 Time: 15:09
Sample: 1995 2015
Included observations: 90

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	2.050483	2	0.3587
D(SMC)	14.4362	2	0.0007
All	14.94347	4	0.0048

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	10.3348	2	0.0057
D(SMC)	2.554907	2	0.2787
All	18.90193	4	0.0008

Table 17: Cointegration of Financial and Economic Variables in BICS

Johansen Fisher Panel Cointegration Test
Series: GDP PC PD SMC
Date: 12/19/18 Time: 15:11
Sample: 1990 2015
Included observations: 104
Trend assumption: Linear deterministic trend
Lags interval (in first differences): 1 2

Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue)

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	77.79	0	59.93	0
At most 1	28.5	0.0004	28.72	0.0004
At most 2	8.631	0.3744	7.309	0.5037
At most 3	10.22	0.25	10.22	0.25

* Probabilities are computed using asymptotic Chi-square distribution.

Individual cross section results

Cross Section	Trace Test Statistics	Prob.**	Max-Eign Test Statistics	Prob.**
Hypothesis of no cointegration				
Brazil	54.0589	0.0117	31.3336	0.0157
India	78.6667	0	39.8467	0.0008
China	92.7488	0	58.7269	0
South Africa	62.6226	0.0012	32.5207	0.0107
Hypothesis of at most 1 cointegration relationship				
Brazil	22.7253	0.2598	13.864	0.3763
India	38.82	0.0035	29.8039	0.0024
China	34.0219	0.0154	27.9419	0.0047
South Africa	30.1018	0.0461	17.7637	0.1389
Hypothesis of at most 2 cointegration relationship				
Brazil	8.8613	0.3784	8.672	0.3145
India	9.0161	0.3639	6.9433	0.4959
China	6.0801	0.6861	6.019	0.6108
South Africa	12.3382	0.1414	9.1773	0.2717
Hypothesis of at most 3 cointegration relationship				
Brazil	0.1893	0.6635	0.1893	0.6635
India	2.0728	0.1499	2.0728	0.1499
China	0.0611	0.8048	0.0611	0.8048
South Africa	3.1608	0.0754	3.1608	0.0754

**MacKinnon-Haug-Michelis (1999) p-values

Table 18: Vector Error Correction (VEC) Model in BICS

Vector Error Correction Estimates
Date: 12/20/18 Time: 21:23
Sample (adjusted): 1993 2015
Included observations: 92 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2
GDP(-1)	1	0
PC(-1)	0	1
PD(-1)	-161.5082	-0.282553
	-91.8083	-1.59312
	[-1.75919]	[-0.17736]
SMC(-1)	4.256111	-0.848017
	-13.038	-0.22624
	[0.32644]	[-3.74824]
C	-1767.384	-8.35461

Error Correction:	D(GDP)	D(PC)	D(PD)	D(SMC)
CointEq1	-0.123728	-0.000132	7.20E-05	-0.00086
	-0.03272	-0.00024	-0.00013	-0.00089
	[-3.78187]	[-0.56217]	[0.56036]	[-0.96565]
CointEq2	-5.039195	0.00446	0.019484	-0.02696
	-1.69676	-0.01221	-0.00666	-0.04633
	[-2.96989]	[0.36534]	[2.92491]	[-0.58187]
D(GDP(-1))	0.367679	0.001169	0.000664	-0.00364
	-0.11291	-0.00081	-0.00044	-0.00308
	[3.25649]	[1.43885]	[1.49699]	[-1.18183]
D(GDP(-2))	0.119136	0.001932	0.000151	0.002323
	-0.11461	-0.00082	-0.00045	-0.00313
	[1.03951]	[2.34258]	[0.33507]	[0.74232]
D(PC(-1))	19.5951	0.52746	-0.05351	0.550772
	-12.7489	-0.09172	-0.05005	-0.34811
	[1.53700]	[5.75067]	[-1.06916]	[1.58218]
D(PC(-2))	15.03829	-0.344794	0.052043	-0.4001
	-11.3752	-0.08184	-0.04466	-0.3106
	[1.32202]	[-4.21312]	[1.16536]	[-1.28815]
D(PD(-1))	97.16186	-0.451479	0.109005	1.021469
	-29.4801	-0.21209	-0.11574	-0.80495
	[3.29584]	[-2.12869]	[0.94184]	[1.26898]
D(PD(-2))	86.4567	-0.244415	0.003958	0.373893
	-31.3002	-0.22519	-0.12288	-0.85465
	[2.76218]	[-1.08538]	[0.03221]	[0.43748]
D(SMC(-1))	-1.338053	0.061445	-0.02468	0.007221
	-4.24804	-0.03056	-0.01668	-0.11599
	[-0.31498]	[2.01047]	[-1.47985]	[0.06226]
D(SMC(-2))	-12.77198	-0.001568	0.033545	-0.30281
	-4.16898	-0.02999	-0.01637	-0.11383
	[-3.06357]	[-0.05229]	[2.04955]	[-2.66007]
C	-90.09903	1.378332	0.544883	2.291084
	-73.0261	-0.52538	-0.28669	-1.99398
	[-1.23379]	[2.62349]	[1.90057]	[1.14900]
R-squared	0.470904	0.478583	0.278593	0.193963
Adj. R-squared	0.405584	0.414211	0.18953	0.094452
Sum sq. resids	23504014	1216.565	362.2618	17523.71
S.E. equation	538.6771	3.875476	2.114797	14.70857
F-statistic	7.209134	7.4346	3.128054	1.949163
Log likelihood	-703.2834	-249.3142	-193.589	-372.02
Akaike AIC	15.5279	5.659005	4.447586	8.326529
Schwarz SC	15.82942	5.960523	4.749104	8.628047
Mean dependent	189.9651	2.276087	0.805576	2.748043
S.D. dependent	698.6877	5.06E+00	2.349094	15.45663

Determinant resid covariance (dof adj.)	3.84E+09
Determinant resid covariance	2.31E+09
Log likelihood	-1513.912

Table 19: BICS Ordinary Least Squares (OLS) Regression Model

Dependent Variable: D(GDP)
Method: Panel Least Squares
Date: 12/20/18 Time: 21:28
Sample (adjusted): 1993 2015
Periods included: 23
Cross-sections included: 4
Total panel (balanced) observations: 92
D(GDP) = C(1)*(GDP(-1) - 161.50818042*PD(-1) + 4.25611084667*SMC(-1) - 1767.38392238) + C(2)*(PC(-1) - 0.282552906462*PD(-1) - 0.848017062332*SMC(-1) - 8.35460975867) + C(3)*D(GDP(-1)) + C(4)*D(GDP(-2)) + C(5)*D(PC(-1)) + C(6)*D(PC(-2)) + C(7)*D(PD(-1)) + C(8)*D(PD(-2)) + C(9)*D(SMC(-1)) + C(10)*D(SMC(-2)) + C(11)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.123728	0.032716	-3.781873	0.0003
C(2)	-5.039195	1.696762	-2.969889	0.0039
C(3)	0.367679	0.112907	3.256486	0.0016
C(4)	0.119136	0.114607	1.039514	0.3017
C(5)	19.5951	12.74894	1.536998	0.1282
C(6)	15.03829	11.37521	1.322023	0.1899
C(7)	97.16186	29.48011	3.295844	0.0015
C(8)	86.4567	31.3002	2.762177	0.0071
C(9)	-1.338053	4.248042	-0.314981	0.7536
C(10)	-12.77198	4.168985	-3.063571	0.003
C(11)	-90.09903	73.02606	-1.233793	0.2208

R-squared	0.470904	Mean dependent var	189.9651
Adjusted R-squared	0.405584	S.D. dependent var	698.6877
S.E. of regression	538.6771	Akaike info criterion	15.5279
Sum squared resid	23504014	Schwarz criterion	15.82942
Log likelihood	-703.283400	Hannan-Quinn criter.	15.6496
F-statistic	7.209134	Durbin-Watson stat	1.716924
Prob(F-statistic)	0		

Table 20: BICS VEC Model Autocorrelation and Heteroscedasticity

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 12/20/18 Time: 21:40
Sample: 1990 2015
Included observations: 92

Lags	LM-Stat	Prob
1	19.3356	0.2516
2	19.86783	0.2262
3	15.91692	0.4588
4	15.55449	0.4845
5	13.19933	0.6581
6	24.41574	0.0808
7	12.8249	0.6855
8	21.92101	0.1458
9	20.55713	0.1962
10	8.88237	0.9182
11	14.08161	0.5926
12	14.25973	0.5794

Probs from chi-square with 16 df.

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 12/20/18 Time: 21:41
Sample: 1990 2015
Included observations: 92

Joint test:

Chi-sq	df	Prob.
361.3197	200	0

Individual components:

Dependent	R-squared	F(20,71)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.455305	2.967404	0.0004	41.88802	0.0029
res2*res2	0.446991	2.86943	0.0006	41.12321	0.0036
res3*res3	0.20262	0.902082	0.5855	18.64106	0.5453
res4*res4	0.402192	2.38836	0.0039	37.00165	0.0117
res2*res1	0.41108	2.47798	0.0027	37.81933	0.0093
res3*res1	0.372161	2.104312	0.0118	34.23877	0.0246
res3*res2	0.460521	3.030428	0.0003	42.36797	0.0025
res4*res1	0.429047	2.667675	0.0013	39.47232	0.0058
res4*res2	0.49099	3.424324	0.0001	45.17109	0.001
res4*res3	0.324004	1.701511	0.0535	29.80838	0.073

Table 21: WALD Test of BRICS OLS Coefficients

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
t-statistic	-3.78187	81	0.0003
F-statistic	14.30256	(1, 81)	0.0003
Chi-square	14.30256	1	0.0002

Null Hypothesis: C(1)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(1)	-0.12373	0.032716

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
t-statistic	-2.96989	81	0.0039
F-statistic	8.820239	(1, 81)	0.0039
Chi-square	8.820239	1	0.003

Null Hypothesis: C(2)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(2)	-5.0392	1.696762

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
F-statistic	7.401993	(2, 81)	0.0011
Chi-square	14.80399	2	0.0006

Null Hypothesis: C(3)=C(4)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(3)	0.367679	0.112907
C(4)	0.119136	0.114607

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
F-statistic	3.100581	(2, 81)	0.0504
Chi-square	6.201161	2	0.045

Null Hypothesis: C(5)=C(6)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(5)	19.5951	12.74894
C(6)	15.03829	11.37521

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
F-statistic	9.718477	(2, 81)	0.0002
Chi-square	19.43695	2	0.0001

Null Hypothesis: C(7)=C(8)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(7)	97.16186	29.48011
C(8)	86.4567	31.3002

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
F-statistic	4.701798	(2, 81)	0.0117
Chi-square	9.403596	2	0.0091

Null Hypothesis: C(9)=C(10)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(9)	-1.33805	4.248042
C(10)	-12.772	4.168985

Restrictions are linear in coefficients.

Wald Test:
Equation: Untitled

Test Statis	Value	df	Probability
t-statistic	-1.23379	81	0.2208
F-statistic	1.522245	(1, 81)	0.2208
Chi-square	1.522245	1	0.2173

Null Hypothesis: C(11)=0
Null Hypothesis Summary:

Normalized Restrictio	Value	Std. Err.
C(11)	-90.099	73.02606

Restrictions are linear in coefficients.

Table 22: BICS VEC Granger Causality 1990 - 2015

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/20/18 Time: 21:32
Sample: 1990 2015
Included observations: 92

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	6.201161	2	0.045
D(PD)	19.43695	2	0.0001
D(SMC)	9.403596	2	0.0091
All	37.56507	6	0

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	10.30524	2	0.0058
D(PD)	5.951605	2	0.051
D(SMC)	4.071274	2	0.1306
All	15.86798	6	0.0145

Dependent variable: D(PD)

Excluded	Chi-sq	df	Prob.
D(GDP)	2.86998	2	0.2381
D(PC)	1.871358	2	0.3923
D(SMC)	6.771659	2	0.0338
All	14.33636	6	0.0261

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	1.576502	2	0.4546
D(PC)	3.141671	2	0.2079
D(PD)	1.860946	2	0.3944
All	7.680236	6	0.2625

Table 23: BICS VEC Granger Causality 1995 - 2015

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/20/18 Time: 21:33
Sample: 1995 2015
Included observations: 84

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	5.086821	2	0.0786
D(PD)	15.45688	2	0.0004
D(SMC)	10.22567	2	0.006
All	33.77613	6	0

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	12.27768	2	0.0022
D(PD)	6.831618	2	0.0328
D(SMC)	3.565443	2	0.1682
All	18.32436	6	0.0055

Dependent variable: D(PD)

Excluded	Chi-sq	df	Prob.
D(GDP)	3.332156	2	0.189
D(PC)	2.55819	2	0.2783
D(SMC)	5.767348	2	0.0559
All	13.9056	6	0.0307

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	2.991969	2	0.224
D(PC)	2.839648	2	0.2418
D(PD)	1.482888	2	0.4764
All	8.715107	6	0.1902

Table 24: BS VEC Granger Causality 1990 - 2015

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/21/18 Time: 23:48
Sample: 1990 2015
Included observations: 46

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	6.719686	2	0.0347
D(PD)	29.29852	2	0
D(SMC)	9.86392	2	0.0072
All	50.56416	6	0

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	7.742076	2	0.0208
D(PD)	4.654027	2	0.0976
D(SMC)	3.741385	2	0.154
All	10.74714	6	0.0965

Dependent variable: D(PD)

Excluded	Chi-sq	df	Prob.
D(GDP)	2.829279	2	0.243
D(PC)	0.439682	2	0.8026
D(SMC)	9.401368	2	0.0091
All	15.29534	6	0.0181

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	0.472519	2	0.7896
D(PC)	1.901625	2	0.3864
D(PD)	1.012644	2	0.6027
All	5.528174	6	0.4781

Table 25: BS VEC Granger Causality 1995 - 2015

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/21/18 Time: 23:49
Sample: 1995 2015
Included observations: 42

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	3.478406	2	0.1757
D(PD)	22.32557	2	0
D(SMC)	9.074386	2	0.0107
All	41.71664	6	0

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	10.5382	2	0.0051
D(PD)	4.749221	2	0.0931
D(SMC)	3.127723	2	0.2093
All	12.53092	6	0.0511

Dependent variable: D(PD)

Excluded	Chi-sq	df	Prob.
D(GDP)	2.919199	2	0.2323
D(PC)	0.572985	2	0.7509
D(SMC)	7.580209	2	0.0226
All	14.04185	6	0.0292

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	1.860932	2	0.3944
D(PC)	2.544088	2	0.2803
D(PD)	0.569064	2	0.7524
All	6.686994	6	0.3508

Table 26: IC VEC Granger Causality 1990 – 2015

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/22/18 Time: 09:11
Sample: 1990 2015
Included observations: 46

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	2.538391	2	0.2811
D(PD)	12.06272	2	0.0024
D(SMC)	19.6121	2	0.0001
All	39.42923	6	0

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	7.08399	2	0.029
D(PD)	1.057134	2	0.5894
D(SMC)	3.461238	2	0.1772
All	18.82537	6	0.0045

Dependent variable: D(PD)

Excluded	Chi-sq	df	Prob.
D(GDP)	3.431271	2	0.1798
D(PC)	1.192062	2	0.551
D(SMC)	1.008466	2	0.604
All	5.340252	6	0.501

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	1.08539	2	0.5812
D(PC)	0.355157	2	0.8373
D(PD)	9.837483	2	0.0073
All	11.73209	6	0.0682

Table 27: IC VEC Granger Causality 1995 – 2015

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 12/22/18 Time: 09:30
Sample: 1995 2015
Included observations: 42

Dependent variable: D(GDP)

Excluded	Chi-sq	df	Prob.
D(PC)	2.095245	2	0.3508
D(PD)	11.1627	2	0.0038
D(SMC)	17.72139	2	0.0001
All	35.68545	6	0

Dependent variable: D(PC)

Excluded	Chi-sq	df	Prob.
D(GDP)	3.830689	2	0.1473
D(PD)	1.29545	2	0.5232
D(SMC)	4.010157	2	0.1346
All	17.9446	6	0.0064

Dependent variable: D(PD)

Excluded	Chi-sq	df	Prob.
D(GDP)	0.619695	2	0.7336
D(PC)	1.490818	2	0.4745
D(SMC)	1.503224	2	0.4716
All	3.812269	6	0.7021

Dependent variable: D(SMC)

Excluded	Chi-sq	df	Prob.
D(GDP)	0.723632	2	0.6964
D(PC)	0.264182	2	0.8763
D(PD)	7.550434	2	0.0229
All	10.06115	6	0.1221