The effect of exchange rate volatility on bond market development in emerging markets

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Dedication and acknowledgements

I dedicate this thesis to my wonderful son who changed my life and made me stronger. May the existence of this dissertation be a constant reminder to you that all things are possible through Christ who strengthens us (Philippians 4:13), that God is able (Ephesians 3:20-21) and that He can be trusted to fulfil His promises (Daniel 6; Psalm 121 and Psalm 130:5).

Thank you to God for carrying me through one of the most difficult processes I have ever undergone. Thank you to my brother, two sisters and the rest of my family for your support. Thank you to my supervisor Dr. Thanti Mthanti for your patience, guidance and always providing meaningful insight.

Thank you to my mom for your prayers, love and support. Your prayers carried me every day. This paper is for you.

To my father who was at the forefront of my mind as I was completing this paper, thank you for always believing in me, loving me and leading your family with integrity, joy, love, faith and positivity. I finished this paper because of you and for you. I hope you are proud.

Abstract

This paper examines the effect of exchange rate volatility on bond market development in 13 emerging markets for the period 2000 to 2020 as well as whether the investor base moderates the relationship between exchange rate volatility and bond market development for the period 2004 to 2020.

Using a panel data set and the feasible generalized least squares (FGLS) method we find that exchange rate volatility has a negative and statistically significant relationship to bond market development. This finding is consistent with existing literature. We also find that the investor base has a negative and statistically significant relationship to bond market development and that in the emerging markets where there is a higher level of foreign investors and exchange rate volatility there are higher levels of bond market development.

Policymakers should therefore implement policies that manage and reduce exchange rate volatility to support bond market development. These can include ensuring that central banks hold healthy levels of foreign exchange reserves to be able to support their currency in a crisis. Policymakers in unrated countries should also engage with reputable external credit rating agencies for foreign investors to have externally validated information on the sovereign's ability to meet its obligations and therefore increase the attractiveness of the local bond market to foreign investors.

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List of Abbreviations

ADB	Asian Development Bank
ADRs	American Depositary Receipts
BIS	Bank for International Settlements
BMD	Bond market development
BRICS	Brazil, Russia, China, India, South Africa
CAPM	Capital Asset Pricing Model
CPI	Consumer Price Index
DAME	Developing Africa and Middle East
DAP	Developing Asia and Pacific
DRC	Democratic Republic of Congo
EMEs	Emerging Market Economies
EMs	Emerging markets
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFC	Global financial crisis
ICRG	International Country Risk Guide
IFC	International Finance Corporation
IMF	International Monetary Fund
LBMD	Local bond market development
LCBM	Local currency bond market
LIDCs	Low-Income Developing Countries
MINT	Mexico, Indonesia, Nigeria, Turkey
NEER	Nominal Effective Exchange Rate
SDGs	Sustainable Development Goals
SSA	Sub-Saharan Africa
US	United States

CHAPTER 1: INTRODUCTION

1.1 Background of the study

The Global Infrastructure Hub estimates that by 2040, the global annual infrastructure financing that will be required to meet the SDGs will be $800 billion (World Economic Forum, 2019). Historically, infrastructure projects have been funded by public institutions. This has however begun to change in recent decades with the rise of private-sector funding (Chong & Poole, 2013). Despite the increased private sector funding, most infrastructure projects still require some government financing.

In the post-pandemic environment EMs have higher fiscal deficits and debt (Lubin, 2021), increased financing requirements to fund support packages for citizens as well as industries negatively affected by the pandemic, and decreased ability to cut domestic interest rates, EMEs need policies to be better integrated so governments achieve the economic growth and political stability they require to continue successfully raising funding to meet their domestic agendas, including the funding of critical infrastructure projects.

An area on which EM governments can focus to help support and diversify their debt-raising sources is their bond markets. Bond markets are important for governments and central banks for multiple reasons. Some of these reasons include (i) being a way for governments to fund budget deficits in a non-inflationary way (Rose et al., 2015a) resulting in more effective monetary policy, and (ii) helping stabilize financial markets by increasing the duration of debt and, in the case of LCBMs, reducing currency mismatches, (iii) helping to generate market-related interest rates (Committee on the Global Financial System, 2007) and (iv) being an effective way to connect capital providers and users.

Bond markets in EMEs are, however, underdeveloped and, to date, many EMEs have limited access to global capital markets or sufficiently large or liquid local bond markets. A focus on developing sufficiently large and liquid bond markets in emerging economies is therefore important to help increase governments' sources of funding.

Table 1:The current state of Bond Markets in Emerging Markets

As % Of GDP	Total Outstanding Debt Securities			Outstanding Domestic Debt Securities			Outstanding International Debt Securities		
	1990	2000	2020	1990	2000	2020	1990	2000	2020
Emerging market and developing economies									
Developing Africa and Middle East									
Egypt	0%	0%	12%	0%	0%	0%	0%	0%	12%
Morocco	0%	0%	10%	0%	0%	0%	0%	0%	10%
Qatar	0%	23%	39%	0%	0%	0%	0%	23%	39%
Saudi Arabia	0%	77%	34%	0%	77%	19%	0%	0%	16%
South Africa	30%	36%	109%	29%	32%	98%	2%	4%	11%
United Arab Emirates	0%	2%	48%	0%	0%	0%	0%	2%	48%
Developing Asia and Pacific									
China	1%	18%	123%	0%	17%	121%	1%	1%	2%
India	1%	2%	42%	0%	1%	40%	1%	1%	3%
Indonesia	2%	30%	45%	0%	28%	31%	2%	2%	14%
Korea	1%	8%	163%	0%	0%	150%	1%	8%	13%
Malaysia	14%	16%	137%	0%	0%	121%	14%	16%	16%
Pakistan	0%	1%	50%	0%	0%	48%	0%	1%	2%
Philippines	2%	20%	57%	0%	0%	38%	2%	20%	19%
Thailand	1%	9%	97%	0%	0%	93%	1%	9%	4%
Vietnam	0%	3%	1%	0%	0%	0%	0%	3%	1%
Developing Europe									
Czech Republic	0%	2%	14%	0%	0%	0%	0%	2%	14%
Hungary	0%	21%	90%	0%	0%	72%	0%	21%	18%
Poland	0%	3%	12%	0%	0%	0%	0%	3%	12%
Russia	0%	15%	35%	0%	0%	28%	0%	15%	7%
Turkey	3%	7%	43%	0%	0%	22%	3%	7%	21%
Developing Latin America & Caribbean									
Argentina	0%	31%	56%	0%	0%	28%	0%	31%	28%
Brazil	0%	13%	142%	0%	0%	135%	0%	13%	8%
Chile	0%	10%	37%	0%	0%	0%	0%	10%	37%
Colombia	0%	8%	63%	0%	0%	40%	0%	8%	23%
Mexico	15%	11%	86%	0%	0%	58%	15%	11%	28%
Peru	0%	8%	63%	0%	0%	31%	0%	8%	32%

Source: *Bank for International Settlements (BIS) database used for bond market data; GDP data from World Bank Indicators database used for GDP data. BMD is measured as total outstanding debt securities as a percentage of GDP.*

EMEs globally have made progress over the past three decades in developing bond markets, with the developing Asia and Pacific (DAP) region showing the most significant progress. Africa, however, continues to lag with the lowest levels of BMD measured, which indicates that LBMD remains elusive for most African countries. As of the end of 2020, South Africa was the only African country with any outstanding domestic debt securities in Developing Africa and Middle East (DAME) region. South Africa held 43% of outstanding domestic debt in the region and the balance was held by Saudi Arabia (17%) and Israel (40%). Outstanding international debt securities are however held by 20 African countries in total, a significant increase from 1990 levels where only two African countries (Algeria and South Africa) held international debt securities. Although the trends are positive, they indicate that LBMD remains elusive for most African countries, who, therefore, suffer quite acutely from the phenomenon of "original sin" first hypothesized by Eichengreen and Hausmann in their paper (1999). Original sin is the inability to raise debt in domestic currency. This inability exposes the borrower to increased exchange rate risks and increases its financial fragility. African states particularly face this risk considering their prevailing inability to raise funding in domestic currency.

Although table 1 reflects an increase in the size of bond markets in EMs, it does not provide any information on the liquidity, composition of investor bases and volatility of these bond markets. This paper aims to add to the literature by considering these additional measures of BMD for EMs.

A factor that may impact LCBM in EMs is that they also have small domestic institutional investor bases. As a result, local currency bond and stock markets in EMs rely on foreign portfolio investors for their growth. If these foreign investors measure their returns in foreign currencies such as dollars or other developed economy currencies, then they are likely to be sensitive to all risk factors that may erode returns on unhedged investments in EMs. An important risk factor that has the potential to erode their returns is the exchange rate. In addition, borrowing in local currency does not insulate EMs from the impact of exchange rate volatility if a significant portion of that debt is held by foreign investors. This is the case in most EMs as demonstrated during the pandemic, which saw portfolio investors respond to exchange rate depreciation in EMs by disinvesting from those markets (Hofmann et al., 2020). The impact of exchange rate volatility on BMD in EMs therefore warrants further study, as it has the potential to materially hinder development in these markets.

1.2 The research problem

Post the Covid-19 pandemic, most EMs are highly indebted with public and external debt to GDP reaching levels of 59% and 44% in most of these markets (Duttagupta & Pazarbasioglu, 2021). These increased debt levels are because governments needed to fund rescue packages for households and sectors negatively impacted by the pandemic.

Despite high levels of indebtedness, governments still require financing to fund public investments and meet development goals. Raising funding will however be difficult given the current state of high indebtedness of these economies. It is therefore vital that EMs have a diverse sources from which to raise funding. One such option is the bond markets, but most EMs have underdeveloped bond markets. Much of the current literature on bond markets in Africa, Asia and other emerging markets details the determinants of BMD and policy interventions needed to successfully develop domestic bond markets. In their paper Adelegan and Radzewicz-Bak (2008) study the determinants of BMD in 23 sub-Saharan African countries between 1990 and 2008. The paper measures BMD by considering the size and stage of development of the bond market, and finds that a combination of factors such as investment profile, law and order, level of economic development, size of the banking sector and various macroeconomic factors impact the development of domestic bond markets in SSA.

Most of the papers that analyse bond market development use a single factor as a measure of BMD such as bonds outstanding as a percentage of GDP, size of bonds outstanding, and/or capitalization of the bond market. None of the papers use a combination of the size, liquidity, volatility, and investor base of the bond market to measure BMD in one paper. This paper will add to the literature by measuring development in a broader way.

There is also limited research that specifically considers and examines the effect of exchange rate volatility on bond market development. In addition, most of the available research focuses on developed markets or emerging markets in Asia or Latin America with limited research on SSA countries and other EMs. This study thus aims to add to the existing literature by examining the relationship between exchange rate volatility and LBMD in a wider range of EMs.

'Emerging markets' is a term used to refer to those economies that experience high levels of economic growth and exhibit a combination of characteristics of developed and developing countries. Although many EMs have long histories (Goetzmann & Jorion, 1997) there is limited economic research, with researchers usually citing insufficient data to support conducting meaningful research. In addition, research has shown that EMs have high returns and low correlations with other markets (Goetzmann & Jorion, 1997). As a result, completing this research on EMs is likely to provide different insights than those obtained from developed markets given the low correlation EMs have to other markets.

1.3 Justification of the research

A significant portion of the literature that investigates exchange rate volatility focuses on the effects on foreign portfolio flows, financial markets, and sovereign bond yields in developed markets, as well as in EMs in Latin America and Asia. Studies devoted to the relationship between exchange rate volatility and BMD in SSA and other EMs are still limited. This study aims to contribute by providing insights to the role of exchange rate volatility as a determinant of BMD for EMs which policymakers and governments can use to support policy decisions.

Bond markets are important in emerging economies as they:

(i) *reduce exposure to external financial shocks* - the 2008/9 economic crisis negatively affected emerging and low-income countries including private capital inflows in emerging markets drying up as capital flight to safety occurred, FDI fell in several LIDCs, remittances to developing and low-income countries fell, reserves became dangerously low in some countries such as the DRC and banking stresses in some low-income countries (te Velde et al., 2010). Having a well-developed LCBM with a broad local investor base can protect emerging markets from some of the exposure and impact of similar external financial shocks.

(ii) *reduce the risk of original sin* (Eichengreen & Hausmann, 1999) – many emerging economies have traditionally been unable to raise long-term funding in their local currency from foreign investors. This has led many emerging economies to have currency mismatches and ultimately currency crises when their exchange rates come under pressure. LCBM can reduce original sin as it allows for borrowing in local currency and providing a space for foreign investors to buy local currency bonds with longer tenures.

(iii) *are a source of funding for development* – Given the global infrastructure funding gap which is estimated to be $800 billion by 2040 (World Economic Forum, 2019) developed LCBMs could be an important funding source for EMs and help bridge this gap through the issuance of government and project bonds

(iv) *aid in developing LCBM* has broader positive implications for emerging economies as the work required to support the development of LCBMs such as developing a stable macroeconomic environment, small fiscal balances, better institutional quality and strong democratic political systems, Burger and Warnock (2006); Essers (2016); Mu et al., (2013) have broader positive economic implications for an economy

(v) *in the African context BMD can help improve the structure of the financial system* in Africa which is dominated by banks. Bond markets can be a source of long-term financing for corporates to finance their growth and for governments to finance fiscal deficits and infrastructure development as bond markets provide longer-term financing as opposed to banks' short-term financing (Mu et al., 2013) and lastly

(vi) *deeper bond markets will provide a wider range of instruments* that central banks can use to for sterilization in addition to short term government debt. This will enable central banks to more effectively conduct monetary policy (Mu et al., 2013).

This study also aims to add to the work on foreign exchange rates and the multiple effects they can have on economies. This understanding can help EM policymakers better navigate the financial volatility caused by exchange rate volatility in their economies.

1.4 Research questions

Based on the discussion above, the primary research question that this study will investigate encompasses the following:

Is exchange rate volatility a significant determinant for local currency bond market development in emerging markets?

In addition to the primary research question, this study will also examine the following sub-questions:

i. *Is exchange rate volatility a significant determinant for the size of the bond market?*
ii. *Is exchange rate volatility a significant determinant for the volatility of the bond market?*
iii. *Is exchange rate volatility a significant determinant for the liquidity of the bond market?*

By posing the above research questions to focus on the impact of exchange rate volatility on the size, liquidity and volatility of bond markets in emerging markets separately we are expanding the definition of BMD.

A follow-up research question is:

Does the investor base moderate the relationship between exchange rate volatility and local currency bond market development in emerging markets?

Answering these research questions will provide an update on the current state of LCBMs in Ems as the study will consider data for the period 2000 to 2021. In addition, it will add to the existing literature thereby helping to better inform policy decisions to support BMD in Ems.

1.4.1 Scope

The above research questions will be answered using a sample of 13 emerging markets (i.e. Brazil, Chile, Colombia, Egypt, Hungary, Indonesia, Malaysia, Mexico, Peru, Philippines, Russia, South Africa and Thailand) for the period 2000 to 2020 using annual observations.

The study therefore includes five (5) Latin American countries three of which have the largest economies in Latin America. We have also included three (4) Southeast Asian countries, two (2) East European countries being Russia and Hungary with Russia being classified as an emerging economy but being the eleventh largest economy in the world by nominal GDP. Lastly the study also includes two (2) countries in Sub-Saharan Africa both of which have some of the highest GDPs in Sub-Saharan Africa. Therefore although all the countries included in the study are classified as emerging markets they are a mix of strong and weak emerging market economies.

A limitation of this paper is that there are only two countries in Sub-Saharan Africa in the sample. This is due to data limitations where other countries considered did not have all the data required for this study. Another limitation of the study is the fact that although all countries in the sample are considered emerging markets they are in different regions and have different economic profiles therefore one has to exercise caution when attempting to generalise the findings. (Chacko, 2004; Campbell & Mentschel, 1991; Poterba & Summers, 1981; Schmalensee & Trippi, 1978; Won et al., 2013; Smaoui et al., 2017a; Adelegan & Radzewicz-Bak, 2008; Bhattacharyay, 2013a; Mu et al., 2013; Vasse, 2019)

1.5 Research objectives

The purpose of this study is to determine the impact of exchange rate volatility on BMD in emerging markets and provide meaningful insights that policymakers can use to foster BMD in emerging market economies.

This study has six aims:

(i) to provide an update on the current state of LCBMs in EMs.

(ii) to contribute to the literature by focusing on the role of exchange-rate volatility as a determinant of BMD in EMs.

(iii) to contribute to the literature on exchange rate volatility's impact specifically on bond markets as most of the literature focuses on the impact of exchange rate volatility on equity markets.

(iv) to contribute to the literature by expanding the definition of BMD to include consideration of the factors of size, liquidity, volatility, and investor base of bond markets to assess the level of development.

(v) to add to the existing literature on exchange rate volatility and provide further insights on its effect on financial markets.

(vi) to provide insights to policymakers on the implications of exchange rate volatility on bond markets to help better inform policy decisions to support BMD in EMs and more effectively navigate the financial volatility caused by exchange rate volatility.

This study is organised as follows: chapter 2 is the literature review, Chapter 3 outlines the methodology of the study, Chapter 4 presents and discusses the findings and Chapter 5 outlines the conclusion and recommendations.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

The literature review is divided into four parts. Part one focuses on BMD in EMs. Part two considers studies that investigate the relationship between exchange rate volatility and bond markets. Part three discusses the results of studies that explored the relationship between investor bases and bond markets. Part four concludes the literature review.

2.2 Theoretical framework

Bond markets can provide an alternative source of funding for emerging market governments. As a result, the development of large, liquid and stable bond markets should be a target for all emerging market governments. There has been much research regarding the determinants of BMD in different economies. Some of the determinants for BMD have been found to be factors such as the size of the economy, GDP per capita (Eichengreen & Hausmann, 1999), trade openness, capital controls (Adelegan & Radzewicz-Bak, 2008), fiscal balance, interest rate volatility (Bhattacharyay, 2013b) and exchange rate volatility.

When considering strategies to develop bond markets in emerging market it would be useful to consider what challenges face emerging market economies that could be hindering BMD. An example of one that plagues many emerging markets is exchange rate volatility. Understanding exchange rate volatility and how it impacts BMD could aid policymakers to implement more effective policies to foster BMD.

The determinants of exchange rate volatility have been found to include trade openness, value of a country's reserve assets, central bank intervention, the stock market index, the productivity of an economy (Ramli, 2019), the factor of news of the country, exchange rate regimes (Stančík & Stančík CERGE-EI, 2006). Some additional factors include domestic investment, government expenditure, money supply, foreign direct investment (Kilicarslan, 2018) and interest rate movements (Ajao, 2015). For countries dependent on mineral resources for income, commodity prices are also found to affect exchange rate volatility (Mpofu, 2016).

The literature therefore alludes to the fact that there are some factors that affect both BMD and exchange rate volatility. These factors include trade openness, capital controls, GDP, interest rate volatility, reserve balances and fiscal balances of a country. Using this understanding of the link between the determinants of BMD and the determinants of exchange rate volatility as a basis, the literature review will consider BMD and the literature available on the impact of exchange rate volatility on BMD in emerging markets.

2.2 Determinants of Bond market development in emerging markets

Sharma (2001) analysed the underlying constraints on corporate BMD in Southeast Asia. This was done by interviewing heads of finance in large corporations, experts at the ADB, rating agencies' representatives, foreign and local institutional investors, and investment and central bankers. The paper aimed to add to the existing literature by unpacking the influence of underlying institutional characteristics on corporate bond markets and the institutional constraints hindering these markets' development, particularly in Indonesia, Thailand, and Malaysia. The author chose Indonesia, Malaysia, and Thailand due to their similarities related to financial liberalization from the late 1980s to the early 1990s, issues in the banking sector, and the structure of their financial systems. Findings were that in Indonesia, Malaysia, and Thailand, the development of the corporate bond market is dependent on the institutional environment, and found that institutional issues and market infrastructure conditions are complementary to developing corporate bond markets and should not be viewed in isolation. Sharma recommends reforms such as improving the legal processes in those countries, reforming the banking and corporate sectors, and increasing business transparency, however, these recommended reforms should not be implemented in a vacuum but rather together with efforts to improve the regulatory environments in these markets to make them more favourable for local and foreign investors as well as implementing policies that strengthen market infrastructure.

Menon (2007) discusses requirements for the successful development of domestic bond markets in EMEs as well as the role that regulators can play to facilitate that development, and also considers what strategies can be employed to help increase market liquidity and diversify the product base of the bond markets. The paper discusses the prerequisites for the development of a domestic bond market including a stable political and macroeconomic environment, an economic expansion that supports issuers and investors, low inflation levels and low-interest-rate volatility, relatively high investment rates, and high levels of savings, a conducive regulatory and legal framework, a diversity of products, a diverse supply of high credit quality paper with a diverse issuer base, availability of hedging instruments, a broad investor base, a benchmark yield curve to attract a broad base of investors, cost-effective and reliable trading and clearing systems, an efficient pricing mechanism to encourage active trading, independent and credible rating agencies and tax equality and efficiency so that tax-related to bonds is at least comparable to other sources of financing. Menon(2007) also touches on some key challenges in developing bond markets, citing over-reliance on the banking sector, too much red tape in the issuance process, lack of investment-grade issuers, large conservative institutional funds which can crowd out the investor market, lack of reliable benchmark yield curves, illiquid markets and deficient pricing infrastructure and insufficient transparency.

To deepen bond market liquidity Menon (2007) suggests tax incentives for investors to encourage foreign investor participation in domestic bond markets, improve trading infrastructure, and innovative structures to enhance issuers' credit quality. He notes the role that the central bank can play including simplifying the bond issuance approval process, regularly issuing benchmark bonds to provide price guidance and enhance the liquidity of the bond market, endorsing cross-border issuances, establish prudent investment guidelines for insurance companies, encourage working groups of market participants (e.g. issuers, investors, arrangers, rating agencies, legal and accounting firms, and other regulators) to cultivate a conducive environment. The paper considered the Malaysian experience and the trajectory of the growth of its domestic bond market and found some lessons that other EMs could learn from Malaysia including that governments need to act as strong facilitators to spearhead the development of their domestic bond markets; pension and insurance funds can be mobilized to fuel BMD; and, adopting international best practices while considering domestic requirements, can help attract international investors.

Amid concerns that emerged following the GFC about how much access to donor funds countries in SSA would continue to have on which they previously depended, the need for domestic and regional bond markets to be developed in Sub-Saharan Africa became clearer. Adelegan et al., (2008) in their paper aimed to better understand what determines bond market development in SSA to better inform policymakers in the region about how to foster this development. Through a regression analysis completed on data on 23 sub-Saharan African countries between 1990 and 2008, the authors conclude that a range of factors collectively result in LCBM underdevelopment in SSA. These factors include the level of economic development in the country, the size of the banking sector, investment profile, economic structure, and law and order. In addition, macro-economic factors such as exchange rates, interest rates, fiscal balances, and whether a country has capital controls or not, also matter. These findings are consistent with those of Eichengreen and Luengnaruemitchai (2004a).

Adelegan recommends that regional approaches to BMD are considered, competition encouraged, governments should focus on implementing appropriate macroeconomic policies, and the investment environment be improved if BMD is to be achieved in the SSA economies analysed.

Burger et al., (2012) examined the development of LCBM in EMEs for the period 2001 to 2008. The paper finds that EMEs have made significant progress in developing LCBMs through establishing the required institutional frameworks and creditor-friendly policies, particularly over the analysed period. Latin America, which was most reliant on foreign currency-denominated bonds, has made the most progress in developing its LCBM. EMEs with stronger legal rights and lower inflation volatility have been most effective at developing their LCBM. In response to this development in LCBMs in EMEs US investors have significantly increased their EME bond holdings from less than $2 billion in 2001 to over $27 billion by 2008. BMD in EMEs fared well during the decade preceding the 2008 GFC due to EMEs enjoying relative stability over that time. The GFC however bought some turbulence to the international financial system. Despite this global financial shock, EMEs were better insulated and did not experience a currency crisis on the same scale as the 1997/1998 Asian currency crisis due to the existence of more robust LCBMs.

Essers et al., (2016) study the current state of local currency government BMD in 17 SSA countries. The paper finds that good progress has been made in developing local currency government bond markets in many African countries. In addition, more African countries can issue fixed-rate local currency bonds with tenures of ten years and more indicating increased LCBM development. Despite the progress made, the paper also finds that many LCBMs in Africa continue to have low levels of liquidity and narrow investor bases made up mostly of domestic banks. In addition, African countries with lower inflation, common law legal origins, higher institutional quality, lower fiscal balances, and stronger democratic political systems have larger government LCBMs. The paper also finds that past debt relief, alternative financing sources including aid, lower interest rate variability, and lower bank lending spreads may be linked to LCBM capitalization – and that further research is required in this area. These findings confirm other literature on the determinants of BMD in Africa (Mu et al., 2013); (Adelegan & Radzewicz-Bak, 2008). The paper focused mainly on LCBM capitalization ignoring other aspects of LCBM development such as liquidity, secondary market turnover, bid-ask spreads, and bond yields.

Presbitero et al., (2016) unpack what LIDCs can learn from other emerging market and low-income countries about what drives market access and the ability to have successful sovereign bond issuances. Using a two-equation system that reports the coefficients and the associated standard errors of 105 developing countries for the period 1995 to 2014, they found that the size of a country, macroeconomic performance including their fiscal position and liquidity, institutional strength, and the prevailing global conditions all have an impact on the success of sovereign bond issuances and the spreads thereof. The research also finds that the US interest rates and commodity prices have a bigger impact on sovereign bond issuances in SSA compared to other regions, and that global interest rates affect sovereign bond issuances as a lower US interest rate environment sees more sovereign bond issuances at higher spreads.

The findings support work done by Gelos et al., (2011); Olabisi and Stein (2015) on the negative correlation that exists between the level of central bank reserves that a country has and its probability of issuing sovereign bonds.

Smaoui et al., (2017a), empirically investigate the determinants of BMD for a sample of 22 emerging and developing countries for the period 1990 to 2013. The paper finds that a combination of macroeconomic, institutional, financial, and structural factors has an impact on BMD. Better fiscal balances and higher interest rate volatility are found to be negatively associated with BMD. More open economies, higher bureaucratic quality, better investment profiles, larger economic size, and larger and more concentrated banking sectors were found to be positive relationship to BMD. For the sample of developed economies, the research finds that macroeconomic fundamentals and economic size are the main factors that drive BMD. The paper concludes that for emerging markets to successfully develop their bond markets they should focus on implementing stable macroeconomic policies that reduce exchange rate and interest rate volatility. They should also focus on improving the quality of their governance institutions and developing their banking systems.

2.3 Exchange rate volatility and bond markets in emerging markets

Aydemir (2021) using the multivariate GARCH model, exchange rate data for the period January 2007 to November 2016, and ten-year bond interest rates for the period January 2010 to November 2016, study the effect of three important financial shocks on the volatility of ten-year bond rates and exchange rates of the Fragile Five (i.e. Brazil, Turkey, India, South Africa, and Indonesia). The financial shocks considered are the 2007-2008 GFC, the US Federal Reserve's first exit signal from quantitative easing programs given in May 2013 ("the Tapering

1 shock"), and the eventual announcement made by the US Federal Reserve indicating their tapering decision ("the Tapering 2 shock") in December 2013. The paper also investigates the interaction between the exchange rates and ten-year bond rates of the Fragile Five. The paper finds that for the Fragile Five, the tapering shocks impact bond markets more than foreign exchange markets, and indicate that bond markets are more responsive than foreign exchange markets to financial shocks. This is to be expected as the shocks considered impacted the supply of money globally and the search for yield. The Fragile Five countries were targets for investors searching for yield at the time. The paper also provides a ranking of the resilience of the Fragile Five to financial shocks, where Brazil was found to be the most fragile country.

Fidora (2006) examines the effect of home bias and exchange rate volatility on global bond and equity markets. Using a panel of 40 investor countries and 120 destination countries (with only two in Africa, Egypt and South Africa), and a Markowitz-type international CAPM model analysis covering the periods 1997 and 2001 to 2003, the results show that home bias in assets that have high local currency return volatility (i.e. equities) have a lower response to real exchange rate volatility than home bias in assets with low local currency return volatility (i.e. bonds). This finding implies that changes in real exchange rate volatility have a larger impact on bond home biases than they do on equity home biases. The paper also finds that reducing the monthly real exchange rate volatility from its sample mean to zero decreases bond home bias by up to 60% and reduces equity home bias by only 20%. These findings suggest that LCBMs are more sensitive to exchange rate volatility than equity markets and that exchange rate volatility is an important element to be considered when looking at home bias and portfolio choices made by investors about whether to invest in bonds or equities.

Gadanecz et al., (2014) empirically examine the effect that exchange rate volatility has on sovereign local currency bond yields in EMs using monthly data from January 2005 to December 2013 of 5-year local currency sovereign bond yields of 20 EMEs. They find that exchange rate risk is a key factor and determinant of EMEs' local currency sovereign bond yields. When exchange rate volatility is high in EMEs, investors expect a higher yield for holding those bonds to compensate for the increased exchange rate risk. This supports financial literature fundamentals that investors expect higher returns when they take on higher risks. The paper also finds that since May 2013 which was when the Federal Reserve first announced its plans to reduce its quantitative easing measures, investors have placed even greater importance on exchange rate risk. The paper also concludes that the findings suggest that where exchange rate exposure is hedged less the impact that exchange rate volatility has on local currency bond yields could be bigger.

With regards to studies of Asian emerging markets, Caporale et al., (2017) examine the impact of bond and equity portfolio flows on exchange rate volatility for the US vis-à-vis eight Asian emerging and developing countries using data from 1993 to 2012. The results show that both net equity and net bond portfolio inflows affect exchange rate volatility in all the countries except for the Philippines. The study further finds that specifically in the Philippines, Thailand, and Pakistan, net bond inflows increase the probability that exchange rate volatility will remain low. This could be because local currency-denominated bonds in emerging markets are relatively less liquid, and bond inflows in emerging markets are usually hedged. In Indonesia, net bond inflows were found to increase the probability of exchange rate volatility remaining high. Given that net bond and equity portfolio flows have been found to have an impact on exchange rate volatility, financial capital controls are effective tools that regulators and policymakers can use to stabilize the foreign exchange market.

Bonga-Bonga and Gnagne (2017) investigate the impact of foreign exchange market volatility on the capital markets in the BRICS countries with a specific focus on the impact of the volatility on equity returns and bond yields using a multivariate GARCH-M with BEKK specifications and using different periods based on the availability of data. The paper finds that exchange rate volatility has a positive effect on ten-year bond yields in all the BRICS countries except South Africa. Additionally, exchange rate volatility is found to have a positive effect on equity returns in South Africa, India, and Brazil and a negative effect on equity returns in China and Russia. These findings are consistent with those presented by Fang et al., (2002) and Kim (2003) with Kim finding that the exchange rate becomes an important consideration in equity returns when there is an increase in capital worldwide. These findings indicate that investors who participate in capital markets in the BRICS countries expect high returns to compensate for the existing risks, and demonstrated by the fact that as per the paper's findings, both bond yields and equity returns will increase with an increase in exchange rate volatility for many of the BRICS countries. Policymakers in the BRICS countries can use these insights to implement more specific and rigorous exchange rate policies to better manage exchange rate volatility and financial market returns.

Leung et al., (2019) study the effect of exchange rate risk on EMEs bond fund flow volatility given the significant growth in local currency bond funds in EMEs over the past decade. They use quantile regression and bivariate VAR-GARCH and BEKK representation and data for the period January 2004 to July 2019. Their research finds that exchange rate volatility has a bigger effect on the volatility of fund flows of local currency bond funds than on fund flows of hard currency bond funds in EMEs. Given the significant growth in local currency bond funds in EMEs over the last decade, this finding means that EMEs are more likely to experience volatile capital flows during significant foreign exchange movements.

The findings imply that foreign investors may not have sufficient tools to hedge against EME foreign exchange risk resulting in foreign investors being forced to move their funds in and out of emerging market economies during periods of increased foreign exchange volatility. EMEs, therefore, need to focus on developing robust and liquid derivative markets that offer hedging tools to enable foreign investors to better manage their exchange rate risk without needing to disinvest in local currency bond funds in times of foreign exchange volatility. Policymakers and regulators also need to focus on developing and deepening domestic investor bases so more local investors are invested in local currency bond funds, thereby reducing some of the need to hedge foreign exchange volatility when it occurs.

Meyer et al., (2020) examine the impact of exchange rate volatility on the South African government bond market using the GARCH technique and monthly data from January 2000 to December 2018. The research found that exchange rate volatility is a factor that hinders the BMD by discouraging foreign investment in the market. A 1% increase in exchange rate volatility depressed the bond market by 0.06%. The research also found that economic growth and inflation have positive and negative effects respectively on bond markets in the long term. A country's fiscal and monetary authorities, therefore, need to cooperate to ensure that policies formulated and implemented reduce the level of exchange rate volatility in the country. The findings of this paper corroborate those of Mu et al., (2013) who found that exchange rate volatility is one of the factors that is negatively correlated to bond market capitalization in African countries.

Hofmann et al., (2019) try to better understand the link between exchange rates and emerging market bond premia through an empirical investigation of the impact of the exchange rate on sovereign bond markets using data for the period January 2005 to December 2017. They find that where an EME's exchange rate against the US dollar appreciates (depreciates), it leads to a reduction (increase) in the credit risk spreads of that emerging market leading to lower (higher) local currency bond spreads. This finding implies that exchange rate movements of

EMEs when measured against the US dollar are used by the market as a proxy to measure the credit risk of the EMEs. The relationship holds specifically for bilateral exchange rates against the US dollar and not the nominal effective exchange rate (NEER). They also find that exchange rate shocks have a larger effect on foreign currency bond spreads than on local currency bond spreads. The paper deduces that exchange rate depreciation goes hand in hand with increasing credit risk. In addition, establishing LCBMs helps emerging market economies be more resilient to exchange rate shocks. Finally, the paper concludes that policymakers should focus on three areas which include: i) policies to reduce the volatility of exchange rates, ii) taking the time to develop a domestic institutional investor base whose investment decisions will not be informed by currency fluctuations, and iii) focus on putting measures in place that slow down bond flows when currency appreciates so exchange rate volatility is lower. The findings support the idea that to the extent that EME local currency bonds are held by global investors, EME borrowers are no longer exposed to currency mismatches. However, it is important to note that the currency risk has not disappeared but has been transferred given that exchange rate fluctuations still affect the decisions made by global investors investing in EME bonds and thus, EME borrowers still ultimately feel the effect.

Aydogan et al., (2007) investigate what impact exchange rate volatility has on international portfolio flows from the United States to the BRICS and MINT countries as a driver of portfolio home bias (i.e. the fact that investors have been shown to prefer investing in their home countries' equity). They explore this using the VAR-BEKK-GARCH model for the period 1993 to 2017 and find that exchange rate volatility negatively impacts net equity flows in Turkey, India, Brazil, and Russia. These findings support Hau and Rey's (2006) results which indicate that the uncertainty of exchange rate affects net equity flows and not bond flows, as bonds are usually well-hedged and therefore less affected by exchange rate volatility, which also supports Fidora et al., (2007), and Caporale et al., (2017). The paper also found that in South Africa, Mexico, and Indonesia exchange rate volatility does not induce any home bias for both net equity and net bond flows.

Regarding local and global financial and currency crises, the paper found that the global financial crisis in particular increases the impact of exchange rate volatility on international portfolio flows in BRICS and MINT countries.

The results are therefore mixed for the MINT and BRICS countries and no general conclusions can be drawn from the paper. However, the findings can be useful to financial regulators and policymakers in the countries where the exchange rate is impacted by net portfolio flows, and these countries, implementing credit and capital controls on net portfolio flows could help reduce exchange rate volatility and help stabilize these economies. Portfolio flows should therefore be regulated and monitored by monetary officials and policymakers to better manage foreign exchange volatility and capital inflows.

2.4 Investor Base and impact on bond markets

In the literature, limited attention is paid to bond investors. The group is often assumed to be homogenous and transient often holding bonds for a limited period before selling them. However, corporate bonds are often illiquid assets when compared to government bonds and stocks, which suggests that bond investors are likely not homogenous or transient. Insurance companies and pension funds usually manage large bond portfolios and given the profile of their liabilities usually hold on to bonds for long periods. Asset managers on the other hand are often chasing performance targets and are likely to sell off bond holdings more frequently to meet performance targets. They are also exposed to market-based runs as evidenced by the credit market distress seen in 2008, which demonstrated that runs could also occur in bond funds. Therefore, if bond investors are non-transient then the composition of the investor base and may have implications on bond markets and BMD (Massa et al., 2013).

Claessens et al., (2007) analyse if macroeconomic and institutional factors affect the level of foreign and domestic currency government bonds by looking at developed and developing countries for the period 1993 to 2000. They find that factors such as inflation, fiscal balance, and legal orientation, economies that have relatively underdeveloped financial systems and small investor bases have smaller LCBMs, because smaller local domestic investor bases mean a lower demand for local currency-denominated debt. Countries are therefore forced to issue more foreign currency debt to cater to foreign investor demand. In addition, countries with exchange rate regimes that are not flexible are found to have higher levels of foreign currency bond financing.

Massa et al., (2013)examine how firms' financing choices and leverage is impacted by bond capital supply uncertainty of institutional investors, looking at the US, Canadian, and European asset managers, US and European insurance companies, and US public pension funds for the period 1998 to 2005. The paper finds that firms' financing decisions are influenced by the supply uncertainty of their bond investor base. Firms are less likely to rely on bond financing if their bond investor base is made up mainly of high volatility or high turnover investors who are an unreliable funding source.. In addition they found that firms whose investor bases have a strong local bias, high propensity for herding, and high geographic clustering are more sensitive to supply uncertainty and less likely to rely on bond financing. The paper supports the hypothesis that the bond investor base and uncertainty around the supply of bond capital from that investor base does impact bond issuers' decisions and therefore could likely impact BMD.

Ji et al., (n.d.) examine the role that the investor base has in explaining stock co-movement using American Depositary Receipts (ADRs) information for the period 1973 to 2003 and finds that the investor base does influence stock co-movement.

Coppola et al., (2022) aim to demonstrate that the investor base is an important determinant of bond price dynamics and the success of firms in raising capital in credit crises by using data of U.S investment-grade corporate bonds that were actively traded for the period 2007 to 2020. They find that the investor base composition has an impact on bond price dynamics and the outcomes of a company's ability to raise financing in response to credit cycle fluctuations. Where an entity's bonds are owned predominantly by "safe-handed" institutional investors like insurers, who are unlikely to liquidate their investments in times of market-wide distress, those entities are better insulated during credit crises as they see lower disruptions in their primary-market bond financing and can issue more new bonds and pay a lower cost of capital during those issuances. These findings demonstrate that investor bases do matter and have an impact on firms over the credit cycle

2.5 Conclusion

The research on BMD finds that across the world, factors that impact bond market development are similar. In Sub-Saharan Africa, Southeast Asia, and other low-income developing and emerging countries, factors such as the level of economic development in the country, the size of the banking sector, investment profile, economic structure, and law and order have an impact on bond market development. In addition, macro-economic factors such as exchange rates, interest rates, fiscal balances, and whether a country has capital controls or not, also matter. These factors, therefore, need to be considered and managed by policymakers when looking at creating environments that nurture developing bond markets.

On exchange rate volatility and bond markets, the literature supports the hypothesis that exchange rate risk and volatility have an impact on bond markets, bond flows, bond spreads, and bond yields in emerging markets. The literature also supports the investment principle that investors require higher returns for taking on higher risks. It also suggests that the importance of exchange rate risk increased after the Federal Reserve announced in May 2013 that it would taper off its injection of capital into the markets. which makes sense because as cheap money started to dry up foreign investors started to pay more attention to all risks they faced in emerging markets, including exchange rate risk.

A critique of the literature, however, is it mostly narrowly defines bond market development by looking only at the size of the bond market. No meaningful analysis has been completed on the impact of exchange rate volatility on bond market liquidity or volatility. This is a limitation in the literature because for a bond market to be considered developed it should not only be large but one can also argue liquid, so investors can easily enter or exit the market, as well as stable, so there is a certainty for traditional investors who are not speculators. Another gap in the existing literature is there are minimal studies with sub-Saharan countries included as historically financial market data on sub-Saharan African countries has been limited.

The research envisioned will add to this body of literature by examining the impact of exchange rate volatility on BMD. The definition of BMD will be expanded to consider not only the size of the bond market but also its liquidity and volatility. In addition, two countries in sub-Saharan Africa will be included in the study, adding to the literature on BMD in African countries. Because data for the period 2000 to 2020 will be used an updated view on the state of BMD in the EMs included in the sample of countries will be provided.

On the investor base and BMD, the literature supports the hypothesis that investor bases impact LCBM. In addition, the literature shows a link between exchange rate risk and BMD. There is cause to investigate how investor bases could moderate the relationship between LCBM and exchange rate volatility.

CHAPTER 3: METHODOLOGY

3.1 Introduction

This paper primarily aims to empirically examine the effect of exchange rate volatility on BMD in EMs for 13 emerging market economies for the period 2000 to 2020. The secondary aim is to empirically examine whether the investor base moderates the relationship between exchange rate volatility and LCBMD in emerging markets. This section describes the research strategy and approach, sources of data and limitations to the methodology.

3.2 Research strategy and approach

In this paper we use a quantitative strategy to investigate the effect of exchange rate volatility on BMD and to examine how the investor base moderates the relationship. The strength of using a quantitative research approach for this study is that it will allow the use of standard, independent, reliable financial data that is uniform across the different countries. Using this standardised financial data facilitates the ability to accurately compare countries that are different from each other more effectively and accurately.

3.3 Data sources and data collection

The quantitative data used in this paper was sourced online from the Bank for International Settlements website, the IMF website, the World Bank website and Eikon.

3.4 Regression equation

In this paper we will be using an approach like that used by Eichengreen & Luengnaruemitchai (2004b) in their paper. In their paper Eichengreen & Luengnaruemitchai (2004b) build multiple regression models using Generalised Least Squares (GLS) with corrections made for heteroskedasticity and panel specific autocorrelation. The equations created are based on groups of variables created by the authors, and which relate to a particular feature such as development or variables related to the structure of the economy.

For this study we will create four regression equations based on groups of structural variables (Equation 1), developmental variables (Equation 2) and macroeconomic variables (Equation 3) and then all the control variables together (Equation 4).

3.4.1 The Model and Equations

The following general model is used to describe the relationship between all the control variables that have been selected and LCBM and will be Equation 4:

$$BMD_{it} = \mu_i + \beta_1 exv_t + \beta_2 SZEcon_t + \beta_3 TRDO_t + \beta_4 BNKSYS_t + \beta_5 LWO_t + \beta_6 GDPpc_t + \beta_7 InRS_t + \beta_8 INFR_t + \beta_9 CC_t + \beta_{10} FB_t + \epsilon_{i,t}$$

Where i is the country, t stands for the time period, μ is an unobserved country-specific effect, exv is exchange rate volatility and ϵ is the error term. LCBM (represented by BMD in the above model) is the dependent variable and exchange rate volatility is the independent variable and main regressor.

- Equation 1 will group all the structural variables and will be as follows:

$$BMD_{it} = \mu_i + \beta_1 exv_t + \beta_2 SZEcon_t + \beta_3 TRDO_t + \beta_4 BNKSYS_t + \epsilon_{i,t}$$

- Equation 2 will group all the developmental variables and will be as follows:

$$BMD_{it} = \mu_i + \beta_1 exv_t + \beta_5 LWO_t + \beta_6 GDPpc_t + \epsilon_{i,t}$$

- Equation 3 will group all the macroeconomic variables and will be as follows:

$$BMD_{it} = \mu_i + \beta_1 exv_t + \beta_7 InRS_t + \beta_8 INFR_t + \beta_9 CC_t + \beta_{10} FB_t + \epsilon_{i,t}$$

3.4.2 Model to answer the follow-up research question

To investigate if the investor base is a moderating factor on the impact of exchange rate volatility on LCBM the following model is employed:

$$BMD_{it} = \mu_i + \beta_1 IB_t + \beta_2 exv_t + (\beta_1 IB_t \, X \, \beta_2 exv_t) + \beta_3 TRDO_t + \beta_4 BNKSYS_t + \beta_5 LWO_t + \beta_6 GDPpc_t + \beta_7 InRS_t + \beta_8 INFR_t + \beta_9 CC_t + \beta_{10} FB_t + \beta_{11} SZEcon_t + \epsilon_{i,t}$$

Where *i* is the country, *t* stands for the period, μ is an unobserved country-specific effect, IB is the investor base of the bond market which will be determined using the investor base risk index (Vasse, 2019), exv is the exchange rate volatility and ϵ is the error term. LCBM (represented by BMD in the above model) is the dependent variable and the investor base is the independent variable and main regressor.

We run Equations 1, 2 and 3 as described above for the follow up research question as well.

3.5 Definition and measurement of sample and variables

3.5.1 The Sample

In this paper we investigate the effect of exchange rate volatility on LCBM in emerging markets using a sample of 13 emerging markets from different regions based on data availability. The countries are Brazil, Chile, Colombia, Egypt, Hungary, Indonesia, Malaysia, Mexico, Peru, Philippines, Russia, South Africa and Thailand. The data is for the period 2000 to 2020 using annual observations.

3.5.2 Description of Variables

3.5.2.1 Bond market development

In this research LCBM development is the dependent variable. We expand the definition of LCBM by considering the factors of the size (SZE), liquidity (LQD) and volatility (VOL) of bond markets as measures of LCBM development. We include liquidity as part of the measurement of LCBM development as liquidity has been found in the literature to affect bond returns (Chacko, 2004). Expected returns have an impact on investors' investment decisions about whether to invest in a particular bond market which can therefore impact how developed that market becomes over time. In addition to liquidity, the paper also includes volatility as an additional indicator to assess LCBM development. This inclusion is supported by the literature which indicates that volatility in markets increases the risk premium and therefore negatively affects asset returns (Campbell & Mentschel, 1991; Poterba & Summers, 1981; Schmalensee & Trippi, 1978; Won et al., 2013).

The empirical specifications will measure how exchange rate volatility impacts the sum of the weighted average of these proxies of bond market development and will lean on the methodology and approach used in Eichengreen & Luengnaruemitchai (2004b) in their paper and Smaoui et al., (2017a).

From an empirical perspective, we will use the sum of the weighted average of the three components of size, volatility and liquidity of bond markets. Where there is no data for liquidity we have assumed that liquidity is at its lowest, where there is no data for volatility we have assumed that volatility is at its highest. We have then reverse scored liquidity and volatility figures, standardised the three components of the size of the bond market, the liquidity and the volatility and then added the sum of the weighted average of the three components to come up with a measure of BMD.

3.5.2.2 Determinants of Bond Market Development (i.e. control variables)

According to the literature, the determinants of BMD can be summarized as factors that over the long term positively affect economic growth and development (Bhattacharyay, 2013a; Eichengreen & Luengnaruemitchai, 2004a; Mu et al., 2013). This is because development and improvement in these factors positively affects the financial markets and overall economies of these countries.

Exchange rate volatility (i.e. the main regressor)

Exchange rate volatility is found in the literature to hinder BMD as it signals increased risk which discourages investors from investing in the bond market. However, on the other hand, stable exchange rates may encourage investors to focus on bank funding which can hinder bond market development. Therefore, the coefficient of the variable can be positive or negative. We measure exchange rate volatility as the standard deviation of the log of exchange rates.

Size of the Economy

The literature indicates that larger economies have more developed LCBMs. We measure size of the economy using GDP in billions. We expect the coefficient to be positive as countries with larger GDPs should have more developed LCBMs all things being equal.

Trade openness

Trade openness gives an indication of a country's economic remoteness (Fujii, 2017). Higher trade openness implies a more open economy in general. The more open an economy, the higher the international capital inflows received by a country in hard currencies. One of the ways that capital inflows would be coming into the economy would be through investing in LCBMs. We measure trade openness as exports as a percentage of GDP. The coefficient of this variable is expected to be positive.

Size of Banking System

The size of the banking system can have a positive or negative effect on LCBM. On one hand, a bigger banking system can crowd out bond market financing; while on the other hand, banks serve an important purpose in bond market development as they serve as dealers and market makers. We, therefore, expect the coefficient of this variable to be positive or negative. We measure the size of the banking system as domestic credit from the banking sector as a percentage of GDP.

Law and Order

Countries with law and order and creditor rights which are enforced have more developed bond markets. We measure the variable using the law-and-order index (ICRG) and expect the coefficient to be positive.

GDP per capita

GDP per capita provides an indication of how prosperous the citizens of a country are and therefore the level of economic development. More developed countries usually have good corporate governance structures, transparency, low-risk investment environments, and strong creditor rights which all support LCBM development. We therefore expect the coefficient of the variable to be positive.

Interest Rate Spread

In environments where interest rate spreads are high the cost of borrowing is high. Corporates and governments are therefore likely to be less willing to go into the bond market to raise funding as it will be more expensive for them. This will likely hinder LCBM. We measure interest rate spread as the difference between the lending rate and the deposit rate/ We expect the coefficient of the variable to be negative.

Inflation Rate

Burger and Warnock (2006) and Claessens et al., (2007) find that inflation volatility is a deterrent to government bond market development. We measure inflation using CPI and expect the coefficient to be negative.

Capital Controls

Low levels of capital controls mean that an economy is more open and makes it easier for foreign investors to access and invest into that economy. Low levels of capital controls therefore result in higher LCBM development consequently we expect the coefficient of the variable to be negative. We use an index constructed by Fernández et al., (2015) to measure capital controls with zero meaning no control and one meaning total control.

Fiscal balance

A large fiscal balance means that government expenditure is higher than government revenue and the government needs to borrow more in order to plug this gap. Bigger fiscal balances are associated with bigger government bond markets. We measure fiscal balance as the central government structural balance as a percentage of GDP. We expect a positive coefficient as larger fiscal balances result in larger government bond markets.

Table 2:Summary of description of dependent and independent variables

Variable	Variable Code	Measure	Expected sign	Source
Dependent Variable				
Bond market development	BMD	Weighted average of the three bond market indicators of size of the bond market, liquidity of the bond market and volatility of the bond market	N/A	
Size of the bond market	SZE	Ratio of outstanding domestic bonds to GDP (in percentage)	N/A	Banking International System (BIS) Database
Liquidity of the bond market	LQD	Bid-Ask spread as % of Ask Price	N/A	Bloomberg/Eikon
Volatility of the bond market	VOL	Standard deviation of the log of mid prices	N/A	Bloomberg/Eikon
Main regressor				
Exchange rate volatility	exv	Standard deviation of the log of exchange rates	+/-	IMF
Investor Base	IB	Percentage of total gross government debt held by foreign investors	+/-	IMF
Control Variables				
Structural				
Size of economy	SZEcon	GDP, current (US$'000)	+	World Development Indicators, WB
Trade openness	TRDO	Export, goods and services (% of GDP)	+	IMF, International Financial Statistics
Size of banking system	BNKSYS	Domestic credit to private sector, from banking sector (% of GDP)	+/-	World Development Indicators, WB

Developmental				
Law and Order	LWO	Law and Order Index (i.e. Rule of Law Estimate)	+	World Development Indicators, WB
GDP per capita	GDPpc	GDP per Capita PPP-adjusted	+	World Development Indicators, WB
Macroeconomic				
Interest rate spread	InRS	(Lending rate - deposit rate %)	-	IMF, International Financial Statistics
Inflation rate	INFR	% Change in CPI	-	IMF, International Financial Statistics
Capital controls	CC	Index that summarizes controls over inflows or outflows, and by ten different categories of assets (0 = no control; 1 = Total control)	-	Fernandez, et al (2015)
Fiscal balance	FB	Net Lending/Borrowings of government as a % of GDP	-	IMF, International Financial Statistics

3.6 Estimation Approach

In this paper we build multiple regression models using a panel data set and the Feasible/Estimated Generalised Least Squares (FGLS/EGLS) approach with corrections made for heteroskedasticity and panel-specific autocorrelation similar to the method used by Eichengreen & Luengnaruemitchai (2004b) in their paper. We use this approach to unpack the relationship between exchange rate volatility and bond market development as well as to investigate whether the investor base has a moderating effect on this relationship. We have used this estimation approach as it has been found that it is a more efficient estimator than the ordinary least squares (OLS) method where heteroskedasticity, cross-sectional dependence and serial correlations are present (Bai et al., 2019) (Reed & Ye, 2011). In addition the fixed effects model does not provide accurate results where there is endogeneity among the variables therefore the fixed effects model would not have been appropriate either.

The presence of heteroskedasticity, cross-section dependence and serial correlation in a data set can result in inconsistent regression results. This is why it is important to identify if a model has any of these issues and choose an estimation approach that accounts for them.

3.6.1 Heteroskedasticity test

We ran a test for the presence of heteroskedasticity where the null hypothesis is that residuals are homoscedastic, and the alternative hypothesis is that the residuals are heteroskedastic. Per the results the null hypothesis must be rejected indicating that the heteroskedasticity is present.

3.6.2 Cross sectional dependence test

There is cross sectional dependence in the panel data set as tested for using the Breusch-Pagan LM test. Per the null hypothesis of the test, no cross-sectional dependence exists in the residuals. The test results indicate that the null hypothesis must be rejected and as a result cross-sectional dependence exists in the panel data set.

3.6.3 Serial correlation test

In order to test for the presence of serial correlation we used the Wooldridge test (Wooldridge, 2010). Per the test the null hypothesis in that the series of residuals is not serially correlated (H_0: The model does not suffer from serial correlation) and the alternative hypothesis is that serial correlation exists (H_1: There is serial correlation). This is tested by creating a series of residuals of the data and then running a regression model with the series of residuals as the dependent variable and the lag of the residuals as the dependent variable. If the coefficient of the lag of residuals does not equal -0.5 then the null hypothesis is rejected, and serial correlation is found to be present. The results of the Wooldridge test indicate that the null hypothesis must be rejected and that the model suffers from serial correlation.

Given the presence of heteroskedasticity, cross-sectional dependence and serial correlation, the feasible generalized least squares (FGLS) estimator method is most appropriate to deal with the above econometric issues.

3.6.4 Hausman test

In a data set there could be fixed or random effects which are unobservable which are correlated with other explanatory variables. To account for these effects, we must specify whether a fixed effect or random effects must be accounted for in our model. To determine this a Hausman test is completed (Hausman & Taylor, 1980). The Hausman test is run to determine whether the fixed effect model or random effects model is most appropriate to use given the data set. The null hypothesis of the Hausman Test states that the Random Effects Model is the most appropriate model to use. If the null hypothesis is rejected, then the Fixed Effects Model is the most appropriate model to use.

In the Hausman Test completed the results show that the null hypothesis must be rejected and as a result the fixed effects model is most appropriate to use for the data set for this study. We have therefore controlled for fixed effects in the FGLS model.

All results of the above tests conducted are attached in Annexure A.

3.7 Addressing endogeneity

Some of the variables included in the model of this study could influence each other and/or depend on each other. The endogenous variables are expected to be the following: the dependent variables liquidity and volatility of bond market development and the control variables size of the economy, trade openness, GDP per capita, interest rate spread and fiscal balance. The demand for bonds will be impacted by the prevailing interest rates as investors will determine if the interest rates make investing in bonds attractive. On the other hand, governments through their central banks can affect the interest rate and therefore make changes if they want their bonds to look more attractive thus affecting the supply of bonds. There is, therefore, reverse causality from bonds to interest rates. Inflation also affects interest rates as central banks use interest rates as a tool to manage inflation. On the fiscal balance, its size is affected by governments' ability to access debt financing. For all the variables mentioned, this paper will use two-stage least-squares method to address endogeneity. This method is used due to the sample size (13 emerging market countries) being smaller than the number of periods (21 periods).

3.8 Robustness checks to be completed

- **Alternative measure of bond market development** – we will test the impact of exchange rate volatility where LCBM is defined as only the size of the bond market, the volatility of the bond market and the liquidity of the bond market to determine if there are different insights when the definition of LCBM is modified.
- **Structural break** – to test if the impact of exchange rate volatility on LCBM has changed over time we will divide the sample period into two sub-periods: 2000-2008 (i.e. pre the global financial crisis) and 2009-2020 (post the global financial crisis) and compare those results to those over the full sample period.
- **Lagging of BMD (i.e. the dependent variable)** – we will lag BMD to determine whether the results differ when the dependent variable is lagged.

3.9 Conclusion

In this chapter we explained the research methodology we will be using; the data sources; described the independent and control variables; the models we will be using; and the estimation approach that we will be using. The results of the models and the discussion of the findings are presented in Chapter 4.

CHAPTER 4: DISCUSSION OF FINDINGS

4.1 Introduction

In this chapter we present and discuss the findings of this study. This chapter is divided into five sections as follows:

Descriptive statistics, correlation analysis, empirical results, robustness checks and empirical results on the follow up question related to the moderating relationship of the investor base.

4.2 Descriptive Statistics

The table below summarises the descriptive statistics of the main variables for the sample of 13 emerging market countries for the period 2000 to 2020.

Table 3:Descriptive Statistics

Variable	Variable Code	Measure	Observations	Mean	Standard Deviation	Minimum	Maximum
Size of the Bond Market as % of GDP	SZE	%	273	46%	34%	0%	142%
Liquidity of Bond Market	LQD	%	273	38%	51%	-186%	51%
Volatility of Bond Market	VOL	%	273	50%	82%	0%	646%
Exchange Rate Volatility	exv	%	273	9%	7%	0%	65%
Size of the Economy	SZEcon	US$ bn	273	501.58	547.68	47.22	2,616.20
Trade Openness	TRDO	%	273	37.62%	24.23%	10.19%	119.81%
Size of Banking System	BNKSYS	%	273	51.66%	29.69%	11.61%	133.96%
Law and Order	LWO	Unit	273	-0.12	0.58	-1.08	1.35
GPD per capita	GDPpc	US$ '000	273	13.74	6.43	3.44	33.51
Interest rate Spread	InRS	%	273	7.52%	8.76%	0%	45.11%
Inflation rate	INFR	%	273	103.15%	35.78%	30.76%	303.13%
Capital Controls	CC	Unit	273	0.54	0.34	-	1.00
Fiscal Balance	FB	%	273	-2.44%	3.31%	-13.33%	7.96%

The standard deviations are high when compared to the means which indicates that there is a large variance in variables. This is to be expected given that our sample size comprises of emerging markets which are usually volatile and given that the sample size is also geographically dispersed including countries in Latin America and the Caribbean, developing Europe, developing Africa and developing Asia and the Pacific.

4.3 Correlation matrix

Table 4 below reflects the correlation coefficients of the control variables selected and used in the regression models.

Table 4: Correlation matrix

VARIABLE	*VARIABLE CODE*	SZE	VOL	LQD	BNKSYS	CC	FB	exv	GDPpc	INFR	InRS	LWO	SZECon	TRDO
Size of the bond market	**SZE**	**1.0000**												
		-												
		-												
Volatiity of Bond Market	**VOL**	**0.3078 *****	**1.0000**											
		(0.0000) p-value	-											
		((5.3264)) t-statistic	-											
Liquidity of Bond Market	**LQD**	**0.5013 *****	**0.3393 *****	**1.0000**										
		(0.0000) p-value	*(0.0000)* p-value	-										
		((9.5381)) t-statistic	*((5.9385))* t-statistic	-										
Size of Banking System	**BNKSYS**	**0.1374 ****	**0.0856**	**0.0852**	**1.0000**									
		(0.0232) p-value	*(0.1585)* p-value	*(0.1604)* p-value	-									
		((2.2837)) t-statistic	*((1.4141))* t-statistic	*((1.4077))* t-statistic	-									
Capital Controls	**CC**	**-0.2086 *****	**-0.0802**	**-0.1192 ****	**0.1716 *****	**1.0000**								
		(0.0005) p-value	*(0.1863)* p-value	*(0.0492)* p-value	*(0.0045)* p-value	-								
		((-3.5107)) t-statistic	*((-1.3249))* t-statistic	*((-1.9757))* t-statistic	*((2.8671))* t-statistic	-								
Fiscal Balance	**FB**	**-0.2217 *****	**-0.1975 *****	**-0.1308 ****	**-0.0162**	**0.2228 *****	**1.0000**							
		(0.0002) p-value	*(0.0010)* p-value	*(0.0307)* p-value	*(0.7894)* p-value	*(0.0002)* p-value	-							
		((-3.7423)) t-statistic	*((-3.3162))* t-statistic	*((-2.1725))* t-statistic	*((-0.2674))* t-statistic	*((3.7622))* t-statistic	-							
Exchange rate volatility	**exv**	**-0.0174**	**0.0359**	**-0.0727**	**-0.0964**	**-0.0064**	**-0.1617 *****	**1.0000**						
		(0.7752) p-value	*(0.5551)* p-value	*(0.2311)* p-value	*(0.1121)* p-value	*(0.9162)* p-value	*(0.0074)* p-value	-						
		((-2.2858)) t-statistic	*((0.5909))* t-statistic	*((-1.2002))* t-statistic	*((-1.5939))* t-statistic	*((-0.1054))* t-statistic	*((-2.6979))* t-statistic	-						
GDP per Capita	**GDPpc**	**0.4290 *****	**0.2828 *****	**0.3937 *****	**0.4162 *****	**-0.2618 *****	**-0.0714**	**0.0709**	**1.0000**					
		(0.0000) p-value	*(0.0000)* p-value	*(0.0000)* p-value	*(0.0000)* p-value	*(0.0000)* p-value	*(0.2397)* p-value	*(0.2429)* p-value	-					
		((7.8174)) t-statistic	*((4.8528))* t-statistic	*((7.0512))* t-statistic	*((7.5341))* t-statistic	*((-4.4647))* t-statistic	*((-1.1784))* t-statistic	*((1.1704))* t-statistic	-					
Inflation Rate	**INFR**	**0.6896 *****	**0.3974 *****	**0.5660 *****	**0.0862**	**-0.1867 *****	**-0.3630 *****	**0.0473**	**0.3969 *****	**1.0000**				
		(0.0000) p-value	*(0.0000)* p-value	*(0.0000)* p-value	*(0.1555)* p-value	*(0.0019)* p-value	*(0.0000)* p-value	*(0.4366)* p-value	*(0.0000)* p-value	-				
		((15.6760)) t-statistic	*((7.1299))* t-statistic	*((11.3025))* t-statistic	*((1.4242))* t-statistic	*((-3.1287))* t-statistic	*((-6.4132))* t-statistic	*((0.7791))* t-statistic	*((7.1194))* t-statistic	-				
Interest Rate Spread	**InRS**	**-0.0983**	**-0.0608**	**-0.1057 ***	**-0.2122 *****	**-0.0869**	**-0.1000 ***	**0.2128 *****	**-0.2210 *****	**-0.0627**	**1.0000**			
		(0.1051) p-value	*(0.3166)* p-value	*(0.0811)* p-value	*(0.0004)* p-value	*(0.1524)* p-value	*(0.0992)* p-value	*(0.0004)* p-value	*(0.0002)* p-value	*(0.3023)* p-value	-			
		((-1.6258)) t-statistic	*((-1.0033))* t-statistic	*((-1.7506))* t-statistic	*((-3.5739))* t-statistic	*((-1.4353))* t-statistic	*((-1.6545))* t-statistic	*((3.5860))* t-statistic	*((-3.7310))* t-statistic	*((-1.0335))* t-statistic	-			
Law and Order	**LWO**	**-0.0260**	**-0.0082**	**-0.0293**	**0.5328 *****	**-0.2660 *****	**-0.0837**	**0.0514**	**0.3993 *****	**-0.0569**	**-0.2335 *****	**1.0000**		
		(0.6687) p-value	*(0.8934)* p-value	*(0.6302)* p-value	*(0.0000)* p-value	*(0.0000)* p-value	*(0.1679)* p-value	*(0.3973)* p-value	*(0.0000)* p-value	*(0.3486)* p-value	*(0.0001)* p-value	-		
		((-0.4283)) t-statistic	*((-0.1342))* t-statistic	*((-0.4820))* t-statistic	*((10.3660))* t-statistic	*((-4.5427))* t-statistic	*((-1.3827))* t-statistic	*((0.8477))* t-statistic	*((7.1693))* t-statistic	*((-0.9390))* t-statistic	*((-3.9540))* t-statistic	-		
Size of the Economy	**SZECon**	**0.1886 *****	**0.1556 *****	**0.2311 *****	**-0.1060 ***	**0.0819**	**-0.0434**	**0.2083 *****	**0.2897 *****	**0.3008 *****	**0.3996 *****	**-0.3285 *****	**1.0000**	
		(0.0017) p-value	(0.0100) p-value	(0.0001) p-value	(0.0803) p-value	(0.1773) p-value	(0.4753) p-value	(0.0005) p-value	(0.0000) p-value	(0.0000) p-value	(0.0000) p-value	(0.0000) p-value	-	
		((3.1612)) t-statistic	((2.5933)) t-statistic	((3.9101)) t-statistic	((-1.7553)) t-statistic	((1.3525)) t-statistic	((-0.7149)) t-statistic	((3.5056)) t-statistic	((4.9822)) t-statistic	((5.1917)) t-statistic	((7.1750)) t-statistic	((-5.7262)) t-statistic	-	
Trade Openness	**TRDO**	**-0.0340**	**-0.0605**	**-0.0751**	**0.6055 *****	**0.0808**	**0.0485**	**-0.2266 *****	**0.4142 *****	**-0.1514 ****	**-0.4141 *****	**0.4675 *****	**-0.3342 *****	**1.0000**
		(0.5756) p-value	*(0.3193)* p-value	*(0.2160)* p-value	*(0.0000)* p-value	*(0.1834)* p-value	*(0.4251)* p-value	*(0.0002)* p-value	*(0.0000)* p-value	*(0.0123)* p-value	*(0.0000)* p-value	*(0.0000)* p-value	*(0.0000)* p-value	-
		((-0.5605)) t-statistic	*((-0.9978))* t-statistic	*((-1.2400))* t-statistic	*((12.5249))* t-statistic	*((1.3337))* t-statistic	*((0.7989))* t-statistic	*((-3.8299))* t-statistic	*((7.4918))* t-statistic	*((-2.5210))* t-statistic	*((-7.4902))* t-statistic	*((8.7060))* t-statistic	*((5.8367))* t-statistic	-

The above table indicates that there are in some cases high and sometimes significant levels of correlation between the control variables chosen.

4.4 Empirical results

Table 5: Summary of key findings

EQUATION	1		2		3		4	
Parameters: BMD is measured as the sum of the weighted average of the size of the bond market (measured as the size of the bond market as a percentage of the GDP), the liquidity of the bond market (measured as the Bid-Ask Spread as a percentage of the ask price) and the volatility of the bond market (measured as the standard deviation of the log of mid prices								
Main Regressor								
Exchange rate volatility	**-0.7700**	***	**-0.7671**	***	**-0.7006**	***	**-0.8570**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0001)*	*p-value*	*(0.0000)*	*p-value*
	((-4.4979))	*t-statistic*	*((-4.4584))*	*t-statistic*	*((-4.1031))*	*t-statistic*	*((-6.7482))*	*t-statistic*
Scenario 1: BMD measured as the size of the bond market as a % of GDP								
Main Regressor								
Exchange rate volatility	**-0.8482**	***	**-0.8337**	***	**-0.4512**	**	**-0.8339**	***
	(0.0006)	*p-value*	*(0.0031)*	*p-value*	*(0.0296)*	*p-value*	*(0.0003)*	*p-value*
	((-3.4747))	*t-statistic*	*((-2.9897))*	*t-statistic*	*((-2.1880))*	*t-statistic*	*((-3.6322))*	*t-statistic*
Scenario 2: BMD measured as the volatility of the bond market								
Main Regressor								
Exchange rate volatility	**-0.0944**		**-0.4377**		**-0.3690**		**-0.8316**	***
	(0.7975)	*p-value*	*(0.1679)*	*p-value*	*(0.1327)*	*p-value*	*(0.0043)*	*p-value*
	((-0.2568))	*t-statistic*	*((-1.3828))*	*t-statistic*	*((-1.5082))*	*t-statistic*	*((-0.2624))*	*t-statistic*
Scenario 3: BMD measured as the liquidity of the bond market								
Main Regressor								
Exchange rate volatility	**-1.0542**	***	**-1.2358**	***	**-1.0100**	***	**-0.9954**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-6.8455))	*t-statistic*	*((-7.9928))*	*t-statistic*	*((-7.0916))*	*t-statistic*	*((-5.0117))*	*t-statistic*

1. ***The table above summaries the results of the regression model for the sample of 13 emerging market countries for the period 2000 – 2020***
2. ***BMD is the dependent variable and is measured differently in each scenario in line with research questions***
3. ***Exchange rate volatility (measured as the standard deviation of the log of annual exchange rate) is the main regressor and the control variable we are investigating***
4. ***We have controlled for fixed effects in all equations***
5. ***All figures are annual figures***
6. ***The coefficients of the control variables have been provided in Table 6 above.***

7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The ***,**,* refer to the 1, 5 and 10% significant levels respectively.***

8. ***The t-Statistics of the coefficients have also been included in double parentheses***

Table 6 below provides the results of the regression equations which have been estimated using the Feasible Generalised Least Squares (FGLS) method for the sample of 13 countries for the period 2000 to 2020.

Table 6: Total Bond Market Development Results

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-0.7700**	***	**-0.7671**	***	**-0.7006**	***	**-0.8570**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0001)*	*p-value*	*(0.0000)*	*p-value*
	((-4.4979))	*t-statistic*	*((-4.4584))*	*t-statistic*	*((-4.1031))*	*t-statistic*	*((-6.7482))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**-0.0000**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((8.3196))	*t-statistic*					*((-4.8205))*	*t-statistic*
Trade openness	**-0.0132**	***					**-0.0040**	**
	(0.0000)	*p-value*					*(0.0123)*	*p-value*
	((-9.1969))	*t-statistic*					*((-2.5231))*	*t-statistic*
Size of banking system	**0.0155**	***					**0.0038**	*
	(0.0000)	*p-value*					*(0.0536)*	*p-value*
	((9.1552))	*t-statistic*					*((1.9390))*	*t-statistic*
Developmental								
Law and Order			**-0.2017**	***			**-0.1674**	***
			(0.0019)	*p-value*			*(0.0093)*	*p-value*
			((-3.1405))	*t-statistic*			*((-2.6216))*	*t-statistic*
GDP per capita			**0.0001**	***			**0.0001**	***

			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((37.5103))	*t-statistic*			*((13.4218))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0413**	*******	**-0.0232**	*******
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-10.4741))	*t-statistic*	*((-4.3362))*	*t-statistic*
Inflation rate					**0.0142**	*******	**0.0085**	*******
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((41.0299))	*-t-statistic*	*((32.5714))*	*t-statistic*
Capital controls					**-0.2588**	*******	**0.0356**	
					(0.0000)	*p-value*	*(0.4255)*	*p-value*
					((-5.1928))	*t-statistic*	*((0.7982))*	*t-statistic*
Fiscal balance					**-0.0116**	*******	**-0.0234**	*******
					(0.0028)	*p-value*	*(0.0000)*	*p-value*
					((-3.0233))	*t-statistic*	*((-5.7565))*	*t-statistic*
Constant	**-0.6052**	*******	**-1.8848**	*******	**-0.9836**	*******	**-1.7928**	*******
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-5.4652))	*t-statistic*	*((-34.8523))*	*t-statistic*	*((-15.9829))*	*t-statistic*	*((-17.0488))*	*t-statistic*
Number of observations	273		273		273		273	
Number of countries	13		13		13		13	
Adjusted R-squared	0.6301		0.8596		0.9241		0.9429	

1. ***The above table summarises the regression model results for the sample of 13 emerging market countries for the period 2000 – 2020.***
2. ***BMD is the dependent variable and is measured as the sum of the weighted average of the size of the bond market (measured as the size of the bond market as a percentage of the GDP), the liquidity of the bond market (measured as the Bid-Ask Spread as a percentage of the ask price) and the volatility of the bond market (measured as the standard deviation of the log of mid prices).***
3. ***Exchange rate volatility (measured as the standard deviation of the log of annual exchange rate) is the main regressor and the control variable we are investigating. It is therefore included in every equation.***
4. ***We have controlled for fixed effects in all equations.***
5. ***All figures are annual figures.***
6. ***The coefficients of the control variables have been provided in Table 6 above.***
7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The ***,**,* refer to the 1, 5 and 10% significant levels respectively.***
8. ***The t-Statistics of the coefficients have also been included in double parentheses.***

Column 1 of Table 6 above presents the outcome of equation 1 which is showing the results of the impact of exchange rate volatility and structural factors on BMD. The results show that exchange rate volatility has a negative relationship to BMD that is significant at the 1% level. The size of the economy and the size of the banking system both have a positive relationship to BMD that is significant at the 1% level. Trade openness is found to have a negative relationship to BMD that is significant at the 1% level. These results are in line with most literature on the determinants of BMD which indicate that larger economies and better developed banking systems usually have larger bond markets (Eichengreen & Luengnaruemitchai, 2004b; Levine, 1997; Mu et al., 2013). The adjusted R-squared of this equation is moderate at 0.6301 which suggests that equation 1 is a satisfactory fit for total bond market development of emerging markets.

Column 2 of Table 6 above presents the outcome of equation 2 which is the results of the impact of exchange rate volatility and the developmental factors on BMD. The results show that exchange rate volatility has a negative relationship to BMD that is significant at the 1% level. Law and Order also has a negative relationship to BMD which is significant at the 1% level. GDP per capita has a positive relationship to BMD that is significant at the 1% level. These results suggest that investors prefer investing in bond markets of emerging markets where there is more development. This finding is consistent with the literature (Burger et al., 2010; Eichengreen & Luengnaruemitchai, 2004b; Smaoui et al., 2017b). The adjusted R-squared of this equation is high at 0.8596 which suggests that equation 2 is a good fit for total bond market development of emerging markets.

Column 3 of Table 6 above presents the outcome of equation 3 which is the result of the impact of exchange rate volatility and the macroeconomic factors on BMD. The results show that exchange rate volatility has a negative relationship to BMD that is significant at the 1% level. Interest rate volatility, capital controls and the fiscal balance all have a negative relationship to BMD that is significant at the 1% level. Interest rate volatility and capital control being significantly correlated to BMD is a different finding to that found by Smaoui et al., (2017b). In their paper Smaoui et al., (2017b) found interest rate volatility not to be significant to BMD. This difference in results may be due to this study only including emerging markets in its sample whereas the Smaoui et al., (2017b) paper includes developed countries in its sample. Fiscal balance is negatively correlated to total BMD at a significance level of 1%. Countries with larger fiscal deficits usually require governments to issue treasury bills and bonds to help fund those deficits. This would likely then help develop the bond markets in those countries therefore fiscal balance being negatively correlated to BMD makes intuitive sense. The adjusted R-squared of this equation is high at 0.9241 which suggests that equation 3 is a good fit for total BMD of emerging markets.

Column 4 of Table 6 above presents the outcome of equation 4 which are the results of the impact of all the control variables on BMD. When interpreting this equation, it is important to note that there are significant levels of collinearity between some of the control variables that may be skewing the results. The adjusted R-squared of 0.9429 does however indicate that the model is a good fit for the data and is the best model fit out of all the equations. The results indicate that exchange rate volatility has a negative relationship to BMD at a significance level of 1%. The size of the economy, trade openness, law and order, interest rate volatility and the fiscal balance are also found to all have a negative relationship to BMD that is significant at the 1% level with the exception of trade openness, which is significant at the 5% level. The size of the banking system, GDP per capita, inflation rate and capital controls are all found to have a positive relationship to BMD and to be significant at the 1% level with the exception of the size of the banking system, which is found to be significant at the 10% level.

4.5 Robustness checks

To determine the robustness of the results we completed robustness checks. The robustness checks include using an alternative measures of bond market development, considering where potential structural breaks may exist, lagging the dependent variable and considering endogeneity of the control variables.

4.5.1 Alternative measure of bond market development

To test the robustness of our results we used an alternative measure of bond market development. For this robustness check we ran three scenarios. In scenario 1 the dependent variable is BMD measured as the size of the bond market as a percentage of GDP, in scenario 2 BMD is measured as the volatility of the bond market and in the scenario 3 BMD is measured as the liquidity of the bond market. The results of three scenarios are presented in the tables below.

Table 7: Scenario 1 – BMD measured as the size of the bond market as a % of GDP

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-0.8482**	***	**-0.8337**	***	**-0.4512**	**	**-0.8339**	***
	(0.0006)	*p-value*	*(0.0031)*	*p-value*	*(0.0296)*	*p-value*	*(0.0003)*	*p-value*
	((-3.4747))	*t-statistic*	*((-2.9897))*	*t-statistic*	*((-2.1880))*	*t-statistic*	*((-3.6322))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**0.0000**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((5.1179))	*t-statistic*					*((-19.0691))*	*t-statistic*
Trade openness	**-0.0016**						**0.0108**	**
	(0.2116)	*p-value*					*(0.0123)*	*p-value*
	((-1.2523))	*t-statistic*					*((7.0947))*	*t-statistic*
Size of banking system	**0.0278**	***					**0.0157**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((12.9954))	*t-statistic*					*((8.0409))*	*t-statistic*
Developmental								
Law and Order			**-0.2842**	***			**-0.0958**	**
			(0.0000)	*p-value*			*(0.0496)*	*p-value*
			((-4.8673))	*t-statistic*			*((-1.9732))*	*t-statistic*
GDP per capita			**0.0002**	***			**0.0001**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((22.7125))	*t-statistic*			*((11.6711))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0233**	***	**-0.0266**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-6.1094))	*t-statistic*	*((-6.2611))*	*t-statistic*
Inflation rate					**0.0177**	***	**0.0145**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((33.2414))	*t-statistic*	*((27.2560))*	*t-statistic*
Capital controls					**-0.6755**	***	**-0.3614**	***

					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-10.7980))	*t-statistic*	*((-6.1035))*	*t-statistic*
Fiscal balance					**-0.0021**		**-0.0101**	**
					(0.6853)	*p-value*	*(0.0313)*	*p-value*
					((-0.4057))	*t-statistic*	*((-2.1650))*	*t-statistic*
Constant	**-1.5539**	***	**-2.1350**	***	**-1.2485**	***	**-2.8812**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-13.3339))	*t-statistic*	*((-21.3476))*	*t-statistic*	*((-17.3015))*	*t-statistic*	*((-30.0630))*	*t-statistic*
Number of observations	273		273		273		273	
Number of countries	13		13		13		13	
Adjusted R-squared	0.5307		0.7362		0.8328		0.9252	

1. ***Table 7: Scenario 1 above summarises the regression model results for our sample of 13 emerging market countries for the period 2000 – 2020.***
2. ***In the above table BMD is the dependent variable and is measured as the size of the bond market as a percentage of the GDP.***
3. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates) is the main regressor and is included in all regression models.***
4. ***We have controlled for fixed effects in all equations.***
5. ***All figures are annual figures.***
6. ***In the table the coefficients of the control variables have been provided.***
7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

As presented in Table 7 Scenario 1, equation 4 has the highest adjusted R-squared at 0.9252 and therefore has the best model fit for the data. Similar to the original results, equation 4 indicates that exchange rate volatility has a negative relationship to BMD that is significant at a significance level of 1%. All other control variables are found to be significant and confirm original results except for capital controls. Capital controls in Table 7 scenario 1 equation 4 are found to be significant at the 1% significance level which is different to the original results where capital controls were found to have a positive relationship to BMDt and to not be significant at all.

Table 8: Scenario 2 – BMD measured as the volatility of the bond market

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-0.0944**		**-0.4377**		**-0.3690**		**-0.8316**	***
	(0.7975)	*p-value*	*(0.1679)*	*p-value*	*(0.1327)*	*p-value*	*(0.0043)*	*p-value*
	((-0.2568))	*t-statistic*	*((-1.3828))*	*t-statistic*	*((-1.5082))*	*t-statistic*	*((-0.2624))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**0.0000**	
	(0.0000)	*p-value*					*(0.7933)*	*p-value*
	((5.6475))	*t-statistic*					*((0.2624))*	*t-statistic*
Trade openness	**-0.0159**	***					**-0.0103**	***
	(0.0000)	*p-value*					*(0.0010)*	*p-value*
	((-5.6923))	*t-statistic*					*((-3.3221))*	*t-statistic*
Size of banking system	**0.0158**	***					**0.0069**	*
	(0.0000)	*p-value*					*(0.0695)*	*p-value*
	((4.6172))	*t-statistic*					*((1.8231))*	*t-statistic*
Developmental								
Law and Order			**-0.0314**				**-0.0984**	
			(0.8017)	*p-value*			*(0.4195)*	*p-value*
			((-0.2514))	*t-statistic*			*((-0.8087))*	*t-statistic*
GDP per capita			**0.0001**	***			**0.0001**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((25.3442))	*t-statistic*			*((5.7447))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0323**	***	**-0.0028**	
					(0.0001)	*p-value*	*(0.8007)*	*p-value*
					((-4.0778))	*t-statistic*	*((-0.2527))*	*t-statistic*
Inflation rate					**0.0099**	***	**0.0041**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*

					((21.2755))	*t-statistic*	*((5.8079))*	*t-statistic*
Capital controls					**0.0898**	***	**0.4328**	***
					(0.3286)	*p-value*	*(0.0002)*	*p-value*
					((0.9787))	*t-statistic*	*((3.7314))*	*t-statistic*
Fiscal balance					**-0.0511**		**-0.0600**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-4.4842))	*t-statistic*	*((-6.4907))*	*t-statistic*
Constant	**-0.5443**	**	**-1.4796**	***	**-0.9167**	***	**-1.6925**	***
	(0.0181)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-2.3785))	*t-statistic*	*((-20.5999))*	*t-statistic*	*((-8.7556))*	*t-statistic*	*((-6.1369))*	*t-statistic*
Number of observations	**273**		**273**		**273**		**273**	
Number of countries	**13**		**13**		**13**		**13**	
Adjusted R-squared	**0.4655**		**0.7339**		**0.6861**		**0.7689**	

1. ***Table 8: Scenario 2 above summarises the regression model results for our sample of 13 emerging market countries for the period 2000 – 2020.***
2. ***In the above table BMD is the dependent variable and is measured as the volatility of the bond market.***
3. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates) is the main regressor and is included in all regression models.***
4. ***We have controlled for fixed effects in all equations.***
5. ***All figures are annual figures.***
6. ***In the table the coefficients of the control variables have been provided.***
7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

As presented in Table 8 Scenario 2, equation 4 has the highest adjusted R-squared at 0.7986 and therefore has the best model fit for the data. Similar to the original results, equation 4 indicates that exchange rate volatility has a negative relationship to BMD that is significant at a significance level of 1%. All other control variables are found to be significant and confirm original results except for the size of the economy, law and order and interest rate volatility. These three control variables are found to not be significant at the 1%, 5% or 10% levels in table 8 scenario 2 which is inconsistent with the original results where these control variables were statistically significant.

Table 9: Scenario 3 – BMD measured as the liquidity of the bond market

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-1.0542**	***	**-1.2358**	***	**-1.0100**	***	**-0.9954**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-6.8455))	*t-statistic*	*((-7.9928))*	*t-statistic*	*((-7.0916))*	*t-statistic*	*((-5.0117))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**0.0000**	
	(0.0000)	*p-value*					*(0.7666)*	*p-value*
	((10.4832))	*t-statistic*					*((-0.2972))*	*t-statistic*
Trade openness	**-0.0193**	***					**-0.0108**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((-26.9346))	*t-statistic*					*((-9.1296))*	*t-statistic*
Size of banking system	**0.0014**						**-0.0109**	***
	(0.1338)	*p-value*					*(0.0000)*	*p-value*
	((1.5040))	*t-statistic*					*((-8.5080))*	*t-statistic*
Developmental								
Law and Order			**-0.3821**	***			**-0.3249**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((-11.8175))	*t-statistic*			*((-5.7928))*	*t-statistic*
GDP per capita			**0.0002**	***			**0.0001**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((69.4167))	*t-statistic*			*((26.6324))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0514**	***	**-0.0371**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-10.4296))	*t-statistic*	*((-6.3670))*	*t-statistic*
Inflation rate					**0.0147**	***	**0.0079**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*

					((19.9589))	*t-statistic*	*((9.8993))*	*t-statistic*
Capital controls					**-0.0840**	**	**-0.0112**	
					(0.0246)	*p-value*	*(0.8417)*	*p-value*
					((-2.2618))	*t-statistic*	*((-0.1999))*	*t-statistic*
Fiscal balance					**0.0169**	***	**0.0010**	
					(0.0000)	*p-value*	*(0.7993)*	*p-value*
					((5.7928))	*t-statistic*	*((0.2545))*	*t-statistic*
Constant	**0.1382**	**	**-2.0108**	***	**-0.9513**	***	**-0.8921**	***
	(0.0321)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((2.1545))	*t-statistic*	*((-60.8251))*	*t-statistic*	*((-8.9616))*	*t-statistic*	*((-6.2422))*	*t-statistic*
Number of observations	273		273		273		273	
Number of countries	13		13		13		13	
Adjusted R-squared	0.8434		0.9724		0.7024		0.8745	

1. ***Table 9: Scenario 3 above summarises the regression model results for our sample of 13 emerging market countries for the period 2000 – 2020.***
2. ***In the above table BMD is the dependent variable and is measured as the liquidity of the bond market.***
3. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates) is the main regressor and is included in all regression models.***
4. ***We have controlled for fixed effects in all equations.***
5. ***All figures are annual figures.***
6. ***In the table the coefficients of the control variables have been provided.***
7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

As presented in Table 9 Scenario 3, equation 2 has the highest adjusted R-squared at 0.9724 and therefore has the best model fit for the data. Similar to the original results, equation 2 indicates that exchange rate volatility has a negative relationship to BMD that is significant at a significance level of 1%. All other control variables are found to be significant and confirm equation two of the original results.

4.5.2 Structural break

To test whether the effect of exchange rate volatility on BMD has changed over time we divided the sample into two sub-periods being pre- and post-global financial crisis (i.e. 2000-2008 and 2009-2020). Table 10 below presents the results of the sub-periods.

Table 10: Results for structural break

EQUATION	1				2				3				4			
Period	2000-2008		2009-2020		2000-2008		2009-2020		2000-2008		2009-2020		2000-2008		2009-2020	
Main Regressor																
Exchange rate volatility	-0.4676		-2.1284	***	-0.2864		-0.7217		0.0622		-1.5513	***	-0.2547		-1.5338	***
	(0.3585)	p-value	(0.0001)	p-value	(0.4891)	p-value	(0.1858)	p-value	(0.8907)	p-value	(0.0000)	p-value	(0.6409)	p-value	(0.0000)	p-value
	((0.9225))	t-statistic	((-4.1500))	t-statistic	((-0.6943))	t-statistic	((-1.3295))	t-statistic	((0.1378))	t-statistic	((-6.0971))	t-statistic	((-0.4679))	t-statistic	((-4.6648))	t-statistic
Control Variables																
Structural																
Size of Economy	0.0000	***	-0.0000	***									0.0000		-0.0000	
	(0.0000)	p-value	(0.0014)	p-value									(0.2817)	p-value	(0.7743)	p-value
	((7.5797))	t-statistic	((-3.2550))	t-statistic									((1.0827))	t-statistic	((-0.2874))	t-statistic
Trade openness	0.0134	***	0.0031										0.0002		0.0056	
	(0.0268)	p-value	(0.5482)	p-value									(0.9808)	p-value	(0.1399)	p-value
	((2.2477))	t-statistic	((0.6020))	t-statistic									((0.0241))	t-statistic	((1.4851))	t-statistic
Size of banking system	-0.0154	***	0.0231	***									-0.0197	***	0.0045	
	(0.0597)	p-value	(0.0000)	p-value									(0.0094)	p-value	(0.2074)	p-value
	((-1.9047))	t-statistic	((6.39806))	t-statistic									((-2.6515))	t-statistic	((1.2667))	t-statistic
Developmental																
Law and Order					0.0423		-0.5722						0.0055		-0.4167	**
					(0.7070)	p-value	(0.0052)	p-value					(0.9710)	p-value	(0.0245)	p-value
					((0.3770))	t-statistic	((-2.8392))	t-statistic					((0.0364))	t-statistic	((-2.2744))	t-statistic
GDP per capita					0.0001	***	0.0001	**					0.0001	***	0.0000	
					(0.0000)	p-value	(0.0000)	p-value					(0.0007)	p-value	(0.0445)	p-value
					((10.5016))	t-statistic	((7.0936))	t-statistic					((3.4872))	t-statistic	((0.0286))	t-statistic
Macroeconomic																
Interest rate spread									-0.0209	*	-0.0056		-0.0187		0.0027	
									(0.0573)	p-value	(0.5582)	p-value	(0.2646)	p-value	(0.8203)	p-value
									((-1.9234))	t-statistic	((-0.5870))	t-statistic	((-1.1224))	t-statistic	((0.2276))	t-statistic
Inflation rate									0.0178	***	0.0096	***	0.0018		0.0079	***
									(0.0000)	p-value	(0.0000)	p-value	(0.7070)	p-value	(0.0000)	p-value
									((6.3196))	t-statistic	((14.9096))	t-statistic	((0.3770))	t-statistic	((7.1681))	t-statistic
Capital controls									-0.1843		0.0644		-0.1224		0.0881	
									(0.3689)	p-value	(0.3397)	p-value	(0.5533)	p-value	(0.3421)	p-value
									((-0.9026))	t-statistic	((0.9580))	t-statistic	((-0.5950))	t-statistic	((0.9534))	t-statistic

Fiscal balance									**0.0190**		**-0.0495**	***	**-0.0014**		**-0.0547**	***
									(0.1269)	p-value	(0.0000)	p-value	(0.9318)	p-value	(0.0000)	p-value
									((1.5395))	t-statistic	((-8.0172))	t-statistic	((-0.0858))	t-statistic	((-6.2057))	t-statistic
Constant	**-0.9333**	**	**-0.4275**	***	**-1.9653**	***	**-0.6551**	***	**-1.6696**		**-0.7211**	***	**-1.0633**	**	**-1.4913**	***
	(0.0242)	p-value	(0.2446)	p-value	(0.0000)	p-value	(0.0006)	p-value	(0.9850)	p-value	(0.0000)	p-value	(0.0186)	p-value	(0.0000)	p-value
	((-2.2881))	t-statistic	((-1.1684))	t-statistic	((-15.3476))	t-statistic	(-3.5154))	t-statistic	((-5.5464))	t-statistic	((-5.3056))	t-statistic	((-2.3957))	t-statistic	((-4.3063))	t-statistic
Number of observations	117		156		117		156		117		156		117		156	
Number of countries	13		13		13		13		13		13		13		13	
Adjusted R-squared	0.4865		0.4136		0.6043		0.3323		0.6347		0.7285		0.5501		0.6974	

1. ***In Table 10 above BMD is the dependent variable and is measured as the sum of the weighted average of the size of the bond market (measured as the size of the bond market as a percentage of the GDP), the liquidity of the bond market (measured as the Bid-Ask Spread as a percentage of the ask price) and the volatility of the bond market (measured as the standard deviation of the log of mid prices).***
2. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates) is the main regressor and included in all equations.***
3. ***We have controlled for fixed effects in all equations.***
4. ***All figures are annual figures.***
5. ***The coefficients of the control variables have been provided in the table.***
6. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

The results indicate that equation 3 provides the best model fit with the highest adjusted R-squared in both the pre- and post-financial crisis periods. Equation 3 results show that the relationship of exchange rate volatility to BMD changes before and after the 20008/2009 financial crisis, went from being a positive relationship that is not significant to being a negative relationship that is significant at a significance level of 1%.

The other significant change is that the fiscal balance has a negative relationship to BMD after 2008 and is significant at a significance level of 1%. This is a change from prior to 2008 where fiscal balance was not statistically significant.

In equations 1, 2 and 4 the results also show that bond market development becomes more sensitive to exchange rate volatility after the global financial crisis of 2008/2009.

4.5.3 Lagging bond market development (i.e. the dependent variable)

To determine the effect of lagging BMD on the results.

Table 11: Results for lagging bond market development (i.e. the dependent variable)

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-0.1430**		**-0.4583**	***	**-0.0464**		**-0.2055**	
	(0.3729)	*p-value*	*(0.0016)*	*p-value*	*(0.7605)*	*p-value*	*(0.1149)*	*p-value*
	((-0.8927))	*t-statistic*	*((-3.1944))*	*t-statistic*	*((-0.3052))*	*t-statistic*	*((-1.5826))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**0.0000**	***
	(0.0000)	*p-value*					*(0.0002)*	*p-value*
	((17.2291))	*t-statistic*					*((-3.7270))*	*t-statistic*
Trade openness	**-0.0117**	***					**-0.0012**	
	(0.0000)	*p-value*					*(0.4511)*	*p-value*
	((-12.8704))	*t-statistic*					*((-0.7549))*	*t-statistic*
Size of banking system	**0.0141**	***					**-0.0003**	
	(0.0000)	*p-value*					*(0.8670)*	*p-value*
	((10.5277))	*t-statistic*					*((-0.1677))*	*t-statistic*
Developmental								
Law and Order			**-0.3006**	***			**-0.2958**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((-4.5170))	*t-statistic*			*((-4.1390))*	*t-statistic*
GDP per capita			**0.0001**	***			**0.0001**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((43.6329))	*t-statistic*			*((18.3221))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0628**	***	**-0.0466**	***

					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-19.2278))	*t-statistic*	*((-13.5222))*	*t-statistic*
Inflation rate					**0.0134**	***	**0.0067**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((33.1479))	*t-statistic*	*((23.4481))*	*t-statistic*
Capital controls					**-0.1654**	***	**-0.0234**	
					(0.0012)	*p-value*	*(0.6040)*	*p-value*
					((-3.2782))	*t-statistic*	*((-0.5194))*	*t-statistic*
Fiscal balance					**-0.0038**		**-0.0191**	***
					(0.3191)	*p-value*	*(0.0000)*	*p-value*
					((-0.9984))	*t-statistic*	*((-4.5409))*	*t-statistic*
Constant	**-0.7950**	***	**-2.0562**	***	**-0.9202**	***	**-1.6164**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-12.3592))	*t-statistic*	*((-40.6676))*	*t-statistic*	*((-13.5909))*	*t-statistic*	*((-13.0263))*	*t-statistic*
Number of observations	260		260		260		260	
Number of countries	13		13		13		13	
Adjusted R-squared	0.8520		0.8868		0.8822		0.9083	

1. ***In Table 11 above the lagged BMD is the dependent variable and is measured as the sum of the weighted average of the three bond market indicators of the size of the bond market (measured as the size of the bond market as a percentage of the GDP), the liquidity of the bond market (measured as the Bid-Ask Spread as a percentage of the ask price) and the volatility of the bond market (measured as the standard deviation of the log of mid prices).***
2. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates) is the main regressor and included in all equations.***
3. ***We have controlled for fixed effects in all equations.***
4. ***All figures are annual figures.***
5. ***We have controlled for fixed effects in all equations.***
6. ***The coefficients of the control variables have been provided in the table.***
7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

As presented in Table 11 above, equation 4 has the highest adjusted R-squared at 0.9083 and therefore has the best model fit for the data. Similar to the original results, equation 4 indicates that exchange rate volatility has a negative relationship to BMD however when BMD is lagged then exchange rate volatility is found to not be statistically significant. All other control variables are found to be significant and confirm equation 4 of the original results except for trade openness and the size of the banking system which are found to not be significant when bond market development is lagged.

4.5.4 Endogeneity

The equations created in this paper up to this point assume that all control variables chosen are exogenous to BMD. This assumption however may not be accurate. For example, although the size of a country's economy may lead to BMD, more developed bond markets may support the ability of economies to grow. Another example is that higher interest rates, where outstanding bond amounts are large (Mu et al., 2013), may affect the fiscal balance therefore the fiscal balance may be endogenous to bond markets. Another example is that interest rate spreads are usually lower in countries with developed bond markets also resulting in lower capital costs and higher economic growth. This suggests that interest rate spreads are endogenous to bond market development (Grandes & Pinaud, 2004; Levine et al., 2004).

Using the Two-Stage Least-Squares ("TSLS") method we control for the endogeneity of control variables. We use the TSLS method as the sample size of thirteen (13) countries is smaller than the number of periods (i.e. 21 periods) The results are reflected in table 12 below.

Table 12: Results when controlling for endogeneity

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-11.3713**	***	**-13.8176**	*	**1.3699**		**-8.3793**	
	(0.0000)	*p-value*	*(0.0933)*	*p-value*	*(0.2418)*	*p-value*	*(0.4213)*	*p-value*
	((-5.8766))	*t-statistic*	*((-1.6847))*	*t-statistic*	*((1.1734))*	*t-statistic*	*((-0.8055))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**-0.0000**	
	(0.0000)	*p-value*					*(0.3035)*	*p-value*
	((5.2955))	*t-statistic*					*((-1.0312))*	*t-statistic*
Trade openness	**-0.0152**	***					**0.0101**	
	(0.0000)	*p-value*					*(0.7900)*	*p-value*

	((-6.7262))	*t-statistic*					*((0.2667))*	*t-statistic*
Size of banking system	**0.0183**	***					**0.0198**	
	(0.0000)	*p-value*					*(0.5211)*	*p-value*
	((4.3261))	*t-statistic*					*((-0.6426))*	*t-statistic*
Developmental								
Law and Order			**-0.0448**				**1.1797**	
			(0.9638)	*p-value*			*(0.8080)*	*p-value*
			((-0.0455))	*t-statistic*			*((0.2433))*	*t-statistic*
GDP per capita			**0.0001**	***			**0.0001**	
			(0.0000)	*p-value*			*(0.1494)*	*p-value*
			((7.6370))	*t-statistic*			*((1.4463))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0706**	***	**-0.0313**	
					(0.0002)	*p-value*	*(0.7547)*	*p-value*
					((-3.7636))	*t-statistic*	*((-0.3128))*	*t-statistic*
Inflation rate					**0.0108**	***	**0.0075**	**
					(0.0000)	*p-value*	*(0.0313)*	*p-value*
					((13.3205))	*t-statistic*	*((2.1667))*	*t-statistic*
Capital controls					**-1.6451**	***	**0.1206**	
					(0.0000)	*p-value*	*(0.9328)*	*p-value*
					((-6.4262))	*t-statistic*	*((0.0844))*	*t-statistic*
Fiscal balance					**0.0063**		**-0.0089**	
					(0.7020)	*p-value*	*(0.7620)*	*p-value*
					((0.3831))	*t-statistic*	*((-0.3032))*	*t-statistic*
Constant	**0.1455**		**-0.6314**		**0.2064**		**-1.9956**	
	(0.6041)	*p-value*	*(0.5379)*	*p-value*	*(0.5589)*	*p-value*	*(0.5255)*	*p-value*
	((0.5192))	*t-statistic*	*((-0.6169))*	*t-statistic*	*((0.5853))*	*t-statistic*	*((-0.6358))*	*t-statistic*
Number of observations	260		260		260		260	
Number of countries	13		13		13		13	
Adjusted R-squared	0.2996		0.3559		0.7720		0.4975	

Number of instruments	5		4		6		11	
Endogenous variables	BMD, exv, SZEcon, TRDO, BNKSYS		BMD, exv, LWO, GDPpc		BMD, exv, InRS, INFR, CC, FB		All control variables	

1. ***In Table 11 above BMD is the dependent variable and is measured as the sum of the weighted average of the size of the bond market (measured as the size of the bond market as a percentage of the GDP), the liquidity of the bond market (measured as the Bid-Ask Spread as a percentage of the ask price) and the volatility of the bond market (measured as the standard deviation of the log of mid prices).***
2. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rate) is the main regressor.***
3. ***We have controlled for fixed effects in all equations.***
4. ***All figures used have been annualised.***
5. ***The coefficients of the control variables have been provided in the table.***
6. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively.***
7. ***The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

Equation 3 in table 12 above is found to have the best model fit for the data at an adjusted R-Squared of 0.7220 and finds that that when accounting for endogeneity exchange rate volatility has a positive relationship to BMD which is not significant at the 1%, 5% or 10% significance levels.

The relationship between exchange rate volatility and BMD is found to be negative in all equations except equation 3 which is in line with the original findings presented in table 12.

The equation 1 results are consistent with the original findings indicating that the size of the economy and the size of the banking system both have a positive and significant relationship to BMD at the 1% significance level. Trade openness is found to have a negative relationship to BMD that is significant at the 1% significance level similar to the original findings. However, the model fit is poor with an adjusted R-squared of 0.2996.

The equation 2 results are consistent with original results where GDP per capita has a positive relationship to BMD and is significant at the 1% level. However, when controlling for endogeneity law and order is found to not be significant to BMD at the 1%, 5% or 10% levels. The model fit for equation 2 is however poor with an adjusted R-squared of 0.3559.

The equation 3 results are mostly consistent with original findings showing that the inflation rate, capital controls and the fiscal balance are significant to BMD. The results show that when controlling for endogeneity, interest rate spread is not statistically significant to bond market development. The model fit moderate for equation 3 is with an adjusted R-squared of 0.5406.

The equation 4 results are inconsistent with original findings as all structural, developmental and macroeconomic, with the exception of the inflation rate, are found to not be significant to BMD when controlling for endogeneity. Given that the control variables are highly correlated the equation 4 results should be interpreted with caution as they can be misleading. This is further supported by moderate model fit reflected in the low adjusted R-squared of 0.4975.

4.6 The investor base impact analysis

Further to the above, we have considered whether the investor base has an impact on or moderates the relationship between exchange rate volatility and BMD. We used a sample of 13 emerging countries for the period 2004 to 2020. The results are presented in the table below.

Table 13: The investor base and its relationship to exchange rate volatility and BMD

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-1.0437**	***	**-0.9515**	***	**-1.8215**	***	**-1.8242**	***
	(0.0000)	*p-value*	*(0.0026)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-7.4056))	*t-statistic*	*((-3.0443))*	*t-statistic*	*((-8.0640))*	*t-statistic*	*(-6.5274))*	*t-statistic*
Investor Base	**-0.3228**	***	**0.4292**	***	**-0.6382**	***	**-0.2266**	*
	(0.0000)	*p-value*	*(0.0063)*	*p-value*	*(0.0000)*	*p-value*	*(0.0949)*	*p-value*
	((-4.6172))	*t-statistic*	*((2.7610))*	*t-statistic*	*((-9.1422))*	*t-statistic*	*((-1.6780))*	*t-statistic*
Investor Base x Exchange rate volatility	**-0.0521**		**1.0147**		**2.5436**	***	**2.1904**	*
	(0.8997)	*p-value*	*(0.3846)*	*p-value*	*(0.0000)*	*p-value*	*(0.0555)*	*p-value*
	((-0.1263))	*t-statistic*	*((0.8713))*	*t-statistic*	*((4.5947))*	*t-statistic*	*((1.9262))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**-0.0000**	***
	(0.0000)	*p-value*					*(0.0001)*	*p-value*
	((4.9862))	*t-statistic*					*((-4.1295))*	*t-statistic*
Trade openness	**-0.0141**	***					**0.0007**	
	(0.0000)	*p-value*					*(0.5931)*	*p-value*
	((-10.2848))	*t-statistic*					*((0.5353))*	*t-statistic*

Size of banking system	**0.0181**	***					**0.0060**	***
	(0.0000)	*p-value*					*(0.0001)*	*p-value*
	((25.6747))	*t-statistic*					*((4.0379))*	*t-statistic*
Developmental								
Law and Order			**-0.2236**	***			**-0.2416**	***
			(0.0011)	*p-value*			*(0.0021)*	*p-value*
			((-3.3001))	*t-statistic*			*((-3.1128))*	*t-statistic*
GDP per capita			**0.0001**	***			**0.0000**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((22.5166))	*t-statistic*			*((7.5674))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0356**	***	**-0.0332**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-7.3489))	*t-statistic*	*((-6.3358))*	*t-statistic*
Inflation rate					**0.0117**	***	**0.0092**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((36.6425))	*t-statistic*	*((22.9555))*	*t-statistic*
Capital controls					**0.0661**		**0.1103**	**
					(0.2074)	*p-value*	*(0.0418)*	*p-value*
					((1.2649))	*t-statistic*	*((2.0485))*	*t-statistic*
Fiscal balance					**-0.0562**	***	**-0.0560**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-23.6122))	*t-statistic*	*((-17.6091))*	*t-statistic*
Constant	**-0.1731**	**	**-1.6621**	***	**-0.6952**	***	**-1.4628**	***
	(0.0476)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-1.9927))	*t-statistic*	*((-18.1158))*	*t-statistic*	*((10.3003))*	*t-statistic*	*((-14.1261))*	*t-statistic*
Number of observations	221		221		221		221	
Number of countries	13		13		13		13	
Adjusted R-squared	0.8432		0.7953		0.9556		0.9621	

1. ***In Table 13 above BMDt is the dependent variable and is measured as the sum of the weighted average of the size of the bond market (measured as the size of the bond market as a percentage of the GDP), the liquidity of the bond market (measured as the Bid-Ask***

Spread as a percentage of the ask price) and the volatility of the bond market (measured as the standard deviation of the log of mid prices).

2. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates), the investor base (measured as the percentage of total gross government debt held by foreign investors) and the interaction of the exchange rate volatility and the investor base are the main regressors.***
3. ***The investor base is measured as the percentage of total gross government debt held by foreign investors.***
4. ***We have controlled for fixed effects in all equations.***
5. ***All figures have been annualised.***
6. ***The coefficients of the control variables have been provided in Table 7 above.***
7. ***The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively.***
8. ***The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***
9. ***The results presented above are for the period 2004 to 2020 and the investor base is measured as the percentage of total gross government debt that is held by foreign investors.***

Equation 4, which has the highest adjusted R-squared at 0.9621 and is therefore the best model fit for the data, indicates that the investor base has a negative relationship to BMD at a significance level of 10%. Exchange rate volatility is found to have a negative relationship to BMD at a significance level of 1%. The results therefore suggest that the less total gross government debt in emerging markets is held by foreign investors, the higher the level of bond market development.

The interaction of exchange rate volatility and the investor base is found to have a positive relationship to BMD and significant at the 10% level. This finding indicates that the higher the number of foreign investors who own outstanding government debt where there is exchange rate volatility, the higher the level of BMD.

The inclusion of the investor base in the equation does also affect the level of statistical significance of some of the other control variables being trade openness and capital controls. Trade openness has a positive relationship to BMD and is not significant in Equation 4 which is different from the original findings. Capital controls are significant when the investor base is included which is different to the original findings where capital controls are found to not be significant.

4.6.1 Robustness check for Investor Base analysis

To test the robustness of our results as they relate to the effect of the investor base on BMD we used an alternative measure of BMD. For this robustness check we ran three scenarios. In scenario 1 the dependent variable is BMD measured as the size of the bond market as a percentage of GDP, in scenario 2 BMD is measured as the volatility of the bond market and in scenario 3 BMD is measured as the liquidity of the bond market. The results of the three scenarios are presented in the tables below.

Table 14: Scenario 1 – BMD measured as the size of the bond market as a % of GDP

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-1.0817**	***	**-1.7716**	***	**-2.2898**	***	**-1.5258**	***
	(0.0066)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-2.7450))	*t-statistic*	*((-6.1020))*	*t-statistic*	*((-5.6620))*	*t-statistic*	*((-5.2291))*	*t-statistic*
Investor Base	**1.0243**	***	**2.2644**	***	**0.8554**	***	**1.0656**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((6.5345))	*t-statistic*	*((16.5218))*	*t-statistic*	*((5.3212))*	*t-statistic*	*((8.3311))*	*t-statistic*
Investor Base x Exchange rate volatility	**-2.3776**	*	**3.0301**	**	**1.6225**	***	**-0.1467**	
	(0.0960)	*p-value*	*(0.0132)*	*p-value*	*(0.2255)*	*p-value*	*(0.8876)*	*p-value*
	((-1.6723))	*t-statistic*	*((2.5004))*	*t-statistic*	*((1.2158))*	*t-statistic*	*((-0.1415))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**						**-0.0000**	***
	(0.3037)	*p-value*					*(0.0000)*	*p-value*
	((1.0311))	*t-statistic*					*((-16.6147))*	*t-statistic*
Trade openness	**-0.0095**	***					**0.0158**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((-5.9100))	*t-statistic*					*((9.3058))*	*t-statistic*
Size of banking system	**0.0334**	***					**0.0091**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((17.1221))	*t-statistic*					*((4.3006))*	*t-statistic*
Developmental								
Law and Order			**-0.0894**				**0.1166**	
			(0.2643)	*p-value*			*(0.1414)*	*p-value*
			((-1.1193))	*t-statistic*			*((1.4764))*	*t-statistic*
GDP per capita			**0.0002**	***			**0.0001**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((20.7915))	*t-statistic*			*((9.6370))*	*t-statistic*
Macroeconomic								

Interest rate spread					**-0.0143**	***	**-0.0180**	***
					(0.0031)	*p-value*	*(0.0002)*	*p-value*
					((-2.9949))	*t-statistic*	*((-3.7506))*	*t-statistic*
Inflation rate					**0.0169**	***	**0.0141**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((27.6703))	*t-statistic*	*((24.7487))*	*t-statistic*
Capital controls					**-0.8234**	***	**-0.5343**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-10.9110))	*t-statistic*	*((-9.0937))*	*t-statistic*
Fiscal balance					**-0.0487**	***	**-0.0466**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-7.7248))	*t-statistic*	*((-11.1706))*	*t-statistic*
Constant	**-1.4107**	***	**-3.0066**	***	**-1.3691**	***	**-3.0747**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-10.6130))	*t-statistic*	*((-19.3646))*	*t-statistic*	*((12,7287))*	*t-statistic*	*((-21.5738))*	*t-statistic*
Number of observations	221		221		221		221	
Number of countries	13		13		13		13	
Adjusted R-squared	0.6913		0.8453		0.7920		0.9444	

1. ***In Table 14 Scenario 1 above BMD is the dependent variable and is measured as the size of the bond market as a percentage of the GDP.***
2. ***The results presented above are for the period 2004 to 2020 for a sample of 13 emerging markets.***
3. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates), the investor base (measured as the percentage of total gross government debt held by foreign investors) and the interaction of the exchange rate volatility and the investor base are the main regressors.***
4. ***The investor base is measured as the percentage of total gross government debt held by foreign investors.***
5. ***We have controlled for fixed effects in all equations.***
6. ***All figures have been annualised.***
7. ***The coefficients of the control variables have been provided. The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

In Table 14 scenario 1 above where BMD is measured as the size of the bond market as a percentage of GDP, equation 4 is the best model fit for the data with an adjusted R-squared of 0.9444. The robustness checks confirm most of the results reflected in Table 14 with exchange rate volatility reflecting a negative and significant relationship to BMD at the 1% significance level. The investor base remains significant in scenario 1 but there seems to be a change in the relationship from a negative relationship as per the original results to a positive relationship in scenario 1. The interaction of the investor base and exchange rate volatility is also found to not be significant in scenario 1 where the original results reflected it being significant at the 10% significance level.

Table 15: Scenario 2 – BMD measured as the volatility of the bond market

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**-2.3668**	***	**-2.6766**	***	**-3.4211**	***	**-3.2235**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-4.5368))	*t-statistic*	*((-6.1279))*	*t-statistic*	*((-10.5832))*	*t-statistic*	*((-9.6695))*	*t-statistic*
Investor Base	**-1.7973**	***	**-1.7381**	***	**-1.9618**	***	**-1.9408**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((-7.3104))	*t-statistic*	*((-8.6196))*	*t-statistic*	*((-9.6269))*	*t-statistic*	*((-9.0272))*	*t-statistic*
Investor Base x Exchange rate volatility	**8.5611**	***	**11.6491**	***	**10.8801**	***	**8.4471**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*	*(0.0000)*	*p-value*
	((5.3363))	*t-statistic*	*((7.8455))*	*t-statistic*	*((6.8414))*	*t-statistic*	*((5.4701))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**0.0000**	
	(0.0000)	*p-value*					*(0.0673)*	*p-value*
	((6.1553))	*t-statistic*					*((1.8397))*	*t-statistic*
Trade openness	**-0.0136**	***					**-0.0055**	***
	(0.0000)	*p-value*					*(0.0019)*	*p-value*
	((-7.2024))	*t-statistic*					*((-3.1429))*	*t-statistic*
Size of banking system	**0.0166**	***					**0.0131**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((7.0248))	*t-statistic*					*((5.1601))*	*t-statistic*
Developmental								
Law and Order			**0.4130**	***			**-0.1177**	***
			(0.0000)	*p-value*			*(0.2463)*	*p-value*
			((4.2222))	*t-statistic*			*((-1.1629))*	*t-statistic*
GDP per capita			**0.0001**	***			**-0.0000**	***
			(0.0000)	*p-value*			*(0.0010)*	*p-value*

			((25.2863))	*t-statistic*			((-3.3351))	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0296**	***	**-0.0167**	**
					(0.0002)	*p-value*	*(0.0418)*	*p-value*
					((-3.7603))	*t-statistic*	*((-2.0485))*	*t-statistic*
Inflation rate					**0.0073**	***	**0.0076**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((19.1767))	*t-statistic*	*((15.0699))*	*t-statistic*
Capital controls					**0.5595**	***	**0.6800**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((7.7972))	*t-statistic*	*((9.9214))*	*t-statistic*
Fiscal balance					**-0.0928**	***	**-0.0865**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-12.2873))	*t-statistic*	*((-8.4919))*	*t-statistic*
Constant	**0.1109**		**-0.2974**	***	**-0.2945**	***	**-0.6905**	***
	(0.5576)	*p-value*	*(0.0021)*	*p-value*	*(0.0000)*	*p-value*	*(0.0006)*	*p-value*
	((0.5873))	*t-statistic*	*((-3.1196))*	*t-statistic*	*((4.2090))*	*t-statistic*	*((-3.5056))*	*t-statistic*
Number of observations	221		221		221		221	
Number of countries	13		13		13		13	
Adjusted R-squared	0.8852		0.8781		0.8401		0.8329	

1. ***In Table 15: Scenario 2 above BMD is the dependent variable and is measured as the volatility of the bond market.***
2. ***The results presented above are for the period 2004 to 2020 for a sample of 13 emerging markets.***
3. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates), the investor base (measured as the percentage of total gross government debt held by foreign investors) and the interaction of the exchange rate volatility and the investor base are the main regressors.***
4. ***The investor base is measured as the percentage of total gross government debt held by foreign investors.***
5. ***We have controlled for fixed effects in all equations.***
6. ***All figures have been annualised.***
7. ***The coefficients of the control variables have been provided. The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

In Table 15 scenario 2 above where BMD is measured as the volatility of the bond market, equation 1 is the best model fit for the data with an adjusted R-squared of 0.8852. The robustness checks confirm most of the results reflected in Table 15 with exchange rate volatility reflecting a negative and significant relationship to BMD at the 1% significance level. The investor base remains significant to BMD in scenario 2 similar to the original results. The interaction of the investor base and exchange rate volatility is also found to have a positive relationship and be significant at the 1% level in scenario 2 where the original results reflected this control variable having a negative relationship and not being significant. These results similar to scenario 1 suggest that the interaction of the investor base and exchange rate volatility is sensitive to how BMD is defined.

Table 16: Scenario 3 – BMD measured as the liquidity of the bond market

EQUATION	1		2		3		4	
Main Regressor								
Exchange rate volatility	**0.5981**	*	**-0.2456**		**-0.0096**		**-0.4340**	***
	(0.0760)	*p-value*	*(0.3936)*	*p-value*	*(0.9730)*	*p-value*	*(0.2312)*	*p-value*
	((1.7837))	*t-statistic*	*((-0.8550))*	*t-statistic*	*((-0.0339))*	*t-statistic*	*((-1.2009))*	*t-statistic*
Investor Base	**-0.4490**	***	**-0.0340**		**-1.0030**	***	**-0.3994**	***
	(0.0000)	*p-value*	*(0.7553)*	*p-value*	*(0.0000)*	*p-value*	*(0.0053)*	*p-value*
	((-4.7353))	*t-statistic*	*((-0.3121))*	*t-statistic*	*((-11.9721))*	*t-statistic*	*((-2.8205))*	*t-statistic*
Investor Base x Exchange rate volatility	**-6.6670**	***	**-3.2879**	***	**-5.5686**	***	**-2.9476**	***
	(0.0043)	*p-value*	*(0.0008)*	*p-value*	*(0.0000)*	*p-value*	*(0.0062)*	*p-value*
	((-7.8928))	*t-statistic*	*((-3.4184))*	*t-statistic*	*((-7.8073))*	*t-statistic*	*((-2.7681))*	*t-statistic*
Control Variables								
Structural								
Size of Economy	**0.0000**	***					**-0.0000**	***
	(0.0000)	*p-value*					*(0.0065)*	*p-value*
	((6.2130))	*t-statistic*					*((-2.7516))*	*t-statistic*
Trade openness	**-0.0191**	***					**-0.0068**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((-43.5093))	*t-statistic*					*((-7.4001))*	*t-statistic*
Size of banking system	**0.0039**	***					**-0.0048**	***
	(0.0000)	*p-value*					*(0.0000)*	*p-value*
	((5.9800))	*t-statistic*					*((-4.4856))*	*t-statistic*
Developmental								
Law and Order			**-0.8568**	***			**-0.7301**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*

			((-15.2083))	*t-statistic*			((-9.7509))	*t-statistic*
GDP per capita			**0.0001**	***			**0.0001**	***
			(0.0000)	*p-value*			*(0.0000)*	*p-value*
			((47.5428))	*t-statistic*			*((15.4132))*	*t-statistic*
Macroeconomic								
Interest rate spread					**-0.0502**	***	**-0.0588**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-8.9139))	*t-statistic*	*((-8.1938))*	*t-statistic*
Inflation rate					**0.0103**	***	**0.0067**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((22.2543))	*t-statistic*	*((8.3448))*	*t-statistic*
Capital controls					**0.1723**	***	**0.1520**	***
					(0.0000)	*p-value*	*(0.0017)*	*p-value*
					((6.5381))	*t-statistic*	*((3.1909))*	*t-statistic*
Fiscal balance					**-0.0231**	***	**-0.0231**	***
					(0.0000)	*p-value*	*(0.0000)*	*p-value*
					((-9.2728))	*t-statistic*	*((-6.0780))*	*t-statistic*
Constant	**0.7590**	***	**-1.4855**	***	**-0.1727**	*	**-0.3623**	***
	(0.0000)	*p-value*	*(0.0000)*	*p-value*	*(0.0514)*	*p-value*	*(0.0160)*	*p-value*
	((12.8937))	*t-statistic*	*((-24.3693))*	*t-statistic*	*((-1.9602))*	*t-statistic*	*((-2.4292))*	*t-statistic*
Number of observations	221		221		221		221	
Number of countries	13		13		13		13	
Adjusted R-squared	0.9806		0.9597		0.9143		0.9619	

1. ***In Table 16: Scenario 3 above BMD is the dependent variable and is measured as the liquidity of the bond market.***
2. ***The results presented above are for the period 2004 to 2020 for a sample of 13 emerging markets.***
3. ***Exchange rate volatility (measured as the standard deviation of the log of exchange rates), the investor base (measured as the percentage of total gross government debt held by foreign investors) and the interaction of the exchange rate volatility and the investor base are the main regressors.***
4. ***The investor base is measured as the percentage of total gross government debt held by foreign investors.***
5. ***We have controlled for fixed effects in all equations.***
6. ***All figures have been annualised.***
7. ***The coefficients of the control variables have been provided. The corresponding p-values of the coefficients have also been included in parentheses below the estimated coefficients. The asterisks i.e. ***,**,* refer to the 1, 5 and 10% significant levels respectively. The t-Statistics of the coefficients have also been included in double parentheses below the estimated coefficients.***

In Table 16 scenario 3 above where BMD is measured as the liquidity of the bond market, equation 1 is the best model fit for the data with an adjusted R-squared of 0.9806. The robustness checks confirm that the investor base has a negative relationship to BMD that is significant at a significance level of 1%. Exchange rate volatility is found to be significant at a significance level of 10% however scenario 3 reflects exchange rate volatility having a positive relationship to BMD which is different to the negative relationship reflected in the original results in table 13. Despite this, equations 2, 3 and 4 of scenario 3 all reflect a negative relationship between BMD and exchange rate volatility. Scenario 3 reflects that the interaction of the investor base and exchange rate volatility has a negative relationship to BMD and is significant at the 1% level. This result is different from the original results. These results, similar to scenario 1 and 2, suggest that the interaction of the investor base and exchange rate volatility is sensitive to how BMD is defined.

4.7 Conclusion

In this chapter the empirical results of the study were presented. The application of the methodology results in findings that indicate that exchange rate volatility has a negative relationship to BMD which is significant. The robustness checks completed confirms this finding.

The investor base is found to have a negative relationship to BMD which is significant. In addition, the higher the amount of government debt is owned by foreign investors where there is an exchange rate volatility, the higher the level of BMD. This result indicates policymakers must encourage higher foreign investor participation in their bond markets as this results in higher bond market development, even in a high exchange rate volatility environment.

Chapter 5 will provide a conclusion of the study including a summary of the key findings, some policy recommendations, and recommendations for additional avenues of research.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This chapter provides a summary of the main findings and conclusions of this study which examines the effect of exchange rate volatility on BMD as well as whether the investor base moderates the relationship between exchange rate volatility and BMD. Based on the findings, we make policy recommendations and recommend areas for future research.

5.2 Summary and Conclusions

5.2.1 Summary

Bond markets in many emerging markets are in their nascent stage of development and, to date, many emerging market countries have had limited access to global capital markets or sufficiently large or liquid local bond markets. A focus on developing sufficiently large and liquid bond markets in emerging economies is therefore important to help increase governments' sources of funding.

This study aims firstly to provide an update on the current state of LCBM in emerging markets. Secondly to contribute to the existing literature by focusing on the role of exchange rate volatility's impact, specifically on bond markets as most of the literature focuses on the impact of exchange rate volatility on equity markets. This paper also contributes to the literature by expanding the definition of bond market development to include consideration of the factors of size, liquidity and volatility of bond markets. This is different to existing literature where bond market development is often measured using the size of the bond market only.

This study employed the Feasible-Generalised Least-Squares ("FGLS") method for a panel data set of 13 emerging markets (i.e. Brazil, Chile, Colombia, Egypt, Hungary, Indonesia, Malaysia, Mexico, Peru, Philippines, Russia, South Africa and Thailand) for the period 2000 to 2020, which was used to answer the research question.

5.2.2 Limitations

There are three main limitations to this study. The first limitation is the small sample size that was used consisting of only 13 emerging markets. This is due to the limited information available on emerging market economies. The second limitation to this study is the fact that there were some gaps on information related to bond market liquidity and volatility. As emerging market bond markets develop, more complete and detailed information will become available which will add to existing literature.

In addition, given that the sample of the study includes mainly Latin American countries (38% of the sample) and Southeast Asian countries (31% of the sample) the results are likely to have a bias to those two regions and may be less reflective of the relationship between exchange rate volatility and BMD in countries in sub-Saharan African countries and Eastern European countries and caution must be exercised when generalising the results.

5.2.3 Conclusions

5.2.3.1 Exchange rate volatility

The paper finds that exchange rate volatility has a negative relationship to BMD which is significant at a significance level of 1%. This is aligned to existing literature on exchange rate volatility's impact on bond market development (Meyer & Hassan, 2020) (Dudzich, 2020). Where BMD is measured using the size of the bond market as a percentage of GDP, the volatility of the bond market or the liquidity of the bond market separately, the relationship between exchange rate volatility and bond market development remains negative and significant at different levels of significance. The findings therefore indicate that higher levels of exchange rate volatility result in less developed bond markets.

These findings answer the research questions by indicating that exchange rate volatility has a negative and statistically significant relationship to BMD when BMD is measured as the size, liquidity or volatility of the bond markets. This study therefore confirms the existing literature on the relationship between BMD and exchange rate volatility and indicates that this relationship remains unchanged even in emerging markets.

The implications of these findings to the field are that EM bond markets are as sensitive to exchange rate volatility as more developed entities. Given that EMs often experience more exchange rate volatility than developed markets, the ability to properly manage and reduce exchange rate volatility should be a priority in development finance if accelerating financial development in EMs is to be achieved.

The robustness checks conducted support the original results confirming that exchange rate volatility has a negative relationship to BMD and is significant.

5.2.3.2 Structural variables

The size of the economy is found to have a negative and statistically significant relationship to BMD. This finding is different to the existing literature which indicates that the size of the economy has a positive relationship to BMD (Bhattacharyay, 2013a). The robustness checks also reflect a positive relationship between the size of the economy and BMD. The difference between the study's findings and the existing literature could be explained by how BMD is measured in existing literature (i.e. as just the size of the bond market) versus in this study where it is measured as a combination of the size, liquidity and volatility of the bond market.

Trade openness is found to have a negative relationship to BMD which is significant. This finding is confirmed in the robustness checks when BMD is measured as volatility and liquidity. However, where BMD is measured as the size of the bond market, the robustness checks indicate a positive relationship. The existing literature on the relationship between trade and financial development is mixed with some studies finding a positive relationship (Beck, 2002) and others finding a negative relationship (Menyah et al., 2014). There is scope to further investigate the relationship between trade openness and BMD.

Per the current literature, the size of banking system has a positive relationship to BMD (Bhattacharyay, 2013a; Eichengreen & Luengnaruemitchai, 2004b). The findings in this study confirm the existing literature finding that the size of the banking system has a positive relationship to BMD which is significant. This finding is confirmed with the robustness checks where the BMD is defined as the volatility and the size of the bond market. However, where BMD is defined as the liquidity of the bond market the size of the banking system is found to have a negative relationship to BMD. An explanation for this negative relationship could be that more liquid bond markets likely mean investors are using bond markets more than the banking system to raise funding.

5.2.3.3 Developmental variables

In this paper we find law and order to have a negative relationship to BMD which is significant. The robustness checks confirm this relationship. This outcome is not aligned to existing literature which indicates a positive relationship between law and order and BMD. This difference, however, is likely due to the way rule of law is defined in this study. How law and order is defined is significant with Haggard et al. (2008) findings that how law and order is defined impacts the empirical results in studies considering rule of law and financial development. There is therefore scope for further study of the relationship between BMD and the rule of law with a focus on the definition of the rule of law.

GDP per capita and BMD is found to have a positive and significant relationship which is in line with existing literature.

5.2.3.4 Macroeconomic variables

Interest rate spread and the fiscal balance are found to have a negative relationship to BMD which is significant. The inflation rate is found to have a positive relationship to BMD which is significant. These findings are aligned to existing literature (Rose et al., 2015b; Smaoui et al., 2017b). Capital controls are found to have a positive relationship to BMD but to not be significant similar to results in Smaoui et al. (2017b). However the robustness checks show inconsistent results with capital controls having a negative relationship to BMD where BMD is measured as the size of the bond market or the liquidity of the bond market. The results are aligned to the work done by Eichengreen and Luengnaruemitchai (2004b). There is therefore scope for further study of the relationship between BMD and capital controls in emerging markets.

The results provide an updated view on BMD in EM as data from 2000 to 2020 was used in this study as well as good insights for policymakers in EM focused on BMD that can be used to develop BMs in their markets.

5.2.3.5 Investor base

The paper also finds that the investor base has a negative and significant relationship with BMD at the 1% significance level. The results of the effect of the interaction of the investor base and the exchange rate to BMD indicates where there is a high number of foreign investors and exchange rate volatility, BMD is higher. This indicates that in an environment where exchange rate volatility is high, having more foreign investors can lead to increased bond market development.

5.3 Policy recommendations

The findings confirm existing literature that exchange rate volatility hinders BMD. The findings also indicate that where more of government debt is held by foreign investors and there is exchange rate volatility, there can be higher levels of bond market development.

Policymakers should therefore focus efforts on implementing policies that stabilise the exchange rate. An example of an effective policy to stabilise exchange rates includes central banks holding healthy levels of foreign exchange reserves to be able to support their currency in crisis. This has been found to be an effective way to manage exchange rate volatility (Hviding et al., 2004). In addition to implementing policies the paper finds that where there is a high foreign investor base and exchange rate there are more developed bond markets. To encourage foreign investors to invest in the local bond market unrated countries should engage with external established credit rating agencies. Being externally rated will provide foreign investors with independent information on the ability of the sovereign to meet its obligations and can increase the attractiveness of the local bond market to foreign investors.

In addition to managing exchange rate volatility, policies that encourage economic development and stability remain important to BMD as reflected by the results of the other factors that remain statistically significant to bond market development. Therefore, policy makers should focus on building stable economies with low interest rate spreads, low inflation rates and appropriate levels of capital controls that protect the country while not stifling capital flows and reducing fiscal balances.

5.4 Avenues for future research

Areas that could benefit from future research include:

1. Investigating how the factors of size, liquidity and volatility of bond markets interact with each other from an empirical perspective in emerging markets and how policymakers can use these insights to support bond market development. This research can provide a more nuanced understanding of what BMD is and how to create policies that are specific and targeted to support BMD in emerging markets.
2. The effect of exchange rate volatility on BMD in a larger sample of emerging markets.
3. Comparing the effect of exchange rate volatility on BMD in emerging markets versus in developed markets.
4. The impact of trade openness on BMD.

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fQ1zgiA6rInAf79vEinS1HR2WwOe4kyN8ipptQD0i29PSuY5fZPWATTXXn-bF0Nwg1I4DjsRO-Tk0m1pTBHDTi0XQbJyKEVHgTYULSdbWmUO6Y0KQKp-SuB5RA0Vh22n1XqrhDi31QPE2xGQxHtSCgsfOzMUHTHcpmPEg0Z6gs3Y16IhXxfASBn-avQm6oOipxk6Yr0Vu9mqp9OBW2yhIb0GCtlWnpG4OCNn0t2M2an08VQ__&Key-Pair-Id=APKAJLOHF5GGSLRBV4ZA

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ANNEXURES

Annexure A

1. Heteroskedasticity test results

H_0 = Residuals are homoskedastic

H_1 = Residuals are heteroskedastic

	Value	df	Probability
Likelihood ratio	35.87463	13	0.0006
Test Equation Results:			
Variable	**Coefficient**	**t-Statistic**	**Probability**
Exchange rate volatility	-0.9342	-2.2087	0.0281
Size of Economy	-1.41E-10	-2.0142	0.0450
Trade openness	-0.0055	-2.8684	0.0045
Size of Banking System	0.0032	2.0591	0.0405
Law and Order	-0.2105	-3.0847	0.0023
GDP per capita	0.0000	5.3614	0.0000
Interest Rate Spread	-0.0023	-0.7442	0.4574
Inflation rate	0.0123	10.9385	0.0000
Capital Controls	-0.0641	-0.5686	0.5701
Fiscal Balance	-0.0178	-1.8508	0.0653
Constant	-1.5964	-10.1288	0.0000
Adjusted R-squared	0.6477		

2. Cross-section dependence test results

H_0 = No cross-section dependence (correlation) in residuals

H_1 = There is cross-section dependence (correlation) in residuals

Test	Statistic	d.f.	Probability
Breusch-Pagan LM	156.2850	78	0.0000
Pesaran scaled LM	6.2678		0.0000
Pesaran CD	4.9760		0.0000

3. Serial Correlation Test results

H_0 = The model does not suffer from serial correlations

H_1 = The model does suffer from serial correlations

Variable	Coefficient	t-Statistic	Probability
RESID01(-1)	0.6383	14.2257	0.0000

4. Hausman Test results

H_0 = The Random Effects model is most appropriate given the data set

H_1 = The Fixed Effects model is most appropriate given the data set

Test Summary	Chi-Sq. Statistic	Chi-Sq. Statistic d.f.	Probability
Cross-section random	56.3040	10	0.0000