Foreign Investors in South African Government Bonds- Do We Know Their Impact on Bond Yields and Volatility?

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Abstract

Portfolio inflows into South African government bonds continue to increase and remain at a high level. Foreign holdings are close to 40% of total outstanding government securities. The theoretical underpinnings supporting foreign participation in local currency debt markets rely on investor base and home bias theories. But do we know the impact of foreign participation on government bond yields and volatility, if any? We examine both aspects employing autoregressive distributed lag (ARDL) approach over monthly data for 2011-2018. Our results show that the impact of changes in foreign participation is more pronounced in the long run. That is, increase in foreign participation reduces bond yields by 7 basis points in the short run and 12 basis points in the long run. We show that central bank policy interest rate, global factors, and the external position including value of the rand matter to bond yields. Our results also show that changes in foreign participation on bond yields volatility is important. Thus, increasing foreign participation in South Africa does come with a cost of higher bond yields volatility. From the analysis, we discuss options to manage portfolio flows.

Keywords: foreign participation, bond yields, bond markets, investor base, South Africa

1. Introduction

Portfolio inflows into South Africa's capital markets have been very high since 1994 with a mix of bonds and equities. Aron, Leape and Thomas (2010) attribute the large inflows to the developed domestic capital markets. Substantial capital inflows impact on exchange rates and bond yields which in turn have monetary policy implications.

Substantial research in South Africa has been devoted to understanding the determinants of capital flows including portfolio flows. For instance, Wesso (2001), and Aron *et al* (2010) and Kavli and Viegi (2015). The non-resident inflows, which we refer as foreign participation, are mainly invested into government bonds. According to National Treasury statistics, the share of foreign participation into government bonds has been rising from less than 10% in 2006 to close to 40% in 2018. Non-residents have been the single largest investor type since May 2012 eclipsing pension funds. While there is substantial amount of research on the fundamental determinants of bond yields in South Africa, there are limited studies that examine changes in the investor base impact on these bond yields in South Africa. Arslanalp and Poghosyan (2016) make a similar case on advanced economies.

For South Africa, some of the changes in investor base (foreign participation) are not necessarily tied to domestic fundamentals, but external factors. For example, US policy on interest rates or recent changes in credit ratings that affect positioning by asset managers. On the latter, falling out of some bond indices such as JP Morgan or Barclays indices in 2017 affected foreign participation and consequently government bond yields. Investment banks have developed bond indices which help to track selected bond securities in different countries, thereby providing investors with a variety of investible options across countries.

The reduction of interest rates in advanced markets post the global financial crisis of 2007/2008 and the generally high interest rates in frontier markets have rendered bond yields attractive for investors in developing markets. Foreign investor participation also helps central banks in monetary policy transmission while a deepening investor base helps with competitive pricing of debt securities. Thus, a deepening bond market can improve the yield curve and therefore, interest rate transmission channel.

Researchers argue that foreign investor participation provides benefits as well as costs. Arslanalp and Poghosyan (2016) argue that foreign participation helps to expand domestic savings base by bringing foreign capital- which in turn can help lower cost of borrowing; and

financial integration which in turn helps portfolio diversification. Andritzky (2012) concurs that foreign investors help to facilitate the development of liquid benchmarks which in turn help to improve liquidity in the secondary markets. The premise of these assertions stems from the assumption that foreign investment could have a different investment philosophy and time horizon relative to domestic investment as domestic institutional investors generally tend to buy bonds and hold them to maturity. In contrast, foreign investors are more likely to trade frequently and therefore contribute to a more liquid market. Moreover, foreign investors add to a more diversified investor base.

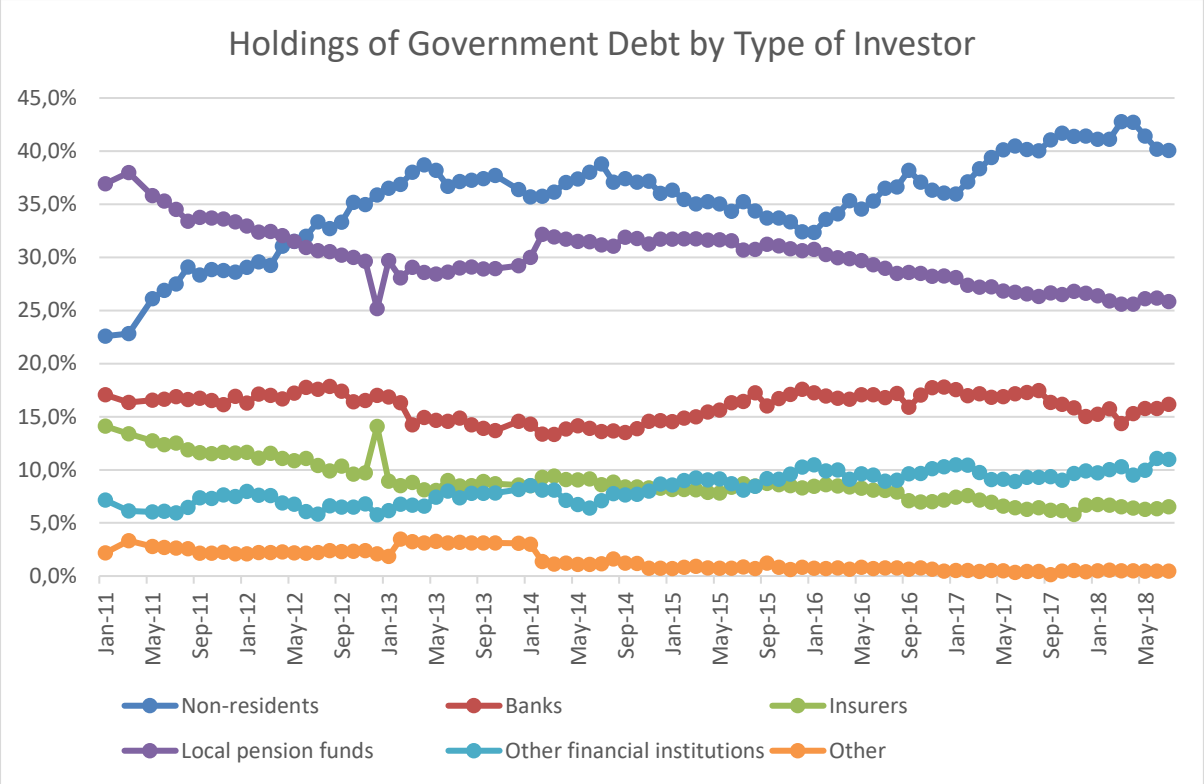
However, changes in foreign investor flows can have destabilising effects, particularly as these portfolio flows can shift over very short periods. Such changes pose risks of greater volatility in bond markets. Emerging markets can experience sudden stops when global risks change (see Calvo and Talvi 2005 on sudden stops). When short term portfolio flows move too frequently, they tend to be "hot money" which can cause problems for monetary policy conduct. Peiris (2010) argued that the collapse of Lehman Brothers in September 2008 resulted in higher outflows in emerging markets and greater yields volatility. The International Institute of Finance (IIF) (2014) which tracks capital flows in emerging markets indicated that since the announcement of US monetary policy normalisation in May 2013 and more recently in 2018, emerging markets have generally suffered significant bond outflows. It is therefore vital to understand the impact of such flows on changes in yields and volatility, if any. These movements can increase volatility in yields and in turn, complicate monetary policy. Notably, empirical analysis is still limited in the assessment of costs and benefits that arise from foreign participation in local currency bond markets.

The rest of the paper is organised as follows: Section 1.1 outlines the recent trends in foreign participation; Section 2 provides the research objectives and key issues; Section 3 reviews the literature; Section 4 reviews the methodologies applied; Section 5 reports the results and provides a discussion, and section 6 concludes.

1.1 Recent Trends in Foreign Participation in Africa

We start our analysis by showing the different types of investors holding government debt in Figure 1 below:

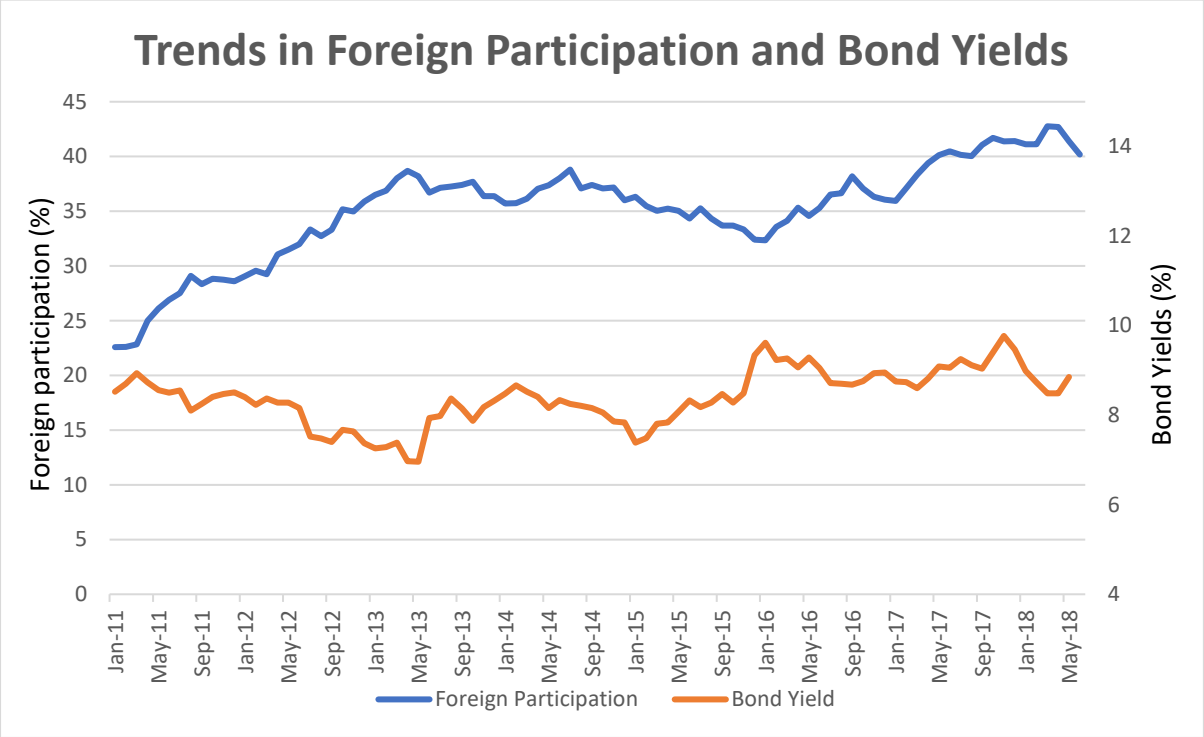
Figure 1: Holdings of Government debt by type of investor.



Source: National Treasury

In 2011, pension funds were the traditional largest investors in government securities with a share of over 35% in 2011. This share has been overtaken by foreign holders who now hold close to 40% of government debt while the share of pension funds has declined to about 25% of total holdings. The increasing share of foreign investors could have implications for bond yields and the volatility of the yields. We analyse the influence of foreign participation on bond yields through the share of holdings to total securities and changes in the benchmark 10-year government bond yields. Analysis using share of holdings demonstrates the extent to which non-residents holdings could influence overall changes in bond yields.

Figure 2: Foreign Participation and Bond Yields Trends in South Africa



Source: National Treasury & SARB

Figure 2 above shows the changes in share of total foreign participation and changes in government bond yields. As an investor category, foreign participation has always been high, at least 20% share of holdings over the sample period. That is, over the last eight years, the extent of foreign participation in local currency government bonds in South Africa has increased from around 20% in 2011 to close to 40% of total debt holdings by June 2018. We believe the changes in foreign participation were driven by generally common factors related to domestic and global factors.

Local currency government bond indices play a part in explaining the trends of foreign participation and bond yields in South Africa. The rising share of foreign participation trend in 2012 is linked to the initial announcement of inclusion of South Africa in the Citibank World Government Bond Index in June 2012 and the actual inclusion in September 2012. In this case, the inclusion in a government bond index was perceived as an endorsement on South Africa's developed local currency debt markets which encouraged inflows from foreign investors. Until Fed tapering in May 2013, foreign participation had been increasing while bond yields were declining.

The effect of global factors also contributes to foreigners' decisions to reduce or increase their share in government debt holdings. Federal Reserve tapering announcements since May 2013 explain the reduction in share of foreign holdings and increase in government bond yields before stabilising in early 2014. The second half of 2014 was followed by an international decline in commodity prices and consequent risk aversion in emerging and frontier markets, resulting in a declining share of foreign participation. Since 2016, foreign participation has substantially increased including 2017 second quarter where South Africa received successive downgrades by all three credit rating agencies, with two of the agencies' ratings falling out of investment grade. Nevertheless, bond yields did increase as a repricing of risk. We also observed that since March/April 2018 the share of foreign participation has been declining while bond yields were increasing, primarily due to the effects of announcements of rising interests in the United States of America.

Other than the overall share of foreign participation in government securities, we also considered the type of securities that foreigners prefer where data is available in a disaggregated form. Foreign participation in South Africa is only in long term bonds. More generally, South Africa has one of the more developed local currency bond markets in emerging markets. Long term bonds contribute 90% of total local currency debt. Within the long-term bonds, the share of fixed rate bonds is about 80%, of which foreign holdings are close to 50% of fixed rate bonds. Peiris (2010) dataset showed emerging markets average ranges from 65-71% share of fixed rate bonds while advanced markets are 90% fixed rate. In contrast, there are large variations in emerging and frontier markets, for example, Latin America has an average of 23% fixed rate out of total debt outstanding. Thus, South Africa stands out as one of the most developed debt markets in emerging markets.

2. Objectives and hypotheses

The paper attempts to explain the extent to which changes in foreign participation impact local currency government bond yields. While domestic investors tend to be more stable and have a long-term view, foreign investors may take a shorter-term view in search of higher yields, causing volatilities when they exit. Thus, our paper aimed to provide a better understanding of the existing dynamic relationships that can help governments improve their own financing options while deepening the domestic capital markets and improving financial intermediation. Understanding these trend drivers is also important to investors and asset managers who have to make investment decisions across a broader set of financial markets.

The analytical techniques that we developed in this paper endeavour to address two questions empirically: (i) Does foreign participation impact on bond yields in South Africa? If so, how and to what extent? If not, what other factors could affect bond yields? (ii) Does foreign participation impact on bond yields volatility in South Africa, and if so, how and to what extent.

3. Literature review

3.1 Theory

The impact of foreign participation on bonds yields is primarily based on investor base and home bias theories. In order to also take into account standard fundamental factors that determine changes in bond yields, we introduce the following theoretical model:

$$Y_t = \alpha + R_t + FP_t + X_t + \varepsilon_t \quad (1)$$

where Y_t are nominal government bond yields, α is a constant, R_t are interest rates such as short-term interbank rate. Short term interest rates are used to control the effects of monetary policy on the bond yield term structure (Peiris 2010). $FP_t$is ratio of foreign participation, X_t is a set of control variables which include real GDP growth rate, government debt to GDP and fiscal deficit to GDP and ε_t is the error term.

A diversified investor base can help improve liquidity, efficiency and effectiveness of local currency bond markets. Different investors may have different objectives, for example, domestic pension funds versus non-resident holdings can employ different investment strategies which can benefit the local markets. Consequently, the diversification of an investor base can lead to more competitive pricing on bonds only to the extent that different investor groups have different risk perceptions and preferences. According to Andritzky (2012), two important factors are key; investors' substitution function of current against future consumption and the universe of available instruments. Although different investors may exhibit different substitution preferences, only a change in the aggregate preference or in the universe of available assets can influence yields.

Others may argue that investor base does not influence bond yields. These arguments are premised on the market expectations theory which supposes that yields are primarily a function of future interest rates and not necessarily investor preferences. The market expectations theory suggests that investors utilise long term interest rate expectations to project short term interest rates influencing bond yields. In such a case, yield curves are usually flatter as arbitragers level

out the differences in investor preferences for the duration, assuming markets are frictionless. In such cases, shifts in demand preferences or supply of bonds would not alter the steepness of the yield curve. However, markets are not frictionless and this results in different slopes of yield curves.

Home bias theory is generally about local investors preferring to invest within the domestic market as they know it well. In developed markets, interest rates tend to be low and stable, making them more predictable. On the other hand, emerging and frontier markets are characterised by frequent changes in prices such as volatile securities returns' and volatile exchange rates among other factors. In order to invest abroad as a diversification strategy, the return should be commensurate with the level of risk taking. From the basic capital asset pricing model (CAPM) by Markowitz (1959) and Sharpe (1964), the investor is able to maximise the returns in a portfolio of assets given a certain level of volatility in the domestic market. The extension to international capital asset pricing model is done to include foreign investments risk by adding the exchange rate risk premium to calculate the required return on foreign assets. Fidora, Fratzscher, and Thimann (2006) argue that higher real exchange rate volatility induces bias towards domestic securities than the risk of investing in foreign securities. More so, home bias is particularly higher for bonds than equities as returns in bond securities are typically less volatile than equity returns.

Other than regulatory requirements and credit conditions, the home bias argument explains why banks are generally the largest holders of government local currency securities. With international portfolio diversification and different types of institutional investors, including asset management companies, there are more substantial international investments and related research in reducing information asymmetries between local and international bond markets. Darvas and Schoenmaker (2017) argue that, *ceteris paribus*, the larger the assets managed by institutional investors, the smaller the home bias which provides risk sharing opportunities. Therefore, international portfolio diversification and institutional investors searching for yields have resulted in trends of rising share of foreign participation, even in emerging and frontier markets that we explore in this paper.

3.2 Review of empirical evidence

SA empirical studies have tended to focus on the determinants of capital flows which include portfolio flows (see Wesso 2001, Aron et al (2010) and Kavli and Viegi (2015). Our empirical

analysis focuses on research that has directly attempted to measure the effect of changes in foreign participation impact on bond yields.

Early studies on the direct impact of changes in foreign investors on bond yields started with Burger and Warnock (2006) and Daniel (2008). The approach taken by Burger and Warnock (2006) was to analyse 41 countries from a US investor portfolio diversification perspective and Daniel (2008) analysed 24 emerging markets from a French investors' perspective. Despite the potential diversification benefits, US investors shunned developing markets and recommended that countries improve their macroeconomic stability in order to attract foreign investor participation. In Daniel (2008), the perception of emerging markets had already started to improve compared to Burger and Warnock (2006). The dataset showed that French investors holdings as share of securities denominated in local currency had increased from less than 10% in 2002 to close to 30% in 2005. Despite this, reporting on foreign participation was very weak and infrequent. Only the International Monetary Fund (IMF), Bank of International Settlement (BIS) and a few national sources had started compiling data on foreign investor participation. As a result, most of the empirical literature reviewed here are only from 2010 as not much studies exist prior to this period.

In the literature surveyed in this paper, there is concurrence that increased foreign participation result in bond yields declining in emerging markets. In our view, seminal work on analysing impact of foreign participation on bond yields probably started with Peiris (2010) who established that an increase in foreign participation by 1% results in government bond yields declining by 6 basis points. This work was followed up by Andritzky (2012) who investigated the same for advanced G20 countries and similarly confirmed 3-7 basis points average reduction in bond yields. More recently, Ebeke and Lu (2014) found that increased foreign participation does indeed reduce bond yields by 7-9 basis points on average. Lee (2014) also found similar results on lower yields (-3 basis points). Arslanalp and Poghosyan (2016) investigated the impact of foreign participation on bond yields in 22 advanced markets using quarterly data 2004-2022. Their results did show a 6-10bps bond yields reduction. Thus, changes in foreign investor participation can have economically and statistically significant effects on bond yields.

However, unlike the literature on the impact of foreign participation on yields, literature on the impact on bond yields volatility is mixed. Badalci and Kumah (2010) and Ebeke and Lu (2014) found that government bond yields volatility will increase with higher foreign participation.

Where volatility impact is less significant, it is usually attributed to other stronger factors impacting on volatility. On the other hand, Peiris (2010) provides mixed evidence. Peiris (2010) found 6 out of 10 countries with foreign participation that did not significantly impact volatility of bond yields. Andritzky (2012) and Lee (2014) also found insignificant relationships between foreign participation and bond yields volatility. Peiris (2010) and Andritzky (2012) further add that the effect may depend on other country specific macro conditions or even time periods considered.

4. Methodologies

4.1 Data and Variables description

The study employed monthly data published by South African Reserve Bank and National Treasury. The global factors were sourced from the Federal Reserve of St Louis. From a starting point of 12 variables, we eliminated some variables by testing each of them on how they impact the model results and chose the variables with the best economic significance to our model. We also systematically eliminated some variables based on economic significance established in our literature survey[1]. For bond yields, we utilised the standard 10-year government bond yields as proxy. In our bond yields volatility, we constructed our volatility measure from the weekly bond yields series to provide a monthly standard deviation series. With regards to foreign participation, we utilised the share of foreign participation to total outstanding local currency debt obligations of the government reported by National Treasury.

Based on theoretical and empirical literature, we control various other determinants of bond yields, including central bank policy rate, inflation, current account balance, exchange rate, fiscal balance, debt, money supply, global policy interest rates, and global volatility. The analytical techniques that we developed in this section endeavoured to test the following hypothesis empirically:

[1]For example, economic growth and US bond yields were not utilised due to little empirical support on economic significance while Zambia did not report quarterly fiscal deficits. Peiris (2010) results suggested domestic monetary aggregates and real economic activity do not impact on government bond yields.

Hypothesis 1- Does foreign participation impact on bond yields in South Africa?

Hypothesis 2- Does foreign participation impact on bond yields volatility in South Africa?

4.3 Time Series Estimation: Autoregressive Distributed Lag (ARDL) Analysis

In testing hypothesis one, we utilised ARDL by Pesaran and Shin (1999) and Pesaran *et al* (2001) as it allows taking different or mixed orders of integration. For instance, the Engle-Granger (1987) technique does not allow combining different orders of integration, I (0) and I (1) while the Johansen and Juselius (1990) technique requires a combination of I (1) to produce I (0). ARDL is a parsimonious OLS based model which takes sufficient number of lags to capture the data generating process in a general to specific modelling framework. ARDL is also good at identifying multiple cointegrating vectors efficient for small samples and obtains unbiased estimates of the long run model (Harris and Sollis 2003).

To test for order of integration, we utilised the Augmented Dickey Fuller (ADF), Dickey Fuller Generalised Leased Squares (DF-GLS) and the Philips Perron (PP) tests. Given our time series data is monthly, we opted for Akaike information criteria (AIC) when choosing the appropriate lag length. These ensured that the residuals are gaussian and allowed us to have economically interpretable results. Automatic lag length section chosen by AIC is an ARDL (2,2,0,0,1,0,0,2) regression, that is gby_sa (-2), fp (-2), polr (0), ffr (0), gby_glob (-1), fb (0), tradeB (0) and reer (-2).

Bounds testing is utilised to test if there are long run relationships. The outcome of the bounds test helped us to choose the correct specification. For the choice of critical values used in F and T tests, Pesaran *et al* (2001) provide lower and upper bounds for the critical values for large samples. We utilised the latest critical values developed by Kripfganz and Schneider (2018). The principle with ARDL is that Yt (bond yields, gby) is determined by its lagged values, current and lagged values of other exogenous variables with lag order p,q where p represents lags for dependent variable while q represents optimal lags for exogenous variables. So, we estimate ARDL equations of the following form:

LR: $$gby_{sa} = \beta_0 + \Phi gby_{sa\,t-2} + \beta_1 fp_{t-2} + \beta_2 polr + \beta_3 ffr + \beta_4 gby_{glob t-1} + \beta_5 fb + \beta_6 tradeb + \beta_7 reer_{t-2} + \varepsilon_t \quad (4)$$

SR: $$\Delta gby_{sa} = \beta_0 + \beta_1 \Delta fp + \beta_2 \Delta polr + \beta_3 \Delta ffr + \beta_4 \Delta gby_{glob} + \beta_5 \Delta fb + \beta_6 \Delta tradeb + \beta_7 \Delta reer + \alpha ECT + \varepsilon \quad (5)$$

Where α is coefficient of error correction coefficient or speed of adjustment term (ECT) which must always be negative and significant, ε ~ iid (0, σ2)- zero mean and constant variance.

In estimating volatility, we utilised similar equations as above. However, we replaced the dependent variable (gby_sa) with the volatility measure (Sdev). For global factors we explored with federal funds rate and global policy rate together with volatility index (VIX) but chose the latter due to economic significance to the model. The lag length selection chosen automatically by AIC is an ARDL model (1,1, 0, 0, 0, 0, 0). The automatic lag length selection from AIC shows one lag for volatility and foreign participation while all other variables have no lags. The following ARDL equations are subsequently estimated:

$$\text{LR}: Sdev = \beta_0 + \beta_1 fp_{t-1} + \beta_2 polr + \beta_3 vix + \beta_4 fb + \beta_5 tradeb + \beta_6 reer + \varepsilon \quad (6)$$

$$\text{SR}: Sdev = \beta_0 + \beta_1 \Delta fp + \beta_2 \Delta polr + \beta_3 \Delta vix + \beta_4 \Delta fb + \beta_5 \Delta tradeb + \beta_6 \Delta reer + \alpha ECT + \varepsilon \quad (7)$$

5. Results and Analysis

5.3 ARDL Time Series Analysis on South Africa.

Discussion of results: Impact of foreign participation on bond yields in South Africa

Our unit roots tests (in appendix) show mixed evidence of stationary and non-stationary characteristics which is permissible in ARDL estimations. For non-stationary in levels, all variables become stationary after first differencing. Therefore, no variable is integrated of order 2 which allows us to perform ARDL.

Table 2: ARDL Bounds test- Pesaran *et al* (2001) using Kripfganz and Schneider (2018) critical values and approximate p-values

F = 5,215, t= -3,473. H0= no level relationship.

Pesaran, Shin, and Smith (2001) bounds test								
	10%		5%		1%		p-value	
	I (0)	I(1)	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
F	2,093	3,307	2,439	3,762	3,210	4,761	0,000	0,005
t	-2,515	-4,173	-2,840	-4,556	-3,483	-5,297	0,010	0,272

We utilised the bounds testing procedure to draw conclusive inferences of relationships in our variables. The outcome of the bounds test indicated that we could proceed to specify an error correction model to assess short and long run relationships.

Table 3: ARDL impact of foreign participation on bond yields

Adjustment (α,)	-0,23 [-3,47]***
Long run terms	
Foreign participation	-0.1236 [-3, 57]***
Policy rate	0,5704 [2,83]***
US Federal funds rate	0,692 [1,60]
US bond yield	0,6913 [3,38]***
Fiscal balance	0,1517 [1,23]
Trade balance	0,6570 [1,76]*
Exchange rate (reer)	-0,064 [-3,33]***
Short run terms (differenced)	
SA bond yield (lagged)	0,1715 [1,87]*
Foreign participation	-0,0715 [-3,18]***
Policy rate	0,1335 [2,84]***
Federal funds rate	0,1620 [1,32]
US bond yield	0,745 [6,47]***
Fiscal balance	0,0355 [1,36]
Trade balance	0,1538 [1,97]*
Exchange rate (reer)	-0,0604 [-8,08]***
Diagnostics	
Serial correlation Durbin Watson	1,931 (value should be close 2 for no autocorrelation)
Serial correlation-Breusch Godfrey (lag1)	0,047 (0,827)
Heteroscedasticity- Breusch Pagan	9,24 (0,0024)***
Ramsey RESET test- omitted variables	3,06 (0,0340)

*Notes: ***, **, * represents significant at the 1%, 5%, and 10% levels respectively. [ ] represents t statistic and ( ) probability values*

The analysis here is based on the alpha, α, adjustment coefficient characteristics that must be well behaved- negative and statistically significant. Since we are modelling government bond yields, the error correction term, α, to be observed is the coefficient of government bond yields. Indeed, we observed that the coefficient is -0,23 and t value is -3.47 and probability was less than 1%, which showed that error correction coefficient was well behaved, negative and statistically significant. The adjustment showed the errors in the previous period were corrected in the current period. Therefore, we can make interpretations of long run relationships. The error correction represents speed of adjustment to long run equilibrium. Therefore, the result

implies there is statistical support for the existence of a long run relationship between the identified cointegrated variables. We show that of the 7 explanatory variables, 4 of these (foreign participation, policy rate, global bond yield, and exchange rate) can consistently explain long and short run dynamics in changes to bond yields, at least at the 5% level of significance. Notably, the magnitude of impact measured by coefficients differs between the two-time horizons.

a) Impact of foreign participation on bond yields in South Africa

The impact of changes in foreign participation is associated with a negative relationship with bond yields which is statistically significant. This is similar to previous literature which confirm the benefits of increasing foreign participation in local currency bond markets. Our results show that the impact of foreign participation is much more pronounced in the long run. An increase in foreign participation reduces bond yields by 7 basis points in the short run and 12 basis points in the long run. Perhaps, this is more to do with South Africa's higher level of financial integration with global markets compared to African peers. For instance, while Nigeria has been excluded in global bond indices[2], South Africa has remained in global bond indices, thereby attracting consistent levels of foreign investment in government bonds. Another view may be associated with sovereign credit risk. South Africa's sovereign ratings are generally at a higher level than peer African countries, despite falling out of investment grade by two credit rating agencies.

b) Impact of policy interest rates on bond yields in South Africa

Our results showed that the impact of policy interest rates on bond yields is positive and consistent with economic theory and previous literature. The impact of a one percent increase in policy rate on bond yields is 13 basis points in the short run and about 57 basis points in the long run. This is plausible considering that South Africa pursues an inflation targeting framework which uses the central bank policy rate, repo rate, as the main tool to target inflation and transmit the policy rate to the financial markets and the real economy.

c) Impact of exchange rate movements on bond yields in South Africa

Exchange rate movements measured by real effective exchange rate have a statistically significant negative relationship with bond yields. An increase in real effective exchange rate

[2] JP Morgan index- was included in 2012 but subsequently excluded in 2015.

(appreciation) comes from the strengthening of terms of trade in a domestic economy. The stronger terms of trade help to narrow the size of current account deficit. If this is the case, the funding need becomes smaller, thereby reducing the country's borrowing levels and consequently bond yields which reflect cost of borrowing of the government. South Africa also experiences exchange rate volatility that is linked to the terms of trade changes or is externally driven by developments in the global markets. The larger the current account deficit, the more the likelihood of a higher exchange rate depreciation which results in higher bond yields. Conversely, a declining current account deficit is also synonymous with exchange rate appreciation, other factors held constant, or at least minimal depreciation and therefore, declining bond yields.

d) Impact of global bond yield changes on bond yields in South Africa

Here, the relationship is positive and statistically significant. A rise in bond yields in the US can attract foreign investors to go back home. This implies that yields are stable and predictable in-home markets and may not be worth the risk of bigger exposures in less developed markets. The effect would then be an increase in global bond yields, leading to an increase in local currency bond yields. This is best explained through the link with foreign participation. When foreign holders depart local markets for home countries, the exit process can result in local currency bond yields being pushed up as new investors demand higher compensation for holding the securities. In the case of South Africa, practical experience has demonstrated that when foreigners exit, local asset managers buy the securities and bid for higher yields, which acts as a normal adjustment mechanism. This was the case in May 2013 when the US Federal reserve started to increase their policy rate and again in 2018 with rising interest rates from the Federal Reserve.

e) Global policy rate and government's fiscal position impact on bond yields in South Africa

While these two variables were statistically insignificant, we considered the reasons why this may have been the case. The result is interesting in a way as it suggests a government's fiscal position does not necessarily affect its own borrowing costs but is rather driven by other macroeconomic factors. In South Africa's case, the size of the fiscal deficit has generally been stable in a range of 3-4% of GDP. Thus, within these levels, bond yields already capture the sovereign risk. Thus, changes in fiscal measures are not statically significant in explaining bond

yields. Importantly, to understand the insignificance of the global policy rate on South Africa data requires a lot more analysis. Our model contains both global policy rate and global bond yield which factor in global influences on bond yields. It is the latter that has provided better economic significance. Thus, it does not take away the effect of global factors on South Africa's bond yields but rather economic significance is better explained by the reaction of global bond yields rather than directly through the global policy rate. We also performed a series of diagnostic tests which confirm no serial correlation, presence of heteroscedasticity and stability of the model which is also correctly specified.

5.4 Estimating Time Series Bond Yields Volatility in South Africa.

After establishing that changes in foreign participation have an impact on bond yields, we tested whether changes in foreign participation have an impact on bond yields volatility in South Africa.

Table 4; Bounds test- Pesaran et al (2001) using Kripfganz and Schneider (2018) critical values and approximate p-values

F = 10,591, t= -8,598. H0= no level relationship.

Pesaran, Shin, and Smith (2001) bounds test								
	10%		5%		1%		p-value	
	I (0)	I(1)	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
F	1,825	2,993	2,160	3,433	2,910	4,393	0,000	0,000
t	-1,614	-3,713	-1,952	-4,084	-2,611	-4,795	0,000	0,000

Table 5: ARDL results on impact of foreign participation on bond yields volatility in South Africa

Adjustment	-0.9581 [-8,60]***
Long run terms	
Foreign participation	0.6097 [2,20]**
Policy rate	-1.2318 [-0,93]
vix	0.4503 [2,27]**
Fiscal balance	0.1092 [0,08]
Trade balance	-1.5368 [-0,37]
Exchange rate (reer)	0.1015 [0,74]
Short run terms (differenced)	
SA bond yield volatility (lagged)	
Foreign participation	-1.3543 [-1,25]
Policy rate	-1.1803 [-0,92]
vix	0.4315 [2,23]**
Fiscal balance	0.1046 [0,08]
Trade balance	-1.4725 [-0,37]
Exchange rate (reer)	0.0973 [0,74]
Diagnostics	
Serial correlation Durbin Watson	1.97 (close to 2 is no serial correlation)
Serial correlation-Breusch Godfrey (lag1)	0,019 (0,8916)
Heteroscedasticity- Breusch Pagan	0,00 (0,9544)
Ramsey RESET test- omitted variables	0,99 (0,4033)

*Notes: ***, **, * represents significant at the 1%, 5%, and 10% levels respectively. [ ] represents t statistic and ( ) probability values*

a) Impact of global volatility index on bond yields volatility in South Africa

In the short run, all variables are insignificant to explain the behaviour of bond yields volatility, except VIX, which is a proxy for global volatility index. Therefore, in the short run, volatility of South Africa's bond yields is primarily a function of volatility in the global capital markets measured by the Chicago Board Volatility Index. As with other global factors, the impact of global volatility on domestic bond yields volatility is mixed. For example, Andritzky (2012) and Ebeke and Lu (2014) do not find a statistically significant relationship while Lee (2014) found the relationship to be significant. Some see the VIX proxy as directly measuring the volatility of the equity indices and not necessarily reflecting bond markets volatility. In South Africa's case, it is plausible to expect transmission between global equity markets and domestic bond markets due to South Africa being more integrated with global markets than its peer African countries.

b) Impact of foreign participation on bond yields volatility in South Africa

In the long run, however, changes in foreign participation also affect the volatility of bond yields in South Africa, that is, an increase of one percent in foreign participation will result in bond yields volatility increasing by close to 60 basis points in the long run. This magnitude is a very strong response which explains that the majority of the volatility is explained by the behaviour of foreign holdings of local currency debt. The result provides credibility to the argument that increasing foreign participation in South Africa can be a cost as it results in higher bond yields volatility. The diagnostic tests were well behaved-no serial correlation, no omitted variables, the model is stable and error variances are homoscedastic.

6. Concluding remarks

We set out to estimate the impact of changes in foreign participation on local currency government bond yields and bond yields volatility in South Africa. We established that foreign participation does indeed impact on bond yields in Africa. In addition to foreign participation, we also established that policy rates, exchange rates and global factors are important in understanding the behaviour of current bond yields. In South Africa's case, the value of the rand matters to bond yields more than the government's own debt position. With respect to the impact on bond yields volatility, we found that indeed, increasing foreign participation comes with increased costs of volatility of bond yields in South Africa. Bond yields volatility in South Africa is also caused by global financial markets volatility. Perhaps it is more to do with the fact that South Africa is more closely integrated with the global financial systems through the

deep capital markets relative to the rest of the African countries in our sample which are less integrated.

We established that foreign participation is beneficial to South Africa as it has helped to diversify the investor base and consequently reduce bond yields in the sample period. Therefore, the South African Reserve Bank and National Treasury should pay attention to changes in the level of foreign participation. More so, they should also monitor changes in macroeconomic variables, that is, interest rates locally and globally, and changes in exchange rates matter to impacting bond yields.

Foreign participation is a reality in local currency debt markets. They provide competition to banks, pension funds and insurance companies that traditionally hold government securities. Such competition can result in lower costs of borrowing reflected in declining bond yields. A broader take away for central banks in general in that increased foreign participation and lower bond yields could actually help to narrow the gap between central banks policy rate, commercial banks' lending rates and bond yields. The narrower the gap, the better the policy rates can be transmitted to the banking sector and the real economy. For portfolio managers, timing is important to maximise yields from government securities by monitoring global changes in policy rates and global yields so that when foreign participation declines in local currency markets in favour of rising rates in advanced markets, it is an opportunity to buy government securities at higher returns levels.

Our paper had a few limitations as do all other studies. The measure of volatility can also be strengthened in other studies by using more complicated techniques such as GARCH provided that higher frequency data on foreign participation is also available.

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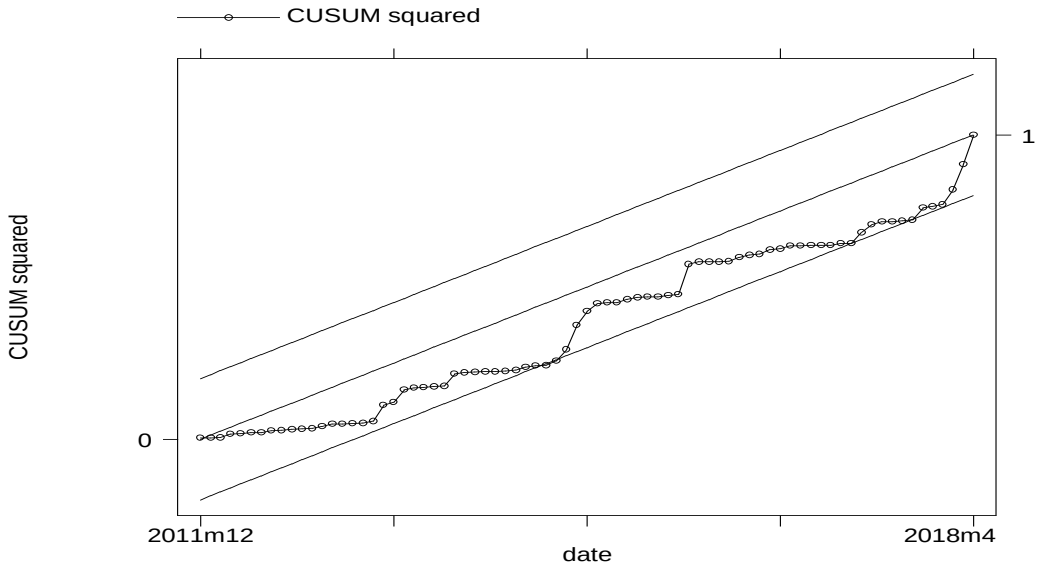
APPENDIX

Appendix 1: South Africa monthly data: Unit root tests

	ADF		PP		DF-GLS	
	Level	1st diff	Level	1st diff	Level	1st diff
Gby_sa	*-2.257*	-7.282	-2.688	-8.096	-2.314	-5.144
fp	*-2.982*	-5.441	-2.393	-8.448	-1.313	-4.274
polr,	-1.484	-5.213	-1.575	-9.346	-1.421	-4.553
m3	*-3.144*	-7.156	*-3.689*	-11.058	*-3.260*	-5.453
ffr	1.886	-6.288	2.362	-7.400	0.464	-6.117
Gby_glob	*-3.133*	-5.941	-2.290	-7.825	-1.564	-5.003
vix	*-3.276*	-7.360	*-3.837*	-9.324	*-3.554*	-6.459
fb	*-10.446*	-17.457	*-15.772*	-35.199	*-3.462*	-6.023
tradeb	*-5.500*	-15.230	*-7.463*	-19.248	-3.020	-6.808
reer	-1.383	-7.264	-1.427	-8.046	-0.972	-4.596
1% critical value	-2.371	-2.372	-4.069	-4.071	-3.626	-3.629
5% critical value	-1.663	-1.663	-3.463	-3.464	-3.025	-3.046
10% critical value	-1.292	-1.292	-3.158	-3.158	-2.734	-2.753

Italised means variable is stationary in levels at 5%

Appendix 3: Model stability- Cusum test- model is stable within the bounds.



ARDL Bond yields Volatility results

Appendix 4; Model stability- Cusum test