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The Impact of Macroeconomic factors on the yield curve in emerging markets: the case of Sub-Saharan Africa

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Abstract

We investigate the impact of local and global macroeconomic factors on Eurobonds and local currency issued bonds in Sub-Saharan Africa, at different points on the yield curve. Using a unique proprietary data set collected from local authorities, central banks and independent international sources over the period 2001-2016, we find the local monetary policy interest rate and the balance of trade to impact both local currency bond yields and Eurobonds; global risk aversion, as proxied by the VIX index, to impact *only* the Eurobonds and much more the commodity importing countries; and the explanatory power of most models to be high.

Key words: yield curve, bond markets, emerging market economies, Sub-Saharan Africa

JEL Clasification: E43; E44; F34; G15; H63

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[2] Duet Asset Management

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"Sub-Saharan African debt markets are thriving as the combination of high interest rates and an easing of political tension in some major countries has fanned an enthusiastic response from yield-hungry investors."

Financial Times 23rd February 2018

1. Introduction

In recent years, Emerging Markets (EM) have increased in overall importance across all financial asset classes. The dramatic rise of EM countries can be seen by the increase in their contribution to the world GDP from 20.8% in 2000 to 38.8% in 2016.[2] In today's context EM form part of many investment portfolios. Burger, et al.,(2012) identified a growing trend of foreign investors participating in EM domestic bond markets, and a clear differentiation in research on EM countries, with the more developed EM countries being more extensively analysed and researched than the less developed ones.

Sub-Saharan Africa (SSA) with the exclusion of South Africa is a geographical area within the EMs, which is the least well investigated. One of the reasons why the region has not been studied extensively is the difficulty in gathering and accessing data and information. Nevertheless, SSA as a region, has issued over the period 2006 - 2016, a total of 31 USD denominated Sovereign Eurobonds, for a total value of USD 25.6 billion (see table 1), indicating that SSA should not be overlooked as an investment outlet. Nowadays the majority of SSA Eurobond debt is included in the main emerging market bond indices, such as the benchmark JP Morgan Emerging Market Bond Index (JPM EMBI), of which SSA Eurobonds accounted for 4.5% to the total index in 2017.[3]

One of the reasons why SSA has grown in importance for investors, is the high yields SSA debt instruments carry for both USD denominated Eurobonds and local currency debt

[2] www.imf.org World Economic Outlook database.
[3] JPM Emerging Markets Bond Index (EMBI) Monitor June 2017.

instruments in the current (2018) low yielding environment. For example, local currency treasury and bond yields in Zambia and Ghana, both offer a high double-digit yield of over 20%. Among the yields on the USD denominated Eurobonds, Angola's 2025 maturing Eurobond offers a yield of over 8%, while Nigeria's 2023 maturing USD Eurobond offers a yield of just under 6%.[4] A number of factors account for why local currency debt instruments in SSA have higher yields than their respective USD Eurobonds. These include high and sometimes double digit local inflation, high local currency volatility versus the USD, large concentration of issuances in local currency debt at the short end of the yield curve, and the shallow depth of the local market.

The SSA investible countries are more heterogeneous than many investors might appreciate. According to the findings from the Mo Ibrahim index (see Appendix A), there is strong differentiation across countries on a human and economic development scale and especially between the commodity exporting countries (CE), such as Angola or Nigeria, and the commodity importing countries (CI), such as Kenya or Rwanda, the latter scoring higher across the board in all the categories, most likely because they are less reliant on one, or a few key commodity exports in terms of revenue generation. Furthermore, SSA benefits from some of the world's highest GDP growth rates according to the IMF growth forecasts (see Figure 1), with again substantial differences between the CI and the CE countries.

Although, SSA Eurobonds remain on the fringes of the global emerging market Eurobond indices, it cannot be refuted that SSA Eurobonds, with the exclusion of South Africa, have outperformed the JPM EMBI since 2008 (see Figure 2), while at the same time the SSA Eurobonds have become more integrated into the wider Emerging Market debt asset class. At the end of 2007 only Gabon and Ghana had issued Eurobonds (not counting the countries'

[4] See Appendix G for more details.

Eurobonds in default or in the process of restructuring), while at the end of 2016, there were 14 different sovereigns that have issued Eurobonds.[5]

There is however, a clear difference between the local bond market development and the international Eurobond market, as the main investors' base is different. In the former market the majority of investors are local, while in the latter they are foreign, who might not necessarily invest in the country's local sovereign debt markets despite the fact that SSA offers some of the highest real interest rates in the wider EM universe. This could be due to the fact that information is either not available, or is not accessible to enable investors to evaluate the risks. Thus, from an investor's perspective there appears to be a difference in the behaviour of local bond and international bond yields, and that motivates our research.

In our study we seek answers to the following questions: What is the impact of macroeconomic factors (MEFs) on the yield curve of both Eurobonds and local currency issued bonds in SSA? Is the response of Eurobonds and local currency denominated bonds different, signalling investors' different perceptions of what shapes the yield curve of Eurobonds and bonds denominated in the local currency? Is the response of debt instruments of CE countries different from that of CI countries, highlighting the different issues faced by these countries in the light of the high volatility of commodity prices? Do bond yields behave differently in CFA franc countries, which do not have the use of the exchange and monetary policy instruments?

To the best of our knowledge this is the first study to investigate the impact of MEFs on both the local bond and treasury yields, and Eurobonds in SSA, offering a better understanding of the SSA debt markets. This is a novel approach versus the more traditional EM literature, as normally local currency debt markets are analysed separately from their respective countries' sovereign hard currency external debt. Furthermore, our analysis will

[5] Only a handful usually do not feature in the indices, such as Tanzania 2020 Floating Rate Note, the Angola 2019 loan participating note, and the Rwanda 2023 Eurobond, mostly to do with the bond structure of issuance size. For more details see section 3 on stylized facts.

allow investors to achieve a better risk and reward analysis of the bond yields, given their macroeconomic scenarios, encouraging them to invest more in those markets.

The two papers which are closest to our study but focussed only on the Eurobond yields are Gevorkyan and Kvangraven (2016) and Senga, et al., (2018).[6] Our study differs from both of those studies in several ways. First, and of great importance here, our data set is unique. We are using proprietary data for on the quarterly frequency for the period Q1 2006 to Q2 2016 for our sample of African countries, namely, the monetary policy rate (**mpr**), consumer price index (**cpi**), quarterly gross domestic product (**qgdp**), balance of trade (**bot**) and foreign exchange reserves (**fxres**), which have been collected by Duet Asset Management. The African economic database has been manually collected from a combination of various local African official sources, such as the individual country Central Banks, Statistic Offices, as well as the IMF, the African Development Bank and Tradingeconomics. The amalgamation of economic data collected by Duet Asset Management is unique, and provides greater data availability for economic data, which is often difficult to obtain on Africa, as data is not regularly posted or updated on easily accessible data portals. Even if the data is available, time delays can play an important role in how price and yields for the various debt instruments react. This is in contrast to Gevorkyan and Kvangraven (2016) whose research is based on data from Bloomberg. Information on Bloomberg often appears with a time lag, and not all the data is available on Bloomberg, while our data are more timely, which is important for investors' sensitivity to MEFs. Similarly, Senga et al., (2018) use international sources and monthly interpolations for key variables. The use of monthly interpolations implies that investors do not have the actual information on a monthly basis, which might be impacting the investors' sensitivity to MEFs.

[6] The financial press has also highlighted the importance of SSA for investors (Rintoul, 2013 and Bowman, 2013).

Secondly, we follow Bekaert (2010) and investigate the impact of MEFs at various points on the yield curve. This issue has not been examined in previous studies.

The literature on the relationship between the state of an economy and its respective term structure of interest rates is vast with the majority of the research concentrating on the US (e.g., Taylor, 1993; Fleming and Remolona, 1999; Evans and Marshall, 2007; Ang and Piazzesi, 2003; Ang et al., 2006; Rudebusch and Wu, 2008, Bekaert et al., 2010). Our work however draws from the strand of literature which uses various MEFs also known as factor models, in their term structure models. These were first examined by Kozicki and Tinseley (2001) followed by Ang and Piazzesi (2003). The advantage that factor models present, is that they impose only a no-arbitrage condition and no other conditions on an economy in equilibrium (Ang and Piazzesi, 2003). The various studies using macroeconomic factors, such as inflation as well as interest rates in a term structure model, find that their research has a better capacity to explain low-frequency bond yield movements. Methodologically, we use a panel analysis, similar to Jaramillo and Weber (2013), who focus on 26 EM countries, but only included South Africa from the African continent. They find that fiscal variables impact 10-year local currency bond yields conditional on global risk aversion. Using a panel methodology to SSA bonds allows us to analyse the behaviour of the local currency and Eurobonds term structure of our group of African countries, which so far has not been covered in previous studies. Our study will exclude South Africa, as it is a country which is substantially more developed financially than the rest of SSA. According to the IMF Country Rankings on Financial Development in 2013 South Africa's ranking is at 28th position, while the first country from our SSA sample to enter the rankings is Kenya, which ranks at 115th position (Svirydzenka, 2016).

Our main results can be summarised as follows: First, on the whole both the local treasury and bond yields, as well as the Eurobonds, are impacted predominantly by two factors,

namely the local **mpr** and the **bot,** and the impact seems to be the *highest* at the *short* end for local instruments, and at the *long* end for the Eurobonds; the impact is contemporaneous for the former and stronger with a lag for the latter.

Secondly, global risk aversion, proxied by the VIX index, is only important for the Eurobonds as expected since investors in Eurobonds are mostly foreigners and the impact increases with time.

Thirdly, when considering the CE countries versus the CI countries, the results show that for the former the **bot** has a key impact upon the local treasury and bond yields, while for the latter it is the **mpr** as well as **cpi** and the amount of **fxres** which stand out as the main determinants. For the Eurobonds global risk aversion impacts much more the *CI* countries than the CE countries. This would indicate that investors in contrast to the development indices, which are lower for the CE countries compared to the CI, are less worried about a global risk off scenario for the cash flows for their exports are generating sufficient USD to service their foreign currency debt. On the whole the explanatory power is high for most models confirming the results of earlier studies about the importance of MEFs. Finally, the results are robust to the exclusion of the CFA countries, Senegal and Cote d'Ivoire, which do not have use of interest rate and exchange rate policies.

Our analysis will allow policy makers to gain a better understanding of the impact their local monetary, economic and fiscal policies have on their local and international debt yields, which will encourage a deepening of their debt markets, while investors will benefit from getting a better understanding of the impact of economic fundamentals on their investments.

The remainder of the paper is organised as follows: Section 2 covers the literature review. Section 3 presents some stylized facts relevant to the analysis. Section 4 explains the model, while Section 5 presents the data, and Section 6 the empirical results. Section 7 summarises the conclusions.

2. Literature Review

Our paper draws from the studies, which focused on the US and other developed markets (DMs) (Subsection 2.1), on the Emerging Markets (EMs) in general (Subsection 2.2) and on the SSA in particular (subsection 3.3).

During the course of this study the terminology of 'term structure' will be used interchangeably with the 'yield curve'. The yield curve in this respect is the amalgamation of the various debt maturities of a country, across local currency and USD denominated debt. For over 40 years researchers have been analysing the relationship between the state of an economy and its respective term structure of interest rates (eg, see Filipova, et al., 2014).

2.1. US and DMs

The largest part of research has been focusing on the US (e.g., Taylor, 1993; Fleming and Remolona, 1999; Evans and Marshall, 2007; Ang and Piazzesi, 2003; Ang et al., 2006; Rudebusch and Wu, 2008) and to a lesser extent on other DMs e.g Japan (Ullah et al., 2013), and Germany (Afonso and Martins, 2012).

The findings from Fleming and Remolona (1999), demonstrate through using the 5 year US Treasury that there is a two-stage reaction to macroeconomic announcements, namely, the immediate repricing within a 2 minute span of the announcement with little trading volume going through, while the second stage sees a higher increase in volume combined with high volatility post the 2 minute gap.

It has become widely accepted that a country's treasury yield curve contains large amounts of information about the economy, especially information regarding the current stance of monetary and fiscal policy as well as future economic expectations (Evans and Marshall, 2007; Ang and Piazzesi, 2003; Diebold et al., 2006, Dewachter et al., 2014). Nevertheless, while there

are various types of models used for yield curve analysis, certain models ignore macroeconomic linkages completely.

The first analysis using various macroeconomic factors, also known as factor models, in their term structure models was done by Kozicki and Tinseley (2001) followed by Ang and Piazzesi (2003). The advantage that factor models have is that they impose a no-arbitrage condition and no other conditions on an economy in equilibrium (Ang and Piazzesi, 2003). Kozicki and Tinseley (2001), using macroeconomic factors such as inflation as well as interest rates in a term structure model, find that their research has a better capacity to explain low-frequency bond yield movements.

Ang and Piazzessi (2003) through the application of a Vector Autoregressive (VAR) model in a Gaussian term structure model with time varying risk premia, using macroeconomic factors, such as inflation and industrial production over the period 1952 to 2000 on US sovereign bond yields find that that macroeconomic factors explain up to 85% of the movement in the short to medium term yield curve in contrast to 40% at the longer end of the yield curve. Furthermore, Ang and Piazzessi's (2003) research highlights that inflation has a higher explanatory power for the yield curve variance than the real economic activity for the short to medium term of the curve. The use of VAR allows them to take into account the joint dynamics of macroeconomic factors and bond prices.

Dewachter et al. (2006), applying also a VAR model, find that observable macroeconomic and latent variables contain clear macroeconomic interpretations. Lu and Wu (2009), following the work of Taylor (1993), use a dynamic no-arbitrage factor model with two macroeconomic releases: inflation related releases and output related releases. A total of 27 macroeconomic releases altogether, and their impact on the dynamics and market prices of the interest rate term structure is assessed. They find that those factors account for 77.9% to 82.1% of the daily variations in Libor and Swap rates from 1 month to 10 years maturity. Inflation

related releases have important, positive impacts on interest rates across all maturities while output related shocks have a larger impact on short term rates, thus impacting the overall slope of the yield curve while the former results in parallel shifts in the yield curve.

Wu's (2006) analysis, using a new Keynesian macroeconomic model, found that a contractionary monetary policy shock has a large but short-lived effect on short-term bond rates, with a diminishing impact on longer dated maturities. Bekeart et al. (2010), use a different approach to previous work in that all macroeconomic variables follow a set of structural macroeconomic relationships, which allow a better economic interpretation of the dynamics of the term structure. Their analysis finds that an inflation target shock is the main influence in the "level factor" of the yield curve as it impacts the relationship between the inflation target, inflation expectation and actual inflation, while monetary policy shocks are the main drivers, underpinning the variations in the "slope and curvature" of the term structure.

These studies covered two hypotheses of yield and macroeconomic factor interaction - yield-to-macro and macro-to-yields links- while focussing on the existence of either unidirectional or bidirectional causality of the yield curve and the macro economy (Ullah et al., 2013).

Filipova et al., (2014) highlight that while it is known that the response of the short interest rate to the state of the economy varies over time, nevertheless it is surprising that the macro-finance literature has generally ignored these stylised facts, Thus, while the link between interest rates and the state of the economy is not defined clearly, Filipova et al. (2014), find that agents observe the state of the economy today and use only the current relevant macroeconomic information and the optimal economic structure, to infer the future state of the economy.

In summary, inflation as well as the output related macroeconomic variables have been commonly used for term structure analysis (Bekeart et al., 2010). Taylor's (1993) research demonstrated that it is preferable for central banks to set their monetary policy rates based on

their own country macroeconomic conditions, and the preferred variables are real economic output and inflation data. Furthermore, Fisher's theory (1930) emphasises a one-to-one relationship between inflation expectation and nominal rates. Hence the notion that the term structure could be a predictor of inflation (Ullah et al., 2013).

2.2. Emerging Markets

Nevertheless, one cannot just generalise the findings for the US market to other countries: the effect of certain MEFs, such as fiscal behaviour can differ, as the research by Afonso and Martins (2012) in contrasting the effects of fiscal shocks for the US and Germany from 1981 to 2009 has demonstrated. They find that for the US, fiscal shocks have a direct effect on the short-end of the yield curve, while in contrast, in Germany the shocks create no significant reaction for the latent factors.

Calvo and Reinhart (2002) demonstrate that foreign exchange shocks in EM tend to pass through more quickly into aggregate inflation than in DM. The same is supported by Choudhri et al. (2005) and Devereux and Yetman (2010).

There is very little literature written about the direct impact of monetary policy on local EM bond yields. Most recent works focused on the development in terms of depth of local EM bond markets (Mohanty et al. 2012) and foreign investors' local EM debt holdings (Bruger et al, 2012; Coche et al. 2015; Ebeke and Lu 2015).

The literature regarding (EM) fixed income tends to be broadly divided into two groups. The first one focusses on the local currency bond and treasury yields and uses as MEFs the local monetary policy rates and foreign exchange rates. The second focusses on the country's external sovereign bond, or Eurobond yields (normally denominated in USDs) and the composition of the spread differentials between different issuers to the U.S. Treasuries and bonds. While much of the literature has focused on the determinants of yields on externally

issued sovereign bonds in emerging market economies, only a small number has focused on the determinants of domestically issued bonds.

For example,Matsumura and Moreira (2011), through a modified approach taken by Ang et al. (2006) for the Brazilian domestic yield, find similar results to Ang et al. (2006), that MEFs do have an influence; the same was also confirmed by the analysis of Morales (2010), for the case of Chile, who added latent factors to the macroeconomic variables. More recently Jaramillo and Weber, (2013) examined the importance of global fiscal policy and global risk aversion on 10-year bonds-data on a sample of 26 EMs and found that the extent of fiscal policy impact depends on the level of global risk aversion with less impact during tranquil times and greater impact during times of greater risk aversion.

The main body of literature on sovereign bonds focusses on their respective bond yields and spreads, related either to a country's creditworthiness, or the premium an emerging market investor would seek as a financial compensation when carrying the sovereign risk in their portfolio (Remolona et al., 2008). It has become apparent through numerous studies that economic fundamentals alone cannot fully explain the spreads of sovereign Emerging Market bonds (Eichengreen and Mody, 1998; Remolana et al., 2008; Mauro et al., 2002; Sy, 2002; Baek et al., 2005; Diaz-Wiegel and Gemmill, 2006). Furthermore, Gelos et al. (2011) identified that a country's perceived quality of economic policy and institutions influence a government's ability to tap the markets. Another key component appears to be the country's vulnerability to shocks, though a country's default will only limit a sovereign's ability to issue debt for just several years. One of the key explanations for understanding the gap in spread is due to global risk aversion (Eichengreen and Mody, 1998; Eichengreen and Mody, 2000; Remolana et al., 2008); in addition there is market sentiment *not* related to fundamentals, which can move the market by a large amount over a short period of time, and to which Bekaert et al., (2014) add the factors of the liquidity of the country's bonds, country-specific economic factors and

political risk. Andritzky et al. (2007) through their analysis of 12 EM countries, excluding SSA Eurobonds between January 1998 to July 2004, identified that the EM countries Eurobond yields respond more to sovereign credit rating changes and US interest rate changes than to domestic data and policy announcements. Nowak et al. (2011) took the argument further by demonstrating that for Brazil, Mexico, Russia and Turkey, surprises in macroeconomic conditions affect the conditional return and volatility of their respective Eurobonds, even if the process is slower to adjust; thus volatility remains higher, compared to DMs.

2.3.SSA

Research focusing on SSA excluding South Africa debt market is scant. The majority of recent EM research on domestic bond yields tended to use broad-based indices. For example Coche et al., (2015) uses a subset of local government debt represented by the Bank of America Merrril Lynch Broad Market Plus Index (GBMP).

One of the recent exceptions on local currency government bonds has been the study by Charteris and Strydom (2016), on the impact of capital market openness on the volatility of SSA Treasury bills. They demonstrate that the size and financial liberalization of capital markets affects the volatility, especially in the markets that contain the highest amount of foreign ownership. Looking at SSA Sovereign Eurobonds, the research by Gevorkyan and Kvangraven (2016) demonstrates that SSA sovereign Eurobonds are influenced significantly by global volatility, commodity prices and global liquidity. Another study, which focused on Eurobond yields in SSA is by Senga, et al., (2018). Their focus is on whether local factors are important in addition to the global factors in explaining Eurobond yields. However, no study has analysed the potential impact of MEFs on the local currency treasury bills and bonds. In this study we are seeking to fill this gap. We will examine the impact of local and global MEFs on both Eurobonds and local currency issued TBs and bonds in SSA at different points on the

yield curve, which has not been covered in earlier studies, largely due to the unavailability of data.

This study will focus on a group SSA countries, which issue both local debt and Eurobonds. The access and availability of data has been a key issue for researchers focussing on SSA. The data used in our analysis is unique in that it combines public data, which Duet Asset Management has collected from local statistics' offices, central banks, and ministries of finance, as well as from certain commercial data providers over a number of years. This unique data set allows for the study of both local currency treasuries and bonds as well as SSA Sovereign Eurobonds.

3. Stylized Facts

As SSA countries represent some of the lower financially and economically developed countries, it is important to highlight certain facts and local monetary and other policy actions to put this research in context. Specifically it deals with the countries which have issued Eurobonds (Subsection 3.2), with the local government treasury and bond issuances (Subsection 3.3), the CFA Zone (Subsection 3.4) and the FX markets in SSA (Subsection 3.5).

3.1. The countries which have issued Eurobonds

The African continent counts 54 countries, 48 out of which are part of the SSA region.[7] As South Africa is substantially more developed than the other SSA countries, has been excluded from our sample. There are at the time of writing this analysis, 16 countries in SSA which have issued successfully either one or numerous Eurobonds. However, not all of the 16 countries are regular issuers of local debt instruments, or they may have restrictions for foreign investors investing in them, and thus the final selection of countries in the sample is reduced down to 9: Angola, Cote D'Ivoire, Ghana, Kenya, Namibia, Nigeria, Rwanda, Senegal and Zambia. Ghana is the only country in the sample, which has a fourth Eurobond outstanding. Given,

[7] https://data.worldbank.org/region/sub-saharan-africa

however, that the fourth Eurobond was only trading for a short time prior to the end of our sample period, it was left out of the analysis.

Table 1 lists the current and on the run Eurobond issuances from SSA. As it can be seen both Angola and Tanzania issued a Loan Participating Note (LPN) which is not a Eurobond. Nevertheless, in both cases these bonds are regarded and traded by the financial markets similarly to regular SSA Eurobonds, and the LPN also settles on a regular trade date plus 2 days through Euroclear or Clearstream. Angola's 2019 maturing LPN has been included in the sample, while Tanzania's Floating LPN, has been excluded as it is highly illiquid and due to the floating component of the coupon combined with the continuous amortisation of its principle does not trade similarly to the other SSA Eurobonds. In addition, we have not included Mozambique as the sovereign defaulted in January 2017, which in turn resulted in the Eurobond prices been influenced by the idiosyncratic debt restructuring negotiations.

Finally, Cote D'Ivoire and the Republic of Congo have both restructured Eurobonds (see Table 1); these bonds trade since their restructuring in the same way as the other issued sovereign Eurobonds. The sample includes the Cote D'Ivoire Eurobonds, while the Republic of Congo has been left out, as the Eurobond rarely trades in the financial markets since it was restructured and is not included in the mainstream EM debt indices.

Another important aspect is that bid and offer spreads in the SSA Eurobonds are wide by EM market standards; the spread can vary between 50 basis points in price to 100 or even 200 basis points and during time of market stress it will widen out even further. This movement is irrespective of maturity. Hence yields can vary substantially for Eurobonds that have a short time left to maturity, as 100 or 200 basis point bid and offer spread can translate to several percentage points of yield difference due to lower duration.

3.2. The Local Government Treasury and Bond Issuances

SSA counties are not homogenous in the issuance of either treasury bills or bonds in local currency. While there are certain issuance tenors or maturities[8] that are more regularly used by the local debt management office (DMO), it is not always the case that they unilaterally apply to all countries.

For example, Kenya does not issue regularly a 3-year local bond and hence for our models we use the 2-year as being equivalent to the 3-year. Similarly Nigeria, which has only recently issued 3 month treasury bills, but has not been doing so for most of the period under consideration. For some countries there are periods when governments, or DMOs did not issue local debt instruments for a period of time, such as during political elections, or during times when they had issued a Eurobond, or had obtained a bilateral loan implying that there was no necessity to borrow from their respective local markets leading to breaks in the observations (See Appendix G for Local Treasury and Bond yields).

Local treasury and bond yields are higher in yield in most countries than their respective USD denominated Eurobond yields. The following reasons may explain the difference. First, inflation rates are high and, in some countries reach double digits, hence the need for a higher yield to justify holding the instruments to compensate for the negative inflation impact on real returns. Secondly, the governments are usually the main issuers of debt in the market, as local investors, who are the main investors in their own local markets, may have low levels of confidence in their own government institutions, leading them to expect higher returns to compensate them for the possibility of default. Thirdly, FX volatility is higher than in DM, and hedging costs are very expensive, hence the requirement from international investors to have enough return on their investment to be able to absorb potential local currency depreciation versus the USD. Fourth, there is a lack of liquidity and market depth in local currency debt

[8] The terms tenor and maturity are considered interchangeable in this analysis.

instruments in SSA versus their respective Eurobonds, as well as even a lack of FX liquidity for some countries. This has again as a consequence the requirement of investors to have a higher expected return to cover the underlying risks of their investments.

3.3. The CFA Zones

The CFA Franc Zone, consists of 14 different countries in SSA, and each one of the countries is affiliated to one of two monetary unions, the West Africa Monetary Union (WAMU), which was created in 1994, and is composed of Benin, Burkina Faso, Cote D'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo; and the Central African Economic and Monetary Union (CAEMC), which is composed of Cameroon, Chad, the Republic of Congo, Equatorial Guinea and Gabon. The CAEMC and WAMU together account for 14% of Africa's population and 12% of the continent's GDP according to the IMF. Both CFA Franc Zones, have each one a central bank and peg their currency to the Euro (Bank of France guaranteeing the FX convertibility). As a consequence of the pegging, the countries are less prone to high inflation than their peers. Furthermore, the union impacts monetary policy as countries cannot issue more of their own currency, or devalue their currency at will, or change their monetary policy rate due to their central bank setting one rate for their respective union.

3.4. The FX markets in SSA

FX markets in SSA not only differ from country to country but also differ between CE and CI countries. SSA has numerous countries that have either a pegged, or a crawling peg exchange rate system while certain countries have free-floating FX regimes. It has been common for countrie, such as, Nigeria and Angola to peg their currencies to the USD, while as mentioned in the previous section the CFA Franc Zones peg their currency to the Euro, due to former post-colonial agreements with France. It is a common practice for SSA central banks to intervene in the FX markets to either provide liquidity in the form of selling USD when demand is high, or to smooth potential spikes in FX volatility. SSA is largely an import dependent country, as

local manufacturing is usually only a small part of the economy and high value-added products, such as cars, mobile phones or computers, need to be imported; nevertheless, a lot of countries also need to import more basic products such as rice. The impact of FX devaluations is often felt by the whole population more so than central banks changing their monetary policy rates, as SSA is largely under banked. The World Bank data shows that for the whole of SSA inclusive of South Africa only 34% of the population had a bank account in 2014, while only 6% of the population had a formal form of borrowing.

The impact of FX devaluations will be reflected in **cpi** readings, especially as **cpi** baskets are dominated by two categories: energy costs (petrol/fuel) and food. Hence, central banks will monitor FX movements, and often provide liquidity or can even be the main source of liquidity in the FX market. Nevertheless, the central banks have been gradually moving towards inflation targeting, and thus use their **mpr** in conjunction with FX liquidity interventions as their main policy tools.

4. The Model

In sub-section 4.1 we present the model, while in sub-section 4.2 we present the details of the variables selected for the analysis.

4. 1. Model Applied

In line with the typical methodology used for developed economies, we estimate an unbalanced panel model as the sample does not have an equal number of observations across the dependent and independent variables for all the countries. The panel model regressions conducted are both fixed effects models and random effects models. Due to the limited amount of available data, the analysis did not use a model to investigate the possible bi-directional causality issues.

We estimate the fixed-effects regression as presented by the following equation:

$$r_{it} = \alpha_{\mathrm{i}} + \beta' x_{it} + \varepsilon_{it} \qquad (1)$$

where r_{it} represents the nominal yields for local treasury bills and local bonds, while for the Eurobonds it is the bond price; x_{it} denotes the vector of explanatory variables which include both macroeconomic and global factors. α_i is a time variant that has been introduced to allow for heterogeneity between countries in the form of fixed effects. SSA financial markets have country specific peculiarities that affect their bond and treasury markets, due to their low level of financial development. The unobservable random errors are represented by ε_i.

The random-effects equivalent is represented by:

$$r_{it} = \alpha_1 + \beta' x_{it} + \gamma z_{it} + \varepsilon_{it} \qquad (2)$$

The difference arising from the fixed- and random-effects model is in that the latter allows for the estimation of the coefficients, γ which are the effects from the time-invariant covariates, z_{it}.

In order to select whether the random- or fixed Effects model is the most appropriate one to use for each debt instrument, a Hausman's specification (1978) test is conducted which tests if the unique errors ε_i are correlated with the regressors; the null hypothesis is that they are not.

We use OLS to estimate our panel model and the mean group estimator of Pesaran and Smith (1995), which averages panel specific coefficients estimated through the OLS with robust standard errors. An additional robustness check is performed through applying equations (1) and (2) with a lag effect upon x_{it} of 1 quarter,or x_{it-1}. This allows us also to investigate if any changes to macroeconomic and global variables require more time to impact the local bond and treasury yields, or the Eurobond prices.

4.2. Variable Selection

The selection of explanatory macroeconomic variables used in equations (1) and (2) for the analysis of their impact on the yield curve or bond prices follows the literature on domestic bond yields in DEs. As such the most commonly used macroeconomic variables are economic growth and inflation (Ang and Piazzessi, 2003; Ang et al., 2006; Andritzky et al., 2007; and

Bekaert et al., 2010). In our study, we expand the list to a total of five domestic macroeconomic variables: **qgdp, cpi, mpr, bot** and **fxres,** and two global risk factors the **vix**, the global volatility measure or risk aversion and the **ust**, the 10-year U.S. Treasury yield. As demonstrated by numerous authors, global risk aversion is one of the underlying drivers in emerging market bond yields (Eichengreen and Mody, 1998; Eichengreen and Mody, 2000; Remolana et al., 2008). Further information about the independent and dependent variables is provided in sections 4.2.1 and 4.2.2 respectively.

As mentioned previously, macroeconomic data is not as abundant in SSA as it is for other EM or DEs, hence certain variables, such as the fiscal balance is not published systematically for many countries.

Looking now at the independent variables we are using short-term treasury bills (Tbills), as SSA debt markets are largely dominated by short-term Tbills (Christensen, 2004), Tbills will form an integral part of the study. From the descriptive statistics in table 2 it clearly appears that this is still the case today. The model follows closely the established literature (Bekaert et al., 2010) and selects various points on the yield curve, while we use the average accepted yields during the issuance auctions for local bonds and treasuries. Arbitrarily, the Tbills selected in this study will follow the more common, 3 months, 6 months and 12 months maturities. For the local sovereign bonds, the selection in this study will capture the 3 year and 5 year bonds; the longer maturities are not yet that frequent in SSA, given that governments finance themselves predominantly at the short end of the yield curve.

The analysis of the paper will extend to the SSA Eurobonds, or often referred to also as SSA External Sovereign debt as well. For the Eurobonds, as these tend to be more liquid with regard to trading, the study will select all the current "on the run" as well as "off the run"[9]

[9] The definition of "off the run", is for any debt instrument that is no longer that latest one to have been issued for that tenor.

Eurobonds that have not yet matured by the 31st December 2016. (See Table 1). As the Eurobonds in this sample have different maturities the paper applies the following novel methodology in order to create a sub-set: Eurobond 1, will denote the *next maturing* Eurobond for a given country, followed by Eurobond 2 that is the *second to mature* and Eurobond 3, which represents the *third to mature* Eurobond for a given country. This methodology allows for the currently in issue Eurobonds to be classified into one of three categories. We omitted in this study Ghana's 4th Eurobond as it is the only country that has a 4th Eurobond on the run.

4.2.1. Explanatory variables

Quarterly GDP: In the classic literature the data used for economic growth, is often quarterly real GDP (qgdp) percentage of change on a year on year basis. Generally, a high **qgdp** is perceived as a positive signal for the market, and as a consequence expectations are that a high **qgdp** would bring local currency treasuries and bonds yields down. Nevertheless, given that in the study we analyse the effect of **qgdp** on Eurobond prices, expectations are that Eurobond prices would go up.

Consumer Price Index: The inflation figure is usually represented by the Consumer Price Index (**cpi**) in percentage of change on a year on year basis. A rise in the inflation rate is expected to see a rise in local currency treasury and bond yields on the back of investors demanding a higher return on their local debt instruments to make up for the loss in purchasing power. While a rise in **cpi** would engender a rise in yield for local currency instruments, no immediate reaction expected on the prices of the Eurobonds, as foreign investors would react to rising inflationary pressures only when there is substantial weakening of the foreign exchange rate or over the medium term, and there is a clear impact on the sovereign debt servicing capacity.

Monetary Policy Rate: The use of interest rates or monetary policy rates (**mpr**) is another key independent variable that has been used in the analysis by (Andritkzy et al, 2007, Nowak et al. 2011 and Morales 2010). As the **mpr** is the risk-free rate in the various markets included in the

sample, expectations are that a change in **mpr** percentage by the respective monetary policy authority, would have an effect upon the local treasury and bond yields. **Mpr** is taken as an actual percentage number at the end of period. A rise in the **mpr** percentage would see a rise in yields for both local currency treasuries and bonds. Nevertheless, the impact upon Eurobond prices would be limited, as these are denominated in U.S. Dollars and thus would be less sensitive to local **mpr** changes. Furthermore, a change in **mpr** will, often have only limited effect on the country's currency versus the USD given the limited depth of foreign exchange market. In addition, there is limited transmission to the economy given the low leverage/banking penetration within SSA economies, so a rise in **mpr** does not always foster a slowdown in the economy.

Balance of Trade: Expectations are that a rise (an improvement) in the balance of trade (**bot**) will be shown as a positive macroeconomic effect upon local currency treasury and bond yields and thus diminish the yields, while the positive effect for the respective Eurobond will be expressed through a rise in price. The balance of trade for our definition is the difference between imports of goods and services versus exports of goods and services. Given that in the sample, there are commodity exporting and importing countries, it would be expected that commodity exporting countries might be more sensitive to a change in the **bot** than the commodity importing countries. In this study **bot** is used, as an indicator of revenue for the government since fiscal data are not published systematically for many of these countries. It is especially useful when we contrast the commodity exporting countries (CE) versus the commodity importing (CI) countries. For example, the government in a country like Nigeria received the equivalent of only 6% of GDP from tax revenues in 2016, while oil exports accounted for 35% of the country's GDP and constituted 90% of the country's exports.[10] Hence, the **bot** will provide a valid indicator on certain commodity exporters' financial

[10] http://www.opec.org/opec_web/en/about_us/167.htm.

revenues. The **bot** is in USD and is divided by the country's GDP in USD for the period in order to generate a percentage figure and smooth out the economic differences in the size of the various countries.

Foreign Exchange Reserves: Foreign Exchange reserves (**fxres)** is another explanatory macroeconomic variable that is used, as it is an important factor for foreign investors when analysing a country's macroeconomic conditions. Further it is also a key metric for the IMF, as the recent global financial crisis from 2007 to 2009 demonstrated.[11] Three main benefits are derived from increasing **fxres**: they can be used as a macroeconomic policy instrument to stabilize the economy; they can allow for more frequent FX interventions by the Central Bank if required; and finally increasing **fxres** send a positive signal to foreign investors when the latter consider investing in a country's external debt (Gevorkyan and Kvangraven, 2016). A rise in **fxres** would be regarded as a positive macroeconomic effect; thus it will have a negative effect on local currency treasury and bond yields while for Eurobonds it will have a positive impact on price increases. It is measured in USD and is divided by the country's GDP in USD for the period in order to generate a percentage figure and smooth out the economic differences in the size of the various countries.

U.S. Treasury Yields: The model follows the classic literature and will use the 10-year U.S. Treasury yield (**ust**), as a proxy for risk aversion in line with numerous studies, such as Jaramillo and Weber (2013). The expected effect from a rise in **ust** is that it would primarily have a negative price effect upon the Eurobond prices. As the **ust** is largely regarded as an equivalent of a base rate for EM investments, a change upwards in **Ust** would normally be reflected in an upward movement in EM Eurobond yields (or a fall in Eurobond prices) as well. Nevertheless, expectations are that there would either be a limited or no immediate effect on

[11] IMF: Assessing Reserve Adequacy, (2011) Monetary and Capital Markets, Research, and Strategy, Policy and Review Departments.

the local currency treasury and bond yields. **ust** is taken in actual percentage number at the end of the period.

VIX Index: We use **vix**, the Chicago Board Options Exchange S&P 500 Volatility Index as another risk aversion proxy the **vix** is regularly used as a global risk aversion proxy (Jaramillo and Weber, 2013, Özatay et al., 2009). The expectations are that a rise in the **vix** would have a negative price effect upon the Eurobond prices, while at the same time expectations are that there will be a limited or no effect upon local treasury and bond yields, as these instruments are still outside of the main stream financial markets. **Vix** is taken in actual percentage number at the end of period.

Expectations are that global risk factors will show no effect on the local currency treasuries and local currency bonds, while there will be an effect on the Eurobonds. Commodity Exporting countries will also show that there is a positive effect from a growing **bot** on the back of increases in commodity prices that will in turn lower the local treasury and bond yields as well as increase Eurobond prices. A summary of expected effects is in Appendix H.

A limitation of the model is the dropping out of variables if the data series comprising dependent and independent variables is not complete for a country; hence the difference in the number of observations as a consequence as well as the change in the number observations between the models with x_{it} and x_{it-1}.

4.2.2. Independent variables

In order to create a country comparable study, we will follow the market and academic convention with respect to using the yields for the local Tbills and Bonds (local denominated bonds get quoted by yield). We use the average yields accepted at the official auctions, as this will reflect to a greater degree the impact of the different macroeconomic data that has been released.

However, as explained in section 3, with Eurobond prices the wide bid and offer spread can vary substantially and can impact yields; hence contrary to academic studies such as Gevorkyan and Kvangraven (2016), and Senga, et al., (2018) who used Eurobond yields, we follow the financial market convention and use the Eurobond prices on the USD denominated sovereign Eurobonds. Aside from financial market convention, another reason for using Eurobond prices as opposed to yields is that for higher yielding or coupon paying fixed income instruments that trade on wider bid and offer spreads, if there is a widening of the bid and offer spreads for bonds closer to maturity the effect on the bond's yield is higher and disproportionate.

5. Data and Research Strategy

In sub-section 5.1.1 we provide information about the local MEFs and the unique aspects of the Duet Asset Management Africa Economic Database (DAM aed), in sub-section 5.1.2 we provide a breakdown of the global factors, while in sub-section 5.3 we explain our research strategy.

5.1 Data

5.1.1 Local MEFs and DAM aed

In our study we use proprietary data at the quarterly frequency for our macroeconomic variables, **mpr, cpi, qgdp, bot** and **fxres,** for the period Q1 2006 to Q2 2016, provided by DAM for our sample of African countries.[12] The African economic database has been manually collected from a combination of various local African official sources, such as the individual country Central Banks and Statistics Offices, as well as the IMF, the African Development Bank and Tradingeconomics. Detailed information about the sources of data is given in Appendix F Table 1F. The amalgamation of economic data collected by DAM is unique, and

[12] For four countries in our sample, namely, Angola, Cote D'Ivoire, Senegal and Zambia, we only have annual data and so we use interpolations based on industrial production, which is published quarterly to obtain quarterly observations of GDP.

provides a far bigger data set than is usually available for SSA economic data, which is often difficult to obtain on Africa as data is not regularly posted or updated on easily accessible data portals. Even if the data is available time delays can play an important role in how price and yields for the various debt instruments react. This is in contrast to Gevorkyan and Kvangraven (2016) whose research is based on data from Bloomberg. Information on Bloomberg often appears with a time lag, and not all the data is available on Bloomberg, while our data are timelier, which is important for investors' sensitivity to MEFs. Similarly, Senga et al., (2018) use international sources and monthly interpolations for key variables. The use of monthly interpolations implies that investors do not have the actual information on a monthly basis, which will be impacting their sensitivity to MEFs.

Our study focuses on Namibia, Ghana, Senegal, Rwanda, Cote D'Ivoire, Angola,[13] Kenya, Zambia and Nigeria, as these are the countries which have issued both local debt and and sovereign Eurobonds, or USD denominated LPN that trade as a proxy for classic Eurobond instruments outstanding. The sample period ranges from Q1 2006 to the end of Q2 2016, with only one exception, which is for Angola, where the last local currency bond and treasury auction took place on the 6th July 2016; this still has been used in the sample period. The above sample period has been selected on the basis of data availability. The start of the period was selected when the majority of countries in the sample started publishing the data required more regularly for our study.

5.1.2. Global factors, Treasury and Bond yields and Eurobond prices

The global factors, namely the 10 year **ust** and the **vix,** have been collected from Bloomberg. During the empirical study, an analysis had been done comparing the **vix** and the **move** index, as the latter is a specific index for measuring bond option volatility. The outcome demonstrated

[13] Angola has issued a 2019 maturing Loan Participating Note that is trading through Euroclear and thus gets mostly traded as a Eurobond even that the loan structure is different from the classic bullet Eurobond

that there has been a high correlation[14] between the **vix** and the **move** index, which this has led us to the decision to use the **vix** as it has been the used more regularly as a volatility index in the literature.

Global factors and all the Eurobond prices have been collected from Bloomberg, while the yields for local currency treasuries and bonds have been collected through a combination of the DAM aed and Bloomberg.

5.3. Research Strategy

Our first model will include all the countries in the sample (Angola, Ghana, Cote D'Ivoire, Kenya, Namibia, Nigeria, Rwanda, Senegal and Zambia) and that will constitute our base model.

As it has been mentioned not all the SSA investible countries share the same attributes in terms of economic, financial and human development indicators (see Mo Ibrahim index Appendix A). The index clearly shows that there is strong differentiation across countries and especially between the CE countries, such as Angola and Nigeria and the CI countries, such as Kenya and Rwanda, the latter scoring higher across the board in all the categories, most likely because they are less reliant on one or a few key commodity exports in terms of revenue generation. Furthermore, compared to CE countries their economic growth performance has also been higher (see Figure 1). These differences motivate us to divide the sample into the commodity CI countries (Cote D'Ivoire, Kenya, Namibia, Rwanda and Senegal) and CE countries (Angola, Ghana. Nigeria and Zambia). Expectations are that CE countries would see a higher pass through effect from positive or negative variations in the balance of trade as often the exported commodities are the main source of government revenues. Hence, expectations are that the investors will be more sensitive to swings in commodity prices for CE countries, for which the balance of trade would be a lead indicator.

[14] For the period of the analysis the correlation between the **vix** Index and the **move** Index was at 0.668.

We will test the robustness of our results by testing whether the inclusion of the two CFA countries, namely, Cote D'Ivoire and Senegal, whose currency is tied to the Euro and have common central bank monetary policy impacts our results.

6. Empirical Results

This section will present first the preliminary results and descriptive statistics followed by the empirical findings and their discussion, and finally by the robustness test.

6.1 Preliminary Results and descriptive statistics

The descriptive statistics are shown in Table 2. In terms of observations, the numbers drop significantly for local debt instruments when maturities are longer than 12 months, as mentioned in the Stylized Facts in section 3.The majority of SSA countries finance themselves through short dated debt instruments. Looking at the Eurobonds, we see a similar pattern to the local currency debt instruments in that euro1 has more observations than both euro2 and euro3. Nevertheless, this could be due to the fact most of the time, euro1 has been issued a long time before euro2 and euro3. What stands out from the local MEFs is the high and at the same time highly variable rate of inflation, which explains the higher yields in local bonds compared to Eurobonds.

As mentioned earlier we perform the Hausman test to decide whether we should use fixed effects or random effects estimation. The results can be found in Appendix C, Table 1C. As it can be seen in the majority of the cases fixed effects is more appropriate.

We present the correlation matrix (see Appendix D, Table 1.D). We can make the following observations. On the whole, the correlations are low. We note that there is a negative correlation between the **mpr** and **cpi,** as we would expect if the **mpr** moves up it will increase borrowing costs and reduce aggregate demand and inflation pressures. The **mpr** has also a negative correlation with **qgdp,** which would indicate that during a hiking cycle the **mpr** might affect a country's growth negatively as credit flows to industries and individuals would become

more expensive. There is a negative correlation between **cpi** and **fxres** for an increase in **cpi** causes a deterioration in **bot** and a reduction in foreign reserves.

The results of the Shapiro-Wilk test are shown in table 2.D. in Appendix D. They confirm that with the exception of euro2, all local currency treasury and bond yields as well as euro1 and euro3 are not normally distributed.

As the analysis is conducted using an unbalanced panel regression, we test whether our variables have a unit root using the Fisher Augmented Dickey-Fuller (ADF) test, which is the most appropriate unit-root test for unbalanced panel models. The results of the ADF test reject the null hypothesis of a unit-root presence in the data for both independent and dependent variables, thus demonstrating that there is no systematic unpredictable pattern in the data (see Appendix E).[15]

6.2.

6.2. Empirical Results

6.2.1 Findings of the Base model which includes all countries in the sample

We begin our analysis by examining the results of our base model, which includes all the countries in the sample. The results are presented in Table 3. The list of abbreviations used in our analysis are given in Appendix B, Table 1B. We first focus our attention on the local Tbills and bonds. **Mpr** is positive and significant across all local Tbills and bonds. This positive impact is in line with our expectations. Its impact however is highest at the *short* end. The results are robust when we allow for a lagged effect, the though impact diminishes. The other MEF which is significant is the **bot**. Its impact is negative across all monthly local tbills as expected since a rise will be perceived as a positive macroeconomic effect; the results are robust when we allow for a lagged effect but the impact diminishes. There is no impact at the long end. These effects, again, are consistent with our a priori expectations. The importance of **bot**

[15] The abbreviations of variables used in our analysis can be found in Appendix B, Table 1B.

is to be expected, as the SSA countries in our sample are either CE, or CI countries and the balance of trade highlights the health of the economy, so an increase (improvement) in **bot** would bring treasury yields down. Nevertheless, this relationship does not hold for the local currency bond yields. The other MEFs do not seem to have an impact either on the short or the long instruments. The global factors have no impact apart from **vix** on the 6 month Tbill. This is to be expected as the main investors are locals. R^2 diminishes with maturity in the short end but is quite high for the 5 year bond, reaching 81%.

Looking now at the Eurobonds, the picture is somewhat different. **mpr** is significant across all Eurobonds but negative as we are referring to prices of bonds. Its impact however is highest at the long end; the results are robust when we allow for a lagged effect and the impact increases, indicating that the effect takes time to impact Eurobond prices, as a hike in **mpr** would normally cool down an overheating economy and strengthen the country's exchange rate versus the USD. These effects depend on a number of factors given the limited depth of the FX market and the limited banking penetration in those countries.

Although **bot** does not impact local bonds, it impacts Eurobonds and its impact increases with the maturity of Eurobonds, but the lagged effect is reduced, indicating more of an immediate impact. From the other MEFs only **cpi** is significant for Euro3. The most important difference between the local debt instruments and Eurobonds is the significance of global factors. **Vix** is negative and significant and the results are robust when we allow for a lagged effect. Its impact is highest at the long end of the yield curve. **ust** also has a negative and significant impact as well but at the short instruments only. R^2 increases with maturity reaching 69% for Euro3.

6.2.2. CI countries versus (CE) countries

The results are presented in Table 4 for CI countries (Cote D'Ivoire, Kenya, Namibia, Rwanda and Senegal) and in Table 5 for the CE countries (Angola, Ghana, Nigeria and Zambia). For this exercise we were not able to estimate euro3 and euro3lag for the CI countries and b_5 and b_5lag for CE because we did not have enough observations.

Looking first at the local Tbills and bonds for CE countries, we note that **mpr** does not impact the local debt instruments at all: while this is not the case for CI countries, where the impact is positive and significant across all local debt instruments, its impact is highest at the short end The results are robust when we allow for a lagged effect, but the effect on the whole diminishes. The impact of **mpr** is similar to that of that of the base model.

As expected the **bot** has a significant negative effect upon the local treasury yields for CE, as an increase in the balance of trade brings the local treasury yields down, given that an increase in the **bot** would result in the government receiving more revenue from the country's commodity exports, resulting in the government needing to borrow less in the market, and this would result in local treasury and bond yields compressing. It is negative and significant at the short end. The effect is still there when **bot** is lagged but is decreasing. The impact of **bot** in CI countries is rather different; its impact is mostly in the long-term instruments, but is not consistently negative or positive across the instruments. The **bot** has a positive effect upon the mtb_3 yields, while this is not confirmed under the lagged results as well as on the b_5 yields. The impact on the b_3 bond is negative and not confirmed when lagged. The other domestic and global MEFs do not impact on the local instruments in CE. **Fxres** have an impact, however, on local debt instruments in CI countries. The effect is positive and significant in the short-end and negative at the long end. On the whole R^2 increases with maturity for both groups of countries reaching 77% for b3 in CE and 95% for b5 in CI.

Now turning to the Eurobonds **mpr** is negative and significant for Euro 2, which is also confirmed by the lagged value for CE. However, the situation is different for CI countries.

Similar to the impact of **mpr** on the local debt instruments, the impact is negative and significant for all instruments and remains robust when lagged (please note we are referring to prices of bonds not yields). Regarding the other MEFs, there is a sporadic impact for both groups of countries, which is not consistent across the various points of the yield curve. For example, for CE an increase in **fxres** has a significant positive effect on the nearer to maturity euro1 bond price, while an increase in **qgdp** demonstrates a positive effect upon euro3 prices. The **bot** has a positive and significant impact for Euro 2 for CE and a negative and significant impact for Euro 1 and Euro 2 for CI. However, what is overwhelmingly clear is that the global factors and, in particular, **Vix,** impacts Eurobonds of both groups of countries, but much more the CI and the impact increases when lagged. Similarly, to local debt instruments R^2 for Eurobonds are high reaching 84% for Euro 3 for CE, and 91% for Euro2 for the CI.

6.3 Discussion

Our main results can be summarised as follows: First, the two domestic macroeconomic factors which impact predominantly the local treasury and bond yields, as well as the Eurobonds, are the **mpr** and the **bot**. The impact seems to be the highest at the short end for the local instruments and at the long end for the Eurobonds; its effect is contemporaneous for the former and stronger with a lag for the latter. Secondly, global risk aversion, proxied by the **vix** index, is only important for the Eurobonds as expected since investors in Eurobonds are mostly foreigners and the impact increases at the longer instruments. Thirdly, SSA is composed of many different countries, with different economic resources, and so when considering the commodity exporting countries versus the commodity importing countries, the results show that for the former the **bot** has a key impact on the local treasury and bond yields, while for the latter it is the **mpr** as well as **cpi** consumer prices and the amounts of **fxres**, which stand out as the main determinants. For the Eurobonds global risk aversion impacts much more the

commodity importing countries than the exporting countries: this indicates that investors in the latter group are less worried by a global risk off scenario for the cash flows from their exports May generate sufficient USD to service their foreign currency debt.

Thus, our results confirm the importance of MEFs found in previous studies on local debt instruments in DEs like the US, and other EMs. However, there are some differences in the type of MEFs which are important for these countries. In the US, inflation and output related factors predominate, while in EMs, such as Brazil it is the exchange rate and expected inflation, and in Chile it is the monetary policy rate. In our study of SSA it is the monetary policy rate and the balance of trade.It is not surprising that there are such differences as the economic and financial environment differs between DMs and EMs and also between EMs and SSA countries, which are the least developed in the emerging market world.

6.4. Robustness Test

We check the robustness of our results by estimating the base model but excluding the CFA Zone countries, Cote D'Ivoire and Senegal, which share a common currency pegged to the Euro, together with the other union members. The CFA members have a common central bank, which dictates the monetary policy for all the members. We will compare the results of all the countries in the sample, versus a sub-sample of all the countries excluding both Cote D'Ivoire and Senegal. This will allow us to analyse if the CFA exerts any specific effects on our analysis due to the policy constraints imposed on monetary and exchange rate policies. Do these constraints give investors more confidence in government policies?

Table 6 presents the results when the two CFA countries are excluded. The findings overall confirm the results in section 6.2.1, that is of the base model. The **mpr** and **bot** remain the dominant factors affecting both the local bond and treasury yields as well as the Eurobond prices. Furthermore, for the Eurobonds both global factors affect the Eurobond prices, while they do not show a material impact on the local currency instruments. So in conclusion the

inclusion of those two countries with their restrictions on exchange rate and monetary policies did *not* impact on our results.

7. Conclusion

The paper looks at the impact of local and global MEFs on both Eurobonds and local currency issued bonds in SSA at different points on the yield curve, over the period Q1 2006-Q2 2016. The few papers on SSA focus on the Eurobond market and disregard the local currency issued bonds. Our paper tries to fill this gap in view of the growing interest by investors in that market. Using a unique proprietary data set provided by the DAM economic database, which is a data set collected from local authorities, central banks and independent international sources across SSA, we run a panel regression to investigate the effect of both local macroeconomic and global factors on SSA local treasury and bond yields, as well as their respective Eurobond prices at different points on the yield curve.

Our results confirm the importance of MEFs to explain the yield curve on local debt instruments found in earlier studies on domestic bonds in DMs and EMs. More precisely the two domestic macroeconomic factors which impact predominantly the local treasury and bond yields,(as well as the Eurobonds), are **mpr** and **bot**. The impact seems to be at the highest at the short end for the local instruments and at the long end for the Eurobonds; it is contemporaneous for the former and stronger with a lag for the latter. R^2 is high for most models confirming the results of earlier studies about the importance of macro factors.

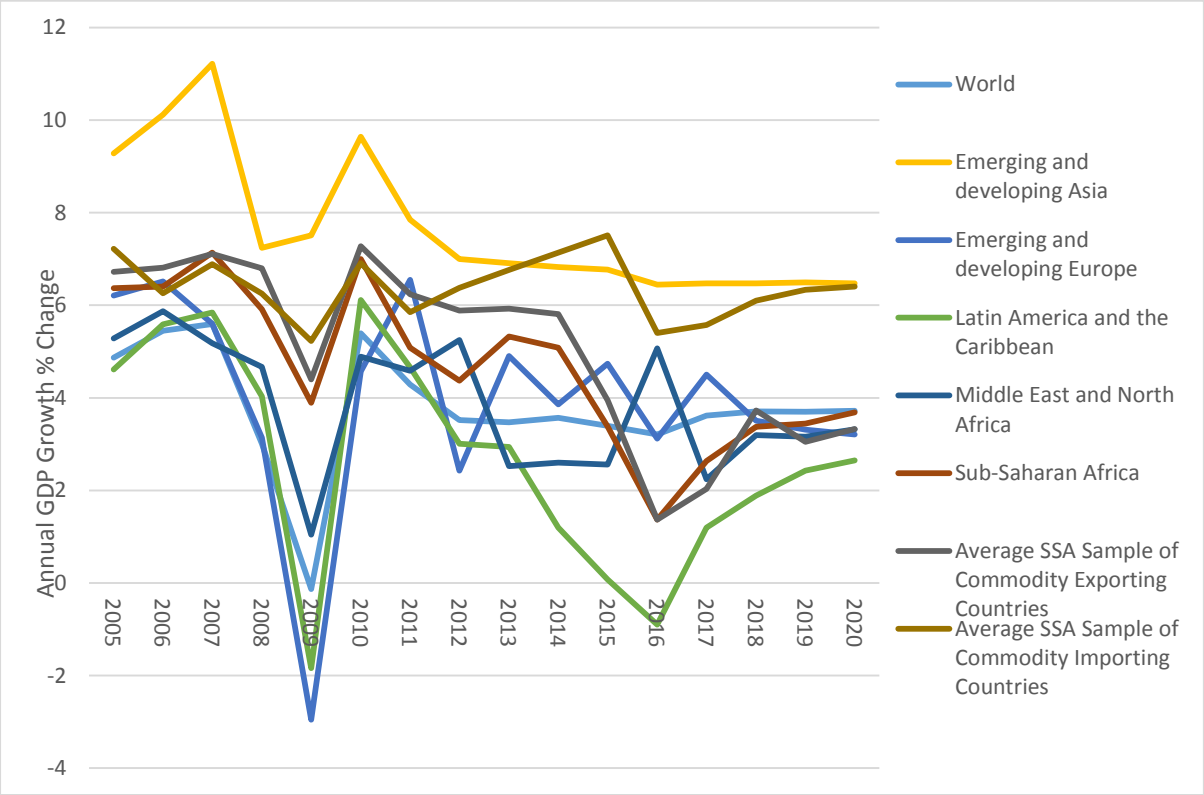
Thus, interest rates have a better capacity to explain low frequency bond yield movements, which is also in line with Schiller's (2015) finding, that a central bank is more successful in influencing the short end of the yield curve through the **mpr** than the long end. Additionally, our results show that global risk aversion, proxied by the **vix** index, is only important for the Eurobonds as expected and the impact increases with time, since investors in Eurobonds are

mostly foreigners. This confirms the importance of global factors found in other studies (Gevorkyan and Kvangraven, 2016; and Senga, et al., 2018).

When dividing the countries into CI and CE countries, the results show that for the former **bot** has a key impact on the local treasury and bond yields, while for the latter it is the **mpr** as well as **cpi** and **fxres** which stand out as exerting some impact. Furthermore, the results show global risk aversion impacts both groups but much more the CI. Thus, our analysis brings out the fact that the impact of MEFs differs amongst SSA. The results also show that the impact is at times different at different points on the yield curve. Finally, the results highlight the impact of domestic MEFs on the yield curve and the role that governments can play to foster the depth and development of their debt markets through the adoption of the right policies.

It should be borne in mind that the results are based on a short history of data, which has not allowed us to explore the impact of additional macro-economic variables, such as the exchange rate and institutional quality. Furthermore, we were not able to allow for bidirectional causality between the yields of the debt instruments and the MEFs.

Figure 1: IMF growth forecast for various Global Regions

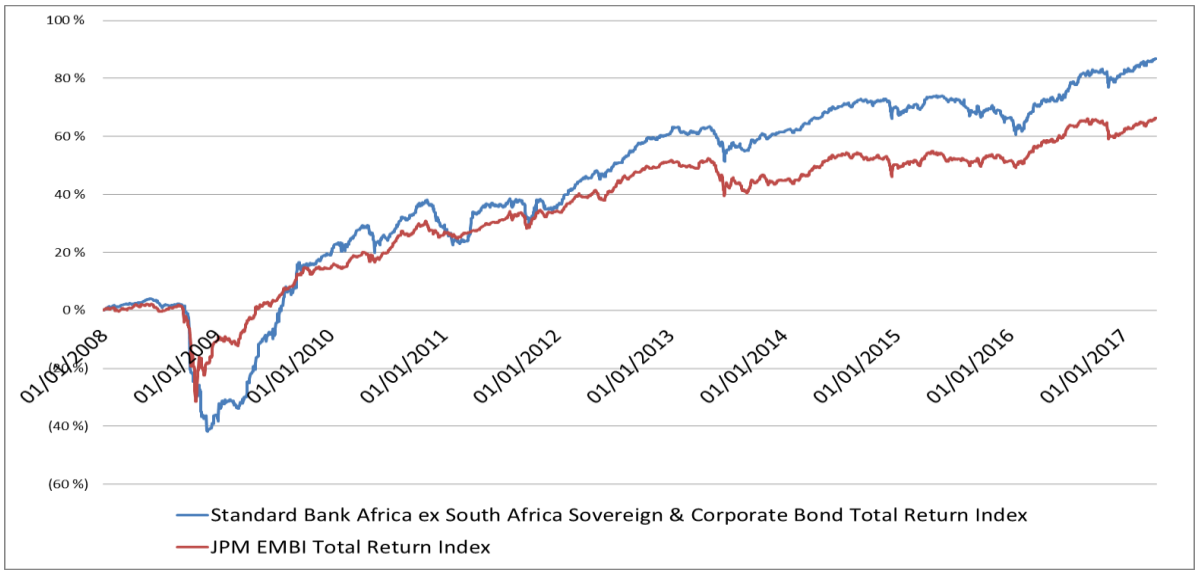


Source: IMF WEO 2017, Bloomberg Data. As off 11/11/2017 Bloomberg Data and Duet Internal Estimation

SSA Sample of Commodity Exporting Countries are: Angola, Cameroon, DRC, Gabon, Ghana, Nigeria, Republic of Congo and Zambia

SSA Sample of Commodity Importing Countries are: Cote D'Ivoire, Kenya, Namibia, Rwanda, Senegal, and Uganda

Figure 2: SSA Eurobond performance versus the JPM EMBI



Source: JP Morgan, Standard Bank, Bloomberg and Duet Asset Management internal estimates

Table 1: Current on the run Eurobond issuances from SSA Sovereigns

Country of Issue	Date of Issue	Maturity Date	Amount Issued in USD billion
Ghana	27/09/2007	04/10/2017	0.750
Gabon	05/12/2007	12/12/2017	1.00
Republic of Congo (Restructured)	07/12/2007	30/06/2029	0. 477
Seychelles	14/01/2010	01/01/2026	0.168
Cote D'Ivoire (Restructured)	15/03/2010	31/12/2032	2.519
Nigeria	21/01/2011	28/01/2021	0.500
Senegal	06/05/2011	13/05/2021	0.500
Namibia	27/10/2011	03/11/2021	0.500
Angola (Loan Participating Note)	10/08/2012	17/08/2019	1.000
Zambia	13/09/2012	20/09/2022	0.750
Tanzania (Floating Rate Loan Participating Note)	27/02/2013	09/03/2020	0.600
Rwanda	16/04/2013	02/05/2023	0.400
Nigeria	02/07/2013	12/07/2018	0.500
Nigeria	02/07/2013	12/07/2023	0.500
Ghana	25/07/2013	07/08/2023	1.000
Gabon	04/12/2013	12/12/2024	1.500
Zambia	07/04/2014	14/04/2024	1.000
Kenya	16/06/2014	24/06/2019	0.750
Kenya	16/06/2014	24/06/2024	2.000
Cote D'Ivoire	16/07/2014	23/07/2024	0.750
Senegal	23/07/2014	30/07/2024	0.500
Ethiopia	04/12/2014	11/12/2024	1.000
Cote D'Ivoire	24/02/2015	03/03/2028	1.000
Gabon	09/06/2015	16/06/2025	0.500
Zambia	14/07/2015	30/07/2027	1.250
Ghana	07/10/2015	14/10/2030	1.000
Namibia	22/10/2015	29/10/2025	0.750
Angola	04/11/2015	12/11/2025	1.500
Cameroon	12/11/2015	19/11/2025	0.750
Mozambique*	09/03/2016	18/01/2023	0.726
The total amount of Eurobonds			25.663
*Mozambique is the restructured EMAMTUM Loan Participating Note			

Source: Bloomberg and Duet Asset Management internal estimates

Table 2: Descriptive Statistics

	denominations	observation	mean	standard deviation	min.	max.
mtb_3	% Yield	197.00	10.22	6.28	1.73	25.90
mtb_6	% Yield	231.00	11.17	6.27	1.68	28.87
mtb_12	% Yield	228.00	11.48	5.81	2.61	28.00
b_3	% Yield	96.00	12.16	5.79	4.86	25.40
b_5	% Yield	74.00	11.77	5.81	5.64	28.50
euro1	% Price	152.00	101.45	9.91	56.75	121.40
euro2	% Price	74.00	98.56	8.83	79.40	118.66
euro3	% Price	49.00	85.70	16.70	42.62	108.23
euro4	% Price	3.00	102.15	3.98	98.35	106.29
mpr	%	273.00	10.01	5.70	3.50	30.00
cpi	%	258.00	18.56	32.50	-5.04	118.10
qgdp	%	272.00	2.64	3.55	-9.87	14.40
bot	% of GDP	217.00	0.09	0.76	-2.81	5.87
fxres	% GDP	305.00	0.10	0.06	0.00	0.28
vix	%	307.00	20.81	8.39	11.39	44.14
ust	%	307.00	2.68	0.84	1.36	5.13

Table 3: Results for all countries in the Sample

Comprising of the following countries: Angola, Ghana, Cote D'Ivoire, Kenya, Namibia, Nigeria, Rwanda, Senegal and Zambia, from the Duet Asset Management Africa economic database, as well as Bloomberg prices for the Eurobonds and average accepted auction yields for the local treasuries and bond yields, from Q1 2006 to Q2 2016, please note that last MPR data used for Angola was 6 days post the Q2 2016 end. Robust Standard Errors are given in parentheses. ***p≤0.001; ** p≤0.01; * p≤0.05; [i] denotes Sigmaless Hausman Test Result.

	mtb_3	mtb_3 lag	mtb_6	mtb_6 lag	mtb_12	mtb_12 lag	b_3	b_3 lag	b_5	b_5 lag	euro1	euro1 lag	euro2	euro2 lag	euro3	euro3 lag
mpr	11.65***	5.94***	10.41***	4.19**	7.66***	3.79*	2.87*	1.55	8.10**	4.34*	-3.29*	-7.23***	-2.42	-11.47***	4.21***	-6.17**
	(0.092)	(0.186)	(0.110)	(0.206)	(0.126)	(0.191)	(0.246)	(0.319)	(0.254)	(0.541)	(0.355)	(0.195)	(0.835)	(0.082)	(0.242)	(0.221)
cpi	4.02*	0.38	1.99	1.26	0.46	-0.24	0.90	1.16	-0.92	0.01	-1.33	-1.41	-0.03	-0.67	-2.46**	-7.95**
	(0.014)	(0.011)	(0.041)	(0.048)	(0.023)	(0.028)	(0.110)	(0.104)	(0.059)	(0.065)	(0.343)	(0.155)	(1.768)	(0.014)	(0.447)	(0.231)
qgdp	-1.19	-0.73	-0.84	-0.87	-0.58	-0.73	-0.09	-0.30	0.50	0.83	2.43	0.79	2.17	-0.11	0.63	0.04
	(0.059)	(0.092)	(0.062)	(0.064)	(0.054)	(0.048)	(0.131)	(0.184)	(0.022)	(0.072)	(0.127)	(0.260)	(0.527)	(0.925)	(1.009)	(0.820)
bp	-22.24***	-8.25***	-10.28***	-7.17***	-8.40***	-6.77***	-1.22	2.16	2.15	-0.24	3.20*	1.03	5.67**	2.55*	5.11***	-0.54
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)	(0.009)	(0.071)	(0.055)
fxres	-0.18	-0.58	-1.12	-1.81	-0.54	-1.62	-0.91	-0.97	2.54	1.34	1.68	1.77	0.20	-2.21*	-1.17	-0.01
	(0.119)	(0.269)	(0.063)	(0.141)	(0.087)	(0.114)	(0.278)	(0.365)	(0.264)	(0.454)	(0.356)	(0.873)	(1.546)	(0.573)	(0.712)	(1.704)
vix	2.02	1.38	3.33*	2.67*	0.71	0.69	1.02	0.50	0.53	0.08	-7.33***	-5.50**	-4.36**	-1.93	-9.08***	-3.50*
	(0.035)	(0.065)	(0.019)	(0.025)	(0.028)	(0.030)	(0.073)	(0.055)	(0.078)	(0.042)	(0.112)	(0.120)	(0.160)	(0.325)	(0.092)	(0.218)
ust	-0.28	-0.01	-0.03	0.05	-1.08	-0.81	-1.41	-0.17	7.75**	1.73	-1.44	-3.24*	-5.30**	-0.96	0.75	0.27
	(0.384)	(0.411)	(0.282)	(0.404)	(0.464)	(0.569)	(0.445)	(0.344)	(0.204)	(0.590)	(1.789)	(1.119)	(1.468)	(3.703)	(2.258)	(1.720)
No. obs Hausman Results	108 Fixed Effect	106 Random Effects	141 Fixed Effect	139 Fixed Effects	144 Fixed Effect	142 Fixed Effects[i]	62 Fixed Effect	61 Fixed Effects	34 Fixed Effect[i]	34 Fixed Effects[i]	86 Fixed Effect	91 Fixed Effects	48 Fixed Effect	53 Random Effects	30 Random Effects	33 Fixed Effects[i]
R2	0.68	0.68	0.51	0.45	0.70	0.63	0.17	0.00	0.81	0.85	0.00	0.03	0.33	0.46	0.69	0.15

Table 4: Results table for Commodity Importing Countries

Commodity Importing Countries comprised: Cote D'Ivoire, Kenya, Namibia, Rwanda and Senegal from the Duet Asset Management Africa economic database, as well as Bloomberg prices for the Eurobonds and average accepted auction yields for the local treasuries and bond yields, from Q1 2006 to Q2 2016. Robust Standard Errors are in parentheses. ***p≤0.001; ** p≤0.01; * p≤0.05; [i] denotes Sigmaless Hausman Test Result; $ denotes in insufficient number of observations.

	mtb_3	mtb_3 lag	mtb_6	mtb_6 lag	mtb_12	mtb_12 lag	b_3	b_3 lag	b_5	b_5 lag	euro1	euro1 lag	euro2	euro2 lag	euro3	euro3 lag
mpr	21.67***	2.74**	17.13***	4.10***	23.67***	4.26***	0.38	-0.25	7.11***	11.64***	-10.32**	-9.66**	-16.19***	-15.16***	$	$
	(0.039)	(0.155)	(0.052)	(0.137)	(0.038)	(0.137)	(0.400)	(0.503)	(0.180)	(0.093)	(0.259)	(0.217)	(0.265)	(0.169)	$	$
cpi	-0.05	-2.02*	-1.05	-1.91	-4.23***	-2.38**	-2.05*	-2.70**	-2.73**	-0.45	4.09	0.64	-4.43***	-1.64	$	$
	(0.002)	(0.007)	(0.003)	(0.007)	(0.002)	(0.007)	(0.022)	(0.020)	(0.001)	(0.006)	(0.018)	(0.046)	(0.030)	(0.024)	$	$
qgdp	-0.90	-0.61	-0.59	-0.39	-0.53	-0.22	-0.62	-0.73	0.96	-0.28	-4.71*	1.41	0.20	2.09*	$	$
	(0.074)	(0.099)	(0.080)	(0.059)	(0.051)	(0.037)	(0.207)	(0.613)	(0.040)	(0.059)	(0.038)	(0.032)	(0.658)	(0.436)	$	$
bot	2.97**	-0.34	-0.51	-0.31	1.06	-0.52	-2.92**	-0.45	2.78**	-0.28	17.44**	-0.25	-11.05***	-41.8***	$	$
	(0.000)	(0.007)	(0.000)	(0.008)	(0.002)	(0.007)	(0.031)	(0.001)	(0.021)	(0.015)	(0.007)	(0.032)	(0.251)	(0.092)	$	$
fxres	0.49	-0.33	4.67***	-0.52	10.82***	-1.52	-2.05	-1.41	1.4	-2.65**	-8.53**	-0.88	0.46	6.89***	$	$
	(0.039)	(0.071)	(0.012)	(0.062)	(0.004)	(0.042)	(0.594)	(0.160)	(0.251)	(0.038)	(0.097)	(0.182)	(0.263)	(0.257)	$	$
vix	0.95	0.98	0.37	0.66	0.22	0.69	1.49	0.37	-0.33	0.55	-5.80*	-7.18*	-20.91***	-61.66***	$	$
	(0.063)	(0.089)	(0.052)	(0.083)	(0.053)	(0.065)	(0.070)	(0.083)	(0.057)	(0.030)	(0.042)	(0.026)	(0.013)	(0.009)	$	$
ust	-0.66	0.27	-1.10	0.10	-1.02	-0.17	-0.61	0.09	0.35	0.95	-3.77	-2.61	-52.25***	1.10	$	$
	(0.269)	(0.651)	(0.296)	(0.555)	(0.349)	(0.519)	(3.228)	(0.739)	(1.145)	(0.776)	(1.549)	(1.669)	(0.072)	(0.668)	$	$
No. obs	60	58	60	59	63	62	22	21	22	22	29	32	11	13		
Hausman Results	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects[i]	Fixed Effects	Fixed Effects	Random Effects	Random Effects		
R2	0.59	0.29	0.63	0.34	0.67	0.40	0.70	0.65	0.92	0.95	0.41	0.25	0.91	0.87		

Table 5: Results for Commodity Exporting Countries:

Commodity Exporting Countries Comprised: Angola, Ghana, Nigeria, Zambia from the Duet Asset Management Africa economic database, as well as Bloomberg prices for the Eurobonds and average accepted auction yields for the local treasuries and bond yields, from Q3 2007 to Q2 2016, please note that last MPR data used for Angola was 6 days post the Q2 2016 end. Robust Standard Errors are in parentheses. ***p≤0.001; ** p≤0.01; * p≤0.05; [i] denotes Sigmaless Hausman Test Result; $ denotes insufficient number of observations.

	mtb_3	mtb_3 lag	mtb_6	mtb_6 lag	mtb_12	mtb_12 lag	b_3	b_3 lag	b_5	b_5 lag	euro1	euro1 lag	euro2	euro2 lag	euro3	euro3 lag
mpr	0.76	0.23	1.03	0.76	1.44	0.85	1.93	1.40	$	$	-0.04	-1.58	-2.89**	-4.60***	-1.30	-1.09
	(0.784)	(1.273)	(0.620)	(0.500)	(0.612)	(0.637)	(0.500)	(0.617)	$	$	(1.054)	(0.762)	(0.629)	(0.408)	(1.975)	(1.757)
cpi	0.97	0.82	1.80	1.27	0.26	0.31	-0.38	-0.05	$	$	-2.06	-1.18	0.57	0.87	0.93	-0.15
	(0.579)	(1.007)	(0.477)	(0.403)	(0.464)	(0.475)	(0.444)	(0.537)	$	$	(0.830)	(0.519)	(0.503)	(0.540)	(1.387)	(4.078)
qgdp	-0.70	-1.60	-0.16	-1.08	-0.05	-1.28	-0.92	-1.04	$	$	15.58**	-0.81	1.45	0.21	12.09***	0.95
	(0.221)	(0.088)	(0.188)	(0.279)	(0.226)	(0.284)	(0.284)	(0.257)	$	$	(0.034)	(0.305)	(0.833)	(1.487)	(0.162)	(0.805)
bot	-4.06***	-2.79	-6.80*	-5.10***	-6.57*	-4.59***	0.23	0.83	$	$	1.74	1.89	12.25***	8.25***	0.01	-1.32
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)	$	$	(0.000)	(0.000)	(0.003)	(0.003)	(0.161)	(0.077)
fxres	-0.33	-0.61	0.19	-1.46	-0.84	-1.69	-0.24	-0.84	$	$	5.20*	2.36	0.17	-0.40	-0.08	2.04
	(0.119)	(0.357)	(0.122)	(0.211)	(0.070)	(0.127)	(0.400)	(0.389)	$	$	(0.082)	(0.750)	(1.287)	(2.037)	(0.427)	(0.880)
vix	-0.21	-0.21	-0.07	-1.33	0.09	-1.46	-0.27	-0.14	$	$	-5.21*	-3.29	-3.66***	-1.94	-0.59	-2.49
	(0.149)	(0.242)	(0.082)	(0.029)	(0.107)	(0.048)	(0.090)	(0.127)	$	$	(0.150)	(0.237)	(0.195)	(0.338)	(0.553)	(0.332)
ust	-1.09	-0.80	-1.21	-1.07	-0.79	-0.80	-1.29	-0.69	$	$	-0.21	-1.64	-5.78***	-2.38*	-0.14	-1.33
	(1.550)	(2.881)	(1.229)	(1.470)	(1.176)	(1.534)	(0.532)	(0.954)	$	$	(3.079)	(1.510)	(1.400)	(3.501)	(2.406)	(2.422)
No. obs	48	48	81	80	81	80	40	40			57	59	37	40	19	22
Hausman Results	Random Effects	Random Effects	Fixed Effects	Random Effects	Fixed Effects[i]	Random Effects	Random Effects	Random Effects			Fixed Effects	Fixed Effects[i]	Random Effects	Random Effects	Random Effects	Fixed Effects
R2	0.79	0.71	0.68	0.70	0.60	0.57	0.77	0.70			0.02	0.09	0.70	0.53	0.84	0.35

Table 6: Results for all countries excluding CFA Zone

Comprising of the following countries: Angola, Ghana, Kenya, Namibia, Nigeria, Rwanda and Zambia from the Duet Asset Management Africa economic database, as well as Bloomberg prices for the Eurobonds and average accepted auction yields for the local treasuries and bond yields, from Q3 2007 to Q2 2016, please note that last MPR data used for Angola was 6 days post the Q2 2016 end. Robust Standard Errors are in parentheses. ***p≤0.001; ** p≤0.01; * p≤0.05;

[i] Sigmaless Hausman Test Result; $ denotes insufficient number of observations.

	mtb_3	mtb_3 lag	mtb_6	mtb_6 lag	mtb_12	mtb_12 lag	b_3	b_3 lag	b_5	b_5 lag	euro1	euro1 lag	euro2	euro2 lag	euro 3	euro3 lag
mpr	21.67***	2.74**	17.13***	4.10***	23.67***	4.26***	0.38	-0.25	7.11***	11.64***	-10.32**	-9.66**	-16.19***	-15.16***	$	$
	(0.039)	(0.155)	(0.052)	(0.137)	(0.038)	(0.137)	(0.400)	(0.503)	(0.180)	(0.093)	(0.259)	(0.217)	(0.265)	(0.169)	$	$
cpi	-0.05	-2.02*	-1.05	-1.91	-4.23***	-2.38**	-2.05*	-2.70**	-2.73**	-0.45	4.09	0.64	-4.43***	-1.64	$	$
	(0.002)	(0.007)	(0.003)	(0.007)	(0.002)	(0.007)	(0.022)	(0.020)	(0.001)	(0.006)	(0.018)	(0.046)	(0.030)	(0.024)	$	$
qgdp	-0.90	-0.61	-0.59	-0.39	-0.53	-0.22	-0.62	-0.73	0.96	-0.28	-4.71*	1.41	0.20	2.09*	$	$
	(0.074)	(0.099)	(0.080)	(0.059)	(0.051)	(0.037)	(0.207)	(0.613)	(0.040)	(0.059)	(0.038)	(0.032)	(0.658)	(0.436)	$	$
bp	2.97**	-0.34	-0.51	-0.31	1.06	-0.52	-2.92**	-0.45	2.78**	-0.28	17.44**	-0.25	-11.05***	-41.8***	$	$
	(0.000)	(0.007)	(0.000)	(0.008)	(0.002)	(0.007)	(0.031)	(0.001)	(0.021)	(0.015)	(0.007)	(0.032)	(0.251)	(0.092)	$	$
fxres	0.49	-0.33	4.67***	-0.52	10.82***	-1.52	-2.05	-1.41	1.4	-2.65**	-8.53**	-0.88	0.46	6.89***	$	$
	(0.039)	(0.071)	(0.012)	(0.062)	(0.004)	(0.042)	(0.594)	(0.160)	(0.251)	(0.038)	(0.097)	(0.182)	(0.263)	(0.257)	$	$
vix	0.95	0.98	0.37	0.66	0.22	0.69	1.49	0.37	-0.33	0.55	-5.80*	-7.18*	-20.91***	-61.66***	$	$
	(0.063)	(0.089)	(0.052)	(0.083)	(0.053)	(0.065)	(0.070)	(0.083)	(0.057)	(0.030)	(0.042)	(0.026)	(0.013)	(0.009)	$	$
ust	-0.66	0.27	-1.10	0.10	-1.02	-0.17	-0.61	0.09	0.35	0.95	-3.77	-2.61	-52.25***	1.10	$	$
	(0.269)	(0.651)	(0.296)	(0.555)	(0.349)	(0.519)	(3.228)	(0.739)	(1.145)	(0.776)	(1.549)	(1.669)	(0.072)	(0.668)	$	$
No. obs Hausman Results	60 Random Effects	58 Random Effects	60 Random Effects	59 Random Effects	63 Random Effects	62 Random Effects	22 Random Effects	21 Random Effects	22 Random Effects	22 Random Effects[i]	29 Fixed Effects	32 Fixed Effects	11 Random Effects	13 Random Effects		
R2	0.59	0.29	0.63	0.34	0.67	0.40	0.70	0.65	0.92	0.95	0.41	0.25	0.91	0.87		

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Appendix A: Mo Ibrahim Index

The Mo Ibrahim index below shows that in average commodity importing countries (Cote D'Ivoire, Kenya, Namibia, Rwanda and Senegal)score higher across all 5 categories compared to the commodity exporting counties(Angola, Ghana, Nigeria, Zambia), even if the commodity exporting countries still outperform the whole African continent.

Table 1.A. Mo Ibrahim Index

Grouping of Countries			**Changes from 2006 to 2015**						**Score 0 to 100; 100=best**		**2014 Export Data**		
Commodity Exporters	**Overall Governance**	**Change over period**	**Safety & Rule of Law**		**Change over period**	**Participation & Human Rights**	**Change over period**	**Sustainable Economic Opportunity**	**Change over period**	**Human Development**	**Change over period**	**Top Exports**	**Top 3 of total Exports**
Angola	39.2	5	44.3	0.9	35.5	4.5	30.4	3.3	46.7	11.2	Petroleum , Crude	96%	**Main Export**
Ghana	63.9	-2.1	70	-2.6	73.1	0.1	48.4	-4.2	64.2	-1.6	Petroleum; Cocoa beans, raw/roasted; Gold	72%	Petroleum 96%
Nigeria	46.5	2.5	42.8	-6	53.1	6.1	39.5	5.1	50.7	5	Petroleum; Gas	93.70%	Petroleum 32.5%
Zambia	58.8	4.3	66.5	2.7	61.4	3.8	46.4	1	61	9.7	Copper; Tobacco	65.50%	Petroleum 81.4%
Average Commodity Exporters	52.1		55.1		55.8		41.7		55.6				Copper 59.7%
Commodity Importers	**Overall Governance**	**Change over period**	**Safety & Rule of Law**	**Change over period**	**Participation & Human Rights**	**Change over period**	**Sustainable Economic Opportunity**	**Change over period**	**Human Development**	**Change over period**	**Top Exports**	**Top 3 of total Exports**	
Cote D'Ivoire	52.3	13.1	55.1	17.3	54.3	18.6	48.4	8.7	51.4	7.8	Cocoa Beans	47.10%	**Main Export**
Kenya	58.9	5.1	56.3	0.8	60.6	3.6	54.8	7.8	63.8	8	Tea; Flowers; Petroleum and other oils	35.50%	Cocoa beans 33.9%
Rwanda	62.3	8.4	61.5	1.1	51.6	8.8	65.1	9.4	71.2	14.4	Minerals; Tin; Coffee	62.30%	Tea 15.9%
Senegal	60.8	3.7	65.5	4.8	69.8	0.9	51.4	3.2	56.6	6.1	Gold; Fish; Phosphoric Acids	34.40%	Minerals 27%
Namibia	69.8	3.6	76.1	1.3	76.1	6	62.2	5.7	64.7	1.1	Diamonds; Zinc; Fish	48.50%	Gold 16.8%
Average Commodity Importers	60.8		62.9		62.5		56.3		61.5				Diamonds 28%
Continental African Average	50	1	52.1	-2.8	50	2.4	42.9	1.8	55	2.9			

Source: http://mo.ibrahim.foundation/iiag/, Export Data from the AFDB website: http://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/AEO_2016_Report_Full_English.pdf

Appendix B: Table of Abbreviations

Table 1.B Table of Abbreviations used in the analysis

Abbreviation of dependent variables and their equivalent abbreviation with the applied 1 quarter lag	None Abbreviated dependent variables	Abbreviation of independent variables	None Abbreviated independent variables
mtb_3 / mtb_3lag	3 Month T-bills	mpr	Monetary policy rate
mtb_6 / mtb_6lag	6 Month T-bills	cpi	Consumer price index
mtb_12 / mtb_12lag	12 Month T-bills	qgdp	Quarterly Real GDP
b_3 / b_3lag	3 Year Bonds	indpr	Industrial production
b_5 / b_5lag	5 Year Bonds	bot	Balance of trade
euro1 / euro1lag	Eurobond 1	vix	VIX Index
euro2 / euro2lag	Eurobond 2	ust	10year U.S. Treasury yield
euro3 / euro3lag	Eurobond 3		

Appendix C: Hausman test Results

The table 1.C. below shows the outcome of the Hausman test, and which subsequent results were used in the analysis. For instance, for the base model with all the countries in the sample, for the mtb_6, the Hausman results was showing a prob>Chi-squared ≤ 0.05 thus we used the Fixed Effects results. If the outcome of the Hausman test showed a prob>Chi-squared > 0.05 then we used the Random Effects results. $ denotes no results could be obtained due to too few observations to conduct the Hausman Test. * denotes where the Hausman test was conducted sigamless. The sigmaless Hausman test, specifies that both covariance matrices be based on the estimated disturbance from the consistent estimator. The decision to use the sigmaless Hausman test was based on the fact that when both the regular Hausman test as well as the sigmaless Hausman test were possible to use both gave the same results for selecting either the Fixed Effects or Random Effects model.

Table 1.C. Hausman Test Results

Hausman test results		mtb_3	mtb_6	mtb_12	b_3	b_5	euro1	euro2	euro3
All Countries	Base Model	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects*	Fixed Effects	Fixed Effects	Random Effects
	Lags	Random Effects	Fixed Effects	Fixed Effects*	Fixed Effects	Fixed Effects*	Fixed Effects	Random Effects	Fixed Effects*
Commodity Exporting Countries	Base Model	Random Effects	Fixed Effects	Fixed Effects*	Random Effects	$	Fixed Effects	Random Effects	Random Effects
	Lags	Random Effects	Random Effects	Random Effects	Random Effects	$	Fixed Effects*	Random Effects	Fixed Effects
Commodity Importing Countries	Base Model	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Fixed Effects	Random Effects	$
	Lags	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects*	Fixed Effects	Random Effects	$
No CFA Zone	Base Model	Random Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Fixed Effects	Random Effects
	Lags	Random Effects	Fixed Effects	Fixed Effects	Random Effects	Fixed Effects	Fixed Effects	Random Effects	Fixed Effects
Interpolated QGDP	Base Model	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	$	Random Effects
	Lags	$	Random Effects	Random Effects	Random Effects	Random Effects	Random Effects	$	Random Effects

D: Correlation matrix and Shapiro-Wilk results

Table 1.D. Correlation matrix:

	mpr	cpi	qgdp	bp	fxres	vix	ust
mpr	1						
cpi	-0.317	1					
qgdp	-0.23	-0.031	1				
bp	-0.077	0.032	0.022	1			
fxres	-0.007	-0.399	0.263	0.029	1		
vix	0.034	0.038	-0.046	0.034	0.113	1	
ust	-0.071	0.113	0.153	0.104	0.065	0.098	1

Shapiro-Wilk results:

Table 2.D. Shapiro-Wilk test:

As the 95% confidence interval for V lies between the value of 1.2 and 2.4 thus we reject that all the independent variables are normally distributed with the exception of euro2.

Variable	No. Observations	V
mtb_3	197	22.974
mtb_6	231	17.553
mtb_12	228	15.246
b_3	96	8.293
b_5	74	9.569
euro1	152	10.633
euro2	74	0.759
euro3	49	6.486

Appendix E Unit root test

Table 1. E. Results of Augmented Dickey-Fuller Test

As the debt instruments as well as independent variables are all nonzero, we included the drift option and we did not specify the trend option. We have used one lag as we did not have enough observations for a different lag structure. Choi (2001) indicates that the best trade-off between sample size and explanatory power is the inverse normal Z statistic. In the table below, the result for the inverse normal Z statistic shows that we reject the null hypothesis of a unit root presence. Unfortunately, the model did not have sufficient observations to generate a result for b_3 and b_5. ***p≤0.001; ** p≤0.01; * p≤0.05; $ denotes insufficient number of observations.

	Dependent Variables								Independent Variables							
	mtb_3	**mtb_6**	**mtb_12**	**b_3**	**b_5**	**euro1**	**euro2**	**euro3**	**mpr**	**cpi**	**qgdp**	**indpr**	**bp**	**fxres**	**vix**	**ust**
inverse chi2	40.467***	49.832***	51.041***	$	$	66.048***	28.243	11.913	46.917***	71.354***	110.612***	54.483***	85.962***	102.380***	103.829***	68.216***
inverse normal	-3.9786***	-4.898***	-5.044***	$	$	-5.664***	-3.196**	-1.884*	-3.920***	-5.486***	-7.994***	-5.341***	-6.861***	-7.407***	-8.114***	-5.981***
inverse log	-4.3669***	-5.180***	-5.321***	$	$	-6.046***	-3.084*	-1.801*	-4.039***	-6.777***	-10.131***	-6.168***	-8.883***	-9.467***	-9.632***	-6.291***
modified inv. Chi2	5.8108***	6.771***	7.000***	$	$	8.008***	3.315**	1.707*	4.819***	9.785***	15.435***	8.671***	13.599***	14.063***	14.304***	8.369***
Number of panels	8	8	9			9	8	4	9	8	9	6	7	9	9	9
Avg. number of periods	24.63	28.88	25.33			16.89	9.25	12.25	30.33	32.25	30.22	26.5	31	33.89	34.11	34.11

Appendix F Data Sources

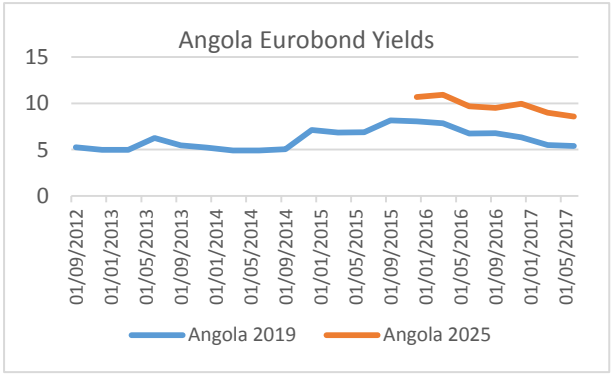
Table 1.F: Overview of data sources

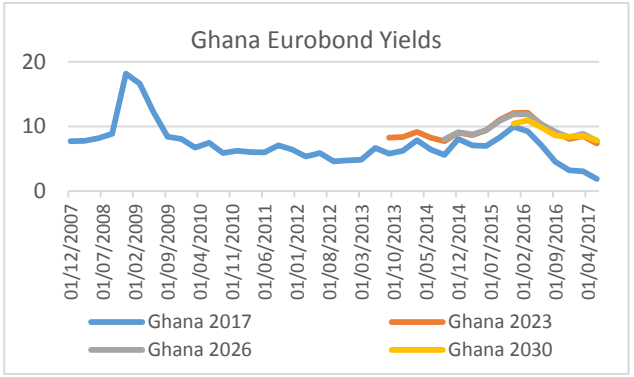
The tables below show the data sources used in the study. The Duet Asset Management African Economic database is abbreviated as DAM aed, while the remaining abbreviations are as follows: mtb_3 is the 3 months Treasury Bill, mtb_6 is the 6 months Treasury Bill, mtb_12 is the 12 months Treasury Bill, b_3 is the local currency 3 year government bond, b_5 is the local currency 5 year government bond, euro1 is the next Eurobond to mature, euro2 is next Eurobond maturity to happen, and finally euro3 is maturing Eurobond after euro2. Kenya has not issued during the sample period a 3year local currency government bond, we use the 2 year local government bond instead. For the Global Factors, ust stands for the U.S. 10 year Treasury yield, and vix is the VIX Index. The monetary policy rate is denoted as mpr, the consumer price index is given as cpi, qgdp denominates the quarter GDP growth in percentage on a year on year basis, the balance of trade is given as bot and fxres is denominating the Foreign Exchange Reserves. The global factors, ust and vix are sourced from Bloomberg for all the countries. * denotes the countries where the qgdp was interpolated.

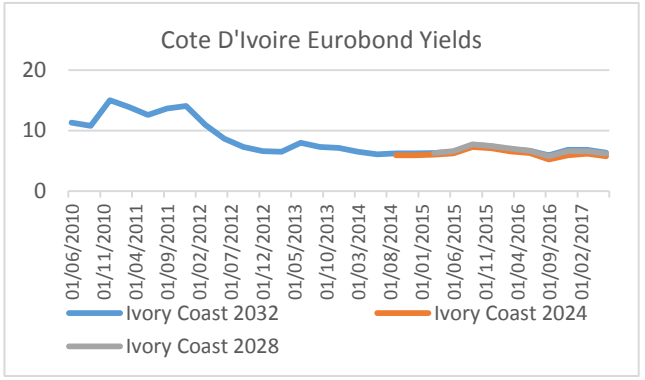
Country	Descriptor	Start Date	Gaps	Source	Country	Descriptor	Start Date	Gaps	Source	Country	Descriptor	Start Date	Gaps	Source
Angola*	mtb_3	Q3 2008	Yes	Bloomberg	Kenya	mtb_3	Q2 2006	Yes	Bloomberg	Rwanda	mtb_3	Q1 2010	Yes	DAM aed
	mtb_6	Q3 2008	Yes	Bloomberg		mtb_6	Q2 2006	Yes	Bloomberg		mtb_6	Q1 2010	Yes	DAM aed
	mtb_12	Q4 2008	Yes	Bloomberg		mtb_12	Q2 2009	Yes	Bloomberg		mtb_12	Q1 2010	Yes	DAM aed
	b_3	Q1 2015	Yes	Bloomberg		b_3	Q2 2009	Yes	Bloomberg		b_3	N/A	N/A	N/A
	b-5	Q3 2014	Yes	Bloomberg		b-5	Q2 2006	Yes	Bloomberg		b-5	N/A	N/A	N/A
	euro1	Q3 2012	No	Bloomberg		euro1	Q1 2014	No	Bloomberg		euro1	Q2 2012	No	Bloomberg
	euro2	Q4 2015	No	Bloomberg		euro2	Q1 2014	No	Bloomberg		euro2	N/A	N/A	N/A
	euro3	N/A	N/A	N/A		euro3	N/A	N/A	N/A		euro3	N/A	N/A	N/A
	mpr	Q1 2008	No	DAM aed		mpr	Q2 2006	No	DAM aed		mpr	Q1 2010	No	DAM aed
	cpi	Q1 2008	Yes	DAM aed		cpi	Q1 2010	Yes	DAM aed		cpi	Q1 2010	No	DAM aed
	qgdp	Q1 2008	Yes	DAM aed		qgdp	Q2 2009	Yes	DAM aed		qgdp	Q1 2010	No	DAM aed
	bot	N/A	N/A	DAM aed		bot	Q2 2009	No	DAM aed		bot	Q4 2010	Yes	DAM aed
	fxres	Q1 2008	Yes	DAM aed		fxres	Q2 2006	No	DAM aed		fxres	Q1 2010	No	DAM aed
Ghana	mtb_3	Q3 2007	Yes	Bloomberg	Namibia	mtb_3	Q1 2006	Yes	Bloomberg	Senegal*	mtb_3	Q4 2015	Yes	DAM aed
	mtb_6	Q3 2007	Yes	Bloomberg		mtb_6	Q2 2006	Yes	Bloomberg		mtb_6	N/A	N/A	DAM aed
	mtb_12	Q3 2007	Yes	Bloomberg		mtb_12	Q1 2006	Yes	Bloomberg		mtb_12	Q4 2011	Yes	DAM aed
	b_3	Q3 2010	Yes	Bloomberg		b_3	Q3 2011	Yes	Bloomberg		b_3	Q1 2011	Yes	DAM aed
	b-5	N/A	N/A	N/A		b-5	Q3 2011	Yes	Bloomberg		b-5	Q3 2009	Yes	DAM aed
	euro1	Q3 2007	No	Bloomberg		euro1	Q3 2011	No	Bloomberg		euro1	Q1 2011	No	Bloomberg
	euro2	Q1 2015	No	Bloomberg		euro2	Q4 2014	No	Bloomberg		euro2	Q2 2014	No	Bloomberg
	euro3	Q3 2014	No	Bloomberg		euro3	N/A	N/A	N/A		euro3	N/A	N/A	N/A
	mpr	Q3 2007	No	DAM aed		mpr	Q1 2007	No	DAM aed		mpr	Q1 2010	No	DAM aed
	cpi	Q3 2007	Yes	DAM aed		cpi	Q1 2006	Yes	DAM aed		cpi	Q1 2009	No	DAM aed
	qgdp	Q3 2007	Yes	DAM aed		qgdp	Q1 2006	Yes	DAM aed		qgdp	Q1 2009	No	DAM aed
	bot	Q3 2007	No	DAM aed		bot	Q1 2006	No	DAM aed		bot	N/A	N/A	DAM aed
	fxres	Q3 2007	No	DAM aed		fxres	Q1 2006	No	DAM aed		fxres	Q1 2009	No	DAM aed
Cote D'Ivoire*	mtb_3	Q2 2013	Yes	DAM aed	Nigeria	mtb_3	N/A	N/A	N/A	Zambia*	mtb_3	Q1 2009	Yes	DAM aed
	mtb_6	Q2 2012	Yes	DAM aed		mtb_6	Q3 2007	Yes	DAM aed		mtb_6	Q1 2009	No	DAM aed
	mtb_12	Q4 2011	Yes	DAM aed		mtb_12	Q3 2007	Yes	DAM aed		mtb_12	Q1 2009	No	DAM aed
	b_3	Q2 2008	Yes	DAM aed		b_3	Q3 2008	Yes	DAM aed		b_3	Q2 2009	Yes	DAM aed
	b-5	Q2 2009	Yes	DAM aed		b-5	N/A	N/A	N/A		b-5	Q2 2009	Yes	DAM aed
	euro1	Q3 2014	No	Bloomberg		euro1	Q3 2013	No	Bloomberg		euro1	Q3 2012	No	Bloomberg
	euro2	Q1 2015	No	Bloomberg		euro2	Q3 2011	No	Bloomberg		euro2	Q2 2014	No	Bloomberg
	euro3	Q2 2010	No	Bloomberg		euro3	Q3 2013	No	Bloomberg		euro3	Q3 2015	No	Bloomberg
	mpr	Q4 2010	No	DAM aed		mpr	Q4 2007	No	DAM aed		mpr	Q1 2012	No	DAM aed
	cpi	Q3 2008	No	DAM aed		cpi	Q4 2007	Yes	DAM aed		cpi	Q1 2009	Yes	DAM aed
	qgdp	Q3 2008	Yes	DAM aed		qgdp	Q4 2007	Yes	DAM aed		qgdp	Q1 2009	Yes	DAM aed
	bot	Q3 2008	Yes	DAM aed		bot	Q4 2007	No	DAM aed		bot	Q2 2009	No	DAM aed
	fxres	Q2 2008	No	DAM aed		fxres	Q4 2007	No	DAM aed		fxres	Q2 2009	No	DAM aed
Global Factors	ust	Q2 2006	No	Bloomberg										
	vix	Q2 2006	No	Bloomberg										

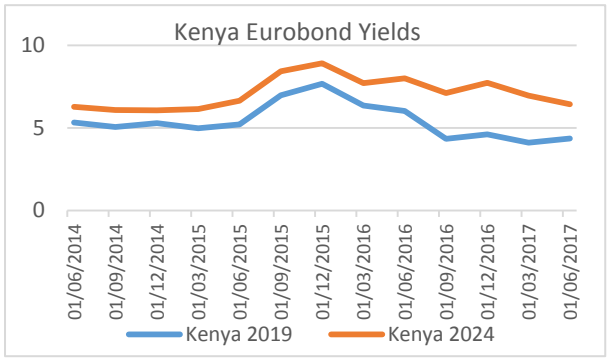
Appendix G: Treasury and Local Bond Yields as well as Eurobond Prices

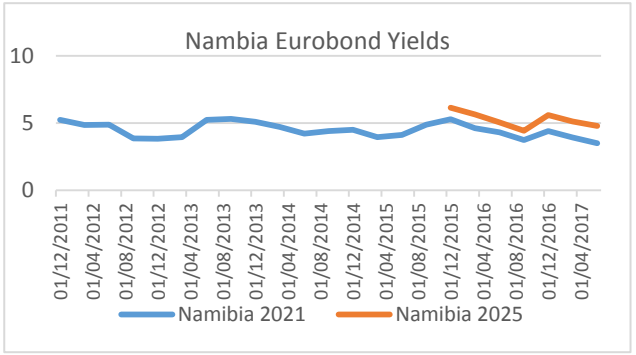
Figures 1.G Eurobond Yields for Sample Countries

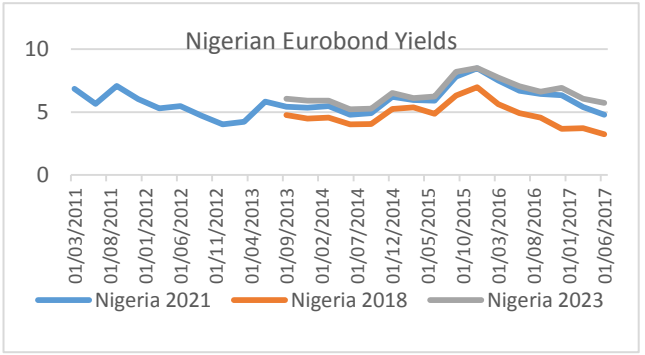


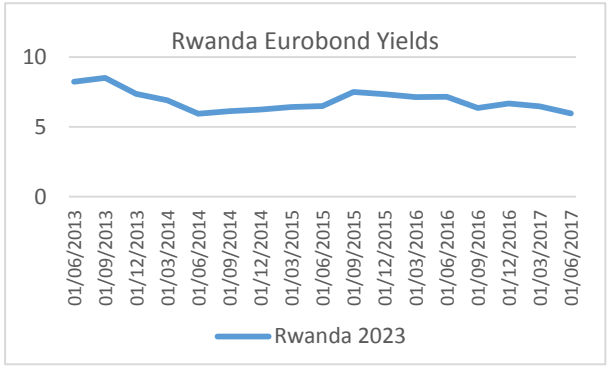


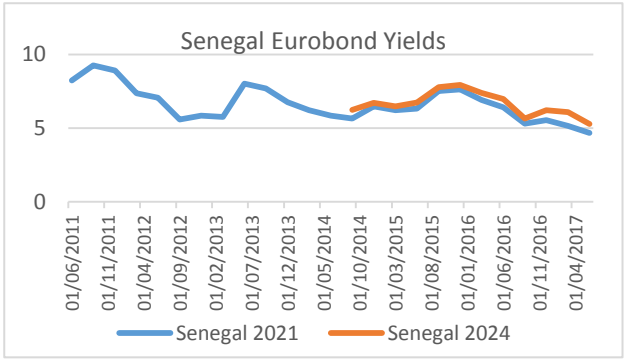


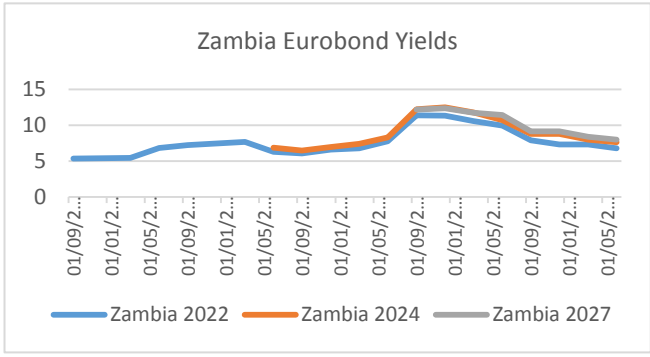




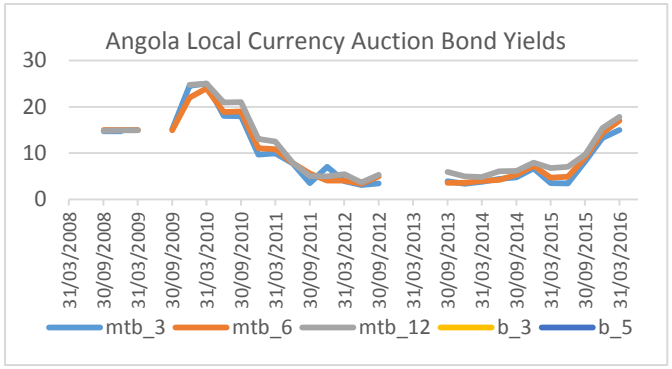


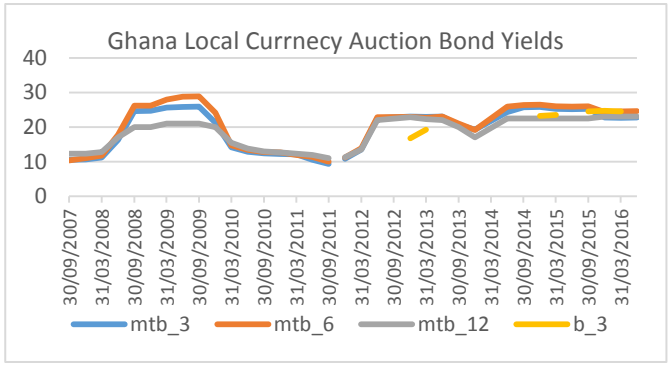


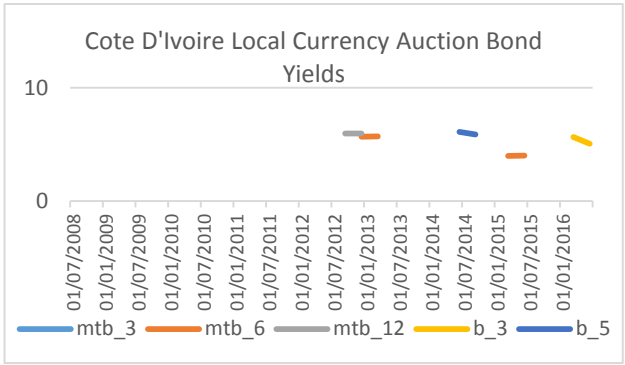


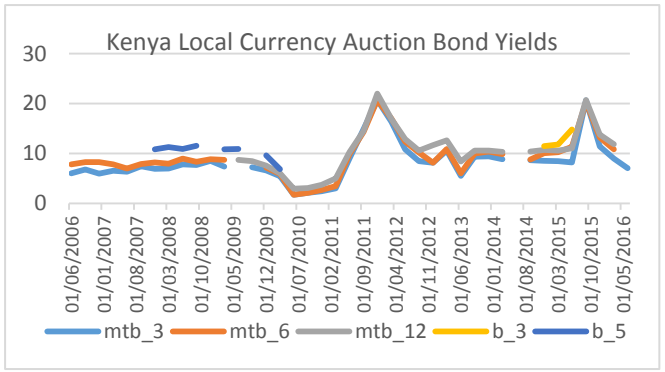


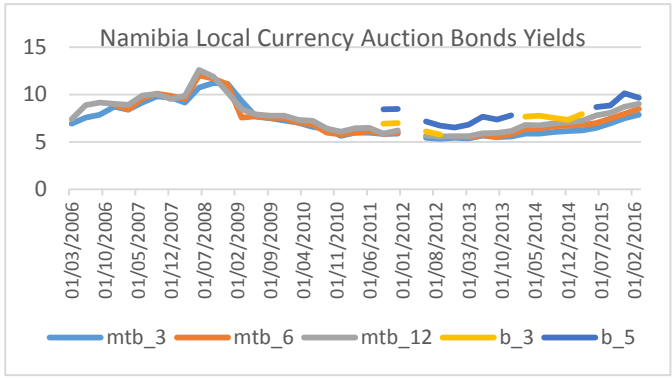
Figures 2.G Local Currency Bond and Treasury Yields

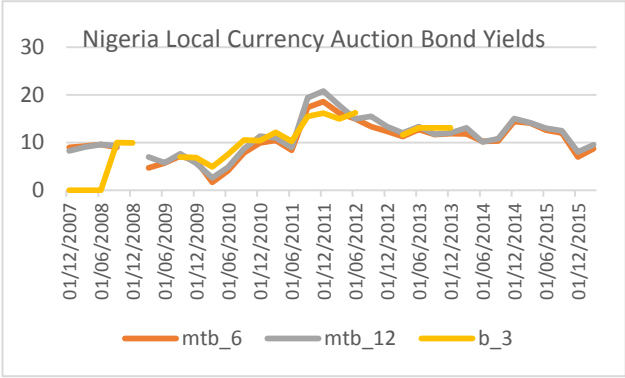


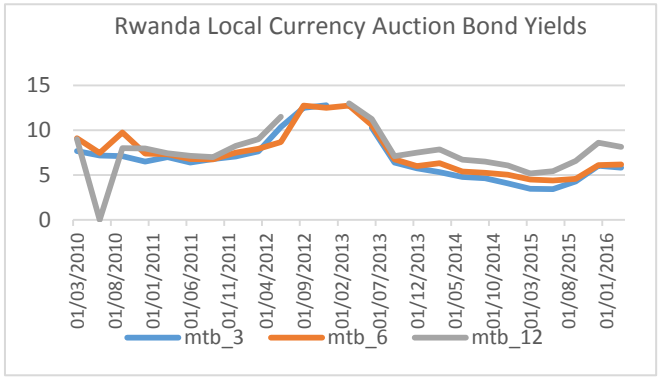


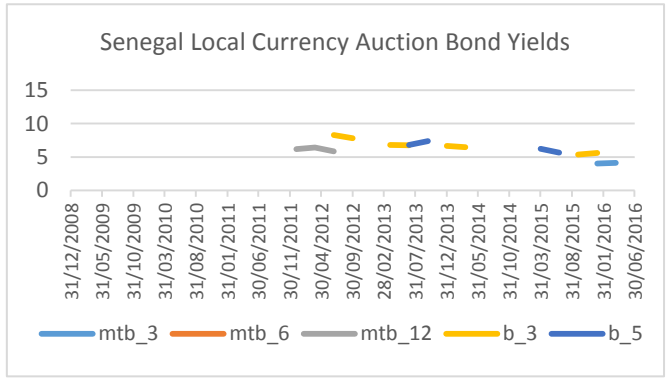


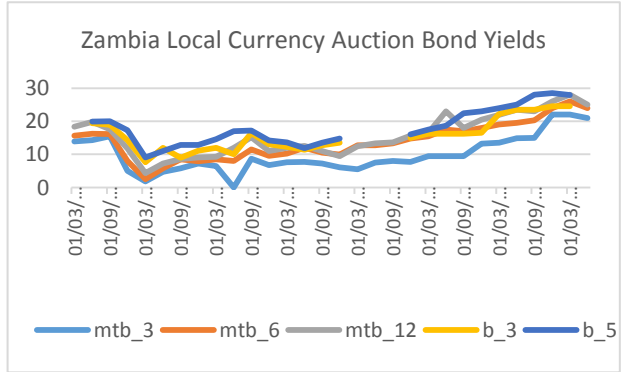












Appendix H Summary of expected impacts of MEFAs

Table 1: Summary Expected results for the Base Model, Commodity Exporting Countries and Commodity Importing Countries

The – sign denotes a negative effect if the independent variable changes on the yields or Eurobond prices. In order words if qgdp grows the local currency treasury bill yields in the Base model should have a lower yield for example. The + sign denotes a positive effect from the independent variable. The "no effect" denotes that there is no effect expected from this independent variable on the dependent variables. The Base Model comprises: Angola, Ghana, Kenya, Cote D'Ivoire, Namibia, Nigeria, Rwanda Senegal and Zambia. The Commodity Exporting Countries are: Angola, Ghana, Nigeria and Zambia, while the Commodity Importing Countries are: Kenya, Cote D'Ivoire, Namibia, Rwanda and Senegal.

Base Model	Independent Variable	Local Currency Treasury Bills Yields	Local Currency Bond Yields	Eurobond Prices
Macroeconomic data	qgdp	-	-	+
	cpi	+	+	no effect
	mpr	+	+	no effect
	bp	-	-	+
	fx	-	-	+
Global risk measures	vix	no effect	no effect	-
	ust	no effect	no effect	-

Commodity Exporting Countries	Independent Variable	Local Currency Treasury Bills Yields	Local Currency Bond Yields	Eurobond Prices
Macroeconomic data	qgdp	-	-	+
	cpi	+	+	no effect
	mpr	+	+	no effect
	bp	-	-	+
	fx	-	-	+
Global risk measures	vix	no effect	no effect	-
	ust	no effect	no effect	-

Commodity Importing Countries	Independent Variables	Local Currency Treasury Bills Yields	Local Currency Bond Yields	Eurobond Prices
Macroeconomic data	qgdp	-	-	+
	cpi	+	+	no effect
	mpr	+	+	no effect
	bp	+	+	-
	fx	-	-	+
Global risk measures	vix	no effect	no effect	-