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African Eurobonds: opportunities and challenges for sustainable economic growth after the HIPC initiative

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To my family

Abstract

This research investigates the sustainability and economic impact of SSA countries resort to international capital markets as well as its subsequent incentives for the quality of macroeconomic management in the borrowing countries. Taking stock of the economic distortions and negative incentives attributed to international aid, and the lessons of the ravaging pre-HIPC debt crisis, it builds on the concerns among the general public about the risk of the resurgence of a debt crisis in SSA and endeavors to tackle this issue in four specific chapters.

Chapter 2 analyzes how SSA eurobonds' secondary market yields are affected by global, country specific and bond-specific factors. We perform a pooled mean group (PMG) estimation to grasp the short and long-run dynamic between these yields and the global and country-specific factors, and apply the dominance analysis (DA) to assess the importance of the global, country-specific and bond-specific factors in the explanation of these yields' evolution. We find evidences of the influence of both the global and country-specific factors in the determination of SSA eurobond yields. The DA results indicate the dominance of country-specific factors over both global and bond-specific factors in the explanation of yields evolutions unlike the general perception of paramount influence of global factors in SSA eurobonds performance.

Chapter 3 complements the analysis of the previous chapter by investigating the possibility of spillover effects among SSA eurobonds. We compute both the overall and time-varying total spillover index, and the directional spillovers using these eurobonds' secondary market daily yields. Ours results indicate significant contagion effects among these bonds and suggest that less resilient economies transmit more to and receive less spillovers from their peers. This total

spillover index has proved sensitive to major economic events and news announcements over this period such as the Angola's request for IMF bailout in April 2016 and the Trump tantrum of November 2016.

In **chapter 4**, an investor's perspective is taken to evaluate the contribution of African securities to the risk-return profile of internationally diversified portfolios. The chapter explores the avenue of the international portfolio theory to investigate the extent to which the risk-return profile of a domestically-diversified portfolio can gain from the diversification over investment opportunities on the African continent in comparison with other international investment opportunity sets from the perspective of a US investor. Using a variety of mean-variance spanning tests, we find that African investment opportunity sets offer statistically significant diversification benefits to the benchmark US domestically-diversified minimum-variance and tangency portfolios. These diversification benefits can also justify the ongoing high appetite of international investors for SSA eurobonds.

Chapter 5 investigates the influence of government borrowing through international capital markets on investment dynamics in Sub-Saharan Africa (SSA). We use the synthetic control method to selected SSA market access countries to evaluate whether and how this kind of international borrowing affects private, public and FDI in these countries. Our results suggest that government and private investment dynamics have not been affected by governments borrowing through international capital markets, but that this move might have boosted these countries capacity to attract FDI as indicates the experience of Gabon and Ghana. This post-treatment increase in FDI lends support to the hypothesis that the resort to international capital markets constitutes as well an opportunity for these countries to register on the investors radar. However, the inconclusiveness of the SC method results regarding private investment cast doubt on the potential of this move to boost the domestic private sector as hypothesized by its proponents.

We conclude this dissertation by highlighting some policy lessons from our findings and setting out avenues for future research.

Abstract (Nederlandstalig)

Deze thesis onderzoekt de drijfveren en effecten van de heroverde toegang tot internationale kapitaalmarkten door landen uit Sub-Sahara Afrika (SSA), met name via de uitgifte van euro-obligatieleningen. Het onderzoek vertrekt vanuit de context waarbij deze hulpafhankelijke landen de laatste decennia doorheen een periode van ondraagbare schuldopbouw en daaropvolgende schuldkwijtschelding, via het HIPC-schuldkwijtscheldingsinitiatief, zijn gegaan, en de bezorgdheid bij de internationale gemeenschap over de mogelijke risicos die deze nieuwe leningen meebrengen voor hernieuwde schuldproblemen.

De analyse gebeurt vanuit verschillende invalshoeken. De thesis onderzoekt in eerste instantie in welke mate en aan welke voorwaarden landen uit Sub-Sahara Afrika toegang hebben verkregen tot de internationale euro-obligatiemarkt, en hoe de prijsnoteringen (als uiting van veranderende risico's) op de secundaire markt evolueren. De thesis onderzoekt vervolgens ook het risico van regionale oversijpeling, met name de mate waarin prijsnoteringen van euro-obligaties van een bepaald land een effect hebben op de prijsnoteringen in andere SSA-landen, en een crisis in n land dus zo kan oversijpelen naar andere landen inde regio. Vervolgens beschouwt de analyse ook het standpunt en gedrag van de uitgever/belegger van de euro-obligaties, vooral vanuit een portefeuille-perspectief. Tenslotte wordt gekeken in welke mate de aanwending van de middelen uit deze obligatieleningen leidt tot positieve economische impact in de ontvangende landen en ook incentives biedt voor deze landen om verder te werken aan een beter macroeconomische beleid. Elk van deze vier invalshoeken wordt behandeld in een apart hoofdstuk.

Hoofdstuk 2 onderzoekt de prijsvorming van SSA-euro-obligaties, en bekijkt meer specifiek in welke mate de evolutie van hun prijs en rendementsnoteringen op de secundaire markt worden beïnvloed door globale factoren, door ontvangende land-specifieke factoren alsook door obligatie-specifieke factoren. De analyse maakt gebruik van de 'pooled mean group' (PMG) schattingstechniek om de zowel korte als lange-termijn dynamische relaties tussen deze rendementen en een reeks verschillende factoren te bepalen, en gebruikt dan zogenaamde 'dominantie analyse' (DA) om het relatief belang van elk van deze drie klassen van factoren te bundelen. De resultaten bevestigen het belang van zowel globale alsook land-specifieke elementen in het verklaren van de evolutie van de rendementen van deze euro-obligaties. De DA-analyse wijst daarbij dat land-specifieke factoren meer dominant zouden zijn dan globale of obligatie-specifieke factoren, wat eerder onderzoek nuanceert dat vooral de dominantie van globale factoren benadrukt.

Hoofdstuk 3 vult de analyse van het vorige hoofdstuk aan door specifiek in te zoemen op de mogelijke regionale oversijpelingseffecten tussen SSA-euro-obligaties. Daarvoor worden zogenaamde globale en tijdsvarirende 'total spillover indices' berekend, alsook 'directionele spillover' effecten vanuit de genoteerde dagelijkse secundaire marktrendementen van deze euro-obligaties. De resultaten wijzen op de aanwezigheid van significante onderlinge besmettingseffecten tussen deze obligaties en suggereren dat meer kwetsbare economien meer risico's doorgeven aan hun regiogenoten, en er naar die meer kwetsbare landen ook minder oversijpeling is van de andere regiogenoten. Deze berekende 'totale spillover index' blijkt ook zeer gevoelig te zijn voor belangrijke economische ontwikkelingen en aankondigingen tijdens de periode van analyse.

In **hoofdstuk 4** kijken we meer vanuit het perspectief van het gedrag van de uitgever/belegger in euro-obligaties. Meer concreet wordt via het gebruik van analysetechnieken uit de portefeuilletheorie beschouwd in welke mate het toevoegen van deze Afrikaanse obligaties in een internationaal-gediversifieerde beleggingsportefeuille een effect heeft op het risico-rendementsprofiel van deze portefeuilles. Of met andere woorden, in welke mate dit risico-rendementsprofiel kan verbeteren door de bestaande portefeuille bijkomend te diversifiren met dit beleggingsinstrument, wat een verhoogde vraag zou genereren naar deze SSA-euro-obligaties. We

beschouwen dit vanuit het perspectief van een belegger uit de Verenigde Staten. De analyse maakt gebruik van een reeks zogenaamde 'mean-variance spanning' tests, en toont aan dat de toevoeging van Afrikaanse beleggingsinstrumenten statistisch-significante diversificatievoordelen opleveren, wat tegelijkertijd ook uitlegt waarom deze obligaties zeer sterk gegeerd zijn bij internationale investeerders.

Hoofdstuk 5 tenslotte onderzoekt het effect van overheidsleningen, via deze euro-obligatie-uitgiften op de internationale kapitaalmarkt, op de dynamiek van overheidsinvesteringen in Sub-Sahara Afrika. Daarbij wordt gebruikt gemaakt van de 'synthetische controle methode' om voor een steekproef van SSA-landen te bepalen wat het effect is van de uitgifte van euro-obligaties op de private, publieke en buitenlandse directe investeringen in deze landen. Onze resultaten tonen aan dat in de beschouwde landen de publieke en private investeringen niet significant worden beïnvloed door deze euro-obligatie-uitgiften, maar wel een invloed kunnen hebben op buitenlandse directe investeringen zoals blijkt uit de landenstudies voor Gabon en Ghana. Dit zou betekenen dat SSA-landen via deze uitgiften wel verhoogde belangstelling kunnen genereren van buitenlandse directe investeerders, maar dat het minder effectief is als instrument om ook binnenlandse private sector-investeringen te stimuleren.

Concluderend formuleren we een aantal beleidssuggesties die voortvloeien uit deze voorlopige resultaten alsmede wegen voor toekomstig bijkomend onderzoek.

Acknowledgments

Even though I take the overall responsibility of its content, this dissertation is an outcome of combined efforts and multiform contributions from various magnificent people and organizations. First and foremost, I owe a debt of gratitude to my supervisor, Professor Danny Cassimon, without whom this journey would have never culminated in this 'happy ending'. In fact, the life of a PhD student cannot be described better than this opinion by Oscar Brousse: "*Pour faire simple : après avoir essuyé les pressions relatives aux financements de leurs recherches, l'isolement et l'obligation à la publication, à la mobilité et l'autonomie, les doctorants doivent encore trouver l'énergie pour faire de leur sujet une étude proche de leurs valeurs, de leurs envies. (...) En moyenne, un tiers souffre de troubles psychologiques, notamment de dépression, et 30 à 50 % des doctorants et des doctorantes finissent par lâcher avant l'accomplissement de leur thèse*"[1]. This is exactly what Professor Cassimon has in many ways helped me survive!

I am equally grateful to Emeritus Professor Stefaan Marysse who sponsored my PhD application at the Faculty of Applied Economics of the University of Antwerp in 2009 and backed my start with a scholarship from the Bruyns Foundation. I would not have met Professor Cassimon without this generous welcome to the University of Antwerp and the Institute of Development Policy (IOB). By the same token, I deeply thank Papa Stanislas Mararo for having introduced me to Professor Marysse and my uncle Charles Harakandi who was, at the beginning, the reason of my visits to Antwerp, a city that ended up becoming my second home in several regards.

[1]Opinion comment published in La Libre Belgique on 26 April 2019 under the title: "*Quand les chercheurs perdent la boule*". See https://www.lalibre.be/debats/opinions/quand-les-chercheurs-perdent-la-boule-5cc1ccf27b50a6029462f137?fbclid=IwAR3RX69WpFnT9-zeJfF5vmES_P1QGOPBfqa-76PdQOTHjBXDHZ8ElegyyXU

My coming to Belgium was facilitated by a scholarship from the 'Commission Universitaire pour le Développement (CUD)', now the 'Académie de Recherche et d'Enseignement Supérieur (ARES)' of the Fédération Wallonie-Bruxelles for an advanced master's in international and development economics at the University of Namur. This is an opportunity for me to reiterate my special thanks to the ARES for this wonderful experience where I met dedicated and inspiring professors and administrative staffs such as Jean-Philippe Platteau, Alain de Combrugghe, Paul Reding, Romain Houssa, Marie-Eve Mulquin and Pierrette Noël.

The early stage of my economics studies was marked by a lot of hesitation and uncertainty about what I wanted to pursue as a career until I met Professor Thomas Kigabo. Not only have I admired his pedagogical skills that made me discover the beauty of the mathematics for economists, econometrics and macroeconomics, I also and above all got inspired by his high ambitions combined with a great sense of humanity and humility. I found in him a role model and blessed I felt to see him recruiting me as teaching assistant after my Bachelor's degree at Kigali Independent University (ULK) in 2004. Thank you seems not sufficient to express the gratitude I owe to him for the inter-generational friendship we have developed and all the support I have benefited from him ever since.

I experienced unspeakable challenges in both my private and academic lives in the course of this PhD. I thank my family and friends who covered me with incommensurable love and support so that I could carry this journey to the end. I am specifically indebted to my kids who have endured the cost of my poor parenting due to my rather demanding PhD activities, as well as other circumstances beyond my control. They have always been my greatest motivation when it comes to endeavors to build our family name; I hope this successful completion of my PhD will give room for a more enjoyable episode of our family life. I hold my parents in high regard for the sacrifice and my siblings for all sorts of support and encouragements.

The IOB and the Faculty of Business and Economics (TEW) of the University of Antwerp have been supportive beyond expectation. I met professors, administrative staffs and colleague researchers with high standards of professionalism coupled with a great sense of humanity. I always found the doors open and the faces welcoming whenever I needed a help, including

when I simply needed a listening ear to share my frustrations and worries. The list is endless; it would take a whole addendum to this dissertation to enumerate the names and elaborate on the individual contribution of each one to my professional and social well-being during this journey. Moreover, IOB as a workplace has been for me a opportunity to meet and interact with researchers and development practitioners from various disciplines and horizons; I am happy to have got friends from different corners of the globe sharing the same ideal and striving to contribute to the construction of a fairer, freer, healthier and wealthier world.

Last but not least, I thank the members of my doctoral commission and jury for having taken time to carefully read and comment on the draft of this thesis. I am particularly grateful to Professors Annaert and Winkler for the one-to-one meetings and the subsequent orientation to Chapters 4 and 5. Altogether, I believe that the constructive comments from the jury have improved the quality of this dissertation. All the remaining errors are mine.

Contents

Chapter 1

General introduction

The issue of economic growth and development in Sub-Saharan Africa (SSA) has been at the core of fierce debates among scholars and development practitioners for many decades. The inadequate quality of governance systems and institutions has always been blamed for the persistence of extreme poverty and poor living conditions in this area. However, while recognizing the link between the quality of governance and the level of development observed in this region, some analysts have also spotted various distortions and negative incentives attributable to external factors that have hampered the emergence of the region's endogenous dynamics for growth and prosperity. For instance, the rules and practices of international trade have been decried for locking poor countries out of industrialized and rich markets and thus closing the door to an escape route from poverty (Watkins and Fowler, 2002). International aid has also been criticized for its negative incentives for domestic growth dynamics and distorting effects on resources allocation in the recipient countries (Moyo, 2009; Bulír and Hamann, 2008; Hudson, 2014)[1]. Likewise, international capital markets have been on the dock for their reckless lending to developing countries and overall responsibility in the 1980's debt crisis (FDIC, 1997; Eichengreen and Portes, 1986).

Irrespective of the reasons, the economic performance of Africa from 1960 though 2002 was sufficiently lamentable to deserve the qualification of the "economic tragedy of the 20th century" by Artadi and Sala-i Martin (2003). In fact, while the rest of the world's economy was growing at an annual real rate of close to two percent during that period, Africa was on a regressing path in almost all of the performance indicators. The authors show that, from 1974 through the mid-1990s, economic growth on this continent was negative, reaching a negative 1.5 percent in the mid-1990s and that, while worldwide poverty fell from 37% in 1970 to 16% in 2000, African poverty rates soared to the extent that, in 2000, almost half of the world's poor population was living in Africa (42% in 2000 against 10.5% in 1970). This poor economic performance was further exacerbated by unsustainable debt levels that got this region mired into a dramatic debt-poverty spiral for a long time. The illustration of the evolution of SSA external debt is provided among others by Greene (1989) who shows that, for the period of 1978 – 1988, this

[1] A more radical position on aid ineffectiveness is discussed by Moyo (2009) who suggests Africa should get rid of international aid and find better ways for its economic growth and prosperity.

region's debt stock grew from around 20% to around 80% of GDP and from around 100% to more than 350% of exports values; the debt service to exports ratio increased from less than 12% to more than 30% in the same period. The economic debate in the end of the 20th century was dominated by the issue of overindebtedness in developing countries (most of which in SSA) and its detrimental effects on economic growth as well as its direct link with the persistence of poverty and worsening living conditions in these countries. By the same token, a consensus emerged about the almost inability of these countries to redeem their external debt without further jeopardizing their already critical socio-economic situations, hence the justification of and recommendations for debt forgiveness and cancellation (Greene, 1989; Iyoha, 1999; Krumm, 1985).

Initial attempts towards the alleviation of SSA debt burden were negotiated in the framework of the Paris and London club forums[2]. The Paris Club concerns public creditors, i.e. official government agencies, and debtor-country governments that meet on an ad hoc basis to discuss and agree on debt rescheduling. The London Club is an informal forum where debtor country governments reschedule debt from private sector creditors such as banks and other commercial lending institutions. Paris Club arrangements are faster and subject to two conditions: 1) the debtor country should be in a situation of imminent default, i.e. there should be clear evidence that the country is bound to default on its external payments if the relief is not granted; and 2) the debtor country should conclude a standby arrangement with the IMF to ensure that it quickly regains its ability to adequately service external debts. London Club negotiations are rather difficult and long since many creditor banks involved in the process have to reach an agreement. This forum conditions any rescheduling on the debtor country to have already a Paris Club rescheduling and an IMF program. The role of the IMF evolved from the coordination of debt restructurings to that of the "honest broker" in 1982 with the dramatic surge in the number of heavily indebted countries seeking reschedulings through these forums (Rieffel, 1985). In this new role, the IMF fulfilled three functions: 1) formulating adjustment programs for debtor countries; 2) providing IMF resources under standby or extended agreements; and 3)

[2]The role and organization of the Paris and London Clubs are discussed in details by Hudes (1985) and Rieffel (1985).

acting as catalyst in raising external finance from commercial banks.

The Heavily Indebted Poor Countries (HIPC) Initiative[3] was launched in 1996 to provide a permanent solution to the issue of repeated debt reschedulings in the Paris Club and bring HIPCs' external debt to sustainable levels[4]. Understandably, official debt, namely the bilateral (i.e. debt owed to donor governments) and multilateral debt (i.e. debt owed to international financial institutions), was mainly concerned. The Initiative was enhanced in 1999 to provide a faster and broader debt relief and strengthen the links between debt relief, poverty reduction and social policies. In face of the pressing need to attain the United Nations Millennium development goals (MDGs), the Initiative was supplemented by the Multilateral Debt Relief Initiative (MDRI) to allow for complete debt relief on eligible debts by the IMF, World Bank and the African Development Bank for countries completing the HIPC Initiative (IMF, 2017a).

In the framework of these initiatives, efforts were made with the support of the IMF and the World Bank to bring HIPCs' debt burdens to sustainable levels while laying the foundations for improved macroeconomic management and poverty reduction. The process consisted of two steps. The first step, called the "decision point", was meant to inform the decision on the eligibility of the applicant country based on the fulfillment of four conditions: 1) to be eligible to borrow from the World Bank and IMF's concessional schemes; 2) to face an unsustainable debt burden that cannot be tackled through traditional debt relief mechanisms; 3) have established a track record of reforms through IMF and World Bank-supported programs; and 4) to have developed a Poverty Reduction Strategy Paper (PRSP) through a broad-based participatory process. The second step, called the "completion point", allowed eligible countries to receive full

[3]The discussions and processes that brought about the Initiative are detailed in Bhattacharya et al. (2004) and IMF (2017a).

[4]The sustainability of the external debt burden was assessed based on a Debt Sustainability Framework (DSF). This framework set thresholds reflecting evidences that a low-income country with better policies and institutions can sustain a higher level of external debt. Therefore, based on the World Bank's Country Policy and Institutional Assessment (CPIA) index, different thresholds have been set depending on whether the country is deem weak, medium or strong. For countries with weak policies, the external debt was deemed unsustainable if the present value of debt stock exceeds 100% of exports, 30% of GDP and 200% of government revenues; and debt service exceeds 15% of exports and 25% of government revenues. For countries with medium quality policies, these thresholds were raised to 150% of exports, 40% of GDP and 250% of government revenues for the present value of debt stock; and 20% of exports and 30% of government revenues for debt service. Countries with strong policies had heir thresholds set at 200% of exports, 50% of GDP and 300% of government revenues for the present value of debt stock and 25% of exports and 35% of government revenues for debt service expenditures.

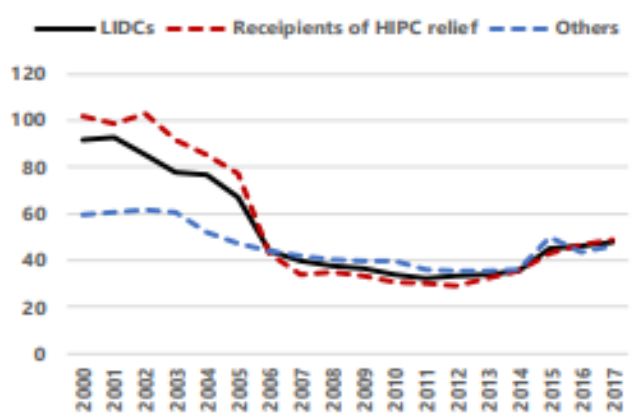
and irrevocable debt relief committed at the decision point conditional on the country 1) establishing sustained track record of good performance under the IMF and World Bank-supported programs ; 2) satisfactorily implementing key reforms agreed upon at the decision point; and 3) adopting and implement the PRSP for at least one year. By end-2015, 36 out of the 39 eligible countries had reached the completion point and nearly US$120 billion present-value debt had been written-off (US$76.9 billion from creditors under the HIPC Initiative and US$42.4 billion from multilateral creditors through the MDRI)[5].

The HIPC initiative is credited for the remarkable improvement in SSA countries' macroeconomic account stances, particularly the breaking of the debt-poverty vicious circle these countries had been mired into for decades as seen in Figure 1.1a. Indeed, the post-HIPC era has been marked by an impressive economic performance of SSA as a region thanks to a notable relaxation of external debt burdens and improvement in macroeconomic policies, coupled with favorable commodity prices since the mid-2000s. Up to recently, SSA has recorded annual economic growth rates averaging 4.6% from 1999 to 2016, next to emerging and developing Asia (7.4%) and above Latin America (2%) and the world average of 3.4% for the same period (IMF, 2017b). An investigation into SSA growth figures shows that oil exporting countries grew at 5% on average with a peak of 9.2% in 2010 (at the height of the oil-price boom) and a contraction of −1.5% in 2016 (as a result of the oil price bust of end-2015). While other resource-rich SSA countries grew at an average rate of 3.6% with a trough of 0.5% in 2009 and a peak of 5.3% in 2011, their non-resource-rich counterparts have registered a steady growth averaging 6% which, interestingly, has proved resilient to oil and other commodity price crises (IMF, 2017).

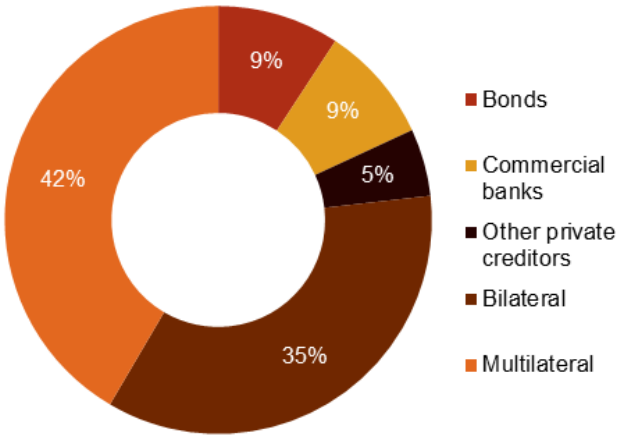
This SSA growth story coincides with what Prizzon et al. (2017) calls the 'age of choice' characterized by an expanding access of developing countries to external development finance beyond official development assistance (ODA) such as the access to international capital markets,

[5]As of October 2017, the following countries (of which 30 SSA) were over the completion point: Afghanistan, Benin, Bolivia, Burkina Faso, Burundi, Cameroon, Central African Republic, Chad, Comoros, Republic of Congo, Democratic Republic of Congo, Cote d'Ivoire, Ethiopia, The Gambia, Ghana, Guinea, Guinea-Bissau, Guyana, Haiti, Honduras, Liberia, Madagascar, Malawi, Mali, Mauritania, Mozambique, Nicaragua, Niger, Rwanda, Sao Tome & Principe, Senegal, Sierra Leone, Tanzania, Togo, Uganda and Zambia. On the other hand, though potentially eligible, Eritrea, Somalia and Sudan were still at the pre-decision point.

an unprecedented move for the SSA region (except South-Africa). In fact, starting in 2006, SSA countries have been issuing eurobonds one after the other in what Willem te Velde (2014) sees like a beauty contest. Surprisingly, this move has met the enthusiasm of international investors showing a very high appetite for these securities despite the recent history of defaults and overindebtedness in this region. To name a few, the issues by Rwanda in April 2013, Kenya in June 2014 and Côte d'Ivoire in July 2014 were oversubscribed for respectively more than 8.5, 4, and 6 times their issue sizes. The same enthusiasm has been observed for more recent issues where, for instance, the US$ 2 billion issue by Kenya in February 2018 and the one of US$ 2.86 billion by Nigeria in November 2018 got order books amounting to US$ 14 billion and US$ 9.5 billion respectively. Until late 2018, 16 SSA countries are reported to have collected more than US$ 47 billion through sovereign and/or government-guaranteed eurobonds. It is reported that this investors' appetite for SSA bonds has been fueled by record-low interest rates in advanced economies and commodity price recovery in the aftermath of the global financial crisis, trends that have now reversed or could reverse in the near future (Sy, 2013; Masetti, 2015; Standard Poor's, 2015; Sy, 2015). On the other hand, it is also believed that investors may have been enticed by the region's economic growth record and improved domestic fundamentals offering new opportunities for the international diversification of their portfolios.



(a) LIDC public debt (median % GDP)
Source: Zhang (2018)



(b) LIDC public debt composition (2016)
Source: Van Cauwenberg and Laleman (2018)

Figure 1.1: LIDC public debt

Either way, the success of SSA eurobonds has been viewed with mixed feelings by some experts who do not believe in its sustainability in the medium-to-long run and therefore warn about the possibility of another debt crisis in the region, a position corroborated by recent trends in SSA's government debt since 2013 (see Figure 1.1a). For instance, Figure 1.1b shows that eurobonds accounted for 9% of government debt in 2016. Albeit modest as this might seem compared to developed economies standards, this new public debt build-up can be detremental for the development of some of these countries. The case in point is Zambia which is reported to spend more on debt service than on education (The Economist, 2018).

This caution about the risk of the resurgence of a debt crisis in SSA is beefed up by the fact that there seems to be close similarities between the world economic conditions that prevailed before the debt crisis of 1980 and now, a situation that pushes some experts to look at the current appetite of international investors for these eurobonds with a sense of deja vu. In fact, FDIC (1997) reminds that capital flows from international financial system to Least Developed Countries (LDCs) were also pulled by the economic performance of 6% annual GDP growth on average in the LDCs and the need by these countries to finance the deficits caused by the oil prices rise of 1973-1974. These capital flows were pushed by the need by the international financial market to recycle the increasing Eurodollar funds supplied by oil-exporting countries (see FDIC, 1997, chap. 5), which looks quite similar to the current situation in many respects. The responsibility of creditors in the defaults of sovereign borrowers is also mentioned by Eichengreen and Portes (1986) who links the 1980's debt crisis to the widespread defaults of the 1930's and say: "... Quite often, defaulting debtors were able to re-enter the international capital market only to default again, occasioning criticism of creditors for engaging in reckless lending ascribed to myopia or excessive competition"(Eichengreen and Portes, 1986, p.600). This valid concern justifies the necessity of a deep analysis of the dynamics of the SSA eurobonds' market and their impact and incentives for the region's sustainable economic growth and development.

This research addresses certain aspects of this important concern by investigating the sustainability and economic impact of SSA countries' resort to international capital markets as well as its subsequent incentives for the quality of macroeconomic management in the borrowing

countries. Taking stock of the economic distortions and negative incentives attributed to international aid, and the lessons of the ravaging pre-HIPC debt crisis, this study endeavors to answer the following specific questions:

1. What are (and what can we learn from) the drivers of SSA eurobond yields?
2. Why have these bonds been so appealing for international investors?
3. How has the SSA governments' resort to international capital markets impacted investment dynamics in borrowing countries?

The first question relates to the disposition and ability of capital markets to integrate the quality of sovereign borrowers' macroeconomic management into the valuation of SSA eurobonds. Important as it is, this question explores the potential of these markets to provide additional incentives for these countries to embrace better macroeconomic management and generate sustainable growth and prosperity. The rationale behind this thinking is the *market discipline hypothesis* that credit markets are capable of disciplining sovereign borrowers in their macroeconomic management exercise (Bayoumi et al., 1995; Manganelli and Wolswijk, 2007; Kula, 2004). The second question tackles the rationale behind investors' enthusiasm for SSA eurobonds in order to assess the ability of this market to outlive the seemingly favorable but temporary global economic conditions and rather become a reliable and sustainable source of development financing for the region. The last question investigates the possibility of government borrowing though capital markets to catalyze sustainable economic growth in the borrowing countries via its impact on domestic investment dynamics. While acknowledging the possibility of complementary and/or alternative answers, the scope of this analysis is limited to the sole macroeconomic and financial aspects of this rather complex and multidimensional issue of SSA sovereign eurobonds. In addition to this general introduction, the results of our attempt to answer these research questions are presented in four chapters followed by a general conclusion.

Chapter 2 scrutinizes the drivers of secondary market yields on Sub-Saharan African (SSA) sovereign eurobonds. We have considered secondary market yields for their double advantage for our analysis. On one hand, based on the efficient market hypothesis[6], they are expected to reveal in real time the changes in market participants' sentiments about the risk-return profile of the bond, the underlying assumption being that, ceteris paribus, bonds with better profiles will enjoy higher demands, hence higher prices corresponding to lower yields. In this perspective, lower yields indicate a higher attractiveness of the bond while increases in yields suggest a shrink in the bond attractiveness, everything remaining equal elsewhere. On the other hand, they are available on a time-series basis providing the possibility to track their evolution against the changes in our variables of interest. Although changes in secondary market yields have no immediate impact on the interest costs of existing fixed-rate securities, they reflect the marginal cost of new borrowing should the country issue similar instruments.

This chapter analyzes how SSA eurobonds' secondary market yields are affected by global, country specific and bond-specific factors. We perform a pooled mean group (PMG) estimation to grasp the short and long-run dynamic between these yields and the global and country-specific factors. We then apply the dominance analysis (DA) to assess the importance of the global, country-specific and bond-specific factors in the explanation of these yields' evolution. From the results of the PMG estimation, we find a sound heterogeneity in terms of both the magnitude and direction of the short-term influence of our explanatory variables across countries and a clear influence of both the global and country-specific of factors in the determination of SSA eurobond yields. The DA results indicate the dominance of country-specific factors over both global and bond-specific factors in the explanation of yields' evolutions unlike the general perception of paramount influence of global factors in SSA eurobonds performance (Gevorkyan and Kvangraven, 2016; Sy, 2013; Presbitero et al., 2016). The precedence of country-specific factors suggests that capital markets are sensitive to the quality of borrowing countries' macroeconomic management since countries with solid fundamentals appear to enjoy favorable yields. Coun-

[6]The 'efficient market' hypothesis is owed to E.F. Fama who pioneered the idea that *in an efficient market, on the average, competition will cause the full effects of new information on intrinsic values to be reflected instantaneously in actual prices* (Fama, 1965, 1969).

tries are therefore incentivized to strengthen their fundamentals should they wish to rely on this source of funding for their development purposes, which is in line with the market discipline hypothesis.

Chapter 3 complements the analysis of the previous chapter by investigating the possibility of spillover effects among SSA eurobonds. It builds on the assumption that, besides the global and country-specific factors, the performance of SSA eurobonds can also be influenced by spillover effects from idiosyncratic shocks to their peers. Following the methodology of Diebold and Yilmaz (2012), we proceed as in Antonakakis and Vergos (2013) to compute both the overall and time-varying total spillover index, and the directional spillovers using these eurobonds' secondary market daily yields for the period January 2015 – June 2017. Ours results indicate significant contagion effects among these bonds as, on average, 66.37% of the forecast error variance in our model come from spillovers. Angola has been identified as the dominant spillover transmitter followed by Ghana and Zambia, while Namibia followed by Tanzania and Rwanda appear to have been the dominant receivers of SSA eurobond yield spillovers during our study period. The results of the time-varying analysis shows that the total spillover index has been sensitive to major economic events and news announcements over this period such as the Angola's request for IMF bailout in April 2016 and the Trump tantrum of November 2016. Therefore, we believe that SSA eurobond issuers can increase their influence over the performance of their securities on secondary markets by mitigating their vulnerability to spillover effects. Besides strong macroeconomic fundamentals, an improvement in transparency and information disclosure is required in order to curb the asymmetry of information underlying investors' behavior-based spillovers and contagion, which supports to a certain extent the market discipline hypothesis in the case of SSA eurobonds.

In **chapter 4**, an investor's perspective is taken to evaluate the contribution of African securities to the risk-return profile of internationally diversified portfolios. The general public perception has been that the observed attractiveness of SSA eurobonds is due to the prevailing economic conditions at the global scale, explaining the investors' attitude by the quest for high yields outside the protracted low economic growth and interest rates in their developed markets (Sy,

2013). The chapter explores the avenue of the international portfolio theory to investigate the extent to which the risk-return profile of a domestically-diversified portfolio can be improved through the diversification over investment opportunities on the African continent. Using data from the most representative S&P Dow Jones traded indices of the US, other developed, emerging and African markets for the period of July 2014 – September 2018, this chapter investigates the diversification benefits of African securities in comparison with other international investment opportunity sets from the perspective of a US investor. The benefits of diversification over these markets is assessed using the traditional and step-down tests of mean-variance spanning. The robustness of the obtained results is tested through a relaxation of the returns' normality assumption. Overall, these results show that, unlike their peers, African investment opportunity sets offer statistically significant diversification benefits to the benchmark US domestically-diversified minimum-variance and tangency portfolios. More specifically, they indicate that the 'All Africa' set contributes to risk profile of the benchmark set while the 'Africa ex-SA' is the only set offering significant improvements to this benchmark's tangency portfolio. These results bring additional evidence to the observation that countries with higher country-risk offer greater potential benefits of global diversification, which justifies to a significant extent the ongoing high appetite of international investors for African securities. Based on these results, we believe that, besides the search for higher yields, investors may be as well interested in SSA eurobonds for international diversification purposes and that the later consideration is likely to keep whetting investors' appetite for Africa's investment opportunities despite the resumption of economic growth in developed economies unlike the prediction of Sy (2013).

Chapter 5 investigates the influence of government borrowing through international capital markets on investment dynamics in Sub-Saharan Africa (SSA). Using a pool of 42 countries from this region for the period 1995-2017, we apply the synthetic control method to selected SSA market access countries to assess whether and how this kind of international borrowing affect private, public and FDI in these countries. We consider as treatment event the respective first eurobond issuance by these countries and restricted the analysis to countries that have had their treatment in 2012 at latest to allow for at least a 5 year observation of the potential

treatment effects. Moreover, we carried out a panel-VAR analysis on a sub-sample of 16 non-market access and 16 market access economies to investigate the possibility of heterogeneous patterns between these two categories of SSA countries when it comes to the interactions among private investment, government investment and FDI.

Our results indicate that, broadly, government access to international capital markets has not affected the dynamics of public and private investment in these countries. More specifically, private investment appears to present some indications of consistent increase before and after the first eurobond issues across the analyzed countries but our results do not lend support to the hypothesis that this increase may have been influenced by this access to international capital markets. As concerns FDI, these results have proved sufficiently conclusive to substantiate a positive impact of the exposure to international capital markets on FDI based on the experience of Gabon and Ghana.This post-treatment increase in FDI observed in the considered countries justifies to some extent the assertion by (Bertin, 2016) that the resort to international capital markets is indeed an opportunity for these countries to register on the investors' radar. However, the inconclusiveness of the SC method results regarding private investment cast doubt on the potential of this move to boost the domestic private sector as hypothesized by its proponents.

As concerns the interactions, we find indications of substantial heterogeneity between SSA non-market access and market access economies regarding government investment, private investment and FDI interactions characterized by, among others, a two-way relationship between government and private investment in the non-market category and a unidirectional impact of government investment on private investment in the market access one. This heterogeneity in investment dynamics between SSA market access and non-market access economies hints at the probable reasons behind the observed insignificant difference in private investment levels between these two categories of countries despite the significant relatively higher levels of government investment, FDI, and financial development and institutions quality indexes in the market access set.

The **last chapter** concludes this dissertation by highlighting some policy lessons from our findings and setting out avenues for future research.

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Chapter 2

Sub-Saharan African eurobond yields: What really matters beyond global factors?**

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Abstract

This study explores the drivers of secondary market yields of Sub-Saharan African (SSA) sovereign eurobonds from 2008 to mid-2017. Our results indicate that country-specific 'pull' factors such as inflation and GDP growth matter more for SSA eurobond performance. A panel error-correction analysis suggests large heterogeneity in the short-term influence of our global and country variables across countries. We find no significant effect of bond-specific factors on yields when push and pull factors are accounted for. By emphasizing the prominence of country-specific variables, our results qualify the common view that SSA countries have little control over their market borrowing costs.

Keywords: Public debt; international bonds; bond yields; Sub-Saharan Africa

JEL classification: F34; G15; H63

2.1 Introduction

During the 1980s and 1990s many Sub-Saharan African (SSA) countries saw an unsustainable build-up of external public debt, due to a toxic combination of commodity boom-bust cycles, easy lending by official creditors and international banks, bad domestic policy and, in some cases, civil war (Brooks et al., 1998; Easterly, 2002; Thomas and Giugale, 2015). Debt relief by creditors was initially limited to non-concessional reschedulings, allowing debtor countries only to postpone repayment. Gradually, however, it was acknowledged that debt problems transcended temporary liquidity concerns and more extensive debt service and debt stock relief was granted (Cassimon and Essers, 2017). A watershed event was the 1996 Heavily Indebted Poor Countries (HIPC) initiative which aimed at reducing even the worst debt burdens to manageable levels, subject to policy reforms. The HIPC initiative was later deepened and complemented with the Multilateral Debt Relief Initiative (MDRI) in 2005 to result in well over US$100 billion of debt cancellation for 30 SSA countries. Merotto et al. (2015) show that the public debt to GDP ratio of the average SSA HIPC came down from over 100% prior to HIPC decision points to below 30% just after HIPC/MDRI completion. Also a number of non-HIPCs, most notably Nigeria, have enjoyed large debt relief (Dijkstra, 2013).

Faced with huge infrastructure and other needs, SSA countries have been filling up again the 'clean slates' debt relief provided them with by borrowing from a wide range of domestic and external creditors (Prizzon and Mustapha, 2014; Cassimon et al., 2015; Merotto et al., 2015). This chapter looks at one channel of external borrowing by SSA sovereigns that has attracted relatively much attention from policymakers, i.e., the issuance of international bonds in the Eurodollar market (henceforth: eurobonds) (Mecagni et al., 2014; UNCTAD, 2016)[1].

Starting in 2006, not less than 16 SSA governments (excluding South Africa) have issued eurobonds, most of them for the first time ever, in what te Velde (2014) has called a 'beauty con-

[1] The term 'eurobond' generally refers to an international bond denominated in a currency other than that of the issuer or of the place where it is issued. In parallel to issuing eurobonds, SSA countries have also begun to develop their domestic bond markets. For more details, see Dafe et al. (2018) Essers et al. (2016), Berensmann et al. (2015) and Mu et al. (2013).

test'. Taken together, they have raised about US$29 billion in 35 issuances between September 2006 and June 2017[2]. Notwithstanding potential benefits from debt diversification, eurobond issuance holds a number of risks for SSA countries. First of all, the US dollar denomination of these bonds exposes their issuers to exchange rate risks. Because the required principal repayments are concentrated, typically in a single 'bullet' installment, eurobonds also involve greater redemption risks than amortizing loans. In contrast to the syndicated bank loans that dominated the commercial debt of African countries during the 1980s, eurobonds are marked by a much more diffused and diverse set of creditors (Bertin, 2016). Moreover, it is widely believed that investor appetite for SSA bonds has been fueled by record-low interest rates in advanced economies and commodity price recovery in the aftermath of the global financial crisis, trends that have now reversed or could reverse in the near future (Masetti, 2015; Standard & Poor's, 2015; Sy, 2015). Indeed, a recent study by Presbitero et al. (2016) finds that low-income developing countries are more likely to issue international bonds when US interest rates are low and commodity prices high, particularly so for SSA sovereigns, and that issuance occurs at higher spreads in times of market uncertainty. But next to global factors, domestic fundamentals seem to matter too at issuance. Presbitero et al. (2016) show that low-income countries' propensity to issue eurobonds rises with economic size and development, lower external debt and higher government effectiveness, and that issue spreads are lower for countries with a stronger current account balance, lower public debt, faster economic growth and an effective government. Olabisi and Stein (2015) demonstrate that, even after controlling for such global and domestic variables, SSA sovereigns pay a premium on their bonds at the moment of issuance, relative to other regions.

This paper takes the analysis of SSA eurobonds beyond the primary market by studying the drivers of the secondary market yields of these bonds. Whereas changes in secondary market yields have no immediate impact on the interest costs of existing fixed-rate securities, they do reflect the marginal cost of new borrowing through similar instruments. Concentrating on secondary market yields allows one to exploit important within-country variation, a dimension

[2]Not all of this constituted additional funds, however, as some bonds were (partly) issued to roll-over or exchange older debt titles.

which is typically very limited in the primary market. It should therefore not come as a surprise that most of the literature on emerging market borrowing takes secondary rather than primary market yields/spreads as the object of study. Given our focus on SSA, where most countries have so far issued only a few bonds each (usually separated by multiple years), the choice for secondary market yields makes much sense, we believe.

A part from Senga and Cassimon (2019) who investigate spillover effects among SSA eurobonds, Gevorkyan and Kvangraven (2016) is, to the best of our knowledge, the only paper to date that attempts to explain the variation in the secondary market yields of a larger set of SSA eurobonds[3]. With monthly data for nine countries (Republic of Congo, Côte d'Ivoire, Gabon, Ghana, Namibia, Nigeria, Rwanda, Senegal and Zambia) over December 2007 - February 2014, the authors find that yields in SSA are driven by commodity prices, global financial market uncertainty and US interest rates. We build and improve upon Gevorkyan and Kvangraven (2016) in several ways. First of all, we extend the sample to 14 countries, discarding the Republic of Congo and adding Angola, Cameroon, Ethiopia, Kenya, Mozambique and Tanzania, and update the time span to June 2017, thereby incorporating the latest oil price bust and recovery, and the start of monetary policy tightening by the US Federal Reserve. Second, next to global factors, we include in our empirical models a broad set of country-level variables, such as international reserves, public debt, GDP growth and inflation. Except for reserves, these variables are absent from the analysis by Gevorkyan and Kvangraven (2016). Including domestic macroeconomic fundamentals enables us to capture the domestic 'pull' factors that may drive SSA Eurbond yields, besides common international 'push' factors. Where possible, we also examine the influence on yields of bond-specific characteristics; among others, the size and maturity of individual bonds, the redemption schedule, and whether or not proceeds are used to fund infrastructure. To evaluate the relative importance of global, domestic and bond-specific variables more formally, we perform a dominance analysis using the methodology of Azen and Budescu (2003). Third, relative to Gevorkyan and Kvangraven (2016), this paper employs a larger variety of estimators, in line with key studies in the emerging market bond spreads literature (see

[3]Some other studies have incorporated a handful of SSA countries in their bond samples, usually as constituents of the JP Morgan Emerging Market Bond Index (EMBI) Plus or Global.

e.g., Dailami et al., 2008; Gonzalez-Rozada and Levy Yeyati, 2008; Bellas et al., 2010; Kennedy and Palerm, 2014). To distinguish between long- and short-run dynamics, we formulate a panel error-correction model, which we estimate with the Pooled Mean Group (PMG) estimator of Pesaran et al. (1999).

To preview our main conclusions, we find that, beyond global push factors, country-specific pull variables, including inflation and GDP growth, also affect SSA eurobond yields. Our panel error-correction results suggest large heterogeneity in the short-term influence of global and country explanatory variables across countries. Bond-specific factors such as bond size and maturity generally enter our regressions with the expected signs but are not statistically significant once global and country variables are taken into account. The importance of country variables as drivers of yield is confirmed by our dominance analysis. Hence, the common view that market borrowing costs are outside the span of control of SSA countries needs to be qualified.

The remainder of the paper is structured as follows. Section 2.2 summarizes the relevant literature on emerging and developing country bond yields/spreads. Section 2.3 describes our SSA sample and outlines the estimation strategy. Our results are presented and discussed in Section 2.4 and Section 2.5 concludes.

2.2 Literature review

We look into the existing literature on emerging market bond yields to inform our choice of global factors and country fundamentals to be considered as determinants of SSA sovereign bond yields. For instance, Hong-Ghi et al. (2003) distinguish three categories of variables in their study on emerging market bond spreads, i.e., liquidity and solvency variables, macroeconomic fundamentals, and external shocks. In the first category they group variables such as exports, imports, ratios of debt and foreign reserves to GDP, GDP growth, the current account balance, and the debt service to export ratio. The second category is made of variables such as inflation (as a proxy of the quality of macroeconomic management), the terms of trade, and the real exchange rate. Finally, US Treasury bill rates and the real oil price are considered as external shocks. The results of Hong-Ghi et al. (2003) indicate that, taken together, liquidity and solvency variables and fundamentals explain most of the spread variations in the 11 emerging market economies they consider during the 1990s. Changes in the US interest rate too appear to affect emerging market spreads. Similar variable categorizations have been used by other studies and their results converge to the importance of some or all of the above variables in determining bond yields and/or spreads (see e.g., Haque et al., 1996; Genberg and Sulstarova, 2008; Jaramillo and Tejada, 2011; Maltritz et al., 2012; Jahjah et al., 2013; Maltritz and Molchanov, 2013, 2014).

Other related literature elaborates on the factors affecting capital flows between advanced and emerging economies. With the Lucas paradox[4] having been empirically invalidated in recent studies (Reinhardt et al., 2013), most researchers now agree that capital flows are driven by both 'push' factors that emanate from the countries where lenders reside and 'pull' factors originating in the borrowing countries (Fratzscher, 2012; Suttle et al., 2013; Gueye and Sy, 2015). A simple but intuitive description of these factors is provided by Suttle et al. (2013) who refer to very loose monetary policy and the prospect of low returns in advanced economies as push factors, and higher growth and interest rates in emerging markets as pull factors driving the flow of

[4]The *Lucas paradox* or the *Lucas puzzle* is the observation that capital does not flow from developed countries to developing countries despite the fact that developing countries have lower levels of capital per worker (Lucas, 1990).

capital between these economies. A more comprehensive view is adopted by Fratzscher (2012) who takes an international diversification perspective and considers common shocks as push factors, and idiosyncratic, country-specific determinants as pull factors in his analysis on the drivers of capital flows from 2005 to 2010. He argues that push factors were the most important drivers of net capital flows in 2005-2007 and during the 2007-2008 global financial crisis, while pull factors dominate in explaining capital flows to emerging market economies in the recovery period thereafter. A similar view is also taken by Gueye and Sy (2015) who estimate the cost of borrowing by African countries from a model including prevailing push and pull factors.

Interestingly, the foregoing frameworks allow to test the market discipline hypothesis since the significance of macroeconomic fundamentals (pull factors) can be interpreted as evidence of markets' ability to discriminate between countries based on their respective economic performance. For example, Bellas et al. (2010) find that fundamentals influence emerging market bond spreads in the long run while financial market volatility is only important in the short run using data on 14 JPMorgan Emerging Market Bond Index (EMBI) constituents from 1997 to 2009. Dailami et al. (2008) consider 17 EMBI countries from 1991 to 2004 and their results indicate a significant non-linear impact of US interest rate policy on emerging market bond spreads, with countries having moderate debt levels suffering less from increases in US interest rates.

Besides push and pull factors, a notable study by Feyen et al. (2015) sheds light on the importance of bond-specific characteristics in the determination of international bond yields of emerging and developing economies on the primary market (i.e., at issuance). Using a sample of 71 countries over 2000-2014 and controlling for global and country-level factors, Feyen et al. (2015) find a statistically significant positive impact of bond maturity on primary market yields, but no independent effect of bond size.

Also the relatively recent move of SSA countries into international markets has caught the interest of researchers and policymakers. Sy (2013) believes that the record-low interest rates in the US and other advanced economies are the main (push) motive for investors' purchases of SSA eurobonds. On the pull side, he cites promising GDP growth supported by stronger policy frameworks, improved governance, and sharply reduced debt burdens. However, Sy (2013)

draws a pessimist picture of the sustainability of SSA eurobonds as, according to him, none of these push or pull factors are expected to continue over the mid to longer term given, for example, monetary policy normalization in advanced economies.

As mentioned above, our analysis complements the work of Gevorkyan and Kvangraven (2016) by extending the sample of SSA sovereign bonds to more countries, and to more than one bond issue per country when available. Along with this extension, we increase the number of country fundamentals that are considered and distinguish between short- and long-run dynamics in our assessment of the association of global and country-specific factors with bond yields. We also carry out an analysis at the individual bond level to assess the significance of bond-specific characteristics in affecting yields.

2.3 Methodology and data

2.3.1 Empirical model specification

To empirically investigate the drivers of SSA eurobond yields in secondary markets, we follow the emerging market bond spreads literature and start with a basic formulation of the long-run relationship between yields, global push factors and country fundamentals/domestic pulls:

$$y_{it} = \alpha_i + \sum_{j=1}^{J} \beta_j GLOB_{jt} + \sum_{k=1}^{K} \gamma_k DOM_{kit} + \varepsilon_{it} \tag{2.1}$$

where y_{it} are the log eurobond yields of country i at time t; $GLOB$ and DOM are vectors of, respectively, J global and K domestic variables; β and γ are sets of slope parameters assumed to be the same for all countries; α_i is an intercept that may vary across countries; and ε_{it} are well-behaved error terms. This static model can be estimated using simple pooled OLS (POLS), the random effects (RE) estimator, or fixed effects (FE), depending on the assumptions one makes with respect to α_i. In addition, limiting ourselves to bonds with sufficiently long yield series we can apply Mean Group (MG) estimation, which averages panel-specific coefficients estimated using OLS (Pesaran and Smith, 1995).

Since yields are expected to depend on their own lags and on lags of the independent variables, it makes sense to also consider a more dynamic specification. Taking heterogeneous parameters we can reformulate the model as:

$$\begin{aligned} y_{it} = \delta_i + \eta_i y_{it-1} &+ \sum_{j=1}^{J} \theta_{1ji} GLOB_{jt} + \sum_{j=1}^{J} \theta_{2ji} GLOB_{jt-1} \\ &+ \sum_{k=1}^{K} \lambda_{1ki} DOM_{kit} + \sum_{k=1}^{K} \lambda_{2ki} DOM_{kit-1} + v_{it}. \end{aligned} \tag{2.2}$$

After rearranging we obtain the following panel error-correction representation:

$$\begin{aligned}\Delta y_{it} = \phi_i \left[y_{it-1} - \alpha_i - \sum_{j=1}^{J} \beta_{ji} GLOB_{jt} - \sum_{k=1}^{K} \gamma_{ki} DOM_{kit} \right] \\ - \sum_{j=1}^{J} \theta_{2ji} \Delta GLOB_{jt} - \sum_{k=1}^{K} \lambda_{2ki} \Delta DOM_{kit} + v_{it}\end{aligned} \tag{2.3}$$

where $\phi_i = (\eta_i - 1)$; $\alpha_i = \frac{\delta_i}{1-\eta_i}$; $\beta_{ji} = \frac{\theta_{1ji}+\theta_{2ji}}{1-\eta_i}$; and $\gamma_{ki} = \frac{\lambda_{1ki}+\lambda_{2ki}}{1-\eta_i}$. The expression in square brackets is the gap between lagged yields and the determinants of their equilibrium levels, with β_{ji} and γ_{ki} the long-run (semi-)elasticities of the variables included in, respectively, $GLOB_j$ and DOM_k for country i (cf. Equation (2.1)). The coefficients θ_{2ji} and λ_{2ki} represent the short-run reactions to shocks in global and domestic variables. And error-correction term ϕ_i captures the speed at which countries' bond yields will return to their long-run equilibrium (steady state) after such shocks.

There are again different ways to estimate Equation (2.3). First, one can impose homogeneity in all parameters, except intercepts, and estimate a dynamic FE model. Alternatively, one could again fall back on the estimation of separate regressions for each panel (country) and then examine the averages of all coefficients across panels, i.e., the MG estimator. We prefer the intermediate Pooled Mean Group (PMG) estimator, first proposed by Pesaran et al. (1999), which constrains the long-run parameters to be common across panels (β_{ji}=β_j and γ_{ki}=γ_k), but allows for panel-specific error-correction terms and other short-run parameters[5].

The PMG approach has an intuitive appeal for our purposes and has featured in key studies on emerging market bond spreads (Dailami et al., 2008; Bellas et al., 2010; Kennedy and Palerm, 2014). As noted in those studies, it can be plausibly argued that in the long run financial markets hold economies to the same standards, while in the short run market perceptions of countries' creditworthiness may react differently to similar shocks (be it in global or country variables).

[5]It is well known that, because of the correlation between the lagged dependent variable and the error term, all three estimators will show bias, which diminishes with longer time series (Nickell, 1981). Since the time dimension of our sample dominates the cross-sectional dimension, we assume that the our series are long enough to mitigate this dynamic panel bias (Gonzalez-Rozada and Levy Yeyati, 2008).

In separate regressions, we also investigate the marginal influence of bond-specific characteristics on secondary market yields, a dimension which is all but absent from the literature on emerging and frontier market bonds (with the notable exception of Feyen et al. (2015), which only considers yields at the time of issuance). More specifically, we extend specification (2.1) as follows:

$$y_{it} = \alpha_i + \sum_{j=1}^{J} \beta_j GLOB_{jt} + \sum_{k=1}^{K} \gamma_k DOM_{kit} + \sum_{l=1}^{L} \mu_l BOND_{lbi} + \omega_{bit} \tag{2.4}$$

where $BOND_l$ is a vector of L bond-specific factors for bond b of country i. Since all bond characteristics we consider are time-invariant, we cannot include bond fixed effects. However, the inclusion of country fixed effects α_i in Equation (2.4) helps us separate the influence of bond factors from country-specific attributes in countries that have issued multiple bonds. We also use this equation to perform a dominance analysis in the spirit of Azen and Budescu (2003), whereby the respective explanatory power of our exogenous variables is assessed. More specifically, the general dominance of one (or set of) independent variable(s) over other regressors is determined based on a comparison of dominance statistics, computed as the weighted average marginal contribution to the overall fit statistic that an (or set of) independent variable(s) makes across all models in which it is included[6]. Such a dominance analysis further clarifies the relative importance of global, country-specific and bond-level factors in explaining the evolution of SSA eurobond yields.

2.3.2 Our dataset

We have been able to collect secondary market yields-to-maturity for 31 sovereign eurobonds of 14 SSA countries from Thomson Reuters Datastream (see Appendix Table A2.1). This covers the near-universe of non-South African SSA sovereign eurobonds issued between September 2006 and September 2016[7]. For our first set of yield regressions, in which we focus on the role of

[6]For a more detailed discussion of the dominance analysis, see Budescu (1993) and Azen and Budescu (2003).

[7]To ensure a minimum time series dimension for yields, we do not include more recently issued SSA eurobonds. Bonds for which no or insufficient yield data could be retrieved from Datastream are the 2006 and 2010 issues of

global push versus country pull factors and leave aside bond specifics, we limit ourselves to one bond per country, so as to better balance the sample in terms of country observations. In case a country has issued multiple bonds, we select for each country the bond with the longest yield series (typically countries' debut bonds), in order to maximize the time dimension of our estimation. After averaging eurobond yields at monthly frequency between January 2008 and June 2017, we end up with an unbalanced panel dataset of 14 countries/bonds and 795 observations in total. When estimating Equation (2.4), which includes bond characteristics, we make use of the whole sample of 31 SSA eurobonds, considering multiple issues per country where available.

We follow the literature and take the Bloomberg Commodity Index, the VIX and yields on 10-year US Treasury bonds to capture the influence of, respectively, global commodity prices, market volatility and liquidity/monetary conditions, i.e., the push factors in our model. As pull factors, we select the following macroeconomic fundamentals: the current account balance, government debt, primary fiscal balance, foreign reserves, GDP growth, exchange rate changes, and inflation. All country variables have been collected at their highest available frequencies and interpolated to monthly frequency where needed. Appendix Table A2.2 provides the exact definitions and original sources of our variables.

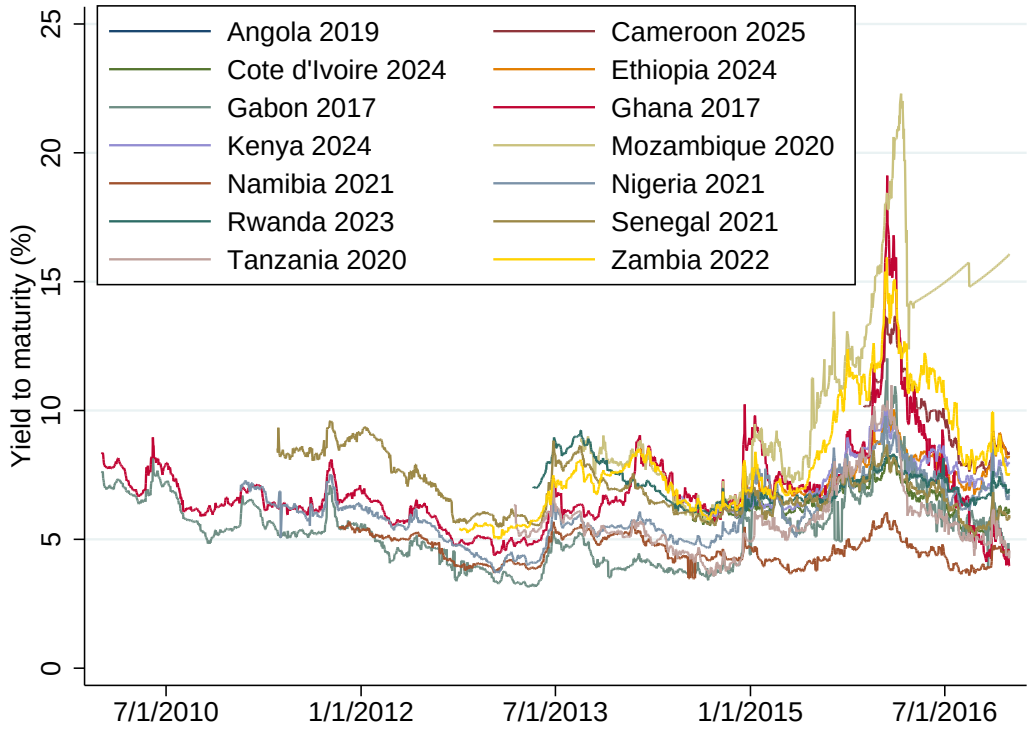
As concerns bond characteristics, we have constructed (time-invariant) dummies to distinguish between bonds involving a single bullet redemption of the principal and bonds with some amortization; debut and non-debut bonds; bonds with different sizes (below, equal to, or above US$1 billion) and original maturities (less than, equal to, or more than 10 years); and whether or not the stated use of proceeds (explicitly) includes an infrastructure component. The rationale for including the infrastructure bond dummy is that infrastructure investments are easier to monitor by international investors and may start generating returns earlier than, say, investments in education or health. This could instill relatively more trust in infrastructure bonds. All infor-

the Seychelles, the 2007 issue of the Republic of Congo, and the 2010 issue of Côte d'Ivoire. We do include in our sample a number of bonds that are, strictly speaking, not 'sovereign eurobonds' but have similar characteristics: Angola's 2012 loan participation notes issued by Northern Lights III, a special purpose vehicle backed by Russian bank VTB Capital, but with the Angolan government as the ultimate guarantor; Mozambique's 2013 government-guaranteed bond, issued by state-owned tuna fishing company Ematum; and the Tanzanian government's 2013 privately placed floating rate notes.

mation on bond characteristics was sourced from the original prospectus documents[8].

Figures 2.1 and 2.2 show the evolution and dispersion of SSA eurobond yields. It is clear that these yields do follow quite similar trends, but also that there is quite some heterogeneity between bonds/countries. Whereas most yields are found in the 5-10% range, within-bond yield variation is substantial. Bonds like those of Ghana, Zambia and Mozambique have seen yields exceeding 15% at times. Mozambique in particular appears to be an outlier in terms of eurobond yields. This may not come as a surprise, given the scandals that have developed around Mozambique's bonds (and a set of other, undisclosed loans) and the country's ultimate default early 2017 (Hanlon, 2016; IMF, 2018). We take the special case of Mozambique into account when testing the robustness of our econometric results. Summary statistics and pairwise correlations between (log) yields and the above-described global and country-level variables are presented in Tables 2.1 and 2.2. Yields correlate positively with the VIX, debt to GDP ratio, exchange rate depreciation, and inflation, and negatively with commodity prices, the current account balance, primary fiscal balance, and GDP growth. In the next section we investigate the drivers of yields in a multivariate setting.

[8]For example, in the prospectus of the 2013 eurobond of Gabon one can read: "The net proceeds of the Offered Notes will be used to accelerate and support the infrastructure projects identified by the *Schéma directeur national des infrastructures*, including the development of the bypass road in the Owendo zone, the development of electricity generation and transmission, in particular the *Chutes de l'Impératrice* dam, the finalisation of the Libreville-Franceville road and the South and South-West corridors". Conversely, the prospectus of the 2011 Nigerian eurobond states: "The net proceeds of the issue, after payment of commissions and expenses, will be used for general budgetary purposes". Accordingly, we classify the first (second) bond as an infrastructure (non-infrastructure) bond.



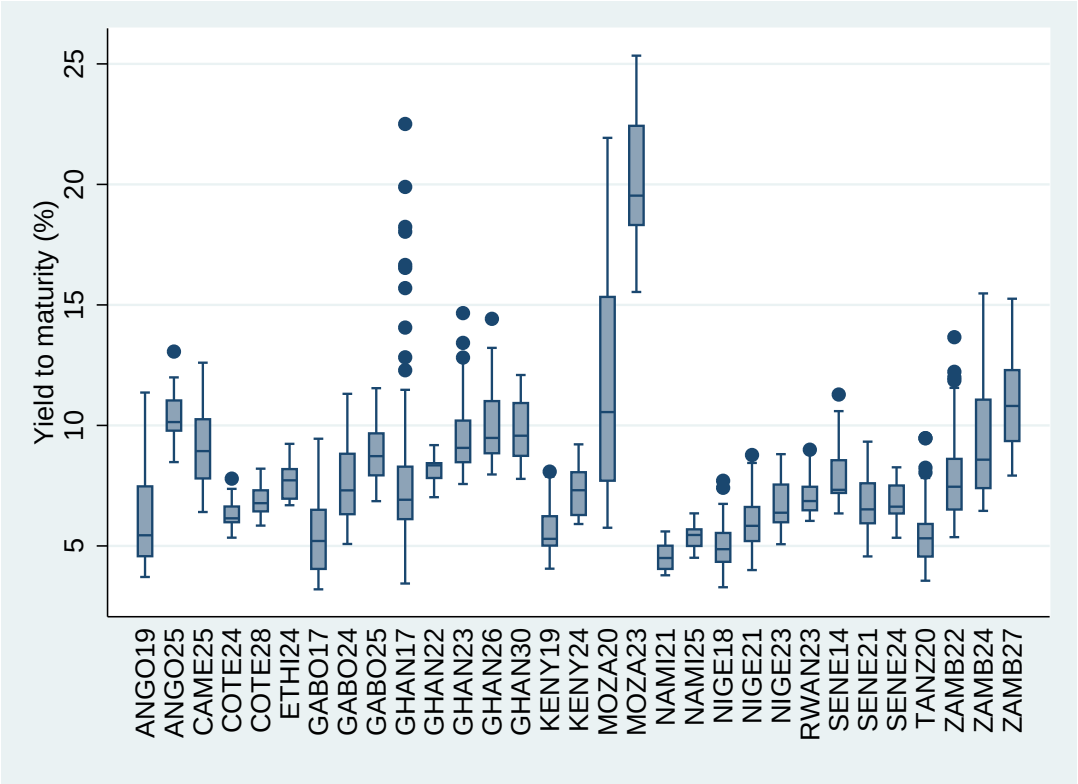
Notes: 14 bonds shown are those with the longest available yield series and are included in the samples of Tables 2.3 and 2.4. Years refer to maturity date. See Appendix Table A2.1 for details.

Figure 2.1: Evolution of yields of selected SSA eurobonds

Variable	Obs.	Mean	Std. Dev.	Min	Max
SSA eurobond yield (YIELD)	1255	0.073	0.026	0.032	0.253
Bloomberg commodity index (BCOM)	3385	374.036	65.539	235.59	509.133
VIX	3385	0.222	0.079	0.124	0.563
10-year US Treasury bond yield (USTB)	3385	0.026	0.007	0.015	0.040
Current account balance to GDP (CABAL)	3385	0.181	6.038	-15.763	29.154
Government gross debt to GDP (DEBT)	3385	36.900	18.126	7.276	115.2
Government fiscal balance to GDP (FISCBAL)	3385	-1.639	3.698	-9.642	12.642
Foreign reserves to GDP (RES)	3385	10.629	6.067	0.016	31.037
GDP growth (GDPGR)	3385	0.004	0.011	-0.026	0.034
Exchange rate change (XRTCH)	3385	0.007	0.036	-0.194	0.350
Inflation (INFL)	3385	0.007	0.008	-0.043	0.098
Log SSA eurobond yield (LYIELD)	1255	-2.674	0.314	-3.442	-1.373
Log Bloomberg commodity index (LBCOM)	3385	5.908	0.182	5.462	6.233
Log VIX (LVIX)	3385	-1.557	0.307	-2.086	-0.575
Log 10-year US Treasury bond yield (LUSTB)	3385	-3.689	0.283	-4.230	-3.210

Notes: For variable definitions and sources, see Appendix Table A2.2.

Table 2.1: Summary statistics of global and country variables



Notes: 31 bonds shown are those included in the samples of Tables 2.5 to 2.8. Two last digits refer to year in which bond matures. See Appendix Table A2.1 for details.

Figure 2.2: Boxplots of SSA eurobond yields

	LYIELD	LBCOM	LVIX	LUSTB	CABAL	DEBT	FISCBAL	RES	GDPGR	XRTCH	INFL
LYIELD	1.0000										
LBCOM	-0.4570*	1.0000									
LVIX	0.2633*	-0.3070*	1.0000								
LUSTB	-0.0188	0.0417*	0.3266*	1.0000							
CABAL	-0.3074*	0.1418*	0.1775*	0.1644*	1.0000						
DEBT	0.5246*	-0.1781*	-0.3108*	-0.2676*	-0.4892*	1.0000					
FISCBAL	-0.1662*	-0.0142	0.1995*	0.1390*	0.4309*	-0.3007*	1.0000				
RES	-0.0142	0.0692*	-0.0328	0.0147	0.2198*	-0.1442*	0.2479*	1.0000			
GDPGR	-0.1551*	0.4007*	0.0942*	0.2575*	0.2050*	-0.1618*	0.0823*	0.0540*	1.0000		
XRTCH	0.0687*	-0.0869*	0.0748*	-0.0363*	-0.0563*	0.0355*	-0.0659*	-0.0270	-0.1071*	1.0000	
INFL	0.3039*	-0.0264	0.0034	0.0875*	-0.0257	0.0987*	-0.1147*	0.1996*	-0.0032	0.1001*	1.0000

Notes: For variable definitions and sources, see Appendix Table A2.2. * significant at 5% level.

Table 2.2: Pairwise correlations between yields and main explanatory variables

2.4 Empirical results and discussion

2.4.1 Push and pull factors

Table 2.3 presents the results of the estimation of Equation (2.1) based on our one-bond-per-country dataset. The presence of panel effects is confirmed by the Breusch-Pagan Lagrangian Multiplier (LM) test, whereas the Hausman test cannot reject the null hypothesis of non-systematic differences between FE and RE coefficients at the 10% significance level. Although static, the results suggest significant correlations of several global and country variables with secondary market SSA eurobond yields. On the push side, the results show, as expected, an inverse relation between SSA yields and global commodity prices, and a positive relation between SSA yields and both the VIX and US Treasury bond yields. On the pull side, we find significant negative effects of GDP growth on SSA yields and positive influences of government debt to GDP and inflation. A plausible interpretation is that higher GDP growth and lower debt increase repayment probabilities and thus investor trust, and that lower inflation may signal better macroeconomic management. The coefficients of the current account balance and reserves to GDP have the expected negative sign when estimated using RE or FE, but are not significantly different from zero.

The MG estimator, which ignores the panel dimension by just averaging the coefficients obtained by country-specific estimations, confirms the significance of the global factors and of inflation. Debt and reserves to GDP are also significant, but the coefficients have counterintuitive signs. We note however that, by construction, this MG estimation may suffer from the still relatively short time series for some countries/bonds. Therefore, overall, these first static estimations seem to suggest that, beyond the global environment, investors also consider country-level conditions and discriminate between countries accordingly. The right-hand side of Table 2.3 shows the outcome of the same estimations when Mozambique's (Ematum) bond is excluded from the sample (given its peculiar nature and yield history). The results are qualitatively very similar. In absolute terms, the influence of commodity prices is slightly stronger and that of debt to GDP

somewhat weaker (in case of the OLS, RE and FE estimations).

Dep. variable:	Full sample				Excluding Mozambique			
LYIELD	OLS	RE	FE	MG	OLS	RE	FE	MG
LBCOM	-0.524**	-0.291*	-0.283	-0.614***	-0.650***	-0.418***	-0.411**	-0.565***
	(0.218)	(0.167)	(0.166)	(0.132)	(0.193)	(0.138)	(0.137)	(0.121)
LVIX	0.530***	0.691***	0.693***	0.393***	0.497***	0.621***	0.624***	0.392***
	(0.0703)	(0.0646)	(0.0642)	(0.0586)	(0.0654)	(0.0449)	(0.0457)	(0.0631)
LUSTB	0.294***	0.351***	0.353***	0.174***	0.251***	0.305***	0.307***	0.209***
	(0.0623)	(0.0432)	(0.0426)	(0.0580)	(0.0597)	(0.0341)	(0.0339)	(0.0608)
CABAL	0.00291	-0.00386	-0.00388	0.0339	-7.11e-05	-0.00456	-0.00461	0.0357
	(0.00353)	(0.00273)	(0.00273)	(0.0509)	(0.00378)	(0.00322)	(0.00324)	(0.0600)
DEBT	0.00655*	0.00651**	0.00653**	-0.00960**	0.00203	0.00255**	0.00264**	-0.0117**
	(0.00336)	(0.00293)	(0.00289)	(0.00489)	(0.00193)	(0.00118)	(0.00120)	(0.00544)
FISCBAL	-0.0104	0.0119	0.0129	0.0191	-0.0112	0.00410	0.00450	0.0160
	(0.0128)	(0.00954)	(0.00952)	(0.0524)	(0.0143)	(0.00832)	(0.00815)	(0.0597)
RES	-0.00578	-0.0114	-0.0125	0.0156*	-0.00856	-0.00852	-0.00869	0.0162*
	(0.00453)	(0.00825)	(0.00925)	(0.00875)	(0.00499)	(0.00814)	(0.00872)	(0.00972)
GDPGR	-3.072	-3.385**	-3.399**	0.574	-0.233	-2.506**	-2.552**	0.277
	(2.063)	(1.437)	(1.449)	(1.809)	(1.701)	(1.109)	(1.113)	(2.026)
XRTCH	0.00782	-0.0933	-0.0977	0.172	0.152	0.0639	0.0624	0.235
	(0.207)	(0.194)	(0.193)	(0.214)	(0.193)	(0.201)	(0.200)	(0.229)
INFL	5.217**	4.639***	4.629***	2.098**	6.200**	4.502***	4.491***	1.846*
	(2.331)	(1.006)	(0.994)	(0.942)	(2.547)	(1.258)	(1.258)	(1.076)
Constant	2.125*	1.412	1.340	2.208*	2.817**	1.943**	1.868**	1.844
	(1.161)	(0.910)	(0.916)	(1.256)	(1.016)	(0.785)	(0.786)	(1.266)
Observations	776	776	776	776	731	731	731	731
Countries		14	14	14		13	13	13
R^2	0.538	0.622	0.622		0.524	0.618	0.618	
Breusch-Pagan LM	3386.69***				2580.36***			
Hausman		8.98				6.61		

Notes: Estimation results based on Equation (2.1). For variable definitions and sources, see Appendix Table A2.2. Robust standard errors, clustered at the country level, in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 2.3: Estimation results for static model specification

Before moving to a dynamic analysis, we have looked into the time series characteristics of our variables. Although, as is often the case, the results are not 100% conclusive, Fisher-type Augmented Dickey-Fuller tests and Im et al. (2003) panel unit root tests suggest that the variables in our panel (after applying log transformations where appropriate) are integrated of order one at maximum (cf. Gevorkyan and Kvangraven, 2016)[9]. We therefore proceed with a panel error-correction model as represented by Equation (2.3) and estimated using the PMG techniques proposed by Pesaran et al. (1999) and applied by Dailami et al. (2008), Bellas et al. (2010), Kennedy and Palerm (2014) and others to similar (non-SSA) bond yield regressions.

The results of our PMG estimation are presented in Table 2.4. First of all, we find a significant,

[9]Results not shown, but available from the authors upon request.

negative error-correction term for all countries. The estimated values of ϕ vary considerably across countries and indicate that between 14% and 65% of the short-term deviations in bond yields from their long-run equilibrium are eliminated over a one month time span. In line with our previous static estimates, the common long-term coefficients in Table 2.4 show a significant inverse relationship of yields with commodity prices and GDP growth, and positive associations with the VIX, US Treasury bond yields and inflation. Additionally, we find a small but statistically significant negative effect of the current account balance and a positive effect of the fiscal balance and exchange rate depreciation. Whereas the positive fiscal balance coefficient is counterintuitive, a depreciation of the exchange rate increases the burden of dollar-denominated debt in local currency terms and may therefore feed into increased yields. The short-term influence of our explanatory variables on yields is very heterogeneous across countries; apart from the downward effect of commodity prices, which is statistically and economically significant for nearly all countries, we find little commonality in the magnitude and even direction of the other short-term coefficients. Of course, given the limited time dimension of some countries' bond yields, one needs to be cautious in interpreting these short-term country-specific coefficients.

Up to this point, our results emphasize the importance of both push (global commodity prices, market volatility and liquidity) and pull factors (GDP growth and inflation) in the long and/or short run dynamics of SSA sovereign eurobond yields. In the next section we investigate whether the inclusion of bond characteristics alters these findings.

Dep. variable:	Short-term coefficients															
LYIELD	Angola	Cameroon	Côte d'Ivoire	Ethiopia	Gabon	Ghana	Kenya	Mozambique	Namibia	Nigeria	Rwanda	Senegal	Tanzania	Zambia	Average	Long-term coeff.
LBCOM	-1.132***	0.220	-0.313**	-0.179	-0.529**	-0.658***	-0.384**	-0.264	-0.311**	-0.380*	-0.0819	-0.384**	-0.218	-0.141	-0.340***	-0.231***
	(0.335)	(0.185)	(0.160)	(0.160)	(0.250)	(0.182)	(0.168)	(0.330)	(0.152)	(0.204)	(0.164)	(0.188)	(0.368)	(0.224)	(0.0825)	(0.0871)
LVIX	0.0923	-0.408***	-0.141**	-0.0728	-0.138	0.165**	-0.122**	-0.109	-0.0403	-0.0153	-0.0503	0.124*	0.165	0.113	-0.0311	0.698***
	(0.117)	(0.141)	(0.0567)	(0.0648)	(0.0899)	(0.0784)	(0.0581)	(0.122)	(0.0633)	(0.0672)	(0.0593)	(0.0644)	(0.115)	(0.0741)	(0.0419)	(0.0525)
LUSTB	-0.223*	-0.662***	-0.122	-0.00351	-0.208*	-0.103	0.00317	-0.288**	0.0589	-0.0324	-0.00440	0.140*	0.0366	-0.0902	-0.107**	0.676***
	(0.124)	(0.112)	(0.0811)	(0.0700)	(0.114)	(0.0982)	(0.0788)	(0.144)	(0.0842)	(0.0873)	(0.0681)	(0.0803)	(0.146)	(0.0913)	(0.0531)	(0.0478)
CABAL	0.0921**		1.051***		0.427***	-0.0697	-0.316*	2.884***	-0.0558	0.0259**	-1.212	-0.420	4.027	-0.385***	0.432	-0.00499**
	(0.0423)		(0.359)		(0.158)	(0.116)	(0.176)	(0.805)	(0.163)	(0.0118)	(1.233)	(0.369)	(3.355)	(0.120)	(0.371)	(0.00245)
DEBT	-0.00639		0.338**	-0.190***	0.124***	0.00582	1.815***	-0.103***	-0.0682***	-0.0614	0.367	0.0180	-2.365	-0.0237	-0.0107	0.00109
	(0.0300)		(0.140)	(0.0432)	(0.0312)	(0.0236)	(0.606)	(0.0260)	(0.0192)	(0.0577)	(0.256)	(0.0391)	(1.887)	(0.0169)	(0.225)	(0.00179)
FISCBAL	0.0660		-2.439***	0.348	-0.0213	-0.0142	2.947***	0.222***	0.0332	-0.0900*	-0.0681	-0.147	3.192	0.0854	0.294	0.0142**
	(0.0856)		(0.719)	(0.219)	(0.0226)	(0.0526)	(0.926)	(0.0530)	(0.0369)	(0.0528)	(0.123)	(0.191)	(3.322)	(0.0520)	(0.362)	(0.00567)
RES	0.0287*	0.00996	0.0554	0.0355*	-0.0138	-0.0124	0.0224	-0.00405	0.00147	-0.0114	-0.0112	-0.222	-0.0182	0.00920	-0.00930	0.00491
	(0.0159)	(0.0536)	(0.0946)	(0.0188)	(0.0106)	(0.00979)	(0.0155)	(0.0150)	(0.00385)	(0.0284)	(0.00936)	(0.256)	(0.0474)	(0.00798)	(0.0174)	(0.00531)
GDPGR	2.215	12.78**	3.191	0.137	1.626	2.974	9.356**	0.465	0.258	0.633	-4.858	-0.0818	3.924	0.496	2.365**	-10.57***
	(2.234)	(5.010)	(1.954)	(18.13)	(1.767)	(1.855)	(4.521)	(3.011)	(2.087)	(2.486)	(7.397)	(2.657)	(6.741)	(1.955)	(1.146)	(2.187)
XRTCH	0.877**	0.677	0.0884	-2.281	0.248	0.602***	0.273	-0.0770	-0.131	-0.119	0.185	-0.0701	0.379	0.133	0.0560	0.530**
	(0.397)	(0.417)	(0.232)	(3.084)	(0.255)	(0.201)	(0.618)	(0.188)	(0.116)	(0.150)	(0.420)	(0.222)	(0.423)	(0.115)	(0.198)	(0.255)
INFL	-4.458	6.399**	-0.302	0.207	-0.0661	0.969	-0.159	-0.798	-0.210	-2.077*	0.242	-0.950	2.402	2.421**	0.258	3.694**
	(4.532)	(2.880)	(1.134)	(0.927)	(0.816)	(2.016)	(1.196)	(1.904)	(1.674)	(1.206)	(0.781)	(1.155)	(5.000)	(1.173)	(0.657)	(1.442)
Constant	1.031***	1.876***	0.990***	1.397***	0.697***	0.320**	0.451*	1.459***	0.978***	1.172***	0.669***	0.482***	0.770**	0.519***	0.915***	
	(0.364)	(0.384)	(0.281)	(0.342)	(0.235)	(0.130)	(0.242)	(0.423)	(0.297)	(0.324)	(0.229)	(0.184)	(0.348)	(0.189)	(0.119)	
Error-correction (ϕ)	-0.459***	-0.653***	-0.468***	-0.506***	-0.384***	-0.144***	-0.346***	-0.556***	-0.477***	-0.507***	-0.330***	-0.200***	-0.216*	-0.202***	-0.389***	
	(0.114)	(0.0786)	(0.0809)	(0.0941)	(0.0727)	(0.0466)	(0.0763)	(0.112)	(0.0873)	(0.0908)	(0.0788)	(0.0630)	(0.112)	(0.0622)	(0.0413)	

Notes: Estimation results based on equation (2.3). For variable definitions and sources, see Appendix Table A2.2. For Cameroon and Ethiopia, some short-term coefficients could not be estimated, because of insufficient variation. The number of observations is 762. Robust standard errors, clustered at the country level, in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 2.4: Estimation results for dynamic model specification

2.4.2 Bond-specific factors

The effects of bond-specific factors on SSA eurobond yields are analyzed by extending our sample to multiple bonds per country, wherever they exist, and by estimating Equation (2.4). To determine the marginal influences of individual bond characteristics, we progressively add (sets of) variables to the estimation and check their contribution to the overall fit of the model using Wald tests of joint significance. Country and year dummies are included to purge uncaptured country and time/year-specific effects from the estimations. Our identification of the effects of bond characteristics is therefore based on within-country, within-year variation in eurobond yields.

The results of our sequence of estimations are presented in Table 2.5. Once again, we find that both global push and country pull factors matter for SSA eurobond yields. A Wald test confirms that adding country-specific variables to the global factors-only model significantly improves the model fit. In this larger, multiple-bonds-per-country sample the negative association of yields with GDP growth and positive association with the debt to GDP ratio and inflation stand out as pull factor influences. The coefficients of the current account balance, reserves to GDP ratio, and exchange rate depreciation have the expected signs but are not (or only marginally) statistically different from zero in this model set-up. The inclusion of different sets of bond-specific factors, i.e., a bullet repayment dummy, debut bond dummy, infrastructure bond dummy, and bond size and maturity dummies, leaves these results largely unchanged and does not contribute much in terms of a better model fit. That notwithstanding, the bond size and maturity coefficients do have the expected signs; larger and longer-maturity eurobonds bear higher yields, but not significantly so in our SSA sample.

Dep. variable: LYIELD	(1)	(2)	(3)	(4)	(5)	(6)	(7)
LBCOM	-0.945***	-0.796***	-0.788***	-0.771***	-0.770***	-0.788***	-0.781***
	(0.102)	(0.160)	(0.160)	(0.153)	(0.152)	(0.144)	(0.142)
LVIX	0.350***	0.373***	0.370***	0.372***	0.375***	0.367***	0.367***
	(0.0311)	(0.0268)	(0.0267)	(0.0290)	(0.0248)	(0.0277)	(0.0288)
LUSTB	0.363***	0.376***	0.377***	0.376***	0.378***	0.377***	0.380***
	(0.0330)	(0.0379)	(0.0373)	(0.0392)	(0.0355)	(0.0350)	(0.0351)
CABAL		-0.00595	-0.00668*	-0.00634*	-0.00673*	-0.00552	-0.00561*
		(0.00356)	(0.00332)	(0.00349)	(0.00320)	(0.00325)	(0.00288)
DEBT		0.0130***	0.0129***	0.0121***	0.0129***	0.0108***	0.0104***
		(0.00165)	(0.00154)	(0.00183)	(0.00150)	(0.00205)	(0.00217)
FISCBAL		0.0102	0.00836	0.00847	0.0122	0.0108	0.00967
		(0.0109)	(0.00960)	(0.00979)	(0.00870)	(0.00930)	(0.00975)
RES		-0.00674	-0.00879	-0.0100	-0.00965	-0.00692	-0.00654
		(0.00565)	(0.00615)	(0.00621)	(0.00594)	(0.00734)	(0.00707)
GDPGR		-2.117*	-1.966*	-2.156**	-1.943**	-2.390**	-2.658***
		(1.035)	(0.916)	(0.901)	(0.786)	(0.900)	(0.854)
XRTCH		0.0748	0.0761	0.0690	0.0805	0.0673	0.0734
		(0.115)	(0.116)	(0.115)	(0.115)	(0.117)	(0.122)
INFL		2.126**	2.526**	2.453**	2.608***	2.105*	1.954*
		(0.840)	(0.846)	(0.816)	(0.827)	(1.029)	(0.989)
BULLET			-0.123*	-0.0989	-0.123*	-0.0618	-0.0131
			(0.0670)	(0.0584)	(0.0672)	(0.0665)	(0.133)
DEBUT				-0.0900			
				(0.0795)			
INFRA					0.0722		
					(0.0418)		
SIZE:							
< US$1 BN						-0.0916	-0.0912
						(0.147)	(0.158)
> US$1 BN						0.141	0.0901
						(0.122)	(0.132)
MATURITY:							
10Y							0.0507
							(0.118)
> 10Y							0.140
							(0.0852)
Constant	4.507***	3.614***	3.657***	3.711***	3.579***	3.684***	3.649***
	(0.533)	(0.928)	(0.967)	(0.979)	(0.927)	(0.921)	(0.922)
Observations	1,255	1,255	1,255	1,255	1,255	1,255	1,255
R^2	0.692	0.742	0.755	0.767	0.763	0.779	0.782
Wald F		33.57***	3.35*	1.28	2.98	4.00**	1.36
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Estimation results based on Equation (2.4). For variable definitions and sources, see Appendix Table A2.2 and main text. Robust standard errors, clustered at the country level, in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 2.5: Estimation results for extended model specification

2.4.3 Dominance analysis

The main conclusion of our analysis so far is that SSA eurobond yields are driven by global (push), country-specific (pull) and, to a much lesser degree, bond-specific factors. In this section we attempt to shed further light on the relative importance of these three variable groups in explaining the evolution of yields, motivated by the focus of previous studies on SSA eurobonds (Gevorkyan and Kvangraven, 2016, in particular) on global factors. We start by fitting Equation (2.4) with global, country and bond variables separately (holding the sample constant), with and without country and/or year fixed effects. Table 2.6 shows that, when none of the country or time fixed effects are included, a model with global variables has an R^2 of 28.6%, less than the 35.5% explained variance in the country-variables-only model and substantially more than the 15.7% of the bond-variables-only model. Adding year fixed effects improves the fit of the global-variables-only model to a lesser extent than it boosts the fits of the two other models, due to the fact that time trends are already partly captured by the global variables. Likewise, the inclusion of country fixed-effects has a smaller impact on the country-variables-only model than on the other two models. Once both country and year fixed effects are accounted for, the model fit is comparable across the three models, with just a slight edge of the global-variables-only model (R^2 of 69.2%) over the other two (R^2s of 66.1% and 66.8%).

To evaluate the relative importance of each of these sets of variables somewhat more formally, we also perform a dominance analysis along the lines of Azen and Budescu (2003). As mentioned in Section 2.3.1, this approach calculates and compares dominance statistics, i.e., the weighted average marginal contributions to the overall fit statistic that different set of variables make across all models in which they are included. We consider two different categorizations. In the first set-up, we categorize our potential eurobond yield determinants in three groups: global factors, i.e., our proxies for global commodity prices, market volatility and liquidity, and year dummies (capturing some of the omitted time effects); country factors, i.e., the earlier-used macroeconomic fundamentals and country dummies (capturing omitted country variation in institutional and other dimensions); and the bond-specific variables of Section 2.4.2. In the

second set-up, year dummies and country dummies are regarded as separate categories, so that we end up with five variable groups.

Dep. variable: LYIELD	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
LBCOM	-0.954***			-0.904***			-0.876***			-0.945***		
	(0.224)			(0.138)			(0.203)			(0.102)		
LVIX	0.373***			0.321***			0.377***			0.350***		
	(0.0792)			(0.0305)			(0.0583)			(0.0311)		
LUSTB	0.211***			0.327***			0.171***			0.363***		
	(0.0487)			(0.0343)			(0.0326)			(0.0330)		
CABAL		-0.00167			0.00176			-0.00650***			-0.00827**	
		(0.00387)			(0.00406)			(0.00194)			(0.00322)	
DEBT		0.00806***			0.00853***			0.00530*			0.0138***	
		(0.00185)			(0.00180)			(0.00282)			(0.00186)	
FISCBAL		0.00261			0.000408			0.00491			0.00627	
		(0.0120)			(0.0148)			(0.0174)			(0.0145)	
RES		-0.00930			-0.00732			-0.0143			-0.00158	
		(0.00586)			(0.00553)			(0.0183)			(0.00892)	
GDPGR		-3.661			-4.748*			-1.817*			-1.436	
		(2.292)			(2.253)			(0.879)			(1.161)	
XRTCH		0.113			0.0818			0.0535			0.128	
		(0.144)			(0.147)			(0.0956)			(0.121)	
INFL		9.493**			7.401**			7.475**			3.336*	
		(3.299)			(2.788)			(3.252)			(1.787)	
BULLET			0.0441			0.0264			0.0999			0.0416
			(0.180)			(0.174)			(0.181)			(0.175)
DEBUT			-0.121			-0.114			-0.0633			-0.0668
			(0.0796)			(0.0671)			(0.0961)			(0.0995)
INFRA			0.0854			0.0586			0.0642			0.0352
			(0.0781)			(0.0747)			(0.0695)			(0.0718)
SIZE:												
< US$1 BN			0.126			0.0782			-0.114			-0.117
			(0.0737)			(0.0795)			(0.150)			(0.136)
> US$1 BN			0.175			0.144			0.0668			0.0835
			(0.131)			(0.116)			(0.185)			(0.172)
MATURITY:												
10Y			-0.00565			-0.0223			0.0889			0.0652
			(0.179)			(0.176)			(0.160)			(0.171)
> 10Y			0.127			0.0856			0.284*			0.188
			(0.117)			(0.103)			(0.144)			(0.122)
Constant	4.366***	-2.983***	-2.779***	4.269***	-2.771***	-2.550***	3.755***	-2.771***	-2.631***	4.507***	-2.958***	-2.545***
	(1.177)	(0.0792)	(0.0989)	(0.807)	(0.0554)	(0.134)	(1.025)	(0.516)	(0.162)	(0.533)	(0.190)	(0.171)
Observations	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255	1,255
R^2	0.286	0.355	0.157	0.321	0.484	0.325	0.665	0.535	0.525	0.692	0.661	0.668
Country FE	No	No	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes	No	No	No	Yes	Yes	Yes

Notes: Estimation results based on equation (2.4). For variable definitions and sources, see Appendix Table A2.2 and main text. Robust standard errors, clustered at the country level, in parentheses. $^{*}p < 0.1$; $^{**}p < 0.05$; $^{***}p < 0.01$.

Table 2.6: Estimation results for extended model specification, by variable group

The results of the dominance analysis with three and five variable sets are shown in Tables 2.7 and 2.8, respectively. Altogether, country factors account for no less than 56.8% of the explained variance in SSA eurobond yields, compared to 31.7% for the global factors and 11.5% for the bond-specific factors. When global and country variables are split into identified and non-identified factors, it appears that country dummies explain the largest part of the variance in yields (36.2%), followed by country fundamentals (20.6%) and (identified) global factors (19.7%). Bond-specific factors contribute the least in terms of explained variance (10%) in our sample. We draw two conclusions from this exercise. First, global push factors are indeed key to understand the evolution in SSA eurobond yields, but country-specific pulls are at least as important, meaning that SSA sovereign do have a degree of control over their market borrowing costs. Second, given the dominance of country dummies over the country fundamentals we selected, more work is needed in identifying the specific country characteristics that investors take into account when trading SSA eurobonds.

Dep. variable: LYIELD	Dominance statistics	Standardized dom. stat.	Ranking
Set 1: Global factors, incl. year dummies	0.2504	0.3166	2
Set 2: Country-specific factors, incl. country dummies	0.4494	0.5682	1
Set 3: Bond-specific factors	0.0910	0.1151	3
Overall fit statistic: 0.791			
Observations: 1,255			

Notes: Results based on equation (2.4). For variable definitions and sources, see Appendix Table A2.2 and main text.

Table 2.7: Dominance analysis, three variable sets

Dep. variable: LYIELD	Dominance statistics	Standardized dom. stat.	Ranking
Set 1: Global factors, excl. year dummies	0.1555	0.1966	3
Set 2: Year dummies	0.1074	0.1358	4
Set 3: Country-specific factors, excl. country dummies	0.1632	0.2063	2
Set 4: Country dummies	0.2861	0.3618	1
Set 5: Bond-specific factors	0.0787	0.0995	5
Overall fit statistic: 0.791			
Observations: 1,255			

Notes: Results based on equation (2.4). For variable definitions and sources, see Appendix Table A2.2 and main text.

Table 2.8: Dominance analysis, five variable sets

2.5 Concluding remarks

This paper has revisited the drivers of secondary market SSA eurobond yields. Covering the near-universe of (non-South African) SSA sovereign eurobonds, we have investigated the global, country and bond-specific determinants of yields, performed a dynamic analysis to distinguish short- and long-term relations between yields and their key drivers, and formally tested the relative explanatory power of different variable sets using dominance analysis. Above all, our results indicate that beyond the global 'push' factors that have already been documented in previous research, country-specific 'pull' factors, most notably inflation and GDP growth, matter too for SSA eurobond performance. A panel error-correction model suggests large heterogeneity in the short-term influence of our global and country variables across countries; only global commodity prices are found to have a significant short-term association with yields across the board. Bond characteristics, including bond size, maturity, redemption schedule and whether bond proceeds are used to finance infrastructure, seem to have no significant bearing on yields in our sample once push and pull factors are accounted for. Further research may be needed in this area as more data on multiple bond issues per country becomes available.

Our dominance analysis confirms that (identified and unidentified) country-specific factors are at least as important as global factors in explaining the variance in SSA eurobond yields. Our results thus qualify the common view that SSA countries have little control over their market borrowing costs. In line with the market discipline hypothesis, investors in SSA eurobonds seem to discriminate between borrowers based on the quality of their macroeconomic management and economic performance. Given the dominance of country dummies over the country fundamentals we have explicitly considered in our models, further research is needed in identifying the country characteristics that investors pay attention to.

The time period covered by our paper, 2008 to mid-2017, was characterized by sluggish economic performance in most advanced economies, following the global financial and European sovereign debt crises. The resumption of positive global economic prospects in advanced economies

since 2017 may herald the start of an episode of portfolio rebalancing that could also impact SSA eurobond performance. The question of whether this recovery triggers a flight home effect by investors from advanced economies is an interesting avenue for future research on the influence of global factors on SSA eurobond yields.

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Appendices

Country/issuer	Issue date	Maturity date	Coupon	Size (US$ mios)	ISIN (RegS/144A)
Angola (Northern Lights III)*	8/16/2012	8/16/2019	7.000%	1000	XS0814512223
Angola	11/12/2015	11/12/2025	9.500%	1500	XS1318576086/US035198AA89
Cameroon*	11/19/2015	11/19/2025	9.500%	750	XS1313779081/US133653AA31
Côte d'Ivoire*	7/23/2014	7/23/2024	5.375%	750	XS1089413089
Côte d'Ivoire	3/3/2015	3/3/2028	6.375%	1000	XS1196517434
Ethiopia*	12/11/2014	12/11/2024	6.625%	1000	XS1151974877/US29766LAA44
Gabon*	12/6/2007	12/12/2017	8.200%	1000	XS0333225000/US362420AA95
Gabon	12/12/2013	12/12/2024	6.375%	1500	XS1003557870/US362420AB78
Gabon	6/16/2015	6/16/2025	6.950%	500	XS1245960684
Ghana*	9/27/2007	10/4/2017	8.500%	750	XS0323760370/US374422AA15
Ghana	8/7/2013	8/7/2023	7.875%	1000	XS0956935398/US374422AB97
Ghana	9/11/2014	1/18/2026	8.125%	1000	XS1108847531/US374422AC70
Ghana	10/14/2015	10/14/2030	10.750%	1000	XS1297557412/US374422AD53
Ghana	9/15/2016	9/15/2022	9.250%	750	XS1470699957
Kenya*	6/24/2014	6/24/2019	5.875%	500	XS1028951850/US491798AF18
Kenya	6/24/2014	6/24/2024	6.875%	1500	XS1028952403/US491798AE43
Mozambique (Ematum)*	9/11/2013	9/11/2020	6.305%	500	XS0969351450
Mozambique	4/16/2016	1/18/2023	10.500%	726.5	XS1391003446
Namibia*	10/27/2011	11/3/2021	5.500%	500	XS0686701953/US62987BAA08
Namibia	10/29/2015	10/29/2025	5.250%	750	XS1311099540/US62987BAB80
Nigeria*	1/21/2011	1/28/2021	6.750%	500	XS0584435142/US65412AAA07
Nigeria	7/12/2013	7/12/2018	5.125%	850	XS0944707651/US65412ACE01
Nigeria	7/12/2013	7/12/2023	6.375%	500	XS0944707222/US65412ACD28
Rwanda*	4/25/2013	5/2/2023	6.625%	400	XS0925613217/US78347YAA10
Senegal	12/15/2009	12/22/2014	8.750%	200	XS0474859757
Senegal*	5/13/2011	5/13/2021	8.750%	500	XS0625251854/US81720TAA34
Senegal	7/30/2014	7/30/2024	6.250%	500	XS1090161875/US81720TAB17
Tanzania (floating rate note)*	2/27/2013	2/27/2020	LIBOR + 600bps	600	XS0896119897
Zambia*	9/13/2012	9/20/2022	5.375%	750	XS0828779594/US988895AA69
Zambia	4/14/2014	4/14/2024	8.500%	1000	XS1056386714/US988895AE81
Zambia	7/30/2015	7/30/2027	8.970%	1250	XS1267081575/US988895AF56

Source: Thomson Reuters Datastream; eurobond prospectus documents.
Notes: Bonds marked with * are those with longest available yield series per country and are included in the samples of Tables 2.3 and 2.4.

Table A2.1: SSA eurobonds sample

Variable	Definition	Source
SSA eurobond yield (YIELD)	SSA eurobond yield to maturity (monthly percentage, averaged from daily data)	Thomson Reuters Datastream
Bloomberg commodity index (BCOM)	Bloomberg spot index composed of energy, grain, industrial metal, precious metal, soft (sugar, coffee, cotton) and livestock prices (monthly, averaged from daily data)	Thomson Reuters Datastream
VIX	Chicago Board Options Exchange (CBOE) volatility index, based on S&P 500 index option prices (monthly, averaged from daily data)	Thomson Reuters Datastream
10-year US Treasury bond yields (US10TB)	10 year US Treasury benchmark bond yield to maturity (monthly percentage, averaged from daily data)	Thomson Reuters Datastream
Current account balance to GDP (CABAL)	Ratio of current account balance to GDP (monthly, linearly interpolated from annual data)	IMF World Economic Outlook
Government gross debt to GDP (DEBT)	Ratio of general government gross debt to GDP (monthly, linearly interpolated from annual data)	IMF World Economic Outlook
Government fiscal balance to GDP (FISCBAL)	Ratio of general government primary net lending/borrowing to GDP (monthly, linearly interpolated from annual data)	IMF World Economic Outlook
Foreign reserves to GDP (RES)	Ratio of international reserves (excluding gold) to GDP (monthly, with GDP linearly interpolated from annual data)	IMF International Financial Statistics
GDP growth (GDPGR)	Change in GDP, expressed in current US$ billions (month-on-month percentage change, with GDP linearly interpolated from annual data)	IMF World Economic Outlook
Exchange rate change (XRTCH)	Change in exchange rate, expressed as local currency units per US$. Increase implies exchange rate depreciation (month-on-month percentage change)	Thomson Reuters Datastream
Inflation (INFL)	Change in seasonally-adjusted consumer price index (CPI) (month-on-month percentage change)	Thomson Reuters Datastream

Table A2.2: Global and country variable definitions and sources

Chapter 3

Spillovers in Sub-Saharan Africa's sovereign eurobond yields**

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Abstract

This study investigates the possibility of spillovers among Sub-Saharan African (SSA) eurobonds from January 2015 to June 2017 using secondary market yields. Ours results indicate significant contagion effects among these bonds, effects that prove sensitive to major economic events and news announcements. They also suggest that less resilient economies transmit more to and receive less spillovers from their peers. SSA eurobond issuers can therefore increase their influence over the performance of their securities on secondary markets by mitigating their vulnerability to these effects. Besides strong macroeconomic fundamentals, an improvement in transparency and information disclosure is required in order to curb the asymmetry of information underlying investors' behavior-based spillovers and contagion, which supports to a certain extent *the market discipline hypothesis* in the case of SSA eurobonds.

Keywords: Contagion, Eurobonds, Spillover index, Sub-Saharan Africa, VAR models,
JEL classification: F34 G14, H63

3.1 Introduction

The year 2016 seems to have marked a halt to the Sub-Saharan African (SSA) eurobond spree with a drastic shrinkage in the number as well as the amount of eurobonds issued by SSA countries to collect financial resources through international markets. From an annual total record of over US$ 6 billion collected in 2014 and 2015, the total amount mobilized by these countries in 2016 dropped to less than US$ 1.5 billion through only two issues of US$ 750 million and US$ 727 million by Ghana and Mozambique, respectively, and in 2017, Nigeria was until June the only one to issue eurobonds worth US$ one billion. Analysts attribute this decline in SSA eurobond issuance to the negative impact of low commodity prices on the economies of many of these countries, and the US tightening economic policy amid the resumption of economic growth in the developed world, factors that lowered the risk appetite of investors for SSA eurobonds and pushed up the latter's yields to dramatic levels that were by no means attractive for these countries to issue new eurobonds[1].

Beyond the influence of global economic factors, empirical studies have also underscored the role of country-specific factors such as the quality of macroeconomic management and the degree of vulnerability to global economic shocks in the determination and evolution of SSA eurobond yields (see Gevorkyan and Kvangraven, 2016; Senga et al., 2018). The experience of SSA eurobonds suggests that markets seem to have been able to sanction countries with erratic economic management behavior such as the absence of economic diversification and over-reliance on a limited number of commodities that exacerbated the vulnerability to global shocks, and loose public finance and debt management that put pressure on the countries' macroeconomic stability and ability to service their foreign debt (Senga et al., 2018). A case in point is the recent history of Mozambique where, in addition to allegations of eurobond proceeds' misallocation, the scandal of hidden debts in end 2017 has irked this country's creditors and donors as well

[1] A detailed analysis on the by-then causes of concern about SSA eurobonds was provided among others by BNP Paribas (see https://economic-research.bnpparibas.com/html/en-US/Saharan-Africa-concern-mounting-7/22/2016,29012). Also, the African Development Bank's President was recorded by Bloomberg as stressing the impact of US economic tightening policy on SSA eurobonds (see https://www.bloombergquint.com/markets/afdb-sees-africa-eurobond-issuance-slowing-on-rate-concern).

as multilateral institutions thus creating nervousness around the performance of the Ematum eurobond on international markets (Cassimon et al., 2017). Likewise, cases of alarming government budget deficits and macroeconomic framework instability have been documented in Angola, Ghana and Zambia in 2014, 2015 and 2016 respectively with noticeable consequences on both their primary and secondary market eurobond yields.

While there seems to be a consensus on the influence of global and country-specific factors on SSA eurobond yields, little is still known about the possibility and extent of spillovers and contagion among these assets[2]. The literature has been prolific about the propagation of economic shocks' consequences across national borders (Alter and Beyer, 2014; Fernández-Rodríguez et al., 2015; Özatay et al., 2009; Frankel and Schmukler, 1997; Rigobon, 2016; Kaminsky et al., 2003). More specifically, Dornbusch et al. (2000) dissect the causes of contagion into two categories depending on whether they relate to the normal interdependence among market economies or to the behavior of investors. The first category, labeled 'fundamentals-based' contagion, attributes the propagation of shocks (whether of a global or local nature) to the real and financial linkages across countries. It includes macroeconomic shocks that have repercussions on an international scale and local shocks transmitted through trade links, competitive devaluations, and financial integration. The second category ascribes spillovers and contagion to investors' behavior, whether rational or irrational, whose actions lead to markets' comovements that cannot be explained by real fundamentals. The authors illustrate the latter situation by, among others, the case of imperfect information where, for instance, investors tend to make decisions on the basis of some known indicators, including those revealed in other countries, which may or may not reflect the true state of the subject country's vulnerabilities. This corresponds to the so-called

[2]Some nuances are documented in the literature as concerns the distinction between spillovers and contagion. According to Dornbusch et al. (2000), contagion refers to the spread of market disturbances –mostly on the downside– from one country to the other, a process observed through comovements in exchange rates, stock prices, sovereign spreads, and capital flows. Kaminsky et al. (2003) refer to 'contagion' as an episode in which there are significant immediate effects in a number of countries following an event – that is, when the consequences are fast and furious and evolve over a matter of hours or days. They stress that the reaction has to be 'fast and furious' to be considered as contagion in contrast to 'spillovers' where the international reaction to news is rather gradual and protracted but can still cumulatively have major economic consequences. Rigobon (2016) reviews the different nuances in the definition of 'spillovers' and 'contagion', and concludes that the distinction between the two is rather tenuous. In this study, we follow the latter author and use interchangeably this rather general definition of these two terms as "describing very loosely the phenomenon in which a shock from one country is transmitted to another" (Rigobon, 2016, p.3).

'wake-up call hypothesis' stating that once investors 'wake up' to the weaknesses that were revealed in the crisis country, they will proceed to avoid and move out of countries that share some characteristics with the crisis country (Kaminsky et al., 2003). Another example is 'herd behavior' where investors 'follow the crowd' in their decision to invest or divest in a particular country, region or asset class (Dornbusch et al., 2000; Kaminsky et al., 2003; Rigobon, 2016; Guney et al., 2017).

However, the literature indicates that the presence of these causes is not sufficient in itself to trigger spillovers and contagion. Kaminsky et al. (2003) use the term 'unholy trinity' to refer to three key elements that determine the materialization of contagion. The first element is the capacity of the shock to provoke a 'sudden-stop', i.e. a swift and drastic reversal of capital flows. The second element relates to the surprise-characteristic of the shock since forewarning allows investors to adjust their portfolios in anticipation of the event. The third element emphasizes the role of a leveraged common creditor –be it commercial banks, hedge funds, mutual funds or bondholders– who may help propagate the contagion across national borders and cause significant immediate international repercussions.

In many respects, SSA eurobond issuers feature certain elements of the above-mentioned causes and conditions of spillovers and contagion. Firstly, their geographic proximity coupled with, in most cases, some similarities in terms of political and economic structures such as the dependence on commodity exports and relatively weak democratic rule and institutions. These commonalities make it possible for investors to treat these eurobonds' block as a single unit, thus leading to shocks from one eurobond to spillover to other markets belonging to the block. Second, not longer than a decade ago, SSA countries were completely mired into a debt-poverty spiral that hindered economic growth and development across the whole region. It is worth mentioning that this region was overwhelmingly represented among the beneficiaries of the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiative (MDRI) initiatives that attempted to curb the protracted issue of government over-indebtedness in these poor countries via massive waves of debt forgiveness by commercial, bilateral as well as multilateral lenders. This history of over-indebtedness by SSA countries is likely to make investors more

watchful about news affecting these countries' creditworthiness as a way to detect the signals for the 'wake-up call' hypothesis mentioned earlier. Lastly, these eurobonds' prospectuses indicate that they are in most cases traded under 'Regulation S' (i.e. to be held by any investor outside the USA market) and 'Rule 144A' (i.e. meant exclusively for qualified institutional buyers in the USA) on most European and the US markets. Therefore, the possibility of these bonds to be held by common creditors cannot be ruled out, which increases the likelihood of spillovers and contagion in case of idiosyncratic shocks to one or some of them.

So far, only a few studies have investigated the interconnectedness of African security markets. Some of the few available studies on this topic have focused on the spillovers of economic growth and financial market shocks from developed and emerging markets to African economies (see Gurara and Ncube, 2013; Labuschagne et al., 2016). Others have investigated the level of economic and financial integration among African countries through the contagion of shocks to domestic economic growth and stock markets (World Bank, 2016; Collins and Biekpe, 2003). An eye-opener on the investors' behavior on African markets is the study by Guney et al. (2017) who investigate herd behavior in African frontier stock markets. The issue of the spillovers and contagion among SSA eurobonds has so far attracted little attention despite its plausibility given the strength of the above-mentioned indications. Moreover, the ongoing debate about the advantages and sustainability of SSA countries' borrowing through international capital markets entails a better grasp of the determinants of SSA eurobond yields and, more specifically, the incentives provided by these markets to borrowing countries in terms of macroeconomic management quality. In fact, the literature advances the *market discipline hypothesis* to describe how credit markets provide borrowers with incentives to restrain excess borrowing by increasing smoothly the yields with the level of borrowing and, eventually, denying the irresponsible borrower further access to credit (Bayoumi et al., 1995). Therefore, since this hypothesis implies that credit markets assign favorable yields to the disciplined borrowers and sanction the irresponsible ones with higher yields, it seems reasonable to believe that SSA countries with better economic performance may be inclined to increase transparency in order to improve their visibility and therefore get assigned yields that match their creditworthiness. This transparency

may at the same time mitigate the information asymmetries underlying investors' behavior-related spillovers and contagion. Against this backdrop, the void of clue about the possibility and extent of spillovers and contagion among SSA eurobonds constitutes a gap in the literature that needs to be addressed.

This study is to our knowledge the first to investigate the degree of interconnectedness and the possibility of spillover effects among SSA eurobond yields on secondary markets. Drawing on insights from Antonakakis and Vergos (2013) and Gande and Parsley (2005), it assesses the extent to which major shocks (news) to individual securities affect the performance of their peers using the Diebold and Yilmaz (2012)'s spillover index. Our results show that, on average, 66.37% of the forecast error variance is explained by cross-SSA eurobonds yields spillovers, and that Angola has been the dominant transmitter of SSA eurobond yield spillovers followed by Ghana and Zambia, while Namibia, followed by Tanzania and Rwanda emerged the dominant receivers of SSA eurobond yield spillovers during our study period. These results indicate also higher levels of spillover effects during moments of economic distress, such as the ones related to shocks in global commodity prices, the alarming fiscal deficits in Ghana and Zambia, and default in Mozambique. We contribute to the existing literature by bringing the spillovers and contagion dimension into the analysis of the drivers of SSA eurobond yields. By doing so, we not only uncover the incompleteness of the 'push' and 'pull'-factor justification of SSA eurobond yields' evolutions documented in previous studies (Gevorkyan and Kvangraven, 2016; Senga et al., 2018) but also contribute to the debate about the sustainability of the SSA eurobond market by analyzing our results' implications in terms of incentives to improve the quality of macroeconomic management in borrowing countries .

Besides this introduction outlining the background and scope of our study, we summarize in Section 3.2 the relevant literature on spillovers and contagion affecting Africa. We elaborate on the methodology in Section 3.3 and present our dataset in Section 3.4. The results of our analysis are presented and discussed in Section 3.5, followed by the presentation of some robustness checks in Section 3.6 and the general conclusions in Section 3.7.

3.2 Literature review

Several studies have been devoted to spillover effects between emerging and developed economies, and across African economies taking different perspectives and approaches. Gurara and Ncube (2013) analyze global spillover effects on Africa using a panel of 46 African countries and 30 developed and emerging market countries. They find significant growth spillover effects to African economies from both the Euro zone economies and the BRICs. However, their results indicate that quantitative easing measures in the US, the Euro zone, the UK, and Japan could have a mild inflationary effect in addition to putting pressure on exchange rates to appreciate. Regarding intra-African growth spillovers, the World Bank (2016) review of the SSA region's progress in regional integration, intra-regional trade and cross-border financing flows concludes that shocks to growth in the two largest economies – Nigeria and South Africa – appear to have no measurable effects on other countries in the region.

Some studies have investigated the contagion and interdependence of African equity markets. For instance, in their studies covering the pre-2008 economic crisis, Collins and Biekpe (2003) find evidence of contagion from global emerging market crises to Egypt and South Africa, the largest and most traded markets in Africa during that period. They also confirm the lack of causal relationships between African markets, which suggests a relatively high degree of isolation among them. This heterogeneity of African equity markets has also been confirmed by the results of Labuschagne et al. (2016) in the context of the 2007-2009 financial crisis. Moreover, the latter study fails to reject the hypothesis of no contagion and no integration effects among the U.S., the U.K., and selected African stock markets (South Africa, Namibia, Egypt, Nigeria, Morocco and Kenya) during the global financial crisis of 2007-2009. Guney et al. (2017) explicitly investigate investors' herd behavior using a sample of eight African frontier markets for the 2002-2015 period. They find evidence of herding, attributed, according to them, to the low transparency levels prevalent in frontier stock exchanges. Besides, their results indicate an overall low level of integration of frontier markets within the global financial system as investors' behavior in the studied African frontier markets is not significantly affected by non-domestic

factors.

The interdependence and contagion effects among African sovereign eurobonds have not yet been investigated, be it in calm or nervous market times. However, the experience of more developed economies sheds light on the possibility of sovereign bond yield spillovers among markets sharing some similarities such as belonging to the same economic union or geographical location, especially during moments of market distress. The case in point is the study by Antonakakis and Vergos (2013) who find highly intertwined bond yield spread spillovers among Euro zone countries during the turbulent period encompassing the global financial crisis and the Euro zone debt crisis. They also find that shocks to sovereign bond yield spreads are related to news announcements and policy changes, which corroborates to some extent the results of Gande and Parsley (2005) indicating significant spillover effects of countries' credit rating downgrades to their peers' sovereign credit spreads and those of Fernández-Rodríguez et al. (2015) suggesting strong spillover effects among European Monetary Union (EMU) sovereign bond markets amounting to slightly more than half of the total variance of the forecast errors during the 1999-2014 period. Equally interesting is study by Belke et al. (2018) which reveals a significant response of sovereign bond yields in emerging Asia to changes to US and eurozone bond yields, though with heterogeneous magnitudes across countries. Our study draws insights from these pieces of research to analyze the possibility of spillover effects among SSA eurobond yields.

3.3 Methodology

As in Antonakakis and Vergos (2013), Fernández-Rodríguez et al. (2015), Hwee Kwan Chow (2017) and Belke et al. (2018), this study follows the methodology of Diebold and Yilmaz (2012)[3] which departs from a generalized N-variable VAR(p), $X_t = \sum_{t=1}^{p} \Phi_i X_{t-i} + \varepsilon_t$ with $\varepsilon \sim (0, \Sigma)$ being a vector of independently and identically distributed disturbances, and analyzes the dynamics of this VAR system using variance decompositions. The latter allow for the decomposition of the forecast error variances of each variable into parts that are attributable to the various shocks to the system, hence allowing for the assessment of the fraction of the H-step-ahead error variance in forecasting x_i that is due to shocks to x_j with $j \neq i$ for each i.

This methodology relies on the generalized VAR framework of Koop et al. (1996) and Pesaran and Shin (1998), henceforth KPPS, which produces variance decompositions that are invariant to the ordering of variables in the VAR specification. It then becomes possible to distinguish between *own variance shares*, the fraction of the H-step-ahead error variances in forecasting x_i that are attributable to shocks to x_i for $i = 1, 2, \ldots, N$, and *cross variance shares* or *chap3Spillovers*, the fraction of the H-step-ahead error variances in forecasting that are due to shocks to x_j, for $i, j = 1, 2, \ldots, N$, such that $i \neq j$.

Denoting by Σ the variance matrix of the error vector ε and $\theta_{ij}^{g}(H)$ [4] the H-step-ahead forecast error variance decompositions for $H = 1, 2, \ldots$, we have

$$\theta_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} \left(e_i' A_h \Sigma e_j \right)^2}{\sum_{h=0}^{H-1} \left(e_i' A_h \Sigma A_h' e_i \right)} \tag{3.1}$$

[3] A new framework tackling the case of a *multi-country model with multiple variables per country* is now available thanks to Greenwood-Nimmo et al. (2015). However, the Diebold and Yilmaz (2012) remains suitable for our case consisting of a multi-country univariate case where different countries are represented by a single eurobond, thus making vain the consideration to intra-units connectedness besides the investigated inter-unit ones.

[4] g denotes the KPPS generalized VAR framework that circumvents the issue of order-dependent spillovers driven by the Cholesky factor orthogonalization in a simple VAR framework.

with σ_{jj} the standard deviation of the error term for the jth equation, and e_i the selection vector with one as the ith element and zero otherwise. The obtained $\theta^g_{ij}(H)$ are normalized as follows to ensure that $\sum_{j=1}^{N} \theta^g_{ij}(H) = 1$ and $\sum_{i,j=1}^{N} \theta^g_{ij}(H) = N$:

$$\tilde{\theta}^g_{ij}(H) = \frac{\theta^g_{ij}(H)}{\sum\limits_{j=1}^{N} \theta^g_{ij}(H)} \tag{3.2}$$

The total spillover index is obtained by

$$S^g(H) = \frac{\sum\limits_{\substack{i,j=1 \\ i\neq j}}^{N} \tilde{\theta}^g_{ij}(H)}{\sum\limits_{i,j=1}^{N} \tilde{\theta}^g_{ij}(H)} \times 100 = \frac{\sum\limits_{\substack{i,j=1 \\ i\neq j}}^{N} \tilde{\theta}^g_{ij}(H)}{N} \times 100 \tag{3.3}$$

Since in the KPPS generalized VAR framework the impulse-responses and variance decompositions are invariant to the ordering of the variables, it becomes possible to measure the *directional spillovers* in terms of 1) spillovers received by market i from all other markets, $S^g_{i.}(H)$, and 2) spillovers transmitted by market i to all other markets, $S^g_{.i}(H)$, and the *net spillovers*, i.e. the difference between the gross volatility shocks transmitted to and those received from all other markets, as follows:

$$S^g_{i\leftarrow j}(H) = \frac{\sum\limits_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}^g_{ij}(H)}{\sum\limits_{i,j=1}^{N} \tilde{\theta}^g_{ij}(H)} \times 100 = \frac{\sum\limits_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}^g_{ij}(H)}{N} \times 100 \tag{3.4}$$

$$S^g_{i\rightarrow j}(H) = \frac{\sum\limits_{\substack{j=1 \\ j\neq i}}^{N} \tilde{\theta}^g_{ji}(H)}{\sum\limits_{i,j=1}^{N} \tilde{\theta}^g_{ji}(H)} \times 100 = \frac{\sum\limits_{\substack{i,j=1 \\ j\neq i}}^{N} \tilde{\theta}^g_{ji}(H)}{N} \times 100 \tag{3.5}$$

$$S^g_i(H) = S^g_{i\rightarrow j}(H) - S^g_{i\leftarrow j}(H) \tag{3.6}$$

We construct a VARX model[5] of the selected SSA eurobond yields with the Bloomberg commodity index, the US 10 year Treasury Bond Index and the VIX index as exogenous variables. The consideration of these exogenous variables is based on the results of the studies by Gevorkyan and Kvangraven (2016), Presbitero et al. (2016) and Senga et al. (2018) indicating a significant influence of these variables (among others factors affecting global economic conditions) in the determination and evolution of SSA eurobond yields. Their inclusion in the model allows for the mitigation of the impact of global factors in our VAR dynamics. The order of our VAR is determined using the Akaike and Schwarz information criteria (the parsimonious suggestion is considered in case of divergence between the two criteria to accommodate the size of our sample), and only 5% significant coefficients are considered in the following steps of our analysis.

Based on the results of the VAR estimation, we proceed as in Antonakakis and Vergos (2013) to compute the normalized $H = 10$ days step-ahead forecast error variance decomposition in Equations (3.1) and (3.2), which are then used to compute the total spillover index, as well as the directional and net spillovers as indicated in Equations (3.3), (3.4), (3.5) and (3.6) respectively. These results are also used for the evaluation of impulse-response functions on a 30-day forecasting horizon.

The same procedure is carried out using 120-day rolling windows to allow for a dynamic analysis of the SSA eurobond yield spillovers. In addition to the dynamic total spillover index, we compute for each of the bonds the dynamic spillovers from and to its peers, and the net spillovers by applying the formulas above on each of the 120 day sub-samples in the rolling windows.

[5]VARX refers to a VAR system supplemented by exogenous variables.

3.4 Data

This study uses daily secondary market yields of SSA eurobonds for the period of January 2015 – June 2017 collected from Thomson Reuters Datastream. The choice of January 2015 as starting point is motivated by the availability of data since, though timidly started in 2006, eurobond issues by SSA countries gained momentum in 2013 and reached their peak in 2014 with more than US$ 6.5 billion collected through six issues in this particular year. Only from then on did a sufficient number of countries issue at least one eurobond to allow for a meaningful size of our sample containing 12 SSA countries. We consider one eurobond per country in order to circumvent the influence of bond-specific characteristics in case of multiple issues. Specific details about the 12 considered eurobonds are provided in Table A3.1.

	Mean	Min	Max	St.Dev	Median	Skew	Kurtosis
ANGOLA	7.3352	3.9856	13.5250	1.8287	7.4043	0.4402	0.5217
ETHIOPIA	7.6645	6.5155	10.0774	0.7715	7.5671	0.7235	-0.0130
GABON	8.3088	6.2410	12.9670	1.3828	8.0572	0.9013	0.5133
GHANA	10.1771	7.2302	16.8398	1.9025	9.5809	1.0553	0.6386
KENYA	7.5183	6.1371	10.0246	0.9046	7.4751	0.4478	-0.4394
MOZAMBIQUE	15.7929	7.1852	28.0906	5.3855	16.4927	0.0349	-1.0697
NAMIBIA	4.3633	3.5404	6.0483	0.5192	4.2355	1.0105	0.6196
NIGERIA	7.1503	5.4896	9.6003	0.9174	7.1239	0.2340	-0.7620
RWANDA	6.9145	5.9953	8.3213	0.5266	6.7445	0.6870	-0.2695
SENEGAL	6.3765	4.4256	8.6826	0.9381	6.4046	-0.0340	-0.6180
TANZANIA	5.8870	3.3904	10.9842	1.6614	5.5868	0.9204	0.2713
ZAMBIA	9.9799	7.1892	16.8179	2.3616	9.1427	0.8106	-0.2253
BCOM	312.6747	252.5313	347.2783	22.9378	319.3677	-0.7851	-0.4071
US10	2.0592	1.3640	2.6080	0.2926	2.1225	-0.2958	-0.9425
VIX	16.7757	11.6300	26.4200	3.0036	16.2700	0.8490	0.5327

Note: These statistics are based on 652 daily observations of secondary market yields of the selected SSA eurobonds, the US 10 year Treasury Bond index (US10), the Bloomberg commodity index (BCOM) and the market volatility index (VIX) for the period January 2015 – June 2017. Values are expressed in percentage.

Table 3.1: Summary statistics

The summary statistics presented in Table 3.1 illustrate the performance and resilience of the individual SSA eurobonds under consideration. With its mean and median of respectively 4.36% and 4.24%, Namibia appears to be the top performer of the group followed respectively by Tanzania, Senegal and Rwanda. Namibia dominates also the group in terms of resilience with the lowest standard deviation of 0.52% followed respectively by Rwanda and Ethiopia. At the other end, Mozambique appears to be by all standards the worst performer of the group with its 15.79% and 5.38% mean and standard deviation respectively. Less pronounced but still worrying are the cases of Angola, Ghana and Zambia whose standard deviations all exceed 1.80%. Also, Table 3.2 shows strong positive correlations among these bonds. Mozambique features a rather exceptional correlation pattern with both its peers and the global factors, which is no surprise given its idiosyncratic shocks experienced during this period.

	ANG	ETH	GAB	GHA	KEN	MOZ	NAM	NIG	RWA	SEN	TAN	ZAM	BCOM	US10	VIX
ANGOLA	1														
ETHIOPIA	0.59	1													
GABON	0.79	0.87	1												
GHANA	0.81	0.75	0.92	1											
KENYA	0.63	0.86	0.91	0.79	1										
MOZAMBIQUE	-0.21	0.47	0.21	-0.03	0.35	1									
NAMIBIA	0.75	0.84	0.88	0.82	0.83	0.07	1								
NIGERIA	0.86	0.80	0.90	0.84	0.79	0.03	0.87	1							
RWANDA	0.73	0.86	0.92	0.89	0.88	0.15	0.87	0.85	1						
SENEGAL	0.84	0.61	0.77	0.83	0.68	-0.33	0.80	0.81	0.81	1					
TANZANIA	0.85	0.61	0.81	0.83	0.74	-0.25	0.84	0.82	0.80	0.90	1				
ZAMBIA	0.75	0.82	0.96	0.93	0.91	0.18	0.83	0.84	0.92	0.77	0.81	1			
BCOM	-0.78	-0.63	-0.86	-0.85	-0.78	0.04	-0.79	-0.80	-0.75	-0.74	-0.87	-0.86	1		
US10	-0.34	-0.01	-0.30	-0.39	-0.12	0.11	0.04	-0.23	-0.19	-0.18	-0.16	-0.31	0.28	1	
VIX	0.82	0.51	0.70	0.73	0.53	-0.25	0.67	0.77	0.66	0.78	0.76	0.67	-0.66	-0.35	1

Notes: This correlation matrix is based on 652 daily observations of secondary market yields of the selected SSA eurobonds, the US 10 year Treasury Bond index (US10), the Bloomberg commodity index (BCOM) and the market volatility index (VIX) for the period January 2015 – June 2017. High positive correlations are observed among these yields, except for the one from Mozambique. It is also observed that, overall, these yields are negatively correlated with commodity prices (proxied here by the Bloomberg commodity index), and positively correlated with market volatility (proxied by the VIX index). Mozambique features a rather exceptional correlation pattern with both its peers and the global factors, which is no surprise given its idiosyncratic shocks experienced during this period.

Table 3.2: Correlation matrix

The evolution of the selected SSA eurobond yields over the period under study is presented on Figure 3.1. The graph shows that, apart from the case of Mozambique after mid-2015, these yields seem to move in tandem and react in almost the same way to common shocks. However, there seem to be salient differences in the magnitude of their reaction to common shocks, with for instance Namibia, Rwanda and Senegal featuring a strong resilience while Ghana and Zam-

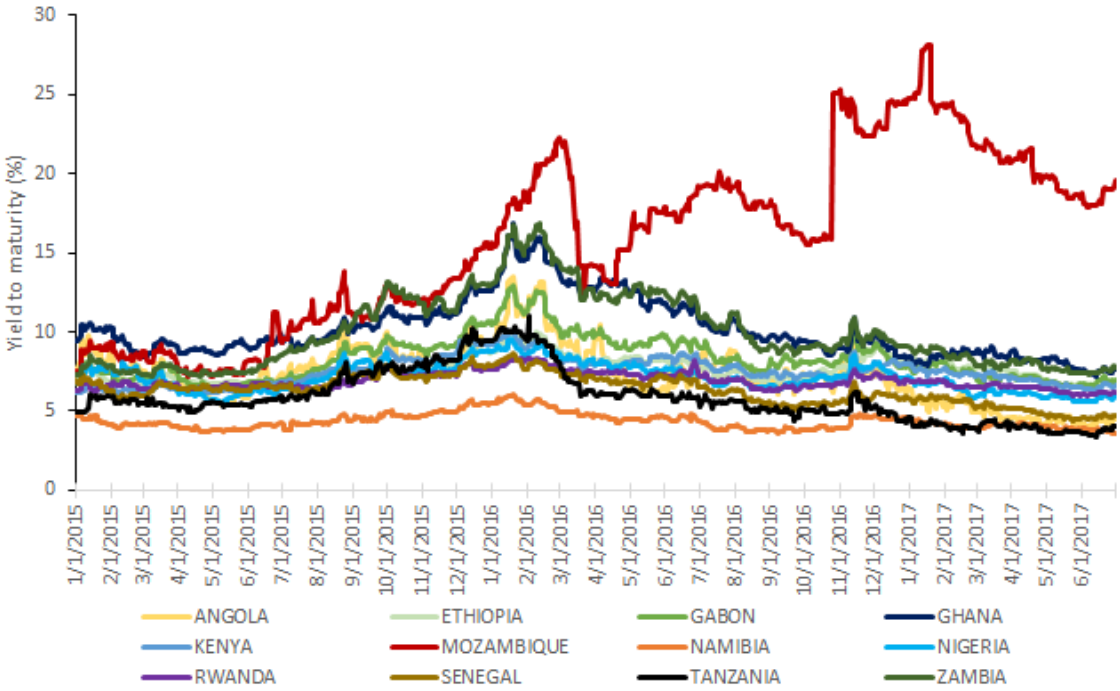

Figure 3.1: Yields evolution

bia showing signs of pronounced vulnerability. Once more, the oddness of Mozambique features prominently, stressing the derailing behavior of this country's yields since the suspicion of cases of hidden debt were raised by the International Monetary Fund (IMF) in May 2015.

3.5 Empirical results

This section presents the results of our static and dynamic spillovers analysis. As indicated earlier, the static analysis uses the whole sample (652 observations) while the dynamic one is based on 120-day rolling windows. We consider the parsimonious VAR(1) system suggested by the Schwartz information criterion to accommodate our small-size 2.5 year sample instead of the VAR(2) system suggested by the Akaike information criterion.

3.5.1 Static analysis of spillovers

The results of the static analysis of secondary market SSA eurobond yields are presented in Table 3.3. Three main messages can be drawn from these results. First, the total spillover index indicates that, overall, 66.37% of the 10-day step ahead forecast error variance across the examined eurobond yields comes from spillovers. Second, Angola appears to be the dominant spillover transmitter followed by Ghana and Zambia, while Namibia followed by Tanzania and Rwanda are deemed the dominant receivers of SSA eurobond yield spillovers. Third, with almost 90% and 60% of own spillovers respectively, Mozambique and Angola share the particularity of having the most of their 10-day step ahead forecast error variance attributed to their own idiosyncratic shocks.

Consistent with the results of Fernández-Rodríguez et al. (2015) for the case of EMU sovereign bonds, we find an indication of substantial contagion effects among SSA eurobonds, suggesting that the evolution of secondary market yields is not only influenced by global and country-specific factors but also to a large extent by spillovers of shocks affecting their peers. For instance, our figures indicate that 83.3% of the 10-day step ahead forecast error variance of Ethiopia's yields comes from spillovers against only 16.7% attributed to its own shocks. On the other hand, the dominance of Angola and Ghana in spillovers transmission is no surprise. In fact, the economy of Angola has been crippled by the recent oil price-crash that has seriously affected the public finances and spilled over to all the other sectors. The protracted worsening

	ANG	ETH	GAB	GHA	KEN	MOZ	NAM	NIG	RWA	SEN	TAN	ZAM	From others
ANGOLA	0.5995	0.0243	0.0705	0.0754	0.0412	0.0181	0.0116	0.0478	0.0112	0.0344	0.0076	0.0582	0.4005
ETHIOPIA	0.1161	0.1670	0.1234	0.1176	0.0715	0.0970	0.0239	0.0681	0.0481	0.0604	0.0137	0.0929	0.8330
GABON	0.1377	0.0462	0.2429	0.1432	0.0951	0.0420	0.0252	0.0626	0.0224	0.0576	0.0073	0.1180	0.7571
GHANA	0.1240	0.0454	0.1161	0.3098	0.0693	0.0342	0.0207	0.0486	0.0315	0.0709	0.0062	0.1234	0.6902
KENYA	0.0921	0.0502	0.1181	0.1374	0.2156	0.0341	0.0127	0.0810	0.0306	0.0731	0.0258	0.1293	0.7844
MOZAMBIQUE	0.0093	0.0351	0.0086	0.0079	0.0118	0.8873	0.0030	0.0092	0.0055	0.0010	0.0029	0.0185	0.1127
NAMIBIA	0.1111	0.0514	0.1172	0.1226	0.0857	0.0326	0.1987	0.0663	0.0579	0.0498	0.0120	0.0946	0.8013
NIGERIA	0.1512	0.0506	0.0922	0.1105	0.0787	0.0406	0.0199	0.2602	0.0355	0.0639	0.0088	0.0879	0.7398
RWANDA	0.0997	0.0487	0.1027	0.1374	0.0777	0.0348	0.0229	0.0767	0.2139	0.0705	0.0085	0.1067	0.7861
SENEGAL	0.1330	0.0554	0.1003	0.1212	0.0818	0.0076	0.0158	0.0747	0.0366	0.2458	0.0178	0.1100	0.7542
TANZANIA	0.1444	0.0264	0.0692	0.0834	0.0801	0.0144	0.0094	0.0488	0.0123	0.0458	0.3827	0.0831	0.6173
ZAMBIA	0.0729	0.0529	0.1079	0.1423	0.0897	0.0330	0.0215	0.0540	0.0278	0.0580	0.0273	0.3125	0.6875
To others	1.1915	0.4867	1.0262	1.1988	0.7828	0.3884	0.1867	0.6378	0.3194	0.5853	0.1379	1.0226	**Total spill-**
Plus own effect	1.7910	0.6537	1.2691	1.5086	0.9984	1.2757	0.3854	0.8980	0.5333	0.8311	0.5206	1.3352	**over index =**
Net spillover	0.7910	-0.3463	0.2691	0.5086	-0.0016	0.2757	-0.6146	-0.1020	-0.4667	-0.1689	-0.4794	0.3352	**66.37%**

Note: This table presents, linewise, the fraction of the spillovers received by the country in line (i) from the country in column (j), i.e. the $S^g_{i\leftarrow j}(10)$ computed as in Equation (3.4). By construction, these spillovers sum to 1 linewise to account for 100% of the spillovers affecting country (i). Columnwise, the table contains the spillovers transmitted by the country in column (j) to the country in line (i), i.e. the $S^g_{i\rightarrow j}(10)$ computed as in Equation (3.5). The diagonal elements correspond to the countries' own spillovers. The total spillover index corresponds to the percentage of the H-step-ahead forecast error variances attributable to other countries in the system's overall H-step-ahead forecast error variance decomposition (from and to others plus own spillovers), i.e. the $S^g(10)$ computed as in Equation (3.3). The net spillovers in the last line correspond to the difference between the percentage of transmitted and received spillovers, i.e. the $S^g_i(10)$ computed as in Equation (3.6).

Table 3.3: Total and directional spillovers

situation resulted in a series of credit rating downgrades in 2016 sending this country into the highly speculative territory, with serious consequences on the amount of foreign investment inflows and indeed the performance of its eurobonds on financial markets[6]. The request for an IMF bailout and the successive devaluations of the Angolan currency (the Kwanza) amid the drastic shrink in foreign reserves were in fact far from reassuring investors (Donnan, 2016).

As concerns Ghana, it is worth reminding that this country issued its debut sovereign eurobond in 2007, making it the first African beneficiary of HIPC/MDRI debt relief to tap into the international bond markets. However, it is documented that the country increased its debt amid the discovery of oil and rapid economic growth, but that the proceeds were used to increase public sector salaries instead of being invested in growth-generating infrastructure or reforms geared toward generating extra revenues to service the debt. As a result, this country faced unsustainable pressure on its public finances that affected the value of the Ghanaian currency (the cedi), leaving no option but to return to the IMF for a three-year rescue package of US $1 billion in 2014 (IMF, 2015). Ghanaian finances were further affected by plummeting commodity prices that considerably restricted the ability of the government to address the soaring prices for elec-

[6]The history of Angola's credit ratings by different rating agencies is available on https://tradingeconomics.com/angola/rating.

tricity, water and fuel, thus stoking public anger amid a perception of politicians mishandling the economic crisis and mismanaging public finances (Matthews, 2016). It is no surprise that, along the way, the deterioration of investors' confidence in the credit quality of Ghana did affect the performance of its bonds on international markets.

Furthermore, the results show negative net spillovers for Namibia, Tanzania, Rwanda, Ethiopia, Senegal, Nigeria and Kenya. Rather than a simple coincidence, these countries have in common a commendable degree of macroeconomic stability and resilience to global economic shocks thanks to improvements in economic diversification and the quality of macroeconomic management. For example, Namibia's eurobond was the only one holding an investment grade credit rating throughout our study period, indicating a sustained level of markets' confidence in the creditworthiness of this country. Also, Tanzania, Rwanda, Ethiopia and Senegal have for a long time been praised for their infrastructure development and service sector-based sustained economic growth in spite of the global shocks, particularly so for Ethiopia and Tanzania that have been projected among the world's 10 fastest growing economies of 2017 by World Bank (2017).

3.5.2 Dynamic analysis of spillovers

The results of the static analysis provide a general picture of spillovers among SSA eurobonds. In the following paragraphs, we move to the dynamic analysis and present the evolution of the total spillover index using 120-day rolling windows.

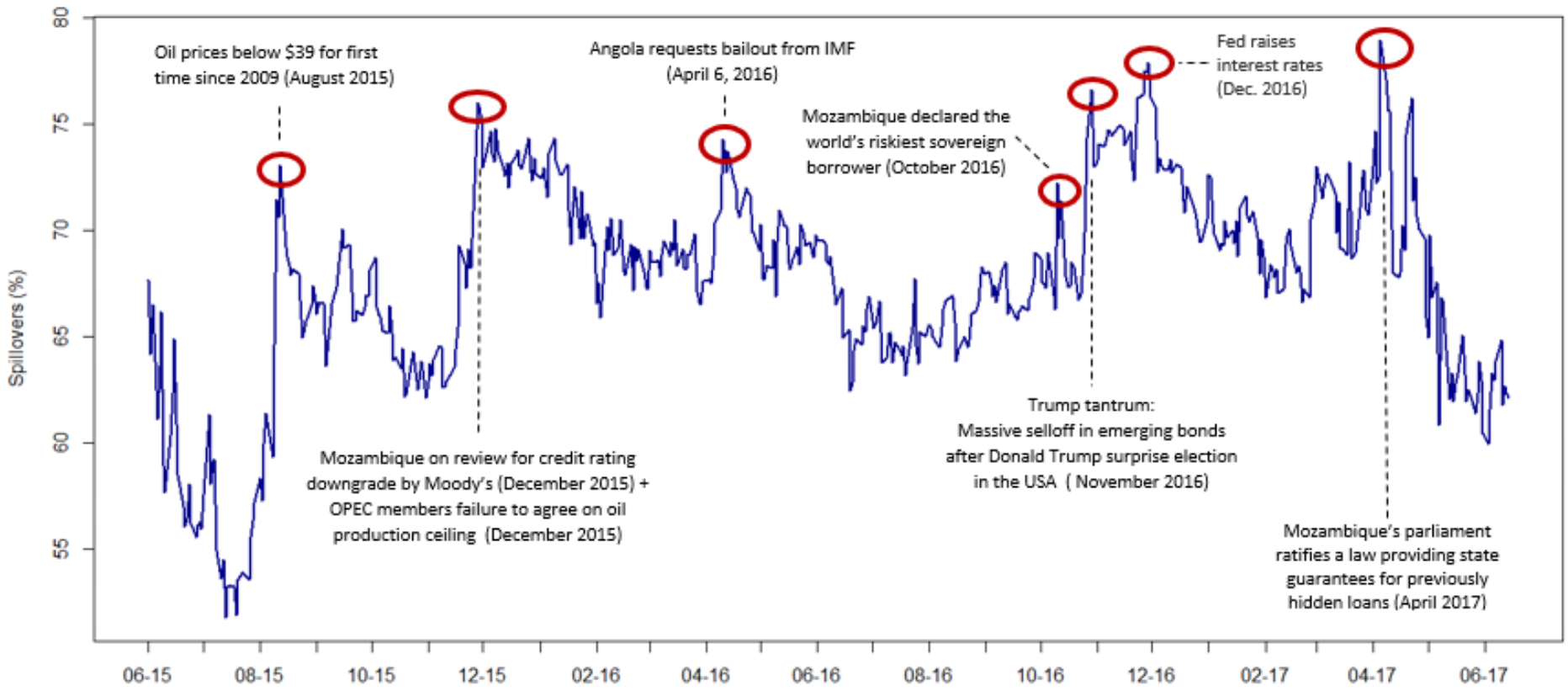

Figure 3.2: Total spillover index

Figure 3.2 shows the evolution of the total spillover index over our study period. As expected, rather than being constant, this index shows a sawtoothed evolution with salient peaks that seem to be related to major news and events that affected these bonds either collectively or individually. Starting at a level of around 65% in mid-June 2015, it is observed that after a declining trend reaching a trough in end-July of the same year, this index hiked to reach a peak of 73% in August, at a time when crude oil was selling at less than 39 US$ per barrel for the first time since 2009. The index increased to 76% in reaction to the news about OPEC's failure to agree on oil production ceilings to curb these falling prices. Besides the effects of plummeting oil prices, the spillover index has been sensitive to idiosyncratic shocks affecting some of the bond issuers as well as the political and economic changes in the USA. It seems justified to relate the peak of 74.29% in April 2016 to Angola's decision to request a bailout from the IMF, and the 72.21% peak to Mozambique's surprise announcement of the intention to restructure once again its eurobond, an announcement that triggered a dramatic hike in the yields making this country the world's riskiest sovereign borrower in October 2016.

Also, the index has not been immune to the 'Trump tantrum'[7] that is documented to have caused a massive sell-off of emerging markets' securities amid uncertainty about the outcomes of Mr. Trump's economic and trade policies, as well as the decision by the FED to raise interest rates in December 2016 for the second time since the 2008 financial crisis, in line with the results of Belke et al. (2018). Likewise, the index has been affected by the default of Mozambique on its interest payments due in January 2017 and, even more, the parliament's ratification of the controversial law providing government guarantee for previously-hidden debts in April 2017 corresponding to the index maximum level of 78.99%.

The evolution of spillovers among SSA eurobonds is further illustrated by the dynamic directional and net spillovers presented in Figure 3.3, Figure 3.4 and Figure 3.5 which present, respectively, the evolution of the percentage amount of the 10-step-ahead forecast error variances spilled over to and received from others, and the net spillovers computed as in the static anal-

[7] The 'Trump tantrum' was coined by the Institute of International Finance (IIF) that estimated the investors' withdrawal out of emerging market (EM) assets in November to amount to a net outflow of US$24.2 billion (see https://international-adviser.com/trump-tantrum-hits-emerging-markets/).

ysis. In line with the evolution of the total spillover index, these graphs show that Angola and Nigeria were the first to be hit as a result of plummeting oil prices. Many among the rest of the countries appear to have followed suit amid the intensification of the commodity price's crisis and also, most probably, the consequences of the Chinese rebalancing[8]. This is particularly the case for Gabon, Ghana and Zambia that got their public finances jeopardized with severe consequences for their macroeconomic and, sometimes, political stability. These stability threats were reverberating into the series of credit rating downgrades and therefore soaring yields at secondary markets.

[8]The Chinese rebalancing refers to the currently ongoing plan by China to gradually rebalance the composition of its economic growth from investment towards household consumption. See Ma et al. (2017) for more details.

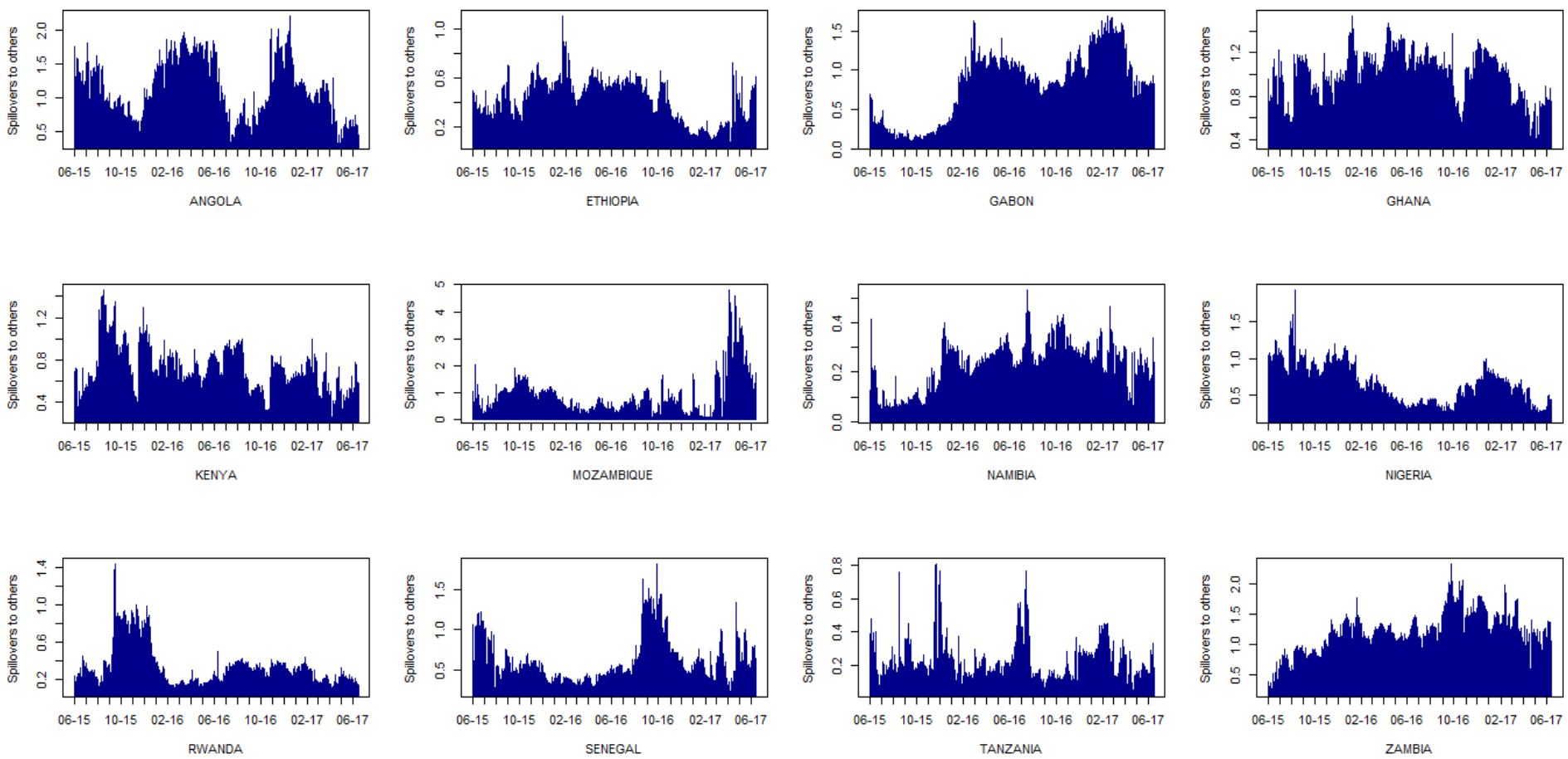

Figure 3.3: Spillovers to others

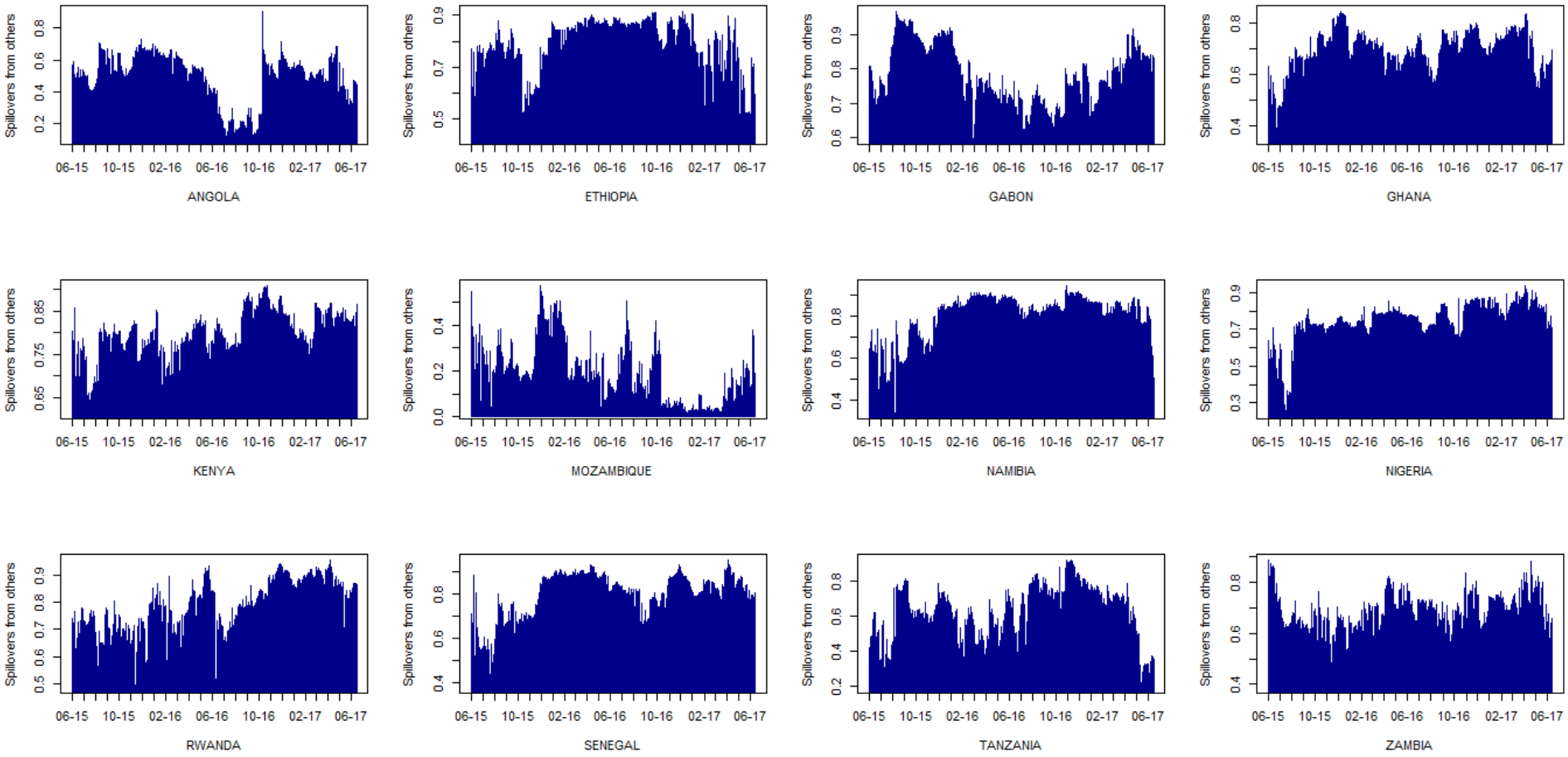

Figure 3.4: Spillovers from others

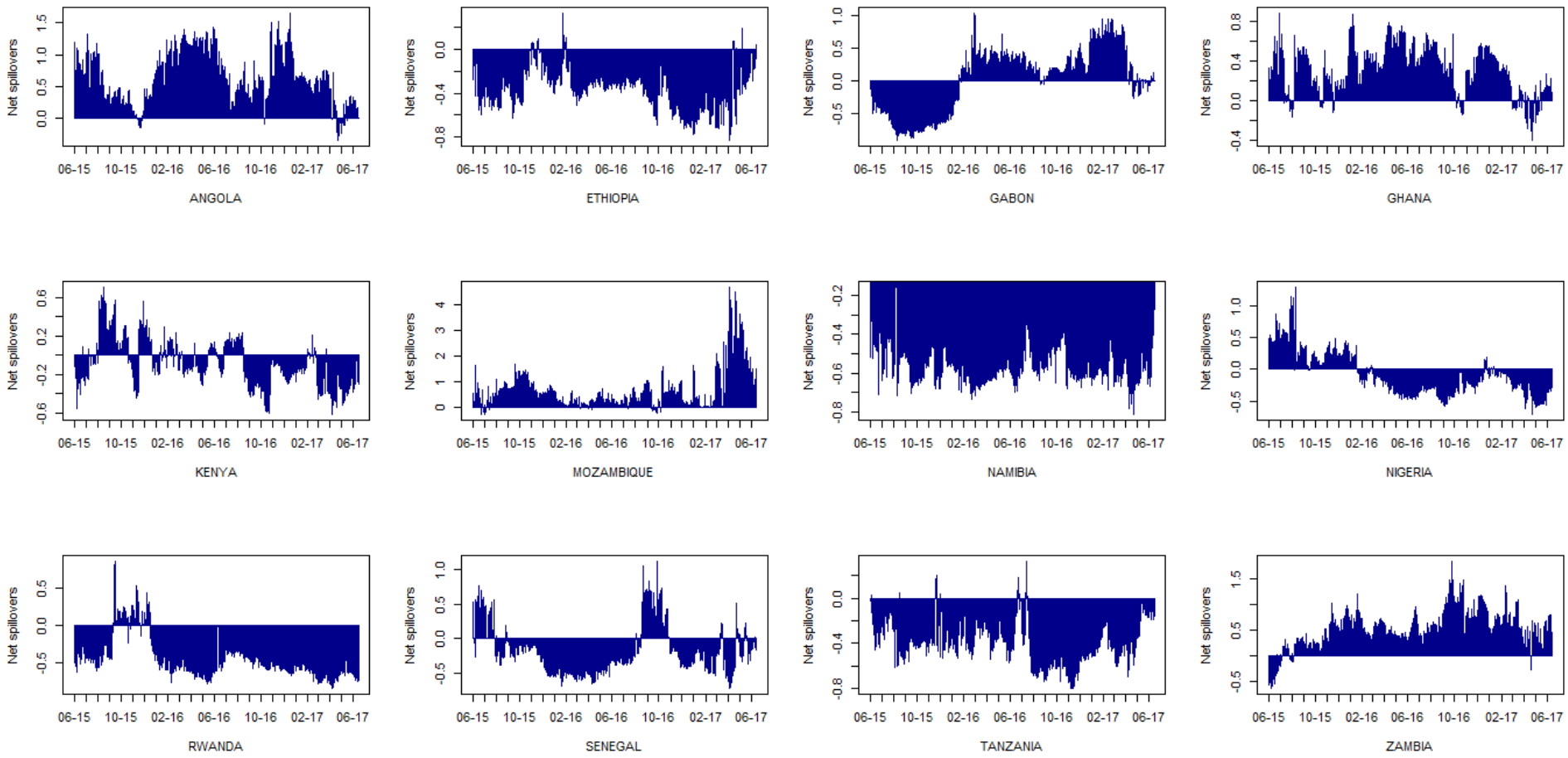

Figure 3.5: Net spillovers

Despite indications of substantial levels of spillovers transmitted by Mozambique's eurobond to its peers from the dynamic analysis (See Figure 3.3, Figure 3.4 and Figure 3.5), the overall picture drawn from the static analysis depicts a rather limited degree of interdependence between this bond and the rest of the SSA eurobonds under consideration. First, it is indicated that 88.73% of the 10-step-ahead forecast error variances of Mozambique's bond come from idiosyncratic shocks and that only 11.27% can be attributable to shocks to all the bonds taken together. Second, the bond seems to transmit in total not more than 38.84% to its peers, just a bit more than the individual contributions of Rwanda, Namibia or Tanzania. While the case of the latter three seems logical given their proven strong resilience and hence the status of net-spillover receivers, the relatively low amount of spillovers transmitted by Mozambique contrasts significantly with the performance of this bond (See Figure 3.1). Commonsense could predict that, given their nature and frequency, the shocks that have been afflicting Mozambique could trigger investors' behavior-related effects and thus spillover to other SSA eurobonds. This aspect is better captured in the results of the dynamic analysis of spillovers to and from others, and net spillovers presented on Figure 3.3, Figure 3.4 and Figure 3.5. These graphs show that spillovers from Mozambique soared dramatically immediately after the ratification of the controversial law providing government guarantee for previously-hidden debts by Mozambique's parliament in April 2017.

3.5.3 Impulse responses

The impulse-response functions of our VAR system are presented in Figure 3.6. These graphs show the impact of a one-standard deviation shock to an individual SSA eurobond's own yields and those of its peers on a 30-day forecasting horizon. However, as stressed by Antonakakis and Vergos (2013), these results should be interpreted with care given that they have been produced in the generalized VAR framework which impairs the orthogonality of shocks affecting these individual bonds[9]. Belke et al. (2018) stress that this generalized approach allows for correlated shocks, taking into account the historically observed distribution of errors, thus suggesting that, rather than identifying the causality of spillovers, this approach relies on historical patterns to identify directionality. Moreover, the global nature of the main shocks that have affected financial markets during our study period increases the chances of synchronization and correlation of shocks across countries, making our generalized impulse-responses simply indicative of the direction of future shocks' impacts as suggested by Antonakakis and Vergos (2013).

Our impulse-response results suggest significant but short-lived reactions of these individual bond yields to their own shocks and those affecting their peers. In almost all cases, the impact appears to die off within 20 days, except for Mozambique whose reactions seem inconsistent and non-convergent. Equally important is Angola's and Mozambique's high reaction in excess of 30% and 80% to their own shocks respectively. Consistent with the results of the directional spillovers, this observation further confirms the fact that the biggest share of impact of the shocks affecting these countries was absorbed internally, with the effects to their peers being rather limited. On the other hand, Namibia and Rwanda appear to be the least affected by their peers' shocks thus confirming their resilient status across the universe of our selected bonds.

[9]The framework of Diebold and Yilmaz (2009) uses an ordinary VAR setting and identifies shocks using a Cholesky factorization. However, this framework has a serious weakness of producing spillover index values that are dependent on the ordering of variables in the VAR system, which makes it less appealing in our case (See Diebold and Yilmaz (2009, p.170) for more details on this framework's drawbacks).

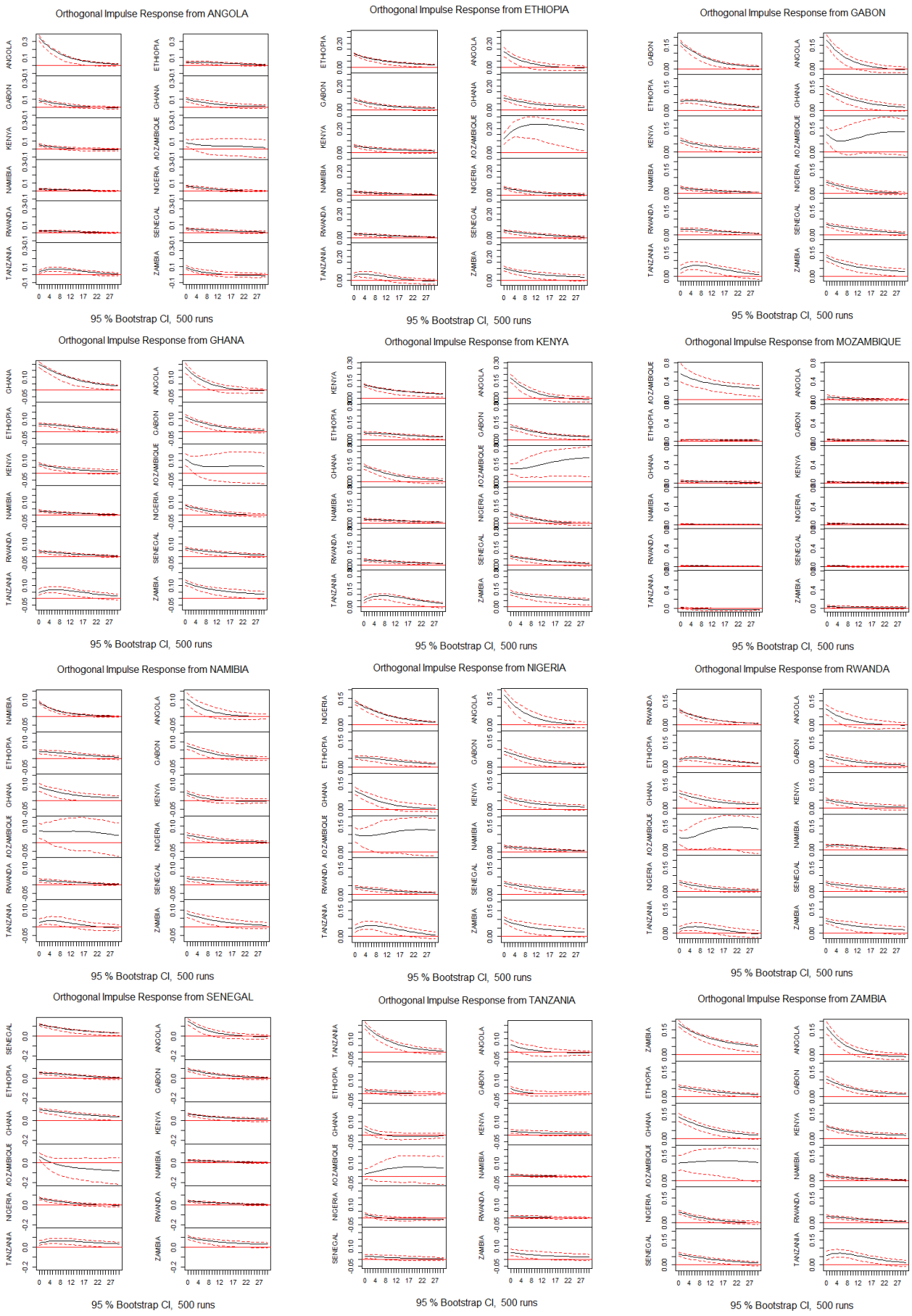

Figure 3.6: Impulse-response functions

All in all, the results of this study confirm the existence of shock-spillover effects among the selected SSA eurobonds over time, and indicate that these spillovers, as measured by the total spillovers index of Diebold and Yilmaz (2012), are responsive to events and news affecting either the global economic environment or the idiosyncratic performance of these bonds. The results of the directional spillovers analysis identify Angola followed by Ghana and Zambia as the dominant spillovers transmitters, while Namibia followed by Tanzania and Rwanda are deemed the dominant receivers of shock spillovers from their peers. These results underscore the fact that eurobonds issued by countries with strong fundamentals and resilient economies tend to receive more from and transmit less spillovers to their peers under distress. This is equally true for Mozambique despite uncertain indications of low spillovers to other from the static analysis. The results of the dynamic analysis show that this country transmitted abnormally high spillovers to other SSA eurobonds at the height of its hidden debt-related distress in April – June 2017.

3.6 Robustness analysis

In this paragraph, we test the robustness of our results by excluding Mozambique which can rightfully be considered as an outlier given its exceptional yield statistics (See Table 3.1) and evolution (See Figure 3.1). We perform the same analysis as before to assess the extent to which the results observed above as well as the subsequent conclusions may have been influenced by the presence of Mozambique, an outlier in our sample. The results of our new analysis (without Mozambique) are presented in Table 3.4. We find a total spillover index of 69.2% indicating the fraction of the 10-day step ahead forecast error variance across the examined eurobonds coming from spillovers. Furthermore, these results do not indicate significant changes in the rankings as Angola remains the dominant spillover transmitter followed by Ghana and Zambia, while Namibia followed by Rwanda and Tanzania keep their positions of the dominant receivers of SSA eurobond yield spillovers.

	ANG	ETH	GAB	GHA	KEN	NAM	NIG	RWA	SEN	TAN	ZAMB	From others
ANGOLA	0.6112	0.0255	0.0719	0.0769	0.0420	0.0118	0.0488	0.0114	0.0346	0.0065	0.0594	0.3888
ETHIOPIA	0.1234	0.1893	0.1387	0.1325	0.0886	0.0257	0.0761	0.0533	0.0666	0.0051	0.1008	0.8107
GABON	0.1446	0.0496	0.2526	0.1492	0.1002	0.0262	0.0654	0.0235	0.0583	0.0072	0.1231	0.7474
GHANA	0.1295	0.0484	0.1193	0.3190	0.0726	0.0214	0.0505	0.0328	0.0722	0.0065	0.1277	0.6810
KENYA	0.0955	0.0515	0.1226	0.1426	0.2237	0.0132	0.0841	0.0318	0.0752	0.0257	0.1342	0.7763
NAMIBIA	0.1149	0.0526	0.1212	0.1267	0.0887	0.2054	0.0685	0.0599	0.0517	0.0126	0.0978	0.7946
NIGERIA	0.1589	0.0543	0.0967	0.1153	0.0829	0.0207	0.2690	0.0371	0.0643	0.0086	0.0920	0.7310
RWANDA	0.1038	0.0498	0.1068	0.1427	0.0808	0.0238	0.0797	0.2220	0.0718	0.0078	0.1109	0.7780
SENEGAL	0.1293	0.0566	0.0860	0.1179	0.0806	0.0152	0.0759	0.0380	0.2718	0.0198	0.1089	0.7282
TANZANIA	0.1178	0.0120	0.0492	0.0674	0.0591	0.0074	0.0417	0.0082	0.0624	0.5001	0.0747	0.4999
ZAMBIA	0.0756	0.0543	0.1119	0.1475	0.0931	0.0223	0.0560	0.0288	0.0597	0.0266	0.3241	0.6759
To others	1.1935	0.4547	1.0242	1.2188	0.7886	0.1879	0.6466	0.3248	0.6169	0.1262	1.0295	**Total spill-**
Plus own effect	1.8047	0.6440	1.2768	1.5378	1.0123	0.3933	0.9156	0.5468	0.8886	0.6263	1.3536	**over index =**
Net spillover	0.8047	-0.3560	0.2768	0.5378	0.0123	-0.6067	-0.0844	-0.4532	-0.1114	-0.3737	0.3536	**69.20%**

Note: As in Table 2, read linewise, this table presents the fraction of the spillovers received by the country in line (i) from the country in column (j), i.e. the $S^g_{i\leftarrow j}(10)$ computed as in Equation (3.4). By construction, these spillovers sum to 1 linewise to account for 100% of the spillovers affecting country (i). Columnwise, the table contains the spillovers transmitted by the country in column (j) to the country in line (i), i.e. the $S^g_{i\rightarrow j}(10)$ computed as in Equation (3.5). The diagonal elements correspond to the countries' own spillovers. The total spillover index corresponds to the percentage of the H-step-ahead forecast error variances attributable to other countries in the system's overall H-step-ahead forecast error variance decomposition (from and to others plus own spillovers), i.e. the $S^g(10)$ computed as in Equation (3.3). The net spillovers in the last line correspond to the difference between the percentage of transmitted and received spillovers, i.e. the $S^g_i(10)$ computed as in Equation (3.6).

Table 3.4: Total and directional spillovers without Mozambique

Besides the robustness to the presence of an outlier, these results indicate a low contribution of Mozambique to the total spillover index as its exclusion raises the index to 69.20% (versus 66.37% previously). In fact, in light of the formula in Equation (3.3), it is obvious that this slight

increase in the spillover index is due to a disproportionately higher reduction in the number of countries (the denominator) than the reduction of the cross-country spillovers (numerators), thus suggesting a rather marginal contribution of Mozambique to the cross-country spillovers captured by the total spillover index. This is consistent with the information in Table 3.3 and Figure 3.2, showing that shocks to Mozambique were mainly affecting its own performance that its peers[10].

As regards the soundness of the methodology, the results of the dynamic analysis presented on Figure 3.7 show that the evolution of the spillover index no longer exhibits the effects of idiosyncratic shocks to Mozambique. Also, we obtain slightly higher levels of the total spillover index compared to Figure 3.2 (except for the Mozambique-related peaks), which is consistent with the observation made above of the static analysis.

[10] An additional robustness check has been performed by replacing the Tanzania's floating rate eurobond by the Côte d'Ivoire's issue of 2014 and the Ghana's 2013 and Senegal's 2011 eurobonds by their succeeding issues of 2014. The purpose was to check whether the floating rate structure and/or the age of the bond, i.e. the difference in issue dates (e.g. Senegal's eurobonds of 2011 and 2014) affect the amount and direction of spillovers among SSA eurobonds. We obtain a total spillover index of 67.04% (and 71.52% without Mozambique) without significant changes to the ranking of net-spillover transmitters and receivers. These results are not reported to save space but but available from the authors upon request.

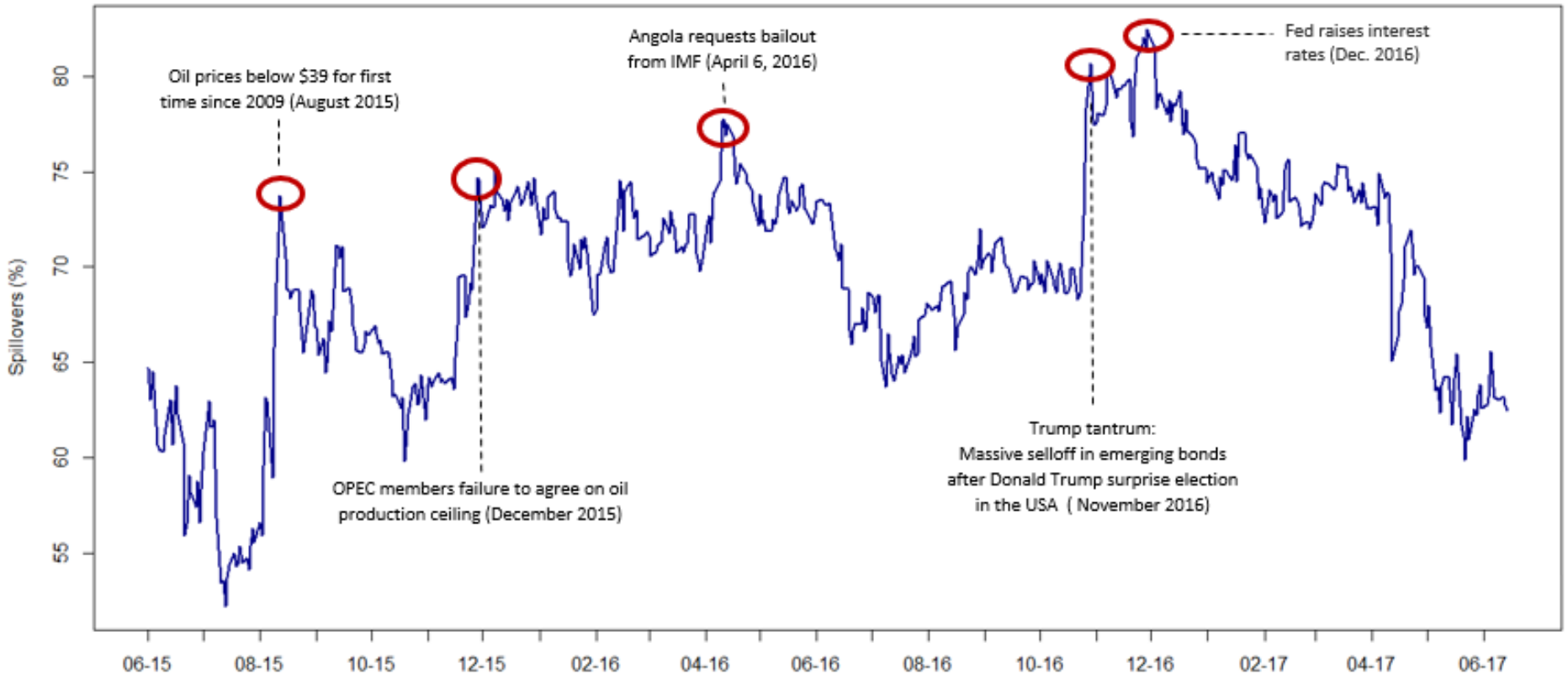

Figure 3.7: Total spillover index (excl. Mozambique)

3.7 Conclusion

This study has investigated spillover effects among selected Sub-Saharan African (SSA) eurobond yields for the January 2015 – June 2017 period. The results of the VAR-based spillover index indicate that 66.37% of the forecast error variance in all the 12 considered SSA eurobond yields comes from spillovers. The directional spillover analysis has pointed to Angola as the dominant transmitter of SSA eurobond yield spillovers followed by Ghana and Zambia, while Namibia followed by Tanzania and Rwanda appear to have been the dominant receivers of SSA eurobond yield spillovers during our study period. The same analysis using 120-day rolling windows has shown that the total spillover index has been responsive to major economic events and news announcements such as OPEC's failure to agree on an oil production ceiling to curb the falling prices in December 2015, Angola's decision to request a bailout from the IMF in April 2016, Mozambique's surprise announcement of the intention to restructure once again its eurobond in October 2016 and the Trump tantrum documented to have caused a massive sell-off of emerging markets' securities in November 2016 amid uncertainty about the outcomes of the newly-elected US president's economic and trade policies. At the individual level, these results underscore the fact that eurobonds from countries with weak fundamentals and less resilient economies transmit more to and receive less spillovers from their peers.

Overall, these results underscore the overwhelming importance of spillovers accounting for 66.37% of the observed SSA eurobond yields' volatility. It appears from the evolution of the total spillover index that these spillovers can be attributable to both fundamental and investors' behavior-related causes. Either way, SSA eurobond issuers had better mitigate their vulnerability to spillovers effects and contagion in order to increase their control over the performance of their securities on secondary markets. While, obviously, sustained efforts in strengthening their macroeconomic fundamentals is key, these countries should also endeavor to improve transparency and information disclosure to curb the asymmetry of information underlying investors' behavior-based spillovers and contagion. Furthermore, as revealed by Essers et al. (2016) and Dafe et al. (2018), the development of their own local currency bond market constitutes, in our

view, a fruitful strategy for these countries to further diversify theirs sources of funding and thus reduce their exposure, hence vulnerability, to external shocks.

The generalized VAR framework used in this analysis has the advantage of producing spillovers that are independent of the ordering of our variables in our VAR system. However, this desirable feature comes at the cost of producing impulse-responses that rather account for the correlation of shocks across the studied SSA eurobonds. As emphasized by Antonakakis and Vergos (2013) and Belke et al. (2018), this correlation of shocks constitutes a limitation to the identification of the effects pertaining to these bonds' idiosyncratic shocks. While caution is advised regarding the interpretation of the impulse-responses with a 'ceteris paribus' mindset, we still believe that our results provide good indications of the impact of shocks on our variables since, in any case, we do not expect shocks to these bonds to appear in isolation from each other given the degree of increased globalization of economies (which increases the synchronization and correlation of shocks across countries). Nonetheless, we recommend the use of a framework allowing for orthogonal shocks for future research.

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Appendix

Country/issuer	Issue date	Maturity date	Coupon	Size (US$ mios)	ISIN (RegS/144A)
Angola (Northern Lights III)	8/16/2012	8/16/2019	7.000%	1000	XS0814512223
Côte d'Ivoire*	7/23/2014	7/23/2024	5.375%	750	XS1089413089
Ethiopia	12/11/2014	12/11/2024	6.625%	1000	XS1151974877/US29766LAA44
Gabon	12/12/2013	12/12/2024	6.375%	1500	XS1003557870/US362420AB78
Ghana	8/7/2013	8/7/2023	7.875%	1000	XS0956935398/US374422AB97
Ghana*	9/11/2014	1/18/2026	8.125%	1000	XS1108847531/US374422AC70
Kenya	6/24/2014	6/24/2024	6.875%	1500	XS1028952403/US491798AE43
Mozambique (Ematum)*	9/11/2013	9/11/2020	6.305%	500	XS0969351450
Mozambique	4/16/2016	1/18/2023	10.500%	726.5	XS1391003446
Namibia	10/27/2011	11/3/2021	5.500%	500	XS0686701953/US62987BAA08
Nigeria	7/12/2013	7/12/2023	6.375%	500	XS0944707222/US65412ACD28
Rwanda	4/25/2013	5/2/2023	6.625%	400	XS0925613217/US78347YAA10
Senegal	5/13/2011	5/13/2021	8.750%	500	XS0625251854/US81720TAA34
Senegal*	7/30/2014	7/30/2024	6.250%	500	XS1090161875/US81720TAB17
Tanzania (floating rate note)	2/27/2013	2/27/2020	LIBOR + 600bps	600	XS0896119897
Zambia	4/14/2014	4/14/2024	8.500%	1000	XS1056386714/US988895AE81

Source: Thomson Reuters Datastream; Eurobond prospectus documents.
Notes: Bonds marked with * have been used for robustness check. The 2016 Mozambique's sovereign eurobond is a result of the restructuring of the government guaranteed Ematum eurobond of 2013 in March 2016.

Table A3.1: SSA Eurobonds sample

Chapter 4

Portfolio optimization at the frontier: Assessing the diversification benefits of African securities**

**I am grateful for the observations and comments by Professor Jan Annaert, and those from the participants in the 2017 Doctoral Day organized by the Faculty of Business and Economics of the University of Antwerp, Belgium. Special thanks go to Professors Raymond Kan and Guofu Zhou for having kindly shared the Matlab codes for the different mean-variance spanning tests. The views expressed in this paper as well as any remaining errors are mine.

Abstract

This study investigates the diversification benefits of African securities in comparison with other international investment opportunity sets from the perspective of a US investor. Using data from the most representative S&P Dow Jones traded indices of the US and other developed markets, as well as those from emerging and African markets for the period of July 2014 – September 2018, I assess the benefits of diversification over these markets using the traditional and step-down tests of mean-variance spanning, and test the results' robustness by deviating from the normality assumption. My results show that, unlike their peers, African investment opportunity sets offer statistically significant diversification benefits to the benchmark US domestically-diversified minimum-variance and tangency portfolio. More specifically, I find that the 'All Africa' set contributes to risk profile of the benchmark set while the 'Africa ex-SA' is the only set offering significant improvements to this benchmark's tangency portfolio. These results bring additional evidence to the observation that countries with higher country-risk offer greater potential benefits of global diversification, which may also justify the ongoing high appetite of international investors for African securities.

Keywords: International diversification, Mean-Variance Spanning, Frontier markets, Africa

JEL classification: G11, G15, C46

4.1 Introduction

Since the last decade, African securities have gained an increased focus from international investors who have been particularly responsive to eurobond issues from this continent including from the post-HIPCs (Heavily Indebted Poor Countries). To name a few, after the African eurobond spree that got issues from this countries such as Zambia in 2012, Rwanda in 2013, Cote d'Ivoire in 2015 and Ghana in 2016 receive order books of respectively 15, 8.5, 4 and more than 5 times their book sizes, recent issues by countries such as Kenya, Senegal and Egypt have been oversubscribed for respectively 7, 5 and 4 times their book sizes in 2018. For many observers, this investors' appetite for African assets is mainly driven by the quest for high yields far afield their domestic environments dominated by protracted low growth and sluggish economic recovery, hence their eagerness to partake of the recent records of Africa's economic performance. It is believed that the stimulus packages to address the consequences of the global financial and European sovereign debt crises of the mid-2000s and early 2010s in advanced economies have resulted in unprecedented low interest rates that shrank growth possibilities for investors who had no alternative but to explore new opportunities in emerging and frontier markets including Africa.

Despite its plausibility, this general perception trying to portray the enthusiasm of investors for African securities as a desperate –and maybe reckless– move in quest for high yields outside the developed world seems to overlook the benefits of these assets in terms of portfolio diversification that can also justify the interest of international investors in light of the international portfolio theory (see Moffett et al., 2011, chap. 17). In fact, it is argued that, over time, the increased economic and financial integration between the developed and major emerging markets has compounded the correlations between these two markets' asset returns with, as a consequence, a decrease in the diversification benefits that directed the attention of international investors to new attractive environments (Piljak and Swinkels, 2017). Empirical studies have shown that the current investors' interest in the next generation of emerging markets (the so-called frontier market) has been whetted among others by their low integration with global markets (see, e.g.

Berger et al., 2011) that offer significant diversification benefits in terms of both expected return increase and portfolio risk reduction (Li et al., 2003; Jayasuriya and Shambora, 2009; Berger et al., 2013, 2011). Moreover, based on the results of Driessen and Laeven (2007) in the context of emerging markets suggesting that countries with higher country risk offer greater potential benefits of global diversification, it seems logical to consider the high potential diversification benefits of African securities as the main driver of international investors' appetite for these assets.

The revival of economic growth in Africa since the mid-2000s – especially in the Sub-Saharan Africa (SSA) part thanks to a successful implementation of the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiative (MDRI) initiatives[1] – has been backed by an arsenal of structural reforms aiming at the improvement of countries' soft and hard infrastructure to expedite and sustain their development, and create a conducive environment for a private sector-led economic growth. In many countries, these reforms have among others facilitated the development of financial markets to allow domestic and foreign investors to contribute to and partake of the economic growth. It is even argued that the issue of sovereign eurobonds by SSA countries on international financial markets was, for many of the first time issuers, an opportunity to register on the investors' radar (Bertin, 2016). The local currency bond market has as well registered significant developments allowing the participation of both domestic and international investors (Essers et al., 2016; Dafe et al., 2018). Importantly, financial assets from Africa have been progressively integrated into globally recognized and traded financial indices such as the JP Morgan Emerging Bond Index (EMBI) and MSCI Frontier Markets Index, or constituted specific independently-traded components of these indices (e.g. MSCI Frontier Markets Africa Index). S&P Dow Jones has since recently launched a variety of specific indices for Africa, a move that arguably improves the visibility of African assets within the investment community.

[1] The Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiative (MDRI) initiatives by the International Monetary Fund (IMF) and the World Bank were meant to address the issue of protracted and unsustainable issue of excessive external debt by poor countries, most of them from SSA. Details about these initiatives' motivation, processes and outcomes can be found in Bhattacharya et al. (2004) and IMF (2017).

Notwithstanding, the literature on the diversification potential of emerging and frontier markets has timidly covered the African market. So far, the few studies on international diversification beyond the developed and traditional emerging markets have only approached the African market as a constituent of the general frontier market category (see, e.g. Jayasuriya and Shambora, 2009; Driessen and Laeven, 2007; Berger et al., 2011, 2013; Piljak and Swinkels, 2017). Despite the growing interest of international investors in this particular market, little is still know about its individual contribution to the risk-return profile of globally-diversified portfolios, and the relative performance its different investment opportunity sets has not yet been fully investigated. This research zooms into the potential diversification benefits of African securities by considering separately the cases of the whole Africa, Africa excluding South Africa and, when applicable, frontier Africa[2]. A comparison is then made between the individual performance of these separated segments of the African market and both the developed and traditional emerging markets. This analysis is kept at the aggregate (continental) level and only covers US dollar-denominated traded indices to allow easy comparability across the asset classes and markets under consideration.

In terms of contribution to the existent literature, this study is to our knowledge the first to specifically focus on Africa and break down the potential diversification benefits of its investable assets per level of their originators' economic and financial market development. Assuming that lower development levels entails high risks, this distinction allows the test of the conclusion of Driessen and Laeven (2007) that the gains from international portfolio diversification appear to be largest for countries with high country risk. Furthermore, in light of the conclusions by Piljak and Swinkels (2017), I test whether the scope of the selected African securities diversification benefits is affected by the prior integration of emerging and/or other developed markets. As a primer to my results, this research shows that 1) unlike the emerging and developed market sets, the selected African investment opportunity sets offer statistically significant diversification benefits to an investor holding the benchmark US diversified portfolio; 2) while the 'All

[2]The term 'frontier markets' refers to countries with markets that are smaller and less liquid than those in the more advanced emerging markets (Nellor, 2008). The S&P Africa Frontier BMI index covers Botswana, Cote d'Ivoire, Ghana, Kenya, Mauritius, Namibia, Nigeria and Zambia (see https://us.spindices.com/indices/equity/sp-africa-frontier-bmi-us-dollar).

Africa' set significantly improve the risk profile of the benchmark portfolio, the 'Africa ex-SA Africa' is the only set of the whole investment universe studied to offer statistically significant diversification benefits in terms of expected portfolio return; and 3) the prior integration of investment opportunity sets from emerging or other developed markets does not abate the diversification benefits of the considered African securities.

In the rest of the paper, after a brief summary of the related literature in Section 4.2, I elaborate on the methodology of the mean-variance spanning tests applied in this analysis in Section 4.3. Data and empirical results are presented in Section 4.4 followed by the general conclusions in Section 4.5.

4.2 Literature review

A good number of studies have investigated the diversification potential of emerging and frontier markets including Africa. Though not exhaustive, the following literature has proved closely related to this research. Jayasuriya and Shambora (2009) use daily data of major world equity markets for the period January 2000 to December 2007 and find that US investors would have achieved substantial international diversification benefits in terms of portfolio risk minimization should they have integrated assets from frontier markets and emerging markets of Europe, Latin America, Middle East, Africa and South Asia. Berger et al. (2011) systematically assess the level of integration among global financial markets using daily data on the constituents of the MSCI World Index. Their findings indicate a low level of frontier markets integration with the world market and thereby support the conclusion that these markets offer significant diversification benefits. Beyond the equity markets, Berger et al. (2013) uses exchange-traded funds (ETFs) from the frontier and US markets and find outstanding benefits of diversification over ETFs from frontier markets. A recent study by Piljak and Swinkels (2017) focuses on government bonds using data from the US and selected emerging and frontier markets over the period 2001-2013. Their results indicate a time-varying but zero-averaged correlation between the returns of frontier markets and US government bonds. Importantly, they emphasize the high correlation between US investment grade corporate bonds, US corporate high yield bonds, and US dollar-denominated debt issued by governments of emerging markets, which limits the diversification benefits for a US portfolio containing these asset classes.

Marshall et al. (2015) push further the investigation of frontier markets diversification benefits by measuring and integrating transaction costs associated to trades on these markets. Using high-frequency tick data covering 19 countries included in the MSCI Frontier Markets Index for the period June 2002 – December 2010, they find that transactions costs in frontier markets are almost three times larger than those in the U.S market. They therefore recommend a three month or longer rebalancing period to safeguard the benefits of diversification over these markets.

The literature on frontier African assets has dominantly focused on the maiden hard-currency sovereign bonds issued by SSA countries on international capital markets (Sy, 2013; Willem te Velde, 2014; Mecagni et al., 2014; Gevorkyan and Kvangraven, 2016; Sy, 2015; Senga et al., 2018). In most cases, these studies have focused on the drivers of African eurobonds' primary and secondary market yields, and disputed the prevalence of global and country-specific factors in influencing these yields' evolution; the perspective of investors seeking diversification benefits has not yet been covered despite the insights from the international portfolio theory. Some other studies have investigated the development of local currency bond markets in these countries, emphasizing the increasing availability of long-term investment opportunities in these markets (Essers et al., 2016; Dafe et al., 2018). To my knowledge, no study has specifically zoomed into the diversification benefits of African assets. An attempt in this avenue has been made by Lagoarde-Segot and Lucey (2007) who limit their investigation on equity markets of the Middle East and North Africa.

The contribution of this research to this literature is twofold. First, it provides a thorough investigation of the potential diversification benefits of dissected segments of the African market, namely the whole of Africa, Africa excluding South Africa and frontier Africa, in comparison with the emerging and other developed markets outside the USA. Second, by covering all the African tradable opportunities including the highly-advertised hard-currency sovereign bonds, it contributes to the ongoing debate on the drivers on the observed enthusiasm of international investors for African securities by bringing in the diversification perspective that has so far been overlooked.

4.3 Methodology

As in Driessen and Laeven (2007), this paper uses the standard meanvariance framework of Markowitz (1952) assuming the normality of asset returns and a mean-variance utility function for the investor. In this *mean-variance* framework, the investor maximizes the expected utility

$$\max_{w} w'\mu - \frac{\gamma}{2} w'\Omega w \tag{4.1}$$

with w the vector of optimal portfolio weights of N risky assets, μ the N-vector of expected excess returns over the risk-free asset, Ω the $N \times N$ covariance matrix and γ the risk aversion parameter. Mishra (2015) recalls that the solution to this maximization problem is given by

$$w^* = \frac{1}{\gamma}\Omega^{-1}\mu \tag{4.2}$$

and that, under the assumption of the sum of the portfolio weights equal to 1 ($w'1_N = 1$), and where a risk-free rate is available and chosen as the zero-beta portfolio and when short-sales are allowed, optimal weights are given by

$$w^* = \frac{\Omega^{-1}\mu}{\mathbf{1}_N'\Omega^{-1}\mu} \tag{4.3}$$

with $\mathbf{1}_N$ the N-dimensional vector of 1. Given the covariance matrix Ω, the vectors of expected returns μ and and optimal weights w, the expected portfolio return (μ_p) and variance (Ω_p) are obtained respectively by

$$\mu_p = w'\mu \quad \text{and} \quad \Omega_p = w'\Omega w \tag{4.4}$$

In essence, the Markowitz portfolio theory aims at maximizing the portfolio return for a given level of portfolio risk or, inversely, minimize the portfolio risk for a given portfolio return. However, it has widely been acknowledged that, in practice, expected returns are more difficult to

estimate due to the high volatility of returns (Li et al., 2003; Mishra, 2015). For instance, Li et al. (2003) underscore the fact that risk-averse investors with little ability to forecast expected returns might be inclined to assess the diversification benefits in terms of reduction in their portfolio variance. This paper takes into account this perspective by applying a *global minimum variance* portfolio strategy whose asset weights are independent of expected returns of individual assets composing the portfolio.

4.3.1 Minimum variance portfolio

The minimum variance portfolio strategy is based on the assumption that sample means differ just because of noise (Mishra, 2015). Therefore, given N assets having a covariance matrix Ω, the minimum variance portfolio weights are given by

$$w^* = \frac{\mu\Omega^{-1}}{\mu\mathbf{1}_N'\Omega^{-1}\mathbf{1}_N} = \frac{\Omega^{-1}}{\mathbf{1}_N'\Omega^{-1}\mathbf{1}_N} \tag{4.5}$$

with all the parameters defined as in (4.1) and (4.3).

More insights can be drawn from David Levermore's lecture notes[3] who considers the minimum variance portfolio strategy as a minimization problem of $\sigma = \sqrt{w'\Omega w}$ with $w \in \mathbb{R}^+$ subject to the constraints $\mathbf{1}_N' w = 1$ and $\mu' w = \mu_p$ for a given μ_p. Since $\sigma > 0$, minimizing σ is equivalent to minimizing σ^2, an easy-to-solve quadratic function of w that can be formalized as follows:

$$\begin{cases} \min\limits_{w\in\mathbb{R}^+} & \frac{1}{2}w'\Omega w \\ s.t. & \mathbf{1}_N' w = 1 \quad \text{and} \quad \mu' w = \mu_p \end{cases} \tag{4.6}$$

hence the following Lagrangian $\mathcal{L}(w, \lambda_1, \lambda_2) = \frac{1}{2}w'\Omega w - \lambda_1(\mathbf{1}_N' w - 1) - \lambda_2(\mu' w - \mu_p)$. By equalizing

[3]See details on http://www.terpconnect.umd.edu/~lvrmr/2011-2012-S/Classes/MATH420/SLIDES/Risky03.pdf.

the first derivatives with respect to w, λ_1, λ_2 to zero, we get

$$\begin{cases} \partial_w \mathcal{L}(w, \lambda_1, \lambda_2) & = \Omega w - \lambda_1 \mathbf{1}_N - \lambda_2 \mu = 0 \\ \partial_{\lambda_1} \mathcal{L}(w, \lambda_1, \lambda_2) & = -\mathbf{1}_N' w + 1 = 0 \\ \partial_{\lambda_2} \mathcal{L}(w, \lambda_1, \lambda_2) & = -\mu' w + \mu_p = 0 \end{cases} \tag{4.7}$$

Since Ω is positive definite, we can solve for $w = \lambda_1 \Omega^{-1} \mathbf{1}_N + \lambda_2 \Omega^{-1} \mu$ and replace w in the other equations to get

$$\begin{cases} \lambda_1 \mathbf{1}_N' \Omega^{-1} \mathbf{1}_N + \lambda_2 \mathbf{1}_N' \Omega^{-1} \mu = 1 \\ \lambda_1 \mu' \Omega^{-1} \mathbf{1}_N + \lambda_2 \mu' \Omega^{-1} \mu = \mu_p \end{cases} \tag{4.8}$$

By setting $a = \mathbf{1}_N' \Omega^{-1} \mathbf{1}_N$, $b = \mathbf{1}_N' \Omega^{-1} \mu$ and $c = \mu' \Omega^{-1} \mu$, the system (4.8) can be written as

$$\begin{pmatrix} a & b \\ b & c \end{pmatrix} \begin{pmatrix} \lambda_1 \\ \lambda_2 \end{pmatrix} = \begin{pmatrix} 1 \\ \mu_p \end{pmatrix}$$

Levermore shows that when $\mathbf{1}_N$ and μ are not co-linear, λ_1 and λ_2 are obtained by

$$\begin{pmatrix} \lambda_1 \\ \lambda_2 \end{pmatrix} = \frac{1}{ac - b^2} \begin{pmatrix} c & -b \\ -b & a \end{pmatrix} \begin{pmatrix} 1 \\ \mu_p \end{pmatrix} = \frac{1}{ac - b^2} \begin{pmatrix} c - b\mu_p \\ a\mu_p - b \end{pmatrix}$$

Therefore, for each μ_p, we have

$$w(\mu_p) = \frac{c - b\mu_p}{ac - b^2} \Omega^{-1} \mathbf{1}_N + \frac{a\mu_p - b}{ac - b^2} \Omega^{-1} \mu$$

with the associated minimum value of σ^2 given by

$$\begin{aligned}
\sigma^2 &= w(\mu_p)'\Omega w(\mu_p) = (\lambda_1\Omega^{-1}\mathbf{1}_N + \lambda_2\Omega^{-1}\mu)'\Omega(\lambda_1\Omega^{-1}\mathbf{1}_N + \lambda_2\Omega^{-1}\mu) \\
&= \begin{pmatrix} \lambda_1 & \lambda_2 \end{pmatrix} \begin{pmatrix} a & b \\ b & c \end{pmatrix} \begin{pmatrix} \lambda_1 \\ \lambda_2 \end{pmatrix} = \frac{1}{ac-b^2} \begin{pmatrix} 1 & \mu_p \end{pmatrix} \begin{pmatrix} c & -b \\ -b & a \end{pmatrix} \begin{pmatrix} 1 \\ \mu_p \end{pmatrix} \\
&= \frac{1}{a} + \frac{a}{ac-b^2}\left(\mu_p - \frac{b}{a}\right)^2
\end{aligned} \tag{4.9}$$

Equation (4.9) corresponds to the hyperbola representing the *frontier portfolios* in the $\sigma\mu_p$-plane, with each point σ, μ_p representing a unique Markowitz portfolio. Replacing a, b and c with meaningful *frontier* parameters $\sigma_{\text{mv}} = \frac{1}{\sqrt{a}}$, $\mu_{\text{mv}} = \frac{b}{a}$ and $\nu_{as} = \sqrt{\frac{ac-b^2}{a}}$, equation (4.9) can be written as

$$\sigma^2 = \sigma_{\text{mv}}^2 + \left(\frac{\mu_p - \mu_{\text{mv}}}{\nu_{as}}\right)^2$$

After some manipulations, we get the following parts of the hyperbola representing respectively the efficient and inefficient frontiers

$$\mu_p^+ = \mu_{\text{mv}} + \nu_{as}\sqrt{\sigma^2 - \sigma_{\text{mv}}^2} \quad \text{and} \quad \mu_p^- = \mu_{\text{mv}} - \nu_{as}\sqrt{\sigma^2 - \sigma_{\text{mv}}^2} \tag{4.10}$$

As $\sigma \to \infty$, these frontiers become asymptotic to the lines $\mu_p = \mu_{\text{mv}} + \nu_{as}\sigma$ and $\mu_p = \mu_{\text{mv}} - \nu_{as}\sigma$ respectively.

4.3.2 Mean-variance spanning

The notion of mean-variance spanning relates to the efficiency of a benchmark portfolio mean-variance with respect to a given set of test assets positing the impossibility of obtaining either, for a given expected return, a portfolio with a lower variance, or, for a given portfolio variance level, a higher expected return, through a combination of the benchmark and test asset portfolios. Following Huberman and Kandel (1987), the benchmark portfolio of K risky assets is said to span a larger portfolio of $K+N$ risky assets if the minimum-variance frontier of the benchmark K assets is identical to the minimum-variance frontier of the K assets plus an additional test portfolio of N risky assets, thus indicating the impossibility of improving the K asset benchmark portfolio's mean-variance profile through the integration of the N asset test portfolio.

The context and usefulness of the mean-variance spanning analysis is provided in the following summary by Kan and Zhou (2012): "When there exists a risk-free asset and when unlimited lending and borrowing at the risk-free rate is allowed, then investors who care about the mean and variance of their portfolios will only be interested in the tangency portfolio of the risky assets (i.e., the one that maximizes the Sharpe ratio). In that case, the investors are only concerned with whether the tangency portfolio from using K benchmark risky assets is the same as the one from using all $K+N$ risky assets. However, when a risk-free asset does not exist, or when the risk-free lending and borrowing rates are different, then investors will be interested instead in whether the two minimum-variance frontiers are identical. The answer to this question allows us to address two interesting questions in finance. The first question asks whether, conditional on a given set of $K+N$ assets, an investor can maximize his utility by holding just a smaller set of K assets instead of the complete set. This question is closely related to the concept of K-fund separation and has implications for efficient portfolio management. The second question asks whether an investor, conditional on having a portfolio of K assets, can benefit by investing in a new set of N assets. This latter question addresses the benefits of diversification, and is particularly relevant in the context of international portfolio management when the K benchmark assets are domestic assets whereas the N test assets are investments in foreign markets" (see Kan

and Zhou, 2012, p. 141).

This paper uses the mean-variance spanning analysis to assess the contribution of African securities to the mean-variance profile of a US domestically-diversified benchmark portfolio. The individual contribution of the selected African securities is evaluated in comparison to that of the portfolios made of securities from developed and emerging economies outside the US market to analyze the rationale behind the recently observed enthusiasm of investors for African securities. This analysis is complemented with the evaluation of the contribution of these African securities against the scenarios where the benchmark portfolio has already integrated one of the developed or emerging markets or both to test the validity of the non-diversification benefits of the kind of Piljak and Swinkels (2017)[4] in the case of African securities.

4.3.3 Tests of mean-variance spanning

The test of mean-variance spanning was first formalized by Huberman and Kandel (HK henceforth) who project the returns of the test portfolio to those of the benchmark portfolio and test the significance of the resulting coefficients. Assuming $R_t = [R'_{1t}, R'_{2t}]$ the raw returns on respectively the K benchmark and N test risky assets at time t, the expected returns on the $K+N$ assets as well as their covariance matrix can be defined as

$$\mu = E[R_t] \equiv \begin{bmatrix} \mu_1 \\ \mu_2 \end{bmatrix} \quad \text{and} \quad \Omega = \text{Var}[R_t] \equiv \begin{bmatrix} \Omega_{11} & \Omega_{12} \\ \Omega_{21} & \Omega_{22} \end{bmatrix} \tag{4.11}$$

By projecting R_{2t} on R_{1t}, we have

$$R_{2t} = \alpha + \beta R_{1t} + \varepsilon_t \quad \text{with} \quad E[\varepsilon_t] = \mathbf{0}_N \quad \text{and} \quad E[\varepsilon_t R'_{1t}] = \mathbf{0}_{K\text{x}N} \tag{4.12}$$

where $\mathbf{0}_N$ is an N-vector of zeros and $\mathbf{0}_{K\text{x}N}$ is an $K\text{x}N$ matrix of zeros. Defining $\delta = \mathbf{1}_N - \beta \mathbf{1}_K$

[4]These authors underscore the high correlation between US investment grade corporate bonds, US corporate high yield bonds, and US dollar-denominated debt issued by governments of emerging markets, which limits the diversification benefits of the latter assets for a US portfolio containing the former two asset classes.

with $\mathbf{1}_N$ and $\mathbf{1}_K$ N and K-vectors of ones respectively, HK check the necessary and sufficient conditions for spanning by testing the following joint hypothesis of

$$H_0: \quad \alpha = \mathbf{0}_N \quad \text{and} \quad \delta = \mathbf{0}_N \tag{4.13}$$

When the hypothesis (4.13) holds, the N test portfolio is said to be spanned (i.e. dominated) by the K benchmark portfolio as it is possible to find a portfolio of K benchmark assets that has the same mean but a lower variance than the N test portfolio.

4.3.3.1 Traditional tests

HK use a likelihood ratio (LR) test to test the hypothesis (4.13). This test compares the likelihood functions under the null and the alternative hypothesis. Recalling that equation (4.12) can be written in the following matrix form

$$Y = XB + E$$

with Y a TxN matrix of R_{2t}, X a Tx$(K+1)$ matrix of $[1, R'_{1t}]$ rows, $B = [\alpha, \beta]'$, and E a TxN matrix of ε'_t. It is assumed that $T \geqslant N + K + 1$ and $X'X$ is non-singular. In order to obtain the exact distributions of the test statistics, it is further assumed that, conditional on R_{1t}, the error terms ε_t are independent and identically distributed as multivariate normal with mean zero and variance Σ. The maximum likelihood estimators of B and Σ are given by

$$\hat{B} \equiv [\hat{\alpha}, \hat{\beta}]' = (X'X)'(X'Y) \quad \text{and} \quad \hat{\Sigma} = \frac{1}{T}(Y - X\hat{B})'(Y - X\hat{B})$$

Assuming $\tilde{\Sigma}$ the constrained maximum likelihood estimator of Σ and $U = |\hat{\Sigma}|/|\tilde{\Sigma}|$, the LR test of hypothesis (4.13) is given by

$$LR = -T\ln(U) \sim \chi^2_{2N} \tag{4.14}$$

Kan and Zhou (2012) contend that, numerically, the performance of the constrained estimation is not needed in order to obtain the LR test statistic. In fact, the null hypothesis (4.13) can be written as $H_0 : \Theta = 0_{2xN}$ with $\Theta = [\alpha, \delta]'$. The maximum likelihood estimator of Θ is given by $\hat{\Theta} \equiv [\hat{\alpha}, \hat{\beta}]' = A\hat{B} + C$ with

$$A = \begin{bmatrix} 1 & 0'_K \\ 0 & -1'_K \end{bmatrix} \quad \text{and} \quad C = \begin{bmatrix} 0'_N \\ 1'_N \end{bmatrix}$$

The authors further define

$$\hat{G} = TA(X'X)^{-1}A' = \begin{bmatrix} 1 + \hat{\mu}'_1 \hat{V}_{11}^{-1} \hat{\mu}_1 & \hat{\mu}'_1 \hat{V}_{11}^{-1} 1_K \\ \hat{\mu}'_1 \hat{V}_{11}^{-1} 1_K & 1'_K \hat{V}_{11}^{-1} 1_K \end{bmatrix}$$

with $\hat{\mu}'_1 = \frac{1}{T}\sum_{t=1}^{T} R_{1t}$ and $\hat{V}_{11}^{-1} = \frac{1}{T}\sum_{t=1}^{T}(R_{1t} - \hat{\mu}_1)(R_{1t} - \hat{\mu}_1)'$ and contend that

$$\tilde{\Sigma} - \hat{\Sigma} = \hat{\Theta}'\hat{G}^{-1}\hat{\Theta}$$

so that $1/U$ can be obtained from the unconstrained estimate alone as

$$\begin{aligned} \frac{1}{U} &= \frac{\tilde{\Sigma}}{\hat{\Sigma}} = |\hat{\Sigma}^{-1}\tilde{\Sigma}| = |\hat{\Sigma}^{-1}(\hat{\Sigma} + \hat{\Theta}'\hat{G}^{-1}\hat{\Theta})| \\ &= |I_N + \hat{\Sigma}^{-1}\hat{\Theta}'\hat{G}^{-1}\hat{\Theta}| = |I_2 + \hat{H}\hat{G}^{-1}| \end{aligned} \tag{4.15}$$

with

$$\hat{H} = \hat{\Theta}\hat{\Sigma}^{-1}\hat{\Theta}' = \begin{bmatrix} \hat{\alpha}'\hat{\Sigma}^{-1}\hat{\alpha} & \hat{\alpha}'\hat{\Sigma}^{-1}\hat{\delta} \\ \hat{\alpha}'\hat{\Sigma}^{-1}\hat{\delta} & \hat{\delta}'\hat{\Sigma}^{-1}\hat{\delta} \end{bmatrix}$$

Denoting λ_1 and λ_2 as the two eigenvalues of $\hat{H}\hat{G}^{-1}$ with $\lambda_1 \geqslant \lambda_2 \geqslant 0$, we have $1/U = (1 + \lambda_1)(1 + \lambda_2)$ such that the LR test can be written as

$$LR = T\sum_{i=1}^{2} \ln(1 + \lambda_i) \tag{4.16}$$

The authors indicate that, besides the LR test, the hypothesis (4.13) can be tested using the Wald test (W) and the Lagrange multiplier test (LM) test given by

$$W = T(\lambda_1 + \lambda_2) \sim \chi^2_{2N} \quad \text{and} \quad LM = T \sum_{i=1}^{2} \frac{\lambda_i}{1+\lambda_i} \sim \chi^2_{2N} \tag{4.17}$$

However, following the observation by Gibbons et al. (1989) and others, Kan and Zhou (2012) warn that, although LR, W and LM have all an asymptotic χ^2_{2N} distribution, we have $W \geqslant LR \geqslant LM$ in finite samples inducing conflicting results with LM favoring acceptance and W favoring rejection (see also Sentana, 2009). Therefore, they recommend the following F-test

$$\begin{cases} \text{If} \quad N \geqslant 2 : \left(\frac{1}{U^{\frac{1}{2}}} - 1\right)\left(\frac{T-K-N}{N}\right) \sim F_{2N,2(T-K-N)} \\ \text{If} \quad N = 1 : \left(\frac{1}{U} - 1\right)\left(\frac{T-K-1}{2}\right) \sim F_{2,T-K-1} \end{cases} \tag{4.18}$$

4.3.3.2 Step-down test

One of the criticisms of the traditional spanning tests is that they jointly test the two components of the spanning hypothesis (4.13), i.e. $\alpha = 0_N$ and $\delta = 0_N$. Kan and Zhou (2012) argue that, this practice does not take into account the economic significance of the departure from the spanning hypothesis as, though statistically significant, a small difference in the global minimum-variance portfolios is not necessarily as economically important as the statistically hard-to-detect potential big difference in the tangency portfolios. This weakness call on some caution in the interpretation of the tests' results as a low p-value does not always imply an economically significant difference between the two frontiers, the same as a high p-value does not always imply a null contribution of the test assets to the mean-variance profile of the benchmark assets.

The step-down test proposed by Kan and Zhou (2012) is a sequential test that first tests the hypothesis $\alpha = 0_N$, and then $\delta = 0_N$ conditional on the constraint $\alpha = 0_N$. The first hypothesis is

tested using

$$F_1 = \left(\frac{T-K-N}{N}\right)\left(\frac{|\bar{\Sigma}|}{|\hat{\Sigma}|} - 1\right) = \left(\frac{T-K-N}{N}\right)\left(\frac{\hat{a}-\hat{a}_1}{1+\hat{a}_1}\right) \tag{4.19}$$

where $\hat{a} = \hat{\mu}'\Omega^{-1}\hat{\mu}$, $\hat{\mu} = \frac{1}{T}\sum_{t=1}^{T} R_t$, $\hat{\Omega} = \frac{1}{T}\sum_{t=1}^{T}(R_t - \hat{\mu})(R_t - \hat{\mu})'$, and $\hat{a_1} = \hat{\mu_1}'\Omega_{11}^{-1}\hat{\mu_1}$ related to the K benchmark assets, and where $\hat{\Sigma}$ is the unconstrained estimates of Σ and $\bar{\Sigma}$ its estimate with the only constraint $\alpha = 0_N$. Under the null hypothesis, F_1 has a central F-distribution with N and $T-K-N$ degrees of freedom.

The second hypothesis is tested using

$$\begin{aligned} F_2 &= \left(\frac{T-K-N+1}{N}\right)\left(\frac{|\tilde{\Sigma}|}{|\bar{\Sigma}|} - 1\right) \\ &= \left(\frac{T-K-N+1}{N}\right)\left[\left(\frac{\hat{c}+\hat{d}}{\hat{c}_1+\hat{d}_1}\right)\left(\frac{1+\hat{a}_1}{1+\hat{a}}\right) - 1\right] \end{aligned} \tag{4.20}$$

where $\hat{c} = 1'_{N+K}\Omega^{-1}1_{N+K}$, $\hat{d} = \hat{a}\hat{c} - \hat{b}^2$ with $\hat{b} = \hat{\mu}'\Omega^{-1}1'_{N+K}$, defined as previously $\hat{c}_1$,$\hat{d}_1$ related to the K benchmark assets, and where $\tilde{\Sigma}$ is the constrained estimate of Σ with both constraints $\alpha = 0_N$ and $\delta = 0_N$. The authors show that, under the null hypothesis, F_2 is independent of F_1 and has a central F-distribution with N and $T-K-N+1$ degrees of freedom.

Unlike the traditional tests, the step-down test has the advantage of unveiling the cause of the rejection. In fact, a rejection due to the first test means that the two tangency portfolios are statistically very different while the one due to the second test indicates a significant statistically difference between the two global minimum-variance portfolios.

4.3.3.3 Tests under non-normality

The traditional spanning tests are based on the assumption that the error term ε_t is normally, and independently and identically distributed. Kan and Zhou (2012) explore two cases cases of non-normality where 1°) ε_t is non-normal but still independently and identically distributed conditional on R_{1t}, and 2°) ε_t exhibits conditional heteroskedasticity, i.e. its variance is time-

varying and can be expressed as a function of R_{1t}. The authors contend that, for the first case, the conditional homoskedasticity, the traditional tests are still asymptotically χ^2_{2N} distributed under the null hypothesis but their finite sample distributions will not be the same as the ones presented in paragraph 4.3.3.1, though without major harm to their ability to provide a very good approximation for the small sample distribution of the non-normality case.

However, in the case of conditional heteroskedasticity, the traditional test statistics are no longer χ^2_{2N} distributed under the null hypothesis, which affects their suitability. As an alternative, Kan and Zhou (2012) propose a generalized method of moments (GMM) approach based on Ferson et al. (1993). Assume $x_t = \left[1, R'_{1t}\right]'$ and $\varepsilon_t = R'_{2t} - B'x_t$, the GMM moment conditions for the estimation of B are

$$E\left[g_t\right] = E\left[x_t \otimes \varepsilon_t\right] = 0_{(K+1)N}$$

Assuming stationary R_t with finite fourth moments, the sample moments are given by

$$\bar{g}_T(B) = \frac{1}{T}\sum_{t=1}^{T} x_t \otimes (R'_{2t} - B'x_t)$$

and the GMM estimate of B is obtained by minimizing $\bar{g}_T(B)'S_T^{-1}\bar{g}_T(B)$ with S_T a consistent estimate of $S_0 = E\left[g_t g'_t\right]$, assuming the absence of serial correlation of g_t. The GMM version of the Wald test is then written as

$$W_a = T\mathrm{vec}\left(\hat{\Theta}'\right)'\left[\left(A_T \otimes I_N\right) S_T \left(A'_T \otimes I_N\right)\right]^{-1} \mathrm{vec}\left(\hat{\Theta}'\right) \sim \chi^2_{2N} \tag{4.21}$$

where

$$A_T = \begin{bmatrix} 1 + \hat{a}_1 & -\hat{\mu}_1 \hat{\Sigma}_{11}^{-1} \\ \hat{b}_1 & -1'_K \hat{\Sigma}_{11}^{-1} \end{bmatrix}$$

Kan and Zhou (2012) illustrate the case of conditional heteroskedasticity by assuming R_t in-

dependently and identically distributed as a non-degenerate multivariate *elliptical distribution* with finite fourth moments. Given the kurtosis parameter

$$\kappa = \frac{E\left[\left((R_t - \mu)' \Sigma^{-1} (R_t - \mu)\right)^2\right]}{(N+K)(N+K+2)} - 1$$

they argue that the GMM Wald test of spanning is then given by

$$W_a^e = T \operatorname{tr}\left(\hat{H} \hat{G}_a^{-1}\right) \sim \chi^2_{2N} \tag{4.22}$$

with $\hat{H}$ defined as in (4.15) and

$$\hat{G}_a = \begin{bmatrix} 1 + (1+\hat{\kappa})\hat{a}_1 & (1+\hat{\kappa})\hat{b}_1 \\ (1+\hat{\kappa})\hat{b}_1 & (1+\hat{\kappa})\hat{c}_1 \end{bmatrix}$$

where $\hat{\kappa}$ is a consistent estimate of the kurtosis parameter κ.

4.4 Data and empirical results

4.4.1 Data

This paper uses weekly data of stock and bond indices for the US, other developed, emerging and African markets downloaded from the S&P indices website for the period of July 2014 – September 2018[5]. The starting date is justified by the availability of certain African indices, notably the S&P Africa Hard Currency Sovereign Bond Index that has been launched in November 2014 with values starting in June 2014. I specifically use the S&P500, S&P500 Corporate Bond and S&P US Treasury Bond indices for US market, the S&P Developed Ex-US Broad Market Index (BMI), S&P International Corporate Bond, and S&P Global Developed Sovereign ex-US Bond indices for other developed markets. The emerging market is represented by the S&P Emerging ex-Africa and S&P Global Emerging Sovereign Inflation-Linked Bond indices for emerging markets. As concerns Africa, I distinguish the following three investment opportunity sets: the 'All Africa' set made of the S&P All Africa stock index, the S&P Africa Sovereign Bond index and the S&P Africa Hard Currency Sovereign Bond index; the 'Africa ex-SA' set excluding South-Africa and made of the S&P All Africa ex-South Africa stock index and the S&P Africa Sovereign ex-South Africa Bond index; and the 'Frontier Africa' set where I combine the S&P Africa Frontier BMI stock index and the S&P Africa Sovereign ex-South Africa Bond index. I consider the US dollar-denominated version of these indices to ensure comparability and overcome the currency-related risk deemed the single greatest source of volatility in local-currency emerging market debt (Zamora, 2016). Also, these indices are considered at their total return values when applicable to take into account all the possible financial influxes generated by investments in these assets.

The summary statistics and correlations are presented in Table 4.1 and 4.2. The indices average and median returns as well as their volatility (standard deviation) are presented in percentage annualized approximations computed from weekly data. As expected, these statistics indicate

[5]Data and details on the indices can be found on https://us.spindices.com/index-finder/

higher volatility levels for stocks compared to bonds across all the considered markets, with the 'All Africa' stock index exhibiting the highest volatility level followed by its 'Frontier Africa' counterpart. As far as the correlation are concerned, three main observations can be drawn from these figures. One, there seems to be significantly high correlations within the equity asset class across all the considered markets, indicating a higher integration level of equity markets compared to the other considered asset classes. Two, the US government bond index displays negligible correlation levels with the rest of of the considered asset classes and markets; it seems to be only correlated with the US market and, to a certain extent, with only government bonds from other developed markets. Last, the 'Africa ex-SA government bonds' and 'Frontier Africa stocks' sets appear to be the least correlated with other markets and asset classes, particularly with the US market. Worth mentioning is also the rejection of the return normality assumption by the Jarque-Bera test for almost all the considered indices, except the US corporate bond and developed government bond indices.

	N	Mean	Median	St. dev	Skew	Kurtosis	Jarque-Bera
US stocks	217	12.89	17.68	10.36	-0.47	2.74	79.02***
US corp. bonds	217	2.93	4.08	3.30	-0.24	0.32	3.22
US gov. bonds	217	1.09	2.37	2.52	-0.41	0.76	11.66***
Developed stocks	217	4.66	20.87	13.22	-0.46	0.84	14.59***
Developed corp. bonds	217	-0.84	1.13	7.60	-0.46	0.71	12.73***
Developed gov. bonds	217	-0.92	-3.00	7.26	0.02	0.38	1.56
Emerging stocks	217	3.03	28.42	15.49	-0.56	1.13	23.94***
Emerging gov. bonds	217	-3.69	4.54	14.52	-0.45	0.77	13.21***
All Africa stocks	217	-0.42	9.52	20.59	-0.41	0.63	10.14***
Africa LC gov. bonds	217	-1.88	-1.45	11.28	-1.50	6.92	527.07***
Africa HC gov. bonds	217	3.98	7.24	6.76	-0.40	1.20	19.71***
Africa ex SA stocks	217	-10.37	-9.18	14.26	-0.48	0.30	9.30**
Africa ex SA LC gov. bonds	217	-3.13	6.51	10.47	-6.68	60.47	35246***
Frontier Africa stocks	217	-9.40	-3.49	17.01	-0.72	5.95	347.85***

Note: Mean, median and standard deviation are presented in percentage annualized approximations computed from weekly data. As in Li et al. (2003), assets' weekly average returns have been multiplied by 52 and their corresponding standard deviations by $\sqrt{52}$ to get their annual approximate values. ***,** and * indicate the statistically significance at 1%, 5% and 10% respectively.

Table 4.1: Summary statistics and normality test

4.4.2 Empirical results

The results of the evaluation of the diversification benefits of the different considered investment opportunity sets are presented in this section. While keeping the perspective of the US investor, I investigate five scenarios starting with my case of interest, i.e. the diversification over the selected investments possibilities in Africa. Then, for the sake of comparison, this scenario is analyzed alongside the scenario where the investor diversifies over the emerging and developed markets outside his domestic US market. The three other case scenarios investigate African securities diversification benefits when the benchmark US portfolio is already diversified over the emerging or other developed markets, or both. These results are first visualized using efficient frontiers corresponding to each of these scenarios followed formal mean-variance spanning tests to assess the statistical significance of the potential benefits of the US benchmark portfolio diversification over the considered investment opportunity sets.

4.4.2.1 Efficient frontiers

In order to set the ground, I plot on Figure 4.1 the investment universe selected for this study in a $\sigma\mu$-plane to visualize the individual risk-return profile of the considered asset class indices, and how their combination produce better profiles thanks to diversification. On the individual basis, the graph shows that US government bonds are the least volatile of all the considered assets while the 'All Africa' stock index lies on the other extreme of the spectrum with more than 20% annual volatility. However, an interesting observation is that, when grouped per opportunity set, these indices yield improved *minimum-variance* levels compared to the sum of their individual risk levels exactly inline with the portfolio theory predictions. The most stunning case is that of the combination of the 'All Africa' stock, local-currency and hard-currency indices that produce the second-best minimum-variance level after the US combination and ahead of both their counterparts from emerging and developed markets.

		A	B	C	D	E	F	G	H	I	J	K	L	M	N
A	US stocks	1.00***													
B	US corp. bonds	-0.04	1.00***												
C	US gov. bonds	-0.23***	0.82***	1.00***											
D	Developed stocks	0.62***	0.07	-0.11	1.00***										
E	Developed corp. bonds	0.15*	0.24***	0.20**	0.40***	1.00***									
F	Developed gov. bonds	-0.06	0.37***	0.43***	0.15*	0.67***	1.00***								
G	Emerging stocks	0.53***	0.18**	0	0.83***	0.35***	0.20**	1.00***							
H	Emerging gov. bonds	0.25***	0.26***	0.16*	0.34***	0.38***	0.27***	0.52***	1.00***						
I	All Africa stocks	0.47***	0.19**	0.06	0.60***	0.42***	0.33***	0.65***	0.46***	1.00***					
J	Africa LC gov. bonds	0.19**	0.22**	0.17*	0.40***	0.38***	0.40***	0.46***	0.41***	0.52***	1.00***				
K	Africa HC gov. bonds	0.33***	0.28***	0.14*	0.58***	0.37***	0.35***	0.59***	0.45***	0.66***	0.56***	1.00***			
L	Africa ex SA stocks	0.34***	0.14*	0	0.47***	0.30***	0.22**	0.55***	0.39***	0.65***	0.36***	0.44***	1.00***		
M	Africa ex SA LC gov. bonds	0.07	0.14*	0.11	0.09	0.11	0.11	0.15*	0.14*	0.1	0.69***	0.13	0.24***	1.00***	
N	Frontier Africa stocks	0.11	0.04	-0.07	0.23***	0.08	0.04	0.30***	0.09	0.22**	0.14*	0.26***	0.57***	0.16*	1.00***

Note: Pairwise Pearson correlations of the assets' weekly returns. ***,** and * indicate the statistically significance at 1%, 5% and 10% respectively.

Table 4.2: Pairwise Pearson correlations

It can also be observed on this figure that, though the USA opportunity set has the least volatility of all, it still lies at a distance from the *global minimum-variance* point of the *efficient frontier* produced by the combination of all the considered investment opportunity sets, which can arguably be considered as an indication of potential international diversification benefits for a US investor holding a benchmark domestically-diversified portfolio.

The insights on the diversification benefits of the selected African opportunity sets are provided on Figure 4.2. To start with, the benchmark scenario corresponding to US diversified portfolio is presented on Figure 4.2a. The related efficient frontier sets the limits in terms of both minimum variance and expected return the investor can envisage by choosing efficient combinations of the considered assets on this market. The scenario corresponding to the diversification over the African market is presented on Figure 4.2b. This figure indicates the possibility of substantial expansion of the efficient frontier once the considered African investment opportunity sets are integrated to the benchmark portfolio. It can be observed that, while the 'Africa ex-SA' and 'Frontier Africa' sets seem not to affect the minimum-variance level of the benchmark combination, the 'All Africa' set clearly induces a up-leftwards move of the benchmark efficient frontier indicating the possibility of improvement of the minimum-variance level thanks to the diversification over this investment opportunity set. Worth mentioning is also the apparent improvement in the tangency portfolio that appears to be induced by the integration of the 'Africa ex-SA' set. These diversification benefits indication will be subjected to rigorous significance tests in the following paragraphs.

On Figure 4.2c, the potential diversification benefits of the 'All Africa' set is compared to those of the 'Developed' and 'Emerging' sets. The figure clearly displays the distant position of the global minimum-variance point of the 'USA + All Africa' efficient frontier compared to the considered alternatives, suggesting that the 'All Africa' set outperforms these alternatives when it comes to improving the risk profile of the benchmark portfolio. This outstanding performance of African sets appears to be robust to prior integration of the other investment opportunities from emerging and developed markets outside the USA as shown on Figure 4.2d, Figure 4.2e and Figure 4.2f.

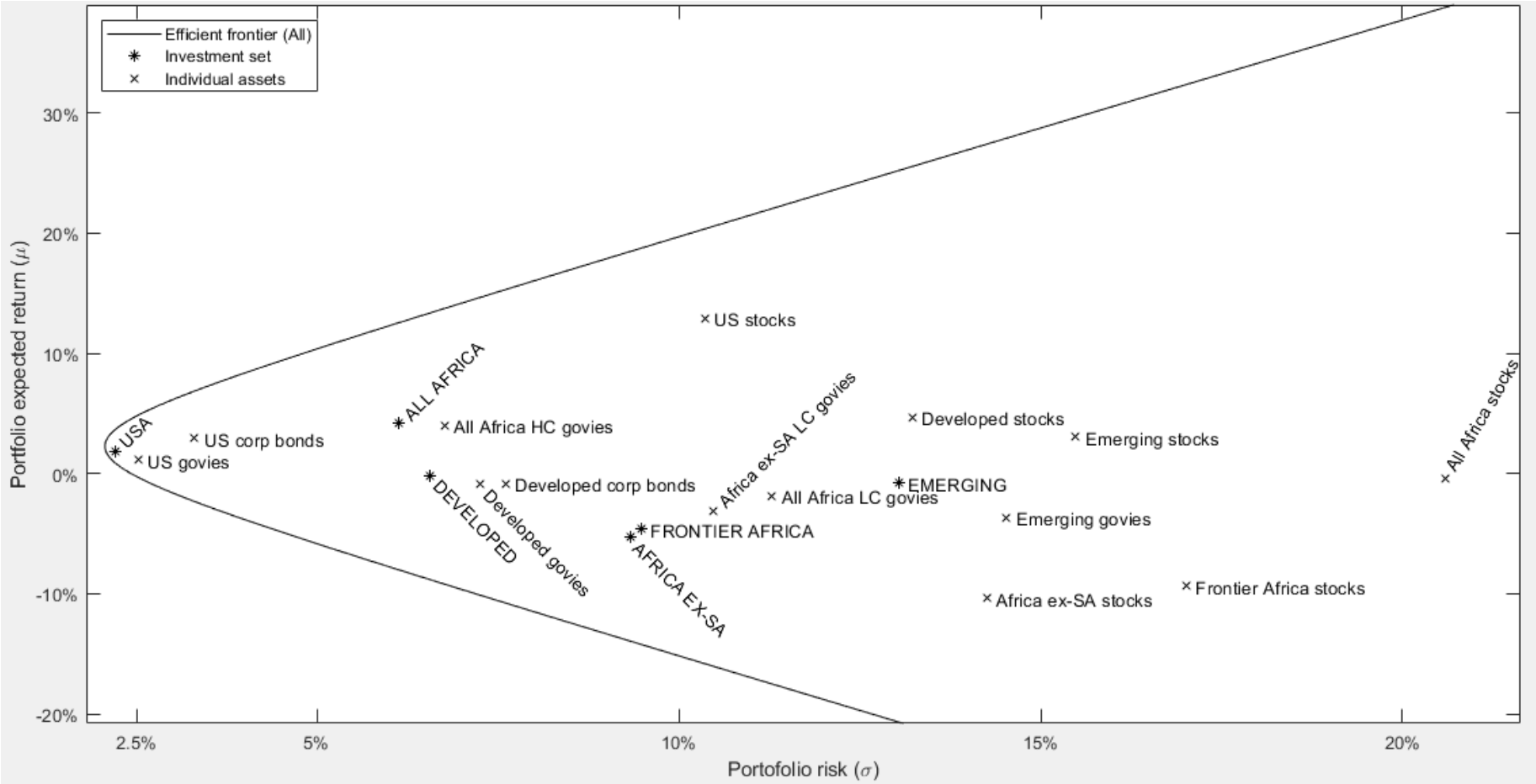
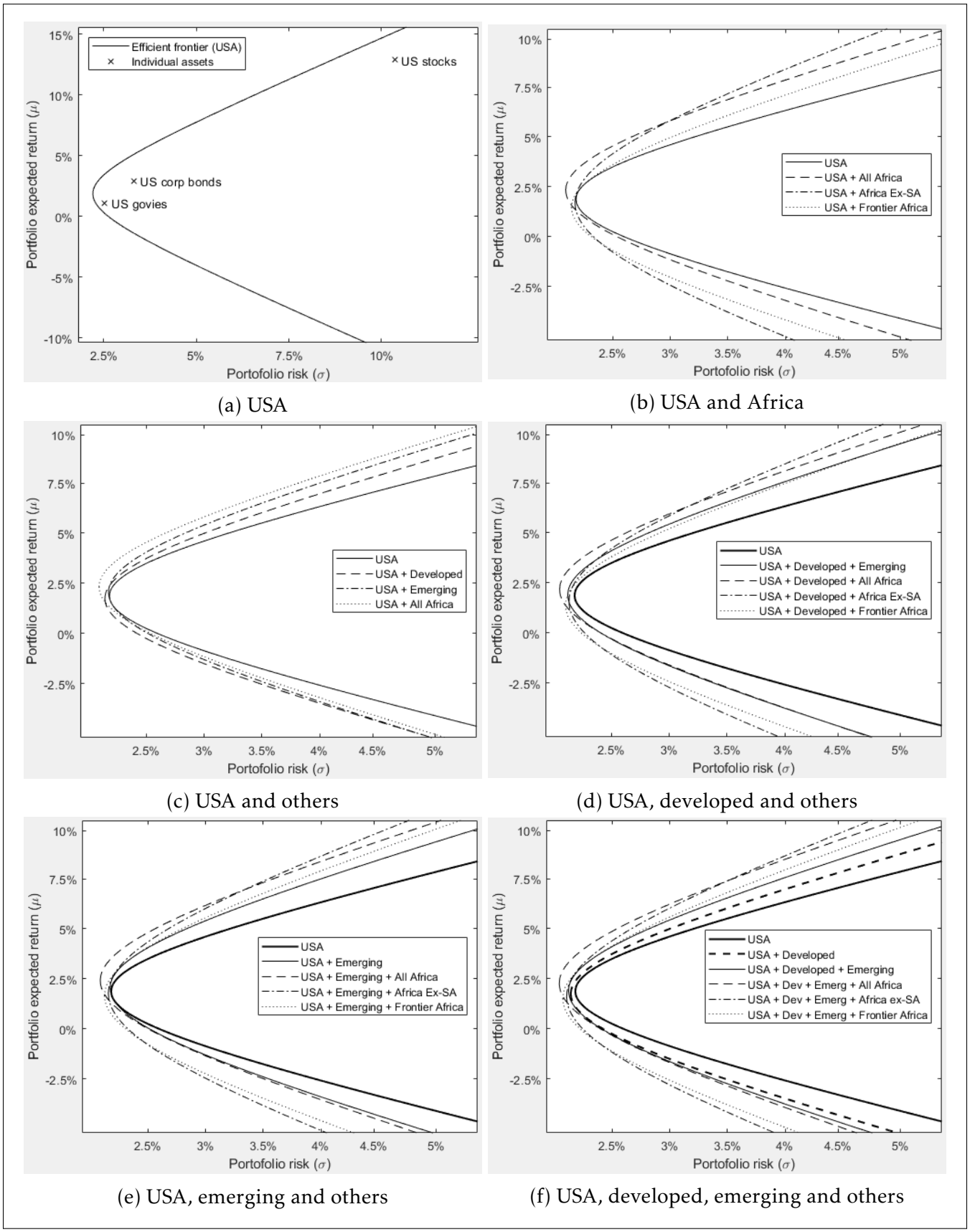


Figure 4.1: Selected investment universe



(a) USA

(b) USA and Africa

(c) USA and others

(d) USA, developed and others

(e) USA, emerging and others

(f) USA, developed, emerging and others

Figure 4.2: Efficient frontiers

The international diversification benefits of African securities is further illustrated in Table 4.3. This table presents the optimal results of the investment scenarios investigated on Figure 4.2 using two strategies, namely the minimum variance strategy that aims at minimizing the portfolio risk and the mean-variance optimization strategy that maximizes the Sharpe ratio, i.e. the portfolio's expected return per unit of risk. To start with the minimum variance strategy, these results show that, across all the investigated scenarios, the lowest portfolio volatility is obtained by the integration of the 'All Africa' set. For instance, it can be observed that the integration of assets from emerging and other developed markets reduces the benchmark portfolio annualized volatility from 2.20% to 2.19% and 2.16% respectively. However, these opportunity sets are outperformed by the 'All Africa' set whose integration lowers the benchmark's volatility to this scenario's minimum of 2.11% and highest Sharpe ratio of 1.10.

	Minimum variance			Mean-variance		
	μ_p	σ_p	SR	μ_p	σ_p	SR
USA	1.86	2.20	0.85	6.36	4.08	1.56
USA + Developed	1.74	2.16	0.80	8.04	4.66	1.72
USA + Emerging	2.04	2.19	0.93	8.11	4.38	1.85
USA + All Africa	**2.32**	**2.11**	**1.10**	7.27	3.75	1.94
USA + Africa ex-SA	1.68	2.19	0.77	**12.83**	**6.07**	**2.11**
USA + Frontier Africa	1.45	2.16	0.67	10.23	5.75	1.78
USA + Developed + Emerging	1.89	2.14	0.88	8.51	4.56	1.87
USA + Developed + All Africa	**2.16**	**2.07**	**1.04**	7.93	3.97	2.00
USA + Developed + Africa ex-SA	1.56	2.15	0.72	**13.57**	**6.37**	**2.13**
USA + Developed + Frontier Africa	1.38	2.12	0.65	11.56	6.16	1.88
USA + Emerging + All Africa	**2.40**	**2.11**	**1.14**	7.91	3.83	2.06
USA + Emerging + Africa ex-SA	1.77	2.18	0.81	**12.64**	**5.84**	**2.17**
USA + Emerging + Frontier Africa	1.65	2.14	0.77	10.91	5.53	1.97
USA + Developed + Emerging + All Africa	**2.26**	**2.06**	**1.10**	8.24	3.95	2.09
USA + Developed + Emerging + Africa ex-SA	1.60	2.13	0.75	**13.38**	**6.15**	**2.17**
USA + Developed + Emerging + Frontier Africa	1.50	2.09	0.72	11.62	5.84	1.99

Note: Portfolio expected return (μ_p) and volatility (σ_p) expressed in percentage annualized approximations as in Table 4.1. SR stands for the Sharpe ratio indicating the return per unit of risk. The mean-variance strategy is presented to illustrate the contribution of the Africa ex-SA set to the benchmark's tangency (return per risk) portfolio. The figures in **bold** correspond to optimal results per investment strategy and diversification scenario.

Table 4.3: Optimal portfolio results

As far as the mean-variance portfolio strategy is concerned, these results show that, despite its minimum volatility across the investigated scenarios, the 'All Africa' set is no longer the most appealing of all the considered investment opportunity sets as it fails to produce the highest portfolio expected return per unit of risk (Sharpe ratio). The results show that this role is better

performed by the 'Africa ex-SA' set whose integration helps attain the highest Sharpe ratio for each of the investigated scenarios. In short, these results underscore the dominance of the 'All Africa' and 'Africa ex-SA' sets' diversification benefits in terms of minimum variance and tangency portfolios respectively once diversified over by an investor holding the US domestically-diversified portfolio. Similar to the observations on Figure 4.2, this performance is not affected by the prior (or simultaneous) integration of investment opportunity sets from emerging or other developed markets (or both) unlike the observation by Piljak and Swinkels (2017).

4.4.2.2 Mean-variance spanning tests

The results of the traditional mean-variance spanning tests are presented in Table 4.4. First of all, as predicted by Kan and Zhou (2012), Sentana (2009) and Gibbons et al. (1989) in case of finite samples, these results consistently feature the inequality $W \geqslant LR \geqslant LM$ across all the investment sets under scrutiny. However, despite this inequality, there appears to be a consistency across the three test statistics regarding the rejection of the spanning hypothesis, which increases the confidence to be attributed to the conclusions of the test.

According to these results, the spanning hypothesis over the 'All Africa' set is rejected at 1% indicating highly significant benefits of diversification over this investment set. This hypothesis is also rejected, though at 5%, for the 'Africa ex-SA' and 'Frontier Africa' sets, which equally support their potential improvement of the benchmark risk-return profile once diversified over. Nonetheless, these three tests have all failed to reject the null hypothesis of spanning in the cases of 'Developed' and 'Emerging' sets indicating the impossibility of statistically significant diversification benefits from the diversification over these sets.

Furthermore, the combination of the 'Developed' and 'Emerging' sets does not help reject the conclusion of these assets' mean-variance spanning conclusion, thus underplaying their diversification benefits for the considered US benchmark portfolio. On the other hand, these results show that African sets still bear significant diversification benefits even in the scenario where the benchmark portfolio is already diversified over the 'Developed' set. It is however important

	W	p-value	LR	p-value	LM	p-value
All Africa	22.6398	0.0016	21.6374	0.0017	20.6961	0.0019
Africa Ex-SA	10.5773	0.0379	10.3697	0.0379	10.1680	0.0379
Frontier Africa	12.1766	0.0201	11.8508	0.0205	11.5366	0.0210
Developed	10.5967	0.1178	10.4206	0.1173	10.2489	0.1167
Emerging	5.1498	0.2879	5.0900	0.2889	5.0311	0.2899
Developed + Emerging	16.2140	0.1187	15.8466	0.1179	15.4916	0.1171
Developed + All Africa	33.1065	0.0022	31.2768	0.0025	29.5918	0.0028
Developed + Africa Ex-SA	19.4231	0.0495	18.9228	0.0486	18.4412	0.0477
Developed + Frontier Africa	22.3721	0.0209	21.4896	0.0218	20.6569	0.0229
Emerging + All Africa	25.3427	0.0084	24.1500	0.0091	23.0358	0.0099
Emerging + Africa Ex-SA	14.2583	0.0932	13.9992	0.0915	13.7469	0.0898
Emerging + Frontier Africa	18.3462	0.0265	17.8976	0.0258	17.4650	0.0251
Developed + Emerging + All Africa	36.6596	0.0060	34.4535	0.0068	32.4375	0.0078
Developed + Emerging + Africa Ex-SA	25.8340	0.0445	25.0009	0.0434	24.2062	0.0424
Developed + Emerging + Frontier Africa	30.3568	0.0136	28.9619	0.0141	27.6608	0.0147

Note: W, LR and LM stand respectively for the Wald, Likelihood Ratio and Langrange Multiplier tests.

Table 4.4: Traditional mean-variance spanning tests

to stress that the spanning hypothesis for the 'Africa ex-SA' set is only rejected at 10% once combined with the 'Emerging' set suggesting a shrink in this set's benefits significance in the case of prior integration of the 'Emerging' set into the benchmark portfolio. This threat to the significance of the diversification benefits of the African investment opportunity sets vanishes when the spanning test is applied to the scenario where the benchmark portfolio is already diversified over both the 'Developed' and 'Emerging' sets.

In substance, these results validate the insights from the efficient frontiers discussed above that it seems unlikely to improve the risk-return profile of the benchmark US diversified portfolio by diversification over assets from emerging and/or other developed markets; only the diversification over investment opportunity sets from Africa are likely to induce diversification benefits to this benchmark portfolio. All the same, it is worth underscoring that this conclusion does not mean that all the studied African investment sets are equivalent with respect to the significance of diversification benefits to the benchmark portfolio. In fact, besides rejecting these assets' mean-variance hypothesis at different levels, these tests provide no indication on whether the rejection of the spanning hypothesis is attributed to the significance of the considered African assets' diversification benefits in terms of tangency or minimum-variance portfolio. This ques-

tion is answered by the step-down test.

	F	p-value	F_1	p-value	F_2	p-value
All Africa	3.5954	0.0017	1.7223	0.1635	5.5434	0.0011
Africa Ex-SA	2.5632	0.0379	3.9793	0.0201	1.1708	0.3121
Frontier Africa	2.9343	0.0205	1.4341	0.2406	4.4765	0.0125
Developed	1.7092	0.1172	0.6989	0.5537	2.7468	0.0439
Emerging	1.2505	0.2889	1.9399	0.1463	0.5681	0.5674
Developed + Emerging	1.5544	0.1178	0.8124	0.5420	2.3205	0.0445
Developed + All Africa	2.5905	0.0025	0.9905	0.4327	4.2829	0.0004
Developed + Africa Ex-SA	1.8628	0.0485	1.6276	0.1540	2.1093	0.0656
Developed + Frontier Africa	2.1218	0.0218	0.8410	0.5220	3.4576	0.0050
Emerging + All Africa	2.3919	0.0091	1.4099	0.2219	3.4125	0.0055
Emerging + Africa Ex-SA	1.7211	0.0915	2.1874	0.0715	1.2647	0.2850
Emerging + Frontier Africa	2.2103	0.0258	1.4116	0.2312	3.0352	0.0184
Developed + Emerging + All Africa	2.1275	0.0068	0.9156	0.5045	3.4110	0.0011
Developed + Emerging + Africa Ex-SA	1.7535	0.0433	1.2530	0.2754	2.2731	0.0299
Developed + Emerging + Frontier Africa	2.0407	0.0141	0.8316	0.5622	3.3139	0.0023

Note: The F-test corresponds the traditional GRS spanning test where F_1 and F_2 relate to the step-down test presented in equations (4.19) and (4.20) respectively.

Table 4.5: Step-down mean-variance spanning test

The results of the GRS F-test of mean-variance spanning as well as the step-down test are presented in Table 4.5. In the first place, the results of the GRS test corroborate the conclusions of the traditional spanning tests performed above as they also reject the null hypothesis of spanning for only the 'All Africa', 'Africa ex-SA' and 'Frontier Africa' sets but not the 'Developed' and 'Emerging' sets. The step-down test goes deep into this analysis by investigating the cause of this rejection and therefore answer the question of which of the tangency or the minimum-variance contribution the investigated asset can be accounted for.

With respect to the objective of this study, the step-down test provides valuable additional information regarding the potential value addition of these individual sets to the optimization of the benchmark portfolio. On one hand, it shows that, though deemed overall significant in terms of diversification, the considered African sets do not affect in the same way the tangency and minimum-variance benchmark portfolios. The null hypothesis of the spanning test is only rejected by the F_2 and not the F_1 tests for the 'All Africa' and 'Frontier Africa' sets, indicating that the diversification over these sets affect only the minimum-variance and not the tangency

portfolio. The same applies to even the 'Developed' set that was deemed not significant by the traditional and GRS tests. On the other hand, while the 'Emerging' set is the only one without sufficient evidence against the spanning hypothesis across all the tests, the 'Africa ex-SA' set appears to be the only one to experience the rejection of the F_1 but not the F_2 step-down spanning test. Combined with the results of the traditional and GRS tests, this observation indicates that the 'Africa ex-SA' set affects rather the tangency portfolio and not the minimum-variance one unlike the other African and the 'Developed' sets. It is the only one of the whole considered investment universe to bear this type of diversification benefits if we believe the results of the step-down test, results that confirm the insights of the efficient frontiers discussed above.

4.4.2.3 Robustness check

The tests of mean-variance spanning performed above using return samples of the US benchmark assets and the test assets from African, emerging and other developed markets have converged to the statistically significance of the benefits of diversification over the investment opportunity sets from Africa, the relative significance of those from the developed and non-significance at all for the investment opportunity sets from emerging markets. However, the normality assumption underlying the above-performed tests lowers the confidence to be attributed to these conclusions from the policy or practitioner point of view given that, in practice, it is widely recognized that asset returns exhibit patterns that deviate from the normal distribution. This robustness check is performed in order to proof-check the validity of these conclusions when the normality assumption is relaxed. I therefore apply, as an alternative, the two GMM versions of the Wald test presented in equations (4.21) and (4.22).

The results of the alternative tests are presented in Table 4.6 alongside those of the traditional Wald-test for sake of comparison. These results provide contradicting indications regarding the rejection of the spanning hypothesis with the W_a validating the conclusions of the traditional Wald test and the W_a^e failing to reject them all except for the 'All Africa' set. So, according to the W_a test, all the investigated sets but the emerging one bear significant diversification benefits while, following the W_a^e test, only the 'All Africa' set can be accounted for statistically

	W	p-value	W_a^e	p-value	W_a	p-value
All Africa	22.6398	0.0009	13.7530	0.0325	32.8520	0.0000
Africa Ex-SA	10.5773	0.0317	7.3834	0.1170	11.0184	0.0264
Frontier Africa	12.1766	0.0161	4.2812	0.3693	11.2619	0.0238
Developed	10.5967	0.1017	8.3466	0.2138	14.8342	0.0216
Emerging	5.1498	0.2723	4.5001	0.3425	4.4144	0.3528
Developed + Emerging	16.2140	0.0937	12.6648	0.2430	20.2091	0.0273
Developed + All Africa	33.1065	0.0009	21.9357	0.0382	61.2872	0.0000
Developed + Africa Ex-SA	19.4231	0.0352	10.3731	0.4084	31.1562	0.0006
Developed + Frontier Africa	22.3721	0.0133	8.2639	0.6031	36.6161	0.0001
Emerging + All Africa	25.3427	0.0047	16.4284	0.0880	35.2697	0.0001
Emerging + Africa Ex-SA	14.2583	0.0753	8.9988	0.3424	14.7666	0.0638
Emerging + Frontier Africa	18.3462	0.0188	7.4833	0.4855	18.6251	0.0170
Developed + Emerging + All Africa	36.6596	0.0023	24.9808	0.0702	65.9381	0.0000
Developed + Emerging + Africa Ex-SA	25.8340	0.0272	12.9182	0.5330	35.4137	0.0013
Developed + Emerging + Frontier Africa	30.3568	0.0068	11.7601	0.6256	41.1654	0.0002

Note: W corresponds to the traditional Wald spanning test while W_a and W_a^e correspond respectively to the general Wald-GMM and the specific case of Wald-GMM under the assumption of conditional heteroskedasticity with R_t independently and identically distributed as a non-degenerate multivariate *elliptical distribution*.

Table 4.6: Alternative mean-variance spanning tests

significant diversification benefits for the benchmark US diversified portfolio. These confirmed diversification benefits of the 'All Africa' seem to vanish when this set is combined with the emerging set, according to the W_a^e test.

Several reasons can explain the observed conflict between the W_a^e and W_a tests. One, while the W_a test results are valid for all distributions, the W_a^e is a specific case where returns are assumed to follow a multivariate elliptical distribution and its results are only valid when this assumption holds. Since this assumption has not been tested, it may be possible that these conflicting results emanate from the failure of the W_a^e test due to a misspecification of the underlying returns distribution. Two, Kan and Zhou (2012) demonstrate that these two tests tend to suffer from the sample characteristics with W_a tending to be inflated such that $W_a^e \leqslant W_a$ in small samples. They stress that, in addition to the compliance to the underlying distribution, the W_a^e test requires a sufficiently large N and preferably a small T to produce reliable results while the W_a test is rather precise with a small N. With $T = 217$ and $N \leqslant 8$ in this case, it seems reasonable to lean towards the validity of the W_a test which is deemed more precise in such cases. In this perspective, the validation of the tradition test results by the W_a test can be seen as a proof of these

results' robustness to conditional heteroskedasticity in the returns. Either way, a more conservative opinion would tend to also consider the W_a^e results and conclude for the overwhelming rejection of the spanning hypothesis for the sole 'All Africa' set across all the test specifications, thus indicating the unequivocal benefits of diversification over this investment opportunity set for a US investor holding the considered benchmark US diversified portfolio.

In summary, three main conclusions can be drawn from the results of this investigation of international diversification benefits of selected African investment opportunity sets from the perspective of a US investor in comparison to their counterparts from emerging and other developed markets. Firstly, there are substantial evidence in favor of the benefits of international diversification over the selected African investment opportunity sets for an investor holding a US domestically-diversified portfolio. Secondly, there are strong indications of the possibility of improving both the risk and return profiles of the US benchmark portfolio by an adequate selection of African investment opportunity sets. In fact, the results of the step-down test have shown that the integration of the 'All Africa' or 'Frontier Africa' sets can improve the minimum-variance of the benchmark portfolio while the 'Africa ex-SA' set can potentially improve the benchmark tangency portfolio. Finally, the prior diversification of the benchmark over the international set does not seem to abate the diversification potential of these African sets; some caution is however recommended when the benchmark is already diversified over the emerging set.

Overall, these results are in one way or the other related to the general conclusions of the studies on diversification benefits of emerging and frontier markets (see Berger et al., 2011, 2013; Driessen and Laeven, 2007; Jayasuriya and Shambora, 2009; McDowell, 2017). For instance, the significantly high performance of selected asset classes from Africa supports the main conclusion by Driessen and Laeven (2007) that the gains from international portfolio diversification appear to be largest investments in developing countries, particularly those with high country risk. However, they qualify in the case of Africa the conclusion by Piljak and Swinkels (2017) about the limited diversification benefits of US dollar-denominated debt issued by governments of frontier markets due to their substantially high correlation with the US market; the inclusion

of the African hard currency government bond index in the 'All Africa' set does not seem to have affected this set's outstanding performance in comparison to the other available investment opportunity sets. Finally, except the 'Africa ex-SA' set, these results substantiate the observation by McDowell (2017) that the international diversification benefits the benchmark US investor more in terms of reduction in the portfolio risk rather than the increase in portfolio expected return.

Nevertheless, the overwhelming evidence of the international diversification benefits of African assets should not overshadow the transaction cost headwinds attached to financial trades in frontier markets. Marshall et al. (2015) underscore that these costs can be considerably high and inhibit the materialization of diversification benefits, particularly for case of monthly portfolio rebalancing. Investors should therefore consider these authors' recommendation for a quarterly or longer portfolio rebalancing period to safeguard the diversification gains from this market. In the same token, the incentives to invest in these rewarding opportunities in Africa should be appreciated with due consideration to the risks they entail not only to the investor and but also to the borrowing countries. So far, the enthusiasm of investors seems to have been directed towards the hard-currency denominated assets which, in most cases, expose borrowing countries to exchange rate risks that might be particularly severe for commodity-dependent countries such as those of Africa. Ideally, investors would consider participating in domestic local currency-denominated markets and find a way to diversify the related risks. Some valuable insights in this direction can be borrowed from the analysis by Zamora (2016) in the case of emerging markets (EM henceforth) local-currency sovereign bonds. The authors breaks down these assets' total returns into three components, namely the duration (including the return of local currency bonds after hedging out the currency risk), the carry (capturing the differential between money market rates in EM and those in US dollars) and currency (capturing the changes in spot exchange rates in EM currencies versus the US dollar) components and spots the different risks associated to each of these components. Although he acknowledges the currency-related risks as the major source of EM total return volatility, he also highlights a significantly positive and less-volatile contribution of the carry component to these returns, thus indicating some offsetting possibilities between currency-risks and carry-gain exposures that, if well strategized,

could help investors generate significant gains from their investments in such assets. Moreover, the availability of currency risk hedging possibilities for emerging and frontier markets by institutions such as the Currency Exchange Fund (TCX) should be harnessed by investors interested in diversification opportunities in Africa[6].

[6]The Currency Exchange Fund (TCX) was founded in 2007 by a group of development finance institutions (DFIs), specialized microfinance investment vehicles (MIVs) and donors to offer solutions to manage currency risks in emerging and frontier markets. It offers hedges for currencies of most of Africa, Asia and Latin America for maturities up to 30 years. More details can be found on https://www.tcxfund.com/

4.5 Conclusion

This study has investigated the diversification potential of African securities from the perspective of a US investor. Building on the observed enthusiasm of international investors for sovereign eurobonds from Africa, I have striven to bring the portfolio optimization perspective into the debate about this investors' enthusiasm by analyzing the potential contribution of African securities to a benchmark US diversified portfolio in comparison to that of their peers from the emerging and developed markets outside the USA. A mean-variance spanning approach has been used and a battery of tests has been applied to a sample of weekly returns on selected asset classes from these markets for the period July 2014 – September 2018 to assess the statistical significance of the potential contribution of African securities to the risk-return profile of the benchmark portfolio.

Three main points summarize the findings of this study. First, unlike their counterparts from emerging and other developed markets, the selected African investment opportunity sets offer statistically significant diversification benefits to the benchmark US diversified portfolio made of the S&P500, S&P500 Corporate Bond and S&P US Treasury Bond indices. In fact, all the deployed mean-variance spanning tests have failed to reject the null hypothesis of the benchmark portfolio spanning the selected emerging and developed markets' asset classes, indicating the impossibility for these assets to impact the benchmark portfolio's risk-return profile once diversified over; only the considered African assets have proved to bear significant diversification benefits to this benchmark portfolio. Second, the diversification benefits of the 'All Africa' and 'frontier Africa' sets have proved only significant in terms of variance minimization but not in terms of increased expected portfolio return. An exactly opposite observation has been made for the 'Africa ex-SA' which is indicated to have no significant impact in terms of risk but rather a significantly positive contribution to the return profile of the benchmark portfolio, making it the only one of the whole considered investment universe to bear significant diversification benefits in terms of tangency portfolio. Third, the prior integration of investment opportunity sets from the emerging or developed world has not proved to abate the diversification benefits

of these African securities.

Against this backdrop, it seems reasonable to conclude for the possibility of an investor holding a US domestically-diversified portfolio to reach substantial international diversification benefits by investing in selected the African securities. This observation constitutes to a certian extent a justification for the observed appetite of international investors for African securities as, beyond the influence of global and debtor's economic conditions, investors may rightfully get interested in these securities for international diversification purposes. The ongoing strides in domestic capital markets across Africa, the availability of investable indices as well as the existence of hedging possibilities covering most of the African currencies should incentivize international investors to fully tap the diversification opportunities of the African market beyond the sole hard currency government bonds advertised and traded on major developed financial markets.

This research has used weekly returns covering a four year period, a reasonably short period to assumes the stability of the coefficients of the return-generating model underlying the different mean-variance spanning tests. Based on the observation by Huberman and Kandel (1987), it is possible that this coefficients' stability assumption would no longer hold once a longer period is considered. As more data become available, it would be interesting to test the robustness of my conclusions to changes in the sample size and/or data frequency. Besides, some studies have underscored the burden of high transaction costs associated to trades in frontier markets, especially when investors consider shorter portfolio rebalancing periods. The investigation of how these results are affected by the consideration of transaction costs constitutes as well an interesting avenue for future research in this domain.

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Chapter 5

Does access to international capital markets affect investment dynamics in Sub-Saharan Africa ? **

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Abstract

This study investigates the influence of government borrowing through international capital markets on investment dynamics in Sub-Saharan Africa (SSA). Using a pool of 42 countries from this region for the period 1995-2017, we apply the synthetic control method to selected eurobond issuers to assess whether and how this kind of international borrowing affects private, public and FDI in these countries. We also carry out a panel-VAR analysis to investigate the potential heterogeneity in these variables' interactions between SSA market access and non-market access economies based on a sub-sample of 16 countries for each of the two categories. Our results suggest that government and private investment dynamics have not been affected by governments' borrowing through international capital markets, but that this move may have boosted these countries' capacity to attract FDI as indicates the experience of Gabon and Ghana. As concerns the interactions, we find indications of substantial heterogeneity in our variables' interactions between these two categories of SSA countries, interactions that appeal for better synergy between government and private investment, especially in market access economies.

Keywords: Investment, synthetic control method, panel VAR, Sub-Saharan Africa

JEL classification: C33, E22, H54, F21, O55

5.1 Introduction

Right from the beginning of the 21st century, Sub-Saharan Africa (SSA) countries have marked an impressive economic performance thanks to favorable commodity prices and notable improvements in their macroeconomic accounts stances at the completion of the Heavily Indebted Poor Countries (HIPC) and Multilateral Debt Relief Initiative (MDRI) initiatives by the International Monetary Fund (IMF) and the World Bank to help poor countries address the then protracted and unsustainable issue of excessive external debt. Up to recently, SSA countries have recorded annual economic growth rates averaging to 4.6% from 1999 to 2016, next to the emerging and developing Asia (7.4%) and above Latin America (2%) and the world average of 3.4% for the same period (IMF, 2017). This SSA growth story has coincided with the rise of new economic powers such as the BRICs and other emerging economies that have intensified their economic presence in SSA providing considerable amounts of aid, loans and foreign direct investment (FDI) to strengthen their diplomatic and economic ties with the region. For instance, it is reported that more than 1700 projects in over 50 African countries were funded by China for over US$ 75 billion between 2000 and 2012 (Amusa et al., 2016)[1].

While the SSA region was experiencing a revival of economic growth, the world economy was suffering the consequences of the global financial and European sovereign debt crises of the mid-2000s and early 2010s that caused global recession and protracted economic slowdown in advanced economies. SSA was particularly affected in different ways: on one hand, it experienced direct negative effects due to shrinking exports revenues, FDI and foreign aid (Allena and Giovannetti, 2011). This loss in revenues definitely deprived SSA from valuable resources for economic development fostering and poverty alleviation. On the other hand though, government stimulus packages meant to revive economic activity in advanced economies created more liquidity and thus resulted in unprecedented low interest rates in their domestic markets. This situation has been exploited to the advantage of some SSA countries which, for the first

[1]More development project funds amounting to US$ 60 billion were pledged by the Chinese president at the China-Africa summit in Johannesburg in December 2015. See https://blog-imfdirect.imf.org/2015/12/21/china-and-africa-will-the-honeymoon-continue/

time, have started mobilizing financial resources through international capital markets. From 2006 to late 2017, 16 SSA countries have managed to collect around US$ 36.5 billion through sovereign and/or government-guaranteed eurobonds with most of them being oversubscribed for more than 5 times their issue sizes according to various media outlets, thus indicating a high investors' appetite for debt securities coming from this region. Parallel with this, an increasingly important development of local-currency bond markets has been observed across many SSA countries (Berensmann et al., 2015; Essers et al., 2016; Dafe et al., 2018).

Overall, with the intensification of ties with new economic powers as well as the development of local-currency bond markets and the resort to international capital markets, SSA is indeed experiencing the 'age of choice', a term coined by Prizzon et al. (2017) to indicate the expanding access of developing countries to a variety of development finance sources beyond official development assistance (ODA). However, much as this diversification of funding sources can be deemed favorable for SSA countries after having for long been constrained by limited capacity in terms of financial resources mobilization, it remains debatable whether these macroeconomic dynamics at both the global and these countries' domestic levels will help spur sustainable economic growth and development in this region. In addition to the concerns about the risk of a resurgence of debt crises following this new wave of borrowings through international capital markets, this skepticism is beefed up by the mixed impact of foreign aid on growth and poverty eradication in recipient countries documented in the literature (Bulír and Hamann, 2008; Hudson, 2014; Moyo, 2009). For instance, Djankov et al. (2008) stress the negative impact of foreign aid on institutions in recipient countries mainly due to its resulting rent seeking behavior akin to that documented in the 'curse of natural resources' literature (Sachs and Warner, 2001). Also, though it is obvious that this broadened access to funding is boosting government spending, it is less obvious that these increases in public spending is stimulating sustainable growth and development in these countries given the ambiguous relationship between public spending and economic growth – especially in presence of weak institutions – corroborated in the empirical literature (Herzer and Grimm, 2012; Everhart and Sumlinski, 2001; Bouton and Sumlinski, 2000; Furceri and Sousa, 2011; Dollar and Easterly, 1999).

It is widely accepted that the success and sustainability of economic growth and poverty reduction policies depend heavily on their impact on the development of the domestic private sector (Bouton and Sumlinski, 2000; OECD, 2006)[2]. This belief seem to be shared by decision-makers in SSA market economies[3] who justify to some extent their resort to international capital markets as an opportunity 'to register on the investors' radar' (Bertin, 2016), and to relax the public-private competition over the domestically available funds to the advantage of the private sector[4]. Specifically, the use of proceeds stated in many of the SSA eurobond prospectuses indicate a plan by borrowing countries to embark on massive soft and hard infrastructure investments to stimulate private investment and thus sustain their growth and socioeconomic development.

However, the unanswered question is whether these soaring public investments will necessarily boost private investments considering the inconclusive theoretical debate and empirical evidences of public investment's crowding-in or crowding-out effects on private investment (Alani, 2006; Beaugrand et al., 2002; Barro, 1989; Emran and Farazi, 2009). Besides, it is not granted that SSA governments' exposure to international capital market may necessarily attract more FDI in the considered countries and, even in the affirmative case, it cannot be taken for granted that the increased flow of FDI necessarily favor domestic private investment given the mixed results of empirical studies on the relationship between these two aggregates (Morrissey and Udomkerdmongkol, 2011; Danakol et al., 2013; Ndikumana and Verick, 2008; Farla et al., 2016). Likewise, it is not straightforward that the glut of foreign aid from mainly the new economic powers can catalyze private investment development in recipient countries given the equivocal conclusions of empirical researches on the relationship between foreign aid and private investment (Herzer and Grimm, 2012; Minoiu and Reddy, 2009).

[2]This mainstream belief is challenged by Devarajan et al. (2001) who find that the positive and significant impact of private investment on GDP growth in Africa is driven by the presence of Botswana in the sample and that omitting Botswana eliminates the finding

[3]This identifier has been used by the IMF (2014) to refer to countries that borrow from international capital markets.

[4]This was for instance recognized by the Ghanaian Minister of Finance who stated on June 23rd, 2015 that "Ghana's planned eurobond will prevent the government from borrowing from the domestic money market and in turn reduce the chances of crowding out the private sector by ensuring small and medium enterprises can access loans at affordable rates". See for details http://afkinsider.com/98707/ghanas-eurobond-will-help-private-sector-by-containing-local-rates/

Several studies have investigated investment dynamics in SSA. Some of them have analyzed the interactions between public and private investment, FDI as well as other macroeconomic variables, and their impact on economic growth with a regional or country-specific focus (Ndikumana and Verick, 2008; Anyanwu, 2006; Adams, 2009; Boateng et al., 2017). Others have focused on the influence of institutions quality and reforms on these interactions and their ultimate effect on countries' sustainable growth and development (Fowowe, 2011; Mlambo and Oshikoya, 2001; Farla et al., 2016). These studies have in common that they tend to consider the quality of institutions as exogenous and use its proxy measures as either explanatory or simply control variables in their models. Despite the intuitive character of their results tending to homogeneously compute and explain the marginal contribution of institutions quality to changes in the variable of interest, these studies discard the empirical evidences that this very quality of institutions may itself be endogenously determined through the same or other macroeconomic structures and dynamics that circumscribe its scope and set predictable heterogeneous institutions quality levels across the studied countries.

For instance, besides the 'curse' of natural resources and foreign aid theory underscoring the negative impact of these windfall resources to the quality of institutions in recipient countries (Djankov et al., 2008; Sachs and Warner, 2001), some evidences of market discipline suggesting strong incentives for better institutions resulting from SSA countries' access to and interactions with international capital markets have been documented in the literature (Senga et al., 2018; Senga and Cassimon, 2019). Therefore, it seems reasonable to expect a significant difference in the quality of institutions between SSA market access and non-market access economies, difference that may as well influence the magnitude and direction of the impact of the ongoing macroeconomic dynamics on investment and economic growth in SSA. This avenue has been explored by Djimeu (2018) who finds a difference in the impact of the HIPC initiative on public, private and FDI between SSA market access and non-market access countries. However, in spite of the commendable insight on difference in dynamics between these two categories of SSA countries, this last paper proxies access to international capital markets by the amounts of net FDI received, using their terciles to categorize them as low, medium and high market access

countries. In our view, the use of net FDI inflows as an indicator of international markets' access is unsatisfactory because, although FDI is a financial balance of payments concept (Farla et al., 2016), it is not obvious that the related transactions occur only through international capital markets.

Consistent with the definition by IMF (2014), our paper considers as 'market economies' SSA countries which have at least once issued debt securities that are quoted and traded on international capital markets, typically sovereign or government-guaranteed eurobonds. Using a pool of 42 countries from this region for the period 1995-2017, we apply the synthetic control method to selected eurobond issuers to assess whether and how this kind of international borrowing affect private, public and foreign direct investment in these countries. We then extract a sub-sample encompassing all of the 16 SSA market economies and 16 non(yet)-market economies to evaluate the potential difference in these variables' interactions between these two sets of countries. By using the issuance of eurobonds as the demarcation criterion between SSA market and non-market access economies, we contribute to the literature by underscoring the determinant influence of market incentives on the quality of institutions and how this difference in institutions quality may affect not only the magnitude but also the dynamics of these investment variables in SSA.

As a primer to our results, we observe a significant increase in foreign direct investment in Gabon and Ghana subsequent to their maiden eurobond issuance but no significant effect with respect to private and government investment in any of the studied countries. As concerns the interactions, we find a considerable heterogeneity between the two categories marked chiefly by a unidirectional impact of government investment on the other variables in market access economies and a feedback loop among the three variables in non-market access economies. This heterogeneity may explain to some extent the insignificant difference in private investment levels between the two categories despite the relatively higher levels of government investment and FDI, as well as better scores in financial development and institutions quality in SSA market access economies. Overall, our findings do not provide conclusive indications that the difference in investment levels between these two categories could be attributable to the sole access to

international capital markets. However, they suggest fundamental differences in investment between SSA market access and non-market access economies. The rest of the paper is organized as follows: we discuss the relevant literature on investment dynamics in Africa in Section 5.2 and outline our methodology in Section 5.3. Section 5.4 is devoted to the description of our data and the presentation of our main results, followed by some concluding remarks and recommendations in Section 5.5.

5.2 Literature review

An important body of literature has been devoted to the private investment behavior in developing countries, particularly in SSA. Already in the early 90s, Oshikoya (1994) investigated the macroeconomic determinants of private investment using a sample of 7 SSA countries for the 1970 – 1988 period and found a significant public investment crowding-in effect on private investment in addition to a positive effect of real exchange rates and an unambiguous negative impact of macroeconomic instability indicators such as inflation and changes in terms of trade. Quite similar results were found a bit later by Ghura and Goodwin (2010) who also find a significant government investment crowd-in effect for SSA using a sample covering Asia, Latin America and SSA for 1975 – 1992. They also highlight the adverse effects of external shocks and the insignificance of real GDP growth on private investment in this region. The results of the study by Mlambo and Oshikoya (2001) add a institutions dimension to these traditional determinants of private investment by underscoring the crucial influence of political stability in investment decisions in Africa.

This influence of institutions quality on the interaction between private investment and its key determinants has also been investigated. Dollar and Easterly (1999) investigate the case of African countries and contend that the quality of economic policies determines the linkages between foreign aid and investment, and between investment to economic growth. An even deeper insight into the influence of institutions quality is provided by Everhart and Sumlinski (2001) who analyze investment dynamics in 63 countries for the period 1970-2000 and find that corruption entails public investment crowding-out by lowering the quality of public investment which in turn lowers private investment. Morrissey and Udomkerdmongkol (2011) explore the impact of institutions on the private investment and FDI using 46 developing countries for the period 1996 – 2009 and find that FDI crowd-out domestic private investment, and this effect is exacerbated in politically stable regimes. However, this finding is objected by Farla et al. (2016) who rather find an FDI crowding-in effect and no evidence of the influence of good governance on domestic investment after improvements in the construction of the proxies and refinements

in the estimation methodology used by Morrissey and Udomkerdmongkol (2011).

The linkages between private investment and FDI in developing countries has particularly attracted researchers' curiosity. Ndikumana and Verick (2008) use a sample of 38 SSA countries for the period of 1970 – 2005 and find a two-way relationship between private investment and FDI. Boateng et al. (2017) explore the complementarity of financial development and FDI on investment in SSA using a panel of 16 SSA countries for the period 1980 – 2014. Their findings indicate that financial development constitutes an important channel through which FDI influences domestic investment. Asiedu (2002) compares the drivers of FDI across 71 developing countries from 1970 to 1999 and find a significant difference between Africa and other regions regarding the reaction of FDI to some of its key determinants such as the return on investment, infrastructure and openness to trade. In the same vein, Kurul (2017) analyze the linkages between institutional factors and FDI using an extended sample of 126 countries over the period 2002 – 2012 and find a nonlinear relationship indicating the existence of a minimum threshold for the institutions quality to positively affect FDI.

Close to our research is the study by Djimeu (2018) who investigates the effect of SSA countries' participation in the HIPC initiative and MDRI on growth and investment. He finds that the two phases of the enhanced initiative, i.e. the decision point and post-completion point periods, are positively associated with increases in public and private investment levels in participatory countries. More importantly, he suggests that these impacts are heterogeneous between SSA market access and non-market access economies. We deviate from this literature by considering the issuance of eurobonds as the demarcation criterion between SSA market and non-market access economies. We focus on the potential of market incentives to influence the quality of institutions to evaluate whether and how access to international capital markets affects investment magnitudes and dynamics in SSA.

5.3 Methodology

5.3.1 Synthetic control method

We apply the synthetic control (SC) method to evaluate whether international borrowing through international capital markets has a significant impact on private investment and domestic banks' financing of the private sector. This method has gained popularity in the impact evaluation of social and economic measures and events. To name a few, the method was used by Abadie and Gardeazabal (2003) to assess the effects of terrorist conflict on business in the Basque country; Abadie et al. (2010) apply the SC method to estimate the effect of California's tobacco control program. This method has been used by the same authors to evaluate the economic impact of the 1990 German reunification on West Germany (Abadie et al., 2015). Essers and Ide (2019) uses the same method to evaluate the effects of the IMF flexible credit line arrangements on Mexican, Colombian and Polish external financing costs and capital infows.

The SC method evaluates the effects of the measure, intervention or event of interest as the difference in outcomes between the 'treated' unit and a 'synthetic control' during and/or after the treatment (i.e. measure implementation, intervention or event occurrence). The synthetic control is constructed as a weighted combination of potential control units composing the 'donor pool'. Assuming that we observe $P+1$ units and only 1 unit is treated, our donor pool is then made of the P untreated and thus potential control units. As posited in Abadie et al. (2010), assuming the treated unit is uninterruptedly exposed to the intervention of interest and posing Y_{it}^N the outcome of unit i at time t in the absence of intervention, for units $i = 1,\ldots,P+1$ and $t = 1,\ldots,T$, T_0 the number of pre-intervention periods, with $1 \leqslant T_0 < T$ and Y_{it}^I the outcome of unit i at time t if i is exposed to the intervention in periods T_0+1 to T, and assuming that the intervention has no effect on the outcome before the implementation period, we have that $Y_{it}^I = Y_{it}^N$ for $t \in \{1,\ldots,T_0\}$ and all $i \in \{1,\ldots,N\}$.

In general, the observed outcome for any unit i at any time t is given by

$$Y_{it} = Y_{it}^N + \alpha_{it} D_{it}$$

with α_{it} the effect of the intervention for unit i at time t and D_{it} defined as

$$D_{it} = \begin{cases} 1 & \text{if } i = 1 \quad \text{and} \quad t > T_0 \\ 0 & \text{otherwise} \end{cases}$$

Since we assume that only unit 1 has been exposed to the intervention and only after T_0 (with $1 \leqslant T_0 < T$), the intervention effect $(\alpha_{1T_0}, \ldots, \alpha_{1T})$ for $t > T_0$ is given by

$$\alpha_{1t} = Y_{1t}^I - Y_{1t}^N = Y_{1t} - Y_{it}^N$$

Abadie et al. (2010) prove that α_{1t} can be estimated using

$$\widehat{\alpha}_{1t} = Y_{1t} - \sum_{i=2}^{P+1} w_i^* Y_{it}$$

for $t \in \{T_0 + 1, \ldots, T\}$ with w_i^* the optimal weights minimizing the root mean squared prediction error (RMSPE) of the outcome variable over the pre-intervention period given by

$$\text{RMSPE} = \sqrt{\frac{1}{T_0} \sum_{t=1}^{T_0} \left(Y_{1t} - \sum_{i=2}^{P+1} w_i Y_{it} \right)^2}$$

In order to assess the quality of the fit, Adhikari and Alm (2016) propose the normalization of the RMSPE using the 'Benchmark RMSPE' defined as the RMSPE obtained from a zero fit model

given by

$$\text{Benchmark RMSPE} = \sqrt{\frac{1}{T_0}\sum_{t=1}^{T_0}(Y_{1t})^2}$$

They then define the 'Fit index' given by

$$\text{Fit index} = \frac{\text{RMSPE}}{\text{Benchmark RMSPE}}$$

This index ranges within [0,U] indicating that the RMSPE is obtained when the treated and the synthetic unit is (U x 100)% on each pretreatment year (Adhikari and Alm, 2016; Essers and Ide, 2019). The fit is deemed perfect if the fit index is 0, i.e. the RMSPE is 0. However, a fit index equal to 1 means that the fit is equal to that created by a zero fit model. Thus, an index of one or more indicates a particularly poor fit (Essers and Ide, 2019).

Moreover, Abadie and Gardeazabal (2003) propose the 'placebo' test where the synthetic control method is applied to every control unit in the sample (the donor pool) to produce a *counterfactual* of how the treated unit would have behaved in absence of the treatment. This inferential exercise examines whether the estimated effect of the actual intervention is large relative to the distribution of the effects estimated for the units not exposed to the intervention, which would confirm the difference in post-intervention outcomes between the treated and untreated units.

We apply the SC method to SSA market access economies using a pool of 42 countries from the region to evaluate the effect of government external borrowing through sovereign and government-guaranteed eurobonds on private and government investment, and FDI. For each of the countries under investigation, we consider as treatment the debut eurobond issuance and constitute a donor pool of the maximum possible of SSA countries that had never issued eurobonds at the time of the treatment.

5.3.2 Vector autoregression (VAR) estimation

The interactions among private investment, government investment and FDI have been studied using a panel-VAR model where all these variables are treated as endogenous to the model. We therefore adopt the specification of Abrigo and Love (2016) and consider the following equation to be estimated with the generalized method of moments (GMM) method:

$$Y_{i_t} = \sum_p Y_{i_{t-p}} \beta_p + X_{i_t} B + \alpha_i + \varepsilon_{i_t} \tag{5.1}$$

with Y_{i_t}: the vector of dependent variables; p: the optimal lag of the VAR system; β: the structural coefficient associated to the endogenous variables coefficients; X_{i_t}: the set of exogenous variables; B: the structural coefficients associated to the exogenous variables; α model constant; ε_{i_t}: the model error term.

The inclusion of exogenous variables is motivated by the results of previous studies on the determinants of private investment, government investment and FDI in SSA. We specifically focus on the variables that have proved significant in explaining investment dynamics such as trade openness, official development assistance, external debt, the terms of trade, real exchange rate, financial development and the regulation quality to proxy the quality of institutions (Oshikoya, 1994; Ghura and Goodwin, 2010; Mlambo and Oshikoya, 2001; Dollar and Easterly, 1999; Everhart and Sumlinski, 2001; Farla et al., 2016; Morrissey and Udomkerdmongkol, 2011). As suggested by Abrigo and Love (2016), we determine the optimal lag (p) of the panel-VAR based on the Akaike (AIC), Bayesian (BIC) and the Hannan-Quinn (HQIC) information criteria.

Based on the results of the panel-VAR estimation, we perform a granger-causality test to evaluate the direction of the causality among our variables of interest and compute the impulse-response functions (IRF) to assess the impact of idiosyncratic shocks to each of our variables on the others. We resort to the Cholesky decomposition for the identification of shocks. The restriction on the contemporaneous impact is based on the fact that our annual data are collected at the end of

the year, i.e. after the investment has already materialized. Assuming that government investment is budgeted and approved in year $t-1$ for the implementation in year t, we rule out the possibility of the shocks happening to private investment and FDI in year t to affect government investment in the same period while keeping open the possibility of a contemporaneous impact in the opposite direction. This is consistent with identification procedure of Blanchard and Perotti (2002), except that we do not deem plausible in the case of SSA economies the hypothesis of contemporaneous government investment adjustments to exogenous changes in the other variables despite our annual frequency. For the sake of completeness, we also assume that shocks on domestic private sector do not contemporaneously affect FDI but leave open the possibility of the opposite.

5.4 Data and empirical results

5.4.1 Data

Our data set is made of annual data on 42 SSA countries[5] from 1995 to 2017 collected from different sources. We have used the Economic Database of the African Development Bank[6] to collect data on gross capital formation, gross capital formation by the public sector and gross capital formation by the private sector. These variables, expressed in percentage of GDP, are used for total investment, government investment and private investment respectively. Data on per capita GDP (expressed in purchasing power parity), real GDP growth and real exchange rate (RER) index have been collected from this same source. The RER index (base year = 2000) represents the price of 1 US$ in domestic currency (nominal exchange rate) adjusted for relative price movements between the considered country and the USA. It has the advantage of providing a better indication of countries' macroeconomic stability in comparison with the rest of the world as its increase indicates either countries' domestic currency depreciation or higher inflation differential between the considered country and the USA. We proceed as in Ndikumana and Verick (2008) and use the Hodrick-Prescott (HP) filter with 6.25 value parameter (as recommended for annual observations by Ravn and Uhlig (2002)) to decompose the RER variable into cyclical and trend components. This decomposition allows a separate evaluation of the specific influence of the RER level and volatility on private investment.

Data on official development assistance (ODA), external debt stock (public external debt), im-

[5]The following countries have been considered in the panel-VAR analysis: Angola, Cameroon, Congo, Rep., Cote d'Ivoire, Ethiopia, Gabon, Ghana, Rwanda, Senegal, Seychelles, Kenya, Namibia, Nigeria, Tanzania, Mozambique and Zambia as market economies; and Benin, Burkina Faso, Chad, Congo, Dem. Rep., Equatorial Guinea, Eswatini, Guinea, Guinea-Bissau, Madagascar, Malawi, Mali, Niger, Sierra Leone, Sudan, Togo and Uganda as non(yet)-market economies. In order to enrich the donor pool for the synthetic control method, the following non-market economies have been added to the sample: Botswana, Burundi, Cabo Verde, Central African Republic, Comoros, Djibouti, Gambia, Lesotho, Mauritania and Mauritius. We purposely do not include Botswana in the VAR analysis following the argument by Devarajan et al. (2003) that this country displays an outlying behavior compared to its SSA counterparts regarding the private investment-economic growth relationship. Mauritius has also been excluded for similar reasons.

[6]This database is available online at http://dataportal.opendataforafrica.org/bbkawjf/afdb-socio-economic-database-1960-2019

ports and exports of good and services and barter terms of trade (TOT) have been collected from the World Development Indicators of the World Bank as updated in October 2018. ODA and public external debt are expressed in percentage of gross national income (GNI) while imports and exports are expressed in percentage of GDP. We construct our proxy of trade openness by summing our imports and exports in their percentage expressions. The indexes of regulatory quality and rule of law have been collected from the World Governance Indicators database[7]. These indexes have values ranging from approximately −2.5 to 2.5 with the lower and upper bounds indicating weak and strong governance performance respectively.

Financial development indicator data have been fetched from the Financial Development Index Database of the IMF[8]. As indicated by its initiators, this composite index summarizes how developed financial institutions and financial markets are in terms of depth (size and liquidity), access (ability of individuals and companies to access financial services) and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues and the level of activity of capital markets). Therefore, it better takes into account the complex multi-dimensional nature of financial development than the other proxies of financial development commonly used in empirical literature such as the ratio of private credit to GDP or stock market capitalization to GDP. Finally, we have collected data on foreign direct investment stock (FDI) from the United Nations Conference on Trade and Development (UNCTAD) database[9]. Unlike many other studies that use net FDI inflows, we use the stock of FDI following the argument by Farla et al. (2016) about the weakness of net FDI inflows to fully account for the growth of physical capital under foreign ownership.

The summary statistics and correlation matrix are presented in Table 5.1 and Table 5.2 respectively. Firstly, a dominance of private investment over public investment is observed across the two sets of countries indicating the importance of the private sector in the build-up of countries' physical capital. Secondly, there appears to be substantial differences between the non-market

[7]This database has been developed by Daniel Kaufmann of Natural Resource Governance Institute (NRGI) and Brookings Institution, and Aart Kraay of World Bank Development Research Group. Data and further details are available on http://info.worldbank.org/governance/WGI/#home

[8]See http://data.imf.org/?sk=F8032E80-B36C-43B1-AC26-493C5B1CD33B for further details.

[9]Data and further details are available on http://unctadstat.unctad.org/wds

	Non-market economies					Market economies				
Variables	Obs	Mean	Std. Dev.	Min	Max	Obs	Mean	Std. Dev.	Min	Max
Total investment	368	21.32	14.42	1.86	138.88	368	23.13	8.52	0.02	55.36
Government investment	368	6.78	6.14	-11.32	50.01	368	8.79	6.32	-6.84	32.55
Private investment	368	13.86	10.40	0.19	81.90	368	14.37	8.30	0.18	54.74
FDI	368	23.35	21.80	0.22	137.07	368	33.94	35.21	0.65	204.66
ODA	368	10.72	8.62	0.00	71.79	368	7.54	7.90	-0.19	56.96
Public external debt	368	65.73	66.84	0.45	504.48	368	68.17	60.57	4.13	489.30
Real GDP growth	368	5.25	10.61	-27.15	149.97	368	5.25	3.98	-8.94	24.54
Per capita GDP	368	3 151.34	6 247.60	545.69	40 015.82	368	4 940.09	5 573.59	373.44	26 382.29
Real exchange rate	368	368.71	527.00	0.07	3 302.46	368	113.08	129.80	.00	713.35
Trade openness	368	72.70	58.88	14.77	531.74	368	79.16	38.94	20.72	225.02
Terms of trade	368	112.23	38.36	21.40	244.44	368	129.08	47.22	39.20	432.92
Financial development	368	0.09	0.04	0.00	0.28	368	0.15	0.08	0.02	0.46
Regulatory quality	368	-0.79	0.46	-2.30	0.20	368	-0.56	0.44	-1.80	0.52
Rule of law	368	-0.90	0.49	-2.13	0.05	368	-0.63	0.54	-1.70	0.60

Note: Market economies refers to countries that have issued sovereign eurobonds to international capital markets.

Table 5.1: Summary statistics

		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Total investment	1.00													
2	Government investment	0.28*	1.00												
3	Private investment	0.70*	-0.03	1.00											
4	FDI	0.43*	0.16*	0.49*	1.00										
5	ODA	-0.16*	0.06	-0.13*	-0.17*	1.00									
6	Public external debt	-0.15*	0.11*	-0.07	0.06	0.40*	1.00								
7	Real GDP growth	0.46*	0.00	0.27*	0.11*	0.05	-0.13*	1.00							
8	Per capita GDP	0.29*	0.16*	0.37*	0.48*	-0.39*	-0.12*	0.01	1.00						
9	Real exchange rate	-0.06	-0.09*	-0.12*	-0.07	0.07	-0.11*	-0.02	-0.12*	1.00					
10	Trade openness	0.65*	0.02	0.50*	0.62*	-0.22*	0.02	0.40*	0.46*	-0.07	1.00				
11	Terms of trade	0.04	0.22*	-0.02	-0.02	-0.24*	-0.37*	-0.01	0.19*	-0.13*	-0.10	1.00			
12	Financial development	0.32*	-0.02	0.15*	0.27*	-0.39*	-0.28*	-0.01	0.31*	-0.25*	0.23*	0.06	1.00		
13	Regulatory quality	-0.06	-0.07*	0.08*	-0.10*	-0.01	-0.23*	-0.08	-0.02	-0.10	-0.14*	-0.05	0.38*	1.00	
14	Rule of law	0.07*	0.03	0.13*	-0.09*	-0.02	-0.24*	-0.05	0.12*	-0.18*	-0.01	-0.05	0.45*	0.83*	1.00

Note: * indicates a 5% significance level.

Table 5.2: Correlations

and market economies in levels of total, public and private investment, as well as the stock of FDI and the amount of received ODA.

This heterogeneity is also remarkable in the evolution of these variables displayed on Figure 5.1. Nonetheless, as well as showing the difference in between these two set of countries, this figure shows also some trends in the evolution of our variables of interest over the study period. In fact, a steady increase is observed for the overall investment level, government and private investment as well as in the stock of FDI, especially after 2000. Likewise, the figure shows a steady decrease in the stock of public external debt and the flow of ODA to SSA countries.

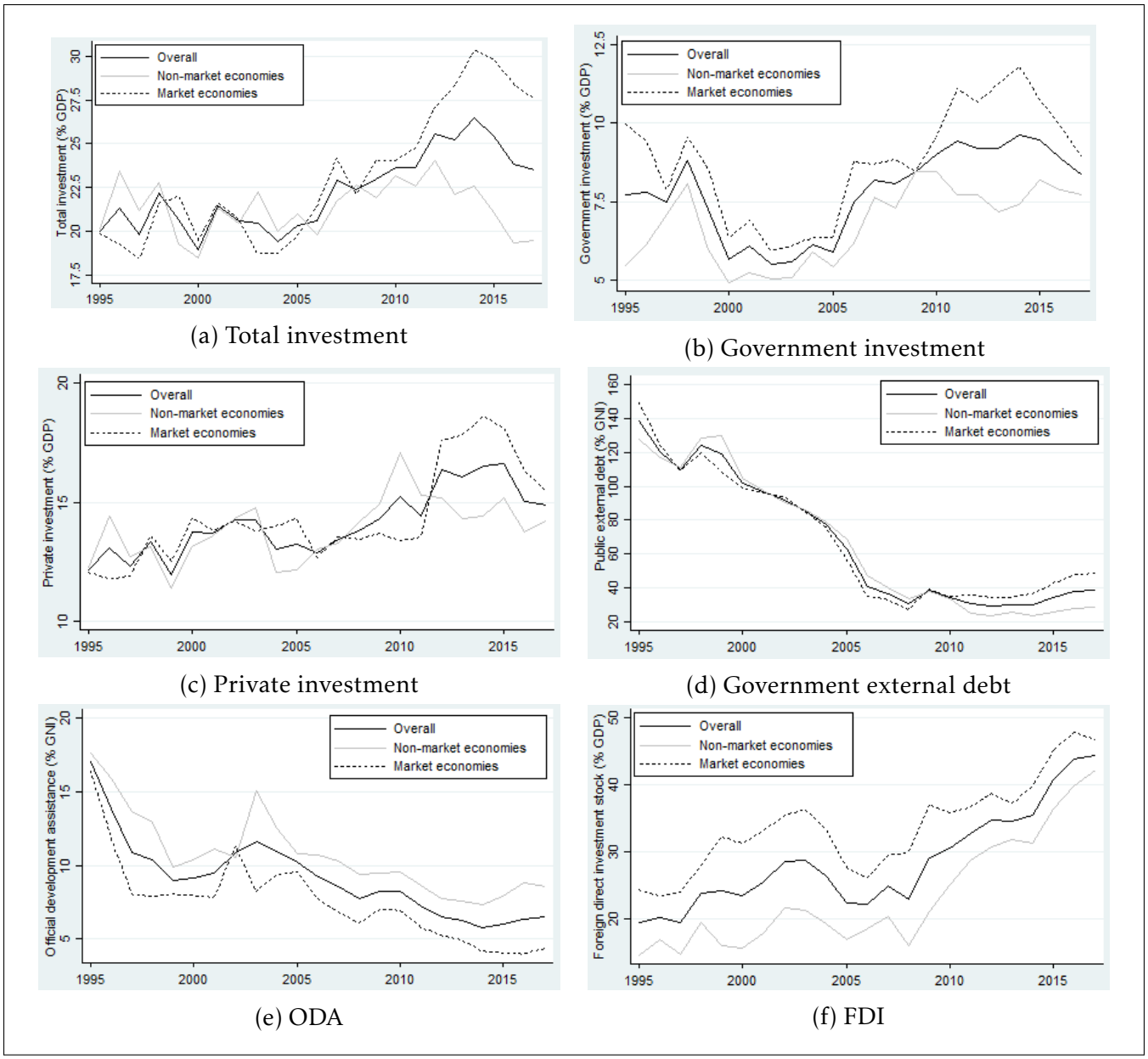
5.4.2 Comparative statistics

The significance of the difference in means of our key variables between market and non-market economies indicated in the summary statistics has been tested using the Student and Welch's t-tests. The results of the tests presented in Table 5.3 confirm the superiority of total investment, public investment and foreign direct investment levels in market economies, and inversely for ODA. However, the significance of the difference in private investment and public external debt levels between these two sets of countries is rejected by both the Student and Welch's t-tests. More importantly, these tests indicate significantly different scores in financial development, regulatory quality and rule of law indexes between these two sets suggesting higher level of financial development and institutions quality in SSA market economies compared to their non-market counterparts.

		Total investment	Government investment	Private investment	FDI	ODA	Public ext. debt	Financial development	Regulation quality	Rule of law
Equal variance	Non-market economies	21.32	6.78	13.86	23.35	10.72	65.73	0.09	-0.79	-0.89
	Market economies	23.13	8.79	14.37	33.94	7.54	68.17	0.15	-0.56	-0.63
	Combined	22.23	7.78	14.11	28.65	9.13	66.95	0.12	-0.67	-0.76
	Difference	-1.81	-2.01	-0.51	-10.59	3.18	-2.44	-0.05	-0.23	-0.27
	$p(T < t)^{*}$	0.02	0.00	0.23	0.00	1.00	0.30	0.00	0.00	0.00
	$p(\|T\| > \|t\|)^{**}$	0.04	0.00	0.46	0.00	0.00	0.60	0.00	0.00	0.00
	$p(T > t)^{***}$	0.98	1.00	0.77	1.00	0.00	0.70	1.00	1.00	1.00
Unequal variance	Non-market economies	21.32	6.78	13.86	23.35	10.71	65.73	0.09	-0.79	-0.89
	Market economies	23.13	8.79	14.37	33.94	7.54	68.17	0.15	-0.56	-0.63
	Combined	22.23	7.78	14.11	28.65	9.13	66.95	0.12	-0.67	-0.76
	Difference	-1.81	-2.01	-0.51	-10.59	3.18	-2.44	-0.05	-0.23	-0.27
	$p(T < t)^{*}$	0.02	0.00	0.23	0.00	1.00	0.30	0.00	0.00	0.00
	$p(\|T\| > \|t\|)^{**}$	0.04	0.00	0.46	0.00	0.00	0.60	0.00	0.00	0.00
	$p(T > t)^{***}$	0.98	1.00	0.77	1.00	0.00	0.70	1.00	1.00	1.00

Notes: The test is performed under the null hypothesis if means equality, i.e. H_0 : Diff=mean(Non-market)-mean(market)=0. Both hypotheses of equal (upper side) and unequal (lower side) variances between groups using the Student and Welch's t-tests respectively (See Delacre et al., 2017). *,** and *** indicate the probability of the alternative hypothesis H_1: Diff < 0, Diff ≠ 0 and Diff > 0 respectively. H_0 is rejected in favor of the indicated alternative if $p(.) < 0.05$.

Table 5.3: Test of mean equality between SSA market and non-market economies



(a) Total investment

(b) Government investment

(c) Private investment

(d) Government external debt

(e) ODA

(f) FDI

Figure 5.1: Some trends and evolutions

5.4.3 Synthetic control method

We applied the synthetic control (SC) method to SSA market access economies to investigate whether the resort to international capital markets affects the dynamics of private investment, government investment and FDI in the borrowing country. For each of these countries, the first eurobond issuance has been considered as the treatment event of interest. The analysis has been restricted to countries that have had their treatment in 2012 at latest to allow for at least a 5 year observation of the potential treatment effects. Based on this criterion, we considered Angola, Congo Republic, Cote d'Ivoire, Gabon, Ghana, Namibia, Nigeria, Senegal, Seychelles and Zambia which have respectively had their first eurobond issuance between 2006 and 2012. We have finally focused on Gabon, Ghana and Senegal whose fit results have passed the quality check for all of the three investigated variables based on the fit index defined in Section 5.3.1 (see Table 5.4).

The results of the SC results for Gabon are presented on Figure 5.2. To start with, Figure 5.2a shows that private investment was already increasing since two years before the treatment after a drastic shrink since 2000. It also shows that, soon after the treatment, Gabon's private investment started by oscillating before a significant and consistent increase that exceeded the prediction of its SC group. However, this post-treatment difference between Gabon and its SC group, also illustrated on Figure 5.2d, does not pass the placebo test as indicated on Figure 5.2g where the performance of Gabon's private sector does not prove exceptional compared to its counterfactuals. Therefore, we do not find unequivocal evidence to attribute the observed increase of private investment in Gabon to the sole access to international capital markets. With respect to government investment, Figure 5.2b shows a flat evolution of this variable since 2000 and a steady increase for more than five years after the treatment. Compared to the prediction of the SC group, this increase has been considerably higher to be deemed significant if we consider the result of the placebo test on Figure 5.2h, at least until 2013. The latter figure shows that government investment in Gabon consistently outperformed its counterfactuals before the drop of 2014-2015, which makes it reasonable to believe that the treatment of 2007 resulted in

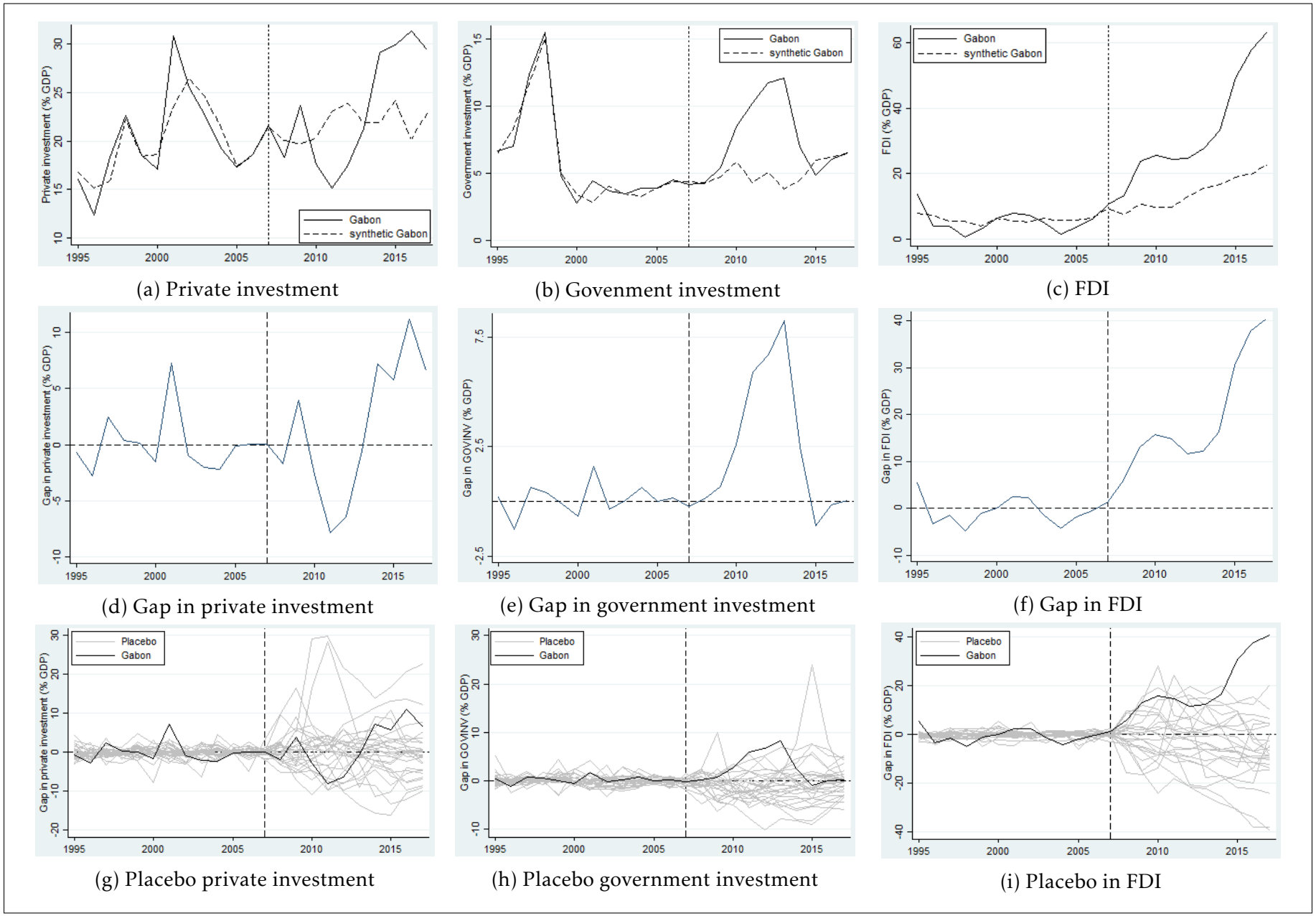
an increase in government investment level in Gabon until 2013. As far as FDI is concerned, Figure 5.2c shows a relatively flat evolution in the whole period before the treatment year and a steady increase since then. This increase appears to be significant compared to prediction of the SC group as shown on Figure 5.2f. When compared to its counterfactuals, Figure 5.2i indicate that this effect is substantially bigger to indicate a significant impact of Gabon's exposure to international capital markets on the level of FDI stocks.

	Gabon						Ghana						Senegal					
	PRIVINV		GOVINV		FDI		PRIVINV		GOVINV		FDI		PRIVINV		GOVINV		FDI	
	Gabon	Synth	Gabon	Synth	Gabon	Synth	Ghana	Synth	Ghana	Synth	Ghana	Synth	Senegal	Synth	Senegal	Synth	Senegal	Synth
PRIVINV			20.06	7.23					12.16	10.49	12.16	14.43			14.92	14.51	14.92	10.81
GOVINV	5.93	7.92			5.93	7.19	4.73	5.55			4.73	7.12	5.43	8.57			5.43	6.07
FDI			5.73	14.64			13.15	13.17	13.15	12.60								
ODA							10.18	10.05	10.18	18.49	10.18	10.18	9.56	9.05	9.56	7.75	9.56	15.74
OPEN	90.23	93.95	90.23	51.47					86.72	56.56	86.72	77.14	66.73	84.54	66.73	68.87		
RGDPG			1.56	1.98			5.06	5.07	5.06	4.60	5.06	4.86	4.19	3.67	4.19	4.46	4.19	4.30
CCG			4.57	5.45														
PCGDP (log)	9.80	8.27			9.80	7.12	7.75	7.76	7.75	7.60	7.75	7.76	7.58	8.02	7.58	8.04	7.58	7.19
EXTDEBT	76.81	70.85	76.81	156.34			90.14	90.22			90.14	66.82	59.50	64.10				
TOT (trend)	126.34	100.64									119.14	99.01	111.90	102.17	111.90	110.49	111.90	104.88
TOT (cycle)	-0.22	0.12											-0.16	-0.15	-0.16	-0.21		
RER (trend)	5.31	2.69			5.31	5.17							5.41	3.31				
FINDEV							0.11	0.11	0.11	0.09			0.12	0.16	0.12	0.17		
RULEOFLAW					-0.45	-0.59												
REGQUAL											-0.23	-0.23	-0.21	-0.29				
RMSPE	2.477533		0.675337		2.819905		0.739576		1.816525		1.196837		1.504533		0.193936		0.991501	
Fit index	0.120538		0.097130		0.420667		0.059385		0.313190		0.087710		0.095863		0.035401		0.128283	

Notes:

- **Private investment (PRIVINV) synthetic composition**: **Gabon**: Botswana 0.322, Cabo Verde 0.237, Chad 0.18, Equatorial Guinea 0.028, Eswatini 0.04, Kenya 0.153 and Liberia 0.041; **Ghana**: Botswana 0.035, Comoros 0.077, Eswatini 0.112, Guinea-Bissau 0.065, Kenya 0.073, Mauritania 0.074, Mauritius 0.037, Mozambique 0.04, Nigeria 0.037, Rwanda 0.106, Senegal 0.139 and Sudan 0.206; **Senegal**: Botswana 0.054, Chad0.009), Djibouti 0.336, Kenya 0.151, Madagascar 0.058, Mauritania 0.028, Mauritius 0.175, Mozambique 0.047, Uganda 0.049 and Zambia 0.091.
- **Government investment (GOVINV) synthetic composition**: **Gabon**: Central African Republic 0.414, Cote d'Ivoire 0.065, DRC 0.231, Equatorial Guinea 0.012, Guinea-Bissau 0.238 and Zambia 0.039; **Ghana**: Botswana 0.22, DRC 0.05, Gambia 0.052, Guinea-Bissau 0.401, Nigeria 0.036, Rwanda 0.196 and Tanzania 0.045; **Senegal**: Angola 0.018, Cabo Verde 0.112, Cameroon 0.157, Central African Republic 0.099, Gambia 0.026, Kenya 0.027, Liberia 0.027, Namibia 0.329, Niger 0.019, Sudan 0.186 and Zambia 0.001.
- **FDI synthetic composition**: **Gabon**: Benin 0.392, Burkina Faso 0.365, Liberia 0.004 and Rwanda 0.24; **Ghana**: Angola 0.016, Benin 0.47, Botswana 0.119, Guinea-Bissau 0.084, Lesotho 0.091, Mauritius 0.114 and Mozambique(0.107); **Senegal**: Botswana 0.079, Burkina Faso 0.396, Guinea-Bissau 0.225,Niger 0.255, Sudan 0.028 and Togo 0.016.

Table 5.4: Synthetic control results



(a) Private investment (b) Govenment investment (c) FDI

(d) Gap in private investment (e) Gap in government investment (f) Gap in FDI

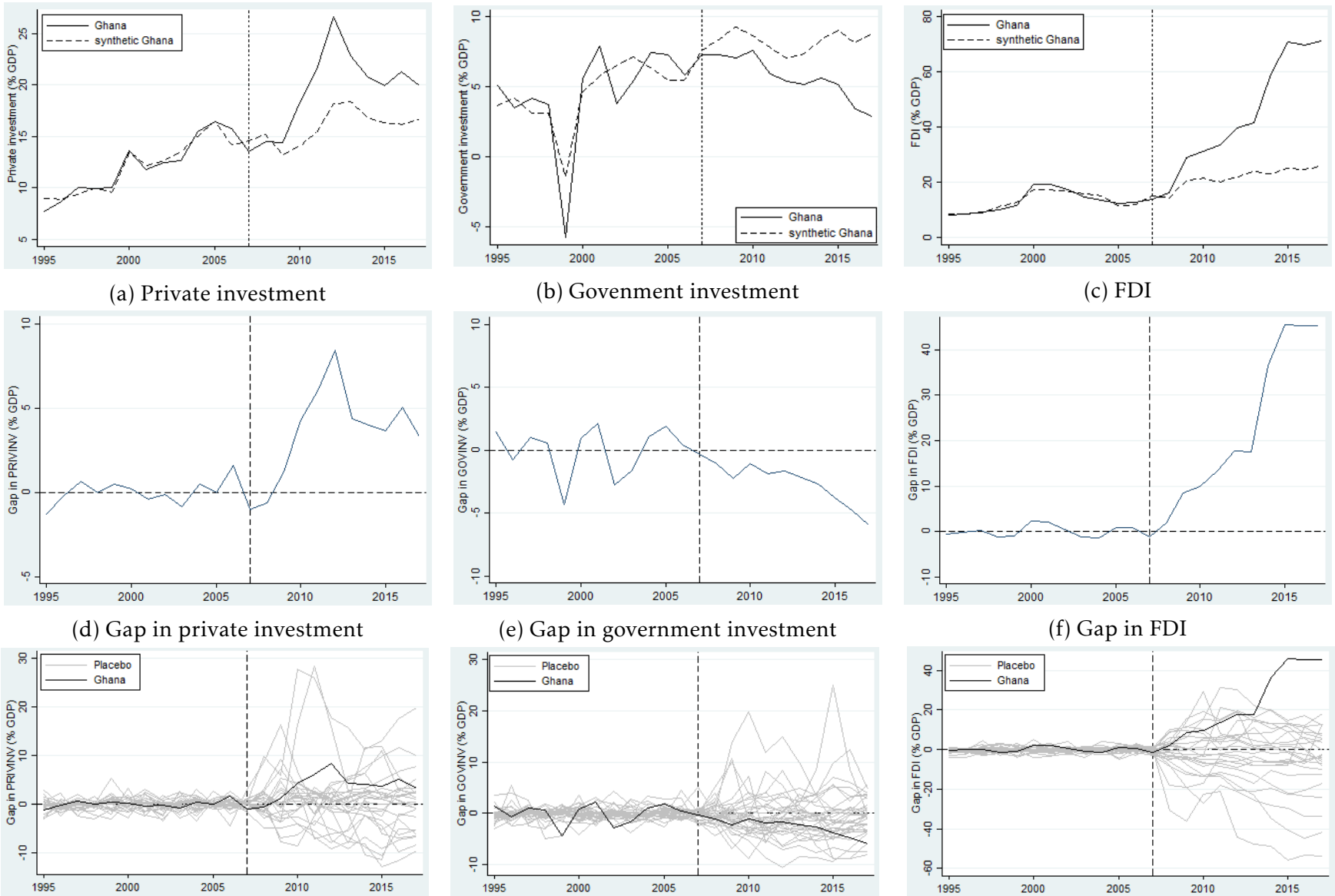
(g) Placebo private investment (h) Placebo government investment (i) Placebo in FDI

Figure 5.2: Synthetic control Gabon

The results SC method for Ghana are presented on Figure 5.3. It can be seen from Figure 5.3a that private investment was already on an increasing path before the treatment and that, this trend became considerably steeper soon after the treatment. Compared to the prediction of the SC group, it seems that Ghanaian access to international capital markets affected positively private investment levels as illustrated on Figure 5.3d. However, when compared to its counterfactuals through a placebo test, the evolution of Ghanaian private investment presented on Figure 5.3g does not appear to be exceptional enough to attribute the observed increase of private investment in Ghana to the sole access to international capital markets. Government investment in Ghana seems to have been rather negatively affected by the treatment as shown on Figure 5.3b and Figure 5.3e. But this negative impact is not supported by the results of the placebo test on Figure 5.3h that does not suggest any exceptional evolution of the Ghanaian government investment vis-à-vis its counterfactuals. With respect to FDI, Figure 5.3c shows a relatively flat evolution in the whole period before the treatment year and a steady increase since then. This increase appears to be significant compared to trend of the synthetic Ghana as shown on Figure 5.3f. When compared to its counterfactuals, Figure 5.3i indicate that the increase in FDI after the treatment is substantial enough to be attributed to the move by Ghana to register on the investors' radar through an exposure to international capital markets.

Finally, we present on Figure 5.4 the results of the SC application to Senegal. Figure 5.4a shows that private investment increased considerably and steadily before dropping drastically one period before the country tapped international capital markets in 2009. It can be seen that, after the treatment year, private investment in Senegal has been following an oscillating trend alternating increases and decreases that hardly indicate any significant effect of the the treatment. This observation is clearly illustrated on Figure 5.4d that indicates no substantial difference between Senegalese private investment evolution and its synthetic, and on Figure 5.4g that shows rather negligible changes in Senegal compared to its counterfactuals. Government investment has also kept increasing quite steadily since some years before the treatment unlike the prediction of the SC group suggesting a monotonic decrease from a year after the treatment (See Figure 5.4b). Nonetheless, as shown on Figure 5.4h, this after-treatment performance has not passed

the placebo test to substantiate any positive effect of government borrowing trough international capital markets on its own investment levels. Quite similar results have been observed for FDI. Figure 5.4c shows that FDI has been increasing in Senegal some years before the treatment in 2009. However, it is seen that the Senegalese increase was not as steep as the one predicted by its SC group, thus suggesting a slowdown in the private investment increase momentum after the treatment. Though Figure 5.4f illustrates this shortfall in the private investment after treatment, the results of the placebo test presented on Figure 5.4i indicate that the case of Senegal is not too exception to substantiate a possible negative impact on FDI due to this country's access to international capital markets.

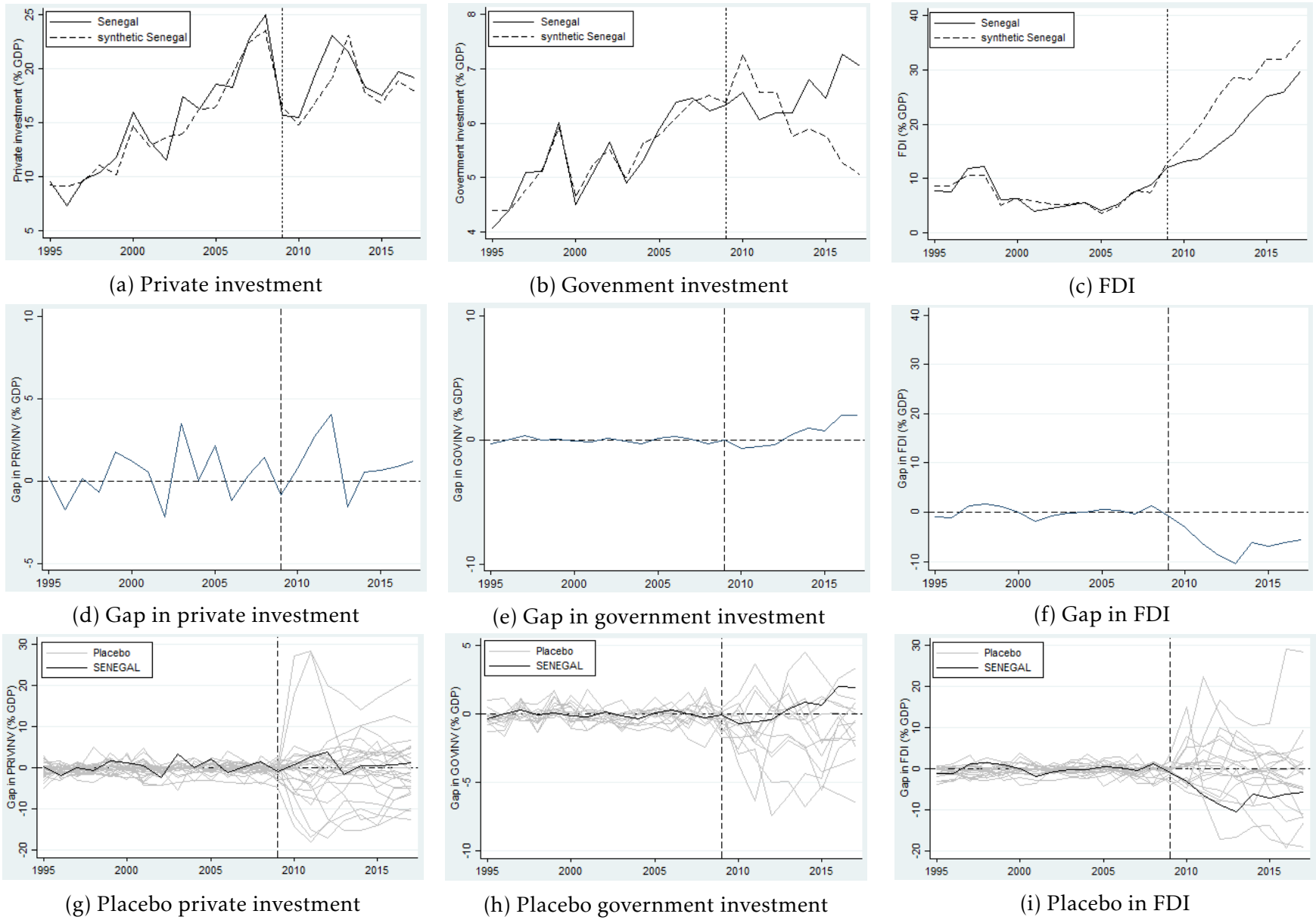


(a) Private investment (b) Govenment investment (c) FDI

(d) Gap in private investment (e) Gap in government investment (f) Gap in FDI

(g) Placebo private investment (h) Placebo government investment (i) Placebo in FDI

Figure 5.3: Synthetic control Ghana



(a) Private investment (b) Govenment investment (c) FDI

(d) Gap in private investment (e) Gap in government investment (f) Gap in FDI

(g) Placebo private investment (h) Placebo government investment (i) Placebo in FDI

Figure 5.4: Synthetic control Senegal

Overall, the results of our SC method to Gabon, Ghana and Senegal indicate that, broadly, government access to international capital markets has not affected the dynamics of public and private investment in these countries. More specifically, private investment presents some indications of consistent increase before and after the first eurobond issues across these countries but our results do not lend support to the hypothesis that this increase may have been influenced by this access to international capital markets. The case of FDI deserves a particular attention. In fact, in addition to evidences of steady increases after these countries debut eurobonds, the results of the SC method for Gabon and Ghana have proved sufficiently conclusive to substantiate a positive impact of the exposure to international capital markets on FDI in these countries. Even in the case of Senegal, despite the inconclusiveness of the SC method results, it seems unfair to overlook the tremendous increase of FDI in the period after its first eurobond issue in 2009. This post-treatment increase in FDI seems to substantiate the assertion by (Bertin, 2016) that the exposure to international capital markets is indeed an opportunity for these countries to register on the investors' radar. However, the inconclusiveness of the SC method results regarding private investment cast doubt on the potential of this move to boost the domestic private sector as hypothesized by its proponents.

Turning to a different perspective, the absence of evidence in favor of any positive impact of government borrowing through international capital markets on private investment across the analyzed countries can be related to the observations made in Section 5.4.2 about the rejection of any difference in private investment levels between SSA market access and non-market access economies despite unequivocal evidences of relatively significant higher levels of government investment, FDI and financial development, as well as better institutions quality in market access economies. In fact, based on the established evidences of government investment and FDI crowding-in effect on private investment in SSA (Oshikoya, 1994; Ghura and Goodwin, 2010; Farla et al., 2016; Ndikumana and Verick, 2008), it would sound logical to expect higher private investment levels in SSA market access economies in accordance to their considerably government investment and FDI levels. The observations at hand cast doubt on the generalization of these theories across these two categories of SSA countries. In the quest for the rationale behind

this paradox, we extend in the following paragraphs our analysis to the investigation of the possibility of heterogeneous patterns between these two categories of SSA countries when it comes to the interactions among private investment, government investment and FDI.

5.4.4 VAR estimation results

In order to estimate our panel-VAR model in Equation (5.1), we started by checking the stationarity of our panels using the Im-Pesaran-Shin (IPS), Augmented Dickey-Fuller (ADF) and Hadri tests (Maddala and Wu, 1999; Hadri, 2000; Choi, 2001; Im et al., 2003). The results of our stationarity tests are presented in Table 5.5. They show that the IPS and ADF null hypothesis of unit root in all the panels is rejected, in levels, for private and public investment but not for FDI. The Hadri null hypothesis of stationarity of all the panels is rejected for all of these variables taken in levels. Conclusive results on the stationarity of all panels across all the tests are obtained when these variables are expressed in first-differences.

	IPS		ADF Fisher-type		Hadri	
Variables	W-statistic	p-value	χ^2 statistic	p-value	Z-statistic	p-value
			Levels			
Private investment	-4.8288	0.0000	180.8473	0.0000	5.1423	0.0000
Government investment	-5.2302	0.0000	199.3804	0.0000	6.6317	0.0000
FDI	4.8023	1.0000	43.0656	0.9794	8.8776	0.0000
			First-differences			
Private investment	-20.0331	0.0000	156.7572	0.0000	-0.9176	0.8206
Government investment	-20.5462	0.0000	136.1416	0.0000	-0.2967	0.6166
FDI	-13.3534	0.0000	86.0634	0.0344	1.1547	0.1241

Notes: The *Im-Pesaran-Shin (IPS)* and *ADF-Fisher* unit-root tests test the null hypothesis of H_0: All panels contain unit-root against the alternative hypothesis H_1: Some panels are stationary. However, the *Hadri* unit-root test posits as null hypothesis H_0: All panels are stationary, which is tested against the alternative hypothesis H_1: Some panels contain unit-root. Test have been performed on the whole sample of 32 panel units (both market and non-market access economies).

Table 5.5: Unit-root test

We first estimate our panel-VAR model using the whole sample. Then, we repeat the same exercise on market access and non-market access economies separately. The results of our model's reduced form are presented in Table 5.6. Based on these results, we perform a Granger-causality

test to determine the direction of the causality among our variables of interest. The results in Table 5.7 suggest a limitation of this analysis to the whole sample combining both market access and non-market access economies. In fact, there is no indication of any of these variables Granger-causing any of the others at 95% confidence level when this test is performed on the overall sample. A different picture is obtained when this sample is split according to the market access criterion. Starting with the non-market access economies, the results show that private investment is Granger-caused by both government investment and FDI indicating the possibility of using the latter variables to predict private investment in these economies. They also indicate that government investment is Granger-caused by both private investment and FDI, and FDI Granger-caused by both private and government investment. So, unlike the case of the overall sample, we find an indication of a feedback loop among these variables where it is possible to predict the evolution of each of them using the others. As regards the markets access economies, these results indicate that private investment is the only one to be Granger-caused by both of the two other variables and that none of the latter is Granger-caused by any of its counterparts at 5% significance level.

These Granger-causality results hint at the heterogeneity of our variables' interactions between market access and non-market access economies, heterogeneity that may explain the paradox mentioned previously concerning the apparently equal levels of private investment despite considerably different levels of government investment and FDI between the two categories of economies. We push this analysis a step further by analyzing the impact of idiosyncratic shocks to our variables to the system using impulse-response functions (IRF).

	Overall			Non-market access economies			Market access economies		
VARIABLES	PRIVINV	GOVINV	FDI	PRIVINV	GOVINV	FDI	PRIVINV	GOVINV	FDI
L.PRIVINV	-0.000776	0.0114	0.173*	0.133**	0.189***	0.271***	0.150**	-0.0353	0.125*
	(0.0665)	(0.0320)	(0.0885)	(0.0566)	(0.0326)	(0.104)	(0.0586)	(0.0483)	(0.0687)
L.GOVINV	-0.00207	-0.111**	0.142	-0.837***	-0.256***	-1.067***	0.224***	-0.299***	0.258*
	(0.0736)	(0.0490)	(0.142)	(0.109)	(0.0678)	(0.206)	(0.0416)	(0.0394)	(0.138)
L.FDI	-0.0497	0.0144	0.0149	-0.162***	-0.0842***	0.140**	0.0466***	-0.00828	0.146**
	(0.0340)	(0.0194)	(0.0543)	(0.0427)	(0.0248)	(0.0676)	(0.0162)	(0.0185)	(0.0629)
OPEN	0.0339	0.0158	0.141*	0.0207	0.0808***	0.219***	0.0411**	0.0304**	0.200***
	(0.0361)	(0.0234)	(0.0778)	(0.0274)	(0.0186)	(0.0502)	(0.0186)	(0.0123)	(0.0556)
ODA	0.214	0.123	0.299	0.214*	0.0195	0.359	0.189	-0.0372	-1.090***
	(0.141)	(0.109)	(0.357)	(0.129)	(0.0860)	(0.330)	(0.144)	(0.0882)	(0.370)
EXTDEBT	-0.00799	0.00135	0.0978***	-0.00915	0.00762	0.0385	-0.0152	0.00174	0.0964***
	(0.00837)	(0.00623)	(0.0309)	(0.00827)	(0.00796)	(0.0312)	(0.0101)	(0.00806)	(0.0293)
TOT	-0.0335**	0.00498	-0.0941***	-0.0224	-0.0152*	-0.0981***	-0.00457	0.0117**	-0.0944***
	(0.0138)	(0.00942)	(0.0340)	(0.0148)	(0.00909)	(0.0303)	(0.00893)	(0.00483)	(0.0254)
RER	1.975	0.547	3.753	0.342	0.432	1.307	1.839	-1.538**	0.838
	(1.258)	(0.863)	(2.612)	(0.929)	(0.705)	(2.771)	(1.198)	(0.598)	(3.082)
FINDEV	-46.19**	-22.22	-36.54	9.532	-9.157	31.95	-3.010	-22.02**	-113.9***
	(20.18)	(14.15)	(43.49)	(26.55)	(17.90)	(51.28)	(15.27)	(11.15)	(36.41)
REGQUAL	2.061	7.171**	18.48*	-7.312*	2.793	15.81**	4.689	-6.733***	-31.33***
	(4.527)	(3.113)	(10.53)	(4.181)	(2.791)	(7.416)	(2.884)	(1.993)	(7.403)
Observations	352	352	352	176	176	176	176	176	176

Notes: Standard errors in parentheses. (***), (**) and (*) indicate significance at 1%, 5% and 10% respectively. The endogenous variables, i.e. private investment (PRIVINV), government investment (GOVINV) and FDI, are expressed in first-differences. The *market access economies* set is made of Angola, Cameroon, Congo, Rep., Cote dIvoire, Ethiopia, Gabon, Ghana, Rwanda, Senegal, Seychelles, Kenya, Namibia, Nigeria, Tanzania, Mozambique and Zambia while the *non-market access economies* one comprises Benin, Equatorial Guinea, Burkina Faso, Chad, Congo, Dem. Rep., Eswatini, Guinea, Guinea-Bissau, Madagascar, Malawi, Mali, Niger, Sierra Leone, Sudan, Togo and Uganda.

Table 5.6: VAR results

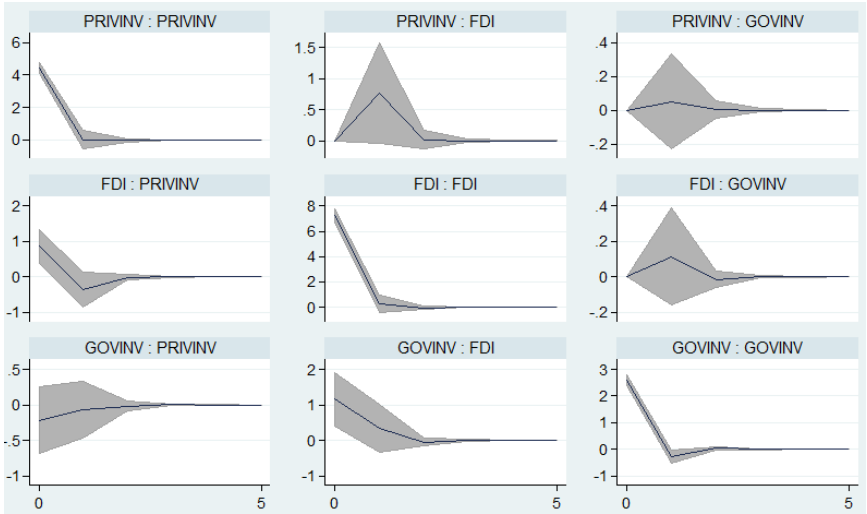
Excluded variables	Private investment			Government investment			FDI		
	χ^2	df	prob	χ^2	df	prob	χ^2	df	prob
				Overall					
Private investment				0.127	1	0.721	3.824	1	0.051
Government investment	0.001	1	0.978				0.999	1	0.318
FDI	2.136	1	0.114	0.551	1	0.458			
All	2.136	2	0.344	0.688	2	0.709	4.757	2	0.093
				Non-market access economies					
Private investment				33.665	1	0.000	6.831	1	0.009
Government investment	58.431	1	0.000				26.784	1	0.000
FDI	14.346	1	0.000	11.546	1	0.000			
All	116.179	2	0.000	38.448	2	0.000	27.003	2	0.000
				Market access economies					
Private investment				0.533	1	0.465	3.287	1	0.070
Government investment	28.891	1	0.000				3.503	1	0.061
FDI	8.232	1	0.004	0.200	1	0.655			
All	36.780	2	0.000	0.843	2	0.656	5.435	2	0.066

Notes: The null hypothesis H_0: the excluded variable does not Granger-cause the equation variable is tested against the alternative H_1: the excluded variable Granger-causes the equation variable. The *market access economies* set is made of Angola, Cameroon, Congo, Rep., Cote dIvoire, Ethiopia, Gabon, Ghana, Rwanda, Senegal, Seychelles, Kenya, Namibia, Nigeria, Tanzania, Mozambique and Zambia while the *non-market access economies* one comprises Benin, Equatorial Guinea, Burkina Faso, Chad, Congo, Dem. Rep., Eswatini, Guinea, Guinea-Bissau, Madagascar, Malawi, Mali, Niger, Sierra Leone, Sudan, Togo and Uganda.

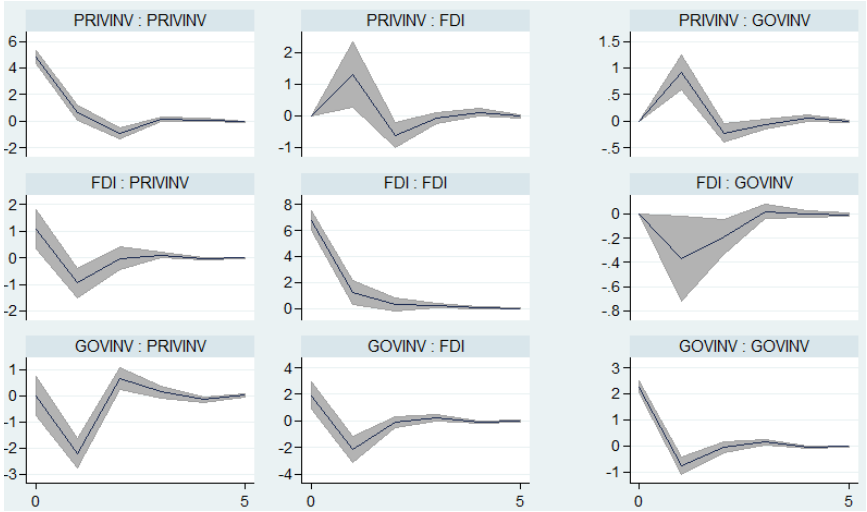
Table 5.7: Granger causality

The IRF associated to our panel-VAR model are presented on Figure 5.5. Like in the Granger-causality analysis, we start with the whole sample then distinguish between market access and non-market access economies to investigate the possibility of heterogeneous interactions among our variables based on this demarcation criterion. The IRF related to the whole sample are presented on Figure 5.5a. They show a significant unidirectional propagation of shocks from government investment to FDI, and from FDI to private investment. They thus suggest the absence of significant impact of shocks to private investment or FDI on government investment, or those to government investment on private investment, neither contemporaneously nor with lags. Figure 5.5b presents the case of non-market economies. We observe that shocks to private investment have an neutral contemporaneous effect on government investment and FDI but affect both of them positively after one lag then negatively before stabilizing afterwards. Shocks to FDI are shown to positively affect private investment contemporaneously then negatively after

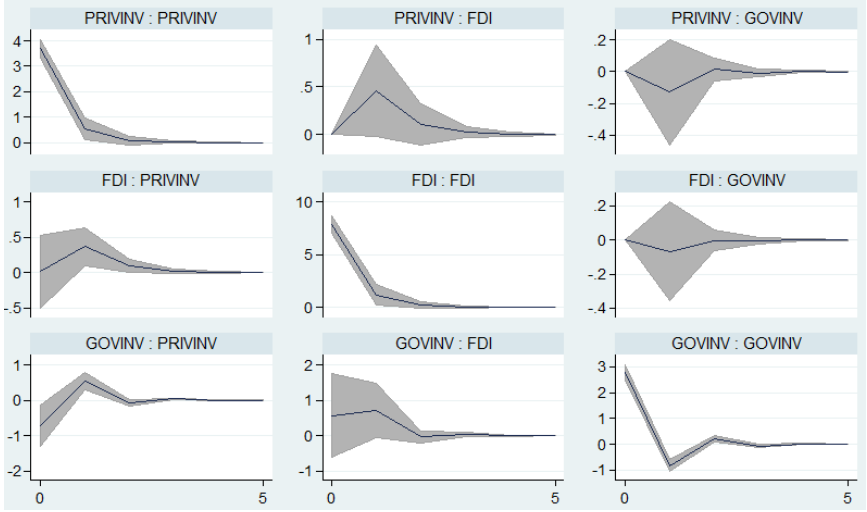
one lag; no significant impact on government investment is indicated, either contemporaneously nor at a distant time. Shocks to government investment are indicated to have no contemporaneous but a significant 'J-curve' effect on private investment, effect characterized by a negative impact followed by a positive one at lags one and two respectively. These shocks are shown to contemporaneously affect FDI positively and negatively the next year before stabilizing afterwards.



(a) Overall sample



(b) Non-market access economies



(c) Market access economies

Notes: Orthogonalized impulse-response functions (IRF) with 95% confidence intervals over 5 year horizon based on 500 Monte Carlo simulations. The 'Impulse:Response' labels indicate the shock and response variables respectively; e.g. the IRF on the upper-right (PRIVINV:GOVINV) represents the response of government investment (Response) to shocks on private investment (Impulse). Shocks have been identified through Cholesky decomposition with GOVINV FDI PRIVINV ordering.

Figure 5.5: Impulse-response functions

The case of market access economies presented on Figure 5.5c contrasts with the previous picture by underscoring only one significant and unidirectional impact of government investment shocks to private investment. These shocks are shown to have a contemporaneous negative effect followed by a positive one in the next year. All the other interactions appear insignificant.

The information from our IRF corroborates the indication of heterogeneous interactions among private investment, government investment and FDI between SSA market access and non-market access economies. For instance, they show that FDI shocks have a contemporaneous significantly positive effect on private investment in non-market economies but this effect does not appear to be significant in their market economies counterparts. This qualifies to some extent the conclusion of Ndikumana and Verick (2008) and Farla et al. (2016) that generalize the FDI crowding-in effect across SSA. As well, the general conclusion of Oshikoya (1994) and Ghura and Goodwin (2010) about government investment crowding-in effect on private investment in SSA is not fully substantiated by our IRF. They rather indicate a neutral contemporaneous, followed by a negative private investment response with one lag to government investment shocks in non-market economies against a negative contemporaneous, followed by a positive response with one lag in market access economies. Besides, there appear to be a two-way relationship between government and private investment in the non-market category against a unidirectional impact of government investment on private investment in their market access counterparts.

In short, we find indications of substantial heterogeneity between SSA non-market access and market access economies with respect to government investment, private investment and FDI interactions. In our view, this heterogeneity can explain, at least partly, the insignificant difference in private investment levels between these two categories of countries despite the significant relatively higher levels of government investment, FDI, and financial development and institutions quality indexes in the market access set.

5.5 Conclusion

This paper has investigated the influence of government borrowing through international capital markets on investment dynamics in Sub-Saharan Africa (SSA). Using a pool of 42 countries from this region for the period 1995-2017, we have applied the synthetic control method to selected SSA market access countries to evaluate whether and how this kind of international borrowing affect private, public and FDI in these countries. We have considered as treatment event the first eurobond issuance by these countries and restricted the analysis to countries that have had their treatment in 2012 at latest to allow for at least a 5 year observation of the potential treatment effects. We have focused our analysis on Gabon, Ghana and Senegal whose fit results have passed the quality check for all of the three investigated variables based on the fit index.

Our results indicate that, broadly, government access to international capital markets has not affected the dynamics of public and private investment in these countries. More specifically, private investment presents indications of consistent increase before and after the first eurobond issues across the analyzed countries, but our results do not lend support to the hypothesis that this increase may have been influenced by the access to international capital markets. As concerns FDI, these results have proved sufficiently conclusive to substantiate a positive impact of the exposure to international capital markets on FDI in Gabon and Ghana which issued their respective eurobonds for the first time in 2007. Even for Senegal, data show a tremendous increase of FDI since 2009, i.e. the period after its first eurobond issue, an increase that should not be overlooked despite the inconclusive results of the SC method. This post-treatment increase in FDI justifies to some extent the assertion by (Bertin, 2016) that the exposure to international capital markets has indeed been an opportunity for these countries to register on the investors' radar. However, the inconclusiveness of the SC method results regarding private investment cast doubt on the potential of this move to boost the domestic private sector as hypothesized by its proponents.

We additionally carried out a panel-VAR analysis to investigate the possibility of heterogeneous patterns between these two categories of SSA countries regarding the interactions among private investment, government investment and FDI. Based on a sub-sample of 16 non-market access and 16 market access economies, we have found indications of substantial heterogeneity in these variables' interactions between these two categories of SSA countries. Our results have revealed, among others, a two-way relationship between government and private investment in the non-market category and a unidirectional impact of government investment on private investment in the market access one.

Overall, our findings suggest that government and private investment dynamics have not been affected by governments' borrowing through international capital markets, but that this move may have boosted these countries' capacity to attract FDI as indicates the experience of Gabon and Ghana. The evidence of substantial heterogeneity in investment dynamics between SSA market access and non-market access economies hints at the potential reasons behind the observed insignificant difference in private investment levels between these two categories of countries despite their tangible differences in the other variables. Further investigation into the causes of this heterogeneity constitutes, in our view, an interesting avenue for future research.

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Chapter 6

General conclusion

This dissertation has contributed to the discussion about the sustainability of the SSA eurobonds market as a source of development funding as well as its prospects and challenges for economic growth and development in the region. Taking stock of the economic distortions and negative incentives attributed to international aid, and the lessons of the ravaging pre-HIPC debt crisis, this study has striven to answer three specific questions related to 1) the disposition and ability of capital markets to integrate the quality of sovereign borrowers' macroeconomic management into the valuation of these securities; 2) the rationale behind investors' appetite for SSA eurobonds; and 3) the possibility of government borrowing through capital markets to catalyze sustainable economic growth in the borrowing countries via its impact on domestic investment dynamics. This concluding chapter summarizes the key findings of each of the four chapters developed in this dissertation and provides, when possible, some policy recommendations and avenues for future research.

Chapter 2 has scrutinized the drivers of secondary market yields on Sub-Saharan African (SSA) sovereign Eurobonds. It built on the general perception that the issuance as well as the performance of these bonds were mainly driven global factors, which are in essence out of the span of control of the bond issuers. In the perspective of our research, such a perception carries along some implications casting doubt on the sustainability of the SSA eurobonds market as well as its ability to foster good governance and development in this region. For instance, it suggests the unreliability of this market as a sustainable source of development funding since investors' appetite for SSA eurobonds –hence the whole success of these securities– is then deemed short-lived because dependent on favorable global economic conditions that are bound to change anytime in the future (Sy, 2013; Masetti, 2015). It equality suggests the irrelevance of the credit quality of bond issuers since investors are supposed to be almost solely driven by conducive global factors. In such circumstances, SSA eurobond issuers are perceived as passive players incapable of any influence or responsibility in the performance of their securities on capital markets. If proved true, these conditions would in no way be different from the one that prevailed in the 1970s and led to the pre-HIPC debt crisis (Eichengreen and Portes, 1986; FDIC, 1997). A similar outcome would be reasonably expected from the ongoing borrowings through

international capital markets by SSA countries' .

The results of our analysis show that SSA secondary market eurobond yields are influenced by both global and country-specific factors and that, interestingly, the latter factors have more bearing in the explanation of these yields evolution unlike the above-mentioned general perception. These yields have proved to react to changes in country fundamentals such as the stance of the current account and fiscal balances, inflation and currency depreciation, and GDP growth. Moreover, there is a clear indication that, above all, these yields have been determined by other country-specific factors that were not captured in our model. Like in the case of primary yields (see Presbitero et al., 2016), one can think of the prominent influence of the quality of institutions and government effectiveness in the determination and evolution of SSA secondary market eurobond yields. Put together, this precedence of country-specific factors suggests that capital markets are sensitive to the quality of borrowing countries' macroeconomic management, thus implying that, rather than just passive players, these countries can influence the performance of their bonds by strengthening their fundamentals and improving their governance. SSA market access economies are therefore incentivized to uphold better economic policies and management should they wish to rely on this source of funding for their development purposes, which confirms to some extent the market discipline hypothesis.

Chapter 3 has complemented the analysis of the previous chapter by investigating the possibility of spillover effects among SSA eurobonds. It built on the assumption that, besides global and country-specific factors, the performance of SSA eurobonds can also be influenced by spillovers from idiosyncratic shocks to their peers. This assumption suggests for instance that issues affecting the credit worthiness of one specific SSA eurobond such as the default of Mozambique in early 2017 could send negative signals about the performance of the rest of SSA eurobonds and thus affect their performance on both primary and secondary markets. Similar to global factors, spillover effects are nothing but a challenge for affected countries given their limited control over the possibility of these effects' occurrence as well as their impact once they have occurred. It was therefore key to understand the dynamics of these spillovers in order to assess how they relate to and what they entail for these countries fundamentals.

Our results have revealed important spillover effects among SSA eurobonds. It has further been indicated that these spillovers flow from countries that have experienced challenges in their fundamentals (e.g. Angola, Ghana and Zambia) towards the ones with strong and stable macroeconomic fundamentals (e.g. Namibia, Tanzania and Rwanda). Besides, it has been observed from the time-varying analysis that spillover levels, measured by the total spillover index, have been sensitive to major economic events and news announcements over this period such as the Angolas request for IMF bailout in April 2016 and the Trump tantrum of November 2016. It logically follows that SSA eurobond issuers can increase their influence over the performance of their securities on secondary markets by mitigating their vulnerability to these effects. Therefore, besides strong macroeconomic fundamentals, an improvement in transparency and information disclosure is required in order to curb the asymmetry of information underlying investors behavior-based spillovers and contagion, which adds to the confirmation of the market discipline hypothesis discussed previously.

Chapter 4 has explored the avenue of international portfolio theory to evaluate the contribution of African securities to the risk-return profile of internationally diversified portfolios. Taking the perspective of a US investor holding a domestically diversified portfolio, it has assessed the benefits of diversification over African securities in comparison with other international investment opportunity sets from other developed and emerging markets.

The results of our analysis have shown that, unlike their peers, African investment opportunity sets offer statistically significant diversification benefits to the benchmark US domestically-diversified minimum-variance and tangency portfolios. More specifically, they have indicated that the 'All Africa' set contributes to risk profile of the benchmark set while the 'Africa ex-SA' is the only set offering significant improvements to this benchmark's tangency portfolio. These results challenge the general public perception tending to associate the success of SSA eurobonds to the sole economic conditions prevailing at the global scale and explain the appetite of international investors for these securities by the quest for high yields outside the protracted low economic growth and interest rates in their developed markets. They rather suggest that investment opportunity sets from Africa can as well attract the interest of investors for their

international diversification benefits, which may arguably be the case for SSA eurobonds.

In **Chapter 5**, we have investigated the influence of government borrowing through international capital markets on investment dynamics in Sub-Saharan Africa (SSA). Using a pool of 42 countries from this region for the period 1995-2017, we have applied the synthetic control method to selected SSA market access countries to assess whether and how this kind of international borrowing affect private, public and FDI in these countries. We considered as treatment event the first eurobond issuance by these countries and restricted the analysis to countries that have had their treatment in 2012 at latest to allow for at least a 5 year observation of the potential treatment effects. Moreover, we carried out a panel-VAR analysis to investigate the possibility of heterogeneous patterns between these two categories of SSA countries regarding the interactions among private investment, government investment and FDI.

We have found that, broadly, government access to international capital markets has not affected the dynamics of public and private investment in these countries. More specifically, private investment has proved to present indications of consistent increase before and after the first eurobond issues across the analyzed countries, but our results have not confirmed the hypothesis that this increase may have been influenced by this access to international capital markets. As concerns FDI, our results have proved sufficiently conclusive to substantiate a positive impact of the exposure to international capital markets on FDI based on the experience of Gabon and Ghana. This post-treatment increase in FDI observed in the considered countries justifies to some extent the assertion by (Bertin, 2016) that theexposure to international capital markets has indeed been an opportunity for these countries to register on the investors' radar. However, the inconclusiveness of the SC method results regarding private investment cast doubt on the potential of this move to boost the domestic private sector as hypothesized by its proponents.

As concerns the interactions, we have found indications of substantial heterogeneity between SSA non-market access and market access economies regarding government investment, private investment and FDI interactions characterized by, among others, a two-way relationship between government and private investment in the non-market category and a unidirectional impact of government investment on private investment in their market access counterparts. In

our view, this heterogeneity in investment dynamics between SSA market access and non-market access economies hints at the potential reasons behind the observed insignificant difference in private investment levels between these two categories of countries despite the significant relatively higher levels of government investment, FDI, and financial development and institutions quality indexes in the market access set.

To sum up, these papers have produced a wealth of information with respect to our research questions. First, we have found indications of market discipline in the case of SSA eurobonds as international capital markets appear to integrate the quality of sovereign borrowers' macroeconomic fundamentals in the valuation of these securities. Second, the results have shown that these securities bear substantial diversification benefits for the construction of internationally diversified portfolios, a quality that can still whet the appetite of international investors beyond the short-lived fluctuations in global economic conditions. Third, we have found indications of a positive impact of government borrowing though international capital markets FDI but inconclusive results concerning government and private investment. We have also found a significant difference in these variables' interactions between SSA non-market access and market access economies, interactions that seem unfavorable to private investment in market access economies.

We therefore concluded that the access to international capital markets provides incentives for better economic governance in SSA but should not be considered as a panacea for sustainable economic growth and development; it should be accompanied by adequate measures and reforms addressing the existing bottlenecks. As concerns the challenges, we think that the unidirectional impact of government investment on private investment in SSA market access economies reveals the limits of government massive investments as a means to spur economic growth and development in this region if not accompanied by reforms enabling better synergies between government and private investment. This underscores the necessity for an intensification of public-private dialogues and partnerships in the design and implementation of projects of public interest.

On another note, it is widely accepted that the absence of conditionality and the possibility to raise substantial amounts are some of the appealing features of eurobond borrowings compared to multilateral or bilateral funding opportunities. In some cases, African countries have been reported to resort to international markets to circumvent high interest rates in their domestic markets or to take advantage of favorable market conditions to restructure their onerous debts by assigning more convenient terms to their issues. However, as it is always the case in finance[1], these advantages come at a certain number of risks and constraints that might be of serious concern in the particular case of SSA borrowers. One of them is that the redemption structure of many of these bonds expose issuers to serious financial risks at maturity especially in the case of 'bullet' bonds where the principal has to be redeemed in one payment. This is exacerbated by the diffuse structure of bondholding entailing a diversity of creditors with sometimes antagonist strategies and interests that might hinder the possibility of common agreement (collective action) in case of debt rescheduling for instance.

Also, the presence of spillover effects among SSA eurobond issuers constitutes another challenge as their individual performances are bound to be affected, though temporary, by idiosyncratic shocks to their peers, including the consequences of their poor performance or derailing behavior. However, this same challenge can also be seen as an incentive in disguise since it intensifies the need for more transparency by good performing countries to clearly display the soundness of their fundamentals and thus mark their difference with the one(s) in distress.

Finally, the resort to the sole quantitative approach to address a multifaceted issue that can reasonably contain some emotional/psychological, socio-economic, political, and even legal aspects constitutes a serious limitation to our study that needs to be acknowledged. While recommending the investigation of these aspects for future research, we join our voice to the ongoing awareness-raising initiatives by multilateral institutions like the IMF (2014) that have owned the modified collective action clauses developed by the International Capital Market Association (ICMA) and recommended their inclusion in the bond contracts of African countries to avoid them the experience of Argentina with US 'vulture funds' in case of default and/or re-

[1] The adage that 'there ain't no such a thing as a free lunch' is common language in finance.

structuring. We also buy the recommendations by Kvangraven (2016) to uphold the 'UN Principles for Responsible Investment (PRI)'[2] and the 'UNCTAD principles on promoting responsible sovereign lending and borrowing' (see UNCTAD, 2012) in the case of African eurobonds to ensure that the benefits of these new debts reach the end-beneficiaries, i.e. the current and coming generation of citizens that are supposed to bear the burden at redemption.

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[2]See www.unpri.org/about

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