Co-movements between frontier and global bond markets.

Exploring the dynamics of frontier bond markets

STIJN VESTJENS

484681

SUPERVISOR: L. SWINKELS

ERASMUS UNIVERSITY ROTTERDAM

MASTER THESIS: ECONOMICS & BUSINESS

SCHOOL OF ECONOMICS

MAY 2020

ABSTRACT

This research scrutinizes the dynamics of co-movements of frontier sovereign bond markets with major global bond markets during the period 2002-2018. This study analyzes in addition whether macroeconomic factors can explain the obtained dynamic conditional correlations on the country level. The last step of this research tests the potential international diversification benefits of frontier bond markets on the aggregate and regional level. This paper finds significant time-varying correlation levels, which are on average close to zero between frontier government bonds and US government bonds. Frontier bond markets co-move stronger with emerging government bonds, US high yield corporates, US investment grade corporates and equity markets resulting in positive correlation levels during the entire sample period. The impact of macroeconomic factors is inconclusive and can therefore not explain the observed time-varying co-movements. Significant diversification benefits of frontier bond markets are vanished on the aggregate level by including higher yielding assets, but significant diversification benefits are present in the period after the financial crisis. In addition, the regional frontier sub-indices Europe and Africa show diversification benefits over the entire sample period. Restrictions on short-selling and incorporating transaction costs could diminish the potential diversification benefits in the realistic investable world.

CONTENT

Preface

This master thesis forms the completion of the Financial Economics master's program at Erasmus University Rotterdam. This research studies the dynamics of frontier bond markets, which can be valuable for investors, policymakers and academics. The choice to study the movements of frontier bond markets can be explained as follows. First, my international experiences in developing countries and the courses I have taken in development economics sparked my interest to study a topic related to emerging markets. In addition, I experienced during my work at Alpha Capital Asset Management that discovering yielding assets in the fixed income market has become a difficult task. Discovering yielding assets in the fixed income market is therefore highly interesting and valuable for investors. Lastly, the research of my supervisor Laurens Swinkels and Vanja Piljak on the diversification benefits of frontier bond markets was a great building block for my master's thesis.

The completion of this thesis also means that my time as a student is coming to an end. This journey started in Tilburg, where I obtained my bachelor's degree in Business Economics. I highly enjoyed my time as a student in Tilburg and also the time as an exchange student in Taiwan at the National Taiwan University. After completing my bachelor I joined Alpha Capital Asset Management in Eindhoven, where I gained practical knowledge of the financial world. The work experience at Alpha Capital led to the choice of the master Financial Economics in Rotterdam. The international experiences led to the choice of this topic and to the enrollment in the master's program International Relations at Leiden University.

Conducting this research besides following coursework in Rotterdam and Leiden and working at Alpha Capital was definitely challenging and I could not have ended this project without the guidance I received along the way. Therefore, I would hereby like to thank my supervisor Laurens Swinkels for his support. I am very grateful for his useful feedback, as I know from my fellow students this is not always the case in such projects. Furthermore, I would like to thank my colleagues at Alpha Capital for their fruitful input, and my family, friends and roommates for supporting me during the process.

Stijn Vestjens

1. Introduction

Constructing a well-diversified yielding portfolio is the main task of asset managers. History shows that creating such a portfolio can be a hell of a job. As time flies by, the world is constantly changing with an ever evolving financial world as result. Globalization, technological innovations and astonishing growth of emerging countries reshaped the world order into an integrated world with many new meaningful participants (Tank, 2012). The new status quo of the financial world is fascinating and comes with new challenges and investable assets. Another recent fascinating phenomenon is seen in the changing environment of the fixed income market.

The fixed income market has been the stage of ever decreasing interest rates in the recent decade, which pushed investors to discover new alternative assets. The quantitative easing program of the European Central Bank led to historical low yields in the European bond market. Similarly, the economic stimulation strategy of the Federal Reserve created an environment with record-breaking low interest rates. Discovering alternative high yielding instruments in such an environment is a difficult task. Therefore, investors crossed borders to reveal new investment opportunities, which resulted in huge capital flows to emerging and frontier markets (Lavigne, Sarker, & Vasishtha, 2014, Miyajima, Mohanty, & Chan, 2015).

Investors flew to emerging markets in the past decades in order to diversify their portfolios (Miyajima, Mohanty, & Chan, 2015). Emerging markets were characterized for their lack of financial integration in comparison with developed markets. Emerging markets offered interesting diversification opportunities in the past, but the extent of diversification seems decreasing over time (Berger, Pukthuanthong & Yang, 2011). Therefore, yield-seeking investors nowadays consider the newest rising powers of the world, the so-called frontier market. The increasing correlation levels between emerging markets and developed markets seems to be in contrast with the movements of frontier markets, which seem to be in the early stages of development. Nevertheless, frontier markets are in a position that give them increasing access to the global capital market. Berger et al (2011) discusses that frontier market equities have a non-integrated position in the financial world, which suggests that diversification benefits are feasible.

Frontier markets seem to follow a similar path as former emerging markets have followed in the past. However, nowadays investors' choice has increased. Previously, investors could diversify their portfolio by investing in the less correlated emerging market, but nowadays

investors can choose between emerging and frontier markets (Piljak & Swinkels, 2017). This additional choice provides academics with new research opportunities. The majority of the research focuses on emerging and frontier market equities, but less research has been done on the emerging and frontier fixed income markets. The limited literature could offer interesting topics, such as discovering possible co-movements between frontier government bonds and developed bond markets. Piljak (2013) investigated the co-movements of emerging and frontier market bonds with bonds issued in the United States. In addition she analyzed possible driving forces of these co-movements, such as global and domestic macroeconomic factors. Piljak (2013) finds that the correlation between these bond markets is time- and region-varying. Secondly, she shows that global and domestic macroeconomic factors can partly explain the time variations in bond co-movements. Piljak and Swinkels (2017) conducted research on the diversification benefits of frontier government bonds for investors from the United States. Their results indicate that the diversification benefits of frontier market bonds diminished when investors already invested in other high yielding assets, such as emerging market bonds or high yielding US bonds. Further literature on frontier bond markets is limited and therefore interesting to study to gain deeper understanding about the dynamics and diversification opportunities of frontier bond markets.

The research of Piljak (2013) and Piljak and Swinkels (2017) are excellent building blocks for this study. The research question of this study investigates the extent of co-movements between frontier governments bonds and global bond markets: the emerging bond markets and the fixed income market of the United States. In addition, the potential diversification benefits of frontier bond markets on the aggregate and regional level are scrutinized, which is highly valuable for investors. In order to strengthen the power of the findings, this research will try to explain the drivers of the observed co-movements on the country level. Driving forces could be the inflationary environment, monetary policies, political risks, global business cycles, global volatility, and the level of international reserves.

The research question of this study will be answered by obtaining the weekly total returns of government bonds of frontier countries denominated in US dollars. These countries reflect the J.P. Morgan NEXGEM Index and currently this index contain 34 frontier countries. During the period 2002 until 2018, the total returns of these government bonds are used to analyze the co-movement with other global bond markets. The Dynamic Conditional Correlation GARCH model

of Engle (2002) is chosen to estimate the time-varying correlations among the aforementioned markets. Data on macroeconomic factors is obtained in order to discover driving forces of possible co-movements. Ordinary least squares regressions are estimated to analyze the obtained co-movements and the effects of macroeconomic variables. The mean-variance spanning tests of Huberman and Kandel (1987) will be used to test the significance of the potential diversification benefits of frontier bond markets benefits in a portfolio with emerging bonds, global equities and representatives of the bond indices of the United States.

The relevance of this research in economic literature is threefold. First, it provides new insights to the literature by studying the co-movements of bond markets in dynamic parts of the world, the frontier market. The frontier market is a quickly changing market with entering and leaving participants, which continuously asks for new research and recent data. Changing levels of co-movements could be interesting to economists and investors who discover the potential diversification benefits. Moreover, the majority of the countries currently included in the analyzed index is not scrutinized on co-movements by earlier literature. Secondly, apart from studying co-movements, this research will provide insights in the drivers of the co-movements between the aforementioned markets, which can be useful for investors and policy makers in those regions to gain a better understanding in the dynamics of this bond market. The impact of macroeconomic factors on the co-movements of the countries under scrutiny is not yet documented by other researchers. Lastly, this research can offer investors in-depth knowledge about potential diversification benefits in the fixed income market, which is highly interesting in this low-yielding environment. Investors can use this study to enhance the risk-return relationship of their portfolio.

The research is structured as follows. The next section will provide a brief review of existing related literature. Section 3 presents a description of the used data. The 4th section will explain the methodology in detail, which will be used to present the empirical results in section 5. This section will examine the co-movements and potential diversification benefits of frontier government bonds and will present a comprehensive overview of the impact of macroeconomic variables. The last section presents the concluding remarks of this study. Additionally, this section will briefly describe the limitations of this study and the recommendations for future research.

2. Literature review

2.1. Background

Historically, literature on bond markets has been focused on traditional markets, such as the United States and the Eurozone (Barr & Priestley, 2004; Hunter & Simon, 2005; Kumar & Okimoto, 2011). However, together with the accelerating integration of emerging countries in global financial markets, the interest in the dynamics of these markets has increased. Several researchers investigated the potential diversification benefits of financial assets from emerging markets, which could improve the risk-return relationship. (Polwitoon & Tawatnuntachai, 2008; Cifarelli & Paladino, 2006; Vo, 2009). In addition, the results indicate that these markets offered diversification benefits, as reported by several academics such as Gau and Liao (2012), Bodie, Kane & Markus (2014) and Erb, Harvey & Viskanta (1999). These studies all document that the excess returns of the majority of emerging markets does exceed the average excess return of developed markets.

It is therefore understandable that the interest towards emerging markets rose in the past decades. The importance of, for example, China is rising rapidly and the country became a noteworthy player in financial markets. The increasing importance of these powers and the unfavorable and non-yielding conditions of developed bond markets made investors cross borders to reveal new investment opportunities. The change of capital allocation resulted in huge capital flows to emerging and frontier markets (Lavigne, Sarker, & Vasishtha, 2014, Miyajima, Mohanty, & Chan, 2015).

2.2. Risk premiums of developing markets

The variety of factors that determine the returns of bond markets is explained in this section to understand the dynamics of bond markets. Countries can possess additional risks apart from the systematic risk, wherefore investors require a risk premium. Hughes, Logue and Sweeney (1975) suggest that factors such as control of capital flows, different trading costs and differences in tax structures are possible explanations of varying risk premiums. Other domestic factors that could influence the riskiness of countries could be monetary policies, political risk, language barriers, capital restrictions and volatility in commodity prices (Hunter and Simon, 2005; Rowland, 2004; Baldacci, Gupta and Mati, 2011; Presbitero, Ghura, Adedeji & Njie, 2016). These domestic actors can influence the risk level and therefore the expected returns of particular countries. According to earlier literature, the additional risk premium on developing bond markets can be categorized in

default risk, liquidity risk, political risk and currency risk (Adritzky, 2006; Bodie et al., 2014; De Nicolo & Ivaschenko, 2009). The majority of the aforementioned risks is also present in developed markets. However, the experienced risk level for developed states is lower in comparison with the risk premiums required in frontier- and emerging markets. The currency risk is for example higher in developing countries: the exchange rate of the Euro with the US dollar is less volatile than the exchange rate of the Zimbabwean dollar with the US dollar. Earlier research documents that liquidity risk is present in emerging and developed sovereign bond markets (De Nicòlo and Ivaschenko, 2009; Hund and Lesmond, 2008). The research of Hund and Lesmond (2008) concludes that liquidity risk has a large effect on emerging government bond spreads, which can be explained by the lower liquidity of these bonds. The political risk premium can also be an important determinant of bond returns in developing countries due to unstable regimes. Eichler (2014) finds that this risk is the highest in autocratic and closes regimes. The aforementioned literature shows that bond returns are dependent on a variety of factors and indicates that the these risk premium of emerging and frontier markets is expected to be higher. The different risk levels point to potential diversification benefits.

2.3. Diversification benefits in global financial markets

It is necessary to first explain the definition of diversification before exploring the movements of bond markets. Diversification benefits arise if the risk-return relationship improves by adding a new asset to the portfolio. Diversification benefits can only be obtained if idiosyncratic risk exists. Idiosyncratic risk is endemic to an individual asset, sector or country. In the context of globalization, if country-specific (‘idiosyncratic’) risk was non-existent, all countries would have the same level of risk and therefore similar expected returns (Bekaert and Harvey, 1995). The recent globalization led to an increase in fully integrated markets, which could decrease the potential of diversifying internationally.

Lee and Kim (1993) discuss that stock markets became more interrelated after the ‘Black Monday’ crash in 1987. The increased attention of investors to international factors for making investment decisions resulted in increased co-movements between national stock markets. Berger et al. (2010) explain that international diversification benefits are inversely related to the extent of financial integration. Investor demand a risk premium to cope with the additional risk of non-integrated markets (Pozzi & Wolswijk, 2012). However, Bekaert et al. (2016) do not find a significant relationship between the extent of market openness and co-movements with global

markets, which contradicts their own assumption: fully integrated countries with similar risk levels should possess equal risk premiums. In addition, Driessen and Laeven (2007) present decreasing levels of international diversification opportunities in stock markets form the 90's until the end of past decade. Bessler and Yang (2003) investigated the correlation among the major stock markets in the world. The findings imply that international stock markets are neither fully integrated nor completely segmented, which points to the existence of diversification benefits. Pukthuanthong and Roll (2009) also report risen levels of financial integration for the majority of the 81 countries under scrutiny. However, the less developed or 'troubled' ones do show lower levels or even decreasing levels of financial integration, such as Bangladesh, Pakistan, Jordan and Sri Lanka. Their study confirms the assumption that not each country is fully integrated into financial markets, which points to other trade barriers or country specific risk premiums.

Summarizing aforementioned literature, the extent of co-movements between national asset markets is increasing, but contains time- and country-varying patterns. Although the majority of countries does show increasing levels of integration, several nations still show low levels of correlation with global asset markets. These findings point to feasibility of international diversification. Consistently, the research of Asness et al. (2011) suggest that international diversification works on the long-run, which could explain the time-varying results of other literature concerning the effects of international diversification.

2.4. Drivers of co-movements of bond markets

Many studies investigated the correlation between macroeconomic factors and co-movements of stock returns, such as Cai, Chou and Chou (2009), Dumas, Harvey and Ruiz (2003), and Kiviaho, Nikkinen, Piljak and Rothovius (2012). Cai et al. (2009) conclude that international stock correlations are time-varying and dependent on cyclical market conditions such as inflation rates and global stock volatility. Dumas et al. (2003) find a relationship between national outputs and stock returns in twelve OECD countries. Furthermore, Kiviaho et al. (2012) investigated the co-movements of European frontier stock markets with the United States and the three largest developed markets in Europe. Their results suggest that macroeconomic factors have great explanatory power in predicting co-movements in the long term. Specifically, the domestic variables do show stronger explanatory power in the short-run, whereas in the long-run global factors tend to have more impact in explaining co-movements.

Research concerning the drivers of co-movements between international bond markets is limited in comparison with similar literature on stock markets. Hunter and Simon (2005) discover that monetary policies and business cycles are important drivers of the co-movements between bond markets of the United States and other major bond markets. Brooks and Mosley (2012) find that the risk of emerging bond markets can be explained by the creditworthiness of peer countries. Moreover, Presbitero et al. (2016) documents that spreads of government bonds of African emerging markets seem to be lower if countries show stronger external and fiscal positions, higher economic growth and higher government effectiveness compared to its peer countries in the African continent. Their study also confirms earlier literature discussing higher levels of bond issuance during periods of high global liquidity and high levels of commodity prices. Research of Rocha and Moreira (2010) suggests that countries should support policies towards financial liberalization, public debt management, and the development of the domestic financial market in order to reduce the multiplier effect of global risk shocks. Rowland's study (2004) indicates that factors like the inflation rate, the level of international reserves, the openness of the economy, external debt ratios and the economic growth rate are important determinants of the credit ratings of sovereign governments bonds of emerging markets. Furthermore, Baldacci et al. (2011) state that political and fiscal factors do matter in determining credit risk of nations. Similar, Eichler (2014) provides evidence that countries with parliamentary systems and low quality of governance face higher bonds spreads. Moreover, political stable nations possess significantly lower sovereign yield spreads, especially those of autocratic regimes. Jaramilo and Weber (2012) conclude that default bond indicators have the highest impact on bond yields during periods of high global risks aversion. During period of low risk aversion, bond yields seem to be mostly affected by global macroeconomic factors. Consistent with these findings, Kennedy and Palerm (2014) find that global risk aversion is the main driver of bond spreads in emerging markets during the financial crisis, which contradicts their findings that provide evidence for country-specific variables as main driver for bond spreads before the financial crisis. The research of Piljak (2013) investigated the driving forces of co-movements between bond markets of the United States and the emerging- and frontier bond markets. Her research used explanatory variables as the industrial production index of the United States, the consumer price index and the interbank interest rates of countries under scrutiny. She documents an important role for macroeconomic factors in explaining the time-varying co-movements of the emerging- and frontier markets with the US markets. Especially

domestic macroeconomic factors were found to have a significant impact on the co-movements compared to global factors. As the reviewed literature shows, a wide variety of factors can have an influence on the dynamics of bond markets. Several researchers documented the importance of domestic variables in explaining bond dynamics of emerging- and frontier markets. The global risk level and global business cycle indicators are also reported as explanatory variables. Therefore, this research uses both domestic and global factors in the attempt to explain co-movements of frontier bond markets with other asset markets, which is similar to the study of Piljak (2013). This research however uses additional explanatory variables which will be explained in Section 3.

2.5. Emerging markets

Emerging markets were characterized for their lack of financial integration in the global financial markets. However, the economic stability of emerging countries rose impressively in the past decades, which resulted in more stable institutions and reliable infrastructure. Nowadays, these emerging countries do not have the same expected growth rates as before due to increasing liquid markets, stronger connections to the global financial markets and a reduction in their risk premiums (Capital Group, 2013). The experienced growth of emerging powers, globalization and accelerated financial integration led to higher correlation levels with developed markets (Berger, Pukthuanthong & Yang, 2011). Therefore, opportunities to diversify internationally with emerging market assets seem to decrease. Similar, emerging bond markets are affected by events in the US, as they tend to overreact to surprising macroeconomic news originated in the US (Nowak et al, 2011). Mauro et al. (2002) find that sharp changes in bond spreads of emerging market bonds are caused by global events rather than domestic events. Cifarelli and Paladino (2006) analyzed the interrelationship between spreads of sovereign emerging market bonds and found strong co-movements between countries that are geographically close to one another. Their time-varying artificial portfolios provide evidence for the existence of diversification benefits for the analyzed countries. The research of Vo (2009) investigated the international financial integration of Asian bond markets. He discusses that low levels of financial integration between the United States and Asian bond markets is due to barriers of international trades, inadequate information, home bias, taxation structures and macroeconomic policies. Moreover, higher levels of credit and liquidity risks in the Asian region can be another explanation of low international integration. Gau and Liau (2012) investigated the correlation of government bond indices in emerging markets. They find positive correlations with global bonds indices for the majority of the scrutinized markets. Bunda,

Hamann and Lall (2009) finds that the extent of correlation accelerated after the financial crisis. To summarize the reviewed literature: a large scale of the available literature points decreasing opportunities to obtain international diversification benefits by including emerging markets bonds to a portfolio.

2.6. Frontier markets

The newest rising powers of the world, the so-called frontier market is interesting to investors to discover potential diversification benefits. The connection of emerging markets with the developed world is in contrast with that of frontier markets, which seem to be in the early stages of development. Several characteristics indicate that frontier markets follow the former path of emerging countries. An example of such a characteristic is the 'demographic dividend', which means that the labor force is accelerating faster than the population that is dependent on this labor force. This phenomenon could lead to sustainable growth, higher income per capita and an increase in the domestic spending of locals (Capital Group, 2013). Moreover, the increasing good governance of frontier markets creates a stable institutional framework supported by global organizations such as the International Monetary Fund (IMF). Countries that comply with the global requirements of good governance can receive funds from international organizations, which can result in improved governance and accountability (Capital Group, 2013). Finally, the presence of many natural recourses, cheap labor forces and the aforementioned characteristics make frontier markets attractive to foreign investments. These foreign direct investments can be a big boost for the economy (Capital Group, 2013). The specific characteristics of frontier markets accompanied with their expected growth and lack of integration in the financial world make this market interesting to study. Moreover, the scarcity of literature on sovereign frontier bond markets is an incentive to explore the dynamics of this part of the world. As investors are constantly looking out for yielding assets, new research on a quickly evolving fixed income market is necessary to make thought-out investment decisions.

Frontier markets are in the early stages of development, low-income states and usually non-integrated in the global financial markets. As aforementioned, frontier markets are countries with specific characteristics with, until recently, no access to international capital markets. Literature on these markets is thin since the emergence of these frontier markets is relatively new. Berger et al. (2011) investigated the international diversification opportunities of frontier stock markets and reveal that these markets exhibit low levels of integration. Moreover, the changing levels of

integration are not consistently increasing, but are randomly shifting across countries. These results point to potential diversification. Similarly, Kiviaho et al. (2012) examined the co-movements of European frontier markets with developed markets and revealed that diversification benefits are significantly feasible in the short term. However, as Marshall, Nguyen, and Visaltanachoti (2015) highlight, the high transaction costs of frontier markets can largely vanish the diversification benefits of frontier markets. Nevertheless, they also find that diversification benefits remain if investors rebalance their portfolios less than four times per year. Another noteworthy result of Marshall et al. (2015) state that higher risk aversion leads to lower diversification benefits. Lastly, they do not find cross-country differences or significant linkages between the extent of development and the extent of diversification benefits. The research of Abidi et al. (2016) studied the extent of integration of frontier financial markets in international capital markets and discover that the level of integration rose impressively after the financial crisis.

Aforementioned literature mainly investigated the dynamics of frontier equity markets. Literature on co-movements of frontier bond markets is scarce. According to my knowledge, the only literature on the diversification benefits of frontier market bonds is done by Piljak and Swinkels. Other literature on frontier market bonds focused on the risk that comes with the issuance of sovereign frontier market bonds or the macroeconomic factors influencing these issuances and related spreads (Guscina, Pedras & Presciuttini, 2014; Presbitero et al., 2016).

The studies of Piljak (2013) and Piljak and Swinkels (2017) focus on the co-movements between sovereign frontier market bonds and developed or emerging markets. The research of Piljak (2013) is closely related to this research, as it investigates the co-movements of emerging and frontier bond markets with bond indices of the United States. Moreover, she investigates the possible explanatory variables of these possible co-movements. Her study examines if domestic and global macroeconomic factors play an important role in explaining the dynamics of bond returns. The results show time-varying results across countries, where Brazil, Turkey, Russia and Ecuador show longer intervals of negative correlation with US markets. Contrary, China, Mexico, Poland, and South Africa are in the long-run positive correlated with the US bond market. Secondly, the research reveals that macroeconomic factors do play an role in explaining the obtained time-varying co-movements. Specifically, domestic macroeconomic factors play a greater role of importance than global factors. Consistent with the findings of Hunter and Simon

(2005), Piljak (2013) identifies that the domestic monetary policy is the most important actor in affecting the co-movements of bond returns.

The study of Piljak and Swinkels (2017) investigates the correlation dynamics of frontier bond markets. They examine the co-movements between US dollar-denominated sovereign frontier bonds with emerging and US bond markets and equity markets. Their results reveal that the correlation between the US Treasury index and the frontier bond markets under scrutiny is time-varying, on average almost zero and even negative in some time periods. However, the correlation between frontier market bonds and US high yield, US investment grade corporates and emerging bond indices is positive during the entire sample period. The significance of the diversification benefits of frontier market bonds vanish by the inclusion of high yield and investment grade indices of the United States, or emerging bond market indices. Moreover, their research document high correlation levels between neighboring countries or geographical close states. Lastly, they discover country-varying patterns, which indicates higher diversification potential for specific countries such as Sri Lanka, Ghana and Georgia.

The frontier bond market universe is a quickly changing environment with entering and leaving participants. The literature on this environment is less-known and asks for continuously new research and data examination to gain deeper insights in the financial behavior of frontier markets. The research of Piljak (2013) and Piljak and Swinkels (2017) are excellent starting points for this study. This research can built on the pillars of their findings. This research explores extra macroeconomic and political factors to gain a better understanding of the time-varying co-movements. In addition, the research of Piljak (2013) focuses mostly on emerging markets, while this research will attempt to explain the impact of macroeconomic factors on the co-movements of frontier countries that are not scrutinized by Piljak (2013). The relative short sample period of Piljak and Swinkels (2017) is expanded and divided into sub-periods to gain deeper insights in potential diversification benefits in particular time periods. Moreover, half of the countries included in the index currently were not present in the index at the time of the study of Piljak and Swinkels (2017), which indicates that research with recent data is desired to make thought-out investment decisions.

3. Data

3.1. Emerging and frontier markets

Data on frontier bond markets is limited and difficult to obtain for students. The increasing interest in frontier bond markets is recognized by J.P. Morgan, which led to the launch of the J.P. Morgan Next Generation (NEXGEM) Index in 2011. The J.P. Morgan indices on emerging markets are known for its extensive data availability. By using a consistent approach to assess inclusion of bonds, J.P. Morgan was able to calculate the index back to 31 December 2001. The consistent set of rules withholds J.P. Morgan from a look-ahead bias, except for the chosen inclusion criteria in 2011. This index is perhaps the only index on frontier bond markets with sufficient data availability on frontier bond markets.

Therefore, the NEXGEM index is used to represent the bond returns of the frontier markets on global, regional and national level. The index constitutes of United States dollar-denominated bonds and tracks the government and quasi-government bonds of the so-called 'next generation markets'. According to J.P. Morgan, these frontier markets have the following characteristics: less liquid, smaller and they are following the same path as former frontier markets. The choice for the NEXGEM index is similar to the index choice of Piljak and Swinkels (2017). J.P. Morgan integrated specific rules for inclusion in the index. First, all bonds in the index are traded outside the issuing country, which means that all included bonds are international bonds. Second, all bonds are denominated in US dollars. Besides these requirements, a credit rating of BB+/Ba1 or lower by S&P and Moody's is obliged to be included into the index. J.P. Morgan removes and includes countries when they reassess the aforementioned requirements for each country. At the end of 2018, the NEXGEM index includes bonds of 34 countries. In order to study regional and national differences, the weekly returns are obtained on aggregate, regional and country level.

The starting date of the sample period is 31 December 2001 and the ending date is 31 December 2018. The data of the index is available from 2001 onwards, which results in the disability to choose an earlier starting date. The data availability per country differs significantly, some countries have only a couple years of data history. As frontier markets are at the earlier stages of development, they are also recently starting with issuing dollar-denominated bonds which results in countries with a very recent starting dates. Besides the varying starting dates, several counties have missing periods in the sample, mostly due to a lack of issuance of eligible bonds.

Countries with one or more of the next characteristics are excluded from the country-level analysis: countries with missing periods or countries with less than ninety observations. The choice to exclude countries with an insufficient amount of observations is underpinned by the findings of Vo (2009). He finds that variables can have inaccurate pairwise correlations when they have less than one year of overlapping data (Vo, 2009). Second, data on domestic macroeconomic factors have to be available to be included in the country-analysis. The choice to exclude countries after observing the data implies a look-ahead bias and might therefore influence the results. The possibility exists that countries with missing data were the worst performers. In that case, predicting the countries that will have missing observations in the future would be fruitful for investors. Unfortunately, this research cannot predict which countries will have missing observations in the future. Excluding particular countries in the mean-variance spanning tests would be problematic and could influence the results. In that case, the disability to predict future missing periods would be a limitation of the research. However, this study only conducts research on correlations at the country-level, and not on average total returns. The effect on the results is therefore expected to negligible. By using a systematic approach, a similar consistent dataset is used in each part of the research. The next countries are included as result of the chosen requirements: Angola, Armenia, Azerbaijan, Bolivia, Costa Rica, El Salvador, Gabon, Georgia, Ghana, Guatemala, Honduras, Jamaica, Kenya, Namibia, Senegal, Sri Lanka. The following countries are excluded due to the applied restrictions: Belarus, Belize, Cote D'Ivoire, Cameroon, Ethiopia, Iraq, Jordan, Mongolia, Mozambique, Nigeria, Pakistan, Papua New Guinea, Paraguay, Suriname, Tajikistan, Tunisia, Vietnam and Zambia.

The paper of Piljak and Swinkels (2017) investigated the diversification benefits of hard currency bonds issued by frontier countries. Piljak and Swinkels (2017) used hard currency bonds in order to eliminate the exchange rate risk. Currencies in frontier markets can be highly volatile and could therefore be the main driver of price changes of sovereign bonds instead of shifting interest rates or fundamental changes in country characteristics (Ladekarl & Peters, 2013). However, as Ladekarl and Peters (2013) state, local currency bonds offer higher exposure to local markets as hard currency bonds, which decreases the correlation with the developed markets. Despite the additional diversification opportunities, the main goal of this research is not to measure the effects of currencies shifts. This paper aims to analyze the fundamental determinants of sovereign bond returns. Therefore, the bonds used in this research will be denominated in hard

currencies, which will be the dollar of the United States. Moreover, the accessibility for foreign investors to local frontier government bonds is lower in comparison with frontier governments bonds issued in hard currencies. Therefore, it is more relevant for investors to gain insights in the dynamics of hard currency bonds. Lastly, the data availability of local frontier government bonds is limited while data of hard currency bonds issued in frontier markets is sufficient. Future research on local currency frontier bond markets would be highly interesting if the accessibility for investors to these markets rises and if sufficient data is available.

Indices that cover emerging market bonds are available on a wider scale. The J.P. Morgan indices are well-known for its extensive research on these markets. Besides this reason, comparing indices that are constructed by the same data provider is desirable and therefore the weekly returns data of the J.P. Morgan EMBI+ Index are obtained as proxy for the emerging bonds markets. The EMBI+ index will be used instead of the J.P. Morgan EMBI Global Index since the latter one uses looser rules. The EMBI Global index includes some frontier countries, which is in contrast with the EMBI+. The EMBI+ has currently none overlapping countries with the NEXGEM Index and if it did in the past, the weight in the EMBI+ Index of a frontier country is too small to make a significant difference in the results. Similar to the NEXGEM Index, the EMBI+ index is dollar-denominated and tracks the total returns of sovereign and quasi-sovereign debt issued by emerging markets. The EMBI+ total returns are obtained on the regional and aggregate level.

The returns in this research are obtained on a weekly basis. The choice for weekly returns is twofold: weekly returns avoid possible non-synchronous pricing between bonds in different regions and weekly returns are preferred over daily returns in order to avoid stale pricing on daily level for particular markets (Piljak and Swinkels, 2017). The use of weekly returns can be problematic due to the sensitivity of the chosen day-of-the-week observation (Chandra, 2006). The day-of-the-week effect could influence the results, but is expected to be negligible in this time frame. In addition, similar to common research and databases, Datastream uses the weekly data based on the observation on Friday. If data was unavailable due to holidays or any other reasons, the price of the previous day is used. Returns in this research are measured as total returns, which implies that dividends and price changes are both included. The return data of frontier and emerging markets is obtained through Datastream and J.P. Morgan, which provide similar data.

For robustness checks, the monthly returns are obtained to repeat the tests in each section of this research. Following Piljak and Swinkels (2017), frontier bond markets can be illiquid, which can lead to non-synchronous trading problems and possible overestimated diversification benefits. Therefore, the conditional correlation analysis will be repeated with monthly returns on the aggregate level. The obtained monthly pairwise correlations on the country level are used for the robustness check to repeat tests with explanatory variables. The robustness check on the country level can perhaps result in blurring results, due to possible insufficient amount of observations. The mean-variance spanning tests (section 5.3) are repeated with monthly returns on the aggregate level.

3.2. Developed markets

The bond markets of the United States belong the most important anchors in the global bond market. It is therefore interesting to investigate to what extent frontier bond markets co-move with one of the most important bond markets worldwide. Each investor in fixed income pays attention to the movements of the United States. Testing whether frontier bonds markets can add value to a fixed income portfolio with US bond indices is therefore an interesting research angle. Data of United States' bond markets is widely available. An attempt is done to use indices of United States' bond markets of J.P. Morgan in order to use datasets from the same data provider throughout this research. However, as student, it was not possible to access indices of J.P. Morgan on bond markets of the United States. The indices of Bloomberg are widely used and therefore the bond indices of Bloomberg are obtained through Datastream as representative of the US fixed income market. The Bloomberg Barclays High Yield Index, the Bloomberg Barclays Corporate Investment Grade Index and the Bloomberg Barclays US Treasury Index are the three indices of a United States' fixed income portfolio used in this research. The choice for these categories can be explained by its different risk levels, where treasuries are perceived as the less risky followed by the investment grade corporate bonds. The high yielding bonds are perceived as the most risky of the three aforementioned categories. A wide range of the US fixed income market is attempted to be represented by choosing three categories with different risk- and return levels.

The total returns on these indices are dollar-denominated and obtained on weekly basis. The High Yield Index seeks to measure the performance of U.S. corporate debt issued by constituents of the S&P 500 with a high-yield rating. The credit rating of a bond has to be BB+/Ba1/BB+ or below in order to be included to this index. Furthermore, each bond must have a minimum par of

USD 250 million and a maturity at least one year from the rebalancing date. In comparison, the Investment Grade index constitutes of bonds with a credit rating of at least BBB-/Baa3/BBB- and a minimum par of USD 300 million. The US Treasury Bond Index is designed to measure the performance of US treasury markets. The risk-free rate is represented by the 4-weeks US Treasury Bills.

As a proxy for a global equity portfolio, the returns of the US dollar-denominated MSCI All Country Index are obtained. This index is value-weighted, which represents a broad range of equities in 23 developed countries and 24 emerging countries. The index is a widely used benchmark for the performance of global equities. In addition, the total returns of the MSCI Emerging Markets Index, denominated in US dollar, is obtained to compare the correlation of frontier bond markets with emerging equity markets.

3.3. Macroeconomic and political data

This sub-section defines which variables are used for the analysis on the explanatory power of macroeconomic factors in explaining the co-movements between frontier and global bond markets. Macroeconomic data is often only available on a monthly, quarterly or yearly basis. This research uses data on macroeconomic factors such as the inflationary environment, monetary policies, political risk, the industrial production index, global volatility and the level of international reserves. The Consumer Price Index of the included countries is used as a proxy for the inflationary environment and is obtained on a monthly basis, which is similar to Piljak (2013). The data is downloaded from Refinitiv Comparable Economics through Datastream, which is known for its accurate data coverage. As aforementioned by Rowland (2004), the inflationary environment can play a role of importance in the dynamics of bond markets. Piljak (2013) and Hunter and Simon (2005) point to the domestic monetary policies as great predictor of bond dynamics. Therefore, the Central Bank Policy Rate is obtained from the International Monetary Fund through Datastream per annum in order to represent the monetary policy of a state. Baldacci et al. (2011) state that political and fiscal factors do matter in determining credit risk. In order to capture the political risk factor, the data of the Political Risk Index of the Heritage Foundation is obtained on a yearly frequency. The Heritage Foundation is well-known research institution and known for its coverage and assessment of political risk of countries worldwide. According to Rowland (2004), the level of international reserves and the external debt ratio can be important determinants of the credit ratings of sovereign governments bonds in emerging markets. In order to capture this factor, the

level of International Reserves will be used as representative and will be downloaded from Datastream. The advantage of the aforementioned sources is the use of one method to construct data. By using national sources, the risk exist that the methodology of data construction is different in each country. The aforementioned sources all use the same the methodology across countries. Therefore, countries can be compared and greater reliable results are expected.

Global volatility can be the main driver of bond spreads in emerging markets as stated by Kennedy and Palmer (2014). The CBOE Volatility Index (VIX) will be the representative of measuring global volatility based on S&P 500 index options. The VIX index is obtained on a monthly frequency. Frontier bond markets can be perceived as 'equity like' and therefore the CBOE Volatility Index is used instead of the Merrill Lynch Option Volatility Estimator (MOVE), which is a proxy for global bond market uncertainty (Piljak, 2013; Kelly, Martins and Carlson, 1998). Piljak (2013) finds that the MOVE is not a great predictor of bond co-movements. Therefore, she concludes that bond co-movements in frontier markets might be influenced by global stock markets uncertainty rather than uncertainty in bond markets. Hunter and Simon (2005) discovered that business cycles are important drivers of the co-movement between bond markets of the United States and other major bond markets. Reliable data on domestic business cycles of frontier markets is difficult to obtain. Leading business cycle indicators such as the Purchasing Manager Index are not available in the majority of the frontier markets. Moreover, the findings of Fiess (2007) and Lee (2012) point to increased business cycle synchronization worldwide. These reasons advocate the choice of a global business cycle variable instead of a domestic one. The global Purchasing Manager Index is obtained on monthly basis from the Institute for Supply Management through Datastream, which is a well-known indicator of the global business cycle. The research of Piljak (2013) tackles the potential problem that the domestic business cycle can incorporate global business cycles by using the approach of Anderson, Mansi and Reeb (2003). This approach estimates a regression with the domestic business cycle per country as dependent variable and the global business cycle as independent variable. The error term of this regression excludes the worldwide business cycle shifts and incorporates the domestic business cycle. By using this error term, the arisen problem of increased business cycle synchronization (Fiess, 2007; Lee, 2012) is tackled. The lack of data availability on domestic business cycles of frontier markets and the use of the EMBI+ as one of the dependent variables explains why this study does not use the approach of Anderson et al. (2003). It is out of the scope off this study to correct for the global business

cycles, because this study cannot obtain domestic business cycles and cannot create an accurate representative of the EMBI+ business cycle. This is a limitation of this research and could be an extension for future studies.

Besides the disability to use the approach of Anderson et al. (2003), it is out of the scope of this research to construct a proxy for the interest rate and inflation rate of the EMBI+ index. Creating such proxies is difficult for two reasons: this study does not have access to the data needed to determine the weight of a specific country at a specific moment in time in the index. In addition, the fact that the countries in the index are continuously changing make the use of a 'index' proxy difficult. The disability to create such proxies is again a limitation of this research. The variable political risk is expected to be less synchronized with global fluctuations, which limits the disadvantage of the disability to correct for international correlation. It could be that the extent of political risk is influenced by global or neighboring events, but it is out of the scope of this study to filter out this possible interconnectedness.

In the second part of the regression analysis, the pairwise conditional correlations between the frontier bond market and the US treasuries is the dependent variable. In this case, it is possible to include variables that could filter out the influence of United States factors. Therefore, the data of the Central Bank Policy Rate, the level of International Reserves and the Consumer Price Index is also obtained for the United States. These three extra variables are included in the regression with the co-movements between frontier- and US bond markets as dependent variable. This approach is similar to Piljak (2013), who included, besides domestic factors, similar US factors into her model that explained the obtained co-movements.

3.4. Descriptive statistics

The descriptive statistics of the J.P. Morgan NEXGEM index are presented in Table 1 and 2 in Appendix A. Table 1 presents the total weekly returns per country, defined as weekly logarithmic returns. The table shows the current weight, the number of observations and the most recent Gross Domestic Product (GDP) of each country in the index. The GDP is obtained from the International Monetary Fund. The regional weights are displayed in Graph 1 in Appendix A. The Asian and African region have the largest weights in the index, respectively 32 percent and 38 percent. The Latin region currently has a weight of 25 percent and Europe and the Middle East do only have three and two countries in the index with a total weight of respectively 4 and 6 percent.

The fifth column lists the starting date of each country in the index. The presented starting dates advocate again the need of new research on these markets since half of the current countries were not (or not more than 2 years) included in the index at the time Piljak and Swinkels (2017) conducted research on these frontier markets. The seventh column shows the current S&P credit rating of a country. The credit rating differs, but most countries have a credit rating of B or BB. If the country is not rated by S&P, the rating of Moody's is shown between brackets. The average weekly returns do vary between across countries, but do on average exceed the mean returns of the United States bond indices. Tajikistan is the only country that shows negative average weekly returns of -0.03 percent (-1.55 percent per year), but this can be explained by its limited number of observations, namely 66. Papua New Guinea is the country with the highest average weekly return: 0.36 percent (20.5 percent per year). Again, the relative high average weekly return of Papua New Guinea can be attributed to the limited number of observations: 44. In general, most countries show average weekly returns between 0,07 and 0.18 percent. As expected, the majority of the frontier bond market returns are negatively skewed and leptokurtic, which is consistent with earlier literature (Erb et al., 1999; Piljak and Swinkels, 2017).

The descriptive statistics of the regional and developed bond indices are presented in Table 2. The shifts in yield to maturities and index market values are presented in graphs 2 and 3 in Appendix A. The yield to maturities of the NEXGEM index declined from 14.07 to 7.95. Similar, the EMBI+ have witnessed declining rates while the region Europe shows the biggest decrease in both indices. The total market value of the NEXGEM index is currently ten times higher compared to the market value at the starting date. The index market value increased from USD 9,768 billion to 114,494 billion. This huge increase is interesting since the total market value of the EMBI+ index only doubled, from USD 149,411 billion to USD 329,687 billion. The noteworthy increase of the NEXGEM market value could indicate that the index is growing and is becoming more liquid. Moreover, it could imply that more countries could issue bonds denoted in US dollars, which could point to a growing investment universe in the fixed income market.

The average annual return of the NEXGEM index of 9.80 percent is slighter higher than the average return of the EMBI+ index, which is 8.67 percent per annum. The weekly volatility, as measured by standard deviation, shows similar results: the NEXGEM is more volatile with a weekly standard deviation of 10.33 percent compared to the 1.23 percent of the EMBI+ index. The

statistics of the bond indices of the United States show lower average returns, ranging from 4.25 to 7.55 percent per annum. A similar is pattern is observed in terms of volatility, which is in all cases lower compared to the bond indices of emerging and frontier markets. These observations are consistent with the common expectation of higher returns and volatilities in emerging and frontier markets.

Table 3 in Appendix A presents the descriptive statistics of the domestic macroeconomic factors for the scrutinized countries. The left panel of the table shows the relative average year-on-year change of each macroeconomic factor: the consumer price index, the central bank policy rate, the level of international reserves and the political risk. On average, the central bank policy rate declined in the majority of the observed states, which is consistent with the declining interest rates in global markets. Moreover, the political risk is on average increasing since a higher score implies less political risk. Similarly, the level of international reserves is increasing in all of the countries, which confirms the suggestion that frontier countries have increased access to international capital markets. The right panel displays the latest value (2018) of each factor, which presents the wide variety of differences across countries. These differences between countries might explain the possible time- and country-varying co-movements of frontier bond markets.

4. Methodology

4.1 Dynamic Covariance Correlation GARCH

The first part of this study investigates the extent of co-movements of frontier bond markets with emerging and US bond markets and equity markets. The Dynamic Conditional Correlation GARCH model (DCC-GARCH) of Engle (2002) is used to estimate the time-varying conditional correlations. The DCC-GARCH model is related to the well-known GARCH methods, which are effective in measuring time-varying correlations (Bauwens, Laurent and Rombouts, 2006). The majority of the papers using GARCH models investigated contagion and market spill-over effects, which often describes the increased global interdependence of a variety of asset classes (Katze, 2013). One of the advantages of the DCC-GARCH model is the possibility to detect possible changes in correlation over time. This feature can be used to detect the dynamic behavior of investors in financial markets (Celik, 2012). The opportunity of the model to measure the possible herding behavior of investors during period of financial stress is another advantage of the DCC-GARCH approach. Moreover, the major advantage of the DCC-GARCH model is the estimation of correlation coefficients of the standardized residuals, which implies that the model automatically accounts for heteroscedasticity. Therefore, the volatility is adjusted during the procedure, which leads to a time varying correlation without volatility biases (Chang, Jeon and Li, 2007).

The weekly returns are calculated by taking the log difference of each index series as:

$$r_{i,t} = ln\left(\frac{p_{i,t}}{p_{i,t-1}}\right) \qquad (4.1)$$

In the above formula, $p_{i,t}$ is the closing price of the total return index, i, at time t. Using log-changes to measure the total returns of government bonds markets is similar to earlier literature of Piljak (2013) and Kim et al. (2006). The model of Engle (2002) is constructed in two steps in order to maximize the log-likelihood function. The first step estimates the univariate GARCH model. In the second step, the dynamic conditional correlations are estimated. The following specification of Engle (2002) is used during this study and is similar to the papers of Piljak (2013) and Piljak and Swinkels (2017):

$$r_t|\emptyset_{t-1} \sim N(0, H_t) \qquad (4.2)$$

$$H_t \equiv D_t R_t D_t$$

The information set at time period $t-1$ is defined in $\emptyset_{t-1}$ and H_t is the conditional covariance matrix; R_t is the (n x n) time-varying conditional correlation matrix $R_t = \{p_{ij,t}\}$; D_t is the (n x n) diagonal matrix of time-varying standard deviations from univariate GARCH models with $\sqrt{h_{i,t}}$ on the i_{th} diagonal, ($D_t = diag\{\sqrt{h_{i,t}}\}$, $i = 1, 2, \dots, n$. In the first stage of the procedure, a univariate GARCH model will be estimated:

$$h_{i,t} = \omega_t + a_t \varepsilon_{i,t-1}^2 + b_i h_{i,t-1} \qquad i = 1, 2, .., n \qquad (4.3)$$

In this univariate GARCH (1,1) models, $h_{i,t}$ is the conditional variance; ω is the constant term; $\varepsilon_{i,t-1}^2$is the 'ARCH term' and thus the lag of the squared residuals. Similar, $h_{i,t-1}$ is the lag of the conditional variance and thus the 'GARCH term'. The ARCH and GARCH effects are measured by a and b respectively (Andersen, Davis, Kreiß and Mikosch, 2009; Bauwens et al., 2006). The residuals of the first stage are standardized and used in the second step to estimate the parameters of the dynamic conditional correlations. The dynamic conditional correlation is defined in the following specification.

$$q_{ij,t} = \bar{p}_{i,j}(1 - \alpha - \beta) + \beta q_{ij,t-1} + \alpha \varepsilon_{i,t-1} \varepsilon_{j,t-1} \qquad (4.4)$$

$$p_{ij,t} = \frac{q_{ij,t}}{\sqrt{q_{ii,t}}\sqrt{q_{jj,t}}} \quad i, j = 1, 2, \dots, n \; and \; i \neq j$$

In the above specification, $p_{ij,t}$ is the dynamic conditional correlation where $\bar{p}_{i,j}$ is the unconditional correlation between the standardized residuals $\varepsilon_{i,t}$ and $\varepsilon_{j,t}$; while a and b are respectively non-negative scalar parameters with their sum less than 1, which leads to a mean-reverting DCC model. These parameters capture the effects of previous shocks on current dynamic conditional correlations. The restriction $a + b < 1$ ensures that the correlation between underlying assets will return to the long-term unconditional level after a shock occurs. The sensitivity and persistence of shocks can be studied through a DCC-GARCH model. The ARCH term measures the sensitivity of the shock of the asset i on the asset j, while the GARCH term measures the persistence of the shock of the asset i on the asset j (Andersen et al., 2009; Bauwens et al., 2006). As robustness check, the dynamic conditional correlation are recalculate with monthly returns on the aggregate level.

4.2 Ordinary least squares regressions

Ordinary least squares (OLS) regressions are used in the second part of this research to regress the obtained pairwise conditional correlations between frontier and emerging bond markets on the aforementioned global and domestic macroeconomic factors. The following regression model will be estimated to test the explanatory power of the macroeconomic factors:

$$\rho_{ij} = \alpha 0 + \beta 1*CPI + \beta 2*CBPR + \beta 3*PR + \beta 4*IR + \beta 5*PMI + \beta 6*VIX + \varepsilon \qquad (4.5)$$

The dependent variable ρ_{ij} represents the obtained correlation coefficients between the returns of frontier and emerging bond markets on a weekly basis. Explaining weekly returns with independent variables with a monthly frequency could be problematic since weekly returns can differ substantially from monthly returns. However, the dependent variable in this regression is the obtained pairwise correlation. These conditional correlations do not have the problem of huge differences between week and month frequencies. Thus, using a dependent variable calculated on weekly frequency with explanatory variables with monthly frequency is not problematic in this case. As robustness check, the correlation obtained on a monthly frequency is used as dependent variable. The emerging bond market returns (i) are the returns of the J.P. Morgan EMBI+ index. The frontier bond market returns (j) are the returns per country under scrutiny, which are specified in Section 3.1. The inflation rate is represented by CPI (Consumer Price Index) and CBPR is the proxy for the monetary policy of a country, which is defined as the Central Bank Policy Rate. PR captures the political risk of a specific country. The global business cycles are captured by the global Purchasing Manager Index (PMI). IR proxies the level of international reserves and VIX is the CBOE Volatility Index, which measures the global risk and market uncertainties (Piljak, 2013).

In addition, the pairwise conditional correlations of frontier markets with the US treasuries will be regressed on the aforementioned factors to draw a comparison with the research of Piljak (2013). The results are not exactly comparable with the findings of Piljak, because her research used not precisely similar independent variables. As robustness check, the previous basic regression model is estimated with the correlation between the NEXGEM and the US Treasury Index as dependent variable. Thereafter, three additional independent variables are included in the regression for the reasons explained in section 3.2. These variables are the United States' data on the consumer price index, the central bank policy rate and the level of international reserves. Therefore, the following regression model will be estimated, where the variables (i) are the factors

of frontier markets and the (j) variables are the macroeconomic factors based on data of the United States:

$$\rho_{ij} = \alpha 0 + \beta 1*CPI_i + \beta 2*CBPR_i + \beta 3*PR_i + \beta 4*IR_i + \beta 5*CPI_j + \beta 6*CPBR_J + \beta 7*IR_J \quad (4.6)$$
$$+ \beta 8*PMI + \beta 7*VIX + \varepsilon$$

The regression model of (4.6) tests whether the changing macroeconomic factors can explain the extent of co-movement between the US treasuries and frontier bond markets. The regression model does not account for the change of a factor relative to the change of United States' factor, it only measures the difference of a singular factor. It could however be interesting to measure the effect of changes relative to the United States macroeconomic factors. The extent of co-movements might change if the percentual change in the inflation rate in a particular country is twice as large compared to the change in the United States. To filter out intercorrelated changes in macroeconomic factor, the following regression model is estimated:

$$\rho_{ij} = \alpha 0 + \beta 1*CPI_{j-i} + \beta 2*CBPR_{j-i} + \beta 3*PR_i + \beta 4*IR_{j-i} + \beta 8*PMI + \beta 7*VIX + \varepsilon \quad (4.7)$$

In the model described in (4.7), the relative change of a macroeconomic factor of a frontier country is subtracted from the relative change of the similar factor in the United States. The dependent variable is similar to the formula (4.6). The factors Purchasing Manager Index and the Volatility Index already measure global data and are therefore not changed. As aforementioned, the political risk factor is expected to be limited influenced by the political risk of the United States. Therefore, the variable will not be different compared to the earlier explained regression models.

4.3. Diversification benefits

4.3.1. Minimum variance portfolio

Markowitz' portfolio selection model (1952) is used to calculate the minimum- and mean-variance portfolio and the efficient frontier. The portfolios are constructed twice: in the first calculation short selling is allowed while in the second one short selling is prohibited. Short selling in frontier markets is not always possible due to low liquidity, low market capitalizations and possible trade barriers. Moreover, the short sale of bonds is a difficult task in general. The second portfolio (where short selling is prohibited) seems therefore to be the most realistic representative of the real investable world. The optimized portfolios show whether frontier bond markets can enhance the risk-return relationship of an existing portfolio. The frontier bond market improves the risk-return relationship if a positive weight is allocated to the NEXGEM index. A positive allocation does not imply a significant improvement of the risk-relationship. The significance of a potential positive allocation will be examined by using mean-variance spanning tests, which are explained in the next section. The following formulas are used to calculate the optimal portfolios, where R_p is the return on the portfolio, R_f is the risk-free rate proxied by the 4-weeks US Treasury Bills and W_i is the relative weight of each asset class in the portfolio. The first formula (4.8) includes short selling while the second one (4.9) prohibits the possibility to short sell assets.

$$\max_{w} E(R_p - R_f) \qquad (4.8)$$

$$\sum_{i=1}^{k} w_i = 1$$

$$\max_{w} E(R_p - R_f) \qquad (4.9)$$

$$\sum_{i=1}^{k} w_i = 1$$

$$w_i \geq 0$$

4.3.2. Mean-variance spanning tests

Following the research of Huberman and Kandel (1987), mean-variance spanning tests are used to analyze whether adding new assets to a portfolio results in an significant enhanced risk-return relationship. Mean-variance spanning tests explain if the mean-variance frontier can be improved if an new asset will be included in the portfolio. In these tests, the new asset group is labeled as the test asset, while the assets that form the existing portfolio are specified as the benchmark assets. Diversification benefits can be obtained if the mean-variance frontier of the benchmark assets does not coincide with the mean-variance frontier of the test asset. If the mean-variance frontiers coincide with each other, there is 'spanning' and no diversification benefits are feasible. According to Huberman and Kandel (1987), two other options are on the table. The first option refers the possibility where the mean-variance frontiers intersect at exactly one point. In this case, there is only one specific point on the mean-variance frontier where an investor cannot achieve diversification benefits by adding the test assets. The latter one refers to the option of no intersection and no spanning, which implies that including the test asset to the existing portfolio has a significant positive effect on the risk-return relationship of the benchmark portfolio.

This study uses the formula of (4.10) to test for mean-variance spanning, where $r_{b,t}$ are the weekly returns of the benchmark portfolio at time t and $r_{t,t}$ are the weekly returns of the test assets. The risk-free rate is expressed as r_f and represented by the 4-weeks US Treasury Bills. There is spanning in the case when $\alpha = 0$. The null-hypothesis is stated in (4.10) and implies that α is zero. Rejection of the null-hypothesis by using a t-test implies no spanning and vice versa. If there is no spanning, α is positive, which implies that adding the test assets to the benchmark portfolio enhances the mean-variance frontier of the portfolio; there is either intersection or no spanning and no intersection.

$$r_{t,t} - r_{f,t} = \alpha + B(r_{b,t} - r_{f,t}) + \varepsilon_t \qquad (4.10)$$

$$H_0 ; \alpha = 0$$

The dependent variable is defined as a value-weighted test portfolio, representing the (regional sub-index of the) J.P. Morgan NEXGEM Index. The mean-variance spanning tests are only performed on the aggregate and regional level, because the data availability on the country level is insufficient to conduct mean-variance spanning tests. The majority of the countries do not have a long data history, which motivates the choice to not conduct mean-variance spanning tests on

the country level. The choice to exclude countries after observing the data implies a look-ahead bias. As aforementioned, the possibility exists that countries with missing data were the worst performers. In that case, excluding particular countries in the mean-variance spanning tests would be problematic and could influence the results. The exclusion of a significant number of countries is not problematic for the research on correlation on the country-level, but can be problematic for the research on the average returns. For these reasons, the mean-variance spanning tests are only conducted on the aggregate and regional level. The independent variable is defined as the benchmark portfolio and will be constructed by corporates and governments bonds of the United States, the (regional) EMBI+ index and an index representing global equities. Different combinations are used to create different benchmark portfolios and therefore additional checks on the effects of adding frontier government bonds to an investment portfolio. Moreover, different time period are analyzed in order to gain knowledge about potential differences across time. Hence, besides the entire sample period, the period before the financial crisis (2001-2007), the years of the financial crisis (2007-2011) and the period after the financial crisis (2011-2018) is scrutinized. The disadvantage of investigating short periods is the loss of power, because investigating short periods and therefore less observations often leads to insignificant results. Nevertheless, the aforementioned short periods will be put under scrutiny in order to strengthen the power of the result of the tests on the entire sample period. In addition, the level of integration of frontier markets seems increasing over time, which could affect the results of the mean-variance spanning tests in different time periods (Pozzi & Wolswijk, 2012). As robustness check, the aforementioned tests are repeated with monthly returns on the aggregate level.

5. Empirical results

5.1. Dynamic Conditional Correlation GARCH

This first section of the results presents the outcomes of the DCC-GARCH analysis. The results provide insights in the co-movements between frontier bond markets and other well-known asset classes, such as the emerging bond market, US fixed income markets and the global equity universe. If the correlation appears to be significantly time-varying, the next section (5.2) will be valuable by explaining these possible time-varying correlation levels. If the frontier bond markets appear to be less correlated to global bond indices, the last section (5.3) is highly relevant by discovering potential diversification benefits. The use of the DCC-GARCH model is motivated by Kim et al. (2006), Piljak (2013) and Piljak and Swinkels (2017). These studies conclude that bond market correlations are dynamic, which advocates the use of the DCC-GARCH model. The outcomes give insights in possible variations in the level of co-movements, which is relevant to investors who are looking out for assets with low correlations to traditional financial markets. First, the results on the aggregate level are presented followed by the results on the regional level and the national level.

5.1.1. Aggregate level

Graph 4, 5 and 6 (4b-4e; 5e-5f; 6 in Appendix B) and Table 3 report the results of the DCC-GARCH model on the aggregate level. The figures present the dynamics of bond return co-movements between frontier markets and emerging bond markets, US bond indices and global equity markets. According to earlier research, frontier bond markets are expected to have low levels of correlation with the US Treasury Index and higher correlation levels with emerging bond markets and equity indices (Piljak and Swinkels, 2017). Consistently, the observed correlation between the NEXGEM and the EMBI+ is on average the highest: 0.76 with a minimum of 0.311 and a maximum of 0.941. As displayed in Table 4 and Graphs 4b – 4e (in Appendix B), the frontier bond market has the highest correlation with European and Latin regions of the EMBI+ index, respectively 0.69 and 0.72. In comparison, the correlation of the NEXGEM index with the regional EMBI+ sub-indices Asia and Africa is 0.62 and 0.56 respectively. The figures 4b – 4e show the varying correlation levels between the frontier bond market and the regional sub-indices of the EMBI+ index. The regions Europe and Latin America seem to have constant correlation levels with the NEXGEM, which are higher compared to the regions Asia and Africa. This observation is surprising as Europe and Latin America have the lowest weight in the NEXGEM index. A higher

correlation with the African and Asian EMBI+ sub-indices was therefore expected. The observed pattern in Graph 4b and 4c reveal rising levels of correlation between the NEXGEM and Asia and Africa in the recent years, while the correlation with Europe and Latina America remains constant (Graph 4d and 4e). A possible explanation for the observed increasing correlation levels with the African- and Asian continent could be attributed to higher levels of financial integration of frontier countries or to the changing composition of the bond indices over time. As can be observed in the research of Piljak and Swinkels (2017), the African and Asian regions did have a lower weight in the NEXGEM index (December 2013) in comparison with the current weights. The shifts in weights can therefore be the driver of rising correlation levels. In general, it can be concluded that frontier bond markets are relatively strong correlated to the emerging bond markets with a maximum documented correlation of 0.941 on the aggregate level. These results could point to less opportunities to diversify internationally when only these two indices are considered.

The sum of the coefficients α and β in the DCC- GARCH analysis are less than 1 in all cases, which points to the mean-reverting nature of the dynamic correlation process. The graphs 4a-4e present relative constant correlations, but the highly statistical significance of parameters α and β in Table 3 however indicate that the conditional correlation is substantially time-varying and therefore not constant. Remember that the α measures the sensitivity of asset i following a shock of asset j, while β indicates the persistence of the volatility shock. The results indicate that the volatility shocks have long-lasting impact on the conditional correlation between the scrutinized assets. These figures are interesting, because substantial correlation shifts over time can point to changing levels of diversification benefits in the sample period, which are analyzed in section 5.3.

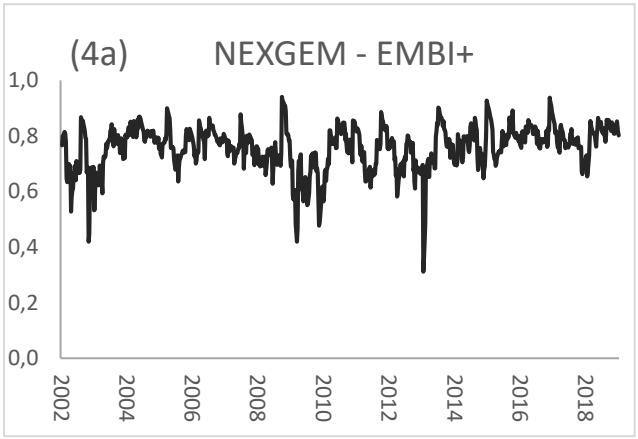
Table 3
Statistics of the dynamic conditional correlations

	α	β	Mean	Min	Max
NEXGEM - EMBI+	0.092***	0.788***	0.757	0.311	0.941
	(0.025)	(0.061)			
NEXGEM – EMBI+ Europe	0.069***	0.767***	0.692	0.317	0.910
	(0.024)	(0.083)			
NEXGEM – EMBI+ Asia	0.021***	0.975***	0.616	0.239	0.834
	(0.005)	(0.008)			
NEXGEM – EMBI+ Africa	0.067**	0.912***	0.562	0.063	0.871
	(0.029)	(0.052)			
NEXGEM – EMBI+ Latin	0.064**	0.827***	0.715	0.366	0.915
	(0.025)	(0.080)			

Figures in parentheses are standard errors. *** p<0.01, ** p<0.05, * p<0.1 denote the statistical significance.

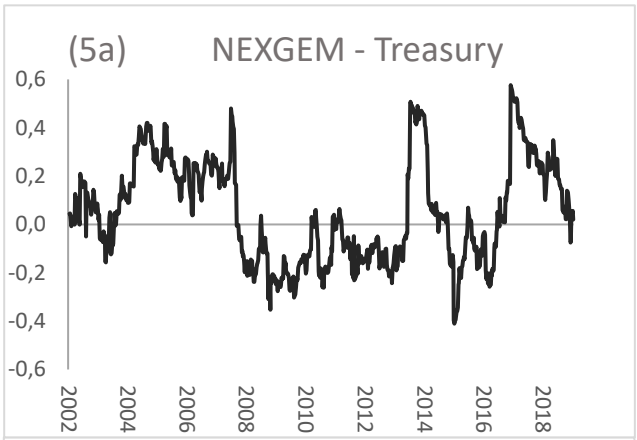
Graph 4a

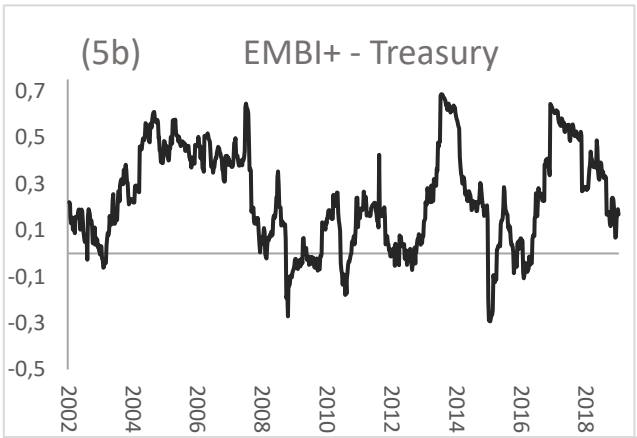
Dynamic conditional correlation NEXGEM - EMBI+

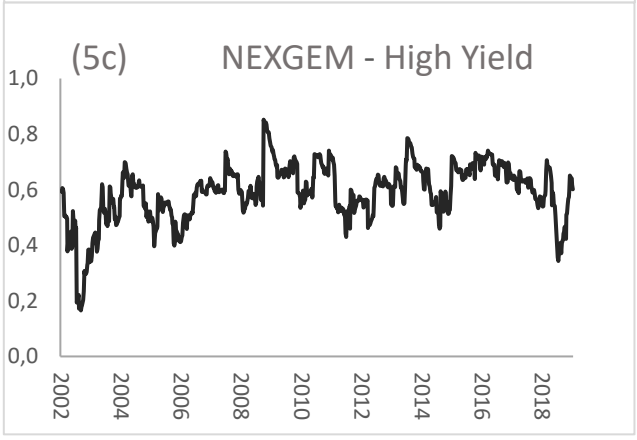


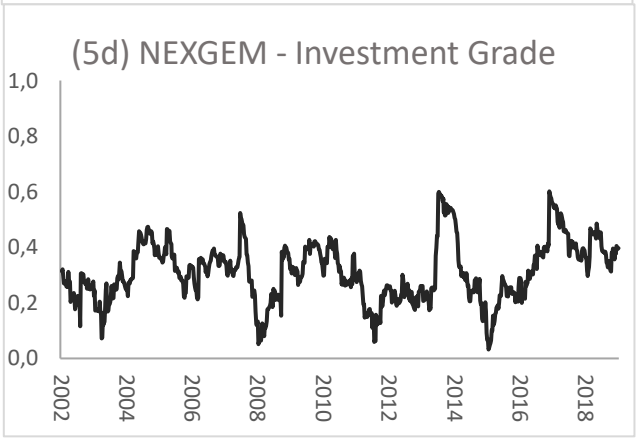
Graph 5a – 5d

Dynamic conditional correlation NEXGEM/EMBI+ - US Bond Indices









In comparison, the extent of correlation between the NEXGEM and US bond indices seems not to be constant. Moreover, the outcomes show lower correlation levels compared to the co-movement between frontier and emerging bond markets. As displayed in figures 5a-5d, the extent of co-movement varies substantially over time. Graph 5a reports even considerable periods of negative correlation between the NEXGEM and the US Treasury index, which is consistent with the findings of Piljak and Swinkels (2017) and the pattern observed between the EMBI+ and the US Treasury Index (Graph 5b). The observed average dynamic correlation with the US Treasury index is 0.050 with a minimum of -0.410 and a maximum of 0.576 as displayed in Table 4. In comparison, the average correlation between the EMBI+ and the US treasuries is higher, namely 0.236. The fact that the extent of co-movement of the NEXGEM is on average lower compared to the EMBI+ could imply that the NEXGEM offers additional diversification benefits.

Graphs 5a-5d report changing patterns of co-movements between frontier- and emerging bond markets and the fixed income market of the United States. The phenomenon 'flight to quality' is observed in multiple periods. Frontier market bonds are perceived as higher risk and as 'equity-like'. Investors therefore sell these riskier assets and turn to safer havens such as US treasuries in periods of financial turmoil (Kelly et al al., 1998; Panchenko and Wu, 2009; Piljak and Swinkels, 2017). The 'flight to quality' is clearly visible in 2007 and onwards, which is the period of the financial crisis. The second period where the extent of co-movements decreases substantially is observed in 2015. This was a struggling year for emerging and frontier markets compared to the global financial markets. The difficulties can be explained by falling commodity prices, the first FED interest rate hike since a decade, an appreciation of the US dollar and a slowdown in China's economic growth. The last flight to quality is observed in 2018, which was the first negative year in terms of returns on equity markets since a decade. The negative returns in 2018 can be explained by trade war tensions, interest rates hikes and the gut feeling of investors that the record heights of financial markets were soon to implode. These flights to quality are clearly visible in graphs 5a and 5b.

The NEXGEM and the US High Yield and Investment Grade indices co-move differently compared to US Treasury index: a positive correlation is observed during the entire sample period. However, the extent of correlation between NEXGEM and US indices is still low as displayed in Table 4: on average 0.59 (high yield) and 0.31 (investment grade). The correlation levels shift between 0.165 and 0.852 (high yield) and 0.032 and 0.601 (investment grade). In addition, the

extent of co-movement seems not to increase, which could point to non-risen levels of financial integration of frontier markets. These findings could contradict aforementioned literature (Pukthuanthong and Roll, 2009; Bunda, 2009; Abidi et al, 2016), which point to risen levels of financial integration. The upward spike in 2013 might be explained by the announcement of the US Federal Reserve to reduce its bond purchasing program, which led to higher correlations between bond markets due to a spike in global bond yields (Piljak and Swinkels, 2017). A possible explanation for the increase in co-movements in 2016 could be the recovery of emerging markets from the disappointing 2015 driven by stabilized commodity prices and the non-occurrence of the expected hike in FED rates.

The statistical significance of parameters α and β in Table 4 indicate again that the conditional correlation is substantially time-varying and therefore not constant. Gulko (2002) finds that stock-bond correlation in developed markets is negative in periods of high market volatility. Considering frontier markets as 'equity-like', it could be that in periods of financial market turmoil, frontier bond markets are less correlated to other bond indices, due to the 'flight to quality'. The observation that the sum of the parameters is close to 1 indicates the volatility shocks have a long-lasting effect on future correlations. These time-varying correlations could therefore point to diversification benefits in particular periods. The results of these possible opportunities to diversify internationally are presented in Section 5.3.

Table 4
Statistics of the dynamic conditional correlations

	α	β	Mean	Min	Max
EMBI+ - US Treasury	0.044***	0.942***	0.236	-0.293	0.686
	-0.01	-0.014			
NEXGEM - US Treasury	0.044***	0.940***	0.052	-0.410	0.576
	(0.011)	(0.017)			
NEXGEM - US High Yield	0.042***	0.923***	0.589	0.165	0.852
	(0.014)	(0.029)			
NEXGEM - US Investment Grade	0.031***	0.945***	0.310	0.032	0.601
	(0.011)	(0.023)			
NEXGEM - EM Equity	0.014**	0.983***	0.541	0.334	0.743
	(0.007)	(0.012)			
NEXGEM – World Equity	0.020**	0.957***	0.463	0.259	0.639
	(0.010)	(0.024)			

Figures in parentheses are standard errors. *** p<0.01, ** p<0.05, * p<0.1 denote the statistical significance.

Lastly, the correlation between frontier markets and equity markets is positive during the entire period and presented in Graphs 6a – 6d in Appendix B. The extent of co-movements between the NEXGEM and the emerging market equities is on average 0.541, while the correlation between the global equity markets and the NEXGEM is on average 0.463. Considering the assumption that frontier and emerging bond markets are perceived as equity like (Piljak and Swinkels, 2017), it is not surprising that the correlation between these assets is positive during the entire sample period.

Summarizing the observed results, the analyzed dynamic conditional correlation do vary significantly over time. The sharp changes in co-movements are observed in periods of financial turmoil, such as the financial crisis, low commodity prices and increased volatility due to trade war tensions. These findings could indicate that diversification benefits do exist in particular period rather than over the entire sample period. This expectation is tested in the last section of this research, section 5.3. The positive correlation in the entire sample period with the US High Yield and Investment Grade indices and the EMBI+ index implies that the benefits of diversifying internationally seems to be diminished when these assets are included to the benchmark assets. However, these co-movements do also vary significantly over time and therefore diversification benefits could perhaps exist in particular time periods. The robustness check with monthly total returns on the aggregate level is presented in Table 4b in Appendix B and confirm the aforementioned findings.

5.1.2. Regional level

This subsection presents the results of the dynamic conditional correlation model on the regional level. The previous section showed to what extent the frontier market bond index correlates with global bond indices on the aggregate level. In order to gain deeper understandings in regional differences, the correlation are estimated on the regional level. The results are shown in table 5 and in graphs 7a-7e and 8a-8e. In general, the results on the regional level confirm the results on the aggregate level. The graphs 7a-7e present the time-varying co-movements of each region of the NEXGEM index with the EMBI+ index. The correlation is positive for each region during the entire sample period. Noteworthy is that the African, European and Middle Eastern region do present a drop in correlation during the financial crisis. Countries in the emerging bond market index are expected to have higher levels of financial integration than frontier bond markets. The African, European and Middle Eastern countries are therefore perhaps less affected by global financial shocks such as the financial crisis. Therefore, the decreasing correlation levels during this period could be explained by the lower level of integration. Moreover, the countries do show weaker co-movements in 2013, which is similar to the findings on the aggregate level. Table 5a presents the average correlation levels and reports that the Latin region has the highest correlation with the EMBI+, namely 0.658. The higher correlation of Latin America can perhaps be explained by the composition of the EMBI+. Latin countries could have had a larger weight in the EMBI+ in the period under scrutiny or countries that were included in the NEXGEM were included in the EMBI+ as well. As for example documented by Piljak and Swinkels (2017), Ecuador and Argentina were (in 2013) included in the EMBI+ index and in the NEXGEM index. The African, Asian and Middle East region do show the lowest levels of correlations on average. Again, this can be attributed to the composition of the EMBI+, lower levels of integration and the possible tendency of Asian frontier bond markets to be stronger correlated with the Chinese bond market. Investigating the precise drivers of these differences in co-movements could be an interesting angle for future research. This research has no access to historical compositions of the frontier and emerging bond indices and can therefore not accurately explain the observed differences.

The results of the estimated co-movements between the regional NEXGEM indices and the US Treasury are presented in table 5b and in graphs 8a-8e. The results again confirm the findings on the aggregate level. Each regions shows notable periods of negative correlation with the US Treasury index. Moreover, the observed pattern is similar with decreasing levels of

correlation during periods of financial turmoil. Similar to the observed correlation on the aggregate level, each regions shows a upward spike in 2013. Table 5b presents the average correlation over the sample period and shows that the Asian regions reports on average the highest correlation with US treasuries, namely 0.100. The lowest observed average correlation is seen in the Middle East, which is on average negative: -0.073. The other three regions have average correlation close to zero. These observed co-movements suggest again that diversification benefits are feasible. The statistical significance of parameters α and β in Table 5 indicate that the conditional correlation is substantially time-varying and therefore not constant. The majority of the parameters is significant indicating time-varying correlations. Therefore, changing levels of diversification benefits are expected in the section were mean-variance spanning tests are conducted. To summarize this section, the results confirm the patterns on the aggregate level with some minor differences on the regional level.

Table 5a

EMBI+ *Statistics of the dynamic conditional correlations*	α	β	Mean	Min	Max
NEXGEM - Africa	0.014***	0.985***	0,532	0,074	0,734
	(0.005)	(0.006)			
NEXGEM - Asia	0.052*	0.837***	0,510	0,237	0,707
	(0.030)	(0.116)			
NEXGEM - Europe	0.018***	0.982***	0,605	0,370	0,769
	(0.006)	(0.007)			
NEXGEM - Latin America	0.017***	0.975***	0,658	0,435	0,765
	(0.006)	(0.009)			
NEXGEM - Middle East	0.018**	0.981***	0,493	0,036	0,699
	(0.007)	(0.010)			

Table 5b

US TREASURY *Statistics of the dynamic conditional correlations*	α	β	Mean	Min	Max
NEXGEM - Africa	0.031**	0.953***	0,038	-0,298	0,356
	(0.012)	(0.028)			
NEXGEM - Asia	0,016*	0.941***	0,100	-0,116	0,300
	(0.012)	(0.038)			
NEXGEM - Europe	0.027**	0.958***	-0,007	-0,320	0,375
	(0.010)	(0.017)			
NEXGEM - Latin America	0.024	0.892***	-0,031	-0,283	0,196
	(0.016)	(0.091)			
NEXGEM - Middle East	0.022*	0.929***	-0,073	-0,322	0,151
	(0.014)	(0.054)			

Figures in parentheses are standard errors. *** p<0.01, ** p<0.05, * p<0.1 denote the statistical significance.

5.1.3. Country level

The composition of the NEXGEM is continuously changing. The changing positions could influence the results of the correlation analysis on the aggregate level. The findings on the aggregate level can therefore be partially driven by differences in country allocation. This section presents the dynamic conditional correlation of frontier countries with the EMBI+ and the US Treasury index. The results can confirm if the aforementioned identified patterns in previous sections hold on country level. The EMBI+ index could contain a dominant region, which can impact the results of this section. If the Latin region is for example the dominant region in the EMBI+, Latin countries in the NEXGEM are expected to show high correlation levels due to the their geographical connection to the dominant Latin region. The pattern of co-movements between frontier countries and the EMBI+ is presented in Graphs 9a – 9p in Appendix B. The statistics of the dynamic conditional correlations are shown in Table 6. Graphs 9a – 9p reveal that the majority of the observed countries report positive levels of correlation during the entire sample period. Only Angola, Ghana and Jamaica show extremely short periods of negative correlation. The extent of co-movement varies across countries: the average dynamic conditional correlations of Azerbaijan (0.725), Kenya (0.731) and Namibia (0.706) is for example higher than the averages of Georgia (0.397), Honduras (0.464) and Jamaica (0.380). The variation in correlation levels can be explained by the composition of the EMBI+: countries can be highly correlated to countries with a relative high weight in the EMBI+. In addition, on average, the Caribbean countries seem to be less correlated to the EMBI+. A possible explanation could be the geographical location of Caribbean countries: close to the United States. These countries are expected to be stronger correlated to the United States and therefore less correlated to the emerging bond market index.

The sum of the coefficients α and β is lower than 1 for all countries, which satisfies the model and . The majority of the parameters is statistical significant. Except of some of the α coefficients, these are insignificant for Armenia, Bolivia, Costa Rica, Gabon, Georgia, Guatemala, Honduras, Jamaica and Kenya. Moreover, for Costa Rica and Kenya, both parameters are non-significant and therefore it cannot be concluded that these correlations are significant time-varying. The significant parameters point to substantial time-varying correlations. The insignificance of α implies that the time-variance of co-movements is less sensitive shocks, but the significant β points to the persistence of past volatility. Therefore, the time-variance in correlation is less pronounced in particular countries with less significant parameters. In general, co-movements on the country

level are statistically significant time-varying, which is especially interesting for the analysis on the explanatory variables of these co-movements. If the co-movements were not significant time-varying and therefore modestly constant, it would make less sense to study the explanatory variables of constant co-movements.

Table 6
EMBI+
Statistics of the dynamic conditional correlations

	α	β	Mean	Min	Max
Angola	0.198***	0.665***	0.595	-0.403	0.944
	(0.048)	(0.079)			
Armenia	0.015	0.975***	0.627	0.354	0.904
	(0.020)	(0.031)			
Azerbaijan	0.216***	0.200*	0.725	0.282	0.961
	(0.056)	(0.120)			
Bolivia	0.095	0.592***	0.509	0.169	0.847
	(0.060)	(0.213)			
Costa Rica	0.0412	0.467	0.609	0.407	0.806
	(0.038)	(0.386)			
El Salvador	0.031***	0.960***	0.549	0.228	-0.753
	(0.008)	(0.011)			
Gabon	0.051	0.57***	0.631	0.484	0.886
	(0.035)	(0.180)			
Georgia	0.020	0.969***	0.397	0.259	0.598
	(0.266)	(0.375)			
Ghana	0.074***	0.808***	0.538	-0.143	0.845
	(0.027)	(0.061)			
Guatemala	0.020	0.881***	0.613	0.516	0.757
	(0.023)	(0.151)			
Honduras	0.023	0.902***	0.464	0.322	0.668
	(0.020)	(0.071)			
Jamaica	0.091	0.800***	0.380	-0.076	0.854
	(0.056)	(0.019)			
Kenya	0.014	0.606	0.731	0.699	0.788
	(0.042)	(0.798)			
Namibia	0.065*	0.753***	0.706	0.371	0.891
	(0.038)	(0.163)			
Senegal	0.046**	0.934***	0.635	0.185	0.840
	(0.020)	(0.038)			
Sri Lanka			0.471	0.397	0.601

Figures in parentheses are standard errors. *** p<0.01, ** p<0.05, * p<0.1 denote the statistical significance.

The analysis on the co-movements between frontier countries and US treasuries is presented in Table 7 and Graphs 10a – 10h. The findings confirm the patterns observed in previous sections, which means that the correlation between frontier bond markets and US treasuries varies over time with notable longer period of negative correlation. Consistently, each country shows periods of negative co-movement in time frames comparable to the aggregate level. The majority of the countries under scrutiny were not included in the NEXGEM index during the financial crisis, causing the disability to compare this time period with the aggregate level. As aforementioned, each country documents periods of negative correlation, but the results nevertheless vary substantially across countries. For example, Angola, Ghana, Gabon and Kenya show more and longer periods of negative correlation compared to Costa Rica, Guatemala and Honduras. The average dynamic conditional correlation for these countries is also lower in comparison with their Caribbean counterparts which is shown in Table 7. The lowest average correlation is observed in Ghana, namely -0.049, while the highest average correlation of 0.179 is observed in Azerbaijan. These differences across countries could point to the possibility that some countries are more favorable to obtain international diversification benefits. In addition, particular countries are perceived to be stronger connected to the United States. The geographical location of the Caribbean states (Costa Rica, Guatemala and Honduras) can perhaps explain its stronger average correlation to the US Treasury index. The regional analysis showed however that the Latin region did not co-move stronger with US Treasury than other regions, which can perhaps be explained by its historical composition. Lastly, the parameters α and β are statistically significant for the majority of countries. The coefficient α is not significant for Bolivia, Guatemala and Kenya, which points to less pronounced time-varying correlations in these countries. However, the significance of time-varying correlations is present in most cases, which is interesting for the next part of this research: the analysis of the explanatory variables of these co-movements.

Summarizing, the analysis on the country level confirms the findings on the aggregate level. The results indicate significant time-varying correlations on the country level, which makes the next section absolutely valuable. The countries show time-varying positive correlation to the EMBI+ and a relative low or even negative time-varying correlation to the US Treasury Index. The correlation with the US Treasury Index decreases in periods of financial distress, low commodity prices or high volatility in financial markets. These findings suggest that the business cycle and volatility factors can be expected to be the significant explanatory variables of the

obtained co-movements. Moreover, interest rates tend to decline during financial crises to stimulate the economy. Therefore, interest rates could play a role of importance in explaining changing level of correlations. The co-movements between the NEXGEM and the EMBI+ seems to be less time-varying compared to the co-movements with the US Treasury Index. Therefore, it is expected that the chosen factors are more able to explain the conditional correlation between the NEXGEM and the US Treasury index. These expectations will be tested in the next section.

Table 7
US Treasury Index
Statistics of the dynamic conditional correlations

	α	β	Mean	Min	Max
Angola	0.092***	0.864***	0.018	-0.463	0.741
	(0.029)	(0.051)			
Armenia	0.0386*	0.937***	0.032	-0.359	0.530
	(0.019)	(0.034)			
Azerbaijan	0.064***	0.898***	0.110	-0.492	0.711
	(0.022)	(0.041)			
Bolivia	0.076	0.816***	0.084	-0.441	0.537
	(0.049)	(0.122)			
Costa Rica	0.082**	0.897***	0.227	-0.352	0.823
	(0.040)	(0.078)			
El Salvador	0.0453**	0.811***	0.139	-0.104	0.423
	(0.22)	(0.093)			
Gabon	0.031*	0.936***	-0.040	-0.299	0.393
	(0.018)	(0.033)			
Georgia	0.073***	0.918***	-0.049	-0.298	0.297
	(0.019)	(0.021)			
Ghana	0.029*	0.936***	-0.049	-0.298	0.297
	(0.016)	(0.026)			
Guatemala	0.074	0.764***	0.169	-0.261	0.767
	(0.046)	(0.154)			
Honduras	0.034**	0.940***	0.179	-0.142	0.638
	(0.015)	(0.023)			
Jamaica	0.023**	0.970***	0.022	-0.188	0.434
	(0.011)	(0.013)			
Kenya	0.022	0.950***	-0.011	-0.235	0.181
	(0.019)	(0.042)			
Namibia	0.077***	0.871***	0.088	-0.470	0.714
	(0.023)	(0.048)			
Senegal	0.088***	0.901***	0.056	-0.562	0.762
	(0.020)	(0.022)			
Sri Lanka	0.035**	0.915***	0.084	-0.279	0.428
	(0.014)	(0.031)			

Figures in parentheses are standard errors. *** p<0.01, ** p<0.05, * p<0.1 denote the statistical significance.

5.2. Macroeconomic and political factors

The results of the estimated regression models are presented in this section. The previous section revealed that the co-movements vary substantially over time. This section will discover whether macroeconomic and political factors can explain these shifts in correlation levels on the country level. First, Table 8 provides insights in the drivers of the co-movements between frontier bond markets and emerging bond markets. Table 9 presents the outcomes of the model with the pairwise correlation between frontier bond markets and the US Treasury index as dependent variable. Table 9 is related to the work of Piljak (2013), who estimated a similar regression as explained in previous sections. The macroeconomic and domestic factors explained in Section 4 are used as explanatory variable of the co-movements of the aforementioned markets. The robustness checks with correlations calculated with monthly returns are presented in table 10 and 11 in Appendix B. Robustness checks with the basic regression model and the regression model with macroeconomic factors relative to US factors is presented in Table 12 and 13 in Appendix B, where the co-movements between the NEXGEM and the US Treasury Index is the dependent variable.

5.2.1. NEXGEM and EMBI+

Table 8 presents the effect of macroeconomic factors on co-movements between frontier and emerging bond markets. The significance of time-varying conditional correlations (as described in section 5.1.3.) between frontier and emerging bond markets differs between countries. Some countries did show less (or non-) significant time-varying conditional correlations. The value of the regression models of these countries is perhaps low since the independent variables explain an insignificant changing dependent variable. However, all countries, except of Costa Rica and Kenya, did report significant time-varying correlations.

In general, domestic factors play a more important role in explaining the time-varying co-movements than global factors. This model included two global factors and four domestic variables. The global factors, the Purchasing Manager Index and the Volatility Index are only significant in respectively two and three countries. In contrast, the domestic variables are significant (at the five percent level) in four or five countries. The number of significant factors varies across countries: Armenia, Azerbaijan, Guatemala, and Senegal have none significant explanatory variables, which implies that the chosen variables are not able to explain the co-movements with the EMBI+. In contradiction, the highest number of significant explanatory

variables are observed in El Salvador (3), Sri Lanka (3), Namibia (6) and Gabon (6). The regressions models of the countries with the highest number of significant factors do have the most explanatory power (as measured by R-Squared). The explanatory power of the model is on average low (0.213) and varies from 0.071 (Armenia) to 0.746 (Gabon). Noteworthy are the number of significant explanatory variables for Gabon, namely six out of six. The business cycle proxy has a negative influence on the obtained correlation, which implies that in times of financial distress, Gabon co-moves stronger with the EMBI+. This results however contradicts the observation that Gabon co-moves stronger when higher market volatility is perceived, which is often related to financial distress.

The level of International Reserves appears to be the most important explanatory variable: the factor is significant in six out of the sixteen cases at the five percent level. The coefficient is positive in three of the six significant observations, which implies that the extent of international reserves can influence the co-movements, but it is inconclusive if a rise in international reserves will lead to stronger or weaker co-movements. The findings of Rowland (2004) indicate that the level of international reserves is an important determinant of the credit rating of emerging countries. It can however not be concluded that the extent of international reserves is a important determinant of the co-movements between frontier and emerging bond market. The study of Rowland (2004) focused on the credit rating of a country, while this research focuses on the extent of co-movements of bond markets, which can be an explanation for the difference in results. Another interesting finding is that the coefficient of the independent variable political risk is positive in three of the four significant cases. This could point to higher levels of correlations with emerging bond markets as political risks decreases since a higher score on the political risk factor implies a decline in political risk (in the index of the Heritage fund). Baldacci et al. (2011) and Eichler (2014) find that the extent of political risk is of great influence on the credibility and the bond spreads of countries. Their studies find that lower political risk results in tighter spreads and lower risk premiums. The results of this study indicate that frontier markets with lower political risk co-move stronger with global emerging markets, which have in general lower risk premiums. The results are therefore consistent with Eichler (2014). However, regarding the relative low number of significant results, it can again not be concluded that the extent of political risk is a great predictor of co-movements between frontier and emerging bond markets.

As explained in earlier literature, US bond market volatility can be a significant driver of bond market volatility in developed European countries (Skintzi and Refenes, 2006). A rise in volatility is often perceived as a signal to review current asset allocation more frequently, which could have an influence on co-movements between bond markets. The research of Piljak (2013) therefore used the Merrill Lynch Volatility Estimator as explanatory variable to explain co-movements between frontier bond markets and US fixed income markets. Her findings reveal that bond market uncertainty was not a great predictor of these co-movements. Piljak (2013) suggests that the low significance of the results could be explained by the tendency of emerging and frontier bond markets to act as equity markets. Therefore, this research uses the CBOE Volatility Index as explanatory variable, which measures the volatility of equity markets. However, the variable is only significant in three out of the sixteen countries. This study therefore concludes that the volatility index cannot explain the estimated co-movements either.

The relative insignificant results could point to the disability of the chosen factors to explain the obtained co-movements. A possible explanation for the low explanatory power of the model can be the fact the EMBI+ index contains a diverse and continuously changing group of countries. Future research could create proxies to measure the macroeconomic factors of the EMBI+ more accurately, which is out of the scope of this research. In addition, the co-movements with the regional sub-indices of the EMBI+ could be analyzed since countries are expected to react on macroeconomic changes of countries of importance in their geographical region. Creating variables that represent the macroeconomic changes of the EMBI+ more accurately or conducting research on the effect of macroeconomic factors on the co-movements between frontier countries and regional sub-indices of the EMBI+ could perhaps increase the explanatory power of the estimated regressions.

The robustness check where correlations are calculated with monthly returns is presented in Table 10 in Appendix B. The explanatory power of these regressions seems to be higher and varies from 0.088 to 0.927. The outcomes do confirm the pattern observed in Table 8. The magnitude of the coefficients is low and the factors therefore cannot be described as great predictors of co-movements in this sample. In general, the robustness check confirms the aforementioned findings that these explanatory variables are not able to explain the obtained co-movements between the NEXGEM and the EMBI+.

Table 8

Table 8 NEXGEM - EMBI+	Angola	Armenia	Azerbeijan	Bolivia	Costa Rica	El Salvcador	Gabon	Georgia	Ghana	Guatamala	Honduras	Jamaica	Kenya	Namibia	Senegal	Sri Lanka
Political Risk	0.097	-0.004	-0.029*	-0.017**	-0.006	-0.052***	0.037***	-0.004	0.001	0.003	0.003	0.003***	-0.003	0.056***	-0.001	-0.000
	(0.083)	(0.007)	(0.016)	(0.008)	(0.006)	(0.013)	(0.011)	(0.006)	(0.008)	(0.010)	(0.016)	(0.001)	(0.004)	(0.016)	(0.001)	(0.006)
CPI (domestic)	0.003*	0.003	0.003	-0.002	-0.003*	0.030***	0.009**	0.000	0.007**	0.000	0.000	-0.000	0.004**	-0.019	0.000	0.011***
	(0.002)	(0.003)	(0.003)	(0.003)	(0.001)	(0.008)	(0.004)	(0.001)	(0.003)	(0.003)	(0.001)	(0.000)	(0.002)	(0.020)	(0.000)	(0.002)
International Reserves (domestic)	0.013	0.037	-0.003	0.002	0.019***	-0.140***	-0.118**	0.002	-0.012	0.021	0.102***	-0.002	-0.038*	-0.001**	-0.000	-0.161***
	(0.014)	(0.045)	(0.007)	(0.008)	(0.006)	(0.048)	(0.048)	(0.019)	(0.008)	(0.041)	(0.034)	(0.002)	(0.023)	(0.000)	(0.002)	(0.037)
Central Bank Policy Rate (domestic)	-0.045**	0.011	-0.006	-	-0.004	-0.005	-0.026**	0.008	0.029*	-0.011	-0.003	0.002	-0.032	-0.265***	0.003	0.078***
	(0.023)	(0.008)	(0.004)	(omitted)	(0.003)	(0.015)	(0.011)	(0.005)	(0.016)	(0.035)	(0.005)	(0.002)	(0.033)	(0.091)	(0.002)	(0.007)
Purchasing Manager Index (global)	-0.015	0.003	0.007	0.003	0.000	-0.007*	-0.015***	-0.000	-0.002	-0.005	-0.005	0.002*	-0.005	0.012**	-0.000	0.003
	(0.012)	(0.003)	(0.007)	(0.004)	(0.002)	(0.004)	(0.002)	(0.005)	(0.003)	(0.004)	(0.003)	(0.001)	(0.003)	(0.006)	(0.000)	(0.002)
VIX	0.005	-0.001	-0.006	-0.003*	-0.001	0.004*	-0.005***	0.004**	0.000	0.000	0.003*	0.000	0.002	0.007***	0.000	-0.001
	(0.004)	(0.001)	(0.005)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.000)	(0.001)	(0.002)	(0.000)	(0.001)
Constant	-3.728	0.217	1.951***	1.535*	1.200**	8.001***	-1.845***	0.559	-0.191	0.537	0.132	0.462***	0.916**	-0.305	0.526***	-0.560
	(4.212)	(0.668)	(0.643)	(0.870)	(0.523)	(-1.738)	(0.427)	(0.641)	(0.432)	(0.615)	(0.989)	(0.086)	(0.356)	(3.084)	(0.073)	(0.481)
Observations	74	62	80	73	77	109	126	108	78	69	134	53	85	92	134	201
R-squared	0.095	0.071	0.113	0.094	0.255	0.372	0.746	0.136	0.104	0.145	0.236	0.186	0.158	0.497	0.124	0.417

Table 8 presents the relationship of macroeconomic factors and co-movements between bond indices. The estimated regression model links the obtained co-movements to a set of macroeconomic and political factors (section 4.2). The explanatory variables include *Political Risk* (the index of the Heritage Foundation); *Consumer Price Index*, which represents the inflationary environment; *Central Bank Policy Rate*, a proxy for the monetary policy of a country; *International Reserves*, which captures a country's creditworthiness, *Purchasing Manager Index*, a global indicator of business cycles and the CBOE VIX as proxy for global volatility.

*** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at the 1%, 5% and 10% levels

5.2.2. NEXGEM and US Treasury Index

Table 9 reports the results of the analysis on the pairwise correlation between the NEXGEM and the US Treasury Index. The obtained dynamic conditional correlations suggest that the extent of co-movements is correlated to periods of financial turmoil and higher levels of volatility. Co-movements tend to decrease in periods of financial distress and higher levels of risk aversion. Therefore, the business cycle variable (PMI) and the volatility estimator (VIX) are expected to play an important role in explaining the co-movements between the NEXGEM and the US Treasury Index.

In general, a similar conclusion to the findings of Piljak (2013) can be drawn: domestic factors tend to play a more important role in explaining co-movements than global factors or variables based on data of the United States. This regression includes four domestic factors and five international factors. In seven out of the sixteen cases the number of significant factors (at the five percent level) is higher for domestic variables than global factors, while in only two cases the international factors seem to play a more important role. The number of significant factors varies substantially between the observed countries. The only country with none significant factors (at the five percent level) is El Salvador. The highest amount of significant explanatory variables is observed in Ghana and Jamaica. The explanatory power of the model (as measured by R-Squared) differs significantly: the lowest explanatory power is documented in El Salvador (0.126) while the highest explanatory power is observed in Armenia (0.787).

The domestic Central Bank Policy Rate is identified as most (from this set of variables) important variable to explain the estimated co-movements. In ten of the sixteen countries under scrutiny, the central bank policy rate reports a significant coefficient. This observation is consistent with the research of Piljak (2013), who concluded that the domestic factors (monetary policies and the inflation rate) are more important in explaining co-movements than international factors. The findings of Hunter and Simon (2005) do align as well with the obtained results. They find that the co-movement between US and German/United Kingdom bond markets can be partly predicted by interest rates. Their research find that countries with similar short rates co-move stronger. It is not clear if this is the case for the countries under scrutiny, which could be an extension for future research. Moreover, the central bank policy rate coefficient is for each countries either significant on the domestic rate or on the US rate, but not both. This implies that a country only is influenced by either their domestic interest rate or interest rates of the United States and vice versa. Another

noteworthy finding is the insignificance of any international factor in five of the sixteen countries. None of the independent international variables is significant in Bolivia, Costa Rica, El Salvador, Gabon and Namibia, which could imply that these countries are not affected by global macroeconomic factors at all. In contrast with Piljak (2013), those countries who seem to be not affected by global factors do not have the lowest average correlation with the US treasuries. Therefore, this study cannot conclude that those countries who are less influenced by global macroeconomic factors are less correlated to US bond markets.

The findings of Piljak (2013) reveal that bond market uncertainty was not a great predictor of co-movements. In addition, the results of Section 5.1 revealed that co-movements tend to decrease in periods of high volatility and financial distress. Therefore, this research used the VIX as explanatory variable. Table 9 however shows that the VIX coefficient is only significant (at the 5 percent level) in three cases, namely Angola, Georgia and Jamaica. The low significance might be explained by the long periods of low volatility in the recent decade and therefore the lack of substantial differences in the volatility index. Moreover, the majority of frontier were not included in the index during the financial crisis, which was a period of financial distress and high volatility. For this sample period, it can be concluded that the volatility index is not a great predictor of co-movements between frontier and US bond markets. The expectation that business cycles or volatility estimators would be correlated to the extent of co-movements is therefore not confirmed by this section.

The magnitude of the coefficients are larger compared to the results of section 5.2.1. The greater magnitude and more significant cases suggest that these variables are more able to explain the co-movements, which can be driven by the fact that these obtained co-movements regards two countries (a frontier country and the United States), while the EMBI+ contains a diverse group of countries. However, none of the variables under scrutiny show all negative or all positive coefficients. Therefore, this research cannot conclude that one of the macroeconomic factors has positive or negative impact on the obtained correlations. The only factor that shows (except one) all negative coefficients is the Central Bank Policy Rate of the United States. The coefficient implies that a rise in the interest rates of the United States leads to lower correlations between frontier bond markets and the US Treasury Index. This can be explained by the tendency of an appreciation of the US dollar when the interest in the United States rises. The appreciation of the

US dollar make the outstanding frontier market bonds denominated in US dollars more expensive to repay. Rising interest rates in US bond markets indicates rising returns on US treasuries, while rising cost of debt in frontier countries should lead to lower returns on frontier market bonds issued in US dollars. This opposite movement can be a possible explanation for the decreasing correlation. The robustness check with monthly returns is presented in Table 11 and the results confirm the aforementioned findings. As robustness check, the basic regression model without US macroeconomic factors is estimated and presented in Table 12. Again, the finding that domestic factors tend to play a more important role than international factors is confirmed. The disability and inconclusiveness of the chosen macroeconomic factors is also observed in this regression analysis. Lastly, a robustness check is conducted where the relative change of a macroeconomic factor of a frontier country is subtracted from the relative change of the similar factor in the United States. These variables are created to filter out global cycles in inflation, the extent of international reserves and interest rates. Table 13 reveals that the created variables do not offer additional explanatory power. In contrary, these variables are less able to explain the time-varying co-movements between the NEXGEM and the United States. It can therefore be assumed that the co-movements are not correlated to the changes in macroeconomic factors of frontier countries relative to the changes in the United States.

Recapping the findings of the analysis on the macroeconomic factors: the chosen macroeconomic factors were not able to explain the co-movements between the NEXGEM and the EMBI+ in this sample period. This could be explained by the changing and diverse composition of the EMBI+. The results of the analysis on the co-movements between the NEXGEM and the US Treasury Index reports more significant variables. However, the coefficients did not point to either increasing or decreasing levels of co-movements. Therefore, macroeconomic factors appear to be inconclusive in predicting co-movements of frontier bond markets. The results of this section suggest that common macroeconomic factors are not able to predict the correlation of frontier bond markets. The disability to predict correlation levels results in uncertainties to choose in which country should be invested. The country-specific risk and uncertainty about future correlations on the country level are reasons to invest in a wider range of assets to reduce idiosyncratic risk: the NEXGEM index. Therefore, the research on the diversification benefits of frontier bond markets in the next section (5.3) will be conducted on the index level rather than the country level.

Table 9

Table 9 NEXGEM - US Treasury Index	Angola	Armenia	Azerbeijan	Bolivia	Costa Rica	El Salvcador	Gabon	Georgia	Ghana	Guatamala	Honduras	Jamaica	Kenya	Namibia	Senegal	Sri Lanka
Political Risk	-0.170*	-0.018	-0.109***	-0.038*	-0.106**	-0.049*	0.099***	0.125***	-0.009	0.055**	0.006	0.086***	0.007	-0.031	0.090	0.023***
	(0.091)	(0.021)	(0.033)	(0.020)	(0.050)	(0.027)	(0.028)	(0.044)	(0.011)	(0.022)	(0.035)	(0.023)	(0.011)	(0.028)	(0.058)	(0.008)
CPI (domestic)	0.008**	-0.005	0.021	0.002	-0.037	-0.030*	-0.006	-0.034***	0.003	0.005	-0.070***	-0.005**	0.017***	0.042	0.186***	0.016***
	(0.004)	(0.022)	(0.013)	(0.012)	(0.023)	(0.018)	(0.008)	(0.012)	(0.003)	(0.010)	(0.021)	(0.002)	(0.003)	(0.025)	(0.035)	(0.005)
International Reserves (domestic)	0.101***	0.297***	0.021	-0.082***	0.037	0.057	-0.043	0.645***	0.013	0.047*	-0.090	0.034	0.019	0.330***	-0.002**	-0.017
	(0.021)	(0.099)	(0.022)	(0.021)	(0.042)	(0.043)	(0.032)	(0.135)	(0.020)	(0.024)	(0.063)	(0.021)	(0.015)	(0.109)	(0.001)	(0.013)
Central Bank Policy Rate (domestic)	0.010	-0.107***	0.008	-	-0.121***	-0.009	0.154***	0.044	0.006	0.142**	-0.470***	0.015***	-0.010	-0.263*	-1.138***	0.062***
	(0.032)	(0.029)	(0.016)		(0.034)	(0.013)	(0.048)	(0.029)	(0.012)	(0.057)	(0.056)	(0.006)	(0.011)	(0.156)	(0.347)	(0.020)
CPI (US)	0.060	-0.010	0.062	-0.041	0.017	-0.001	0.002	-0.008	-0.024	0.005	0.144**	0.027**	-0.000	-0.076	-0.098**	-0.046**
	(0.042)	(0.031)	(0.038)	(0.044)	(0.055)	(0.021)	(0.012)	(0.023)	(0.021)	(0.022)	(0.055)	(0.011)	(0.020)	(0.104)	(0.041)	(0.018)
International Reserves (US)	-0.008	-0.011***	0.011**	0.007	-0.002	0.004*	-0.000	-0.010**	0.007**	-0.008*	-0.003	-0.001*	0.005	0.001	0.012*	-0.001
	(0.006)	(0.003)	(0.005)	(0.005)	(0.005)	(0.003)	(0.001)	(0.004)	(0.003)	(0.004)	(0.006)	(0.001)	(0.003)	(0.005)	(0.007)	(0.001)
Central Bank Policy Rate (US)	-0.389*	-0.121	-0.339**	-0.141	-0.163	-0.026	-0.013	-0.182**	-0.122*	-0.229***	-0.184*	-0.023	-0.274***	-0.495***	0.015	-0.058**
	(0.221)	(0.115)	(0.168)	(0.100)	(0.164)	(0.051)	(0.022)	(0.082)	(0.068)	(0.063)	(0.103)	(0.020)	(0.050)	(0.124)	(0.158)	(0.027)
Purchasing Manager Index (global)	-0.004	0.014*	0.008	0.000	0.025	-0.007	0.003	0.012	0.012*	0.004	0.027***	-0.004	0.007	0.009	0.031**	0.010**
	(0.015)	(0.008)	(0.018)	(0.011)	(0.017)	(0.005)	(0.003)	(0.010)	(0.006)	(0.005)	(0.008)	(0.003)	(0.009)	(0.014)	(0.013)	(0.004)
VIX	0.014***	0.003	-0.002	0.001	-0.007	-0.002	-0.001	-0.006**	-0.003	0.002	-0.002	-0.003**	-0.001	0.005	0.007	-0.001
	(0.005)	(0.004)	(0.004)	(0.003)	(0.006)	(0.002)	(0.001)	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.005)	(0.004)	(0.002)
Constant	-1.509	3.845	-4.667	6.363	9.134	6.404*	-5.927***	-5.572**	0.873	-4.216**	-4.629	-7.696***	-3.949**	5.424	-13.260*	0.930
	(5.379)	(3.990)	(4.202)	(4.252)	(5.807)	(3.314)	(1.541)	(2.272)	(1.264)	(1.902)	(3.531)	(1.432)	(1.547)	(9.848)	(7.537)	(1.507)
Observations	74	62	80	73	77	110	132	126	108	78	69	134	53	85	92	134
R-squared	0.494	0.787	0.440	0.321	0.491	0.126	0.293	0.407	0.219	0.509	0.702	0.661	0.779	0.220	0.495	0.312

Table 9 presents the relationship of macroeconomic factors and co-movements between bond indices. The estimated regression model links the obtained co-movements to a set of macroeconomic and political factors (section 4.2). The explanatory variables include *Political Risk* (the index of the Heritage Foundation); *Consumer Price Index*, which represents the inflationary environment; *Central Bank Policy Rate*, a proxy for the monetary policy of a country; *International Reserves*, which captures a country's creditworthiness, *Purchasing Manager Index*, a global indicator of business cycles and the CBOE VIX as proxy for global volatility.

*** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at the 1%, 5% and 10% levels

5.3. Diversification benefits

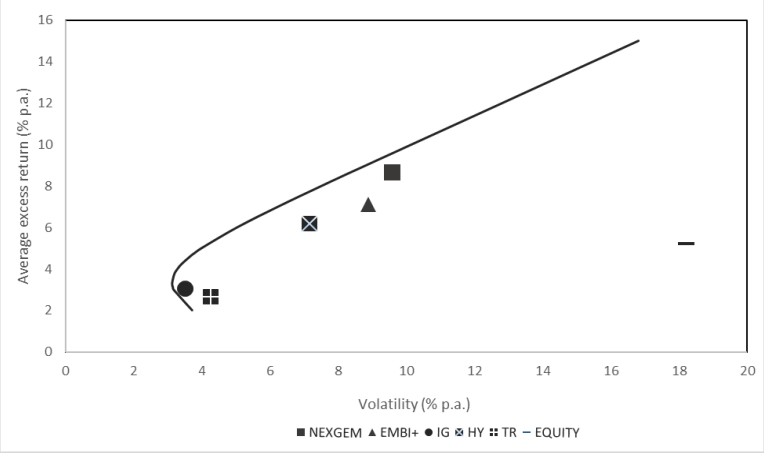
The last part of the study analyzes the potential diversification benefits of frontier bond markets. The analysis of the dynamic conditional correlation in the previous sections suggests that diversification benefits might be feasible. The previous section (5.2) finds that macroeconomic factors are not able to predict correlations on the country level. Investing in a wider range of countries should diminish idiosyncratic (country-specific) risk and therefore this section investigates the diversification benefits on the aggregate level: the NEXGEM. This section tests the feasibility of diversification benefits in a portfolio context. In order to do so, the minimum- and mean-variance portfolios and the efficient frontier is estimated and presented in Table 14 and Graph 11. Mean-variance spanning tests are conducted to test whether the potential positive allocation to frontier bond markets offer significant diversification benefits. These results are displayed in Table 17a – 17h.

5.3.1. Minimum variance portfolio

The efficient frontier is presented in Graph 11 together with the relative volatility and return of each asset under scrutiny. Noteworthy is the low volatility and relative high return on investment grade corporates compared to the treasuries. Therefore, a larger weight is expected to be allocated to the investment grade index. In previous sections, the EMBI+ showed higher correlation levels to the other asset classes compared to the NEXGEM. Moreover, the EMBI+ and the equity market show higher levels of volatility relative to the average returns, which leads to the expectation that a negative or zero weight is allocated to these assets in the optimal portfolios.

Graph 11

The efficient frontier when all assets are included in the opportunity test. The graph shows the average excess returns (y-axis) and the volatility (annual standard deviation) of the asset classes over the sample period (2002 – 2018)



Before conducting mean-variance spanning tests, the relevant assets are analyzed in a risk and return context. Therefore, the excess returns of the assets under scrutiny relative to risk-free rate proxied by the 4-weeks US Treasury Bills are used to create the minimum- and mean-variance portfolio. Following the Markowitz' model for obtaining the minimum- and mean-variance portfolios, the portfolio is constructed twice: once with the restriction on short sales and once without this restriction. The weights are presented in Table 14. Panels (A) of the table present the weights of each asset when short sales are allowed while Panels (B) show the weights when short sales are not allowed. In both cases, the frontier bond market receives a positive allocation, which implies that investing in frontier bond markets contributes to the optimal portfolio. Frontier bond markets are expected to be more volatile and therefore the allocated weight to this market is lower in the minimum-variance portfolio, namely 1.76% and zero in the portfolio without short-selling.

The mean-variance portfolio with the restriction on short selling is perhaps the most realistic, since short shelling of bonds (in particular in emerging and frontier markets) is difficult or even non-existent. The positive weight of 13.4% to the NEXGEM indicates that the frontier market bond added value to the optimal portfolio. Similar to the research of Piljak and Swinkels (2017), there is a zero (or a negative) allocation to emerging bond markets. The portfolio without short selling has a yearly volatility of 3,64% and an annual expected return of 4.51%.

Mean-variance spanning tests with restrictions to short selling require complex calculations which are out of the scope of this research. Therefore, the optimal portfolio which allows for short selling is calculated. The positive allocation to frontier bond markets (16.05%) indicates again that frontier markets offer diversification benefits. Moreover, similar to the optimal portfolio without short selling, the majority of this portfolio is invested in the corporate investment grade index (respectively 67.09% and 49.46%). This high allocation to the investment grade corporates can be explained by its low volatility compared to the treasury index as shown in Graph 11. The high volatility of equity markets accompanied with the relative low returns in this sample periods leads to a negative or zero weight in the optimal portfolio for this asset class. The optimal portfolio has an average expected annual excess return of 4.62% and a yearly volatility of 3.66%. The portfolios are recalculated without the NEXGEM as investable opportunity and the results are presented in Table 15 in Appendix B. Again, the largest weight is allocated to the investment grade index. A negative or zero weight is allocated to the EMBI+ and the outcomes confirm the results of Table

14. As robustness check, the minimum- and mean-variance portfolios are calculated in three sub-periods: before- (2002-2007), during- (2007-2011) and after the financial crisis (2011-2018). The optimal weights are presented in Table 17 in Appendix B. The results confirm the results of the entire sample period, with the exception of the mean-variance portfolio during the financial crisis. During this period of 'risk-off', a negative weight of 5.80 percent is allocated to the NEXGEM. The NEXGEM has a positive weight in all other minimum- and mean-variance portfolios without short sale restrictions. The allocated weight seems to increase overtime, suggesting increasing diversification benefits. The portfolios in general suggest that frontier bond market enhance the risk-return relationship of a portfolio. These results are consistent with earlier outcomes in the previous sections of this study. The next subsection will test the hypothesis which states that a positive allocation to frontier bond markets statistically enhances the risk-return relationship of a portfolio.

Table 14	Mean-Variance		Minimum-Variance	
2002-2018	(A)	(B)	(A)	(B)
NEXGEM	16.05%	13.40%	1.76%	0.00%
EMBI+	-4.01%	0.00%	-12.29%	0.00%
Treasury	-3.92%	12.99%	-23.85%	0.00%
IG	67.09%	49.46%	115.88%	83.33%
High Yield	29.58%	24.16%	17.27%	16.45%
Equity	-4.79%	0.00%	1.24%	0.21%

Table 14 shows the weights of the minimum- and mean-variance portfolios. Panel (A) shows the weight of each asset class when short selling is allowed, while Panel (B) presents the weights when short selling is restricted.

5.3.2. Mean-variance spanning tests

The results of the mean-variance spanning tests are presented in Table 17. As the results in section 5.1 revealed, the correlation with the US bond markets declines during the financial crisis and therefore the table is divided into four panels, where each panel represents a different time period: panel A shows the results over the entire sample period; 17b presents the results before the financial crisis; 17c documents the results during the crisis, and 17d reports the results after the financial crisis. The mean-variance spanning tests of Huberman and Kandel (1987) regresses the test asset (base 1 – base 6, the NEXGEM index and in base 7, the EMBI+ index) on the benchmark assets, which are represented by US Treasury-, US High Yield-, US Investment Grade-, EMBI+ and MSCI All Country Equity Index. The test asset improves the risk-return relationship significantly when the null-hypothesis is rejected: this means that the intercept alpha is

significantly larger than zero. Table 17a answers the hypothesis whether the positive allocation to frontier bond markets of 16.05% calculated in the previous section is statistically significant in a portfolio context.

The benchmark asset in the first column is the US Treasury index and the risk-free rate proxied by the 4-Week Treasury Bills. The correlation analysis already showed that the frontier bond markets are not (or even negative) correlated to the US Treasury index. Hence, it can be expected that the NEXGEM offers diversification benefits relative to this benchmark asset. The 8.68% annual alpha is statistically significant with a t-statistic of 3.56. This result is similar to the results of Piljak and Swinkels (2017) and indicates that frontier market bonds can significantly enhance a portfolio of US government bonds and the risk-free rate. However, it is not realistic that investors cannot invest in a wider range of assets when he is willing to invest in frontier bond markets. Hence, this study expanded the benchmark asset by adding new assets: investment grade corporate bonds, high yield bonds, emerging mark bonds, and equities. By introducing extra assets, the alpha declines and becomes statistically insignificant. Frontier bonds still offer significant diversification benefits when investment grade bonds are introduced, but when the high yield index is included, the significance disappears. The main hypothesis that assumes significant diversification benefits of frontier bond markets is therefore rejected. The t-statistic in base 5 of 1.22 and an annual alpha of 1.92% suggest that there is no significant evidence that frontier bonds can enhance the optimal portfolio in this sample period. Moreover, there is not enough statistical evidence to conclude that investors in only emerging bond markets can enhance the risk-return relationship of their portfolio by adding frontier bond markets as indicated by the t-statistic of 1.63 with an alpha of 2.79 percent.

To tests whether diversification benefits might exist in particular time periods, the sample period is divided into three sub-periods. The results do show noteworthy observations. First, the alphas in the period before the financial crisis were larger (e.g. 12.45% compared to 8.68% in base 1), but the alphas have similar significance levels compared to the complete sample period. This indicates that however the outperformance could be larger, no statistical evidence is found to conclude that frontier bond markets add value to the benchmark assets in base 5. Again, the null-hypothesis (significant diversification benefits) is rejected. During the crisis, the significance and alphas decline, where the alphas become even negative. This can be explained by the flight to quality phenomenon, which is described in earlier sections. Investors flew to safe havens and a

sell-off of frontier bonds led to diminishing returns in these markets. The minimum- and mean-variance portfolios already presented a negative or zero weight to the NEXGEM during the financial crisis. However, the alphas are insignificant and therefore no statistical evidence exist that advocate significant diversification benefits of frontier bond markets. The period after the financial crisis is especially interesting since it covers a period that is not researched before. The noteworthy result of this period shows that the positive alpha of 3.34% per annum in base 5 is statistically significant with a t-statistic of 2.48. The observation suggests that frontier bond markets offer diversification benefits in the most expanded portfolio setting (base 5) when short selling is allowed. The null hypothesis which states that frontier bond markets offer significant diversification benefits it not rejected in this time period. The positive alpha is however not significant if the benchmark asset contains only the risk-free rate, treasuries and investment grade bonds (or high yield). Those findings indicate that only in the case that short sales of emerging market bonds and equity markets is possible, frontier bond markets can offer significant diversification benefits. Moreover, the large alpha of 5.05% with a t-statistic of 3.20 in base 6 (with the EMBI+ and the risk-free as benchmark asset) is noteworthy. This result together with the significant negative alpha of the EMBI+ in base 7 indicate that the emerging bond market did not add value to an investment portfolio in the period after the financial crisis. These results are interesting and can offer insights in the diversification opportunities of investors. These findings also differ from the findings of Piljak and Swinkels (2017), who analyzed the period 2002-2013 and concluded that frontier bond markets did not offer diversification benefits. The different sample period can be an explanation for the difference in results.

The findings suggest that in the period 2011-2018 (Table 17d), frontier bond markets offer diversification benefits if emerging bond markets are included in the benchmark asset. The outcome confirms the findings of the optimal portfolio weights per asset, where emerging bond markets received a negative allocation. In addition, Asness et al. (2011) suggest that international diversification benefits work in the long-run and may be limited in the short-run due to market crashes. This research did however observe diversification benefits in the short-run rather than in the long-run, where diversification benefits where not significantly presents which can be explained by the market crash during the financial crisis. Connolly et al. (2005) find that bond returns tend to be high relative to stock returns when implied volatility is high. If frontier markets are perceived as equity like, it is reasonable that the returns were relative low during the financial

crisis with higher levels of implied volatility. Consistent with these findings, Marshall et al. (2015) reports that frontier stock markets offer lower diversification benefits in period of high risk aversion. The research of Kiviaho et al. (2014) documents that the frontier European stock markets do offer diversification benefits in the short-run, which is consistent with the findings of this study. The results of section 5.1 revealed that the correlation with the US Treasury Index is decreasing in times of financial distress and high volatility. Especially during these periods, frontier bond markets tend not to offer diversification benefits, which can be explained by a sell-off (and thus lower returns) in times of financial distress. The EMBI+ seems not to be a great improver of the risk-return relationship in the entire period regarding the small or negative alphas of the EMBI+ index in each period (base 7). However, short selling emerging government bonds is difficult and therefore it is expected that the significant positive alpha of the NEXGEM index would not hold in the investable real world. Incorporating restrictions on short selling to examine whether the positive significant alpha holds in the period after the financial crisis could be an extension for future research.

In addition, this research did not consider transaction costs for any of the asset classes. Not considering transaction costs can improve the image of asset classes with higher transaction costs. As shown by Piljak and Swinkels (2017), transaction costs (proxied by the bid-offer spread) of the NEXGEM index are twice as expensive compared to the transaction costs of the EMBI+ and is fairly constant over time with exception of the period of the financial crisis. The problem of using the bid-offer spread as proxy for transaction costs comes with the disability to account for any market impact costs that arise with larger trading volumes (Piljak and Swinkels, 2017). This research has no data on the recent transaction costs and no accurate estimation on the effect of transaction costs over the entire period. It is therefore not clear what the impact on the results would exactly be. However, it can be assumed that the (insignificant) diversification benefits of frontier bond markets are less pronounced or non-existent when transaction costs would be taken into account. Similar, Marshall et al. (2015) point to the vanishing effect of transaction costs on diversification benefits of frontier markets. They nevertheless document that the diversification benefits can sustain if investors do not rebalance their portfolio more than four times per year.

As robustness check, the mean-variance spanning tests are repeated with monthly excess returns. The outcomes are reported in table 18a – 18d in Appendix B and confirm the earlier findings. The coefficients in general align with earlier findings.

In addition to analyzing the diversification benefits on the aggregate level, this study conducts research on the diversification benefits on the regional level. The weekly total returns of the regional sub-indices of the NEXGEM are therefore obtained. The risk-return relationship of the regional sub-indices is presented in Graph 12 in Appendix B. The graph shows that the Latin and Middle East appear to be the most volatile during the entire sample period. The risk-return of the region Europe seems to be the most appealing and a higher return is observed in this region compared to the aggregate index and the other regional sub-indices. Graph 12 suggests that the European region is expected to offer the most diversification benefits as the region has the greatest risk-return relationship among the regions under scrutiny. To test these potential diversification benefits, mean-variance spanning tests are conducted for each region separately with a similar approach used on the aggregate level.

Analyzing the potential diversification benefits on the regional level of frontier bond markets is interesting since no earlier research has investigated the possibilities to diversify internationally by investing in the regional sub-indices of frontier bond markets. The results of the mean-variance spanning tests on the regional level are presented in Tables 19-23 in Appendix B. In general, the tables confirm the findings on the aggregate level. The diversification benefits diminish or disappear during periods of financial distress (sub-period 2007-2011, table 19c-23c). These results are consistent with Marshall et al. (2015), who state that higher risk aversion leads to lower diversification benefits for frontier asset markets. Periods of financial turmoil are often associated with 'risk-off' attitudes of investors. Consistent with the findings of Graph 12, the coefficients that should indicate diversification benefits are the lowest in the regions Middle East and Latin America during the entire sample period. These regions do not show any significant diversification benefits in any sub-periods, except Latin America in the most recent period. The Latin region offer significant diversification benefits in the period after the financial crisis (Table 22d) with an annual coefficient of 7.35% and a t-statistic of 2.71. The diversification benefits of the Latin region in the most recent time frame could also be one of the drivers of the significant diversification benefits observed on the aggregate level in the most recent time period. Similar, the Asian region does not

offer significant diversification benefits during the entire sample periods, but offers significant diversification benefits in the period before and after the financial crisis. The African region does offer significant diversification benefits during the entire sample period, but during the financial crisis the coefficient is no longer significant. During the entire sample period (Table 19a), the positive alpha of 4.66% per annum is significant with a t-statistic of 2.20. Similar to the African region, the region Europe presents significant positive alphas in each time period except during the financial crisis, where the positive alpha of 7.35% is not significant with a t-statistic of 1.49. The significant annual alpha of 7.30% with a t-statistic of 2.95 in the mean-variance spanning test over the entire sample period suggests that Europe is the best region to invest in this sample in order to obtain international diversification benefits. However, the weight in the total index of the region Europe is low and at the time of this research only three European countries are included in the index.

Summarizing the results on the diversification benefits of frontier bond markets, it can be concluded that null-hypothesis is rejected: frontier bond market on the aggregate level did not offer significant diversification benefits during the entire sample period. However, in the most recent period, the time frame after the financial crisis, the frontier bond market index did offer significant international diversification benefits in the most expanded benchmark portfolio. The analysis conducted on the regional level confirm the results on the aggregate level. In addition, the results point to additional diversification benefits for the African and European region, where only during the financial crisis non-significant diversification benefits were observed. The weak performance of frontier bond markets during the financial crisis is consistent with Marshall et al. (2015), who reports lower diversification benefits for frontier markets when risk aversion is high. Lastly, the obtained results would probably not hold in the real investable world since transaction costs and restrictions on short selling were not considered in this research.

Table 17a – 17d

2002-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	8,68%	4,13%	2,20%	1,88%	1,92%	2,79%	0,85%
t-value	*3.56*	*1.92*	*1.07*	*1.16*	*1.22*	*1.63*	*0.51*
Treasury	-0.003	-3.310	-1.51	-0.807	-0.736	-	0.778
t-value	*-0.03*	*-7.29*	*-2.59*	*-1.65*	*-1.87*	*(-)*	*-1.71*
Investment Grade	-	4.306	2.148	0.807	0.777	-	1.760
t-value	*(-)*	*7.2*	*2.83*	*1.38*	*1.49*	*(-)*	*2.88*
High Yield	-	-	0.605	0.296	0.284	-	0.359
t-value	*(-)*	*(-)*	*5.39*	*3.15*	*2.46*	*(-)*	*3.01*
Emerging Markets	-	-	-	0.620	0.614	0.807	-
t-value	*(-)*	*(-)*	*(-)*	*6.81*	*7.11*	*8.88*	*(-)*
Equity Markets	-	-	-	-	0.014	-	0.122
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.37*	*(-)*	*3.81*
R-Squared	0.000	0.325	0.444	0.632	0.632	0.562	0.471

2002-2006	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	12,45%	7,62%	6,15%	2,94%	2,96%	3,21%	4,33%
t-value	*3.15*	*1.99*	*1.6*	*1.13*	*1.17*	*1.27*	*1.17*
Treasury	0.372	-3.295	-1.968	-0.332	-0.144	-	-1.760
t-value	*2.76*	*-4.49*	*-2.28*	*-0.60*	*-0.27*	*(-)*	*-1.58*
Investment Grade	-	4.630	2.916	0.357	0.186	-	2.967
t-value	*(-)*	*5.07*	*2.69*	*0.54*	*0.29*	*(-)*	*2.18*
High Yield	-	-	0.397	0.034	0.009	-	0.419
t-value	*(-)*	*(-)*	*1.93*	*0.29*	*0.08*	*(-)*	*2.49*
Emerging Markets	-	-	-	0.771	0.762	0.789	-
t-value	*(-)*	*(-)*	*(-)*	*10.64*	*10.96*	*13.81*	*(-)*
Equity Markets	-	-	-	-	0.039	-	0.068
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*1.46*	*(-)*	*1.10*
R-Squared	0.039	0.195	0.239	0.611	0.615	0.610	0.371

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	7,53%	2,38%	-0,49%	-0,64%	-0,64%	-0,60%	1,83%
t-value	*1.23*	*0.47*	*-0.10*	*-0.16*	*-0.17*	*-0.14*	*0.52*
Treasury	-0.452	-3.284	-1.508	-0.960	-0.964	-	-0.634
t-value	*-1.74*	*-5.53*	*-1.97*	*-1.63*	*-1.94*	*(-)*	*-1.07*
Investment Grade	-	3.841	1.907	0.972	0.975	-	1.374
t-value	*(-)*	*4.58*	*1.88*	*1.29*	*1.45*	*(-)*	*1.71*
High Yield	-	-	0.590	0.369	0.371	-	0.238
t-value	*(-)*	*(-)*	*3.92*	*2.70*	*2.11*	*(-)*	*1.29*
Emerging Markets	-	-	-	0.511	0.512	0.825	-
t-value	*(-)*	*(-)*	*(-)*	*2.65*	*2.77*	*4.07*	*(-)*
Equity Markets	-	-	-	-	-0.002	-	0.156
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-0.17*	*(-)*	*2.99*
R-Squared	0.030	0.375	0.504	0.607	0.607	0.484	0.5093

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	7,81%	2,59%	1,17%	3,36%	3,34%	5,05%	-4,85%
t-value	*2.72*	*1.16*	*0.59*	*2.47*	*2.48*	*3.20*	*-1.62*
Treasury	0.200	-4.175	-1.779	-0.573	-0.476	-	-1.586
t-value	*1.13*	*-10.46*	*-5.22*	*-2.03*	*-1.67*	*(-)*	*-4.49*
Investment Grade	-	5.589	2.603	0.541	-0.472	-	2.927
t-value	*(-)*	*11.90*	*6.13*	*1.51*	*1.31*	*(-)*	*6.70*
High Yield	-	-	0.745	0.344	0.289	-	0.477
t-value	*(-)*	*(-)*	*8.19*	*5.56*	*4.19*	*(-)*	*4.48*
Emerging Markets	-	-	-	0.643	0.624	0.798	-
t-value	*(-)*	*(-)*	*(-)*	*11.99*	*11.41*	*21.03*	*(-)*
Equity Markets	-	-	-	-	0.049	-	0.107
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*2.31*	*(-)*	*4.17*
R-Squared	0.010	0.426	0.554	0.755	0.759	0.696	0.574

The statistics of the mean-variance spanning tests with 7 different base assets. In base (1) - base (6), the weekly return of the frontier bond market index (NEXGEM) is the test asset. In base (7), the emerging bond market index (EMBI+) is the test asset. The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); before the financial crisis period (2002-2006); the financial crisis (2007-2011); and after the financial crisis (2012-2018).

6. Concluding Remarks

6.1 Conclusion

Discovering high yielding assets in the current fixed income market became a difficult task in the past decade. Therefore, investors crossed borders to reveal new investment opportunities, which resulted in huge capital flows to emerging and frontier markets (Lavigne, Sarker, & Vasishtha, 2014, Miyajima, Mohanty, & Chan, 2015). This study conducted research on the dynamics of the co-movements between frontier and global bond markets. To strengthen the power of the estimated results, macroeconomic factors have been obtained to gain deeper understanding of these time-varying co-movements. Lastly, this research investigated the diversification benefits of frontier bond markets. This paper presented new insights to the literature by studying the co-movements of bond markets in dynamic parts of the world. The frontier bond market is a quickly changing environment with entering and leaving participants, which asks for new research and recent data examination.

Earlier research on frontier bond markets has been conducted by Piljak (2013) and Piljak and Swinkels (2017). Their articles found that the correlation with global bond markets is significantly time-varying. Piljak (2013) documented a greater role of importance for domestic macroeconomic factors in explaining time-varying co-movements than international macroeconomic factors. According to Piljak and Swinkels (2017), diversification benefits vanished when investors also had the opportunity to invest in higher yielding bond markets, such as emerging bond markets or high yielding bond indices of the United States.

The relevance of this research in economic literature is threefold. First, the findings confirm earlier findings of Piljak and Swinkels (2017) that the dynamic conditional correlation between frontier- and global bond indices is statistically time-varying. The longer sample period (2002 – 2018) of this research reports positive correlation levels during the entire sample period between frontier- and high yielding fixed income markets, such as the emerging bond market and high yield bonds indices of the United States. The longer periods of negative co-movement with the US Treasury Index documented by Piljak and Swinkels (2017) is also observed in this paper. In general, the analysis on the country level confirms the findings on the aggregate level although country-varying results are observed.

Secondly, this paper reveals that the chosen macroeconomic factors are not able to explain the estimated significant time-varying co-movements. The inconclusive and insignificant coefficients of the estimated regression of the correlation between frontier countries and the EMBI+ indicate that the chosen macroeconomic factors cannot predict future levels of co-movement. In comparison, macroeconomic factors are to a higher extent able to explain the dynamics of the correlation between frontier countries and the US Treasury Index. The explanatory variables are inconclusive except of the interest policy rate of the United States, which tend to weaken the co-movements when interest rates rise. The results confirm the findings of Piljak (2013), who documented that domestic macroeconomic factors play a greater role of importance in explaining co-movements than international factors. Business cycles and volatility levels were not able to predict future co-movements although the estimated dynamic conditional correlation revealed declining levels of correlation during period of high volatility and financial distress. An explanation for this disability could be the long period of low volatility and absence of great financial distress in the recent decade. The fact that the majority of the countries under scrutiny were not included in the index during periods of financial turmoil strengthens this explanation. The disability to predict future country co-movements by using macroeconomic factors could be a reason for investors to invest in indices rather than countries to reduce (unexplainable) country-specific risk.

Lastly, frontier bond markets offer diversification benefits during the entire sample period if the investable universe only contains the risk-free rate, the US Treasury Index and the frontier bond market. The significant diversification benefits however disappeared when higher yielding assets are included. These results are consistent with the findings of Piljak and Swinkels (2017). Dividing the sample period into three sub-periods revealed interesting results for two reasons. First, the period after the financial crisis is not fully analyzed by earlier literature. Second, frontier bond markets did offer significant diversification benefits in the period after the financial crisis in the benchmark portfolio with the widest range of assets. If emerging bonds and global equities are not included, the significance of the positive alpha vanished. In addition, the regional frontier sub-indices Europe and Africa offered significant international diversification benefits during the entire sample period and in each scrutinized sub-period except from the financial crisis. Incorporating transaction costs and restrictions on short selling could influence the results. The results that

indicate changing opportunities to diversify internationally can be highly interesting to investors who consider frontier bond markets as investment.

6.2. Limitations and recommendations

The majority of the limitations of this research are mentioned in previous sections. The first limitation relates to the relative short period of data availability for the majority of the countries under scrutiny. The relative short period of data history did not allow to gain insight into the long-term dynamics of co-movements. Asness et al. (2011) reported that diversifying internationally works in the long-run and may be limited in the short-run. Their research used 60 years of historical data, which could be an explanation for the absence of diversification benefits of frontier bond markets during the entire sample period, which is relative short. This study has documented significant time-varying correlations. However, the reported co-movements did not visualize whether the correlation with global bond markets was significantly increasing or decreasing. Therefore, analyzing the direction of the changing levels of correlation could be an interesting angle for future research and for investors searching for non-correlating asset markets.

Another limitation of this research is the disability to control for dominant regions in the EMBI+. The observed co-movements of specific frontier countries could be driven by its geographically location which is close to a country with a large weight in the EMBI+. In addition, this study was not able to create representative proxies for the macroeconomic factors of the EMBI+ due to limited data availability and the continuously changing composition of the index. Future research can extent on this paper by obtaining more relevant macroeconomic factors that better reflect the EMBI+. This research used macroeconomic factors based on the actual historical values due to data availability. As explained in Andersson, Krylova and Vähämaa (2008), inflation and economic growth expectations are considered to be more appropriate in explaining bond prices since bond prices reflect market participants' expectations of future values of these macroeconomic factors. This research might be extended by using economic expectations as explaining variables rather than factors based on actual historical values.

As aforementioned, short selling of frontier and emerging bonds is difficult or non-existent. This research however conducted mean-variance spanning tests where short selling was allowed. Future research can conduct mean-variance spanning tests where short selling is restricted, which would be a more realistic portrait of the investable world. Moreover, this research did not

incorporate transaction costs into the analysis of diversification benefits. As Piljak and Swinkels (2017) showed, transaction costs are in general higher for frontier bond markets compared to other global bond markets. Therefore, the diversification benefits are expected to be diminished or vanished when transaction costs were taken into account. Incorporating trading costs and restrictions on short selling would be a great extension for future research, and can make the results more applicable to real-life investment decisions. Using a wider range of benchmark assets and considering higher moments than mean and variance in the portfolio analysis can be other extensions for future research. Lastly, the majority of frontier market bonds is issued in local currencies (Aberdeen, 2015). As Ladekarl and Peters (2013) state, local currency bonds offer higher exposure to local markets than hard currency bonds, which suggests higher potential diversification benefits. Data availability on these local currencies bonds is however limited currently. Moreover, these markets are not yet fully investable for many investors. Nevertheless, analyzing the dynamics and diversification benefits of frontier local currency bonds could be an interesting angle for future research.

7. References

Aberdeen (2015) Frontier Markets: The Next Chapter. *Aberdeen Asset Management*

Abidi, N., Hacibedel, B., Nkusu, M. (2016) Changing times for frontier markets: a perspective from portfolio investment flows and financial integration. *IMF Working Paper, No. 16/177*.

Andersen, T.G., Davis, R.A., Kreiß, J.P., Mikosch, T. (2009) Handbook of Financial Time Series, *Springer.*

Anderson, R.C., Mansi, S.A., Reeb, D.M. (2003) Founding family ownership and the agency cost of debt, *Journal of Financial Economics 68*, 263–285.

Andersson, M., Krylova, E., Vähämaa, S. (2008) Why does the correlation between stock and bond returns vary over time? *Journal of Applied Financial Economics 18 (2)*, 139-151

Andritzky, J.R. (2006) Sovereign Default risk valuation: implications of debt crises and bond restructurings. *Springer.*

Asness, C.S., Israelov, R., Liew, J.M. (2011) International diversification works (eventually). *Financial Analysts Journal 67* (3), 24–38.

Baldacci, E., Gupta, S., Mati, A. (2011) Political and fiscal risk determinants of sovereign spreads in emerging markets. *Review of Development Economics 15 (2),* 251–263

Barr, D.G., Priestley, R. (2004) Expected returns, risk and the integration of international bond markets. *Journal of International Money and Finance 23*, 71–97.

Bauwens, L, Laurent, S., Rombouts, J.V.K. (2006) Multivariate GARCH models: a survey. *Journal of Applied Economics 23* (3), 79-109.

Bekaert, G., Harvey, C.R. (1995) Time-varying world market integration. *The Journal of Finance 50* (2), 403–444.

Berger, D., Pukthuanthong, K., Jimmy Yang, J. (2011) International diversification with frontier markets. *Journal of Financial Economics 101*, 227–242.

Bekaert, G., Harvey, C.R., Kiguel, A., Wang, X. (2016) Globalization and asset returns. *Annual Review of Financial Economics 8*, 221–288.

Bessler, D., Yang, J. (2003) The structure of interdependence in international stock markets. *Journal International Money Finance 2,* 261-287.

Bodie, Z., Kane, A., Marcus, A. (2014) Investments. *McGraw-Hill*

Brooks, S., Mosly, L. (2012) Categories, Creditworthiness and Contagion: How Investors' Shortcuts Affect Sovereign Debt Markets. *Prepared for the 2012 Annual Meetings of the American Political Science Association, New Orleans, LA,* August 30–September 2.

Bunda, I., Hamann, A.J., Lall, S. (2009) Correlations in emerging market bonds: the role of local and global factors. *Emerging Markets Review 10*, 67–96.

Cai, Y., Chou, R.Y., Chou, D. (2009) Explaining international stock correlations with CPI fluctuations and market volatility. *Journal of Banking & Finance 33*, 2026-2035.

Capital Group (2013) Emerging market local currency bonds: investing in frontier markets. *Investment Insights, March 2013.*

Celik, S. (2012) The more contagion effect on emerging markets: The evidence of DCC-GARCH model. *Economic Modelling 29,* 1946-1959

Chandra, M. (2006) The day-of-the-week effect in conditional correlation. *Review of Quantitative Finance and Accounting 27*, 297-310

Chang, T.C., Jeon, B.N., Li, H. (2007) Dynamic correlation analysis of financial contagion: evidence from Asian markets. *Journal of international Money and Finance,* 1026-1228.

Cifarelli, G., Paladino, G. (2006) Volatility co-movements between emerging sovereign bonds: is there segmentation between geographical areas? *Global Finance Journal 16,* 245–263.

Connolly, R., Stivers, C., and Sun, L. (2005) Stock market uncertainty and the stock-bond return relation. *Journal of Financial and Quantitative Analysis, 40*, 161-194.

De Nicòlo, G., Ivanschenko, I. (2009) Global liquidity, risk premiums and growth opportunities. *IMF Working Paper, No. 09/52.*

Driessen, J., Laeven, L. (2007) International portfolio diversification benefits: Cross-country evidence from a local perspective. *Journal of Banking & Finance 31* (6), 1693-1712

Dumas, B., Harvey, C.R., Ruiz, P. (2003) Are correlations of stock returns justified by subsequent changes in national outputs? *Journal of International Money & Finance 22*, 777-811.

Eichler, S. (2014) The political determinants of sovereign bond yield spreads. *Journal of International Money and Finance 46*, 82–103.

Engle, R. (2002) Dynamic Conditional Correlation, A Simple Class of Multivariate Generalized Autoregressive Conditional Heteroskedasticity Models. *Journal of Business & Economic Statistics 20 (3)*, 339-350

Erb, C.B., Harvey, C.R., Viskanta T.E. (1999) New perspectives on emerging market bonds. *Journal of Portfolio Management 25* (2), 83–92.

Fiess, N. (2007) Business cycle synchronization and regional integration: a case study for Central America. *World Bank Economic Review 21*, 49–72

Gau, Y.-F., Liao, W.-J. (2012) The predictability of excess returns in the emerging bond markets. *Applied Financial Economics 22*, 1429–1451.

Gulko, L. (2002) Decoupling. *Journal of Portfolio Management*, *28*, 59-67.

Graham, M., Kiviaho, J., Nikkinen, J. (2012) Integration of 22 emerging stock markets: a three-dimensional analysis. *Global Finance Journal 23*, 34-47

Guscina, A., Pedras, G., Presciuttini, G. (2014) First-time international bond issuance: new opportunities and emerging risks. *IMF Working Paper, No. 14/127.*

Huberman, G., Kandel, S. (1987) Mean-variance spanning. *The Journal of Finance 42 (4)*, 873–888

Hughes, J.S., Logue, D.E., Sweeney, R.J. (1975) Corporate International Diversification and Market Assigned Measures of Risk and Diversification, *Journal of Financial and Quantitative Analysis 10* (4), 627-637.

Hund, J., Lesmond, D.A. (2008) Liquidity and credit risk in emerging debt markets. *14th Annual Conference on Financial Economics and Accounting.*

Hunter, D.M., Simon, D.P. (2005) A conditional assessment of the relationships between the major world bond markets. *European Financial Management 11* (4), 463–482.

Jaramillo, L., Weber, A. (2012) Bond yields in emerging economies: it matters what state you are in. *IMF Working Paper, No. 12/198.*

Katze, N. (2013) South African Sector Return Correlations: using DCC and ADCC Multivariate GARCH techniques to uncover the underlying dynamics. *Stellenbosch Economic Working Papers*

Kelly, J.M., Martins, L.F., Carlson, J.H. (1998) The relationship between bonds and stocks in emerging countries. *Journal of Portfolio Management 24* (3), 110-122.

Kennedy, M., Palerm, A. (2014) Emerging market bond spreads: the role of global and domestic factors from 2002 to 2011. *Journal of International Money and Finance 43,* 70–87

Kim, S.J., Lucy, B.M., Wu, E. (2006a) Dynamics of bond market integration between established and accession European Union countries. *Journal of International Financial Markets, Institutions and Money 16,* 41-56.

Kiviaho, J., Nikkinen, J., Piljak, V., Rothovius, T. (2014) The co-movement dynamics of European frontier stock markets. *European Financial Management 20* (3), 574–595.

Kumar, M.S., Okimoto, T. (2011) Dynamics of international integration of government securities 'markets. *Journal of Banking and Finance 35,* 142-154.

Ladekarl, J., Peters, E.E., (2013) Emerging market currency: the common risk factor in emerging markets. *Journal of Investing 22 (3),* 135–143.

Lavigne, R., Sarker, S., Vasishtha, G. (2014) Spillover effects of quantitative easing on emerging-market economies. *Bank of Canada Review 2,* 23–33.

Lee, S.B., Kim, K.J. (1993) Does the October 1987 crash strengthen the co-movement among National Stock Markets. *Review of Financial Economics, 3* (1), 89-102.

Lee, J. (2012) Measuring business cycle co-movements in Europe: evidence from a dynamic factor model with time-varying parameters. *Economic Letters 115*, 438–440

Longstaff, F.A. (2004) The flight-to-liquidity premium in U.S. Treasury bond prices. *The Journal of Business 77* (3), 511–526.

Markowitz, H. (1952). The utility of wealth. *Journal of Political Economy 60* (2).

Marshall, B.R., Nguyen, N.H., Visaltanachoti, N. (2015) Frontier market transaction costs and diversification. *Journal of Financial Markets 24*, 1–24.

Mauro, P., Sussman, N., Yafeh, Y. (2002) Emerging market spreads: then versus now. *The Quarterly Journal of Economics 117* (2), 695–733.

Miyajima, K., Mohanty, M.S., Chan, T. (2015) Emerging market local currency bonds: diversification and stability. *Emerging Markets Review 22*, 126–139.

Nowak, S., Andritzky, J., Jobst, A., Tamirisa, N. (2011) Macroeconomic fundamentals, price discovery, and volatility dynamics in emerging bond markets. *Journal of Banking & Finance 35*, 2584–2597.

O'Neill, J. (2001): Building better global economic BRICs. *Global Economics Paper, 66.*

Panchenko, V., Wu, E. (2009) Time-varying market integration and stock and bond return concordance in emerging markets. *Journal of Banking & Finance 33* (6), 1014-201.

Piljak, V. (2013) Bond markets co-movement dynamics and macroeconomic factors: evidence from emerging and frontier markets. *Emerging markets review 17*, 29–43.

Piljak, V., Swinkels, L. (2017) Frontier and emerging government bond markets. E*merging Markets Review 30*, 232–255.

Polwitoon, S., Tawatnuntachai, O. (2008) Emerging market bond funds: a comprehensive analysis. *The Financial Review 43*, 51–84.

Pozzi, L., Wolswijk, G. (2012) The time-varying integration of euro area government bond markets. *European Economic Review 56*, 36–53

Presbitero, A.F., Ghura, D., Adedeji, O., Njie, L. (2016) Sovereign bonds in developing countries: drivers of issuance and spreads. *Review of Development Finance 6*, 1–15.

Pukthuanthong, K., Roll, R. (2009) Global market integration: an alternative measure and its application. *Journal of Financial Economics 94*, 214-232.

Rocha, K., Moreira, A. (2010) The role of domestic fundamentals on the economic vulnerability of emerging markets. *Emerging Markets Review 11*, 173-182.

Rowland, P., Torres, J.L. (2004) Determinants of Spread and Creditworthiness for Emerging Market Sovereign Debt: A Panel Data Study. *Borradores De Economía 295. Bogotá, Colombia: Banco de la República.*

Skintzi, V.D., Refenes, A.N. (2006) Volatility spillovers and dynamic correlation in European bond markets. *Journal of International Markets, Institutions and Money 16* (1), 23-40.

Tank, P. (2012) The concept of 'rising powers', *Norwegian Peacebuilding Resource Centre NOREF*

Vo, X.V. (2009) International financial integration in Asian bond markets. *Research in International Business and Finance 23,* 90–106.

Appendix A

Table 1

	Weight	Observations	Start Date	GDP (PPP)	Mean	Standard Deviation	Credit Rating	Min.	Max.	Skew.	Kurt.
NEXGEM	100%	888	Jan-02		0,19%	1,35					
Asia	26,19%										
AZERBAIJAN	5,49%	348	May-12	231	0,11%	1,18	BB	-4,60%	3,99%	-0,321	2,033
MONGOLIA	2,98%	344	Jun-12	68	0,15%	1,36	B	-4,12%	8,26%	0,798	4,655
PAPUA NEW GUINEA	0,44%	9	Nov-18	44	0,36%	0,48	B	-0,27%	1,11%	-0,013	-1,056
PAKISTAN	4,29%	822	Jan-02	1614	0,18%	1,79	B-	-23,50%	10,79%	-2,732	45,285
SRI LANKA	11,74%	579	Jul-07	417	0,14%	1,78	B	-22,12%	16,70%	-1,989	60,213
TAJIKISTAN	0,35%	66	Oct-17	45	-0,03%	0,99	B-	-3,95%	2,23%	-1,039	3,074
VIETNAM	0,91%	683	Dec-05	1166	0,12%	1,56	BB	-18,34%	20,23%	-0,645	82,629
Africa	38,16%										
ANGOLA	4,57%	322	Nov-12	261	0,12%	1,34	B-	-5,91%	5,89%	-0,324	2,697
COTE D'IVOIRE	2,82%	78	Jan-02	141	0,17%	2,85	(Ba3)	-10,82%	26,14%	1,344	12,784
CAMEROON	0,70%	768	Jul-17	180	0,00%	0,94	B	-2,74%	2,62%	0,047	0,739
ETHIOPIA	0,88%	209	Jan-15	370	0,12%	1,44	B	-4,12%	4,27%	-0,029	0,508
GABON	1,85%	574	Jan-08	54	0,14%	2,00	(Caa1)	-16,01%	8,45%	-1,767	14,870
GHANA	5,87%	583	Nov-07	294	0,16%	2,10	B	-14,96%	9,61%	-1,709	13,890
KENYA	5,49%	231	Aug-14	281	0,07%	1,40	B+	-7,60%	5,19%	-0,552	4,707
MOZAMBIQUE	0,64%	266	Dec-13	63	0,09%	2,99	(Caa3)	-31,29%	9,73%	-4,503	48,009
NAMIBIA	1,07%	370	Dec-11	35	0,09%	0,94	(Ba1)	-4,49%	2,70%	-0,719	3,230
NIGERIA	9,57%	646	Oct-05	1529	0,18%	1,45	B	-8,83%	7,12%	-0,946	7,359
SENEGAL	2,23%	396	Jun-11	106	0,13%	1,28	B+	-7,62%	4,13%	-1,028	5,373
TUNISIA	0,75%	662	Jun-02	196	0,10%	1,32	(b2)	-18,71%	17,25%	-1,175	104,670
ZAMBIA	1,73%	322	Nov-12	91	0,02%	2,10	CCC+	-9,79%	8,32%	-0,383	3,618
Latin America	25,69%										
BELIZE	0,26%	614	Apr-07	4	0,07%	3,63	B-	-34,73%	36,75%	-2,686	55,050
BOLIVIA	1,61%	318	Dec-12	125	0,08%	0,92	BB-	-5,77%	4,64%	-1,169	11,050
COSTA RICA	4,42%	335	Aug-12	117	0,06%	1,02	B+	-4,35%	6,23%	-0,191	6,280
EL SALVADOR	5,69%	476	Nov-09	69	0,13%	1,30	B-	-10,59%	8,68%	-1,041	14,634
GUATEMALA	3,40%	340	Jul-12	202	0,10%	0,84	BB-	-3,40%	2,73%	-0,854	3,666
HONDURAS	1,53%	296	May-13	69	0,15%	0,86	BB-	-4,41%	3,85%	-0,863	6,476
JAMAICA	4,76%	583	Nov-07	34	0,17%	1,70	B+	-12,58%	13,00%	-0,685	18,003
PARAGUAY	3,66%	305	Mar-13	95	0,10%	1,06	BB	-3,48%	4,29%	-0,123	2,309
SURINAME	0,38%	78	Jul-17	12	0,11%	0,79	B	-2,42%	2,66%	-0,390	3,943
Middle East	5,61%										
IRAQ	2,99%	665	Apr-06	902	0,18%	2,12	B-	-11,29%	11,84%	-0,347	6,085
JORDAN	2,62%	356	Feb-11	123	0,10%	0,72	B+	-2,54%	3,03%	-0,067	2,845
Europa	4,02%										
ARMENIA	0,87%	270	Nov-13	45	0,13%	0,90%	(Ba3)	-5,12%	5,84%	-0,258	11,206
BELARUS	2,26%	400	Oct-10	216	0,14%	1,64%	B	-12,69%	6,63%	-1,510	12,673
GEORGIA	0,89%	548	Jul-08	64	0,16%	1,32%	BB	-11,98%	7,66%	-2,258	23,472

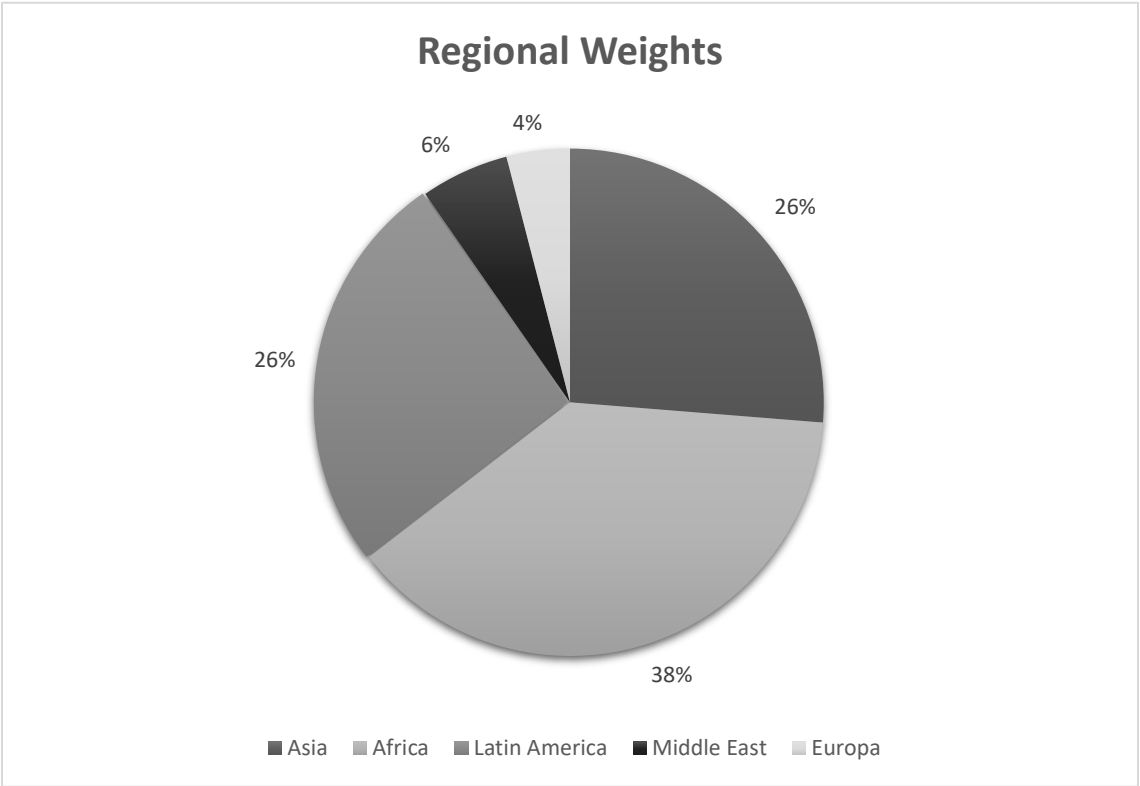
Table 1 presents the descriptive statistics and characteristics of the frontier bond markets of the JP Morgan NEXGEM index. The *Weight* statistics are start 2019 figures and show the weight of each country in the NEXGEM index. *Start Date* indicates the starting date in the JP Morgan NEXGEM index, while *Observations* presents the number of weekly observations in the sample period (some countries have missing periods of observations). The *GDP* statistic is the gross domestic product of a country at the sample ending date: obtained from International Monetary Fund through Datastream. The *Credit Rating* indicates the credit rating of a country in 2018 and is taken from S&P (or Moody's if S&P did not rate a particular country).

Table 2

	Start MV	Start Yield	End MV	End Yield	Mean	Standard Deviation	Min.	Max.	Skew.	Kurt.
NEXGEM	9768	14,07	114494	7,95	0,18%	1,33%	-14,85	3,86	-2,94	24,14
NEXGEM - Asia	530	14,67	20301	7,56	0,15%	1,32%	-13,03%	7,13%	-2,40	27,74
NEXGEM - Africa	2073	13,28	50753	8,89	0,15%	1,19%	-9,73%	7,04%	-1,50	12,91
NEXGEM - Europe	1006	13,17	10749	5,88	0,19%	1,32%	-9,19%	6,69%	-1,19	10,42
NEXGEM - Latin	2845	16,84	26409	7,33	0,17%	2,51%	-35,71%	14,36%	-4,57	59,29
NEXGEM - Middle East	3314	10,79	6282	7,75	0,17%	1,97%	-11,29%	11,84%	-0,39	8,10
EMBI+	149441	11,48	329687	7,15	0,16%	1,23%	-7,60%	13,15%	0,229	18,760
EMBI+ Asia	8515	10,16	57669	4,52	0,16%	1,31%	-20,21%	22,78%	-1,317	96,014
EMBI+ Africa	2857	10,94	13735	5,89	0,12%	1,06%	-9,61%	6,70%	-1,131	17,128
EMBI+ Latin America	109964	11,05	151654	8,72	0,15%	1,40%	-14,76%	11,86%	-1,468	21,092
EMBI+ Europe	29853	14,55	106598	6,35	0,16%	1,31%	-13,60%	10,90%	-2,046	32,270
Barclays US HY					0,14%	0,99%	-6,40%	5,75%	-1,233	10,570
Barclays US IG					0,08%	0,49%	-4,07%	3,31%	-0,395	2,262
Barclays US Treasury					0,08%	0,59%	-3,22%	3,69%	-0,314	0,971
MSCI All Country					0,12%	3,13%	-17,89%	15,23%	-0,654	6,280

Table 2 presents an overview of the indices used in this research. *Observations* indicates the number of observations, which is similar for each index. *Start MV* and *End MV* present the market value of frontier or emerging bond index at the start and end of the sample period taken from JP Morgan. *Start Yield* and *End Yield* shows the average yield-to-maturity at the sample starting and ending date (obtained from JP Morgan).

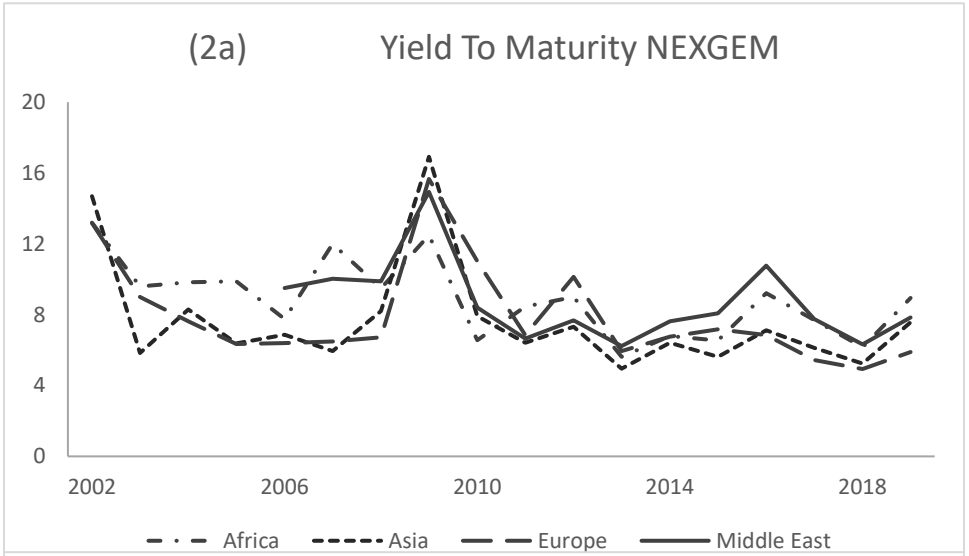
Graph 1

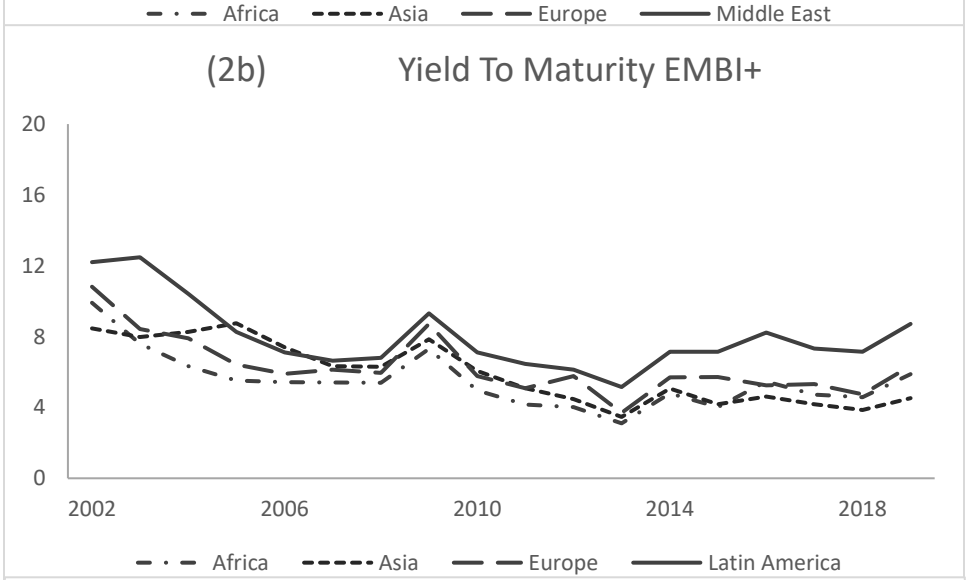


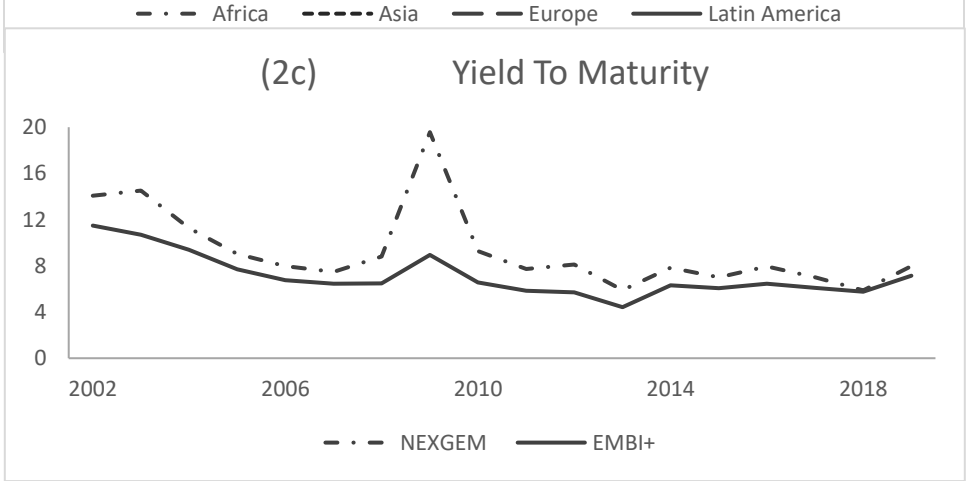
Graph 1 shows the weights of each region in the JP Morgan NEXGEM index at the sample ending date (the end of 2018).

Graph 2a-2c

Graph 2a – 2c show the changing yield to maturities of each region in the NEXGEM index and of the NEXGEM and EMBI+ indices during the sample period (2002-2018)







Graph 3a-3c

Graph 3a-3c show the changing market values of each region in the NEXGEM index and of the NEXGEM and EMBI+ indices during the sample period (2002 – 2018).

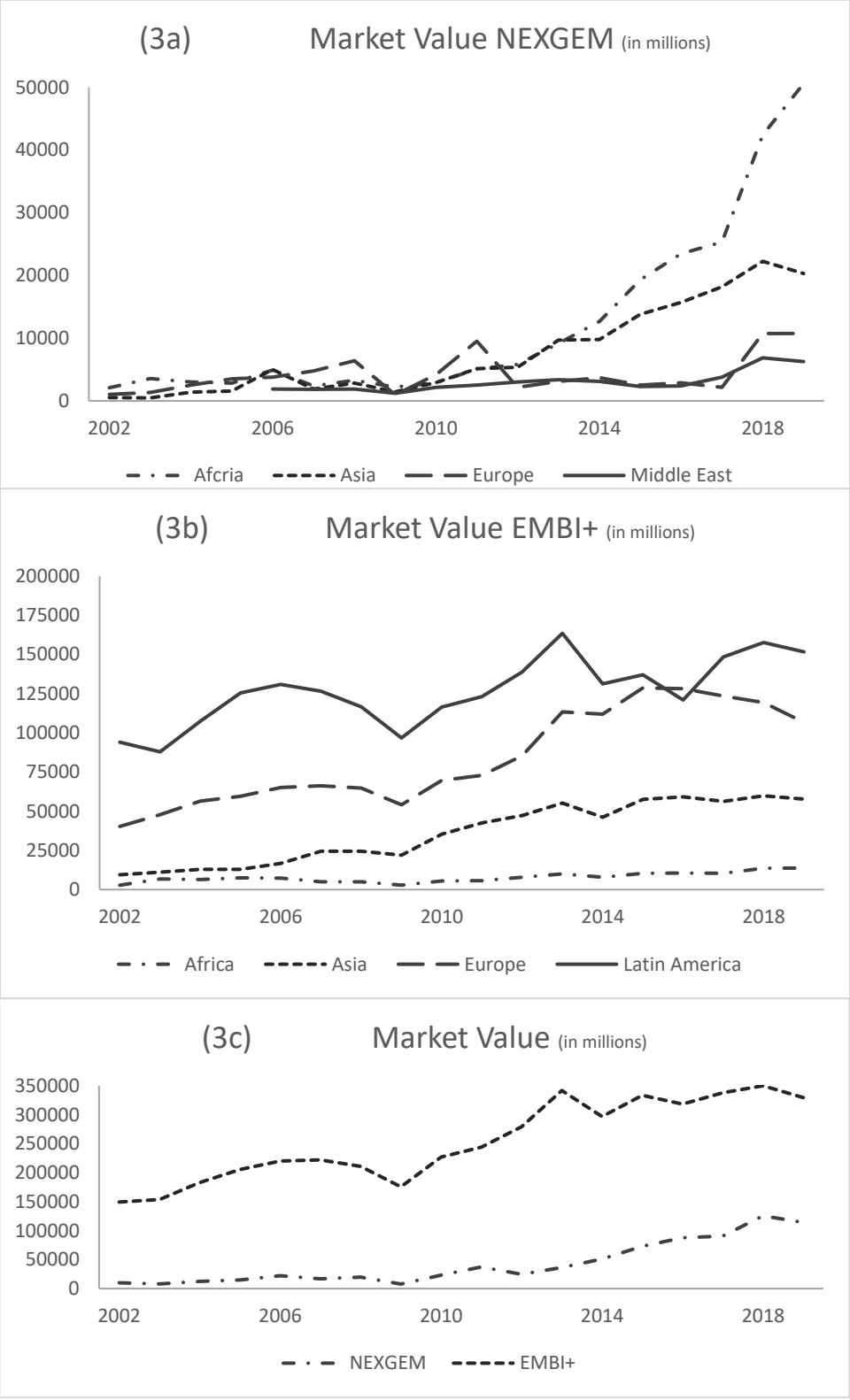


Table 3

	AVERAGE YOY%				2018			
	CPI	Central Bank Policy Rate	International Reserves	Political Risk	CPI	Central Bank Policy Rate	International Reserves	Political Risk
Asia								
AZERBAIJAN	6.98%	24.82%	19.56%	1.48%	154	9.8	6.67	64.30
SRI LANKA	7.96%	-2.44%	16.80%	-0.74%	151	7.4	6.91	57.80
Africa								
ANGOLA	25.65%	8.47%	31.55%	0.72%	364	16.5	16.20	48.60
GABON	2.31%	-3.09%	80.22%	0.33%	122	3.5	1.34	58.00
GHANA	14.01%	0.91%	10.32%	-0.15%	263	20.0	7.03	56.00
KENYA	9.45%	8.61%	13.96%	-0.27%	185	9.0	8.20	54.70
NAMIBIA	5.99%	-2.48%	18.01%	-0.55%	156	6.8	2.16	58.50
SENEGAL	1.47%	-3.64%	38.58%	-0.29%	108	2.5	496.41	55.70
Latin America								
BOLIVIA	5.06%	-1.42%	16.00%	-2.45%	146	4.0	8.95	44.10
COSTA RICA	6.66%	8.29%	11.59%	-0.16%	127	5.3	7.50	65.60
EL SALVADOR	2.42%	-0.11%	4.67%	-0.84%	111	3.8	3.35	63.20
GUATEMALA	5.35%	-1.46%	10.72%	-0.13%	140	2.8	12.76	63.40
HONDURAS	6.02%	-0.09%	6.79%	0.41%	147	5.5	4.77	60.60
JAMAICA	8.91%	-8.94%	5.64%	0.51%	158	1.8	3.53	69.10
Europa								
ARMENIA	3.90%	-1.07%	14.54%	0.22%	128	6.0	2.25	68.70
GEORGIA	5.06%	4.77%	22.57%	1.71%	129	7.0	3.29	76.20

Table 2 provides insights in the country characteristics of the countries of the JP Morgan NEXGEM index under scrutiny in this research. The left side of the table shows the average year-on-year percentual change of each macroeconomic or political factor, which indicates the development of each variable in each country. The right side shows the value of each factor at the ending date of the sample period, which makes it easy to compare the variables across countries. *CPI* indicates the Consumer Price Index: the level of inflation taken from Datastream. The *Central Bank Policy Rate* shows the interest rate set by the government of the countries under scrutiny (obtained from the International Monetary Fund through Datastream). *International Reserves* shows the level of international reserves and is obtained from Datastream. *Political Risk* is taken from the Political Risk Index of the Heritage Foundation and shows the extent of political risk.

Appendix B

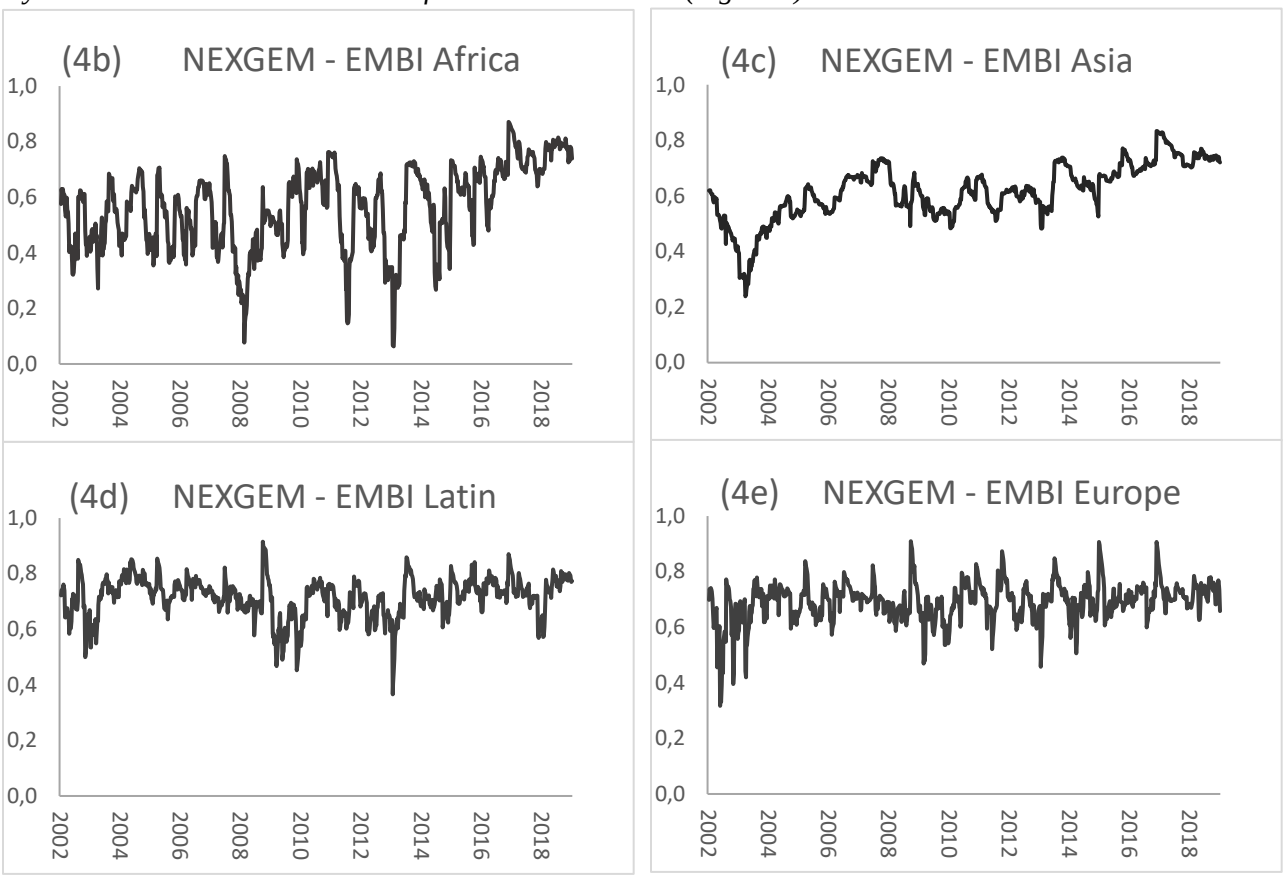
Table 4b

Table 4b Statistics of the dynamic conditional correlations	α	β	Mean	Min	Max
NEXGEM - EMBI+	0.063***	0.871***	0,7855	0,6668	0,9305
	(0.020)	(0.049)			
NEXGEM - EMBI+ Europe	0.070***	0.813***	0,6940	0,3982	0,8714
	(0.023)	(0.065)			
NEXGEM - EMBI+ Asia	0.065***	0.836***	0,6151	0,5274	0,7197
	(0.023)	(0.063)			
NEXGEM - EMBI+ Africa	0.098***	0.834***	0,6609	0,5017	0,7360
	(0.027)	(0.055)			
NEXGEM - EMBI+ Latin	0.044**	0.911***	0,7822	0,7287	0,8674
	(0.017)	(0.046)			
NEXGEM - US Treasury	0.034***	0.949***	-0,0498	-0,4966	0,4598
	(0.012)	(0.020)			
NEXGEM - US High Yield	0.067***	0.850***	0,6957	0,2904	0,9802
	(0.036)	(0.102)			
NEXGEM - US Investment Grade	0.035**	0.930***	0,4944	0,3093	0,7767
	(0.016)	(0.036)			
NEXGEM - EM Equity	0.016*	0.980***	0,6727	0,3735	0,8139
	(0.009)	(0.014)			
NEXGEM - World Equity	0.015*	0.975***	0,6052	0,4741	0,6548
	(0.008)	(0.018)			

*Figures in parentheses are standard errors. *** p<0.01, ** p<0.05, * p<0.1 denote the statistical significance significance at the 1%, 5% and 10% levels*

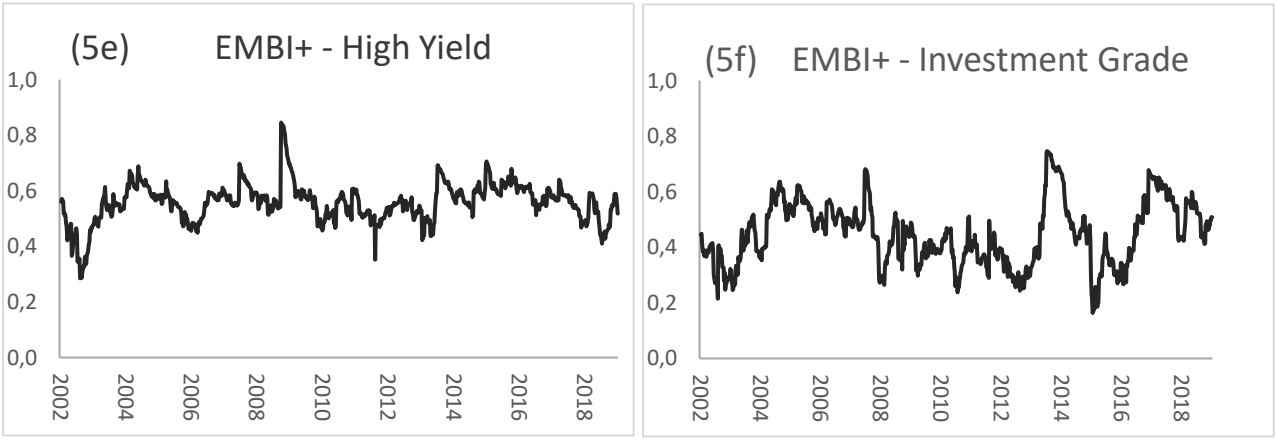
Graph 4b – 4e

Dynamic Conditional Correlation of NEXGEM – EMBI+ (regional)



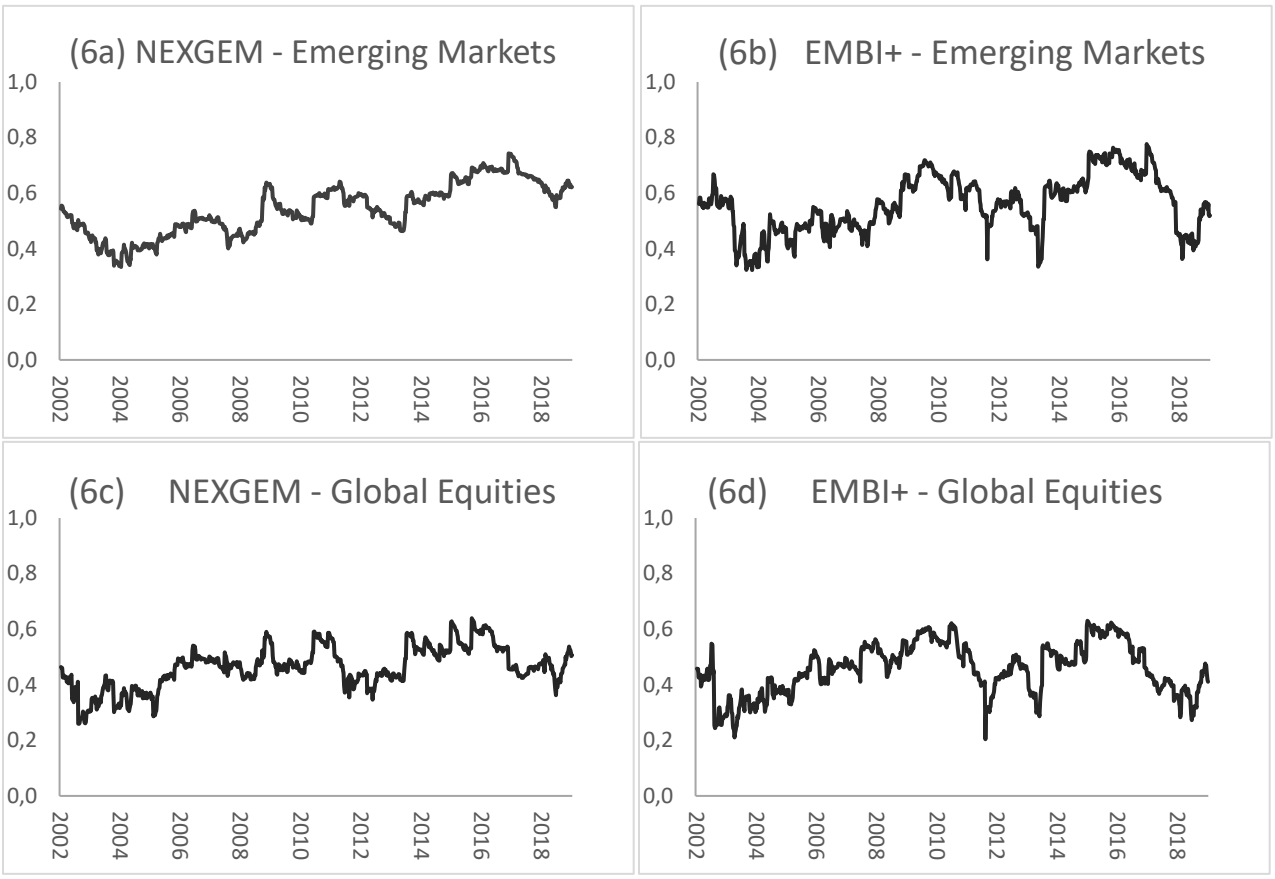
Graphs 5e – 5f

Dynamic conditional correlation EMBI+ - US bond indices



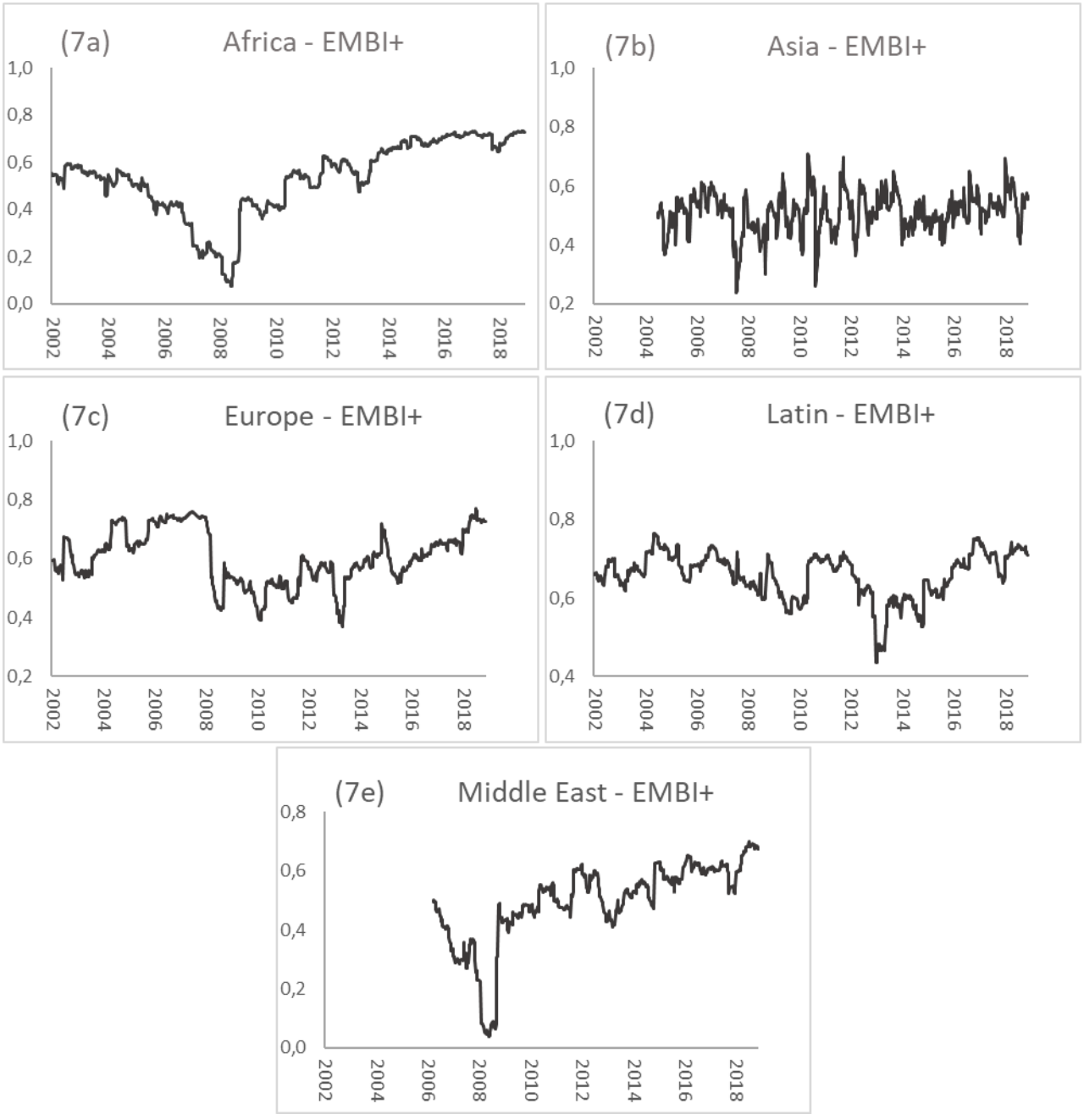
Graph 6a – 6d

Dynamic Conditional Correlation: NEXGEM and EMBI+ - Equity Markets



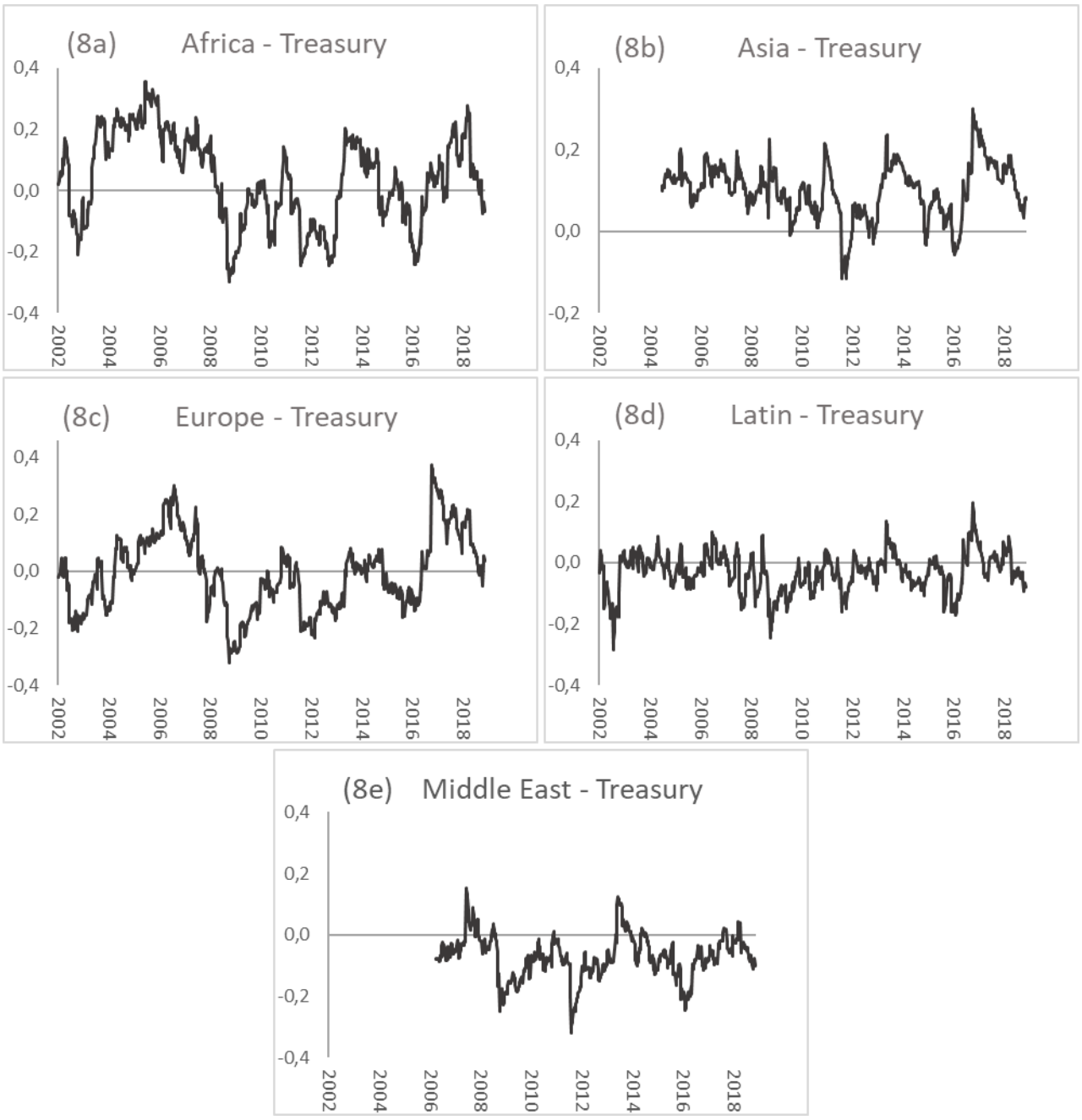
Graph 7a – 7e

Dynamic Conditional Correlation: NEXGEM (regions) - EMBI+



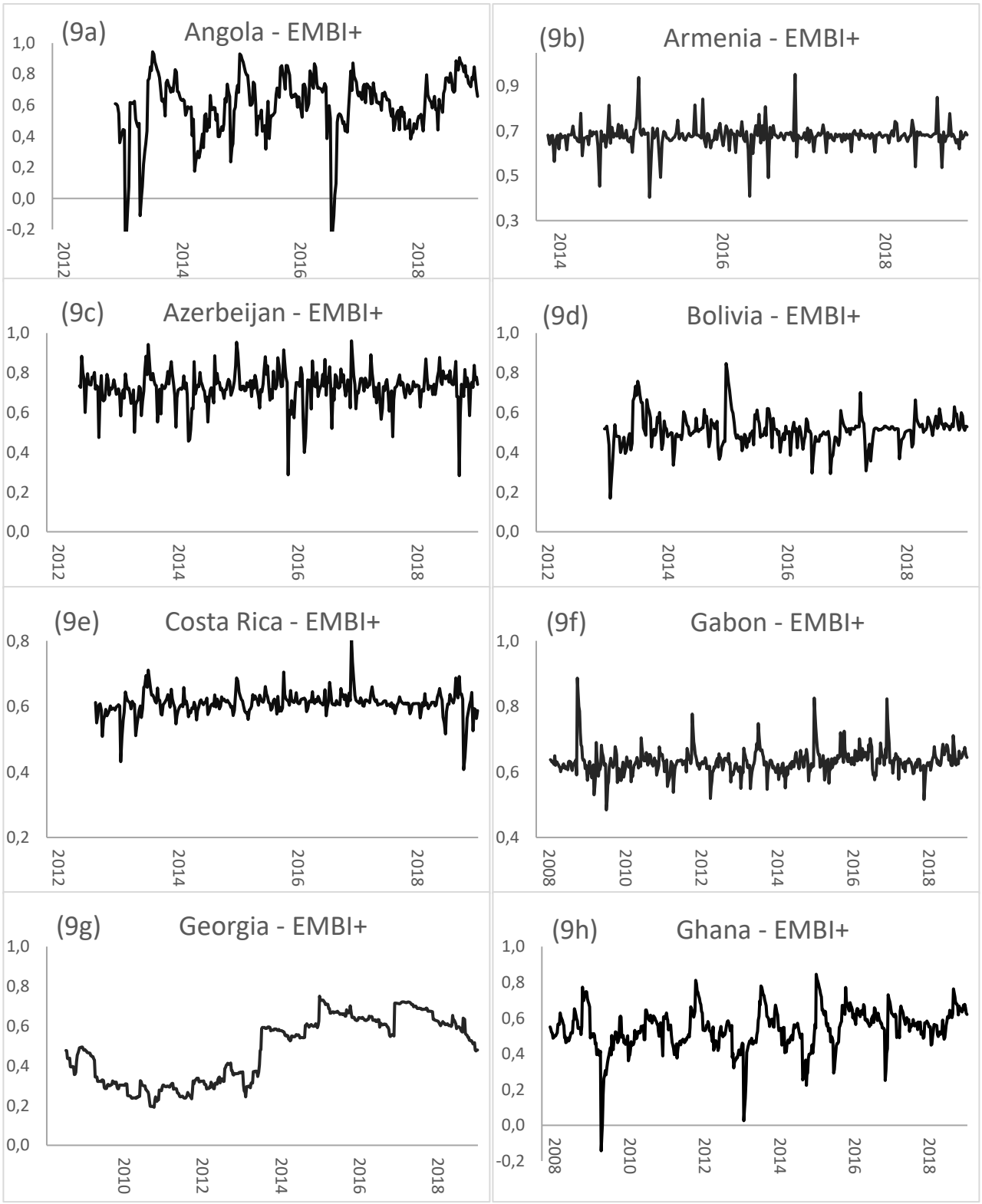
Graph 8a – 8e

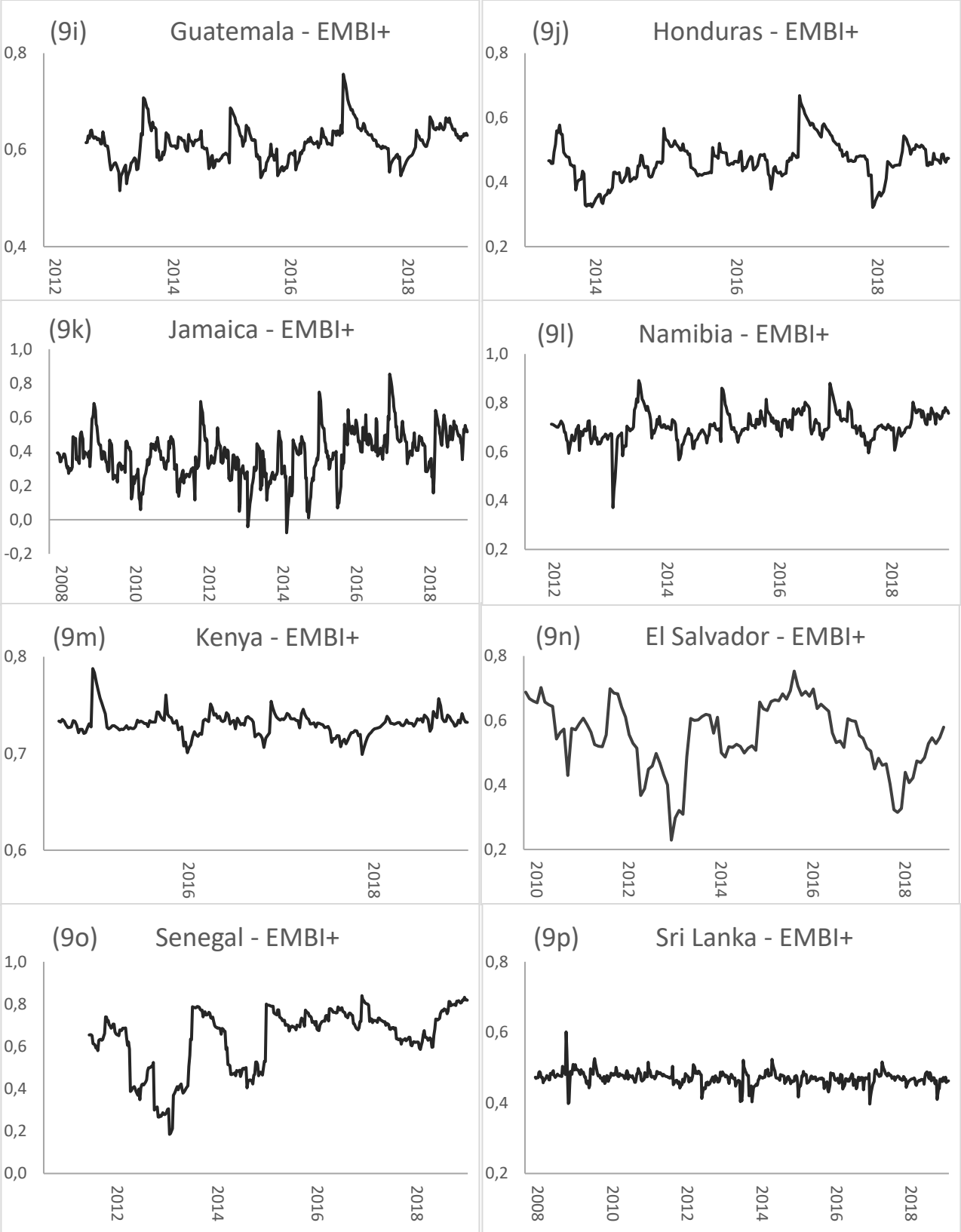
Dynamic Conditional Correlation: NEXGEM (regions) – US Treasury



Graph 9a – 9p

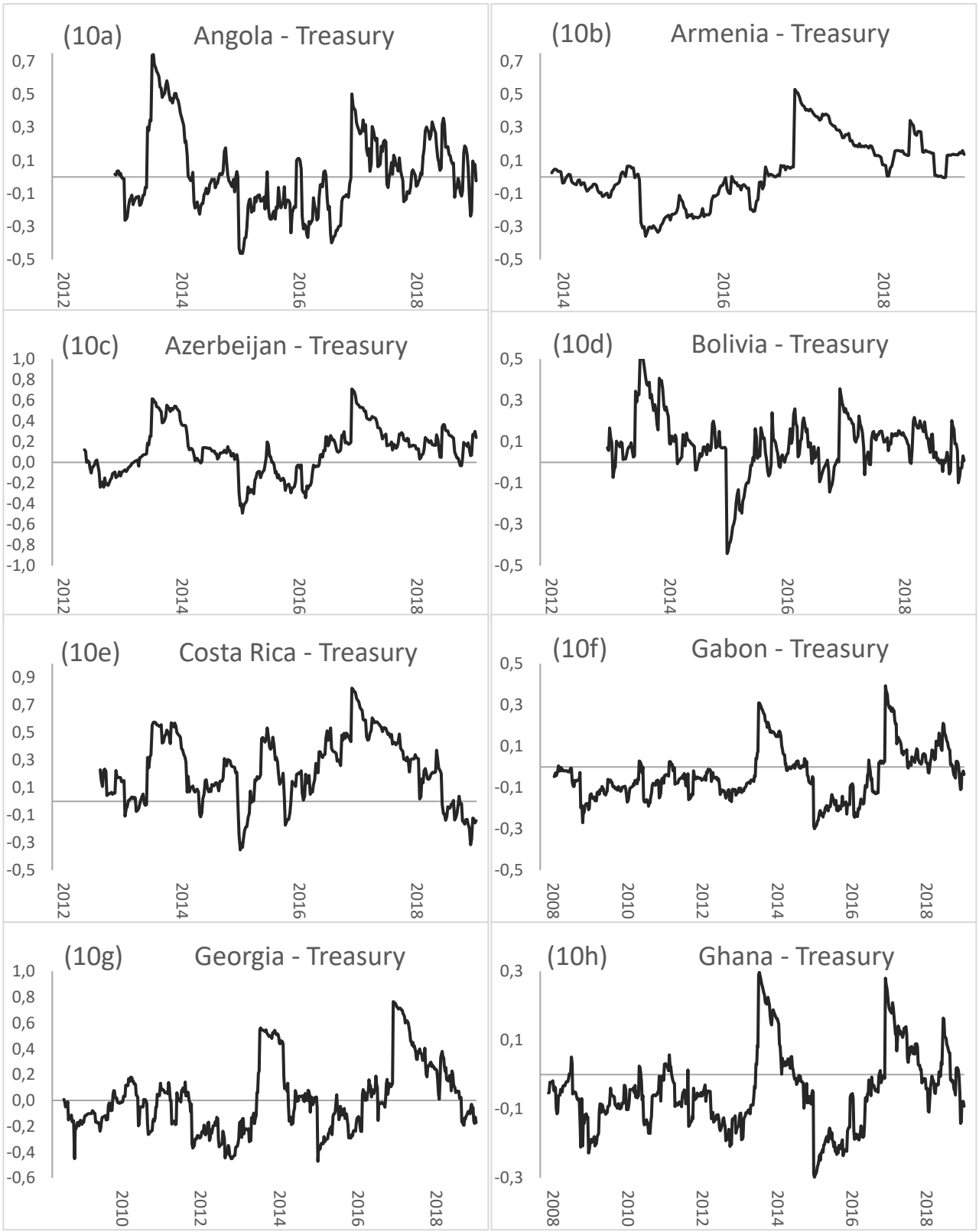
Dynamic Conditional Correlation: NEXGEM - EMBI+




(9i) Guatemala - EMBI+
0,8
0,6
0,4
2012
2014
2016
2018
(9j) Honduras - EMBI+
0,8
0,6
0,4
0,2
2014
2016
2018
(9k) Jamaica - EMBI+
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
2008
2010
2012
2014
2016
2018
(9l) Namibia - EMBI+
1,0
0,8
0,6
0,4
0,2
2012
2014
2016
2018
(9m) Kenya - EMBI+
0,8
0,7
0,6
2016
2018
(9n) El Salvador - EMBI+
0,8
0,6
0,4
0,2
2010
2012
2014
2016
2018
(9o) Senegal - EMBI+
1,0
0,8
0,6
0,4
0,2
0,0
2012
2014
2016
2018
(9p) Sri Lanka - EMBI+
0,8
0,6
0,4
0,2
2008
2010
2012
2014
2016
2018

Graph 8a – 8p

Dynamic Conditional Correlation: NEXGEM – US Treasury Index



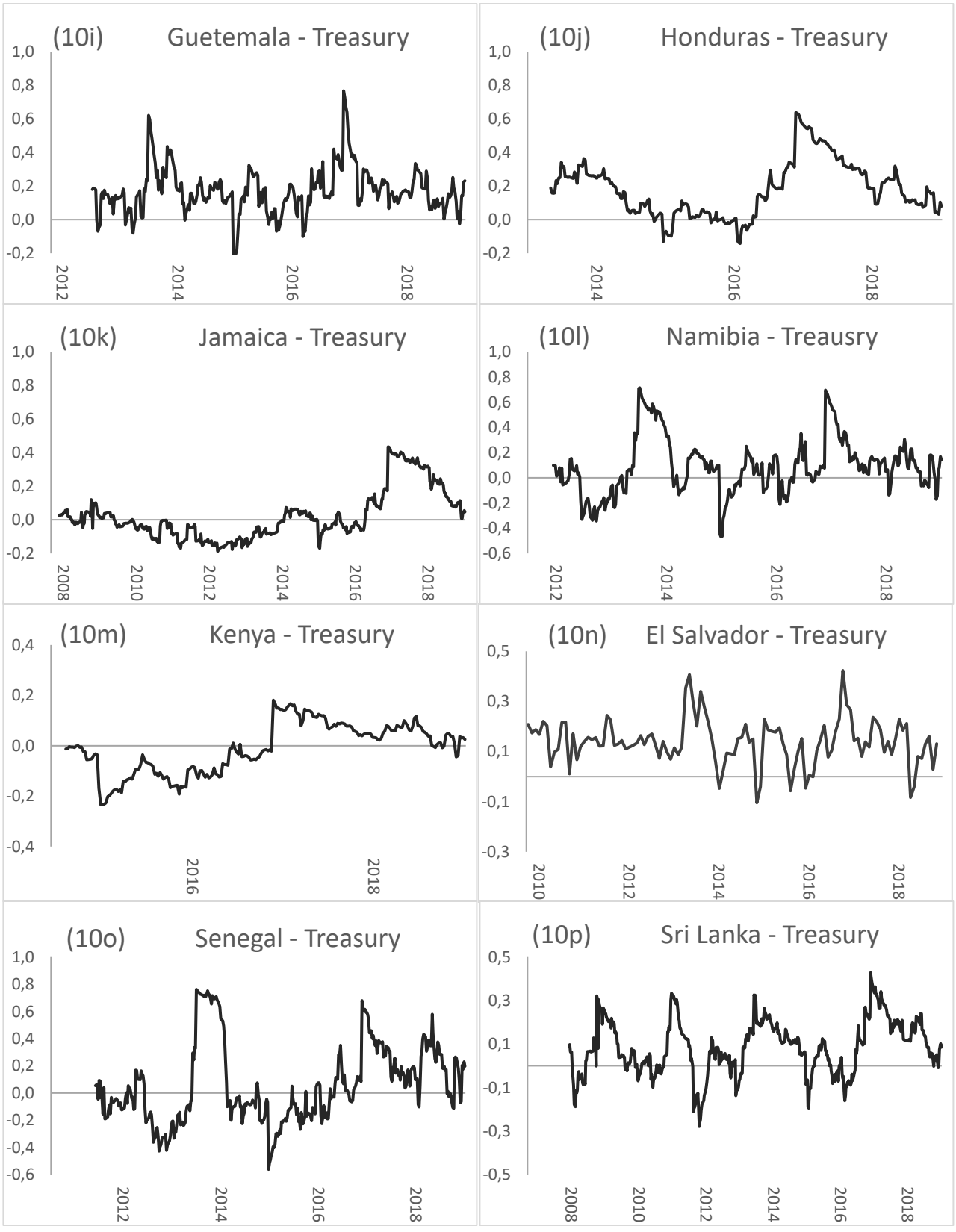

(10i) Guetemala - Treasury
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
2012
2014
2016
2018
(10j) Honduras - Treasury
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
2014
2016
2018
(10k) Jamaica - Treasury
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
2008
2010
2012
2014
2016
2018
(10l) Namibia - Treausry
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
-0,4
-0,6
2012
2014
2016
2018
(10m) Kenya - Treasury
0,4
0,2
0,0
-0,2
-0,4
2016
2018
(10n) El Salvador - Treasury
0,5
0,3
0,1
-0,1
-0,3
2010
2012
2014
2016
2018
(10o) Senegal - Treasury
1,0
0,8
0,6
0,4
0,2
0,0
-0,2
-0,4
-0,6
2012
2014
2016
2018
(10p) Sri Lanka - Treasury
0,5
0,3
0,1
-0,1
-0,3
-0,5
2008
2010
2012
2014
2016
2018

Table 10

Table 10 NEXGEM - EMBI+	Angola	Armenia	Azerbeijan	Bolivia	Costa Rica	El Salvcador	Gabon	Georgia	Ghana	Guatamala	Honduras	Jamaica	Kenya	Namibia	Senegal	Sri Lanka
Political Risk	0.071**	0.007**	-0.011	-0.024	0.001	0.027***	0.001	-0.001	0.001***	-0.042	-0.006**	0.030***	0.002	-0.000	0.013***	-0.001
	(0.035)	(0.003)	(0.010)	(0.019)	(0.003)	(0.005)	(0.007)	(0.004)	(0.000)	(0.039)	(0.003)	(0.008)	(0.011)	(0.001)	(0.005)	(0.003)
CPI (domestic)	-0.000	-0.001	-0.005**	-0.002	-0.001*	0.003	0.002**	-0.001	-0.000**	0.033**	0.009***	0.000	-0.003	0.000	0.001	-0.000
	(0.001)	(0.001)	(0.002)	(0.004)	(0.001)	(0.004)	(0.001)	(0.001)	(0.000)	(0.014)	(0.001)	(0.001)	(0.002)	(0.000)	(0.004)	(0.000)
International Reserves (domestic)	0.038***	-0.007	-0.003	0.015	0.002	-0.064***	0.008	0.015	0.004***	-0.084**	-0.048***	-0.040***	0.005	0.009**	-0.000***	-0.005
	(0.006)	(0.012)	(0.005)	(0.016)	(0.003)	(0.016)	(0.005)	(0.018)	(0.001)	(0.039)	(0.009)	(0.015)	(0.028)	(0.003)	(0.000)	(0.004)
Central Bank Policy Rate (domestic)	0.021*	0.007***	0.015***	-	-0.006***	-0.008	0.022*	0.001	0.001***	0.061	0.022***	-0.007**	0.061**	0.003	-0.222***	-0.009*
	(0.011)	(0.002)	(0.003)	(omitted)	(0.002)	(0.008)	(0.012)	(0.003)	(0.000)	(0.069)	(0.008)	(0.003)	(0.024)	(0.004)	(0.022)	(0.005)
Purchasing Manager Index (global)	0.024***	-0.000	0.013***	0.009	0.003***	0.006***	-0.003***	0.002*	0.000**	-0.003	-0.006***	-0.004**	0.001	-0.001	0.003*	0.002
	(0.005)	(0.001)	(0.004)	(0.007)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.010)	(0.001)	(0.002)	(0.008)	(0.000)	(0.001)	(0.001)
VIX	0.001	-0.000	-0.002	0.005	-0.001***	0.001	0.002***	0.000	-0.000***	0.005	0.001	-0.005***	0.004	0.000	-0.001	-0.002***
	(0.003)	(0.000)	(0.002)	(0.005)	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.005)	(0.000)	(0.001)	(0.003)	(0.000)	(0.001)	(0.001)
Constant	-5.348***	0.241	1.258***	1.199	0.614**	-1.466**	0.466	0.732***	0.582***	-0.290	0.175	-1.083**	0.180	0.784***	0.755	0.878***
	(1.780)	(0.210)	(0.387)	(1.463)	(0.287)	(0.791)	(0.396)	(0.212)	(0.020)	(2.347)	(0.177)	(0.515)	(0.984)	(0.048)	(0.696)	(0.224)
Observations	74	62	80	73	77	109	132	126	108	78	68	134	53	85	89	133
R-squared	0.673	0.374	0.500	0.088	0.322	0.788	0.523	0.059	0.690	0.142	0.759	0.654	0.492	0.276	0.927	0.301

Table 10 presents the relationship of macroeconomic factors and co-movements between bond indices. The estimated regression model links the obtained co-movements to a set of macroeconomic and political factors (section 4.2). The explanatory variables include *Political Risk* (the index of the Heritage Foundation); *Consumer Price Index*, which represents the inflationary environment; *Central Bank Policy Rate*, a proxy for the monetary policy of a country; *International Reserves*, which captures a country's creditworthiness, *Purchasing Manager Index*, a global indicator of business cycles and the CBOE VIX as proxy for global volatility.

*** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at the 1%, 5% and 10% levels

Table 11

Table 11 NEXGEM - US Treasury Index	Angola	Armenia	Azerbeijan	Bolivia	Costa Rica	El Salvcador	Gabon	Georgia	Ghana	Guatamala	Honduras	Jamaica	Kenya	Namibia	Senegal	Sri Lanka
Political Risk	0.101**	-0.025	-0.051	-0.004	-0.044**	-0.013	-0.006	0.050**	0.001	0.055**	-0.042	0.103***	0.021	0.001	0.031	-0.005**
	(0.051)	(0.024)	(0.041)	(0.011)	(0.018)	(0.032)	(0.010)	(0.023)	(0.003)	(0.022)	(0.028)	(0.030)	(0.023)	(0.015)	(0.022)	(0.002)
CPI (domestic)	-0.000	-0.027	0.027**	0.010*	-0.021***	0.032*	0.002	-0.015***	-0.000	0.005	-0.080***	0.000	0.034***	0.016	0.025*	-0.008**
	(0.002)	(0.028)	(0.014)	(0.006)	(0.007)	(0.017)	(0.003)	(0.005)	(0.001)	(0.010)	(0.019)	(0.003)	(0.009)	(0.014)	(0.013)	(0.003)
International Reserves (domestic)	-0.012	0.291***	0.011	-0.033***	-0.009	-0.057	0.027**	0.260***	-0.000	0.047*	0.072	-0.007	0.039	0.142*	-0.001***	0.003
	(0.009)	(0.105)	(0.021)	(0.010)	(0.010)	(0.051)	(0.011)	(0.066)	(0.005)	(0.024)	(0.050)	(0.036)	(0.058)	(0.084)	(0.000)	(0.004)
Central Bank Policy Rate (domestic)	-0.000	-0.117***	0.009	-	-0.040***	0.019	0.016	0.035**	0.002	0.142**	-0.129**	-0.028***	0.015	-0.116	-0.459***	0.012
	(0.018)	(0.037)	(0.016)	(omitted)	(0.008)	(0.013)	(0.012)	(0.014)	(0.004)	(0.057)	(0.051)	(0.006)	(0.032)	(0.097)	(0.128)	(0.012)
CPI (US)	-0.009	0.022	0.049	-0.018	0.038**	-0.031	0.002	0.004	0.002	0.005	0.164***	-0.010	-0.071	-0.020	-0.030**	0.027**
	(0.029)	(0.047)	(0.035)	(0.022)	(0.015)	(0.029)	(0.006)	(0.011)	(0.005)	(0.022)	(0.054)	(0.015)	(0.051)	(0.056)	(0.012)	(0.012)
International Reserves (US)	0.004	-0.014***	0.017***	0.007***	0.002	-0.001	-0.001	-0.003	0.000	-0.008*	-0.010**	-0.003**	0.003	-0.002	0.004	-0.001
	(0.003)	(0.004)	(0.005)	(0.002)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.004)	(0.005)	(0.001)	(0.007)	(0.004)	(0.002)	(0.000)
Central Bank Policy Rate (US)	-0.045	-0.168	-0.569***	-0.069	-0.092**	0.073	-0.005	-0.084**	0.022	-0.229***	-0.001	-0.022	-0.523***	-0.291***	-0.012	-0.019
	(0.110)	(0.109)	(0.169)	(0.060)	(0.046)	(0.071)	(0.008)	(0.042)	(0.025)	(0.063)	(0.078)	(0.027)	(0.142)	(0.100)	(0.051)	(0.015)
Purchasing Manager Index (global)	-0.023***	0.028**	0.017	-0.005	0.011**	-0.003	-0.000	0.008	0.000	0.004	0.036***	0.012***	0.054***	0.011	0.010**	-0.002
	(0.007)	(0.012)	(0.018)	(0.006)	(0.005)	(0.004)	(0.001)	(0.006)	(0.002)	(0.005)	(0.006)	(0.004)	(0.018)	(0.007)	(0.005)	(0.001)
VIX	-0.003	0.002	-0.002	0.004**	-0.002	0.003	-0.000	-0.001	0.000	0.002	-0.001	-0.004**	0.000	0.003	0.000	-0.001
	(0.002)	(0.003)	(0.005)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.000)	(0.002)	(0.003)	(0.002)	(0.004)	(0.004)	(0.001)	(0.001)
Constant	-2.962	3.289	-8.518**	0.651	1.045	1.168	-0.251	-3.470***	-0.504*	-4.216**	-4.826	-5.831***	-2.152	0.511	-0.454	-1.572*
	(2.575)	(4.543)	(4.268)	(2.027)	(1.737)	(3.970)	(0.331)	(1.119)	(0.257)	(1.902)	(3.081)	(1.861)	(4.182)	(5.248)	(3.105)	(0.827)
Observations	74	62	80	73	77	110	132	126	108	78	68	134	53	85	91	133
R-squared	0.556	0.823	0.590	0.282	0.680	0.166	0.162	0.426	0.019	0.509	0.688	0.811	0.658	0.240	0.366	0.223

Table 11 presents the relationship of macroeconomic factors and co-movements between bond indices. The estimated regression model links the obtained co-movements to a set of macroeconomic and political factors (section 4.2). The explanatory variables include *Political Risk* (the index of the Heritage Foundation); *Consumer Price Index*, which represents the inflationary environment; *Central Bank Policy Rate*, a proxy for the monetary policy of a country; *International Reserves*, which captures a country's creditworthiness, *Purchasing Manager Index,* a global indicator of business cycles and the CBOE VIX as proxy for global volatility.

*** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at the 1%, 5% and 10% levels

Table 12

Table 12 NEXGEM - US Treasury Index	Angola	Armenia	Azerbeijan	Bolivia	Costa Rica	El Salvcador	Gabon	Georgia	Ghana	Guatamala	Honduras	Jamaica	Kenya	Namibia	Senegal	Sri Lanka
Political Risk	-0.003	0.005	-0.118***	-0.004	-0.083*	0.004	0.101***	0.138***	-0.004	0.025	0.012	0.103***	0.010	0.009	0.040	0.012
	(0.084)	(0.029)	(0.034)	(0.015)	(0.048)	(0.005)	(0.023)	(0.030)	(0.007)	(0.018)	(0.014)	(0.011)	(0.012)	(0.015)	(0.044)	(0.009)
CPI (domestic)	0.004**	0.009*	0.014**	-0.014***	-0.035***	-0.000	-0.005	-0.034***	-0.001	0.008	-0.035***	-0.002**	0.005**	0.004	0.160***	0.003***
	(0.002)	(0.006)	(0.007)	(0.005)	(0.009)	(0.001)	(0.003)	(0.011)	(0.001)	(0.007)	(0.005)	(0.001)	(0.002)	(0.006)	(0.042)	(0.001)
International Reserves (domestic)	0.068***	0.167	0.038**	-0.052***	0.050	-0.014	-0.040**	0.314**	0.032*	-0.039**	-0.112	0.055**	0.005	0.025	0.001	-0.034***
	(0.015)	(0.101)	(0.017)	(0.017)	(0.033)	(0.028)	(0.020)	(0.123)	(0.018)	(0.020)	(0.071)	(0.025)	(0.023)	(0.092)	(0.001)	(0.011)
Central Bank Policy Rate (domestic)	0.022	-0.105***	0.022**	-	-0.135***	0.003	0.145***	0.039**	-0.000	-0.013	-0.495***	0.011***	0.010	-0.072	0.215	0.006
	(0.025)	(0.017)	(0.010)	-	(0.023)	(0.006)	(0.037)	(0.017)	(0.006)	(0.027)	(0.064)	(0.003)	(0.017)	(0.133)	(0.197)	(0.014)
Purchasing Manager Index (global)	0.002	-0.017**	0.018	-0.003	0.021	0.001	0.003	-0.004	0.006	0.004	0.036***	-0.007**	0.006	0.001	0.015	0.005
	(0.014)	(0.007)	(0.013)	(0.006)	(0.014)	(0.002)	(0.002)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.006)	(0.013)	(0.014)	(0.004)
VIX	0.010**	0.001	-0.002	0.002	-0.009	-0.002	-0.001	-0.007**	-0.004**	-0.003	-0.003	-0.003**	-0.004**	-0.004	0.003	-0.001
	(0.005)	(0.003)	(0.004)	(0.004)	(0.006)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.003)	(0.001)	(0.002)	(0.004)	(0.004)	(0.002)
Constant	-2.968	-0.090	4.024***	3.027*	9.095**	-0.121	-5.845***	-6.922***	-0.101	-1.989*	5.640***	-6.445***	-1.711**	-0.562	-20.937***	-1.104*
	(4.203)	(2.250)	(1.316)	(1.517)	(4.045)	(0.387)	(1.189)	(1.129)	(0.684)	(1.027)	(1.166)	(0.729)	(0.795)	(1.266)	(6.774)	(0.660)
Observations	74	62	80	73	77	109	132	126	108	78	69	134	53	85	92	134
R-squared	0.427	0.697	0.407	0.249	0.465	0.081	0.292	0.328	0.162	0.329	0.645	0.642	0.546	0.048	0.308	0.183

Table 12 presents the relationship of macroeconomic factors and co-movements between bond indices. The estimated regression model links the obtained co-movements to a set of macroeconomic and political factors (section 4.2). The explanatory variables include *Political Risk* (the index of the Heritage Foundation); *Consumer Price Index*, which represents the inflationary environment; *Central Bank Policy Rate*, a proxy for the monetary policy of a country; *International Reserves*, which captures a country's creditworthiness, *Purchasing Manager Index*, a global indicator of business cycles and the CBOE VIX as proxy for global volatility.

*** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at the 1%, 5% and 10% levels

Table 13

Table 13 NEXGEM - US Treasury Index	Angola	Armenia	Azerbeijan	Bolivia	Costa Rica	El Salvcador	Gabon	Georgia	Ghana	Guatamala	Honduras	Jamaica	Kenya	Namibia	Senegal	Sri Lanka
Political Risk	-0.038	0.042	-0.024	0.017	-0.068	0.008***	0.019**	0.042***	-0.007	0.032***	0.030	0.085***	-0.008	0.008	0.010	0.007
	(0.081)	(0.032)	(0.024)	(0.011)	(0.042)	(0.002)	(0.008)	(0.010)	(0.005)	(0.010)	(0.020)	(0.007)	(0.013)	(0.014)	(0.039)	(0.009)
CPI (Domestic - US)	-2.934	-9.158**	4.566	-0.354	-17.115**	-0.031	1.268	2.392	-1.317	-4.804*	-10.481	3.521***	1.363	-4.268	2.337	-1.456
	(4.766)	(3.946)	(2.983)	(6.113)	(6.722)	(1.152)	(1.432)	(2.506)	(2.682)	(2.879)	(10.040)	(1.221)	(1.870)	(7.858)	(5.046)	(1.128)
International Reserves (Domest - US)	-0.620	0.029	-1.204*	0.895	-0.473	0.036	0.032	0.288	-0.161	0.117	-0.011	-0.040	0.028	-0.006	1.386	0.055
	(0.656)	(0.371)	(0.643)	(0.660)	(0.475)	(0.071)	(0.113)	(0.207)	(0.141)	(0.288)	(0.288)	(0.099)	(0.276)	(0.139)	(1.750)	(0.061)
Central Bank Policy Rate (Domestic - US)	-0.013	-0.128	0.006	-0.014	0.068	0.044	0.057	-0.003	-0.008	-0.065	0.073	0.002	-0.035	0.029	-0.009	0.027
	(0.008)	(0.096)	(0.081)	(0.031)	(0.063)	(0.039)	(0.050)	(0.132)	(0.058)	(0.047)	(0.103)	(0.066)	(0.052)	(0.077)	(0.098)	(0.059)
Purchasing Manager Index (global)	0.016	0.017**	0.032**	-0.000	-0.027**	0.001	0.005**	0.001	0.005	0.001	-0.002	-0.003	0.012***	0.008	0.027**	-0.000
	(0.011)	(0.008)	(0.013)	(0.007)	(0.012)	(0.002)	(0.002)	(0.005)	(0.004)	(0.003)	(0.006)	(0.002)	(0.004)	(0.008)	(0.011)	(0.004)
VIX	-0.001	-0.001	-0.010*	0.002	-0.014**	-0.002**	-0.001	-0.004	-0.005***	-0.002	-0.011***	0.001	-0.003	-0.005	-0.003	-0.002
	(0.006)	(0.004)	(0.005)	(0.004)	(0.007)	(0.001)	(0.001)	(0.003)	(0.001)	(0.002)	(0.004)	(0.001)	(0.002)	(0.004)	(0.004)	(0.003)
Constant	1.058	-3.806*	-0.002	-0.727	6.442*	-0.385**	-1.362***	-2.996***	0.200	-1.631***	-1.275	-5.517***	-0.190	-0.768	-1.931	-0.273
	(3.547)	(1.946)	(0.943)	(0.852)	(3.298)	(0.180)	(0.453)	(0.731)	(0.493)	(0.529)	(0.995)	(0.444)	(0.910)	(1.030)	(2.643)	(0.660)
Observations	74	62	80	73	77	109	132	126	107	78	69	134	53	85	92	134
R-squared	0.092	0.307	0.221	0.038	0.187	0,549	0.165	0.219	0.155	0.287	0.134	0.563	0.341	0.042	0.113	0.055

Table 13 presents the relationship of macroeconomic factors and co-movements between bond indices. The estimated regression model links the obtained co-movements to a set of macroeconomic and political factors (section 4.2). The explanatory variables include *Political Risk* (the index of the Heritage Foundation); *Consumer Price Index*, which represents the relative change of the inflationary environment in country i subtracted by the relative change in the consumer price index of the United States; *Central Bank Policy Rate*, a proxy for the monetary policy of a country: the relative change of the United States is subtracted from the relative change of country i; *International Reserves*, which captures a country's creditworthiness: relative change of country i subtracted by the relative change in the extent of International Reserves in the United States. *Purchasing Manager Index*, a global indicator of business cycles and the CBOE VIX as proxy for global volatility.

*** p<0.01, ** p<0.05, * p<0.1 denote statistical significance at the 1%, 5% and 10% levels

Table 15

Mean- and minimum-variance portfolio without the NEXGEM. Panels (A) have no restrictions: Panels (B) prohibit short selling.

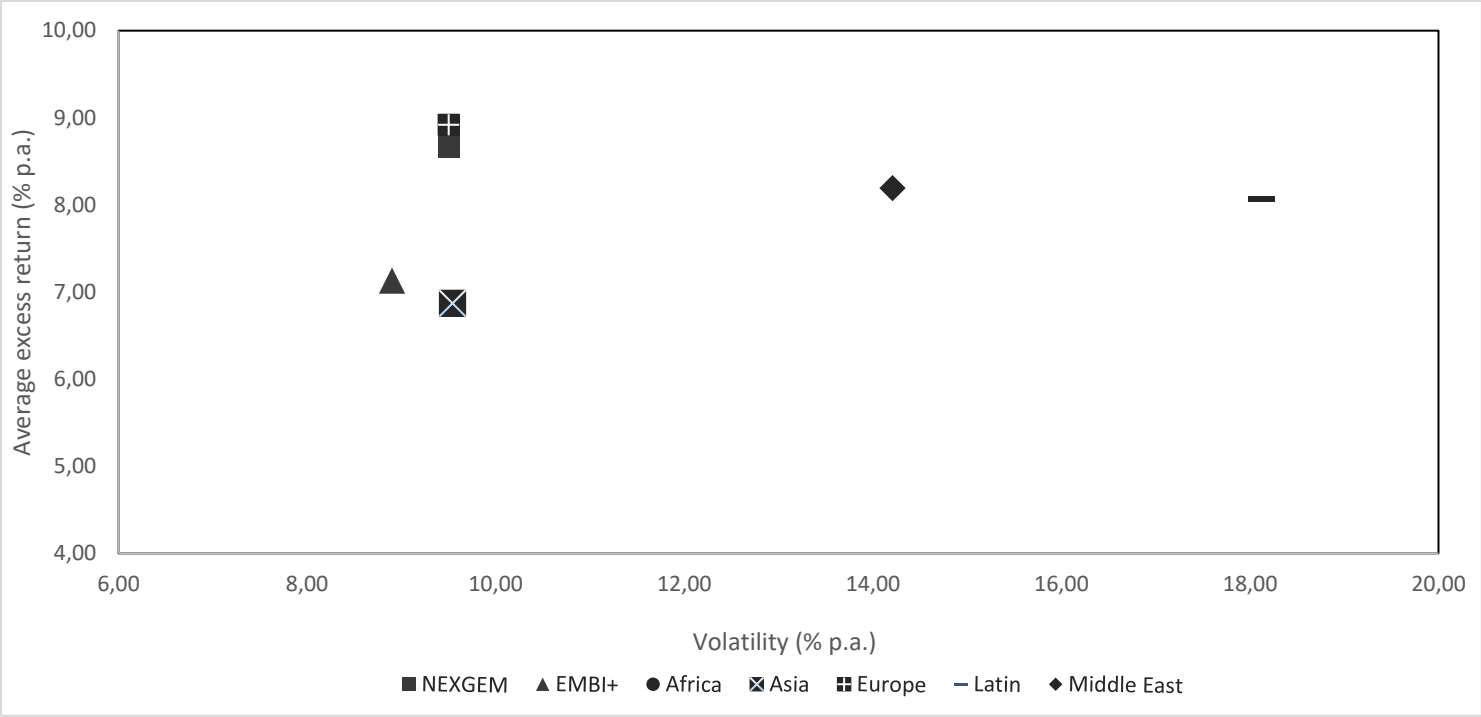
	Mean-Variance		Minimum-Variance	
2002-2018	(A)	(B)	(A)	(B)
EMBI+	-42.38%	0.00%	-57.66%	0.00%
Treasury	21.09%	0.00%	14.86%	0.00%
Investment Grade	99.90%	73.93%	130.77%	83.33%
High Yield	22.84%	26.07%	7.68%	16.45%
Equity	-1.46%	0.00%	4.35%	0.21%

Table 16

Mean- and minimum-variance portfolios in three sub-periods. Panels (A) have no restrictions: Panels (B) prohibit short selling.

	Mean-Variance		Minimum-Variance	
2002-2007	(A)	(B)	(A)	(B)
NEXGEM	23.86%	30.01%	4.00%	0.00%
EMBI+	3.21%	6.69%	-13.93%	0.00%
Treasury	-138.89%	0.00%	-189.01%	0.00%
Investment Grade	190.33%	23.98%	292.43%	76.50%
High Yield	22.34%	37.92%	4.31%	17.36%
Equity	-0.85%	1.41%	2.20%	6.14%
	Mean-Variance		Minimum-Variance	
2007-2011	(A)	(B)	(A)	(B)
NEXGEM	-5.80%	0.00%	2.14%	0.24%
EMBI+	11.46%	0.71%	-4.47%	0.00%
Treasury	30.45%	57.30%	36.63%	41.79%
Investment Grade	41.85%	20.88%	47.51%	40.60%
High Yield	32.26%	21.11%	19.17%	17.36%
Equity	-10.22%	0.00%	-0.97%	0.00%
	Mean-Variance		Minimum-Variance	
2011-2018	(A)	(B)	(A)	(B)
NEXGEM	49.07%	18.77%	2.14%	1.98%
EMBI+	-57.06%	0.00%	-4.47%	-21.79%
Treasury	-94.13%	0.00%	36.63%	-96.15%
Investment Grade	174.38%	35.61%	47.51%	194.77%
High Yield	25.97%	45.63%	19.17%	20.72%
Equity	1.77%	0.00%	-0.97%	0.47%

Graph 12



Graph 12 shows the risk-return relationship of the NEXGEM, EMBI+ and the regional sub-indices of the NEXGEM index. The graph shows the average excess returns (y-axis) and the volatility (annual standard deviation) of the asset classes over the sample period (2002 – 2018). Note that the regions Asia and Middle East has later starting dates due to limited date availability, respectively May 2004 and June 2006.

Table 18a – 18d

2002-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	9,16%	1,55%	1,04%	1,06%	0,11%	1,16%	0,62%
t-value	*2.81*	*0.53*	*0.42*	*0.45*	*0.04*	*0.43*	*0.49*
Treasury	-0.220	-4.686	-0.298	-0.159	-0.322	-	-0.113
t-value	*-0.72*	*-7.42*	*-0.21*	*-0.11*	*-0.25*	*(-)*	*-0.29*
Investment Grade	-	6.302	0.763	0.058	0.179	-	1.042
t-value	*(-)*	*6.9*	*0.44*	*0.03*	*0.12*	*(-)*	*2.12*
High Yield	-	-	0.938	0.616	0.392	-	0.666
t-value	*(-)*	*(-)*	*2.81*	*1.63*	*1.44*	*(-)*	*10.42*
Emerging Markets	-	-	-	0.543	0.740	1.039	-
t-value	*(-)*	*(-)*	*(-)*	*4.89*	*7.95*	*7.15*	*(-)*
Equity Markets	-	-	-	-	0.157	-	-0.107
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*2.26*	*(-)*	*-4.29*
R-Squared	0.006	0.487	0.629	0.678	0.7193	0.557	0.72

2002-2006	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	11,61%	5,42%	5,12%	3,33%	1,66%	3,52%	4,59%
t-value	*2.89*	*1.54*	*1.42*	*1.12*	*0.62*	*1.14*	*1.71*
Treasury	0.472	-4.064	-2.044	-1.188	-0.970	-	-1.156
t-value	*1.61*	*-4.86*	*-1.65*	*-0.99*	*-0.87*	*(-)*	*-0.90*
Investment Grade	-	5.782	3.142	1.508	1.123	-	2.184
t-value	*(-)*	*5.18*	*1.85*	*0.95*	*0.77*	*(-)*	*1.41*
High Yield	-	-	0.424	-0.017	-0.233	-	0.789
t-value	*(-)*	*(-)*	*1.67*	*-0.05*	*-0.77*	*(-)*	*6.27*
Emerging Markets	-	-	-	0.647	0.861	0.720	-
t-value	*(-)*	*(-)*	*(-)*	*3.51*	*4.57*	*5.90*	*(-)*
Equity Markets	-	-	-	-	0.140	-	-0.195
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*2.40*	*(-)*	*-3.79*
R-Squared	0.059	0.394	0.456	0.637	0.682	0.624	0.744

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	10,07%	-2,25%	-2,18%	-1,93%	-1,93%	-4,26%	-0,96%
t-value	*1.00*	*-0.25*	*-0.35*	*-0.64*	*-0.32*	*-0.67*	*-0.54*
Treasury	-0.908	-4.918	2.011	1.784	0.749	-	0.937
t-value	*-1.57*	*-6.08*	*0.76*	*0.61*	*0.33*	*(-)*	*2.83*
Investment Grade	-	6.484	-2.181	-2.181	-1.224	-	-0.414
t-value	*(-)*	*4.40*	*-0.73*	*-0.70*	*-0.50*	*(-)*	*-0.98*
High Yield	-	-	1.386	1.151	0.492	-	0.787
t-value	*(-)*	*(-)*	*2.57*	*1.49*	*0.90*	*(-)*	*13.18*
Emerging Markets	-	-	-	0.338	0.985	0.825	-
t-value	*(-)*	*(-)*	*(-)*	*0.86*	*3.37*	*4.07*	*(-)*
Equity Markets	-	-	-	-	0.216	-	-0.098
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*2.32*	*(-)*	*-4.91*
R-Squared	0.054	0.503	0.711	0.717	0.7683	0.602	0.880

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	7,83%	2,48%	1,30%	2,94%	2,74%	4,85%	-1,91%
t-value	*2.84*	*1.32*	*0.76*	*2.19*	*1.96*	*2.99*	*-1.13*
Treasury	0.065	-4.142	-2.042	-0.8778	-0.873	-	-1.900
t-value	*0.22*	*-9.28*	*-3.94*	*-1.63*	*-1.60*	*(-)*	*-3.45*
Investment Grade	-	5.571	2.990	0.816	0.834	-	3.521
t-value	*(-)*	*10.90*	*4.44*	*1.16*	*1.18*	*(-)*	*5.00*
High Yield	-	-	0.663	0.380	0.382	-	0.398
t-value	*(-)*	*(-)*	*5.75*	*3.08*	*3.18*	*(-)*	*3.35*
Emerging Markets	-	-	-	0.626	0.627	0.818	-
t-value	*(-)*	*(-)*	*(-)*	*6.74*	*6.52*	*14.10*	*(-)*
Equity Markets	-	-	-	-	0.034	-	-0.059
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.91*	*(-)*	*-1.36*
R-Squared	0.001	0.542	0.625	0.776	0.783	0.651	0.619

The statistics of the mean-variance spanning tests with 7 different base assets. In base (1) - base (6), the weekly return of the frontier bond market index (NEXGEM) is the test asset. In base (7), the emerging bond market index (EMBI+) is the test asset. The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); before the financial crisis period (2002-2006); the financial crisis (2007-2011); and after the financial crisis (2012-2018).

Table 19a – 19d (Africa)

2002-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	6.97%	4.60%	3.72%	3.58%	3.55%	4.66%	-0.09%
t-value	*3.37*	*2.26*	*1.75*	*1.71*	*1.68*	*2.20*	*-0.06*
Treasury	-0.106	-1.840	-1.021	-0.711	-0.742	-	-0.229
t-value	*-1.13*	*-5.46*	*-2.70*	*-2.07*	*-2.17*	*(-)*	*-0.61*
Investment Grade	-	2.258	1.273	0.713	0.736	-	1.161
t-value	*(-)*	*5.83*	*2.75*	*1.62*	*1.71*	*(-)*	*2.30*
High Yield	-	-	0.276	0.147	0.156	-	0.349
t-value	*(-)*	*(-)*	*2.84*	*1.79*	*1.74*	*(-)*	*3.28*
Emerging Markets	-	-	-	0.259	0.265	0.363	-
t-value	*(-)*	*(-)*	*(-)*	*4.17*	*3.99*	*6.15*	*(-)*
Equity Markets	-	-	-	-	-0.011	-	0.065
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-0.45*	*(-)*	*2.58*
R-Squared	0.003	0.114	0.1444	0.185	0.185	0.104	0.417

2002-2006	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	5.24%	4.03%	3.64%	3.45%	3.46%	3.92%	3.16%
t-value	*3.52*	*2.79*	*2.50*	*2.36*	*2.42*	*2.72*	*1.98*
Treasury	0.131	-0.840	-0.411	-0.318	-0.160	-	-0.371
t-value	*2.43*	*-2.79*	*-1.32*	*-1.01*	*-0.52*	*(-)*	*-0.87*
Investment Grade	-	1.226	0.672	0.527	0.385	-	1.127
t-value	*(-)*	*3.51*	*1.81*	*1.39*	*1.03*	*(-)*	*2.21*
High Yield	-	-	0.129	0.108	0.086	-	0.219
t-value	*(-)*	*(-)*	*2.33*	*2.00*	*1.81*	*(-)*	*3.86*
Emerging Markets	-	-	-	0.043	0.035	0.223	-
t-value	*(-)*	*(-)*	*(-)*	*1.26*	*1.10*	*4.45*	*(-)*
Equity Markets	-	-	-	-	0.032	-	0.007
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*2.18*	*(-)*	*0.39*
R-Squared	0.030	0.099	0.128	0.136	0.152	0.087	0.453

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	11.93%	8.21%	6.61%	6.16%	5.74%	6.33%	1.13%
t-value	*2.78*	*2.01*	*1.53*	*1.49*	*1.35*	*1.40*	*0.34*
Treasury	-0.372	-1.951	-1.077	-0.615	-0.702	-	-0.229
t-value	*-2.04*	*-4.58*	*-2.20*	*-1.58*	*-1.85*	*(-)*	*-0.51*
Investment Grade	-	2.178	1.204	0.421	0.488	-	1.057
t-value	*(-)*	*4.60*	*2.05*	*0.92*	*1.13*	*(-)*	*1.68*
High Yield	-	-	0.301	0.117	0.154	-	0.293
t-value	*(-)*	*(-)*	*2.14*	*0.98*	*1.14*	*(-)*	*1.73*
Emerging Markets	-	-	-	0.424	0.453	0.446	-
t-value	*(-)*	*(-)*	*(-)*	*4.12*	*4.32*	*4.23*	*(-)*
Equity Markets	-	-	-	-	-0.039	-	0.077
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-1.10*	*(-)*	*1.73*
R-Squared	0.028	0.167	0.208	0.301	0.304	0.141	0.411

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	7.94%	5.31%	4.82%	5.71%	5.72%	7.10%	-3.19%
t-value	*2.28*	*1.51*	*1.32*	*1.60*	*1.61*	*2.07*	*-1.40*
Treasury	-0.026	-2.203	-1.399	-0.992	-0.998	-	-0.247
t-value	*-0.19*	*-3.84*	*-2.09*	*-1.31*	*-143*	*(-)*	*-0.52*
Investment Grade	-	2.781	1.779	0.964	1.018	-	1.442
t-value	*(-)*	*4.23*	*2.17*	*1.03*	*1.10*	*(-)*	*2.42*
High Yield	-	-	0.250	0.092	0.134	-	0.601
t-value	*(-)*	*(-)*	*1.46*	*0.56*	*0.73*	*(-)*	*5.20*
Emerging Markets	-	-	-	0.254	0.268	0.273	-
t-value	*(-)*	*(-)*	*(-)*	*1.96*	*1.97*	*3.97*	*(-)*
Equity Markets	-	-	-	-	-0.038	-	0.075
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-0.66*	*(-)*	*2.20*
R-Squared	0.001	0.068	0.077	0.098	0.099	0.060	0.445

The statistics of the mean-variance spanning tests with 7 different base assets. In base (1) - base (6), the weekly return of the regional sub-index (Africa) of the frontier bond market index (NEXGEM) is the test asset. In base (7), the regional sub-index of the EMBI+ (Africa) is the test asset. The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); before the financial crisis period (2002-2006); the financial crisis (2007-2011); and after the financial crisis (2012-2018).

Table 20a – 20d (Asia)

May 2004-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	6.56%	4.51%	2.54%	2.56%	2.40%	4.70%	1.38%
t-value	*2.51*	*1.69*	*0.93*	*0.95*	*0.89*	*1.72*	*0.77*
Treasury	0.120	-1.445	0.397	0.612	0.476	-	-0.527
t-value	*0.61*	*-2.28*	*0.56*	*0.91*	*0.80*	*(-)*	*-0.87*
Investment Grade	-	2.029	-0.121	-0.521	-0.420	-	1.662
t-value	*(-)*	*2.70*	*-0.14*	*-0.64*	*-0.58*	*(-)*	*2.00*
High Yield	-	-	0.616	0.520	0.578	-	0.239
t-value	*(-)*	*(-)*	*3.31*	*2.53*	*2.45*	*(-)*	*1.60*
Emerging Markets	-	-	-	0.193	0.229	0.292	-
t-value	*(-)*	*(-)*	*(-)*	*1.33*	*1.66*	*2.10*	*(-)*
Equity Markets	-	-	-	-	-0.061	-	0.168
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-1.21*	*(-)*	*3.98*
R-Squared	0.003	0.082	0.203	0.219	0.226	0.092	0.424

May 2004 -2006	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base*
Alpha (ann.)	11.77%	10.06%	9.36%	8.45%	8.23%	8.84%	6.96%
t-value	*3.53*	*2.84*	*2.57*	*2.39*	*2.35*	*2.53*	*3.09*
Treasury	0.366	-1.435	-0.899	-0.586	0.768	-	0.060
t-value	*2.71*	*-1.81*	*-1.13*	*-0.69*	*-0.84*	*(-)*	*0.13*
Investment Grade	-	2.040	1.374	0.868	1.024	-	0.923
t-value	*(-)*	*2.29*	*1.50*	*0.86*	*0.97*	*(-)*	*1.62*
High Yield	-	-	0.188	0.981	0.136	-	0.124
t-value	*(-)*	*(-)*	*1.07*	*0.54*	*0.72*	*(-)*	*1.36*
Emerging Markets	-	-	-	0.172	0.192	0.228	-
t-value	*(-)*	*(-)*	*(-)*	*1.35*	*1.50*	*2.48*	*(-)*
Equity Markets	-	-	-	-	-0.035	-	0.837
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-0.73*	*(-)*	*3.30*
R-Squared	0.049	0.083	0.092	0.109	0.113	0.050	0.415

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	7.02%	3.85%	0.23%	0.00%	-0.95%	4.27%	3.27%
t-value	*1.18*	*0.64*	*0.04*	*0.00*	*-0.17*	*0.73*	*0.80*
Treasury	0.016	-1.395	0.683	0.909	0.699	-	-0.417
t-value	*0.05*	*-1.84*	*0.80*	*1.17*	*1.05*	*(-)*	*0.59*
Investment Grade	-	1.946	-0.372	-0.755	-0.592	-	1.259
t-value	*(-)*	*2.10*	*-035*	*-0.80*	*-0.75*	*(-)*	*1.26*
High Yield	-	-	0.715	0.626	0.713	-	0.193
t-value	*(-)*	*(-)*	*2.96*	*2.30*	*2.27*	*(-)*	*0.86*
Emerging Markets	-	-	-	0.207	0.277	0.295	-
t-value	*(-)*	*(-)*	*(-)*	*0.87*	*1.23*	*1.48*	*(-)*
Equity Markets	-	-	-	-	-0.096	-	0.224
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-1.34*	*(-)*	*2.96*
R-Squared	0.000	0.071	0.222	0.236	0.249	0.079	0.405

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	6.24%	3.84%	3.29%	4.14%	4.14%	5.15%	-2.08%
t-value	*3.04*	*1.86*	*1.60*	*2.08*	*2.07*	*2.63*	*-1.04*
Treasury	0.165	-1.845	-0.926	-0.463	-0.430	-	-1.412
t-value	*1.68*	*-4.71*	*-2.05*	*-1.02*	*-0.96*	*(-)*	*-3.23*
Investment Grade	-	2.566	1.422	0.629	0.606	-	3.065
t-value	*(-)*	*4.52*	*2.28*	*1.01*	*0.98*	*(-)*	*5.27*
High Yield	-	-	0.286	0.132	0.114	-	0.278
t-value	*(-)*	*(-)*	*4.14*	*1.74*	*1.35*	*(-)*	*3.12*
Emerging Markets	-	-	-	0.247	0.241	0.297	-
t-value	*(-)*	*(-)*	*(-)*	*4.33*	*4.17*	*3.72*	*(-)*
Equity Markets	-	-	-	-	0.016	-	0.112
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.57*	*(-)*	*4.74*
R-Squared	0.013	0.007	0.214	0.269	0.270	0.175	0.516

The statistics of the mean-variance spanning tests with 7 different base assets. In base (1) - base (6), the weekly return of the regional sub-index (Asia) of the frontier bond market index (NEXGEM) is the test asset. In base (7), the regional sub-index of the EMBI+ (Asia) is the test asset. The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); before the financial crisis period (2002-2006); the financial crisis (2007-2011); and after the financial crisis (2012-2018). Different starting date: May-2004.

Table 21a – 21d (Europe)

2002-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	9.66%	7.30%	6.23%	6.16%	5.94%	7.30%	1.21%
t-value	*4.12*	*3.19*	*2.68*	*2.67*	*2.58*	*2.95*	*0.67*
Treasury	-0.255	-1.937	-0.970	-0.822	-1.016	-	-1.015
t-value	*-2.29*	*-3.85*	*-1.42*	*-1.23*	*-1.64*	*(-)*	*-1.85*
Investment Grade	-	2.190	1.029	0.760	0.914	-	2.010
t-value	*(-)*	*3.46*	*1.20*	*0.90*	*1.17*	*(-)*	*2.69*
High Yield	-	-	0.325	0.263	0.325	-	0.312
t-value	*(-)*	*(-)*	*2.72*	*2.11*	*2.36*	*(-)*	*2.22*
Emerging Markets	-	-	-	0.125	0.159	0.210	-
t-value	*(-)*	*(-)*	*(-)*	*1.00*	*1.32*	*1.85*	*(-)*
Equity Markets	-	-	-	-	-0.069	-	0.134
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-1.80*	*(-)*	*3.30*
	0.013	0.098	0.133	0.141	0.150	0.044	0.4287

2002-2006	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	8.89%	6.95%	7.03%	7.04%	7.05%	7.45%	6.59%
t-value	*2.83*	*2.08*	*2.04*	*1.94*	*1.96*	*2.07*	*2.01*
Treasury	-0.168	-1.521	-1.603	-1.610	-1.451	-	-1.158
t-value	*-0.16*	*-2.52*	*-2.36*	*-2.59*	*-2.18*	*(-)*	*-1.51*
Investment Grade	-	1.899	2.005	2.016	1.871	-	2.309
t-value	*(-)*	*2.53*	*2.32*	*2.57*	*2.29*	*(-)*	*2.46*
High Yield	-	-	-0.245	-0.023	-0.045	-	0.244
t-value	*(-)*	*(-)*	*-0.22*	*-0.21*	*-0.42*	*(-)*	*1.72*
Emerging Markets	-	-	-	-0.003	0.012	0.106	-
t-value	*(-)*	*(-)*	*(-)*	*-0.04*	*-0.13*	*1.24*	*(-)*
Equity Markets	-	-	-	-	0.033	-	0.050
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.90*	*(-)*	*1.11*
R-Squared	0.000	0.040	0.091	0.040	0.041	0.013	0.313

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	15.14%	11.48%	9.29%	9.14%	7.35%	10.05%	1.81%
t-value	*2.78*	*2.22*	*1.80*	*1.78*	*1.49*	*1.75*	*0.50*
Treasury	-0.615	-2.129	-0.965	-0.809	-1.164	-	-0.834
t-value	*-2.80*	*-3.42*	*-1.11*	*-0.98*	*-1.690*	*(-)*	*-1.33*
Investment Grade	-	2.087	0.789	0.524	0.801	-	1.657
t-value	*(-)*	*2.56*	*0.72*	*0.50*	*0.91*	*(-)*	*185*
High Yield	-	-	0.401	0.338	0.487	-	0.245
t-value	*(-)*	*(-)*	*2.38*	*1.78*	*2.37*	*(-)*	*1.18*
Emerging Markets	-	-	-	0.143	0.262	0.198	-
t-value	*(-)*	*(-)*	*(-)*	*0.55*	*1.05*	*1.07*	*(-)*
Equity Markets	-	-	-	-	-0.162	-	0.198
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-2.66*	*(-)*	*2.90*
R-Squared	0.050	0.135	0.184	0.191	0.229	0.034	0.487

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	8.88%	6.55%	5.83%	6.96%	6.96%	7.15%	-1.24%
t-value	*3.34*	*2.61*	*2.34*	*2.91*	*2.91*	*2.95*	*-0.54*
Treasury	0.010	-1.901	-0.774	-0.150	-0.161	-	-1.753
t-value	*0.09*	*-5.18*	*-1.61*	*-0.31*	*-0.031*	*(-)*	*-4.16*
Investment Grade	-	2.442	0.999	-0.017	-0.010	-	2.855
t-value	*(-)*	*5.49*	*1.75*	*-0.03*	*-0.01*	*(-)*	*5.48*
High Yield	-	-	0.359	0.162	0.168	-	0.378
t-value	*(-)*	*(-)*	*3.94*	*1.89*	*1.71*	*(-)*	*2.98*
Emerging Markets	-	-	-	0.317	0.318	0.361	-
t-value	*(-)*	*(-)*	*(-)*	*4.14*	*3.96*	*6.95*	*(-)*
Equity Markets	-	-	-	-	-0.005	-	0.079
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-0.17*	*(-)*	*2.88*
R-Squared	0.000	0.093	0.128	0.184	0.185	0.160	0.419

The statistics of the mean-variance spanning tests with 7 different base assets. In base (1) - base (6), the weekly return of the regional sub-index (Europe) of the frontier bond market index (NEXGEM) is the test asset. In base (7), the regional sub-index of the EMBI+ (Europe) is the test asset. The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); before the financial crisis period (2002-2006); the financial crisis (2007-2011); and after the financial crisis (2012-2018).

Table 22a – 22d (Latin)

2002-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	9.04%	6.12%	3.13%	2.78%	2.21%	3.92%	0.23%
t-value	*2.12*	*1.58*	*0.71*	*0.65*	*0.51*	*0.80*	*0.11*
Treasury	-0.337	-2.434	0.326	1.107	0.597	-	-0.804
t-value	*-1.36*	*-3.65*	*0.23*	*0.71*	*0.44*	*(-)*	*-1.75*
Investment Grade	-	2.731	-0.585	-2.001	-1.598	-	1.764
t-value	*(-)*	*3.10*	*-0.31*	*-0.91*	*-0.80*	*(-)*	*2.99*
High Yield	-	-	0.929	0.603	0.766	-	0.443
t-value	*(-)*	*(-)*	*2.38*	*2.32*	*2.48*	*(-)*	*3.73*
Emerging Markets	-	-	-	0.655	0.746	0.591	-
t-value	*(-)*	*(-)*	*(-)*	*2.17*	*2.37*	*3.55*	*(-)*
Equity Markets	-	-	-	-	-0.183	-	0.105
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-2.34*	*(-)*	*3.05*
R-Squared	0.006	0.043	0.121	0.179	0.197	0.108	0.400

2002-2006	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	18.24%	14.28%	11.10%	10.64%	10.63%	14.31%	2.63%
t-value	*1.95*	*1.47*	*1.10*	*1.00*	*1.00*	*1.36*	*0.55*
Treasury	0.059	-2.807	0.469	0.676	0.577	-	-2.475
t-value	*0.14*	*-1.52*	*0.27*	*0.39*	*0.31*	*(-)*	*-1.58*
Investment Grade		3.619	-0.608	-0.933	-0.843	-	3.817
t-value	*(-)*	*1.66*	*-0.28*	*-0.41*	*-0.35*	*(-)*	*2.00*
High Yield	-	-	0.981	0.935	0.948	-	0.561
t-value	*(-)*	*(-)*	*2.27*	*2.30*	*2.38*	*(-)*	*2.67*
Emerging Markets	-	-	-	0.098	0.103	0.291	-
t-value	*(-)*	*(-)*	*(-)*	*0.35*	*0.39*	*1.46*	*(-)*
Equity Markets	-	-	-	-	-0.01	-	0.079
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-0.16*	*(-)*	*0.95*
R-Squared	0.000	0.017	0.063	0.064	0.064	0.144	0.343

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	3.59%	-0.30%	-5.26%	-6.44%	-10.32%	-9.72%	2.56%
t-value	*0.42*	*-0.04*	*-0.62*	*-0.84*	*-1.33*	*-1.01*	*0.78*
Treasury	-0.844	-2.638	0.352	1.717	0.811	-	-0.672
t-value	*-1.91*	*-3.33*	*0.19*	*0.90*	*0.57*	*(-)*	*-1.16*
Investment Grade	-	2.475	-0.861	-3.173	-2.468	-	1.350
t-value	*(-)*	*2.13*	*-0.33*	*-1.18*	*-1.16*	*(-)*	*1.78*
High Yield	-	-	1.029	0.488	0.866	-	0.283
t-value	*(-)*	*(-)*	*1.83*	*1.45*	*2.09*	*(-)*	*1.66*
Emerging Markets	-	-	-	1.252	1.554	1.182	-
t-value	*(-)*	*(-)*	*(-)*	*2.35*	*2.94*	*3.14*	*(-)*
Equity Markets	-	-	-	-	-0.414	-	0.111
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*-3.24*	*(-)*	*2.59*
R-Squared	0.033	0.068	0.173	0.346	0.425	0.258	0.447

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base	(7) Base
Alpha (ann.)	9.29%	7.26%	6.53%	7.35%	7.35%	8.65%	-5.22%
t-value	*3.29*	*2.64*	*2.37*	*2.72*	*2.71*	*3.25*	*-2.07*
Treasury	0.114	-1.546	-0.370	0.065	0.095	-	-1.666
t-value	*1.02*	*-3.98*	*-0.73*	*0.12*	*0.18*	*(-)*	*-3.66*
Investment Grade		2.120	0.655	-0.088	-0.110	-	3.083
t-value	*(-)*	*4.24*	*1.00*	*-0.13*	*-0.16*	*(-)*	*5.53*
High Yield	-	-	0.365	0.221	0.204	-	0.653
t-value	*(-)*	*(-)*	*3.31*	*2.01*	*1.66*	*(-)*	*4.74*
Emerging Markets	-	-	-	0.232	0.226	0.266	-
t-value	*(-)*	*(-)*	*(-)*	*2.84*	*2.67*	*5.79*	*(-)*
Equity Markets	-	-	-	-	0.015	-	0.124
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.36*	*(-)*	*3.24*
R-Squared	0.003	0.065	0.096	0.123	0.123	0.122	0.516

The statistics of the mean-variance spanning tests with 7 different base assets. In base (1) - base (6), the weekly return of the regional sub-index (Latin) of the frontier bond market index (NEXGEM) is the test asset. In base (7), the regional sub-index of the EMBI+ (Latin) is the test asset. The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); before the financial crisis period (2002-2006); the financial crisis (2007-2011); and after the financial crisis (2012-2018).

Table 23a – 23d (Middle East)

June 2006 - 2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base
Alpha (ann.)	9.55%	5.20%	3.71%	4.36%	4.41%	4.46%
t-value	*2.39*	*1.42*	*0.99*	*1.20*	*1.21*	*1.19*
Treasury	-0.4666	-3.551	-2.149	-1.566	-1.531	-
t-value	*-2.61*	*-6.37*	*-3.10*	*-2.93*	*-2.92*	*(-)*
Investment Grade	-	4.043	2.419	1.341	1.315	-
t-value	*(-)*	*6.09*	*2.88*	*2.18*	*2.20*	*(-)*
High Yield	-	-	0.468	0.25	0.189	-
t-value	*(-)*	*(-)*	*3.34*	*1.28*	*1.09*	*(-)*
Emerging Markets	-	-	-	0.526	0.516	0.721
t-value	*(-)*	*(-)*	*(-)*	*4.75*	*4.49*	*7.68*
Equity Markets	-	-	-	-	0.016	-
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.35*	*(-)*
R-Squared	0.019	0.178	0.212	0.271	0.271	0.206

2007-2011	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base
Alpha (ann.)	17.31%	10.13%	7.75%	7.00%	7.00%	5.43%
t-value	*2.44*	*1.60*	*1.19*	*1.15*	*1.15*	*0.88*
Treasury	-0.666	-3.634	-2.356	-1.600	-1.601	-
t-value	*-2.64*	*-5.66*	*-2.98*	*-2.67*	*-2.69*	*(-)*
Investment Grade	-	4.095	2.668	1.388	1.388	-
t-value	*(-)*	*5.19*	*2.77*	*2.10*	*2.14*	*(-)*
High Yield	-	-	0.440	0.140	0.141	-
t-value	*(-)*	*(-)*	*2.57*	*0.71*	*0.65*	*(-)*
Emerging Markets	-	-	-	0.694	0.698	0.916
t-value	*(-)*	*(-)*	*(-)*	*5.84*	*5.60*	*8.11*
Equity Markets	-	-	-	-	0.000	-
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.00*	*(-)*
R-Squared	0.035	0.223	0.269	0.368	0.368	0.306

2012-2018	(1) Base	(2) Base	(3) Base	(4) Base	(5) Base	(6) Base
Alpha (ann.)	6.36%	3.32%	2.23%	3.40%	3.40%	4.56%
t-value	*1.46*	*0.77*	*0.51*	*0.80*	*0.80*	*2.78*
Treasury	-0.195	-2.753	-0.922	-0.276	-0.231	-
t-value	*-1.03*	*-3.77*	*-1.14*	*-0.33*	*-0.28*	*(-)*
Investment Grade	-	3.269	0.986	-0.119	-0.151	-
t-value	*(-)*	*3.93*	*1.00*	*-0.11*	*-0.14*	*(-)*
High Yield	-	-	0.569	0.356	0.329	-
t-value	*(-)*	*(-)*	*2.87*	*1.99*	*1.55*	*(-)*
Emerging Markets	-	-	-	0.344	0.336	-0.372
t-value	*(-)*	*(-)*	*(-)*	*2.06*	*1.92*	*2.78*
Equity Markets	-	-	-	-	0.022	-
t-value	*(-)*	*(-)*	*(-)*	*(-)*	*0.34*	*(-)*
R-Squared	0.004	0.063	0.094	0.117	0.118	0.834

The statistics of the mean-variance spanning tests with 6 different base assets. In base (1) - base (6), the weekly return of the regional sub-index Middle-East of the frontier bond market index (NEXGEM) is the test asset. The EMBI+ has no regional sub-index on the Middle-East, which results in the absence of base (7). The base assets are the US Treasury Index; US Investment Grade Index, US High Yield Index, EMBI+ and the All Country World Equity Index. In base (6), the base asset is the EMBI+. The t-values are below the parameter estimates in italics and correspond to the null hypothesis that the parameter equals zero. The regression is estimated on the full sample period (2002-2018); the financial crisis (2007-2011); and after the financial crisis (2012-2018). *Absence of regression before the financial crisis (2002-2006) due to insufficient number of observations.