Investigating the risk-return effect of Emerging Market Debt (EMD) in a diversified portfolio

Promoteur ICHEC : Christel Dumas

Mémoire présenté par
Geoffrey Loïc Katshungu
Pour l'obtention des grades de

Master en Gestion de l'Entreprise (ICHEC)   Master en Sciences de Gestion (LSM)

Groupe ICHEC – ISC St-Louis – ISFSC

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ABSTRACT

The purpose of this thesis is to explore the asset selection processes of investors and investigate the potential benefits of adding emerging market debt to portfolios. Over the past fifteen years, we witnessed two interesting phenomena: first, low-interest rates in the Western world, which have made bonds attractive for portfolio stability but less so in terms of returns. Ironically, despite this phenomenon, the prominence of the home bias remained strong. Second and more recently, due to extreme global macroeconomic conditions, namely the COVID-19 pandemic, the war in Ukraine, and high inflation rates, every developed economy was forced to take radical monetary policies having dire consequences on investors' portfolios and on the market as a whole.

In practice, the study utilizes a comprehensive research methodology involving firstly, a literature review on Emerging markets, portfolio theory, home bias, and geographical diversification. Secondly, this thesis utilizes historical data from global financial markets, through indexes of Emerging markets and major Euro-denominated asset classes, to study using the modern portfolio theory Framework, the potential benefits of emerging market debt into a diversified portfolio. And thus, for the composite period in terms of characteristics spanning from 2008 to 2022. The results reveal that EMDs can exhibit return-enhancing properties when combined with traditional asset classes, such as Euro-equities and Euro-denominated bonds. Moreover, the thesis explores the macroeconomic conditions that are susceptible to influencing the risk-return profiles of a portfolio geographically diversified through EMDs. The findings offer valuable insights to institutional investors and portfolio managers seeking to enhance portfolio performance by capitalizing on emerging market return opportunities.

All in all, this research contributes to the body of knowledge on portfolio management, by providing empirical data on the potential benefits of integrating emerging market debts into diversified investment strategies.

ACKNOWLEDGMENTS

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Table of Contents

ILLUSTRATION TABLE

INTRODUCTION

In an increasingly interconnected and dynamic global economy, investors continually seek to enhance portfolio performance by exploring new avenues for diversification. The appeal of higher returns, coupled with the promise of diversification benefits, has turned the spotlight toward emerging market debt as a potential asset class for savvy investors. This thesis intends to determine the potential diversification benefits of Emerging Market debt. The need to investigate emerging markets' potential is motivated by two main factors:

Firstly, "In the wake of the 2008 financial crisis, the developed world has experienced a persistent period of low-interest rates, with a significant proportion of global debt - $18,000bn in December 2020 - generating negative returns (Bloomberg, 2020). In contrast, emerging market debt has continued to offer attractive yields over the past decade. Moreover, many emerging economies have become structurally stronger and therefore less risky in the eyes of international investors. This is partly due to the increased independence of emerging market central banks, as well as their rising foreign exchange reserves, improving governments' ability to repay their debt." (Elbaz & Strigo, 2021). The decline in the performance of treasury bonds in developed markets observed in the last decade, as depicted in the graph below, might not have necessarily meant the reduction of their appeal to investors. Nonetheless, it served as a signal that there might have been during that period other promising candidates worth considering for inclusion in portfolios.

Figure 1: Record low yields and record high duration of developed markets government bonds.
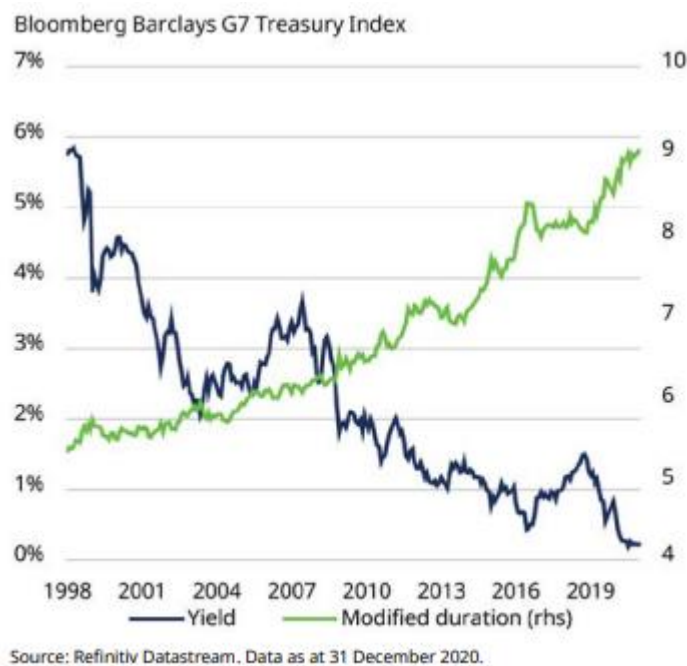
Source: Refinitiv Datastream. Data as at 31 December 2020.

Source: Mee, K. (2021). The essential guide to investing in emerging market debt. *www.schroders.com*. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

Secondly, approximately during the same period, there was an observable rise in capital flows toward emerging markets, possibly influenced by the factors mentioned earlier. The following graphs show the Non-resident portfolio flows of capital to Emerging markets. This is an indicator that some investors have seen some upside potential in these markets.

Figure 2: Capital flows in Emerging Markets
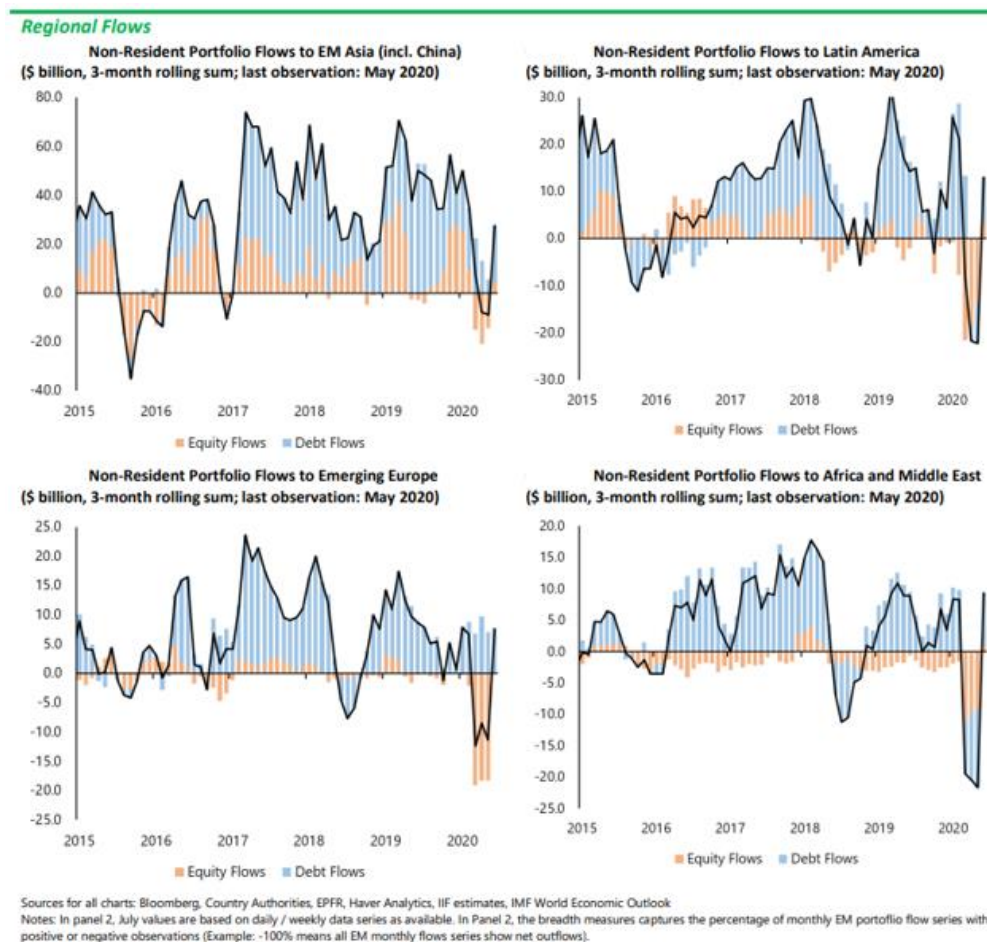
Source: Goel R. (2020). *EM Capital Flows Monitor.* Monetary And Capital Markets Department. IMF. Retrieved on August 4th, 2023 from
https://www.imfconnect.org/content/dam/imf/News%20and%20Generic%20Content/GMM/Special%20Features/July2020EMCapitalFlowsMonitorMCM.pdf

The combination of those two intriguing factors led us to a line of questioning to explore the diversification benefits of emerging market debt. We then decided to "**Investigate the risk-return effect of emerging market debt in a diversified portfolio.**" because, if the purpose of diversification is to not put one's eggs in the same basket, expanding the investable universe to choose from for the portfolios (the basket, in our analogy), becomes an obvious answer. The very purpose of this thesis is to investigate if investors should expand their baskets to the emerging markets fixed-income universe. It also aims to identify the most profitable market conditions for such expansion of the investable universe by examining the risk-return effect of emerging market debt in portfolios.

Throughout this thesis, we aim to investigate the potential benefits of integrating Emerging Market debt (EMD) into a diversified portfolio. We hypothesize that this integration enhances

the portfolio's performance. To test this hypothesis, we first conducted a correlation analysis between various asset classes. Second, we empirically evaluate the risk-return dynamics of both portfolios excluding emerging markets debt and portfolios including emerging markets debt using both the Sharpe ratio and the Modified Sharpe ratio, supported by inference tests. Moreover, by comparing the macroeconomic contexts via the efficient frontier, we aim to shed light on the most favourable conditions for EMD investments. Ultimately, our research seeks to determine the role of EMD in bolstering portfolio performance and in achieving superior risk-adjusted returns.

The insights obtained from this study can be instrumental for investors, asset managers, and policymakers, guiding them in making well-informed decisions. As the global investment landscape evolves, understanding the potential advantages and risks associated with integrating emerging market debt into diversified portfolios can lead to more effective and robust investment strategies.

This thesis is organized into three main parts: the first one consists of a condensed version of our literature review on the subject at hand, the second one describes the methodology we followed to reach the answer to our investigation and lastly, we will in the last part of this thesis exposes the results to our empirical study.

LITERATURE REVIEW

In this section, we will explore the existing research from scholars and industry professionals in order to have a better grasp of the question at hand. This section has a vital role as it allows us to understand key factors related to our study, to determine if there already exists a consensus and if so, what is the consensus in the industry regarding the integration of emerging markets debt in portfolios and most importantly to determine how our study would be contributing to the existing research.

This section is divided into four main parts:

- Overview of asset allocation and diversification. This section focuses on broadly accepted asset allocation and diversification frameworks, providing the basic knowledge upon which the rest of this thesis is built.
- Traditional assets and their role in portfolios. This section presents the commonly used assets in portfolios.
- Home bias and Geographic diversification. This section examines the phenomenon of home bias and its implications for portfolio management. Also, it presents the benefits and challenges of geographic diversification that have been recognized by scholars and industry professionals.
- Emerging markets. Central to the thematic focus of this study, this section introduces important concepts relating to emerging markets and their tradable fixed-income assets. This section also delves into the existing research on emerging markets and the potential advantages and challenges of integrating these assets into global portfolios.

Through a thorough research process whose results are summarized in this part of the thesis, this sectio constitutes the bedrock upon which this entire study is built.

1. Overview of asset allocation and diversification
    1.1.   Definition of asset allocation

Asset allocation is a key investment strategy that involves determining the right mix of asset classes within a portfolio and their respective weights, based on an investor's risk tolerance, time horizon, and investment goals. According to Welsch et al. (2007), asset allocation is responsible for 75 to 90% of the return variation and plays a significant role in determining the variability of portfolio performance. One of the most well-known models for asset allocation is Harry Markowitz's mean-variance portfolio theory. This theory suggests that investors generally prefer portfolios with lower standard deviations or variances for a given level of expected return. Portfolios that minimize the standard deviation for a given expected return are known as efficient portfolios, while those that do not are considered inefficient portfolios (Welsch et al., 2007).

This theory is based on three fundamental tenets:

- "Investors should hold portfolios and focus on how individual securities in the portfolio are related to one another.
- The priced risk of an individual security is affected by holding it in a well-diversified portfolio.
- Systematic or non-diversifiable risk should be the only risk that affects the asset's price." (D'hondt, 2021)

In practice, the problem can be defined as an effort to minimize the volatility in a portfolio's value while targeting a specific level of return, taking into account the investor's utility function by assigning weights to the various assets in the portfolio.

$$Min \; \sigma_p = \sqrt{W^t v W}$$

Equation 1: Portfolio Optimization (Markowitz Portfolio Theory)

In its simpler form, this optimization must be performed under the following constraint:

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

With

- W = the nx1 matrix of the weights (w_i) allocated to each asset in the portfolio
- W^t = The transpose of the Matrix W
- v = The covariance matrix of the assets of the portfolio
- w_i = weight allocated to asset i in the portfolio

And in more complex forms, this optimization problem sometimes has additional constraints. Indeed, portfolio managers often apply various constraints to their investment strategies. These constraints can be based on regulatory requirements, risk management concerns, specific mandates from clients, or the fund's own objectives and guidelines. For example,

certain funds might mandate that a specific portion of the AUM always remains liquid. Others might set diversification rules requiring a spread of investments across industries, regions, or asset types to mitigate risk, etc.

Knowing that the portfolio expected return is defined by the weighted average return of each asset, in other words:

$$E(R_p) = \sum_{i=1}^{n} E(R_i)\, w_i$$

Equation 2: Expected Return formula

With

- $E(R_p)$= Expected return of the portfolio
- w_i= weight assigned to asset i in the portfolio
- R_i= return of asset i

And the volatility of the portfolio with n assets can be defined by

$$\sigma_p = \sqrt{\sum_{i=1}^{n}\sum_{j=1}^{n} \sigma_{ij} w_i w_j}$$

Equation 3: Portfolio Volatility Formula

With

- σ_{ij} = the covariance between the returns of the assets i and j
- w_i & w_j= Respectively weights assigned to asset i & j in the portfolio

1.2.   Efficient Frontier

Depending on the investor and his/her utility function, various combination of volatility and return of the portfolio are given by this optimisation problem. "The set of all possible (σ^2, μ) combinations is called the attainable set. Those (σ^2, μ) with minimum σ^2 for a given μ or more and maximum μ for a given σ^2 or less are called the efficient set (or efficient frontier). Since an investor wants a high profit and a small risk, he/she wants to maximize μ and minimize σ^2 and therefore he/she should choose a portfolio which gives a (σ^2, μ) combination in the efficient set." (Marling & Emanuellson, 2012)

Figure 3: Efficient Frontier
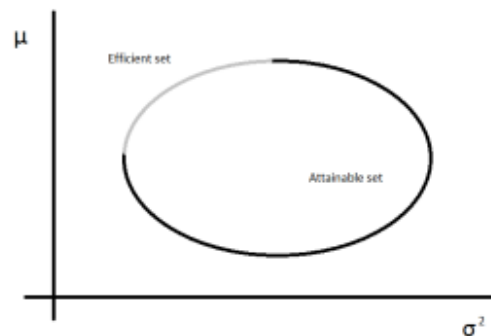
Source: Hannes, M., Emmanuelsson, S.(2012). *The Markowitz Portfolio theory.* Retrieved on April 27th, from https://smallake.kr/wp-content/uploads/2016/04/HannesMarling_SaraEmanuelsson_MPT.pdf

As represented above, the efficient frontier (efficient set on the graph) can be drawn as a curve on a graph showcasing the relationship between the risk and the expected return of a portfolio (see Figure 3). The efficient frontier is a fundamental concept in portfolio construction and valuation, serving as a guide to achieving the optimal balance between risk and return. It represents the set of portfolios that offer the highest expected returns for a given level of risk or the lowest level of risk required to achieve a specific expected return. Diversification plays a vital role in relation to the efficient frontier. By diversifying an undiversified portfolio, it can be shifted closer to the efficient frontier, allowing for increased returns without a corresponding increase in risk, or a reduction in risk without sacrificing expected returns. In essence, the efficient frontier showcases the benefits of diversification by illustrating how it can improve portfolio performance by striking an optimal risk-reward balance.

1.3.   Capital Asset Pricing Model (CAPM)

"The Markowitz (1952) framework was extended by Sharpe (1964), Lintner (1965), and Mossin (1966) to include a risk-free asset. Whilst risk-free assets are impossible to find in practice, a short-term treasury bill may be taken as an approximation. In this extension, commonly known as the Capital Asset Pricing Model (CAPM), investors may reduce portfolio return variability by holding a greater proportion of the risk-free asset in conjunction with a market portfolio. The CAPM introduces an important distinction between firm-specific risks and systematic risks. The former types of risks may be easily diversified away through a random selection of stocks since unsystematic risk is different across companies. Conversely, systematic risks are common to the economy in general, and therefore may not be diversified away given that all companies in the particular economy are exposed to such risks." (Camilleri, 2009)

1.4.   Criticism and limitations of Markowitz portfolio theory

The Markowitz Portfolio Theory has been a cornerstone in the field of finance since its publication. However, over the years, numerous scholars have pinpointed its limitations and expressed concerns about its applicability in real-world scenarios.

Firstly, Riccetti (2012) has pointed out one of the core issues with the theory, explaining that various scholars have suggested that the mean-variance framework, conceived by Markowitz (1952), is not the best approach for determining asset allocation. This is because a function incorporating higher moments would more accurately represent an investor's anticipated utility. Additionally, since returns often exhibit non-normal distributions, showcasing asymmetry or leptokurtosis, the mean-variance model fails in accurately reflecting the expected utility in such scenarios. (Riccetti, 2012)

Adding to the complexities, the theory has been critiqued for its assumptions and oversights. Grujić (2017) notes, "One of the biggest problems of this theory is ignoring transaction costs…" Additionally, the assumption that all investors possess the same information and behave rationally, focusing solely on profit maximization, is seen as way too simplistic. Grujić (2017) further mentions that the results of the diversification process heavily rely on the data employed, thus questioning the reliability and stability of the method.

Another shortfall of this theory is presented by Welsch et al. (2007) in their paper focused on Robust Statistics to Asset Allocation Models. They pinpoint several drawbacks that can explain why the original form of mean-variance portfolio optimization has rarely been applied in practice: "[…] The method uses variance as the risk measure, which is often considered to be a simplistic measurement when the asset returns do not follow normal distributions. In reality, many of the financial assets' returns do have fat tails or are skewed. Besides, the one-period nature of static optimization also does not take dynamic factors into account, and some researchers argue for more complicated models based on stochastic processes and dynamic programming. However, the most serious problem of the mean-variance efficient frontier is probably the method's instability. The mean-variance frontier is very sensitive to the inputs, and these inputs are subject to random errors in the estimation of expected return and covariance. Small and statistically insignificant changes in these estimates can lead to a significant change in the composition of the efficient frontier. This may lead us to frequently and mistakenly rebalance our portfolio to stay on this elusive efficient frontier, incurring unnecessary transaction costs." (Welsch et al., 2007)

Moreover, Bessler et al. (2014) while acknowledging the importance that this model has on the investment theory, drew attention to practical challenges when the Markowitz Portfolio Theory is applied to the real environment of asset management. They pinpointed issues such as estimation errors in input parameters, corner solutions, and the high transaction costs arising from extreme portfolio reallocations, which often culminate in unsatisfactory out-of-sample portfolio performance.

Lastly, The Markowitz Portfolio Theory (MPT) is primarily designed as a single-period model. However, its validity across multiple periods relies on two key conditions: either the investor

utility functions only focus on immediate gains, or the asset returns remain independent from one period to another. These conditions allow for the extension of MPT's applicability beyond a single period. It is important to recognize these limitations and considerations when evaluating the theory's suitability for long-term portfolio management. (D'hondt, 2021)

1.5. Alternatives to the Markowitz portfolio theory

To address the limitations of the Markowitz portfolio theory, researchers have developed several alternative approaches. These methods aim to solve various challenges encountered when applying the original Markowitz framework. In the following section, we will explore some of these alternatives.

In their publication in the REVSTAT-Statistical Journal titled "Application of Robust Statistics to Asset Allocation Models ", Welsch et al. (2007) mention alternative asset allocation models. Namely, one approach involves factor-based models that aim to simplify the model complexity by utilizing a limited number of common factors to explain asset return variances and covariances. Another method is the use of multivariate GARCH models, which incorporate the time dependence of returns in the covariance matrix to address fat tails and volatility clustering. However, neither of these approaches effectively deals with the influence of outliers in the data. Even a small percentage of outliers, or sometimes just a single outlier, can distort the final estimated variance and covariance. Studies have revealed that the most extreme coefficients in the estimated covariance matrix often contain the largest errors. Consequently, when applying mean-variance optimization based on such a matrix, these unreliable coefficients tend to receive the highest weights, whether positive or negative. This phenomenon, known as "error-maximization," severely affects the performance of the mean-variance technique unless appropriate measures are taken to rectify these errors (Welsch et al., 2007).

In summary, while the Markowitz Portfolio Theory has provided insights into asset allocation and diversification, its limitations have necessitated the exploration of alternative models. As we've seen, researchers have attempted to improve portfolio construction by addressing the complexities of real-world financial markets. But to understand these complexities further, one must delve deeper into the components that make up these portfolios. As we transition into our next section, "Traditional Asset Classes and Their Roles in Portfolios," we will explore the fundamental building blocks of investment portfolios, shedding light on how each asset class contributes to the broader goals of risk management, diversification, and return optimization.

2. Traditional asset classes and their role in portfolios

In this section, we will present the different types of assets that can be added to a diversified portfolio. Each asset type will be presented with its role and importance for an investor, providing valuable information to understand the asset allocation process.

2.1. Definition

"An asset class is a set of assets that bear some fundamental economic similarities to each other, and that have characteristics that make them distinct from other assets that are not part of that class. […]" (Greer, R.J., 1997)

The understanding and overall knowledge of those asset classes are important for asset managers as the mix of those asset classes serves a purpose for both passive and active strategies. For active approaches to investment decisions, the allocation process allows to choose the classes of assets that investors think are most likely to increase in value over the chosen horizon and for passive approaches to investment decisions, the allocation process is used to bring controlled diversification to the portfolio, which should decrease its volatility (Greer, R.J., 1997)

2.2. Types of assets

Broadly, assets are classified into:

- Capital Assets: they encompass:
  - Equities: Anticipated indefinite dividends
  - Bonds: Interest payments and principal return.
  - Real Estate: Offers a continuous net operating income stream with distinct characteristics. Its correlation with equity prices varies based on the nature of ownership.
  - Foreign Debt and Equity: Valued considering regional economic factors.

All capital assets can be valued based on the net present value of expected returns. Their value is inversely linked to the investor's discount rate.

- Consumable/Transformable (C/T) Assets: These do not generate ongoing value but can be consumed and transformed, like physical commodities. They differ from capital assets in valuation methods, primary investment mechanisms (usually commodity future contracts), and exposure to global supply-demand factors.
- Store of Value (SOV) Assets: They don't generate income or get consumed, but maintain value, e.g., currency and art. Though challenging to manage due to their illiquidity and other non-monetary values, they can provide safety in uncertain times, as pointed out by Greer (1997).

By understanding these categories and their characteristics, portfolio managers can better plan their allocations to achieve desired investment outcomes.

3. Home Bias and Geographic Diversification

This thesis has the primary objective to determine the benefits of emerging market fixed-income assets in a diversified portfolio. In light of this, it becomes imperative to understand the existing research on home bias and geographic diversification. This section delves into previous studies on home-bias, offering insights into how it potentially impacts the risk and return dynamics, especially when considering investments in emerging markets.

3.1. Definition

Diversification in portfolio theory refers to the practice of spreading investments across a variety of assets and/or asset classes. It is based on the principle that, when done correctly, holding a diversified portfolio reduces the overall risk while maximizing the potential return.

Home-bias is defined by Sercu and Vanpée (2007) as a preference of investors for domestic assets. This means that, despite international portfolio theory prescribing that optimal portfolios should be well-diversified internationally, investors still tend to favor domestic assets.

3.2. Causes for the home bias.

The inclination towards home bias in investment decisions can be attributed to the familiarity bias. Investors often lean towards what they are familiar with, finding comfort in visible businesses, despite often overlooking portfolio theory (Huberman, 2001). Grinblatt and Keloharju (2001) identify multiple dimensions of familiarity, including geographical proximity, language, and culture. For instance, investors have been observed to show a preference for nations that are geographically closer to their home country (Tesar & Werner, 1995; Levis et al., 2016) or those on the same continent, as seen with the "Europe bias" (Oehler et al., 2008). Additionally, investing in countries with a shared language is a noted trend (Sarkissian & Schill, 2004; Batten & Xuan Vinh, 2010). Notably, a CEO's cultural background can also influence investment choices (Grinblatt & Keloharju, 2001).

Sercu & Vanpée (2007) note that contemporary explanations for the equity home bias gravitate towards factors such as information asymmetries, governance issues, and behavioural biases, given that other explanations seem to empirically fall short in decoding the actual portfolio choices of investors.

The preference for domestic assets can also be explained by behavioural causes:

Research into behavioural biases suggests regret theory as a possible explanation. As mentioned by Solnik (2008), investors often adopt the domestic portfolio as a benchmark. Consequently, they experience regret when their foreign investments fail to keep pace.

Another intriguing aspect of this behaviour is the role of overconfidence, which is defined as an "irrational confidence in the accuracy of decision-making "(Dumas, 2022), in influencing diversification decisions. Overconfident individuals often misjudge their capability to forecast familiar assets, leading them to overly invest in assets they recognize. An experimental observation by Kilka and Weber (2000) revealed that German investors, for instance, felt better equipped to evaluate domestic stocks than U.S. stocks. This perceived competence led

to expectations and probability assessments. However, Dorn and Huberman (2005) provide a counter-perspective, arguing that there isn't compelling evidence to uphold overconfidence as the primary explanation. Their findings, based on questionnaire data from Germany, underscored that both diversification and turnover are predominantly influenced by an investor's risk attitude, suggesting portfolios of risk-averse investors usually carry double the positions compared to their risk-tolerant counterparts.

Furthermore, gender dynamics are also mentioned as a probable cause for home bias. Karlsson and Nordén (2007) discerned that men display a higher proclivity towards home bias than women. A plausible rationale for this pattern might be men's heightened overconfidence relative to women, as underscored by Barber and Odean (2001).

Yet, broader societal elements could be at play beyond individual behavioural biases. Morse and Shive (2006) put forward the notion that patriotism can potentially influence investors to heavily lean towards domestic stock holdings. Their study done in 53 countries discerned a significant correlation between measures of patriotism and home bias indicators, even after factoring in variables like capital controls, diversification advantages, information benefits, and familiarity.

3.3. Measure of Home bias

Mathematically, the "home-bias is the relative difference between the actual foreign holdings of a country and the optimal foreign weights. "(Mishra, 2015)

The home bias can be measured using the following formula:

$$Home - Bias_i = 1 - \frac{Actual\ w_i}{Optimal\ w_i}$$

Equation 4: Home Bias Formula

With

- $Actual\ w_i$ = "An actual foreign holding is the ratio of foreign equity holdings of a country and total equity holdings. The total equity holding comprises both foreign and domestic holdings."
- $Optimal\ w_i$ is determined through the mean-variance model.

"The home bias measure takes values between 0 and 1 in cases where actual foreign weight is lower than optimal portfolio weight: 0 when actual and optimal portfolio weights are equal, and 1 when investors hold only domestic assets." (Mishra, 2015)

3.4. Cost of geographical under-diversification for portfolios

The prevalence of home bias in investment portfolios has attracted significant attention in numerous studies due to its potential negative impact on portfolio returns and volatility. In this section, we will delve into a few scholarly papers that examine the costs associated with geographical under-diversification. These studies shed light on the implications of home bias, revealing how an overemphasis on domestic assets can result in reduced investment performance and heightened portfolio risk.

Errunza, Hogan, and Hung (1999) as cited by Sercu & Vanpée (2007), empirically argue that the perceived costs from under-diversification, when viewed through the traditional mean-variance approach, might be overstated. They find that U.S. investors can successfully mimic foreign market indices by using domestically traded multinationals, closed-end country funds, and American Depository Receipts. Interestingly, the gap between gains from a domestically created diversified portfolio and one constructed of shares trading abroad is found to be both statistically and economically insignificant. However, they also highlight specific instances when international markets provide diversification benefits that are irreplaceable domestically, especially from the U.S. investors' perspective. It is significant to note that this may not be the case for investors from other countries, especially those emerging markets, as they might have fewer chances to formulate such efficient portfolios using only domestic assets.

While this study provides insights into the potential insignificance of diversification costs, other researchers recognize the value of international diversification. Bessler et al. (2014) reference the findings of Chiou, Lee, and Chang (2009), which indicate that international diversification benefits U.S. investors. Specifically, it helps in reducing portfolio volatility and enhances risk-adjusted returns.

Indeed, there is a widespread agreement among researchers and investment professionals that there are benefits to geographic diversification. For instance, in an interview with the Financial Express (2020), Swatik Nigam stated: "Global diversification offers new opportunities which are not accessible domestically. For example, many of the world's largest tech companies are listed in the US. Geographical diversification also protects against the risk of a single economy, and the low correlation helps build a stable portfolio. " (Kumar, 2020).

Additionally, Goetzmann and Kumar (2004), delved into this question by analyzing individual portfolio holdings between 1991 and 1996. Dividing portfolios based on diversification levels, they revealed that the least diversified investors endured a 2.4 percent lower annual return than their most diversified counterparts. This difference was not attributed to turnover or transactional costs. They further elaborated that certain investor traits, like age and trading frequency, directly correlated with the economic costs of under-diversification. For older and infrequent traders, the risk-adjusted performance differentials between the least and most diversified were 3.60 percent and 3.12 percent, respectively.

In summary, home bias and geographical under-diversification present both intriguing behavioral phenomena and real financial implications. As we've seen, the choices investors make, driven by various types of factors ranging from familiarity bias to patriotism, can significantly affect the risk-return relations of their portfolios. However, as we aim to explore the potential benefits of diversification further, it's essential to explore promising international markets. The next section, 'Emerging Markets', dives deep into these rapidly developing economies, examining their unique characteristics, opportunities, and the potential role they can play in achieving a truly geographically diversified portfolio.

4. Emerging markets

As we are investigating fixed-income assets from emerging markets as a candidate to solve the problem of under diversification, we should firstly, properly understand some concepts. This section is an overview of existing research from scholars and industry professionals on emerging markets and on Emerging Market debt which will help us understand the current opposing arguments of scholars on the matter and build our study to contribute to it.

4.1. Definition of emerging market

Although authors generally share a similar understanding, there is no commonly agreed-upon definition of an emerging market, leading to a definition of emerging market that we can only qualify as fluid.

According to some authors, "A country is deemed "emerging" if its GDP per capita is less than a designated threshold that is periodically revised by the World Bank. The term conveys the idea that such economies "emerge" from less-developed status and join the group of developed countries; a process known as convergence in development economics" (Bekaert and Harvey, 2002).

Where other authors might utilize other concepts and metrics like Elbaz and Strigo (2021): "From an economic standpoint, an emerging country is one whose GDP per capita and HDI (Human Development Index) are lower than those of developed economies, but which is experiencing rapid economic growth." (Elbaz & Strigo, 2021)

The IMF, however, clearly states that "There is no official definition of an emerging market." (Duttagupta, Pazarbasioglu, 2021). Through an elaborate methodology explained below, "The IMF *World Economic Outlook* classifies 39 economies as "advanced," based on such factors as high per capita income, exports of diversified goods and services, and greater integration into the global financial system. The remaining countries are classified as "emerging market and developing" economies. Among these, 40 are considered "emerging market and middle-income" economies by the IMF *Fiscal Monitor,* based on their higher incomes." (Duttagupta, Pazarbasioglu, 2021).

4.1.1. IMF Methodology to identify an emerging market.

The IMF (2021) methodology is the following:

Firstly, it is important to note that the IMF considers that the Characteristics of an emerging market extend beyond income and include sustained strong growth, stability, production of higher-value-added goods, participation in global trade, and financial market integration.

The IMF (2021) considers three main factors to identify an emerging market:

- Systemic presence: The size of the country's economy (nominal GDP), its population, and its share of exports in global trade.

- Market access: The share of a country's external debt in global external debt, as well as whether it is included in global indices used by large international institutional investors and the frequency and amount of international bonds issued.
- Income level: A country's GDP per capita in nominal US dollars

Then, a score is derived for each economy using five weighted variables, such as nominal GDP, population, GDP per capita, share of world trade, and share of world external debt.

"If a country is ranked in the top 20 for 2010–20, it receives a score of 1 for that variable. Otherwise, it is assigned zero. The final score is calculated as the weighted sum of the individual scores. This approach identifies the following countries in the emerging market group, in alphabetical order: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, the Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkey, and the United Arab Emirates. Two countries were excluded: Nigeria because of its classification as a low-income country (eligible for IMF Poverty Reduction and Growth Trust financing) during the sample period considered (2010–20) and Qatar because of its population of less than 5 million." (Duttagupta, Pazarbasioglu, 2021).

4.1.2. Definition of frontier Market

In addition to the already ambiguous definition of emerging markets, another classification worth considering is that of frontier markets, which "[…] are a subset of the emerging markets universe, offering high yields in exchange for liquidity and informational constraints. Idiosyncrasies between frontier economies drives diversification, limiting risk and underpinning a key advantage to an active investment approach." (Coppersmith, 2023).

Those frontier markets increase the pool of 40 countries identified by the IMF (Duttagupta, Pazarbasioglu, 2021). This increase suggests a more substantial investable universe, offering potentially greater opportunities for diversification.

4.2. Size of the Market

Regardless on the definition we decide to apply, emerging markets account for a significant portion of the global nominal GDP. The following graphs from Schroders (2023) with data from the IMF and the World bank, presents some key figures on the emerging markets:
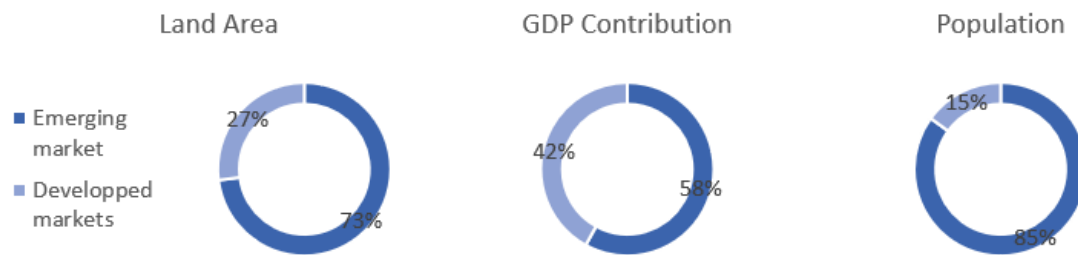
Land Area — Emerging market, Developped markets: 27%, 73%

GDP Contribution: 42%, 58%

Population: 15%, 85%

Source: Mensack, J., & Bonanni, S. (2023). The importance of EMD in diversified fixed income portfolios. *www.schroders.com*. Retrieved on June 20th from https://www.schroders.com/en-us/us/individual/insights/the-importance-of-emd-in-diversified-fixed-income-portfolios/

4.3. Introduction to Emerging Market debt

Emerging markets debt refers to loans, bonds, and other debt instruments issued by corporate, national and supranational entities from countries classified as emerging markets as defined in the previous section. The debt can be denominated in either local currency or a major global currency, such as the U.S. dollar or Euro.

In recent years, there has been a growing interest among investors in emerging market debt.

Figure 5: Size and structure of EMD universe

Figure 2: Size and structure of EMD universe
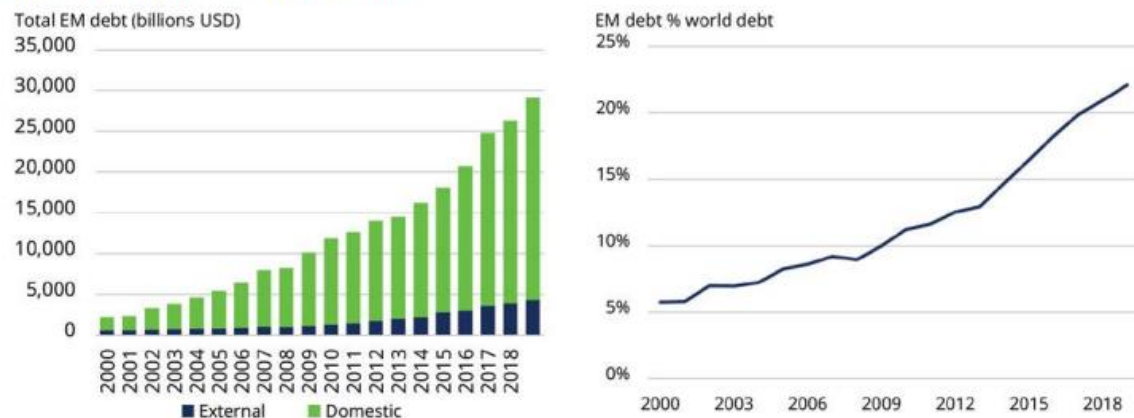
Total EM debt (billions USD) — External, Domestic (2000–2018)

EM debt % world debt (2000–2018)

Source: BofA Merrill Lynch Global Research, BIS, Bloomberg. Data as at 31 December 2019.

Source: Mensack, J., & Bonanni, S. (2023). The importance of EMD in diversified fixed income portfolios. *www.schroders.com*. Retrieved on June 20th from https://www.schroders.com/en-us/us/individual/insights/the-importance-of-emd-in-diversified-fixed-income-portfolios/

The delayed interest in the Emerging market debt could be attributed to what Eichengreen and Hausmann (1999) referred to as the "Original Sin" theory. Indeed, "With what they called the original sin theory, the two authors showed that emerging economies were more vulnerable to financial crises than industrialized countries because of their inability to borrow in international capital markets in their own currency. Indeed, the weight of outstanding external liabilities denominated in foreign currencies increases financial vulnerability because

of the high exposure to foreign exchange and interest rate risk of these economies. It can trigger foreign exchange crises." (Brana & Prat, 2010)

According to Miyajima et al. (2015), a key implication of this theory is that Emerging markets bonds are more sensitive to global factors than they are to local factors which ultimately impacts foreign investors' interest.

We could also argue that the growing interest of investors in emerging markets is correlated with the integration of markets. The "Economic integration refers to decreased barriers to trading in goods and services. Financial integration refers to reduced restrictions on capital flows and this implies that assets of comparable risk in different countries should promise similar expected returns (Bekaert and Harvey, 2000). In theory, liberalization should bring about integration with the global capital market; foreign investors bid up the prices of local stocks with diversification potential while inefficient sectors are sidelined. This may imply changes in the cost of equity. Market integration is a gradual process, and the speed of the process is determined by the particular circumstances of the country." (Camilleri, 2009)

This integration of markets and increasing correlation between emerging markets and developed economies can be attributed to various factors. Camilleri (2009) mentions lower restrictions on capital flows, more efficient trading systems, information availability, and cross-border trading are making it easier for larger companies to cross-list abroad and the growing interest for cross-border mergers and acquisitions.

Even though this increasing connection between markets may bring benefits to both emerging and developed economies, Obstfeld (2014) warns that this increasing level of integration could diminish the ability of emerging market economies to mitigate the domestic consequences of global financial and monetary influences using their own monetary policies.

Various other researchers studied the effects of market integration. Unfortunately, there appears to be a lack of consensus on this impact. Indeed, research regarding the effects of financial integration during crises showcases varied conclusions. Lane and Milesi-Ferretti (2010) did not find evidence that increased financial integration intensified the crisis's impact, while Berglöf et al. (2009) report mixed findings. These differences might be attributed to the selection of countries, with the former including both advanced and emerging markets and the latter focusing on Emerging Europe.

In contrast, the BIS (2009a, 2009b) implies that financial connectedness was indeed influential. Meanwhile, Rose and Spiegel (2009a, 2009b) found no relation between widely used crisis determinants and its occurrence across countries, noting that their sample was limited to growth reductions only through 2008. Supporting the notion of market integration, De Santis and Gérard (1997) utilized an extension of the multivariate GARCH model by Engle and Kroner (1995) and confirmed the integration hypothesis in several markets, while also underscoring that the benefits of international diversification for American investors remained unchanged at an average annual gain of 2.11%, irrespective of market integration.

4.3.1. Characteristics of Emerging Market debt

In this section, we will delve into the classification and the characteristics of emerging markets fixed-income assets. Those assets distinguish themselves by two fundamental factors: the currency in which they are issued and the type of entity that issued them.

Table 1: Characteristics of sub-classifications of EMD

Sub-classification of Emerging market debt	Indexes and characteristics
US-denominated emerging market sovereign debt	Accounts for the smallest part of the emerging markets debt investable universe. It is however the oldest. Reference index: JP Morgan Emerging Market Bond Global Diversified Index: - Market Capitalisation: USD 1 100 Bn - Geographical coverage: 73 countries - Average Maturity: 7,2 years - Yield-to-maturity: 5,6%
Local currency Emerging markets sovereign debt	This segment is the most important. Reference index: JP Morgan GBI-EM Global Diversified Index: - Market capitalisation: USD 1 200 Bn - Geographical coverage: 19 countries - Average Maturity: 5,4 years - Yield-to-maturity: 5,7%
US-denominated corporate Emerging market debt	Reference index: JP Morgan CEMBI broad Diversified Index: - Market Capitalisation: USD 2 000 Bn - Geographical coverage: 52 countries - Covers 12 sectors of activity. - Average maturity: 4,7 years - Yield-to-maturity: 5,6%
US-denominated Frontier Markets debt	This segment is recent. It has been adopted by international investors throughout the last decade. Reference index: JP Morgan NEXGEM Index: - Market capitalisation: USD 715 Bn - Geographical coverage: 35 countries - Average maturity: 6,1 years - Yield-to-maturity: 6,5%

Source : Elbaz, J. & Strigo, S. (2021). Investir dans la dette des marchés émergents. *Revue d'économie financière*, 141, 71-88. https://ezproxy.ichec.be:2098/10.3917/ecofi.141.0071

Another interesting characteristic of many emerging market local currency bond markets is that the performance of the bond is correlated to the GDP of the country in an interesting fashion. Indeed, according to Miyajima et al. (2015), better GDP growth tends to reduce the yield of local currency bonds whereas they reduce the country risk premium and attract

capital flows. In other words, the decreasing return expectation of local currency emerging markets debt tend to attract investors.

Emerging market debt is also characterized by a strong influence to global shocks. Past research has provided substantial evidence of the strong correlation between global shocks and the performance of these assets, with a particular focus on the spreads of foreign currency government debt (Eichengreen & Mody, 2000; IMF, 2004; Gonzalez & Levy-Yeyati, 2008). One significant study, conducted by Gonzalez and Levy-Yeyati (2008) on the period following the Russian default (2000–05), found that approximately 50% of the long-run variability in emerging market foreign currency sovereign spreads could be attributed to two main global factors: international risk appetite, as indicated by US corporate bond spreads, and international liquidity, as represented by US Treasury yields. By considering country-specific elasticity to these global factors, the contribution of these factors to the variability in sovereign spreads increases to about 80%.

More recent research by Csontó (2014) has revealed that idiosyncratic fundamentals play a crucial role in determining emerging market international sovereign spreads. However, during times of market stress, global financial conditions become a more dominant influence in determining these spreads. Csontó (2014) suggests that more robust domestic fundamentals can help mitigate the impact of an adverse global shock on international sovereign spreads.

As demonstrated by the Russian default (2000–05), global shocks can have a significant influence on emerging market sovereign spreads, leading to long-lasting effects on the returns of these assets. The case illustrates the need to consider the impact of global events and market conditions on emerging market debt.

All in all, the evidence suggests that emerging market debt is greatly influenced by global shocks, investors in emerging market debt should be aware of the macroeconomic context that may affect their returns and consider strategies to mitigate potential adverse effects. In our study (See Infra p. 40) we intend to demonstrate this reality through an analysis of the behaviour of the returns depending on the macroeconomic context.

4.3.2. Distribution of Emerging Market fixed-income assets

As we could have expected, these assets are not equally distributed. Indeed, "Sovereign bonds - i.e., those issued by a government - account for the larger part of the market. However, corporate bond issues are on the rise, accounting for 26% of the investment universe. The local-currency corporate bond universe is still mainly reserved for local investors, while hard-currency corporate bonds have clearly gained in popularity with international investors." (Ebaz & Strigo, 2021)

Speaking of corporate EMD, we should mention its rapid expansion. This asset sub-class reached 2.7 trillion USD in 2021, totaling almost twice the size of US High yield corporates.

Figure 6: Comparison of fixed-income sector sizes

Global Fixed Income Sector Sizes (US$ Trillion)
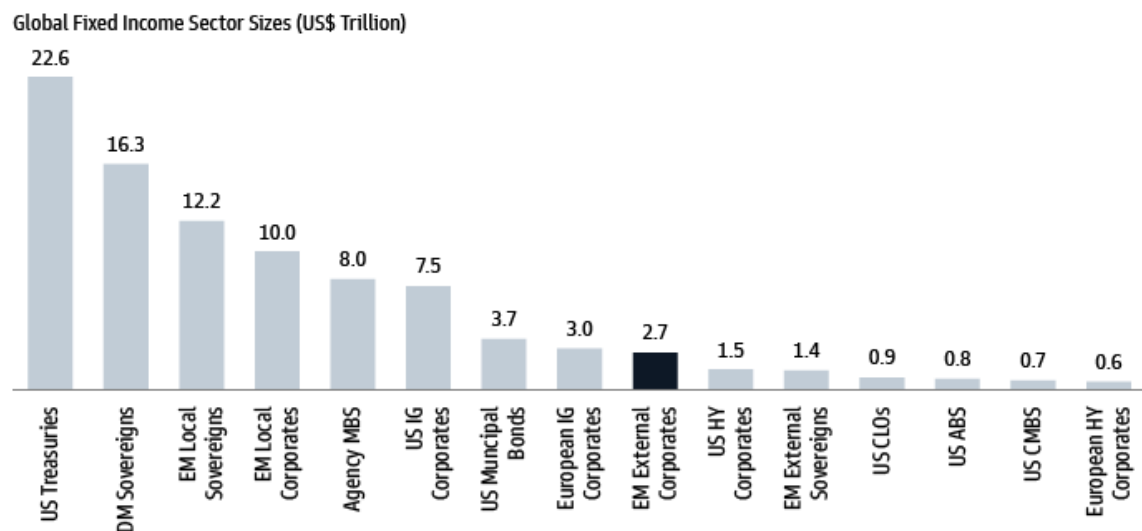
Source: J.P.Morgan. As of 2021.

Source: Saunders, N., Trombley, B. (2022). Navigating The EM Corporate Bond Market. Retrieved on July 6th, 2023 from https://www.gsam.com/content/gsam/us/en/institutions/market-insights/gsam-insights/2022/navigating-the-em-corporate-bond-market.htmlb

Emerging market debt (EMD) assets distinctly vary based on their currency traits. The local EMD market, associated with local currencies, appeals to global investors due to its superior liquidity, stemming from a diverse array of market participants. In comparison, the hard currency market, often dominated by foreign currencies, is primarily influenced by foreign investors, leading to potential imbalances especially for smaller issuers' bonds. A testament to the liquidity of local currency markets is the FX forwards market, which sees significant trading volume as it's predominantly used for currency hedging. Over the last decade, however, there's been a noticeable dip in the liquidity of hard currency EMD. For instance, the proportion of trading volume to hard currency EM debt stock has seen a decline from 150% in 2010 to around 50% in 2019. (Mee, 2021)

The graph presented above also reveals a compelling observation: the combined outstanding amount of all emerging market debt constitutes a significant portion of the fixed-income market. Mensack & Bonanni (2023) from Schroders argue that this proportion is around 25% as observable in the graph below (see Figure 7).
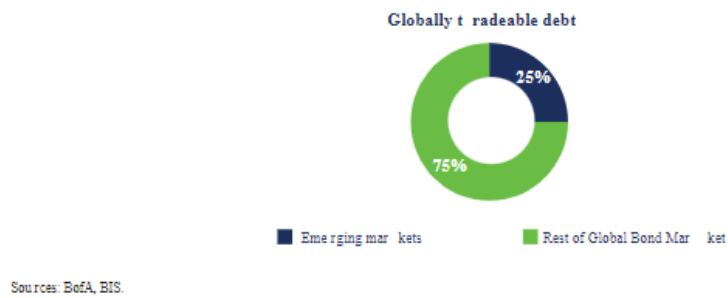
Globally tradeable debt

- Emerging markets
- Rest of Global Bond Market

Sources: BofA, BIS.

The split between high-yield (HY) and investment-grade (IG) emerging market debt in the investable universe shows a split of approximately one-third for high-yield and two-thirds for investment-grade. This distribution reflects a wide range of choices for investors based on their risk-aversion.

Figure 8: Relative scale of EMD IG and HY markets
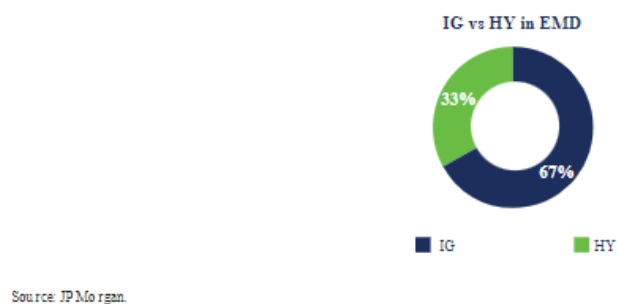
IG vs HY in EMD

- IG
- HY

Source: JP Morgan.

Regarding the split between regions, as observable in the graph below, Asia is the largest region with China leading the way with approximately 20% of all tradable emerging markets tradable debt. In Latin America, Mexico and Brazil seem to be the largest countries in terms of investable universe.

Figure 9: Asia dominates in both hard and local currency EMD.
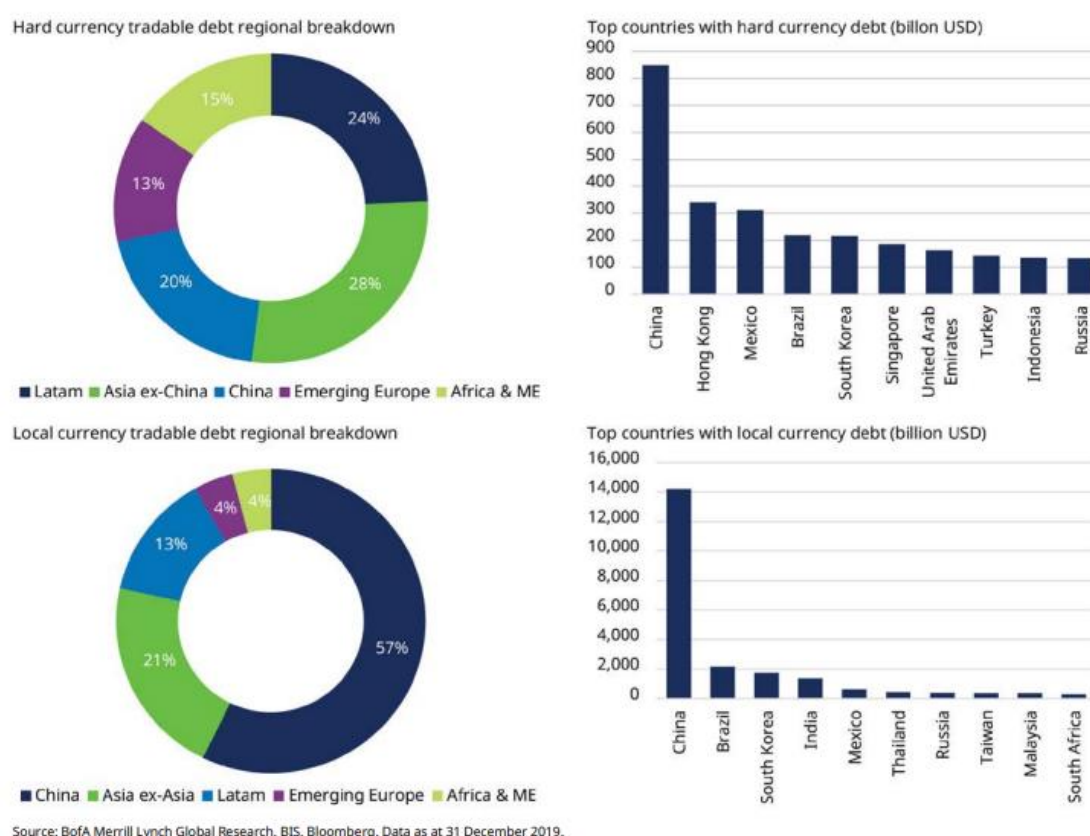
Hard currency tradable debt regional breakdown

Top countries with hard currency debt (billon USD)

Local currency tradable debt regional breakdown

Top countries with local currency debt (billion USD)

Source: BofA Merrill Lynch Global Research, BIS, Bloomberg. Data as at 31 December 2019.

Source: Mee, K. (2021). The essential guide to investing in emerging market debt. *www.schroders.com*. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

4.3.3. Investing in emerging markets debt: uncover the why.

In this section, we focused on existing research by scholars and professionals in the financial industry that delve into the motivations that could push investors to choose this type of investment to diversify their portfolios.

Emerging market debts ought to be a good prospect for diversification because in recent years we have observed that "[…] many asset classes have become increasingly correlated, making it harder for investors to build genuinely diversified portfolios. And for non-US dollar investors, the recent weakness in the US dollar and the prospect of further decline adds another layer of complexity. "(Mee, 2021).

In addition, Mensack & Bonanni (2023) underline the growing sophistication and significance of EMD over the past few decades in a way that we can here on out consider this asset class as a major asset class. Furthermore, Emerging markets and frontier markets' debt encompasses several continents and over 70 countries, offering a diverse range of investment opportunities in both major and local currencies from both sovereign and corporate entities. Notably, numerous emerging markets now showcase developed yield curves, complemented

by enhanced liquidity and pricing efficiency. This creates an unmatched diversification potential within this investable universe.

Furthermore, as depicted in the graph below (see Figure 10), investors who opt for emerging markets corporate debt instead of developed markets corporate debt can benefit from a spread premium when compared to equivalently rated peers in developed markets.

Figure 10: EM corporate bonds offer a spread premium over comparably rated DM bonds.
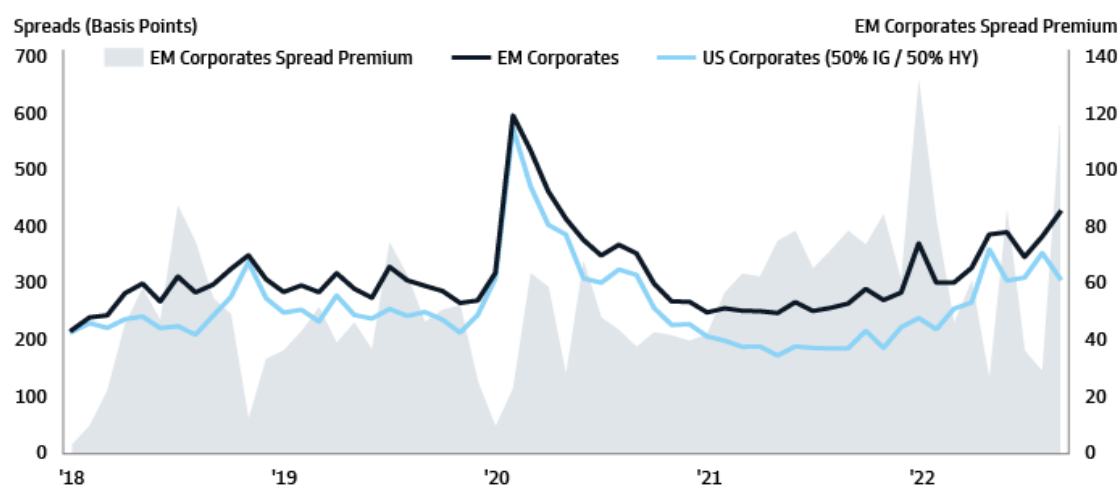
Source: J.P.Morgan, Bloomberg, Goldman Sachs Asset Management. Spread premium = EM corporate spread – US corporate portfolio (50% IG, 50% HY) spread. As of October 31, 2022. Past performance does not guarantee future results, which may vary. For illustrative purposes only.

Source: Saunders, N., Trombley, B. (2022). Navigating The EM Corporate Bond Market. Retrieved on July 6th, 2023 from https://www.gsam.com/content/gsam/us/en/institutions/market-insights/gsam-insights/2022/navigating-the-em-corporate-bond-market.htmlb

The development in emerging markets' central banks would also be a reason to consider EMD for a portfolio. Indeed, "Even though emerging market debt has long been considered a risky asset class, many emerging countries now have independent central banks and more credible monetary policies. In addition, foreign-currency-denominated debt issuance has fallen, while foreign exchange reserves have risen, increasing their ability to repay debt. These trends have led to declining default rates: since 2000, they have fallen by an average of 0.7% a year for the countries in the JP Morgan EMBI Global Diversified Index, a benchmark index of the broadest emerging market bond issues (Aberdeen Standard, 2019)." (Elbaz & Strigo, 2021)

Furthermore, Emerging Markets' Economies, which boast robust economic growth and solid balance sheets, are seen as lucrative investment avenues. Additionally, the past ten years have witnessed EMEs fostering domestic bond markets through enhanced domestic institutions, macroeconomic and monetary policies, and better market infrastructure (BIS, 2002, 2012a, 2012b; Claessens et al., 2007; Gagnon, 2014; Goldstein & Turner, 2004; Montoro & Rojas-Suarez, 2012). Supporting this view, there has been a consistent rise in foreign ownership of EM local currency bonds over the last decade. Moreover, many EMEs now have

their local currency government bonds featured in prominent global bond indices (Miyajima et al., 2015).

What is more, we have noted a significant trend toward Socially Responsible Investing (SRI). The US SIF Foundation trends report (2020) supports this observation, indicating that between 2018 and 2020, assets under management focused on social responsibility grew by 42%, reaching USD 17.1 trillion. It is worth noting that emerging markets present some of the most interesting investment opportunities for those willing to address global climate and socioeconomic challenges. In fact, companies in these emerging markets are now in direct competition with those in developed markets in terms of the sophistication and potential of their sustainability practices (Danila, 2022). Emerging markets investing, thus would also present some responsible and ethical benefits.

Surprisingly, remark Mensack & Bonanni (2023), there is evidence that emerging market debts are still not enough represented in a professionally managed portfolio compared to peer asset classes with sometimes smaller market capitalization. In the following section, we will attempt to determine through research from scholars and industry professionals, the reasons that stop investors to gain exposure to Emerging Market debt.

4.3.4. Barriers to investment

Investors face certain limitations when seeking exposure to emerging market debt, and it is important to highlight that most of these limitations are linked, to some extent, to the challenges of accessing data on these markets and assets. In this section, we will explore some barriers that hinder investment for asset managers who wish to invest in emerging market debts.

The first barrier to investment is the home bias (See Supra p.14) which is fueled by information asymmetries. This argument is further strengthened by empirical evidence. Earlier research by Brennan and Cao (1997) showcased that foreign purchases by U.S. investors were positively correlated with the previous returns of foreign markets. This indicates a reactive rather than proactive approach by U.S. investors, suggesting that they might be operating under an information deficit compared to their foreign counterparts.

These information asymmetries are further reinforced by factors such as geographical proximity to foreign countries, as well as cultural differences including language, religion, and more.

Secondly, we consider the presence of a size bias, as examined by Faruquee et al. (2004) and Chan et al. (2005), who demonstrate that portfolios are significantly impacted by the market's size. This phenomenon can be attributed to the fact "that information on large economies and stock markets is more universally widespread than information on small markets" (Sercu & Vanpée, 2007)

Thirdly, the world of finance is gradually becoming more and more sensitive to ESG factors which renders the investment in emerging market debt difficult. As Elbaz & Strigo (2021) explained, there is a lack of transparency and due diligence on investment projects which raises concerns about ESG and corruption risks. However, the Amundi Blue Paper (2020) reports that measures have been implemented to mitigate these issues. This is exemplified by calls from BIS member countries for more comprehensive policy reforms and China's establishment of international trade tribunals. Additionally, the approach of the BIS has undergone significant evolution: improved project risk assessment and enhanced backing from international agencies are expected to eventually contribute to a decrease in both financial and sovereign risks.

Lastly and less linked to the information asymmetries, Elbaz & Strigo (2021) have noticed that there is a segregation in the emerging markets corporate bonds universe. Indeed, they state that while hard-currency bonds are gaining more and more popularity among international investors, the corporate bonds issued in local currency tend to be reserved for local investors.

4.3.5. Risks associated with Emerging Market debt.

Investing in emerging market debt doesn't spare investors from known risks inherently linked to fixed-income assets. In this section, we will briefly present the risks that an investor gets exposed to when exposed to emerging market debt.

4.3.5.1.   Credit risk

Credit risk relates to the ability of the issuer to meet its payment obligations. The intensity of risk varies from issuer to issuer. However, Elbaz & Strigo (2021) note that it tends to be greater in emerging markets where there is a high potential for political instability and economic volatility.

4.3.5.1.1. Default risk

"Default risk is the risk that the issuer will fail to satisfy the terms of the bond obligation with respect to the timely payment of principal and interest." (Fox, 2021).

This risk is particularly important to take into account when seeking exposure to Emerging Market debt. Indeed, Emerging Market fixed-income assets tend to experience higher levels of default than developed economies.

Figure 11: 5-y CDS and Emerging economies ratings
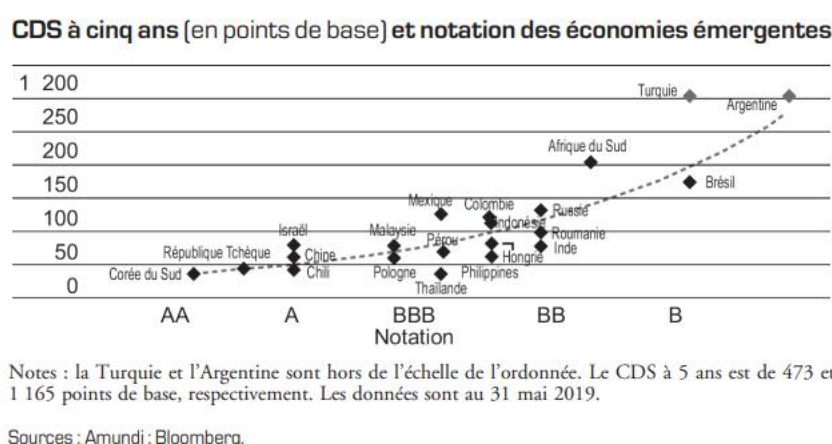
CDS à cinq ans (en points de base) et notation des économies émergentes

Notes : la Turquie et l'Argentine sont hors de l'échelle de l'ordonnée. Le CDS à 5 ans est de 473 et 1 165 points de base, respectivement. Les données sont au 31 mai 2019.

Sources : Amundi ; Bloomberg.

Source : Elbaz, J. & Strigo, S. (2021). Investir dans la dette des marchés émergents. Revue d'économie financière, 141, 71-88. https://ezproxy.ichec.be:2098/10.3917/ecofi.141.0071

4.3.5.1.2. Credit spread risk.

The credit spread risk is the risk that a bond value decreases because the return demanded by the market has increased (Fox, 2021). The phenomenon by which the spread of a bond increases can happen for various reasons. The most common is if the creditworthiness of a bond issuer decreases which tends to be more frequent in emerging countries than in developed countries.

4.3.5.1.3. Downgrade risk

Bonds receive ratings from rating agencies such as Standard & Poor's. A bond can have its rating decrease if a rating agency deems the credit quality of the bond has deteriorated. Those decreases are usually accompanied by bond price declines. (Fox, 2021)

4.3.5.2. Sovereign risk

Sovereign risk in the context of financial markets refers to the potential for adverse outcomes due to the actions of a foreign government. Specifically, there is a risk that actions taken by such governments may result in either a default or a price change even in the absence of a default (Fox, 2021).

A significant aspect of sovereign risk in emerging markets relates to cross-border risks. When issuing local currency bonds, there are inherent risks related to currency devaluations and exchange rate fluctuations. While an appreciating currency can positively influence returns, a marked depreciation can critically affect the absolute performance of local currency bonds (Elbaz & Strigo, 2021).

Moreover, the landscape of emerging markets brings along an additional layer of risk: the contagion effect. Emerging markets, despite their individual disparities, display a tendency to behave uniformly in times of significant economic downturns or heightened risk aversion. The financial systems of these markets typically move in tandem, especially when facing deteriorating macroeconomic situations. During periods of increased volatility, there's an

inflated correlation among these markets, and the absence of a safe haven or reserve currency means that any common factor can spur a contagion effect that impacts these countries almost uniformly. Notably, with regard to capital flows, there's a pronounced correlation between these countries, with China being an outlier (Elbaz & Strigo, 2021).

In conclusion, when considering fixed-income assets in emerging markets, investors should be aware of the multifaceted nature of sovereign risks and the potential for significant impacts due to governmental actions, currency fluctuations, and the interconnectivity of these markets.

4.3.5.3. Liquidity risk

Liquidity risk is an important risk, especially within emerging markets. Compared to their counterparts in developed economies, emerging markets generally exhibit a higher degree of illiquidity. This is characterized by bonds in which transaction volumes are low, creating scenarios where investors find it challenging to sell their assets swiftly and at their preferred prices (Elbaz & Strigo, 2021).

The importance of this risk is demonstrated in the debt dynamics of emerging markets. As observable in the graph below (see Figure 12), within the fixed-income universe, emerging market bonds rank among the sectors with the lowest liquidity. Consequently, in times of market turbulence, making adjustments to high-yield or emerging market bond holdings becomes not only expensive but also problematic. Efforts to do so might cause substantial market disruption, which will increase the importance of liquidity considerations (Liu, B., & Xie, H., 2019).

Figure 12: Deteriorating secondary markets liquidity conditions in hard EMD.
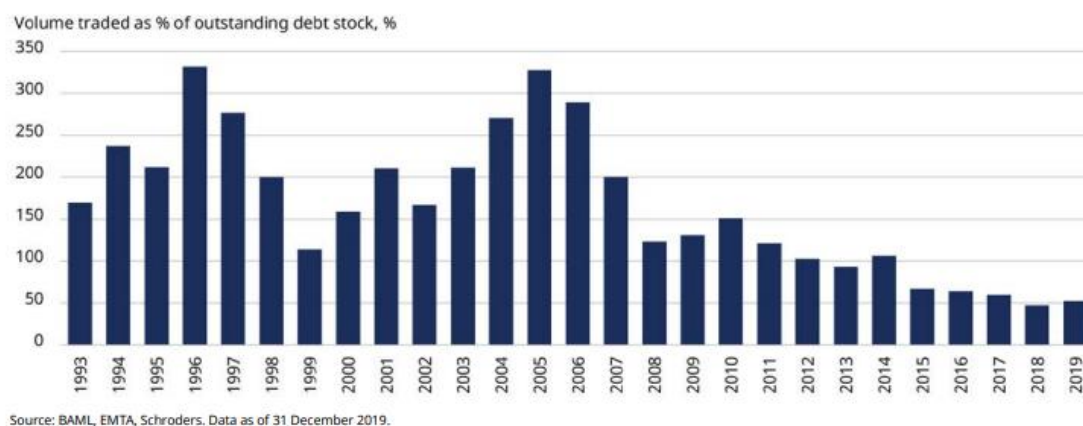
Source: Mee, K. (2021). The essential guide to investing in emerging market debt. *www.schroders.com*. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

In summary, for those contemplating investments in Emerging Market fixed income assets, it's essential to understand and be prepared for the pronounced liquidity challenges that these markets can present.

4.3.5.4. Interest rate risk

Interest rates and bond prices have an inverse relationship. As market interest rates change, bond prices adjust accordingly. Therefore, when interest rates go up, bond prices tend to decrease, posing a risk for investors. (Fox, 2021)

This risk is accentuated for Emerging Market debt issued in hard currency because they are exposed to the movements of two interest rates. Indeed, the US-denominated bonds are exposed to both the US interest rate changes and the interest rate changes of the corporate or sovereign issuer. (Liu, B., & Xie, H., 2019)

4.3.5.5. Yield curve risk

The yield curve shows the relationship between the yield of a bond and its maturity. Consequently, each change that the yield curve experiences is bound to affect the value of the bond positively or negatively.

4.3.5.6. Reinvestment risk

This risk relates to the possibility of reinvesting the proceeds of a bond at an interest rate that is lower than the security that generated the proceeds. (Fox, 2021)

4.3.5.7. Other risks

The final risk factor for an international portfolio is influenced by three specific cross-correlations:

- The relationship between the negative returns of emerging securities in their local currency and the downturns in the respective emerging currencies,
- The association between the downturns in returns of emerging securities in local currency and the downturns in the currencies of other emerging nations,
- The interrelation between downturns in local emerging currencies and negative returns in securities from other emerging nations. (Brana & Prat, 2010)

4.4. Pros and cons of Emerging markets debt

While the previous section highlighted certain risks, it is important to note that investing in emerging markets comes with its own set of advantages and disadvantages. In this section, we will outline and consolidate some of the key points commonly acknowledged by scholars and investment professionals.

4.4.1. Advantages of emerging markets debt

Investing in emerging markets offers the advantage of potentially higher returns, given that emerging economies frequently experience faster growth compared to their developed counterparts (Wilson, 2006 as cited in Camilleri, 2009). With yields in developed markets consistently decreasing, there is a growing attraction toward higher-yielding bonds in

emerging markets (Mee, 2021). This potential is increased when focusing on frontier markets. These markets, characterized by their diversity spanning across continents, offer very high returns. Bonds in USD or EUR from frontier markets can yield upwards of 10%, and their local currency counterparts can sometimes offer even double that amount. Frontier markets include a variety of economies, from larger, complex ones like Nigeria or Pakistan to smaller ones such as the tourism-reliant Bahamas or the budding hydrocarbon powerhouse, Mozambique (Coppersmith, 2023).

Figure 13: EM Countries have had significantly higher ex-ante real yields than DM countries.
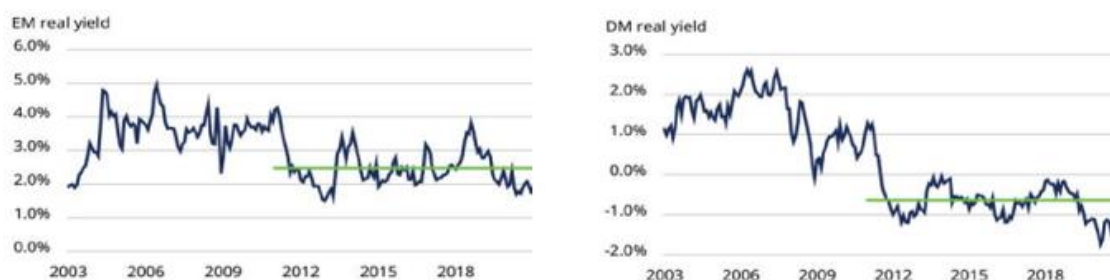
Source: Mee, K. (2021). The essential guide to investing in emerging market debt. *www.schroders.com*. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

Secondly, the diversification potential of Emerging Market debt is high. Indeed, "The diversification these idiosyncrasies [of emerging markets and frontier markets countries] provide helps limit the risk of the asset class and drives another advantage of an active approach, remembering that traditional indices hold only a fraction of the entire emerging markets universe." (Coppersmith, 2023). Mee (2021) works seconds those of Coppersmith (2023) as he stated that local currency emerging markets debt is the largest part of the global EMD market and that it is more liquid, and a better diversifier compared to hard currency EMD. Also, "[…] within local EMD, the greatest value is in EM currencies, but this value is not uniform and varies considerably by country. Investing in EMD can be risky. As we show, adopting a flexible, unconstrained approach with the capability to avoid certain countries can help to mitigate some of the risks." (Mee, 2021).

Lastly, as observable in the graph below (see Figure 14), the EMD tends to have a very low correlation with DM bonds.

Figure 14: EMD hard rolling 3-year correlation with DM bonds.

Source: Schroders, J.P. Morgan, Barclays. Data as at 31 December 2020. DM bonds are the Bloomberg Barclays G7 Treasury Index.

Source: Mee, K. (2021). The essential guide to investing in emerging market debt. *www.schroders.com*. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

4.4.2. Cons

Emerging market debt investing presents several challenges, largely revolving around volatility, currency depreciation, and potential limited diversification benefits. As noted by Miyajima et al. (2015), emerging market (EM) currencies tend to exhibit more volatility than those of advanced economies. Therefore, the anticipated diversification benefits from EM assets in local currency might be marginal at best. Burger and Warnock (2007), as cited in Miyajima et al. (2015), concur with this assessment, emphasizing that the root of exchange rate volatility is of utmost importance. They argue that when such volatility comes from macroeconomic factors, then developing better policies within EMEs can motivate foreign investors to direct their funds into EM assets. Turner (2012), as cited by Miyajima et al. (2015), accentuates this sentiment, stating that the inherent volatility of EM exchange rates intensifies the disadvantage, especially when investments are in local currency assets.

One might conclude from the attractive state of consistently positive real yields in local currency emerging market debt (EMD) that they outperform their developed market counterparts. Yet, Mee (2021) paints a different picture. Despite the high yields of local currency EMDs, the US dollar total return of prominent indices like the JPM GBI-EM Global Diversified Index is near zero since 2013. This low performance is attributed to important losses in the value of EM currencies since 2011, essentially nullifying the high yields of local currency bond returns.

Figure 15: Components of EMD local index total dollar return

Past performance is not a guide to future performance and may not be repeated.
Source: J.P. Morgan. Data as at 31 December 2020. Based on the J.P. Morgan GBI-EM
Global Diversified index.

Source: Mee, K. (2021). The essential guide to investing in emerging market debt. *www.schroders.com*. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

Yet, the pitfalls of investing in emerging market assets don't stop at volatility. The distribution of returns also weighs in. Susmel (2001), as referenced by Camilleri (2009), affirms that Latin American market returns exhibit "fatter tails" than normal distributions. In other words, they have a higher probability of negative returns, indicating a high-risk profile. While the incorporation of Latin American stocks in a US-centric portfolio may mitigate the potential of the portfolio value decreasing below a certain threshold, the overall risk from such EM assets remains elevated.

An equally significant concern in EM bond investment revolves around market liquidity. As Miyajima et al. (2015) highlight, bond markets' ability to endure shocks without undergoing substantial price changes is due to their liquidity. The U.S. and Japanese government bond markets for instance had stocks of outstanding bonds of about $15 trillion and $9 trillion respectively by the end of 2013. In stark contrast, EM bond markets, due to their relatively smaller sizes, are more sensitive to shocks, leading to possible heightened volatility in returns.

It is worth noting that despite the risks and disadvantages associated with emerging markets, some diversification benefits may still persist, even during financial crises. Meyer and Rose (2003), cited by Camilleri (2009), analysed the impact of the Asian crisis of the 1990s on diversification benefits. Their research highlighted increased market correlations during the crisis, but diversification benefits remained viable.

In sum, while emerging market debt investing may offer opportunities, the challenges presented by currency volatility, the potential for significant negative returns, and the

heightened risk due to limited market liquidity, require the need for caution, for meticulous and continuous analysis.

4.5. Investing in Emerging market debt: exploring the How.

As outlined above, despite the numerous risks, emerging market debt has the potential to be a good diversifier of the portfolio. The question to be raised now would be: "how can an investor efficiently gain exposure to this universe?". Indeed, Mee (2021) observed that the majority of investors' approaches to this asset class are not optimal. Specifically, the prevalent focus on hard currency dollar-denominated bonds and the observed constraint of investors to invest in bonds that are included in mainstream benchmark indexes. In this section, we will explore the scholars' and industry professionals' views on the optimal ways for investors to approach emerging market debt.

As observable in the table below, the most popular indexes only represent a fraction of the investable universe. For instance, the J.P. Morgan suite of EM bond indices which forms the basis for a large portion of investors' allocations only represents a fraction of the investable universe (Mee, 2021). That is why attempting to win exposure to Emerging market debts investable universe through EMD indices is not the most efficient way to do so as they exclude a large portion of the universe.

Table 2: Index coverage in EMD varies considerably

Bn of dollars	Hard sovereign	Hard corporate	Local	Total
All outstanding	1,368	2,966	24,805	29,139
JP Morgan EMD Index	1,327	1,248	2,050	4,625
JP Morgan EMD Diversified Index	750	583	1,374	2,707

Source: BofA Merrill Lynch Global Research, BIS, Bloomberg, JP Morgan. EMD debt outstanding as at 31 December 2019. J.P. Morgan indices' market values as at 31 December 2020.

Source: Mee, K. (2021). The essential guide to investing in emerging market debt. www.schroders.com. Retrieved on June 29th ,2023 from https://www.schroders.com/en-ch/ch/professional/insights/the-essential-guide-to-investing-in-emerging-market-debt/

Brana and Prat (2010) present the benefits of such diversification. They emphasize that through a process of risk-ranking, an internationally diversified portfolio incorporating assets from emerging countries in their local currencies has a different risk profile compared to portfolios focused on emerging securities in hard currencies (Brana & Prat, 2010). However, a balance is essential. Bonds in hard currency from emerging markets can serve as a hedge against certain policy risks (Brana & Prat, 2010).

Yet, as Coppersmith (2023) suggests that dedicated research is imperative in this asset class. The potential in EMD largely rests on the scarcity of broad analytical coverage. This necessitates an in-depth approach, with reliance on multiple sources for information, ranging from formal data to on-ground visits (Coppersmith, 2023).

All in all, for investors looking into EMD, the strategy advised requires two important aspects:

- Diversify globally, balancing both hard and local currencies to maximize portfolio efficiency while hedging against potential policy risks.
- Invest in in-depth research, understanding that credit ratings are just the tip of the iceberg and that the real alpha generation potential in EMD lies in understanding the nuances that aren't immediately apparent.

Mee (2021) from Schroders proposes a list of options for investors willing to gain exposure to this market:

a. The Passive Strategy using index funds or ETFs is cost-effective but has underperformed the J.P. Morgan EMD indices over five years, largely due to liquidity issues and trading costs. Moreover, it might expose investors to higher risks by providing full exposure to financially unstable countries.

b. The Active Approach using Separate Managers for hard and local EMD is straightforward in its implementation and emphasizes environmental, social, and governance (ESG) factors. However, it's limited by its rigidity in adjusting between hard and local EMD allocations.

c. An alternative Active Strategy with a Single Manager for both hard and local EMD offers more flexibility in allocation adjustments. Yet, managers tend to stick close to benchmarks, limiting deviation. For example, completely omitting a country like Turkey, which constitutes 10% of the EMD local index, would be unlikely.

d. Absolute Return Strategies cater to investors desiring maximum flexibility. This approach allows managers to exclude specific bonds or countries, including those outside benchmark indices. However, its success is heavily reliant on the manager's expertise, and it might not capture the full upward potential of EMD.

4.6. Previous research on emerging debt as a diversification tool

Various researchers have addressed the question, "Is emerging market debt an effective diversifier?" In this section, we will examine a selection of these studies, including their objectives, and findings.

Firstly, following on from the study by Zayati et al. (2016), which investigates the links between stock market indices and the transmission of volatility between the oil market and the indices of countries such as Germany, England, Brazil, France, Kuwait, Mexico and Switzerland over the period 2003-2014, Montassar et al. (2021) propose in their paper a dynamic measure of the gains from international diversification. The extension of the multivariate GARCH model to an asymmetric framework that captures the effect of shocks on the risk premium, diversification gains and in particular the effect of conditional volatility in

the Sharpe ratio framework in terms of measuring the performance and composition of the international portfolio across all the assets in our sample.

Montassar & al. (2021) reported that their empirical findings demonstrated the notable impact of emerging countries on the performance of international portfolios, particularly in terms of expected returns. They highlighted that this performance was amplified due to a decrease in risk and a boost in profitability. Furthermore, they suggested that their methodology might be broadened to include a distinct segmentation factor, like information costs. They believed that such an inclusion might diminish the advantages of international diversification if there was insufficient information on international markets.

Second, studying Emerging Market Sovereign Debts as a Means for Profit Maximization and Portfolio Diversification, Yesuf (2017) examined the eligibility of sovereign emerging market debts as a mean for profit maximization and portfolio diversification by using descriptive analysis.

Thirdly, triggered by the strength of capital inflows toward the Emerging market local currency bond market after the collapse of Lehman brothers, Miyaijima et al. (2015b) examined what factors dictate the yield on EM local currency government bonds by adopting a diversification framework in which "The appeal of an asset to investors depends on, at least, two crucial factors. First, the asset is more attractive when the return is determined by a set of idiosyncratic factors and less correlated with other asset returns. Second, the asset is more attractive when the volatility of returns is low, thereby allowing investors to anticipate the asset's future returns with a lower degree of uncertainty. This suggests that to be attractive as an investment proposition, not only should returns on EM bonds be determined more by domestic factors than global ones, but they must also be resilient to various shocks." (Miyajima et al., 2015b)

According to Miyajima et al. (2015), a noteworthy finding is that the returns on government bonds denominated in local currencies in emerging markets (EM) have shown relative resilience when faced with global risk aversion shocks. Some experts even argue that EM bonds may have emerged as a new safe haven, especially given the scarcity of secure assets from advanced economies. Although the aspect of EM bonds serving as safe havens remains a subject of debate, the study provided evidence that in recent times, EM government bond yields tended to decrease rather than increase in response to deteriorating global risk sentiment. This is in contrast to historical patterns, where worsening global risk sentiment typically led to a surge in domestic bond yields. The research findings also indicate that foreign capital inflows into EM local currency bonds have been partly motivated by the search for higher yields. A substantial portion of fluctuations in EM domestic bond yields can be attributed to changes in US Treasury yields, and the level of influence has significantly increased since May 2013, when investor expectations grew that the Federal Reserve might reduce the pace of its bond purchases. Consequently, it can be inferred that the reversal of

exceptionally accommodative global monetary policies is likely to exert a strong negative impact on EM local currency bond markets.

In conclusion, the research on emerging market debt (EMD) as a diversifier presents a mixed picture. When researchers such as Montassar et al. (2021) found that EMD can enhance portfolio performance by offering higher expected returns and diversification benefit, other such as Miyajima et al. (2015) noted the sensitivity of EM local currency bonds to global risk aversion shocks and US Treasury yields. While EMD offers potential rewards, it also carries risks, particularly due to external factors like global monetary policies. Therefore, investors must carefully consider these factors when incorporating EMD into their portfolios.

4.7. Critiques of emerging debt as a diversifier

The purpose of this thesis is to provide evidence that Emerging market (EM) debt can be used as a diversifying asset for global investment portfolios. Advocates of this theory argue that these bonds can deliver a potential for higher returns due to the unique growth and development trajectories of emerging economies. However, several critical perspectives arise when considering this asset class as a diversifier. In this section, we will present some of the most important.

- **Inherent Risks of Emerging Markets**: As highlighted by Camilleri (2009), emerging markets are naturally riskier than their developed counterparts. The former is subject to higher price volatility and fluctuating liquidity. While the diversification benefits come from the difference in market behaviours between developed and emerging economies, the inherent risks of EMs can annihilate these potential benefits. The core objective of a diversified portfolio is risk reduction; however, if the components of the portfolio, like emerging market debt, present elevated risks on their own, the overall objective could be compromised.
- **Declining Diversification due to Market Integration**: The globalization of financial markets has led to the increasing integration of emerging economies with their global counterparts. As Camilleri (2009) articulates, this growing integration can dilute the traditional diversification prospects of emerging economies. If returns start to display more correlation across markets due to this integration, the diversifying benefits of including EM debt in a portfolio diminish. However, it's worth noting, as Li et al. (2003) and Miles (2005) found, that while integration might reduce the diversification benefits, it does not totally eliminate them, especially from the perspective of U.S. investors.
- **Macroeconomic Volatility and Correlation among Emerging Markets**: Elbaz & Strigoz (2021) shed light on another significant concern. During periods of macroeconomic downturns or elevated risk aversion, emerging markets often display correlated behaviours, behaving almost uniformly as a block. This correlation is in stark contrast to the basic premise of diversification which seeks assets that behave differently under varying conditions. The contagion phenomenon, which sees the spread of market disturbances from one country to another country, can quickly reduce any

diversification benefits. The absence of a safe haven or reserve currency in the emerging world further exacerbates this issue. China, as noted, might be an exception, but the broader trend of co-movement during times of distress remains a concern.

In conclusion, while the attraction of emerging market debt as a diversifier remains rooted in the differences between emerging and developed markets, the critiques surrounding its true diversification potential are noteworthy. Investors should approach the inclusion of emerging market debt in their portfolios with caution and a comprehensive understanding of these challenges to ensure that the return enhancement benefits are realized.

METHODOLOGY

1. Research design and approach

This thesis examines the risk-return effect of Emerging Market Debt (EMD) in a diversified portfolio, aiming to determine its effectiveness as a tool for diversification and the appropriate macroeconomic context for its recommendation.

To address these objectives, a quantitative methodology with a comparative approach was selected. This choice is justified by the inherently quantitative nature of portfolio diversification and the efficiency of the comparative approach in assessing the incremental impact of adding specific assets to a portfolio. The quantitative approach, as defined by Coghlan and Brydon-Miller (2014), involves strategies, techniques, and assumptions used to study numeric patterns in psychological, social, and economic processes. The specific comparative approach used in this thesis is the variation-finding comparison, which involves "[...] comparing numerous forms of a single phenomenon to discover logical differences among instances and establish a standard of variation in the character or intensity of that phenomenon." (Adiyia, M., Ashton, W.,2017).

To begin, a correlation analysis was conducted between Emerging Market Debt and other markets to demonstrate the effects of home bias on portfolios and determine the potential diversification benefits of incorporating EMD. The Markowitz mean-variance model was used to evaluate the benefits of diversification. A low level of correlation between these markets serves as an initial indicator of the potential diversification gain from EMD in a diversified portfolio.

Next, the quantitative and comparative process was applied to compare an original Europe Biased portfolio strategy as defined by Oehler et al. (2008) and a fully diversified portfolio. The original portfolio was designed with Eurocentric characteristics to highlight the home bias that European portfolio managers may exhibit. A comparison was then made with a portfolio consisting of Emerging Market Debt in addition to the selected assets from the original strategy. This methodology enabled the assessment of the impact of adding EMD to a portfolio in terms of its risk-return metrics. Each portfolio was constructed with the objective of minimizing risk while maximizing return, Sharpe Ratio, and Modified Sharpe Ratio.

Lastly, we addressed the question of the ideal macroeconomic circumstances for adding Emerging Market Debt to a balanced portfolio. To do so, we built and compared the efficient frontier of both portfolios at different periods. Each period was selected based on its specific macroeconomic conditions.

1.1. Data collection methods and sources

The raw data essentially came from Refinitiv and Bloomberg. We downloaded and treated:

- The daily end price of assets comprised in the investable universe.

Both portfolios built are balanced with an Equity side that has Eurocentric characteristics. Indeed, the Equity side of the portfolios is the MSCI Europe. The collected daily end-price are spread out in a period going from January 2008 to December 2022.

This Index has been selected, primarily due to its perfect fit to the balanced European strategy. Indeed, the MSCI Europe Index "captures large and mid-cap representation across 15 Developed Markets (DM) countries in Europe*. With 423 constituents, the index covers approximately 85% of the free float-adjusted market capitalization across the European Developed Markets equity universe." (MSCI Factsheet, 2023). Secondly, the index has an inception date before the start of the study period.

Figure 16: Country weights - MSCI EUR Index

COUNTRY WEIGHTS

- United Kingdom 22.48%
- France 18.92%
- Switzerland 15.34%
- Germany 13.15%
- Netherlands 7.08%
- Other 23.03%
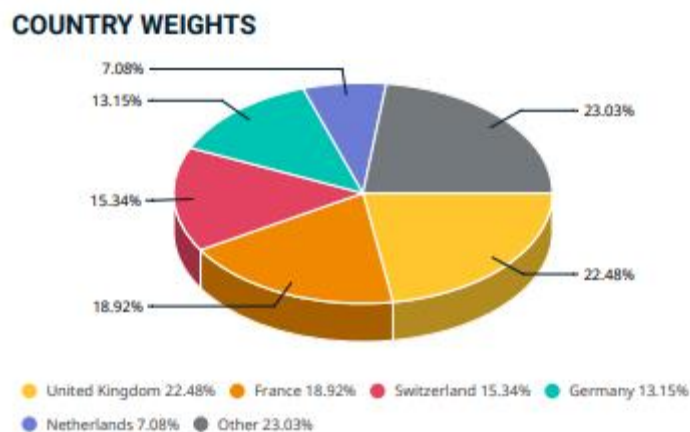
Source: MSCI (2023). *MSCI Europe (USD).* Index Factsheet. Retrieved on July 11th, 2023 from https://www.msci.com/documents/10199/db217f4c-cc8c-4e21-9fac-60eb6a47faf0

This index had the following characteristics on June 30th, 2023:

- o Bloomberg ticker: MXEU
- o Constituents 428
- o Market capitalization: USD 10 201 753.79 Mn

The fixed-income portion of the portfolio is also built through indexes. This decision has been made for operational reasons. Indeed, it would have been difficult to monitor the criteria of a bond portfolio during the studied period of 15 years and maintain at all times the portfolio objectives in terms of duration, maturity and maintain the level of exposure to different markets.

The selected indexes offer exposure to capital assets (see Supra p.13):

Firstly, the Bloomberg Euro-Aggregate Treasury Bond Index whose strategy is totally in line with the Eurocentric strategy of the portfolio. It provides a diversified exposure to euro-

denominated government fixed-income assets issued by 17 countries. This index has the following characteristics:

- o Bloomberg ticker: LEATTREU
- o Ticker (Future): I02004EU
- o Constituents 505
- o Rebalancing: Monthly
- o Market Capitalization: USD 6 813 Bln
- o Average Maturity: 9 years

Secondly, the Bloomberg Euro-aggregate corporate bond index whose strategy is in line with the strategy of the portfolio. It provides a diversified exposure to Investment grade Euro-denominated corporate fixed-income assets. This Index has the following characteristics:

- o Bloomberg Ticker: LECPTREU
- o Ticker (Future): I02002EU
- o Constituents 3 571
- o Rebalancing: Monthly
- o Market Capitalization: USD 2 418 Bln
- o Average Maturity: 5,1 years

- The daily end price of EMD indexes

For this study, even though this methodology has been deemed suboptimal by Mee (2021), it has been decided to expose the portfolios to Emerging markets debts through indexes. We did so, for various reasons. The main one is operational. Indeed, there is the challenge associated with accumulating, synthesizing and treating data on a large quantity of emerging markets for a 15-year period and this challenge becomes more intense when an investor decides to select assets outside of the indexes.

Additionally, it has been decided to prioritize hard currency and local currency sovereign debt over corporate debt, primarily because together they constitute the majority of the outstanding assets in the emerging market debt asset class (see Figure 17). This has been corroborated by Elbaz & Strigo as they accounted for 74% of EMD being issued by sovereign entities (see Supra p. 22).

Figure 17: EMD Market sizes

Development of the three most accessible EMD categories
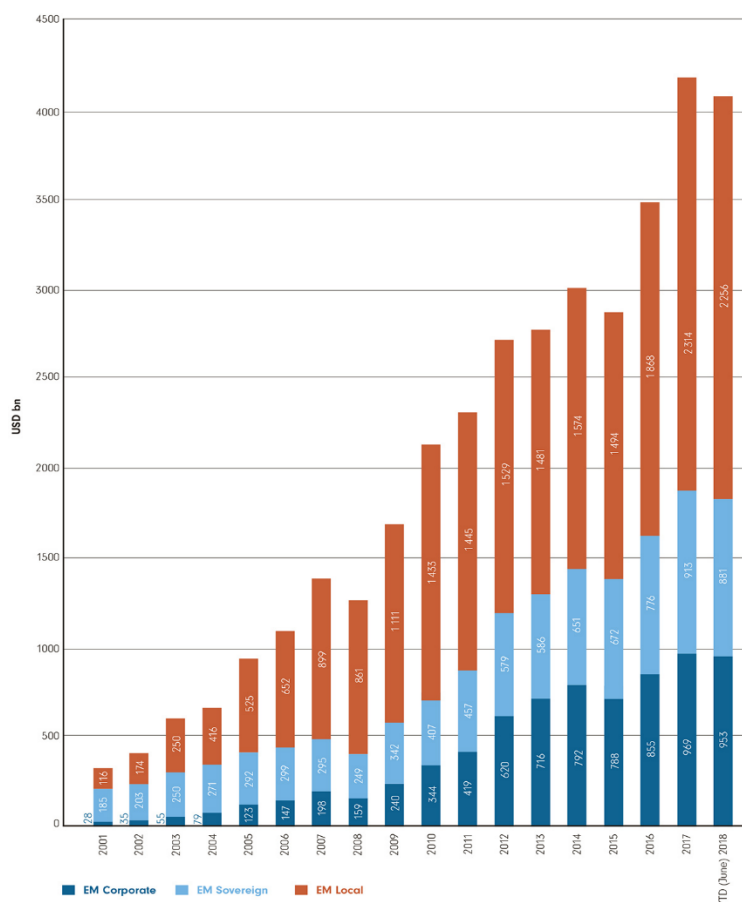
Source: Fidelity International (2018). *Emerging market debt.* Retrieved from https://www.fidelity.lu/articles/pages/2018-08-20-emerging-market-debt-1539685369762

Firstly, we selected the JP Morgan EMBI Global Core Index. This index has been selected for its particular criteria that are in line with the strategy of the portfolio. Indeed, this index is a US-dollar denominated index that covers 30+ emerging markets sovereign debt issued in hard-currency with a scope of credit ratings going from AA to NR and with return and statistics spanning from December 1997 to this day.

Figure 18: Index criteria – JP Morgan EMBI Global Core Index

Instrument Type:	Includes both fixed and floating rate securities along with capitalizing/amortizing bonds or loans. Excludes convertibles and inflation-linked instruments[2].
Issuer Type:	Only those bonds or loans issued by sovereign and quasi sovereign entities are eligible in the index.
Remaining Maturity:	Only those instruments with at least 2.5 years until maturity are considered for inclusion. Once added, an instrument may remain in the index until 12 months before it matures.
Amount Outstanding:	Only issues with a current face amount outstanding of $1 billion or more are considered for inclusion[3].
Currency:	Only USD denominated bonds are included. Instruments where the amount of coupon or redemption payment is linked to an exchange rate are not eligible for inclusion.
Country:	Country's GNI per capita must be below the Index Income Ceiling (IIC) for 3 consecutive years or Index PPP ratio (IPR) is below the EM threshold for 3 consecutive years

Source: JP Morgan (2021). *Global Index research.* JP Morgan Emerging markets Bond Index Global core. Retrieved on July 11th, 2023 from https://www.jpmorgan.com/content/dam/jpm/cib/complex/content/markets/composition-docs/pdf-22.pdf

Secondly, we selected the GBI-EM Global Diversified 10% Cap 1% Floor (GBI-EM Global 10/1) which" is designed to track the performance of bonds issued by emerging market governments and denominated in the local currency of the issuer. The GBI-EM Global 10/1 is designed to be investible and is based on the well-established methodology and composition of the flagship GBI-EM Global Diversified index (GBI-EM GD). The main difference between these two index families is that the GBI-EM Global 10/1 does not include new markets below 1%. The index includes only those countries that are accessible by most of the international investor base and selects bonds from each of the emerging market countries set forth below that are fixed rate, domestic currency government bonds with greater than 6 months to maturity." (JPMorgan, 2021).

Figure 19: Index Criteria – JP Morgan GBI-EM Global Diversified index

Instrument Type:	Local Currency denominated fixed coupon instruments.
Remaining Maturity:	Only bonds with greater than 2.5 years to maturity are included in the GBI-EM Indices. Bonds with less than 6 months to maturity are removed from the indices at rebalance date.
Amount Outstanding:	Local issues with a current face amount outstanding of $1 billion or more, as well as Global issues with $500 million or more are considered for inclusion.
Currency:	All eligible currencies are available within the set of eligible countries.
Country Eligibility:	**Index Entry:** A country's GNI per capita must be below the JPMorgan defined Index Income Ceiling (IIC) for 3 consecutive years. Additionally, for inclusion in this index, new markets require a weight of at least 1% in the flagship GBI-EM Global Diversified index. **Index Exit:** A country's GNI per capita is above the Index Income Ceiling (IIC) for three consecutive years as well as the country's long term local currency sovereign credit rating (the available ratings from all three agencies: S&P, Moody's & Fitch) is A-/A3/A- (inclusive) or above for three consecutive years. Treatment around country removals, timing, currency adoption, re-entry of an excluded country and extraordinary event will all inherit the flagship GBI-EM Global Diversified rules. Existing country would NOT be removed if its weight drops below 1% in the flagship.
Capital Controls:	The GBI-EM Global 10/1 Index excludes countries with explicit capital controls, but does not factor in regulatory/tax hurdles in assessing eligibility, unless such regulatory or tax hurdles significantly hinder investors' ability to replicate the index

Source: JP Morgan (2021). *Global Index research.* Government Bond Index-Emerging Markets Global Div 10% Cap 1% Floor. Retrieved on July 11th, 2023 from https://www.jpmorgan.com/content/dam/jpm/cib/complex/content/markets/composition-docs/pdf-21.pdf

2. Sample selection and data processing

The portfolio strategies used in this thesis are passive and built thanks to Indexes. Each index has been selected for its appropriateness regarding the strategy of the portfolio.

The data used are the logarithmic daily returns of each of the assets that we selected to reach our results. Those allowed us to determine the daily returns of our portfolios which were the central elements to conduct this study.

3. Empirical models and statistical analysis techniques

This thesis first used descriptive statistics on the data collected from Refinitiv regarding the assets aforementioned. Secondly, the thesis focused on offering the first elements of answer to the central questions by determining the level of correlation between the different asset classes from developed markets and from emerging markets through indexes We selected the following indexes for this analysis:

Table 3: List of Indexes for Correlation analysis

Geography	Type of index	Name of the index
	Commodities	S&P GSCI Tot Return Index
	Green Bond	S&P Green Bond Index
Developed markets	Equity	MSCI World
	Treasury Bonds	FTSE World Government Bond Index
	Corporate bonds	Bloomberg US Corporate Investment grade Bond index
	Corporate bonds	Bloomberg Euro-aggregate corporate index
Emerging markets	Equity	The MSCI Emerging Markets Index
	Treasury bonds	J.P. Morgan EMBI Global Core Index
	Corporate bonds	Morningstar Emerging Markets Corporate Bond GR USD

The second set of elements of answer relates to the portfolio analysis. Indeed, this thesis had the ambition of determining if Emerging Market Debt is a good candidate for portfolio diversification and in the eventuality of a positive answer to this first question of determining the ideal circumstances within which the benefit from this geographical diversification is greater.

To do so, the construction of two types of portfolios was executed. The first category comprised of one original portfolio without EMD, and the second category comprised of one portfolios with exposure to EMD. Those portfolios were built with the objective of minimizing volatility and maximizing return, Sharpe and Modified Sharpe ratios.

Then, we determined the Sharpe Ratio and Modified Sharpe Ratio of both portfolios.

The Sharpe Ratio is a metric devised in 1966 as a measure of performance for mutual funds which aims to measure the desirability of a risky investment (Rollinger, T., Hoffman, S., sd). It is determined with the following formula:

$$Sharpe\ ratio = \frac{R_p - R_f}{\sigma_p}$$

Equation 5: Sharpe Ratio Formula

With

- R_p= Portfolio return
- R_f= Risk-free rate
- σ_p= Volatility of the portfolio

The Sharpe Ratio is a very popular and useful tool to quantify the performance of a portfolio. However, "When the distribution of returns cannot be considered as normal, it becomes necessary to rely on performance measures that take non-normality into account. To solve the non-normality issue, Favre & Galeano (2002) and Gregoriou & Gueyie (2003) introduced a modification of the traditional Sharpe ratio, the modified Sharpe ratio (mSR). It is defined as the ratio between the excess return of a market, an asset, or a fund, and its Value-at-Risk or VaR (the definition of VaR appears in appendix A), where VaR is computed using the Cornish Fisher expansion, denoted as mVaRα in the literature, with α being the probability level […]" (Amédée-Manesme, et al., 2017). It can be determined with the following formula:

$$Modified\ Sharpe\ ratio = \frac{R_p - R_f}{mVAR_\sigma}$$

Equation 6: Modified Sharpe Ratio Formula

With

- R_p= Portfolio return
- R_f= Risk-free rate
- $mVAR_\sigma$= Modified Value at Risk which "approximates the VaR under the true (unknown) distribution with the second order Cornish–Fisher expansion" (Ardia & Boudt, 2015)

Once the portfolios were built and the daily returns and the performance measures of the portfolios were collected, we used the methodology explained by Olivier Ledoit and Michael Wolf (2007) to do the necessary comparisons and statistical inferences on the difference (Δ) of the portfolios risk-adjusted performance measures (Sharpe and Modified Sharpe ratios).

The choice of the Sharpe ratio for this analysis was motivated mostly, by its popularity in the finance industry, where both professionals and scholars use it to evaluate the performance of a portfolio and to compare different portfolios. We decided to include the modified Sharpe ratio as an adjunct to our analysis to address the limitations of the Sharpe ratio in certain settings. Indeed, "If one of the funds has non-normally distributed returns, comparing funds

based on the Sharpe ratio is often not enough, as it ignores investors' positive preferences for odd moments and aversion to even moments." (Ardia & Boudt, 2015)

The technique employed on those ratios in our study is referred by Ledoit and Wolf (2008) as the studentized Bootstrap on time-series data method (Boot-TS). As stated, by Ledoit and Wolf (2008), this is the methodology that works well for both time series and independent and identically distributed and time series data.

Lastly, to provide insight into the variation of the impact of emerging market debt into a diversified portfolio depending on the macroeconomic state of the European Union and accessorily depending on the level of risk that an investor might be willing to take, we built and compared the efficient frontiers of both types of portfolios. This analysis comparing the two portfolios has been done on the following periods as per their very nature are fundamentally different in term of macro-environment:

- '08 - '12
- '13 - '19
- '20 – '22

The overall study period has been divided the aforementioned way as each sub-period is characterized by particular movements in some of the key macroeconomic indicators, indubitably leading to changes that have undoubtedly led to a positive or negative impact on investors' portfolios. This thesis focused on:

- Gross Domestic Product which "is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources." (World bank, 2023);
- Consumer confidence index (CCI) which "provides an indication of future developments of households' consumption and saving, based upon answers regarding their expected financial situation, their sentiment about the general economic situation, unemployment and capability of savings. An indicator above 100 signals a boost in the consumers' confidence towards the future economic situation, as a consequence of which they are less prone to save, and more inclined to spend money on major purchases in the next 12 months. Values below 100 indicate a pessimistic attitude towards future developments in the economy, possibly resulting in a tendency to save more and consume less." (OECD, 2023)
- Unemployment rate: "The unemployed are people of working age who are without work, are available for work, and have taken specific steps to find work. The uniform application of this definition results in estimates of unemployment rates that are more internationally comparable than estimates based on national definitions of unemployment. This indicator is measured in numbers of unemployed people as a percentage of the labour force, and it is seasonally adjusted." (OECD, 2023)

- Consumer Price index (CPI) which "reflects changes in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. [...]"
- The central bank policy rate which "is the rate that is used by central bank to implement or signal its monetary policy stance. It is most commonly set by the central banks 'policy making committees (e.g., Fed Open Market Committee)." (IMF, 2023)

    o Periods studied (GDP per capita growth (annual %) - European Union | Data (worldbank.org))
        ▪ Great Recession and Fallout '08 – '12'

This period ranging from 2008 to 2012 was a difficult time for the European Union. Indeed, during this period the EU underwent a global financial crisis and a sovereign debt crisis. The world experienced a recession that lasted from 2008 to 2009 during which European GDP, European inflation plunged radically, and the unemployment rose significantly. This crisis ultimately affected the debts levels of European government with some of them, namely Greece and Portugal defaulted and required a bailout from the EU and the International Monetary Fund. Here is a summary of the movements of the selected indicators:

    o GDP

Figure 20: EU GDP - Great Recession
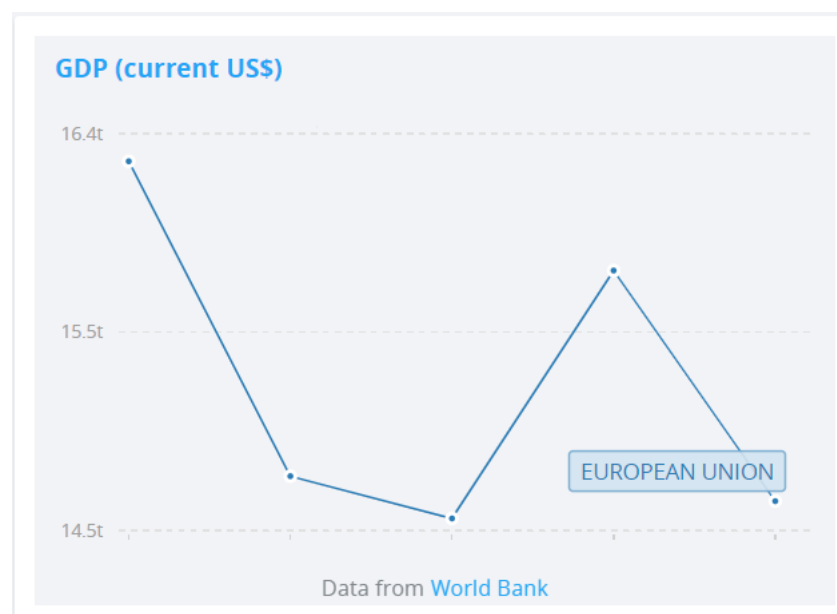
Source : Worldbank. (2023). *GDP (current USD$) – European Union.* Retrieved on May 9th, 2023, from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2012&locations=EU&start=2008

    o Consumer Confidence Index

During this period the monthly CCI peaked at 99,6235 and floored at 96,16221 in the European Union (OECD, 2023).

    o Unemployment rate

During this period, the unemployment rate movements were upward. Indeed, during this period, the unemployment rate increased by 4,3 percentage points, peaking in December 2012 at 11,7% at and flooring in January 2008 at 7,2% at in the European Union (OECD, 2023). Those numbers are worse when we consider only the Euro Area as the floor was at 7,4% in January 2008 and the peak reached 12,3% in December 2012 (Eurostat, 2023). Those upward movement were prompted by the 2008 financial crisis which indirectly impacted the job market as it resulted in a drastic reduction in demand of products and services consumption throughout the continent. Ultimately, the pressure has been felt by businesses that were forced to reduce costs.

- o Change in Consumer Price Index (Inflation rates)

The inflation in the European Union at this period experienced various movements. Indeed, during this period, the growth of the CPI peaked in 2008 at 3,7%, drop sharply to 0,8%, which is the floor that it reached during this period, in 2009 and restarted its increase the next year (OECD, 2023). Those movement are once again explained by the financial crisis and its fallouts.

- o ECB Policy rate

During this period, the ECB policy rate experienced decreases in order to restore the trust in the financial markets and to stimulate the economic activity by making it cheap for the public and the private sectors to access funding. From 2008 to 2012, the interest rates in the Eurozone decreased from 3,75% in October 2008 to 0,75% in December 2012 (ECB, 2023).

- ▪ Expansion '13 – '19

During the period ranging from 2013 to 2019, we saw a recovery of the European economy from the period exposed above. The European Union achieved a return to normality in the GDP growth, experiencing constant yearly growth. Regarding the employment, improvement have been experienced by the union in the unemployment rates. All in all, this period is definitely a step-up from the one before it with signs of recovery seen all around Europe. Here is a summary of the movements of the selected indicators:

- o GDP

GDP (current US$)

Data from World Bank

Source : Worldbank. (2023). *GDP (current USD$) – European Union.* Retrieved on May 9th, 2023 from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2012&locations=EU&start=2008
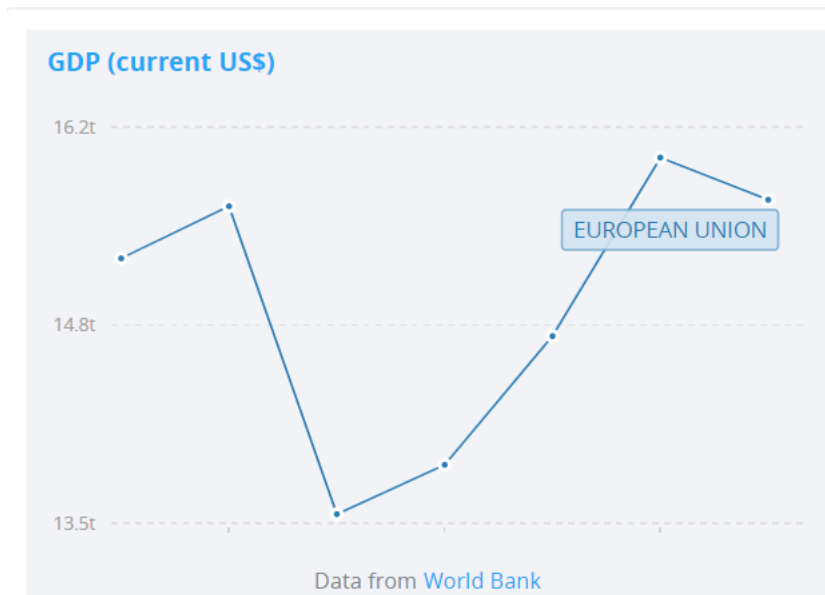
o   Consumer Confidence Index

During this period, the monthly CCI peaked at 102,683 and floored at 96,79428 in the European Union (OECD, 2023).

o   Unemployment rate

In 2013, the Unemployment rate in the European Union initiated a decline that has been near to constant for 7 years. This was a period of recovery for the European Union and the rest of the world after the tumultuous previous period. Indeed, during this period the unemployment rate decreased from its peak at 11,7% to a floor at 6,7% in December 2019 (OECD, 2023). Those movements were prompted by the policies adopted by European governments to boost the European economy.

o   Change in Consumer Price Index (Inflation rates)

During this period, the levels of inflation of the European Union were more relatively low as the maximum that the inflation rate reached was 1,8% in 2018 and the minimum that it reached was 0,2% in 2016.

o   ECB Policy rate

During this period, the ECB policy rate in the European Union continued its fall but at a less important rate. The objective being to continue the recovery efforts and achieving growth throughout the Eurozone despite the challenges that some European economies faced at the time. During this period, the decrease in the policy rate continued from 0,50% in May 2013 to 0,00% in September 2019 (ECB, 2023).

- Covid Crisis '20 – '22

During the period that started in the beginning of 2020, we saw in Europe and in the world a cascade of catastrophes, the first domino to fall being the outbreak of covid 19 in the first quarter of the year. Those elements led to negative impacts in all the economic known metrics, for instance, we witnessed an important reduction in production. Indeed, in 2020, the GDP dropped by 5,7% (OECD, 2023). At the dusk of the global pandemic, the dominoes continued falling with the beginning of a war in Eastern Europe disrupting the supply chain of important industries in Europe and levels of inflation reaching all times high throughout European economies. Here is a summary of the movements of the selected indicators:

- o Change in GDP (2020 to 2021)

Figure 22: EU GDP - COVID Crisis
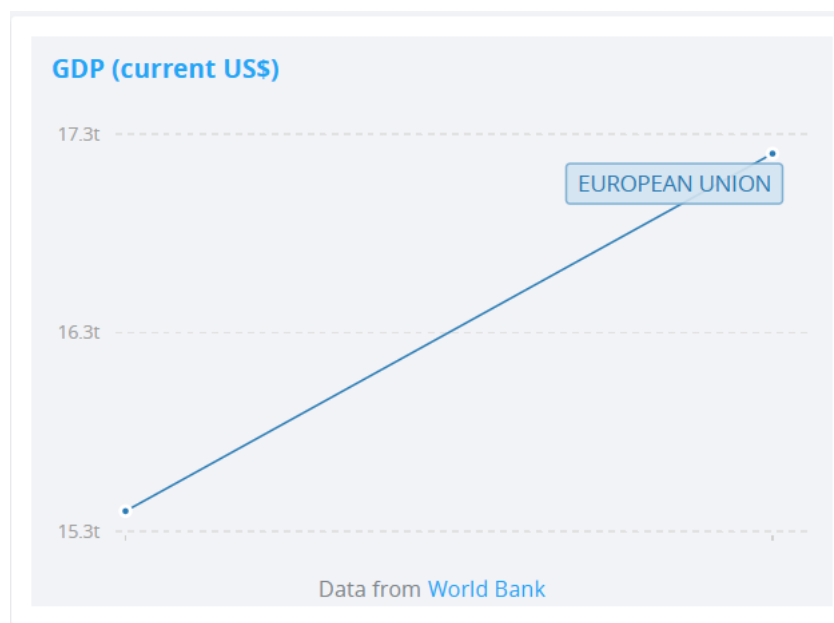
Source : Worldbank. (2023). *GDP (current USD$) – European Union.* Retrieved on May 9th, 2023, from https://data.worldbank.org/indicator/NY.GDP.MKTP.CD?end=2012&locations=EU&start=2008

- o Consumer Confidence Index

During this period, the monthly CCI peaked at 101,8668 and floored at 93,65088 in the European Union (OECD, 2023).

- o Unemployment rate

The movements of the unemployment rates in the European union during this period experienced a radical change in the beginning of 2020. Indeed, in the first quarter of 2020, the constant reduction of this metric was stopped a reversed due to the Covid-19 outbreak and the measures taken to tackle this disease. The unemployment rate in the EU peaked at 7,8% in the EU in September 2020, stagnated for a few months and resumed its fall by the end of 2021.

- o Change in Consumer Price Index (Inflation rates)

This period started with similar movement in the inflation rates of the European Union. However, in 2022, the inflation rate soared to an impressive level of 9,2% (OECD, 2023). This movement can be explained by a succession of events that occurred in the world. To name a few, the pandemic which had an unprecedented effect on demand of goods and services, and the Russian invasion of Ukraine and the international community sanctions on the invader that caused a sharp increase in Energy prices.

- o ECB Policy rate

During this period, the ECB policy rate remained stable at 0,00% until July 2022 when due to impressive levels of inflation recorded at 8,3% by 2022 end. The ECB, whose primary objective is to maintain price stability and the purchasing power of the Euro, found itself in a situation where it had to slow down the economy in order to tackle the inflation problem. Since July 2022, the ECB Policy rate increased from 0,50% to 2,50% by the end of the year.

In the meantime, in Emerging markets, during the:

- ▪ Great recession and Fallout 08'-12'

Llaudes et al. (2010) highlighted that even though the global crisis initiated in financial centers of advanced economies, emerging markets (EMs) bore a significant impact. Specifically, the median EM's output decline was slightly larger than that of the median advanced economy, measured at 4.9% compared to 4.5%. This impact was uneven across EMs. Some were more affected than the hardest-hit advanced economies, while others experienced growth throughout the crisis. Additionally, when observing high-frequency financial variables, there was a considerable cross-country variability within EMs.

Similarly, Miyajima et al. (2015) noted that from mid-2009, the global economy's recovery was marked by two distinct events. Notably, even after the 2010-euro area debt crisis, capital inflows into EMEs remained robust. As Graph 1 in their study depicts, mutual funds dedicated to EM bonds saw cumulative net inflows increase from just over $20 billion at the end of December 2009 to $180 billion by the end of May 2013. About half of these inflows targeted local currency denominated bonds.

Kose & Ohnsorge (2021) further observed that some emerging market developing economies (EMDEs) managed the crisis more effectively than others. Notably, countries with fewer dependencies on external trade and finance, stronger pre-crisis fundamentals, and quicker, more aggressive policy responses experienced less severe growth decelerations. Notably, China and India were among the first to recover due to prompt policy measures. However, EMDEs heavily reliant on short-term and potentially volatile capital flows struggled, especially those in ECA.

Figure 23: EMs GDP Growth
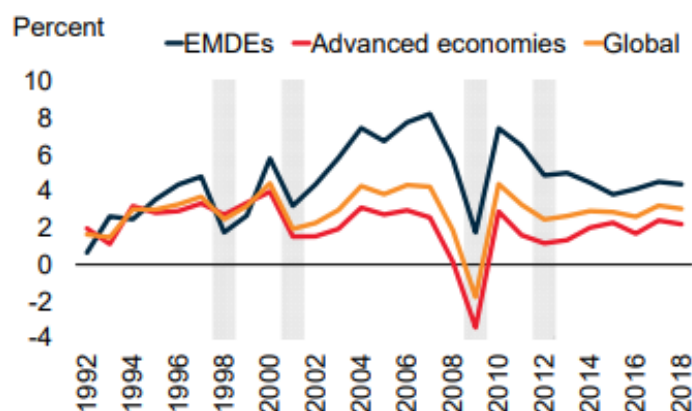
Source: Kose, M. A., & Ohnsorge, F. (2021). *A Decade after the Global Recession: Lessons and Challenges for Emerging and*

Developing Economies. World Bank Publications.

Figure 24: EMDs during the Great recession
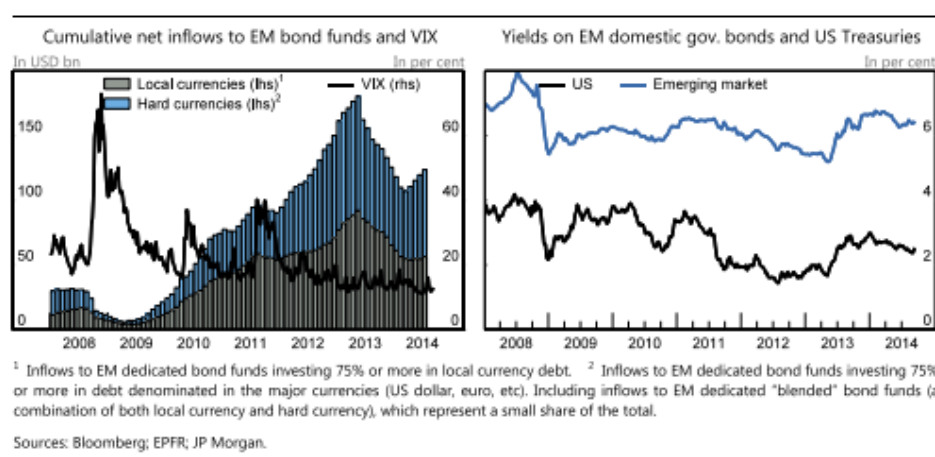
Source: Miyajima, K., Mohanty, M., & Chan, T. (2015). Emerging market local currency bonds: Diversification and stability.

Emerging Markets Review, 22, 126-139. https://doi.org/10.1016/j.ememar.2014.09.006

▪ Expansion 13'-19'

"Since the 2009 global recession, EMDE growth has slowed, from a peak of 6.5 percent in 2011 to a trough of 3.8 percent in 2015, continuing at a moderate 4.3 percent during 2017-19. This still robust, albeit slowing, growth in EMDEs, combined with the sluggish post recession recovery in advanced economies, has resulted in a growing role of EMDEs in the global economy. By 2018, the share of EMDEs increased to 39 percent of global GDP, compared with 31 percent in 2007. Given the increasing importance and international connectedness of EMDEs, an adverse shock originating in any part of the world economy could generate greater spillovers to EMDEs than those associated with the 2009 global recession." (Kose & Ohnsorge, 2021)

The deceleration in economic growth during this period can be attributed, in part, to the downturn in the commodities market. The uncertain trajectory of commodity prices during that period brought adverse effects on emerging markets, as they are often major exporters of raw materials.

- Ongoing Crisis since 20'

Duttagupta & Pazarbasioglu (2021) observed that after a brief phase of financial distress in March 2020, the majority of emerging markets managed to re-engage with global financial markets, thereby issuing new debt to fulfill their financing demands.

Boucher (2023) emphasized the profound ramifications of the pandemic and geopolitical tensions on the global economic landscape. These events intensified inflationary pressures globally, leading to the major monetary entities increasing their interest rates to unparalleled levels. Emerging nations felt the pinch of escalating energy and food costs, combined with the dollar's strength affecting their exports. Consequently, their central banks opted for a more restrictive monetary approach. Furthermore, this crisis emphasized the widening chasm between the two dominant global powers and spotlighted the vulnerabilities in developed nations' reliance on certain emerging economies.

Figure 25: Emerging Market global Bond index spreads
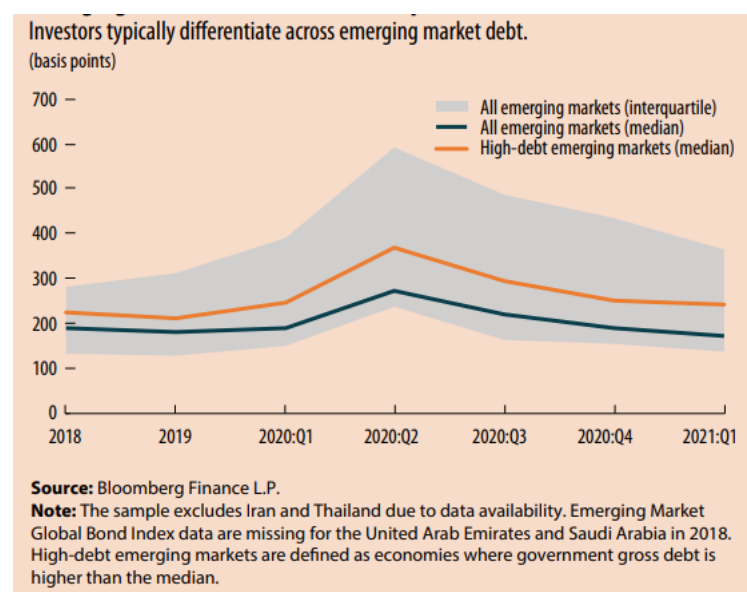
Source: Duttagupta, R., Pazarbasioglu, C. (2021). *Miles to Go: The Future of Emerging Markets – IMF F&D.* Retrieved on June 6th, 2023 from https://www.imf.org/external/pubs/ft/fandd/2021/06/the-future-of-emerging-markets-duttagupta-and-pazarbasioglu.htm

Figure 26: EMDs GDP - COVID Crisis
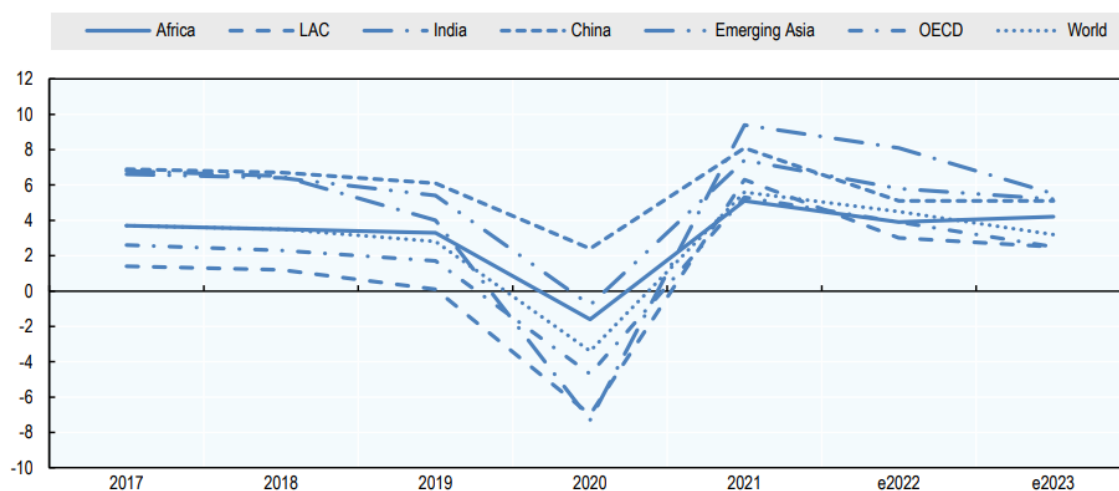
Note: OECD: Organisation for Economic Co-operation and Development – e2022/e2023: estimated projections
Source: OECD (2021), *OECD Economic Outlook, Volume 2021 Issue 2*, https://dx.doi.org/10.1787/66c5ac2c-en.

In 2022, emerging economies initially rebounded from the COVID-19 pandemic, benefiting from strong fundamentals and flexible exchange rates. However, the outbreak of the war in Ukraine caused a slowdown in GDP growth for emerging markets. Despite this, China and India contributed to modest global growth, with India experiencing rapid economic expansion and China surpassing expectations despite challenges.

Figure 27: Inflation drivers during the Covid Crisis
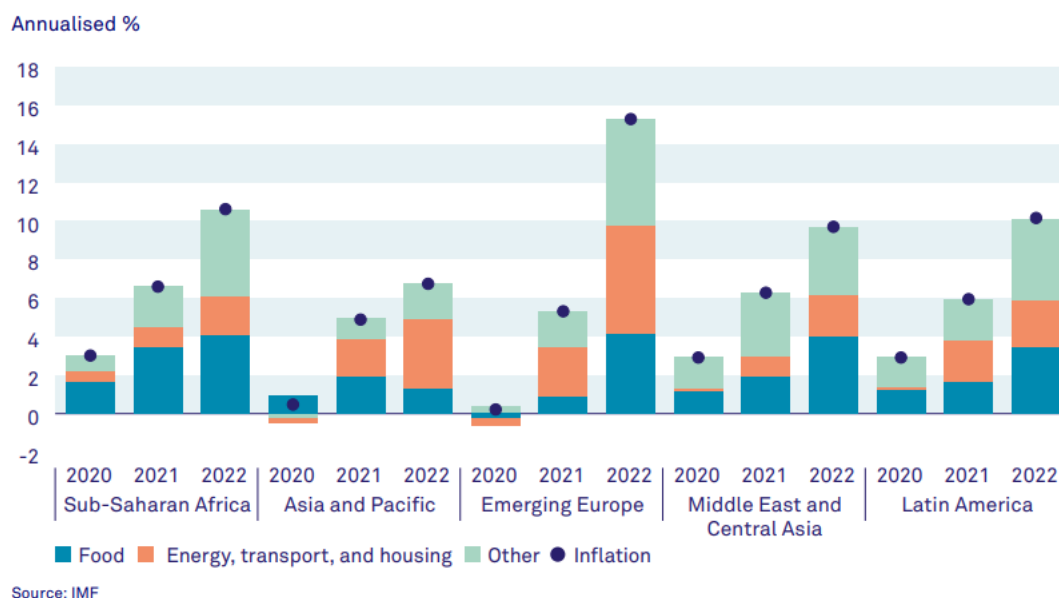
Source : Triodos Investment management (2023). *Emerging markets: The resilient and the vulnerable.* Emerging market outlook 2023. Retrieved on June 6th ,2023 from https://www.triodos.be/binaries/content/assets/tbbe/nl/economic-outlook/emerging-markets-outlook-2023.pdf

RESULTS AND FINDINGS

This thesis aims to provide insight into the potential candidacy of emerging market debt as a diversification tool for a portfolio. The pursuit of this research objective led us to conduct a series of rigorous experiments, each contributing crucial elements towards answering the primary question. This section is structured into three main parts, each revealing vital insights.

Firstly, using daily log returns of indexes that span from August 2014 to December 2022, which were acquired from Bloomberg on July 14th, 2023, we analysed the descriptive statistics. We then performed a correlation analysis to examine the interrelationships between Emerging Market fixed-income assets and assets from other markets. Evaluating the level of correlation between these assets provides valuable insight into the diversification benefits of merging markets' debt.

Secondly, using index returns spanning from December 31st, 2007, to December 31st, 2022 and retrieved from Bloomberg on July 14th, 2023 a portfolio analysis and inference tests part in which we compare the risk-return performance metrics of two types of portfolios: a diversified balanced Europe biased portfolio and its equivalent with emerging markets debt during a 15-year period. The evaluation of risk-return characteristics and semi-parametric statistical inference tests helps discern the impact of including emerging market debt on portfolio performance.

Lastly, our study includes an efficient frontier analysis, where we compare the efficient frontiers of both strategies mentioned earlier across three distinct periods (see Supra p. 46), each characterized by unique macroeconomic conditions. Through this analysis, we gained valuable insights into the optimal macroeconomic characteristics to maximize the diversification benefits of Emerging Market debt.

Our rigorous analysis is complemented by the use of relevant visual aids, including tables and charts, to enhance the clarity and presentation of the findings.

1. Correlation analysis of emerging debt with other asset classes

As mentioned earlier, the initial step in assessing the risk-return impact of including emerging market debts in a diversified portfolio involves conducting a correlation analysis. This analysis aims to measure the relationship between emerging market debts and other frequently utilized asset classes for diversification purposes.

Before conducting the correlation analysis, we carried out a descriptive statistical analysis of the data. The table below presents a summary of the results of this analysis.

Table 4: Descriptive statistics on Indexes daily log returns (Correlation analysis)

	Commodities	Green Bonds	DM-Equity	DM-Treasury Bonds	US-Corp Bonds	EUR-Corp Bonds	EM-Equities	EM-Treasury	EM-Corp Bonds
Mean	-0,000147692	-6,94339E-05	0,000190124	-5,36972E-05	7,03933E-05	5,43023E-06	-4,93158E-05	5,25638E-05	7,22483E-05
Standard Error	0,000313063	7,6788E-05	0,000209943	8,68263E-05	7,53931E-05	4,04489E-05	0,000219344	9,37753E-05	5,3269E-05
Median	0,000359421	0	0,000469284	3,4621E-05	0,00011254	6,16853E-05	0,000418302	0,000164724	0,00025583
Mode	0	0	0	0	0	0	0	0	0
Standard Deviation	0,014670617	0,003598402	0,009838265	0,00406881	0,003533032	0,001895496	0,010278799	0,004394452	0,002496265
Sample Variance	0,000215227	1,29485E-05	9,67915E-05	1,65552E-05	1,24823E-05	3,5929E-06	0,000105654	1,93112E-05	6,23134E-06
Kurstosis (Flattening Coefficient)	7,928861631	5,170441861	17,52727642	3,270624308	12,6058602	15,75794821	4,725689511	33,9878902	57,17048646
Skewness	-0,847336391	-0,350840761	-1,101814789	-0,122545457	-1,178307561	-1,169005555	-0,483910998	-2,304938138	-3,691361567
Range	0,20139013	0,046817434	0,188479695	0,046087805	0,061242663	0,033313731	0,125162705	0,095716841	0,059020505
Minimum	-0,125224025	-0,024143094	-0,104417216	-0,02438477	-0,039274714	-0,022455855	-0,06942533	-0,056058547	-0,039579623
Maximum	0,076166106	0,02267434	0,084062479	0,021703035	0,021967949	0,010857875	0,055737375	0,039658294	0,019440881
Sum	-0,324332409	-0,152476744	0,417511526	-0,11791908	0,154583696	0,011924785	-0,108297498	0,115430139	0,158657204
Number of Samples	2196	2196	2196	2196	2196	2196	2196	2196	2196

A few factors attract the attention of this table. To begin with, we observe that with the exception of commodities, green bonds, DM treasuries and EM Equities, all the markets present a positive expected return. When it comes to the volatility of those markets, we can observe that commodities and EM equities tend to lead the way in terms of volatility of returns. Concerning the distribution of returns, none of the markets displays normally distributed returns. However, it is worth noting that DM treasuries present a kurtosis (3.27) and a skewness (-0.122) level close to the thresholds suggesting a distribution that closely aligns with normalcy.

The previous and subsequent analyses were performed using the same daily log returns of predefined indexes (see Supra p. 44) that represent distinct markets, each with unique characteristics. For the purpose of this study, we limited ourselves to indices that offered exposition to Capital markets assets and Consumable/Transformable assets. The data consisted of daily log returns of each index for a period spanning from August 2014 to December 2022 and that were acquired from Bloomberg on July 14th, 2023.

Table 5: Correlation analysis

	Commodities	Green Bonds	DM-Equity	DM-Treasury Bonds	US-Corp Bonds	EUR-Corp Bonds	EM-Equities	EM-Treasury	EM-Corp Bonds
Commodities	1								
Green Bonds	0,05784	1							
DM-Equity	0,36908	0,22174	1						
DM-Treasury Bonds	-0,02121	0,72461	-0,00849	1					
US-Corp Bonds	-0,05600	0,54008	0,09850	0,58476	1				
EUR-Corp Bonds	0,03304	0,47097	0,21962	0,41492	0,58674	1			
EM-Equities	0,32174	0,21805	0,58038	-0,00123	0,08460	0,18604	1		
EM-Treasury	0,24076	0,46885	0,53570	0,27568	0,48244	0,49225	0,55959	1	
EM-Corp Bonds	0,16977	0,42223	0,29999	0,32209	0,49966	0,49638	0,42232	0,74040	1

The analysis clearly indicates notably low correlation levels between Emerging Market debt and other markets.

There are however some outliers, such as the relationship between the returns of treasury EMD and developed markets equity. Indeed, we observed during this period a correlation of 0.53570 between emerging markets treasury and developed markets equity. As this shows a positive but moderately linked relationship between the two asset categories, it does limit the diversification advantages the combination would offer. Despite this, as they do not move

in perfect synchronization, a portfolio manager can still derive benefits from including this asset combination.

Secondly, we can mention the relationship between US-corporate bonds and sovereign emerging market debt. Indeed, we noticed a correlation coefficient of 0.48244. While this figure is relatively high, it does not significantly reduce the diversification benefits of combining these asset classes. Nevertheless, it does require attention. This moderately high correlation can be partly attributed to the fact that both the J.P. Morgan EMBI Global Core Index and the Bloomberg US Corporate Investment Grade Bond Index are denominated in US currency, tying them together in this aspect.

2. Portfolio analysis

In this section, we analysed the performances of two portfolios for a period of 15 years going from 2008 to 2022: the first one was composed of three types of assets: Euro-equity, Euro-sovereign Bonds and Euro-corporate Bonds and the second one was better geographically diversified as it was composed of five types of assets: Euro-equity, Euro-sovereign Bonds, Euro-corporate, EM-sovereign bonds in local currency and EM-sovereign bonds in hard currency. Both these portfolios were built to maximize their respective returns, and Sharpe ratios and minimize their respective volatility.

For the reasons stated above (see Supra p.41), we selected a passive portfolio strategy through indexes to conduct this experiment.

2.1. Descriptive statistics of the data

In this section, we present the descriptive statistics of the assets that constituted the portfolios. As outlined above, those are balanced portfolios passively managed through the following indexes: MSCI EUR, Bloomberg Euro-Aggregate Treasury Bond Index, Bloomberg Euro-aggregate corporate bond index, GBI-EM Global Diversified 10% Cap 1% Floor index and JP Morgan EMBI Global Core Index.

For those indexes, we extracted from Bloomberg the daily end price for a period spanning from December 31st, 2007, to December 31st, 2022. Subsequently, we conducted two sets of calculations on those data:

First, we determined their overall achieved return over the entire 15-year study period. Second, we computed the daily returns of the index using the following formula:

$$Daily\ return_N = \ln\left(\frac{Price_N}{Price_{N-1}}\right)$$

Equation 7: Daily Log Return Formula

This second operation gave us 3913 observations whose descriptive analyses are summarized in the table (see Table 6) and whose distributions are graphically presented on the graphs (see Figure 28).

- Euro-equity through the index MSCI EUR

We determined the overall performance achieved by the index throughout the entire study period The MSCI EUR index reported an overall return of 13.23% for the 15-year period, with an associated volatility of 19.36%.

Regarding their distribution(see Figure 28), and as observable in the graph below the daily log returns of the MSCI EUR index from 2008 to 2022, with a kurtosis of 9.3285, reveal a noteworthy distribution characteristic: this kurtosis coefficient value, being significantly greater than 3, indicates as explained by DeCarlo, L. T. (1997), a leptokurtic shape rather than a Normal distribution, implying as we can see on the graph a higher concentration of data around the mean and more frequent occurrences of extreme events.

- Euro-Sovereign debt through the index Bloomberg Euro-Aggregate Treasury Bond Index

We determined the overall performance achieved by the index throughout the entire study period. Notably, the index's overall realized return amounted to 42.31%, and its volatility stood at 4.48%.

Regarding their distribution (see Figure 28), the daily returns of the Bloomberg Euro-Aggregate Treasury Bond Index for the studied period have a kurtosis coefficient of 4.7218. This reveals a rather leptokurtic distribution than Normal pattern. The kurtosis coefficient value, being greater than 3, as explained by DeCarlo, L. T. (1997) indicates heavier tails and a higher peak compared to a normal distribution. The graph below illustrates this characteristic, demonstrating a distribution with more extreme values and a sharper peak around the mean.

- Euro-Corporate debt through the index Bloomberg Euro-aggregate corporate bond index

We determined the overall performance achieved by the index during the entire studied period. The overall realized return for the Bloomberg Euro-aggregate corporate bond index amounted to 45.90%, accompanied by volatility of 2.98%.

Regarding their distribution (see Figure 28), the daily returns of the Bloomberg Euro-aggregate corporate bond index, for the studied period has a kurtosis coefficient of 10.3741. This reveals a rather leptokurtic distribution than Normal pattern. A kurtosis value of 10.3741, which is way higher than 3, indicates, as explained by DeCarlo, L. T. (1997) a very high degree of tailedness, with a much higher concentration of data points around the mean and even more frequent occurrences of extreme events. The graph of the distribution below illustrates this distribution with remarkably heavy tails and a sharp peak in the centre.

- EM-Sovereign debt through hard-currency the index JP Morgan EMBI Global Core Index

We determined the overall performance achieved by the index during the entire studied period. The overall realized return for the JP Morgan EMBI Global Core Index amounted to 88.79%, accompanied by a volatility of 6.57%.

Regarding their distribution (see Figure 28), the daily returns of the JP Morgan EMBI Global Core Index for the period going from 2008 to 2022 present a kurtosis coefficient of 44.8598. This is the sign of an exceptionally leptokurtic distribution. A kurtosis value of 44.8598, which is way higher than the kurtosis coefficient of the normal distribution indicates as explained by DeCarlo, L. T. (1997), an extremely high degree of tailedness, with a much higher concentration of data points around the mean and even more frequent occurrences of extreme events. The graph below illustrates this phenomenon.

- EM-Sovereign debt local-currency through the index JP Morgan GBI-EM Global Diversified 10% Cap 1% Floor

We determined the overall performance achieved by the index during the entire studied period. The overall realized return for the JP Morgan GBI-EM Global Diversified 10% Cap 1% Floor amounted to 24.80%, accompanied by volatility of 10.07%.

Regarding their distribution (see Figure 28), the daily returns of the GBI-EM Global Diversified 10% Cap 1% Floor index have a kurtosis coefficient of 6.2820. This reveals a noteworthy distribution characteristic: This kurtosis coefficient value, being significantly greater than 3, indicates as explained by DeCarlo, L. T. (1997), a leptokurtic shape rather than a normal distribution, implying as we can see on the graph a higher concentration of data around the mean and more frequent occurrences of extreme events.

As one would expect the Emerging Market debt, both in hard and local currency rank before the corporate and sovereign debt in Europe in terms of high volatility: Emerging Market Debt (EMD) in both local and hard currency exhibits higher volatility when compared to Euro sovereign and corporate bonds. Due to its higher volatility profile, Emerging Market Debt (EMD), both in hard and local currency may not be suitable for all types of investors. While this volatility and exacerbated uncertainty can present opportunities for potentially higher returns, it also comes with the potential for significant losses. Before considering EMD as part of their portfolio, investors should carefully assess their risk tolerance, time horizon, and overall financial goals.

Here is the summary of the descriptive statistics of all those assets:

Table 6: Descriptive statistics of daily log returns of Indexes (Portfolio analysis)

	EMD_hardCurrency	EMD_LocalCurrency	MSCI EUR	EUR_Govies	EUR_Corp
Mean	0,000162918	5,76058E-05	2,8565E-05	9,18775E-05	9,79971E-05
Standard Error	6,61346E-05	0,000101383	0,000195	4,51197E-05	3,00229E-05
Median	0,000281809	0,000231241	0,000433783	0,000115405	0,000130898
Mode	0	0	0	0	0
Standard Deviation	0,004136981	0,006341908	0,012198021	0,002822414	0,001878054
Variance of the sample	1,71146E-05	4,02198E-05	0,000148792	7,96602E-06	3,52709E-06
Kurstosis	44,85980361	6,282065216	9,328464214	4,721803337	10,37415391
Skewness	-2,594551522	-0,52681919	-0,462921439	-0,073273581	-0,975012983
Range	0,100223984	0,090085904	0,218924091	0,035507689	0,033313731
Minimum	-0,059771423	-0,050533399	-0,123144436	-0,016996966	-0,022455855
Maximum	0,040452562	0,039552505	0,095779654	0,018510723	0,010857875
Sum	0,637499968	0,225411442	0,111774805	0,359516652	0,383462826
Number of Samples	3913	3913	3913	3913	3913
Realized return 2008 - 2022	88,79%	24,80%	13,23%	42,31%	45,90%
Annualized Volatility	6,57%	10,07%	19,36%	4,48%	2,98%
Annualized Expected return	4,19%	1,46%	0,72%	2,34%	2,50%

Figure 28: Distribution of daily log returns of Indexes (Portfolio Analysis)
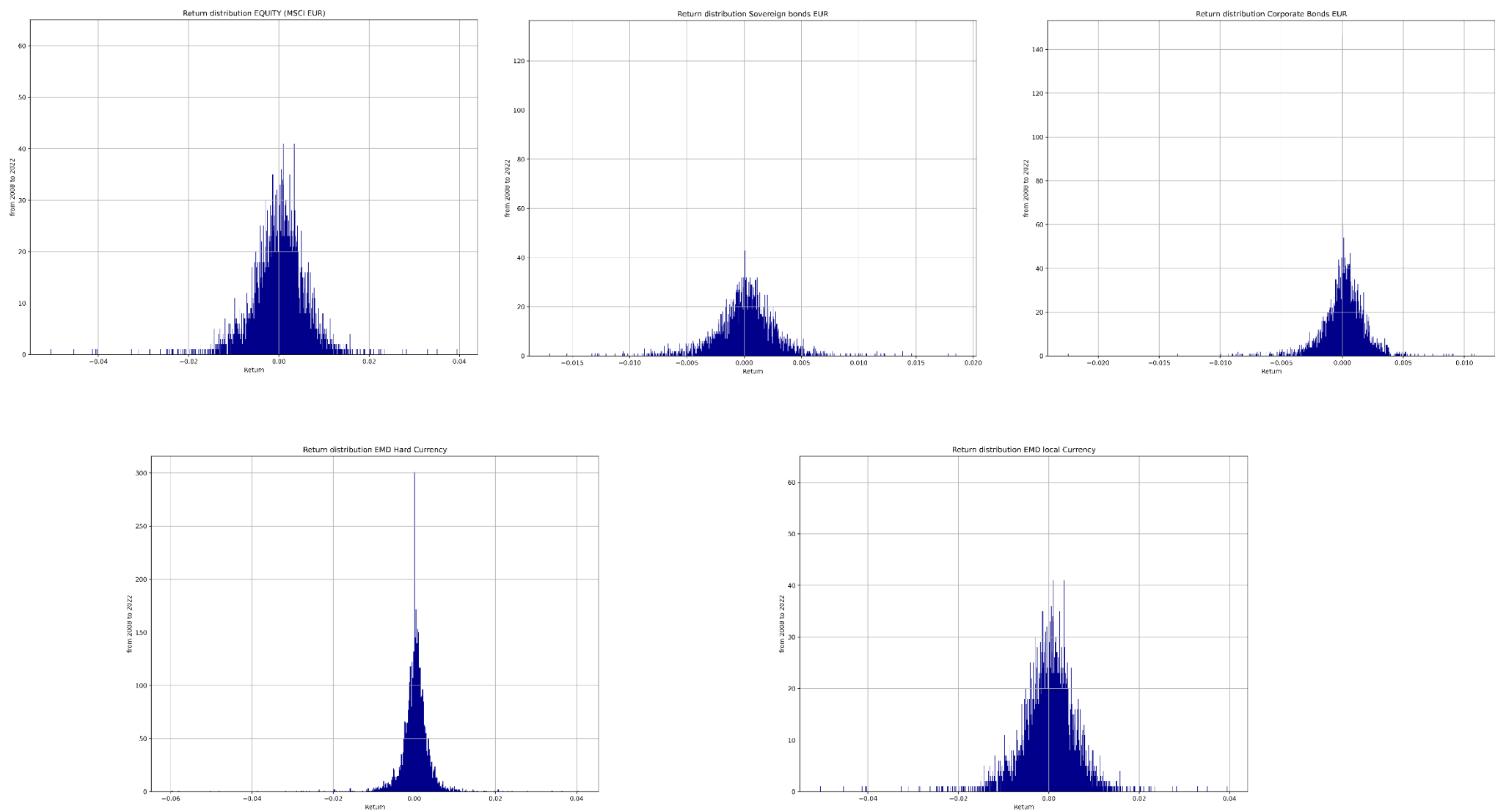
2.2. Portfolio construction: Asset-allocation

To determine the optimal portfolios, we used a Python library named "PyPortfolioOpt" (See Appendix 1: Python code – Portfolio optimisation). It "is a library that implements portfolio optimization methods, including classical efficient frontier techniques and Black-Litterman allocation, as well as more recent developments in the field like shrinkage and Hierarchical Risk Parity, along with some novel experimental features like exponentially weighted covariance matrices." (Martin, 2018)

This tool allowed us to determine the optimal portfolio weights based on the daily return data collected from December 31st, 2007 to December 31st, 2022. Also, to ensure minimum exposure to each type of asset, a minor condition was introduced. It required that a minimum of 5% of the portfolio be invested in each asset category at all times.

From this tool, we extracted the following weighting schemes. Firstly, the portfolio with a Eurocentric strategy has been built with the following asset allocation:

- Euro-Equity through the MSCI EUR index had a 5% capital allocation.
- Euro-sovereign bonds through the Bloomberg Euro-aggregate treasury bond index had a 5% capital allocation.
- Euro-corporate bonds through the Bloomberg Euro-aggregate corporate bond index had a 90% capital allocation.

Secondly, the geographically diversified portfolio with EMD has been built with the following capital allocation:

- Euro-Equity through the MSCI EUR index had a 5% capital allocation.
- Euro-sovereign bonds through the Bloomberg Euro-aggregate treasury bond index had a 5% capital allocation.
- Euro-corporate bonds through the Bloomberg Euro-aggregate corporate bond index had a 5% capital allocation.
- Hard-Currency Emerging Markets Debt through the JP Morgan EMBI Global Core Index had an 80% capital allocation.
- Local-currency Emerging markets debt through the GBI-EM Global Diversified 10% Cap 1% Floor index had a 5% capital allocation.

The levels for both those portfolios have been set respecting the following conditions:

- In accordance with the optimization problem that seeks to minimize the volatility of the portfolio, 100% of the AuM must be invested at all times. (See Supra p. 9)
- In accordance with the optimization problem that seeks to determine the optimal portfolio, the allocation should maximize the return and the Sharpe ratio and minimize the volatility. (See Supra p.9)
- An additional diversification condition had been added to these investment strategies in order to ensure that the portfolio would be exposed to all the indices. This condition is that at least 5% of the portfolio must be invested in each asset.

Here is a summary of the descriptive statistics of those built portfolios:

Table 7: Descriptive statistics on Monthly Log returns of Portfolios

PF With EMD		PF Without EMD	
Moyenne	0,000156848	Moyenne	9,38947E-05
Erreur-type	6,40955E-05	Erreur-type	2,96273E-05
Médiane	0,000271905	Médiane	0,00015894
Mode	0	Mode	0
Écart-type	0,004008915	Écart-type	0,001853066
Variance de l'échantillon	1,60714E-05	Variance de l'échantillon	3,43386E-06
Kurstosis (Coefficient d'aplatissement)	42,50472217	Kurstosis (Coefficient d'aplatissement)	11,11680086
Coefficient d'asymétrie	-2,541204943	Coefficient d'asymétrie	-1,079828125
Plage	0,093898008	Plage	0,032694687
Minimum	-0,05591042	Minimum	-0,02204622
Maximum	0,037987588	Maximum	0,010648467
Somme	0,613590887	Somme	0,367316096
Nombre d'échantillons	3912	Nombre d'échantillons	3912
Annualized Expected return	4,03%	Annualized Expected return	2,39%
Volatility	6,36%	Volatility	2,94%

Indeed, we can observe in the table above that the geographically diversified portfolio exhibits an annualized expected return of 4.03% which is approximately 60% higher than the portfolio without Emerging market debt (EMD). However, it's important to note that this increased return comes with a trade-off, as the volatility of the geographically diversified portfolio more than doubles compared to the Europe biased portfolio. This strongly impacts the risk-adjusted return indicators of the portfolio.

The graph below illustrates the performance comparison between the portfolios, With Emerging Markets Debt (PFWEMD) and Without Emerging Markets Debt (PFWOEMD), over time. It is evident from the graph that, except for a brief period between 2008 and 2009, the geographically diversified portfolio consistently outperformed the Euro-centric portfolio. What is more, from 2009 onwards, the portfolio with emerging market debt displayed a remarkable upward trend, maintaining a steady and superior growth trajectory. Notably, the largest spread between the two portfolios occurred between 2020 and 2022, indicating a significant performance gap in favour of the portfolio with emerging market debt. During this period, an investor since January 2008 would have doubled his initial investment. Overall, the graph below underscores the long-term success of the portfolio with emerging market debt, making it a compelling choice for investors seeking consistent growth and returns.
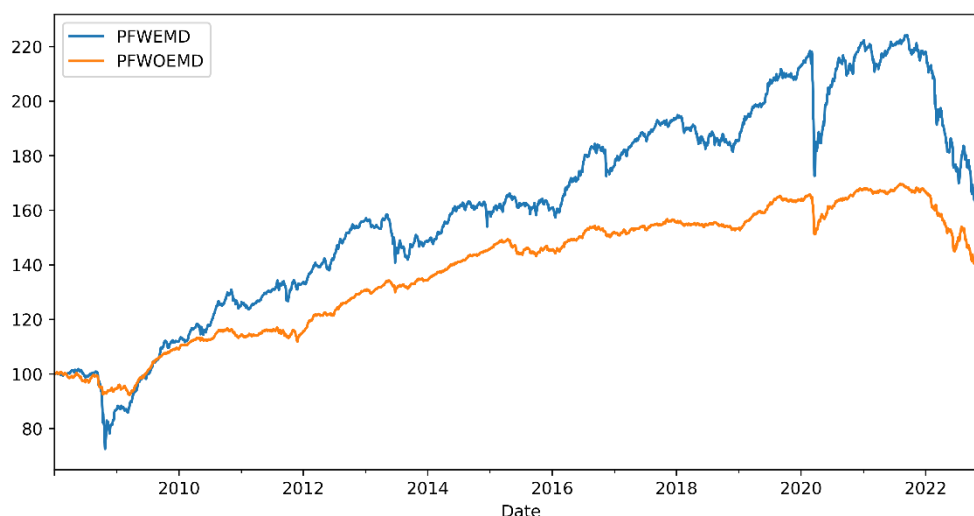
Additionally, the graph highlights an important aspect regarding the two portfolios, with emerging market debt (PFWEMD) and without emerging market debt (PFWOEMD): the level of volatility. It showcases a higher level of volatility from the portfolio with Emerging markets debt compared to its counterpart without Emerging markets debt. This increased volatility significantly impacts the risk profile of the PFWEMD portfolio. While PFWEMD may offer higher expected returns, it also comes with a higher risk level due to its increased volatility, making it essential for investors to carefully assess their risk tolerance and investment objectives before choosing to diversify thanks to Emerging Market fixed income assets.

Based on two key observations, which were that the PFWEMD has a better return profile than the PFWOEMD whereas it seconds the PFWOEMD in terms of volatility, we were motivated to compare the risk-adjusted return metrics of the Eurocentric strategy and the geographically diversified strategy. These metrics are crucial as they factor in both the volatility and the return, providing a comprehensive view to determine the superior strategy. In addition, we conducted statistical inference tests on these metrics to verify the significance of our findings.

2.3. Inference tests

The graph and the table above give two important pieces of information on the addition of Emerging market debt to a portfolio strategy aimed at maximizing the return and minimizing the volatility: firstly, the collected set of data showcases an important increase in the realised return over the studied period and the expected return of the portfolio diversified with emerging market debt from the Europe biased portfolio. Secondly, the collected set of data showcases an important increase in the volatility of the portfolio diversified with emerging market debt in comparison with the Europe biased portfolio. This raises the question at the centre of this thesis which is "what is the risk-return impact of this change of investment strategy?".

We, therefore, conducted inference tests on the risk-adjusted return indicators of both portfolios to test, at confidence levels of 90% and 85%, whether the inclusion of emerging markets debt truly provides advantages for the investor. By subjecting the data to rigorous analysis, we sought to determine the significance of incorporating emerging markets debt in a portfolio and its potential impact on risk-adjusted performance.

The statistical t-test for the collected data was conducted following the approach presented by Ledoit & Wolf (2008). In their work, they introduced inference methods as an alternative to the traditional Jobson and Korkie test to assess the difference in Sharpe ratios between two distinct investment strategies. By adopting Ledoit and Wolf (2008)'s methodology, we aimed to make robust and reliable comparisons between the performance of the two investment strategies based on their respective Sharpe and Modified Sharpe ratios.

In practice, for the execution of the T-tests, the Luck-Corrected Peer Performance Analysis library in R called "PeerPerformance" (see Appendix 4: R code – Inference tests) was used as a valuable tool on the realised returns of the portfolios for the period going from 2008 to 2022. This package provides an efficient and user-friendly framework for performing various performance analysis tasks, including hypothesis testing, on investment strategies. Thanks to the capabilities of the "PeerPerformance" library, we were able to implement the statistical T-tests on the realised monthly log returns of the portfolios with Emerging market debt and the portfolio without Emerging market debt. Thus, because those are the default settings of the packages.

The package's functionalities provided robust and accurate results, facilitating a comprehensive assessment of the differences in Sharpe ratios and Modified Sharpe ratios between the two investment strategies.

- o Normality test on the monthly log returns

Before diving into the results, it is important to grasp the reasons that motivated us to use the studentized bootstrap on time series methodology to realise our statistical inferences. We tested the normality of the monthly log returns of the portfolios from the January 2008 to December 2022.

We conducted this test using 180 observations and obtained the following p-values:

- The portfolio with Emerging Market debt (PFWEMD): p=0.000
- The portfolio without Emerging Market debt (PFWOEMD): p=0.000

The null hypothesis, which states that the monthly log returns follow a normal distribution, was rejected based on these results.

The following graphs (see Figure 30) tell the same story, as we outline the influence of the residuals in the tails of the distribution. As observable, we clearly see the graph curving away from the line at the ends implying abnormal tails compared to a normal distribution.

Q-Q Plot for Monthly Log Returns of PFWEMD

Q-Q Plot for Monthly Log Returns of PFWOEMD
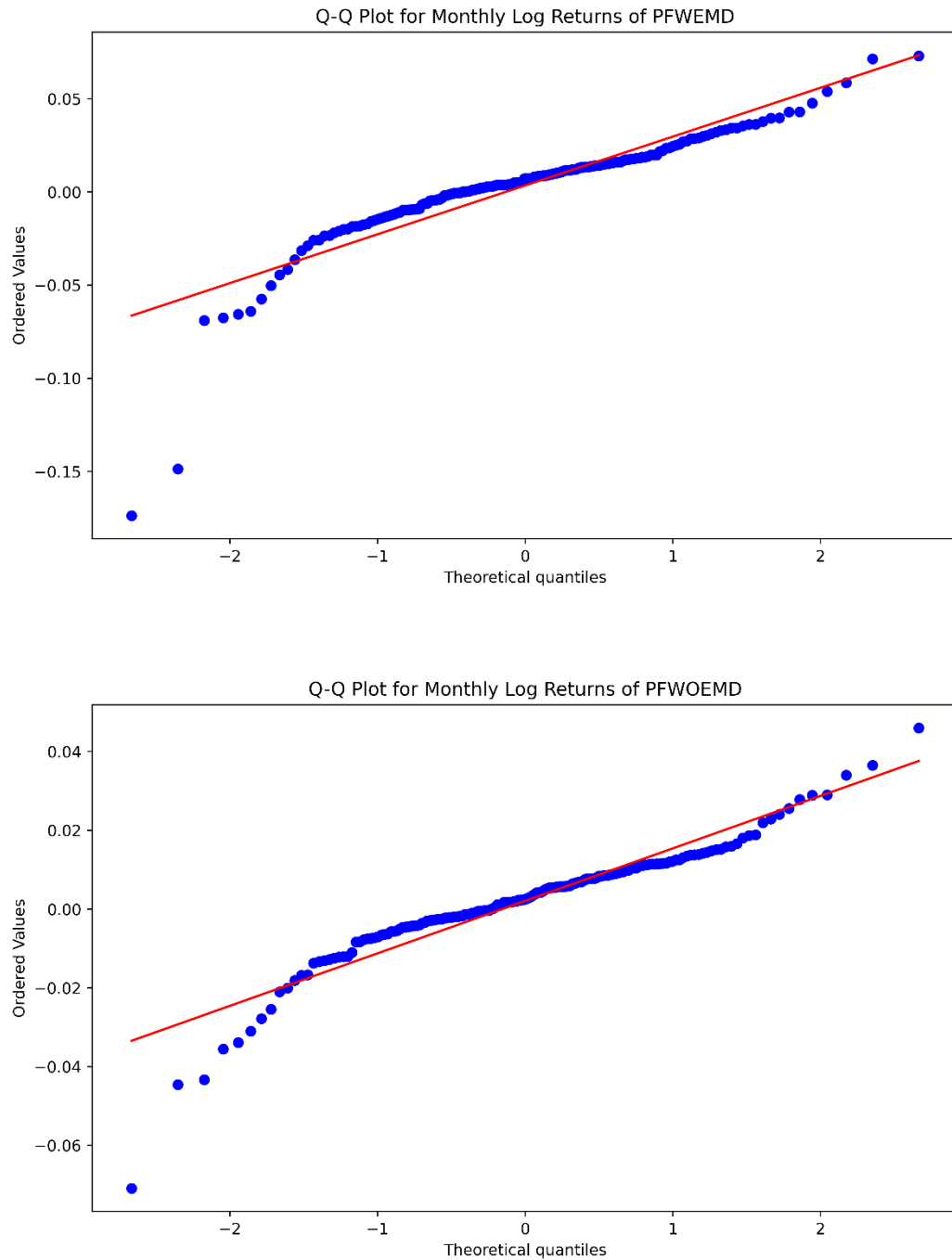
This is why we chose a semi-parametric approach to compare the risk-adjusted performance metrics of the portfolios instead of a parametric one.

The null hypotheses tested below are all in line with the work of Bekaert and Harvey (2000) that imply that assets of comparable risk should promise similar expected returns even if they are in different countries.

o   T-test on Sharpe ratios

First, we calculated the Sharpe ratios of our portfolios. Then, we used the studentized bootstrap on time series data methodology, as suggested by Ledoit & Wolf (2008), to make inferences about the population with the purpose of determining if there is a significant difference between the Sharpe ratios of the Europe biased portfolio and the portfolio diversified through Emerging markets debt.

Here are the two hypotheses that we tested at a confidence level of 90%:

H0: There is no significant difference between the Sharpe ratio of the PFWEMD and the Sharpe ratio of the PFWOEMD.

H1: there is a significant difference between the Sharpe ratio of the PFWEMD and the Sharpe ratio of the PFWOEMD.

The Studentized bootstrap output from the PeerPerformance Tool on R (see Annexe) are:

- Number of observations/monthly returns (n): 180
- Europe biased portfolio (PFWOEMD) Sharpe ratio: 0.1505777
- Diversified Portfolio (PFWEMD) Sharpe ratio: 0.1224671
- Difference between Portfolios of Sharpe ratio (Δ): -0.02811059
- T-stat: -0.4559673
- P-value: 0.7011952

Firstly, the p-value of 0.7011952 indicates that the difference in the Sharpe ratios between the two investment strategies is not statistically significant. In other words, there is not enough evidence to conclude that one investment strategy has a higher Sharpe ratio than the other.

Secondly, the t-statistic of -0.4559673 is also consistent with the p-value. This level of t-stat is not consequent enough to conclude that there is a significant difference between the Sharpe ratios.

We therefore have the obligation not to reject the null hypothesis, this means that the data collected and analysed did not demonstrate a significant difference between this risk-adjusted return performance indicator of the portfolios.

o   T-test on Modified Sharpe ratios

We also applied the same studentised bootstrap on time series data on the Modified Sharpe ratios of our portfolios. We decided to include a test on the modified Sharpe ratio to account for the extreme results that we observed in the distribution of the emerging markets indexes (see Figure 28). As this measure determines the risk-adjusted return by dividing the excess return by the Modified Value at Risk, it takes into account the non-normality of the distribution of the returns.

- Msharpe 90%

Here are the two hypotheses that we tested at a confidence level of 90%:

H0: There is no significant difference between the Modified Sharpe ratio of the PFWEMD and the Modified Sharpe ratio of the PFWOEMD.

H1: there is a significant difference between the Modified Sharpe ratio of the PFWEMD and the Modified Sharpe ratio of the PFWOEMD.

The Studentized bootstrap output from the PeerPerformance Tool on R (see Annexe) are:

- Number of observations/monthly returns (n): 180
- Europe biased portfolio (PFWOEMD) Modified Sharpe ratio: 0.1584346.
- Diversified Portfolio (PFWEMD) Modified Sharpe ratio: 0.1376497.
- Difference between Portfolios of Modified Sharpe ratio (Δ): -0.02078489
- T-stat: -0.2188344
- P-value: 0.826779

Based on the analysis conducted, the obtained P-value of 0.826779 suggests that there is no statistically significant difference in the modified Sharpe ratios between the two investment strategies.

This conclusion is consistent with the t-statistic of -0.2188344, which also fails to provide substantial evidence to reject the null hypothesis. The t-statistic's value is not large enough to support the idea that the difference in the modified Sharpe ratios is different from zero.

We, therefore, have the obligation not to reject the null hypothesis, this means that the data collected and analysed did not demonstrate a significant difference between this risk-adjusted return performance indicator of the portfolios.

- Msharpe 85%

We decided to add to our study comparing the modified Sharpe ratios of the portfolios, the same analysis with a significance level (α) at 15%. This unorthodox decision to also use a significance level (α) at 15% was motivated by the fact that "Other authors, like Jaschke (December 2002) and Boudt et al. (2008), warn against the use of small values of α, based on the fact that the Cornish–Fisher approximation of the quantile function becomes less and less reliable for α→0" (Ardia & Boudt, 2015).

We then realised the same studentised bootstrap methodology on the Modified Sharpe Ratios with α at 15%. Testing the following hypothesis at a confidence level of 85%:

H0: There is no significant difference between the Modified Sharpe ratio of the PFWEMD and the Modified Sharpe ratio of the PFWOEMD.

H1: there is a significant difference between the Modified Sharpe ratio of the PFWEMD and the Modified Sharpe ratio of the PFWOEMD.

The results that we obtained from the PeerPerformance Tool on R (see Annexe) are:

- Number of observations/monthly returns (n): 180
- Europe biased portfolio (PFWOEMD) Modified Sharpe ratio: 0.2637846.
- Diversified Portfolio (PFWEMD) Modified Sharpe ratio: 0.2935611.
- Difference between Portfolios of Modified Sharpe ratio (Δ): 0.0297765
- T-stat: 0.1246677
- P-value: 0.9007866

Based on the analysis conducted, the obtained P-value of 0.9007866 suggests that there is no statistically significant difference in the modified Sharpe ratios between the two investment strategies.

Once again, the T-stat, which this time is at 0.1246677 fails to provide substantial evidence to reject the null hypothesis. The t-statistic's value is not large enough to support the idea that the difference in the modified Sharpe ratios is different from zero.

However, it is noteworthy that, when lowering the confidence level, the results still indicate no significant difference, yet the performance gap shifts in favour of the globally diversified portfolio.

Also, even though the PFWEMD tends to have lower risk-return performance metrics, its underperformance is not significant as observable by the graphs and the small Δs.

3. Efficient frontier comparison

In this section, through an analysis of the efficient frontiers of our portfolios, we determined the macroeconomic frameworks that maximise the benefits obtained by the addition of emerging market debt into a portfolio. We did so by comparing the efficient frontier of the strategies outlined in the previous section. The comparison involved evaluating the strategies under three distinct scenarios: a recession, an expansion, and a global health crisis by observing the realised return for each level of risk.

First, we observed our portfolios for the period going from 2008 to 2012 and which we refer to in this paper as the Great Recession and Fallout period. When observing the graph (see Figure 31), a few key elements are immediately emerging. Firstly, both the Maximum Sharpe portfolio and the Minimum Variance portfolio have both higher returns and higher volatility for the globally diversified strategy than the Eurocentric strategy. Secondly, the entire efficient frontier slightly shifts up and to the left, indicating increases in return and decreases in volatility. Thirdly, we observe that the curvature of the efficient frontier also increases from the Eurocentric strategy to the globally diversified strategy, indicating a gain in returns for the same levels of volatility. On average, this difference in return amounts to 97.63 basis points (bps). In summary, during periods of global economic challenges akin to the one witnessed between 2008 and 2012, incorporating emerging market debt into a diversified portfolio may result in heightened volatility as well as an anticipated increase in the expected return of the investor.

Secondly, we observed our portfolios for the period going from 2013 to 2019 and which we refer to in this paper as the expansion period. Once again, when observing the graph (see Figure 32), some interesting key elements emerge. Firstly, the Maximum Sharpe portfolio experiences an increase in the expected return and volatility. However, this time, the delta of volatility is less pronounced for this portfolio between the strategies. Which is an indicator of the decrease in the volatility of the assets of the emerging market during that period. This is reinforced by the fact that the Minimum Variance portfolio of the globally diversified strategy has a slightly lower volatility than the Minimum variance portfolio of the Eurocentric strategy. Furthermore, with the inclusion of emerging market assets into the portfolio, a noticeable augmentation in the curvature of the entire efficient frontier is observed, suggesting higher returns for equivalent levels of volatility. Additionally, there is a clear upward shift observed in the entire efficient frontier. On average, this variation of returns for equivalent levels of volatility amounts to 6 basis points(bps). In summary, during periods of global economic expansion similar to the one witnessed between 2013 and 2019, incorporating emerging market debt into a diversified portfolio may result in a slight increase in volatility as well as an anticipated increase in the investor's expected return.

Lastly, we observed our portfolios for the period going from 2020 to 2022 and which we refer to in this paper as the COVID-19 crisis period. This time, when observing the graph (see Figure 33), there is only one element that requires to be mentioned. Indeed, there is no change in the shape or the position of the efficient frontier. This finding is intriguing because it indicates that, with the data collected, in tumultuous periods resembling the COVID crisis, there is no portfolio iteration containing emerging market debt that would bring significant

benefits to the investor. In summary, during periods of global health and economic crisis similar to the one we witnessed between 2020 and 2022, there would be no benefits to adding emerging markets debt into a diversified portfolio.

Figure 31: Efficient frontier comparison – Great Recession

Portfolio Optimisation with the Efficient Frontier PFWOEMD
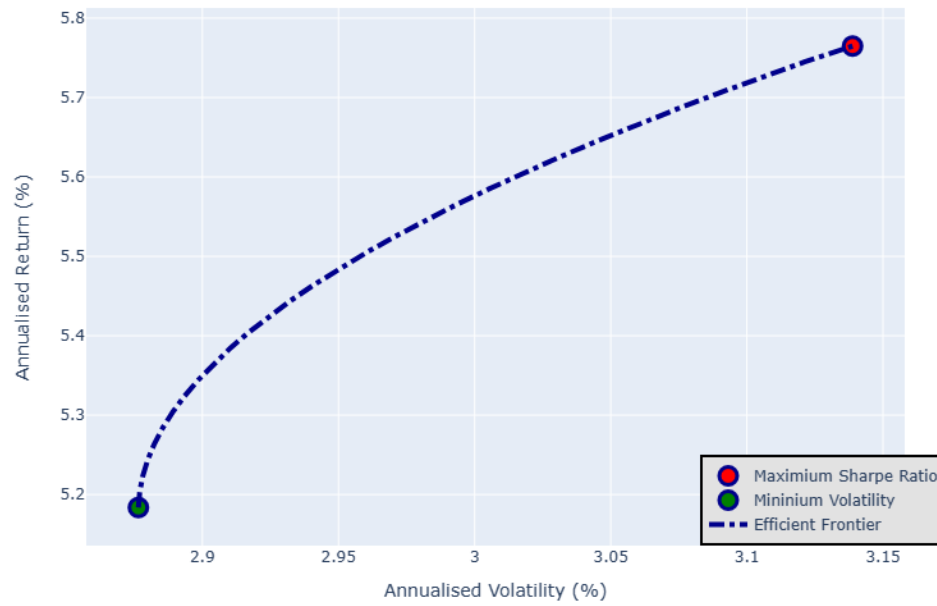
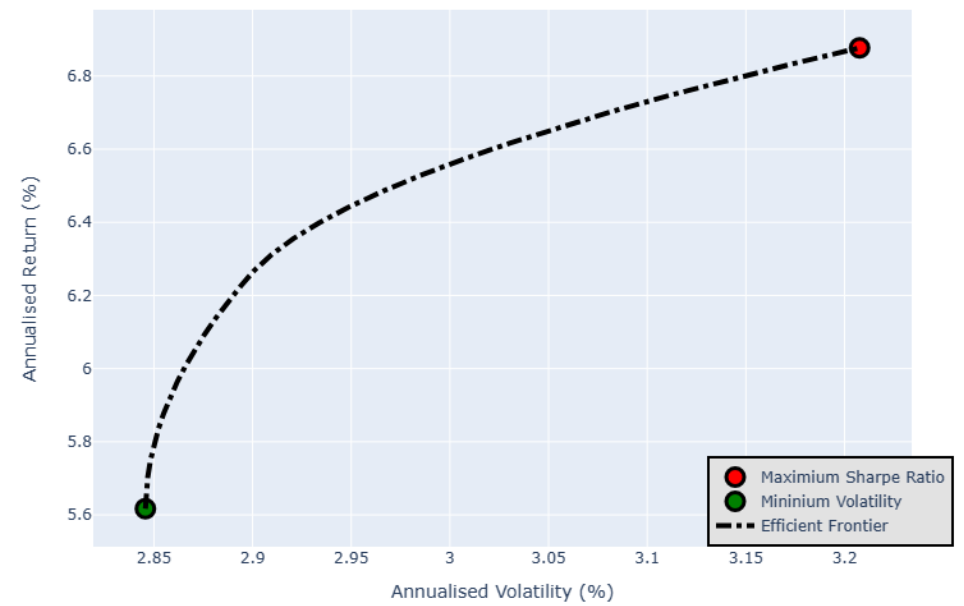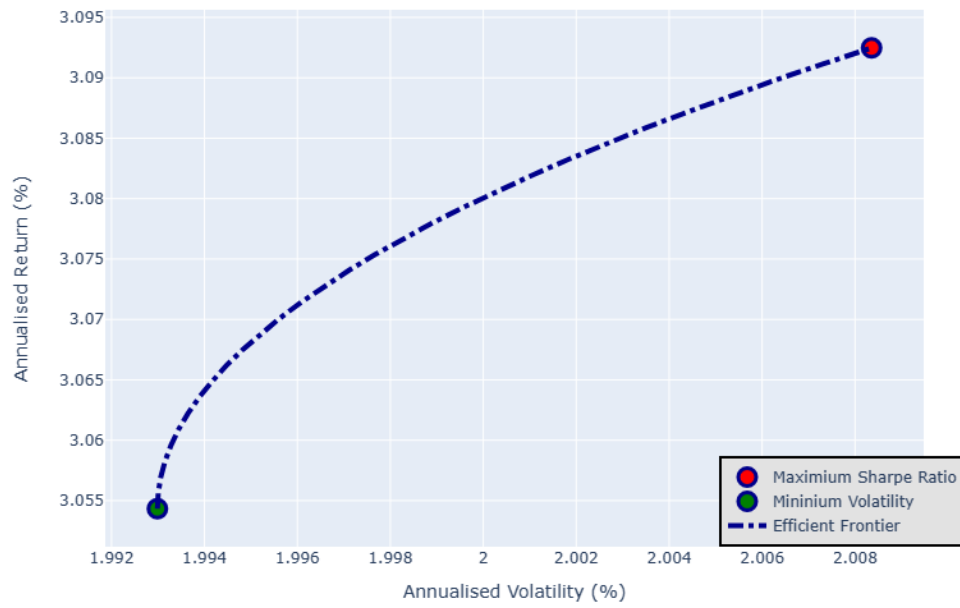Portfolio Optimisation with the Efficient Frontier PFWEMD

Figure 32: Efficient Frontier comparison - Expansion

Portfolio Optimisation with the Efficient Frontier PFWOEMD

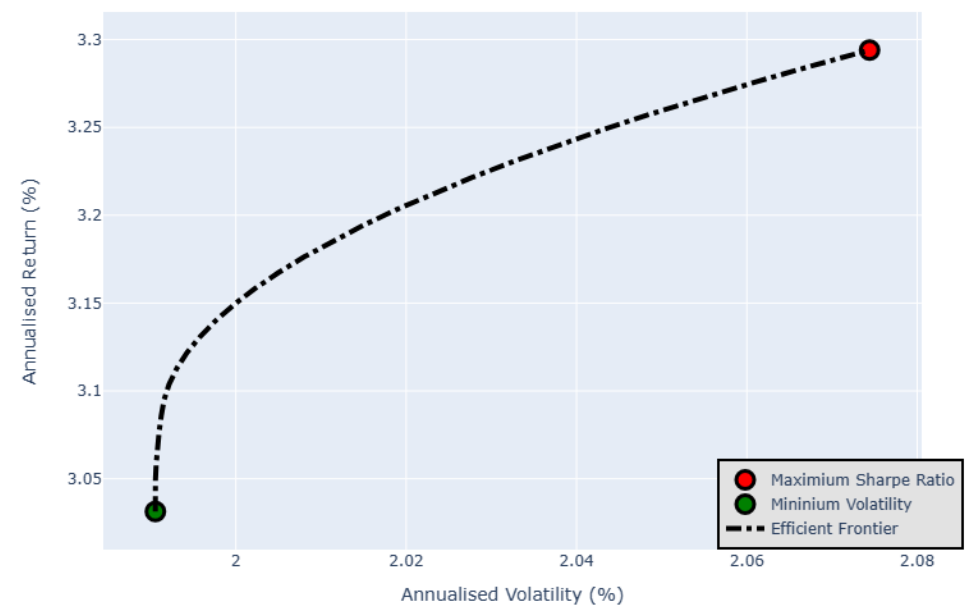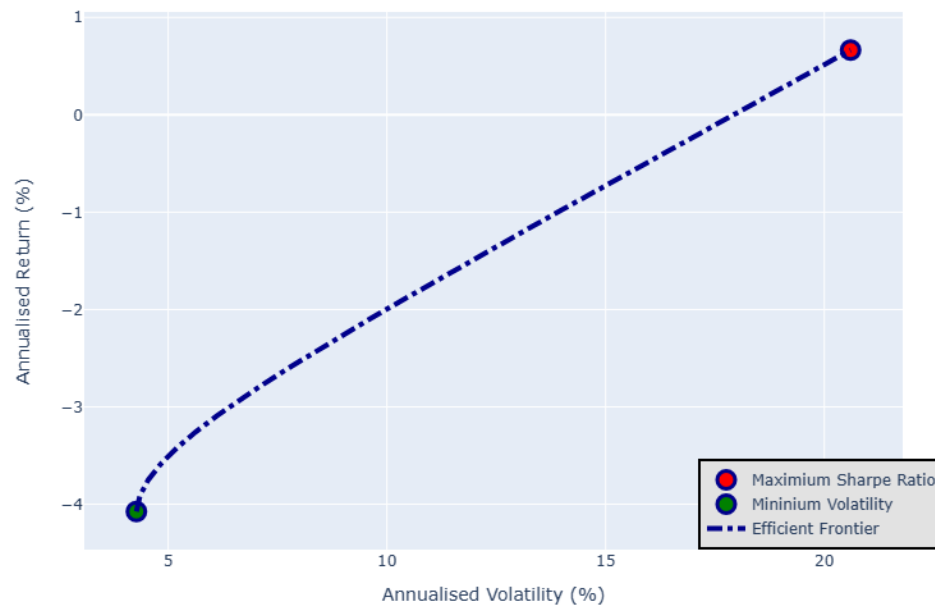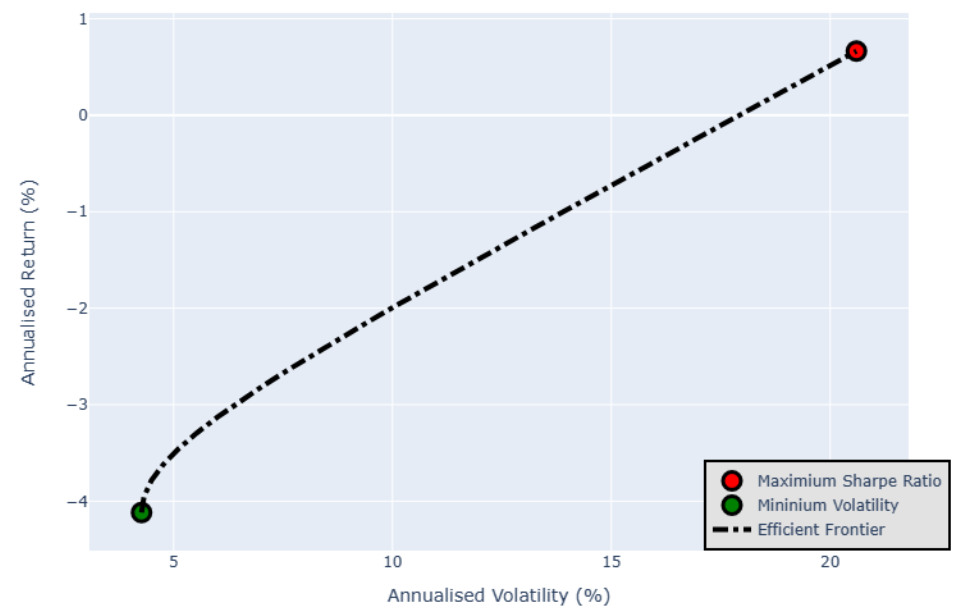Portfolio Optimisation with the Efficient Frontier PFWEMD

Figure 33: Efficient Frontier comparison - COVID Crisis

Portfolio Optimisation with the Efficient Frontier PFWOEMD

Portfolio Optimisation with the Efficient Frontier PFWEMD

4. Interpretation and discussion of the results

In this thesis, our focus was on exploring the potential of emerging markets debt as a suitable option for portfolio diversification. To achieve this goal, we conducted three experiments. In the following section, we will present our findings and provide a comprehensive interpretation of the results obtained.

Firstly, the correlation analysis revealed key elements of answer. Indeed, the results revealed low levels of correlation between emerging market fixed-income assets and the markets studied in the analysis. Specifically, the highest correlation level was observed between emerging markets equity and developed markets equity, registering at 0.58038.

These impressively low numbers are self-explanatory as they shed light on an essential aspect of portfolio diversification. As the correlation between Emerging Market debt both in hard and local currency and the other asset classes are relatively modest, this means that the fixed income-market in emerging markets present some very effective diversification prospect for portfolios predominantly composed of developed markets assets. This analysis reveals that by incorporating emerging markets debt into portfolios, investors can potentially mitigate risks.

Secondly, the portfolio analysis which we conducted on two balanced portfolio strategies, the first one without emerging markets debt and the second one with emerging market debt provided us with a somewhat tempered answer. Indeed, in absolute terms, the portfolio strategy containing emerging markets debt performed better in terms of return: the portfolio with emerging markets debt (PFWEMD) realised an absolute return of 84.70% return whereas the portfolio without emerging markets debt (PFWOEMD) realised an absolute return of 44.39% return.

Over the studied 15-year period, the portfolio with investments from all around the world (including emerging markets) showed higher returns. However, when we factor in the risks taken to achieve those returns, things look different. We use tools called "Sharpe ratios" and "Modified Sharpe Ratios" to measure the risk-adjusted return at a significance level of 10%. Surprisingly, the portfolio that didn't include debt from emerging markets performed better by these measures. This tells us that investments in emerging markets were likely more unpredictable or volatile during this time.

Then, we performed T-stat tests on the observed risk-adjusted returns metrics for both strategies. This analysis provided us with no more conclusive information as for each one of those two risk-adjusted return metrics, we were not able to reject the null hypothesis that stated that there is no difference between them. Those results echo with the work of Bekaert and Harvey (2000) that stated that at equivalent risks, assets should have comparable returns regardless of their country of origin.

Lastly, we sought for clues on the best macroeconomic conditions to maximize the benefits of adding emerging markets assets into a diversified portfolio. We did so, by comparing the efficient frontier of both strategies during three distinct periods per their characteristics. As expected, the strategies' behaviour largely varied from one period to another. Indeed, during the period that we addressed as the great recession and its fallout, the globally diversified

Maximum Sharpe portfolio outperformed its Eurocentric counterpart in both the expected return and the Sharpe Ratio. Also, as outlined above (see Supra p. 68), at each common point of volatility, the globally diversified strategy gains an average of 97.63 bps in comparison to the Eurocentric strategy. This adds to the argument that using emerging markets debt in a portfolio could be beneficial for investors, especially in a context similar to the one of the period spanning from 2008 to 2012.

Secondly, during the period that we addressed as the expansion period, we noticed that the globally diversified strategy performed better than its Eurocentric counterpart. On average, for each common volatility point, the globally diversified portfolio gained on average 6 bps, which was much less impressive than in the previous period. However, the most remarkable change, as depicted in the graph (see figure 32), was the reduction in the overall volatility of the portfolio.

To illustrate this, the table below shows the performance metrics of the Maximum Sharpe portfolios: as we can see, the delta between the volatilities is the smallest during the expansion period compared to the other periods. This highlights the significant impact of the expansion macroeconomic context on minimizing globally diversified portfolio volatility and underscores the advantages of this approach during comparable periods.

Table 8: Comparison of Maximum Sharpe Portfolios between periods

Maximum Sharpe portfolios			
	Great Depression	Expansion	Covid Crisis
PFWOEMD			
rf (%)	2.85	0.59	0.14
Volatility (%)	3.14	2.01	20.60
Return (%)	5.76	3.09	0.66
Sharpe Ratios	0.93	1.25	0.03
PFWEMD			
rf (%)	2.85	0.59	0.14
Volatility (%)	3.21	2.07	20.60
Return (%)	6.87	3.29	0.66
Sharpe Ratios	1.25	1.30	0.03

Lastly, during the period we refer to as the COVID Crisis period, we noticed that the efficient frontiers for the globally diversified portfolio was exactly the same than the efficient frontier of the Europe biased portfolio. As presented in the graph (see Figure 33), this period was characterized by large decreases in value for the markets selected for our analysis and an impressive increase in their volatility. The consequence being that their existed no combination of the portfolio whose Sharpe ratio would have benefited from an addition of emerging markets debt.

This provides important elements of answer to the question at hand. Indeed, our experiment reveals that in periods similar to the one we witnessed between 2020 and 2022, ceteris paribus, there would be absolutely no scenario in which an investor's Sharpe ratio would benefit from adding emerging market debt in a portfolio.

In conclusion, we cannot affirm that Emerging Market debt has the power of significantly improving the risk-return performance of a portfolio. However, there is a nuance to consider as EMD does not significantly harm those performance. The decision to add Emerging Market debt into a diversified portfolio should be taken only after strong consideration of the risk-aversion of the investor.

Regarding the ideal circumstances to geographically diversify through Emerging Market debt a portfolio, our efficient frontier analysis revealed that the macroeconomic context of the Great recession and fallout period (See Figure 31) had the best potential to maximize return whereas the macroeconomic context of the expansion period (See Figure 32) had the best potential to minimize the volatility of the portfolio.

CONCLUSION

This thesis had as an objective to demonstrate the risk-return effect of the addition of Emerging Market debt into a diversified portfolio. Through a thorough investigative process involving a correlation analysis, inference tests, and efficient frontier comparison, we have gathered elements of the answer to the question "Is Emerging Market debt a good prospect for portfolio diversification?".

Indeed, our investigative process provided us with a nuanced answer to the question. Thus, we find ourselves in a situation where we cannot affirm that Emerging Market debt systematically and significantly improves the risk-adjusted return of a portfolio. However, we should also, shed light on the fact that Emerging Market debt when added to portfolios did not lead to a loss in value. This brings nuance to our conclusion as the fact that we did not provide evidence of a significant increase in risk-adjusted return does not disqualify Emerging Market debt from the candidate list for the diversification of portfolios as we did not provide evidence of a significant decrease in risk-adjusted return either.

In more detail, three sides emerged from our investigation:

Firstly, the correlation analysis of our investigation reported very low levels of correlation between EMDs and other asset classes. In addition, our efficient frontier analysis demonstrated that in a recession context, the EMD diversified portfolio performed on average 97.63 bps better than the Europe biased portfolio for equivalent levels of risk and during the expansion period, our efficient frontier analysis also demonstrated an average of 6 bps improvement when introducing EMD into the portfolio. Those three factors all would advocates that Emerging Market debt can improve the risk-adjusted return of a portfolio.

Secondly, some of our findings presented a different perspective than Montassar et al. (2021). While they reported that emerging countries significantly influenced the performance of international portfolios, especially regarding expected returns, our results tell a different story. Using the "studentized bootstrap on time-series data" methodology, we found no evidence that the inclusion of Emerging Market debt has a significant effect on the risk-return relationship of a diversified portfolio.

Indeed, while adding Emerging Market debt to the portfolio contributed an additional 164 basis points to the expected return, it also led to a 116% increase in volatility, resulting in a suboptimal risk-adjusted return.

However, even though the globally diversified portfolio performed less than the Eurocentric one in terms of risk-adjusted return, the inference test on the Sharpe ratio and the Modified Sharpe ratio at a 90% confidence level returned the following p-values, respectively, 0.7011952 and 0.826779 suggesting that we did not have enough evidence to reject the null hypothesis which proposed that they were no significant difference between the portfolio's risk-adjusted performance metrics.

Thirdly, our efficient frontier analysis provided evidence that in dire macroeconomic conditions similar to the COVID crisis, the addition of Emerging Market debt into a portfolio would negatively impact a portfolio.

As outlined earlier, the results present a conundrum and make it challenging to firmly determine if Emerging Market debt is an ideal candidate for portfolio diversification. Nevertheless, the study does suggest potential opportunities within this market under specific macroeconomic conditions, especially for investors who have higher risk tolerance. Until these markets are fully integrated into the global financial system, there will likely continue to be low correlations offering diversification prospects. This suggests that investors who are looking to overcome home bias could consider diversifying their portfolio through this asset class without significantly compromising their risk-adjusted returns. Moreover, diving into emerging markets also holds an element of socio-environmental impact. As Fletcher (2021) from Schroders points out, the urgency for addressing environmental and social issues is paramount in emerging markets. After all, they house nearly 6.6 billion people, accounting for approximately 86% of the global population, as per data from the International Monetary Fund

In conclusion, the risk-return effect of emerging market debt in a diversified portfolio presents positive return opportunities worth exploring for both less risk-averse investors and impact investors, but it demands prudent risk management, a long-term perspective, and a comprehensive ESG analysis methodology. As financial markets continue to evolve, we hope this research will provide valuable insights and serve as a foundation for further studies in the asset management industry.

- Addressing the limitations of the study

In this section, in order to be as transparent as we can be, we will address the limitations that may have had an impact on the findings of this study.

The most significant limitation of our study is the inability of the analysis to provide insight into identifying the home bias and its impact on portfolio management. While our research was primarily designed around a passive investment strategy – relying on indexes – it was efficient in addressing our central question. However, this approach constrains our capacity to delve into follow-up questions, notably the question of whether debt from emerging markets serves as a viable solution to counter home bias.

The concept of home bias in investment, where investors show a preference for domestic over international securities, is a complex phenomenon. Evaluating its nuances, especially in the context of Emerging Market debt, requires a comprehensive analysis. Our current study's methodology does not fully cater to this depth.

For a more insightful exploration, adopting a research methodology rooted in an active investment strategy would be essential. Such an approach would not only provide a deeper understanding of the dynamics at play but also shed light on the relationship between home bias tendencies and the strategies employed in portfolio management.

SUGGESTIONS FOR FUTURE RESEARCH

For future research, it would be beneficial to study the risk-return effect of Emerging Market assets on different types of portfolios with different strategies and diversification schemes. This would allow for a more comprehensive set of information regarding the attractiveness of these markets for investors.

It could also be interesting to assess the negative impact of a larger integration of emerging markets into the global market on the diversification benefits that emerging markets could bring to a portfolio properly geographically diversified. Indeed, the "[…] modern portfolio theory shows that gains in international diversification are inversely related to the level of integration of financial markets, which has progressed significantly as a result of trade liberalisation, the dismantling of barriers to international investment and the movement of capital between markets. In this respect, liberalisation movements have favoured the convergence of behaviour and reactions of stock market indices. This has led to an increase in correlations between markets, and greater variation in asset volatility over time. High correlation between stock market indices reduces earnings and could compromise its effectiveness as a tool for improving performance. For example, King et al (1994) found that the similarity of market reactions to events can be explained by their increasing integration, which leads to sub-optimal portfolio allocation and reduces the performance of international diversification." (Zayati et al., 2016). As connections between markets strengthen, their correlation also intensifies, potentially leading to adverse impacts on diversification and risk-adjusted gains. Conducting a study to evaluate this influence would be intriguing.

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APPENDIX