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CARRY TRADE ON BONDS

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Abstract: This study will contribute to a comprehensive understanding of the carry trade strategy in the context of bonds. We will extend the application of the carry concept, typically associated with forex markets, to the bond asset class. Our focus is to delve into the statistical aspects of this strategy and explore how its performance varies across different types of bonds. Additionally, we aim to identify and comprehend the factors that have shaped and could continue to influence this strategy from 2003 to 2023. Our primary objective is to analyze the carry of the slope of the global yield curve.

Keywords: Carry Trade, Bonds, Governative Bonds, Corporate Bonds, Emergent Economies Bonds

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Introduction:

Carry is a financial concept that has gained significant attention in recent years due to its ability to predict returns across various asset classes. The carry can be thought of as the compensation an investor receives for holding an asset, and it can be decomposed into three components: expected price appreciation, unexpected price appreciation, and the carry itself [1]. The carry is a function of the capital amount and can be calculated for different asset classes, including currencies, equities, bonds, and commodities. In currency markets, carry has been studied extensively. The concept of carry has been found to predict returns cross-sectionally and in time series for a host of different asset classes, including global equities, global bonds, commodities, US Treasuries, credit, and options. One specific application of carry is the carry on slope, which captures the slope of the yield curve for bonds. The slope is a standard predictor of bond returns. The carry on slope can be computed for different maturities of US Treasuries. The carry on slope is also examined for assets in each country that capture the slope of the yield curve. Our research extends this exploration by investigating the relationship between carry and returns across various types of bonds. The goal is to gain a deeper understanding of how various types of bonds generate distinct returns within carry trades across different time periods. Our focus is on government bonds, bonds from emerging economies, and corporate bonds. Furthermore, we seek to analyze the potential synergies and effects of combining these bond types. Specifically, we will delve into the last 20 years of data to gain insights into the dynamics and outcomes of these different bond combinations. This study seeks to provide valuable insights into the intricate dynamics between carry trade and various bond types, placing a specific focus on unraveling the potential for enhanced returns through strategic combinations.

Literature Review:

Bonds, also known as fixed-income securities, are typically valued for their predefined payment commitments, presenting an attractive challenge for economic theorists in bond pricing. However, practical scenarios often deviate from theoretical ideals. Our research aims to explore the potential for generating returns by investing in the evolving slope of the yield curve. The literature on the yield curve, well-summarized in [2], outlines common practices and customs related to this curve. For instance, it notes that short-term yields tend to be more volatile than long-term yields. Despite the general stability of long yields, even minor fluctuations can lead to substantial changes in long bond prices, resulting in unpredictable returns. This observation underscores the dynamic nature of long yields and bond returns over time. However, over time, we have encountered the development of papers that present opposing views, demonstrating different perspectives on this topic. For example as suggested by [3], their analysis indicates a consistent trend across various maturities (ranging from one month to ten years). Specifically, when there's a notable difference between longer-term and shorter-term interest rates (yield spread is high), we observe that the yield on the longer-term bond tends to decrease as the shorter-term bond matures, contrary to the expectations theory. Conversely, shorter-term rates tend to increase as the longer-term bond matures, aligning with the expectations theory. These insights from the referenced paper provide crucial information on interest rate dynamics and yield spreads. In the context of your thesis on carry trading strategies and bond investments, understanding how yield spreads impact the behavior of long-term and short-term interest rates contributes valuable insights. This understanding enhances our comprehension of the factors influencing bond returns and the effectiveness of carry trade strategies in response to changes in interest rates.

In particular our analysis wants to explore how the carry strategy for different types of bonds

performs differently at various times. To better understand this topic, let's start by delving into and better understanding government bonds.

Government Bonds: Treasury securities are obligations of the government, considered almost risk-free. They're highly liquid, meaning they're easily traded, with narrow differences between buying and selling prices. Because of this, Treasury securities are often used to set prices and protect against risks in other investments and predict interest rate trends. They're also a standard for risk-free rates and important reserve assets for central banks and financial institutions. Emerging Markets Bond: They refer to debt securities issued by countries that are considered to be in the process of rapid industrialization and experiencing significant economic growth. These bonds are typically issued by governments or corporations in emerging market countries, which are nations characterized by a transitioning economy, undergoing development, and displaying features of both developed and developing nations. They are mostly traded in their currency of their own country. [4] Investors are attracted to these bonds due to the potential for higher returns compared to bonds from more established, developed economies. However, they also come with higher risks, including political instability, currency fluctuations, and less-developed financial markets.

Corporate Bonds: The company promises to pay a certain percentage of the bond's value on specific dates and to give back the full value of the bond when it matures. If the company fails to make these payments or doesn't meet other terms in the agreement, it's considered a legal default, and legal action can be taken to enforce the contract. Bondholders, who are like lenders, have a legal claim over the company's income and assets, and they might get paid before other creditors if there are debts secured by assets.

Corporate bond yields, or the returns for bondholders, consist of the Treasury rate plus a risk premium for the possibility of the company defaulting. The Treasury rate includes a real interest rate and a premium for expected inflation. The Treasury yield curve reflects investors' expectations

about the business cycle and its connection to inflation. Spreads on corporate debt depend on overall economic factors, how sensitive a sector is to the business cycle, and company-specific elements like debt levels. Investor risk appetite, especially in the high-yield sector, also plays a role. The "spread curve" considers two factors: the longer the maturity, the higher the chance of a negative event. At the start of an economic rebound, longer time frames increase the chance of the economy and companies gaining earnings momentum. Bond behavior across different timeframes and a closer look at how corporate bonds respond to economic changes yields important insights for finance. Let's break down the main findings:

High-Grade Corporate Bonds:

- Correlation and Stability: High-grade corporate bonds move in sync with government bonds throughout economic ups and downs. These corporate bonds tend to be less unpredictable compared to government bonds.
- Credit Spreads Trend: The extra interest, or credit spreads, for high-grade corporate bonds follow a pattern—they shrink during good economic times and widen during tougher periods. This trend is key for understanding the risk and return aspects of these bonds. [5]

High-Yield Corporate Bonds:

- Economic Sensitivity: Similar to high-grade bonds, the interest extras for riskier bonds also change with the economic cycle, getting wider during economic slumps and narrower during economic booms. However, these riskier bonds are more responsive to economic shifts.
- Portfolio Impact: Riskier bonds show more unpredictable extra interest compared to safer ones. Additionally, beyond offering higher returns, they also have more unpredictable extra interest over time. [5]

In order to start our research, we have decided to analyze some good relevant paper that constructed the literature of this concept. The literature review has helped us to understand what type of data we should use and how we should use it. Furthermore, it was import to understand what type of statistic was better to use in order to have the best analyzes of the data:

"An Introduction to Bond Carry Trading Strategies" is a comprehensive guide that provides an overview of the mechanics of bond carry trading. The paper discusses the risks and rewards of this strategy, including the potential for profit or loss depending on changes in bond yields. The capital requirements for bond carry trading are also covered, which can be significant due to the need to cover short positions. The amount of capital required depends on the size of the trade, the credit quality of the bonds, and the leverage ratio used by the investor. The paper also discusses several performance metrics for bond carry trading strategies, including yield, total return, and the Sharpe ratio. To determine whether a bond carry trading strategy has generated alpha (excess returns), investors can compare the returns earned with a benchmark return, which represents the return that would have been earned if the investor had simply held a passive investment in the market. [6]. In [1] delve into the intricate dynamics of bond return premia, with a specific focus on the influences stemming from the level, slope, and curvature of the yield curve. This empirical study spans a significant period, encompassing the years 1971 to 2015, and centers on international government bonds across seven countries, namely Australia, Canada, Germany, Japan, Sweden, the UK, and the US. A notable aspect of their approach is the incorporation of pricing factors from diverse asset classes—value, momentum, and carry an innovative strategy aimed at providing a fresh perspective on yield curve premia. In their research, they discovered that a combination of these factors provides a better understanding of bond return rewards. What is fascinating is that these factors not only relate to predicting returns in different asset classes but also highlight the pivotal role played by the curvature of the yield curve in determining bond returns. This revelation not only deepens

our comprehension of bond return rewards but also opens up the exciting prospect of a comprehensive framework for pricing assets across diverse classes. While the paper takes important steps in suggesting a new way to think about yield curve return rewards, it recognizes that there are ongoing and substantial debates in the theoretical realm regarding the economic forces that drive these style rewards.

Within the specific context of bond return premia, the authors underscore the importance of the carry factor. They define carry as the anticipated future yields assuming a consistent yield curve, and their findings suggest that carry encapsulates information from the second principal component, which is tied to the slope of yields. Arguing for the significance of carry in determining bond returns, the authors posit that it captures the expected future returns from holding a bond until maturity. Additionally, they emphasize the connection between carry and the term spread, defined as the variance between long-term and short-term interest rates [1] . The summary statistics reported include annualized mean excess return, annualized standard deviation of return, mean annualized carry, and annualized standard deviation of carry for each instrument. A specific focus of the study is on the carry-on slope, which captures the yield curve's slope for bonds. Employing regression analysis, principal component analysis, and factor analysis, the authors delve into statistical methods to analyze the data. To construct a comprehensive global representation of bonds, they calculated synthetic futures prices using an extensive dataset of zero-coupon rates. In addition to the synthetic global bond futures, they discussed earlier, they also explored test assets in each country to understand the slope of the yield curve. Specifically, in each country, they took a long position in the 10-year bond and a short position in the 2-year bond. Additionally, they examine the carry of US credit portfolios, sorting them by maturity and credit quality. In this context, carry refers to the credit spread (yield over the risk-free rate) plus the roll down on the credit curve. The outcomes they achieved in the Fixed Income 10Y-2Y strategy revealed a Sharpe

ratio of 0.35, indicating a balance between returns and risk. The kurtosis, a measure of the distribution's tail risk, stood at 6.26, suggesting a moderate degree of fat tails. The skewness, representing the asymmetry in returns distribution, was slightly negative at -0.11, indicating a minor tilt towards the left. Similarly, in the Credit strategy, they obtained a Sharpe ratio of 0.45, indicating a slightly higher risk-adjusted return compared to the Fixed Income 10Y-2Y. The kurtosis was notably higher at 22.53, suggesting a distribution with heavier tails, potentially indicating occasional extreme events. The investigation delves into the correlation between carry and the yield curve's slope in the context of bonds. Uncovering that carry on the slope serves as a consistent predictor of bond returns, the authors emphasize that the carry definition approximates the slope augmented by a roll-down component. Employing a range of statistical techniques such as regression analysis, principal component analysis, and factor analysis, the paper employs diverse methodologies to enhance the depth of analysis. We adopted a similar methodology, leading us to comparable results [7]

Data Methodology:

The data utilized in this study is sourced from Bloomberg to ensure consistency, with all data retrieved from the same database. For the analysis, we require a span of 20 years, in particular daily data for the top 10 economies for government bonds. These economies include Belgium, Canada, France, Germany Italy, Japan, the Netherlands, Sweden, Switzerland, the United Kingdom, and the United States. In addition, we extend our examination to the bonds of major emerging economies. Specifically, we have gathered data from Bloomberg covering the period from 2003 to 2023. The selected emerging economies for this segment are India, Brazil, Thailand, Turkey, Mexico,

Indonesia, Russia, Malesia, Hungary, Cechia and South Africa. In the realm of corporate bonds, we adopt a methodology similar to the approach outlined in reference [7]. The credit aspect involves utilizing ETF corporate bond indices for "Intermediate" (with an average maturity of about 3 years) and "Long-term" (with an average maturity of about 8 years) maturities. In terms of credit quality, we consider categories such as AAA, AA, A, and BAA. While the reference paper covered the period from January 1973 to September 2012, our study the sample period from 2009 to 2023. Accessible bond futures are limited to a handful of nations and are usually only abundant for the nearest expiration. To represent a diverse range of bonds worldwide, we take a different approach. We calculate synthetic futures prices using a comprehensive dataset of zero-coupon rates and then implement the same carry definition. To construct these synthetic futures, we initiated the process by generating spot prices for zero-coupon bonds (ZCB). Theoretical prices for zero-coupon bonds were calculated using the formula: 100/(1+yield) ^t. This yielded theoretical prices for zero-coupon bonds with a face value of 100. Subsequently, we computed the returns on these bonds and compared their cumulative returns with those of real futures, specifically TY1 (U.S. Treasury Bond futures with a 10-year maturity) and RX1 (German Bund futures with a 10-year maturity). TY1 and RX1 are globally recognized benchmarks, representing the 10-Year U.S. Treasury Note and 10-Year German BUND futures contracts, respectively. Both contracts are highly watched, renowned for their unmatched liquidity and capital efficiency *Appedix 1-4.* Examining the graph and statistics revealed a growing disparity between the synthetic ZCB returns and the returns of the TY1 and RX1 futures Appendix 1. This divergence stems from the synthetic ZCBs not accounting for coupon payments, leading to an increasing discrepancy over time. To address this, we introduced an additional return to the synthetic spot returns. This extra return is equal to the difference between the returns at time t and the returns at time t-1, multiplied by the duration. For our calculations, we set the duration to 8.5 for assets with a maturity of 10 years and 1.5 for assets

with a maturity of 2 years. It is based on market practices. Duration is a gauge of interest rate sensitivity in fixed income markets. The chosen values are frequently used to estimate how sensitive bonds' prices are to changes in interest rates. For 10-year bonds, a duration of 8.5 indicates that for every 1% movement in interest rates, the bond's price will vary by about 8.5% on average. In a similar vein, 2-year bond durations of 1.5 suggest a reduced susceptibility to changes in interest rates. This return is then added to the return at time t, divided by 260 (the number of trading days in a year). This adjustment allowed us to create a good replication of a future in various selected markets. By comparing our replication with the actual future in the graph, we successfully eliminated the previous gap. Additionally, the statistics show significant improvements for both RX1 and TY1 futures. *Appedix 5-8*

Government Bonds: We collected yields from government bonds with maturities of 2 and 10 years from various countries: USA, UK, Switzerland, Italy, Denmark, France, Japan, Netherlands, Sweden, Belgium, and Canada. Subsequently, we computed the slope of the curve, which forms the basis for our signal. If the curve's slope is positive the day before, we will invest in the difference between the synthetic 10-year bond and the synthetic 2-year bond. This means taking a long position on the 10-year bond and a short position on the 2-year bond. This approach is designed to capture opportunities based on the yield curve slope. The main goal of this project is indeed understood if investing in a long-term maturity bond while shorting a short-term maturity bond can lead to consistent and lasting returns. We can explore a different market reaction to two asset classes that essentially incorporate the same default risk. The strategy involves investing when the yield curve is positive and, conversely, divesting when the yield curve is negative. Since we can't predict how the curve will be on our trading day, the signal has a one-day lag. If the signal (10Y yield - 2Y yield) was positive the previous day, we'll have a buy signal; otherwise, we'll have a sell signal. The core idea is that the yield curve, explaining the relationship between bond yields and

their maturities, typically slopes upwards. We then calculated investment returns and cumulative returns for each country. Statistical analyses were applied to understand the results better. Annual returns were derived by taking total returns, averaging them, and multiplying by 260 (trading days in a year). Similar calculations were performed for volatility, involving the standard deviation of returns multiplied by the square root of 260. Additional statistics, such as the Sharpe ratio, were considered to gauge the portfolio's actual return adjusted for volatility. Skewness and kurtosis were also calculated to assess how returns were distributed. The last metric incorporated was the correlation of the strategy with the market. This was done to explore the possibility of having a strategy that is minimally correlated with the market, potentially serving as a hedge against market movements.

Ranking: In an attempt to boost returns, we experimented with strategies aiming to exclude the worst-performing assets and instead focus on achieving more positive returns or higher returns. So what we'll do is categorize the signal based on the difference between the two yields, 10Y - 2Y. Of course, since we don't know the exact difference between the two yields for the day, we'll perform the ranking based on the yield difference from the previous day. Specifically, for government bonds, we ranked the countries from 1 to 11 and decided to invest in the top 3. We then assigned a binary position (0 or 1) to each country; if it was 1, we invested, otherwise not. Subsequently, we repeated the previously presented statistics for these new results.

MOVE**:** Since the yield curve tends to invert during economically challenging periods, and as central banks often intervene with monetary policy during such times, it creates significant market volatility. This volatility can lead to scenarios that may negatively impact the yield curve [1]. We addressed the challenges faced by the bond strategy during periods of heightened volatility by introducing a volatility parameter. If this parameter exceeded a predefined threshold, we refrained from investing on those specific days. We utilized the MOVE index, similar to the equity VIX

index, to gauge bond market implied volatility, but if the VIX include at the money options, the MOVE use out the money options. Usually the investor to avoid risk tend to buy OTM option in order to be hedge against particular event. If the MOVE index surpassed 100, we opted not to enter the strategy for that day. The choice of 100 is informed by historical observations indicating challenging economic conditions and financial turmoil, aligning with [8] since they observed that once this value was surpassed, it led to crises and negative returns in the bond market. The MOVE Index assesses expected volatility in the bond market based on prices of over-the-counter options on U.S. Treasury bonds, reflecting traders' anticipation of significant price fluctuations and market uncertainty. [9]

Transaction Costs: To gain a clearer insight into the limitations of this strategy and assess the strength of these limitations, we introduced transaction costs. These transaction costs were assumed to be 0.05%. This nominal percentage allows us to explore the impact of transaction costs without overshadowing the primary analysis. It strikes a balance between realism and simplicity, enabling a focused examination of the strategy's behavior under transaction-related constraints, keeping in line with common practices in financial research.

Emergent Markets Bonds: We expanded our analysis to include bonds from significant emerging economies. Specifically, we collected data from Bloomberg spanning the years 2003 to 2023. The chosen emerging economies for this segment are India, Brazil, Thailand, Turkey, Mexico, Indonesia, Russia, Malesia, Hungary, Cechia and South Africa. We applied a similar analytical approach as used for government bonds, focusing on the yields of 2 and 10-year bonds. Calculating prices involved subtracting 100 from the yield, and we computed portfolio returns and various statistics based on this data. Subsequently, we implemented a ranking approach for these countries, determining positions as done previously for government bonds. We then constructed a portfolio centered on investing in the top three countries. To avoid bias, we applied a one-day lag to this

portfolio and computed various statistics. In this case, we also introduced the MOVE index and assumed transaction costs at 0.05%. We calculated the relevant statistics following the two previously mentioned approaches.

Corporate Bonds: For Corporate Bonds, we took a different approach since we couldn't locate bonds for specific companies or returns on them. Consequently, we had to find bonds or ETFs with bonds on the same underlying, ensuring that the risk probabilities of the assets were equivalent, and all other parameters were identical except for maturity. Specifically, we used the ISHARES 1-5Y INV GR and ISHARES 5-10Y INV GR indices. Additionally, we employed US high yield 1-3Y and US high yield 7-10Y Index. Additionally, we incorporated the use of exchange-traded funds (ETFs) such as Vanguard Intermediate-Term Corporate Bond ETF, Vanguard Short-Term Corporate Bond ETF, SPDR Portfolio Intermediate Term Corporate Bond ETF, and SPDR Portfolio Short Term Corporate Bond ETF into our analysis. The consistent aim was to invest in assets with longer maturities while taking short positions on assets with shorter maturities. Among other necessary data manipulations, we also transformed indices into ETFs. This involved subtracting the annual costs of similar ETFs in the market and dividing them by 260 to obtain the daily cost. This daily cost was then subtracted from the market price each day. For instance, in the case of the I15588US Index, we accounted for an annual cost of 0.07%. Similarly, for the I33392US Index, we considered an annual cost of 0.25%. This adjustment allowed us to incorporate the impact of ongoing expenses associated with these indices, enhancing the accuracy of our financial analysis. By factoring in these costs, we aimed to present a more realistic portrayal of the performance of these indices as if they were represented by corresponding ETFs. This approach aligns with industry practices and provides a clearer understanding of the potential effects of expenses on the overall investment returns. As we lacked the yield curve values for all ETFs, we opted to utilize the 10-Year High-Quality Market (HQM) Corporate Bond Spot Rate [10] and 2-

Year High-Quality Market (HQM) Corporate Bond Spot Rate [11]. W e think of these indices as dependable tools that help us follow the carry and give us signals for when to buy or sell chosen ETFs. Unlike some other sets of data, these indices get updated every month, causing the signals to change from month to month. As we already had prices for these securities, we calculated returns and implemented a carry strategy, investing in the asset with a longer maturity and shorting the one with a shorter maturity if the signal was bigger than 0. We applied a similar logic to our previous approach. Following this, we incorporated the MOVE index and included transaction costs in our analysis. Since we only had a carry signal, it was not feasible to implement the ranking approach.

All Bonds: Ultimately, we formulated a comprehensive strategy that incorporated all types of bonds, merging the diverse bond classes we had analyzed so far. Initially, we create a portfolio of all securities and countries. Following this, we established another portfolio based on a ranking system, directing investments toward the top 4 securities from the preceding day. Subsequently, we designed a portfolio that adjsuted returns and the decision-making process for entering or exiting the strategy, integrating insights from the MOVE index. Additionally, we introduced transaction costs, maintaining a consistent rate of 0.05%. Naturally, we presented graphical representations and statistical analyses for all the varied portfolio types. Transaction costs are an important factor to consider, representing a potential average across various costs associated with different securities. For instance, government bonds from major countries might incur transaction costs lower than 0.05%, while transaction costs for bonds from emerging markets could be significantly higher. Even in the case of corporate bonds, transaction costs might be higher, especially considering that, although we utilized ETFs, which generally have lower transaction costs compared to other securities, they could still exceed 0.05%. This is because the ETFs used may not always be highly liquid. Transaction costs play a crucial role in providing readers with a clearer understanding of how this strategy is notably influenced by these costs. It's worth noting

that these costs might surpass 0.05%, given the strategy involves investing in a long-maturity asset class and shorting one with a shorter maturity. The impact of transaction costs is particularly relevant in assessing the feasibility and effectiveness of the strategy, emphasizing the need for a comprehensive consideration of these costs when evaluating its performance. As investors navigate the trade-offs between potential returns and transaction costs, this insight into the cost dynamics enriches the analysis and aids in making informed investment decisions.

Results:

Governative Bonds: As previously explained, we developed bond prices and calculated returns for government bonds. In the standard strategy, which invests in the 10-year bond and shorts the 2-year bond when the carry from the previous day is positive, we achieved an annual return of 1.8% with a volatility of 3.8%. This resulted in a Sharpe ratio of 0.48, a slightly negative skew of -0.01, kurtosis of 1.92 (normal distribution kurtosis is 3), a maximum drawdown of -1.17%, and a highly negative correlation with the market at -20%. The strategy performed well until 2013, after which returns stabilized. The fundamental reason might be the publication of a paper in 2013 [7] that analyzed the strategy, leading the market to adapt and produce less significant returns. *Appendix 9-10*

Ranking: Turning to the ranking strategy, investing in the top 3 countries yielded annual returns of 1%, with an annual volatility of 1.5%. This resulted in an increased Sharpe ratio from 0.48 to 0.71. While the kurtosis was slightly higher, and the skew was slightly positive compared to the previous case, the ranking strategy allowed us to reduce the maximum drawdown from 1.17% to 0.72%, maintaining a negative correlation with the market. *Appendix 11-12* Move Signal: As mentioned in the data methodology, another signal was considered. Specifically, we

entered the strategy only if the MOVE was below 100; otherwise, we did not enter or closed all positions. This strategy yielded a return of 2.8% with a volatility of 2.9%, resulting in a Sharpe ratio of 0.97. The skew was -0.13, kurtosis was 3, and the correlation with the market remained negative at -11.8%. This additional MOVE signal demonstrated a promising performance, contributing positively to the overall strategy's risk-adjusted returns. *Appendix 13*

Ranking plus Move Signal: The final test conducted involved combining the ranking and MOVE signals. We ranked the top three daily rankings and invested in the best three rankings from the previous day. Additionally, we exited the strategy if the MOVE exceeded 100. Remarkably, this particular combination yielded the best results. The return reached 1.2%, with a volatility of 1.13%, resulting in an Info Sharpe of 1.10. *Appendix 14-15* This mix of these various elements appears to have generated superior returns. An interesting observation is that, in this strategy, returns remained substantial until 2016, despite the strategy having been explored previously. This suggests a robustness and adaptability in the combined strategy, potentially capitalizing on nuanced market dynamics that were not fully exploited by individual components alone. The strategy's continued efficacy even after prior exploration highlights the evolving nature of financial markets and the potential for new insights to enhance performance**.**

Transaction Costs: Introducing transaction costs at 5 basis points significantly impacted the results. In the ranking strategy, the annual return dropped from 1% to 0.6%, resulting in a decrease in the Sharpe ratio from the previous 0.7 to 0.43. *Appendix 16-17* Similarly, for the Move strategy, transaction costs lowered the Sharpe ratio from 0.97 to 0.88, with returns losing 30 basis points annually. All other statistics are detailed in the appendix. *Appendix 18-19*. The observed reduction in returns and Sharpe ratios highlights the importance of accounting for transaction costs in strategy evaluation. This insight aids in understanding the potential impact

on performance and allows investors to make informed decisions, balancing the trade-offs between returns and the associated costs of executing transactions.

Linear Regression: We performed a linear regression analysis between Federal Reserve rates and the yield difference of 10Y and 2Y government bonds, averaging across all countries. The main goal was to explore any potential relationship between these variables. We aimed to model and analyze the connection between Federal Reserve rates and cumulative returns, with the latter being the dependent variable and the former as the independent variable. Our results indicate a p-value below 0.05, signifying statistical significance in the relationship. The negative coefficient implies an inverse connection, suggesting that a 1% increase in rates results in a 24 basis point loss in the strategy. The R^2 value of 0.48 indicates that 48% of the variation in cumulative returns of government bonds can be explained by the independent variables. In simpler terms, almost half of the changes in cumulative returns are influenced by Federal Reserve rates. These statistical insights provide valuable perspectives on how Federal Reserve rates impact the performance of government bond strategies**.** *Appendix 20.*

Emergent Economies Bonds: The asset class where we undoubtedly experienced the weakest performance was this one, as we obtained negative or very small Sharpe ratios. In the more traditional strategy, we observed a negative annual return of 1% with an annual volatility of 5%, resulting in a negative Info Sharpe of -0.24. A particularly unusual data point is the kurtosis at 31. However, this anomaly is explained by the fact that the returns of these countries are often nearly constant, with exceptions during events that significantly alter the foreign perception of the country, leading to substantial daily return fluctuations. This also explains the notably higher maximum drawdown compared to other asset classes, standing at -4.72%. Additional statistics are provided in the appendix. *Appendix 21-22.*

Ranking: Consistent with our earlier observations, the inclusion of ranking significantly enhances the performance of the strategy in this asset class. In this case, annual returns, though modest, turn positive at 80 basis points, with an annual volatility of 3.6%. Unlike government bonds, the strategy appears to have worked well even after 2013, the year of the paper's publication. Similar to government bonds, the strategy for emerging economies seems to perform well during market upswings and poorly during interest rate hikes. Specifically, in emerging economies, it performed poorly during the recent interest rate hikes from 2022 to 2023. This is likely due to the fact that emerging economies have suffered more and experienced deeper recessions compared to G10 economies. *Appendix 23*

MOVE: Further confirmation of our earlier assertions is evident as the strategy achieves a significantly higher Sharpe ratio when we incorporate the MOVE signal. In this manner, we can notably reduce volatility to 2.3%, coupled with returns standing at 2.2%. Notably, we managed to minimize the occurrence of negative days. This is explained by a skew of 0.62 with the MOVE strategy, while previously, the skew was strongly negative, particularly without any additional signals beyond carry, registering at -3.18. The maximum drawdown has also markedly decreased, shifting from -4.34% to 2.19%. Being out of the market during the recent interest rate hikes in 2023 and also during the 2008/2009 financial crisis proved crucial, given that the MOVE exceeded 100 in these periods. *Appendix 24*

MOVE Plus Ranking: Following the approach used in government bonds, we combined the signals from ranking and MOVE, developing a strategy that enters the market in the top 3 countries only if MOVE is below 100. This strategy also yielded favorable returns, reaching 2.2%, with a volatility of 2.3%. Consequently, it achieved a Sharpe ratio of 2.3. *Appendix 25-26*

Transaction Costs: With transaction costs in play, the scenario worsens, particularly in the ranking strategy, as returns decline significantly and hover close to zero, standing at 41 basis points

annually. This descent leads to a notable drop in the Sharpe ratio to 0.12, down from the previous 0.23. Unsurprisingly, transaction costs also have a substantial impact on the MOVE strategy. In this case, returns decline to 1.84%, and the Sharpe ratio decreases to 0.79. The influence of transaction costs on both strategies underscores the critical importance of considering these costs in the evaluation and implementation of trading strategies. It serves as a practical reminder for investors and analysts alike that the real-world execution of strategies involves expenses that can significantly influence the overall performance and risk-return profile. Therefore, a comprehensive understanding of transaction costs is imperative for crafting realistic and effective investment strategies in financial markets. As we delve into the intricacies of transaction costs, it becomes evident that their influence extends beyond mere numerical adjustments. The impact on returns and risk metrics underscores the need for a nuanced approach to strategy evaluation, where the incorporation of transaction costs becomes an integral part of the decision-making process. This nuanced perspective not only adds realism to performance assessments but also facilitates the development of strategies that are robust and adaptive in the face of practical market conditions.

Appendix 27-28-29-30

Linear Regression: Following a similar approach as we did in government bonds, we conducted a linear regression on the yield difference between 10-year and 2-year yields in emerging market economies. The results closely resemble those observed in government bonds, with an R^2 value of 0.36, indicating an explanatory power of 36%. The negative coefficient of -0.15 suggests a consistent trend, indicating that a one-percentage-point increase in rates corresponds to a 15-basis point reduction in returns. This mirrors the findings from the government bond regression. These results highlight the potential impact of changes in Federal Reserve rates on the yield curve, reinforcing the observed negative relationship. Such insights contribute to understanding how

shifts in interest rates may affect investment strategy performance, providing valuable perspectives on the dynamics between central bank policies and financial market outcomes. *Appendix 31*

Corporate Bonds: Regarding the outcomes of the strategy on corporate bonds, we achieved possibly the best results, with returns averaging around 1.4% annually and an annual volatility of approximately 1.75%. This led to a Sharpe ratio of 0.84, making it a standout performance within this asset class. This success can be attributed to the relative novelty of a carry strategy on assets like corporate bonds, which is less explored compared to more conventional assets such as government bonds. A noteworthy aspect contributing to these results is the use of physically existing ETFs that are highly liquid. This contrasts with bonds from emerging economies, contributing to the favorable performance of volatility and thereby aiding the ascent of the Sharpe ratio. In terms of other metrics, we observe a significantly high kurtosis, indicating that even though most returns are positive (with a skew of 1.37), they are relatively small. This implies a concentrated distribution of returns (kurtosis 55.49). The maximum drawdown is relatively contained, with a maximum loss of –1.44%. The historical data could have played a role here, as the observations span from 2009 onward, excluding the 2009 crisis, which, as seen in other bond types, resulted in significant drawdowns. Similar to previous cases, the strategy exhibits almost no correlation with the market, particularly with the SPY, indicating a level of independence from broader market movements. *Appendix 32-33*

MOVE: We then examined the impact on the asset class when adding the MOVE signal. Introducing this signal led to a substantial increase in the Sharpe ratio, reaching 1.22. This enhancement was accompanied by a one-percentage-point annual increase in returns compared to the previous approach, coupled with a reduction in volatility by over one and a half percentage points. Appendix 34-35 Even with the inclusion of the MOVE signal, the skew remains strongly positive, experiencing a further increase to 2.54. While kurtosis decreased to 51.57, it still remains

relatively high. There were no significant changes in the correlation with the market. Incorporating the MOVE signal enabled us to stay out of the market during days of major losses, evident in the maximum drawdown decreasing from –1.44% to –1.15%. This additional signal proved effective in improving risk-adjusted returns and minimizing exposure during periods of heightened market stress, contributing to a more resilient and adaptive strategy. *Appendix 34-35*

Transaction Costs: We included transaction costs of 0.05%, albeit with a less pronounced impact than in previous cases. Notably, these costs had a mitigated effect in this instance, primarily due to the persistent positive nature of the carry signal and the omission of the 2008 financial crisis in our dataset. Examining the strategy without the MOVE signal, the results presented in the appendix indicate a decrease in the Sharpe ratio, dropping from 0.84 to 0.52. This decline can be attributed to the decrease in returns, influenced by the introduction of transaction costs. Nevertheless, the strategy continues to exhibit a positive risk-adjusted performance. As for the strategy with the MOVE signal, the impact on the Sharpe ratio was more pronounced, decreasing from 1.22 to 0.80. This reduction is primarily attributed to the increased frequency of entries and exits from the index, leading to a notable decrease in returns by one percentage point annually. *Appendix 36-37-38-39*

Linear Regression: We also examined the relationship between Federal Reserve interest rates and the difference in yield of corporate bonds using a linear regression. Similar to our previous analyses, we observed a negative correlation in the results. While the coefficient of the variable is slightly positive, indicating a small association, the regression is statistically significant with a P value below 0.05. However, it's important to note that the data from 2009 has notably influenced the results. In this case, the coefficient stands at -0.58, suggesting that for every one-percentage-point increase in interest rates, the strategy's returns decrease by 58 basis points. This implies a positive correlation between interest rate hikes and strategy performance. The R^2 value, consistent

with our earlier findings, remains at 0.60, signifying that approximately 60% of the variability in cumulative returns can be explained by the changes in Federal Reserve rates. *Appendix 40*

All Bonds: Initially, we entered all securities simultaneously, investing only when a security's yield curve slope was positive the previous day. This approach yielded returns of 30 basis points with 2.7% volatility, resulting in a Sharpe ratio of 0.11. However, examining the appendix statistics reveals a strongly negative skew, indicating that negative returns outweighed the positive ones. Shifting to the ranking strategy, we ranked bonds based on their previous-day carry and invested in the top 4 securities with the highest carry. Unfortunately, results were disappointing, with a negative annual return of -23 basis points, 1.3% volatility, and a Sharpe ratio of -0.16. The skew remains strongly negative at -3.98. The main reason behind these outcomes is our significant investment in emerging markets compared to government bonds, with nearly negligible investment in corporate bonds, as shown in the appendix graph. The market's perception of emerging markets as highly risky led to a steeper yield curve, contributing to the challenging performance of the strategy. This emphasizes the need to understand market dynamics and risk perceptions for crafting diversified and effective investment strategies across different asset classes. *Appendix 41-42*

Ranking**:** We also applied the ranking strategy to all bonds, ranking the securities and creating a signal to enter only into the top 4 securities with the highest carry values. The results for this strategy remained negative, with a negative return of 20 basis points and a volatility of 1.3%. The skewness significantly worsened, now standing at -3.82, and the kurtosis increased notably. *Appendix 43*

MOVE: The incorporation of MOVE has proven effective in enhancing our strategy's performance. We achieved annual returns of 91 basis points with a volatility of 2.8%, resulting in a final Sharpe ratio of 0.31. While the skew remains negative, it is significantly lower than the previous scenario.

In this case, MOVE played a crucial role in safeguarding our positions during periods of high volatility, contributing to lowering the drawdown to -2.21%. *Appendix 44*

MOVE and Ranking: Building on our approach to other bond types, we implemented the MOVE and ranking strategies concurrently. Although the combined strategy yields positive results, the returns from this approach are modest, standing at 32 basis points with an annual volatility of 1%. Nevertheless, we successfully managed to reduce the drawdown to -1.22% (Info Sharpe 0.29). This underscores the importance of considering multiple signals simultaneously to fine-tune strategies and navigate the complexities of the financial markets. *Appendix 45*

Transaction Costs: The Sharpe ratio turns negative, hitting -1.74, as annual returns plunge to -2%, while volatility remains at 1.4%.

We also compared the cumulative returns of the ranking strategy with the same strategy and the addition of transaction costs. In this way, we observed a significant deterioration, as depicted in the graph in the appendix. Indeed, we can see that the cumulative returns have markedly decreased, and the overall Sharpe ratio of the ranking strategy with the addition of transaction costs is -1.75, with returns equal to -0.025%.

Similarly, the move strategy is heavily influenced by transaction costs, leading to a decline in the Sharpe ratio from 0.31 to 0.13. This is due to a considerable drop in returns to 32 basis points.

In the final strategy, which combines carry, move, and ranking signals, transaction costs play a role in lowering the Sharpe ratio from 0.29 to 0.23, causing an 8-point percentage decrease in returns. This emphasizes the critical consideration of transaction costs in evaluating and refining trading strategies for optimal financial performance. *Appendix 46-47-48-49-50-51*

Conclusion and final consideration:

While we still consider the carry trade strategy a viable approach for securing additional returns in the market, especially when complemented with signals like the MOVE, it's crucial to examine the challenges associated with this strategy. Among the issues previously mentioned, transaction costs stand out prominently. It's essential to remember that implementing this strategy involves investing in a long-maturity asset and divesting from a short-maturity one, resulting in double transaction costs. Moreover, transaction costs might be higher than anticipated, particularly for securities such as emerging market bonds. Estimating these costs can be challenging, especially considering that we are dealing with synthetic futures. Although the cost estimation might be conservative, it's challenging to precisely gauge these expenses. Transaction costs can exert a substantial impact on this strategy, potentially altering its overall performance. Additionally, given that the returns from the strategy are relatively modest, there might be an inclination to employ substantial leverage, introducing higher associated costs. Another consideration is that the results we presented earlier span from 2003 to 2023. This temporal range means that the data encompasses outcomes before 2013, the year when the paper [] was published. Post-2013, the strategy appears to exhibit notably inferior performance. This could signal that the strategy has been explored, and future returns may not be as robust. It highlights the importance of cautious consideration, especially in the context of evolving market dynamics and the potential saturation of well-known strategies. In any case, the topic deserves and requires further research, particularly in our case, where due to a lack of data, we were unable to observe whether such a strategy is feasible for green bonds and municipal bonds. Examining if the carry strategy works better in specific sectors for options and equity, or on certain pairs in the forex market, could offer valuable insights for other asset classes.

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Sitografy:

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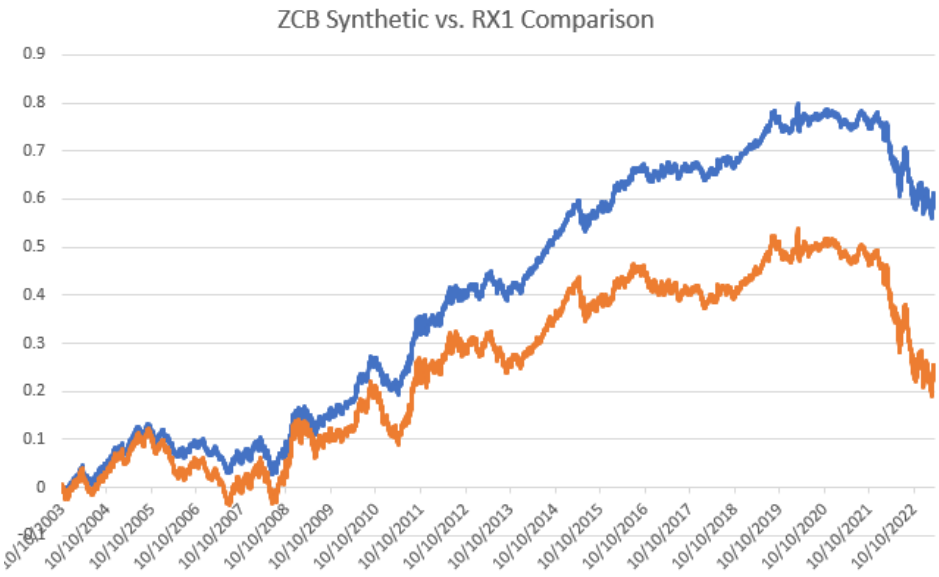
[10] 10-Year High Quality Market (HQM) Corporate Bond Spot Rate (HQMCB10YR) | FRED | St. Louis Fed (stlouisfed.org)

[11] 2-Year High Quality Market (HQM) Corporate Bond Spot Rate (HQMCB2YR) | FRED | St. Louis Fed (stlouisfed.org)

APPENDIX:



Appendix 1: ZCB Synthetic (Orange) vs. RX1 (Blue) Comparison

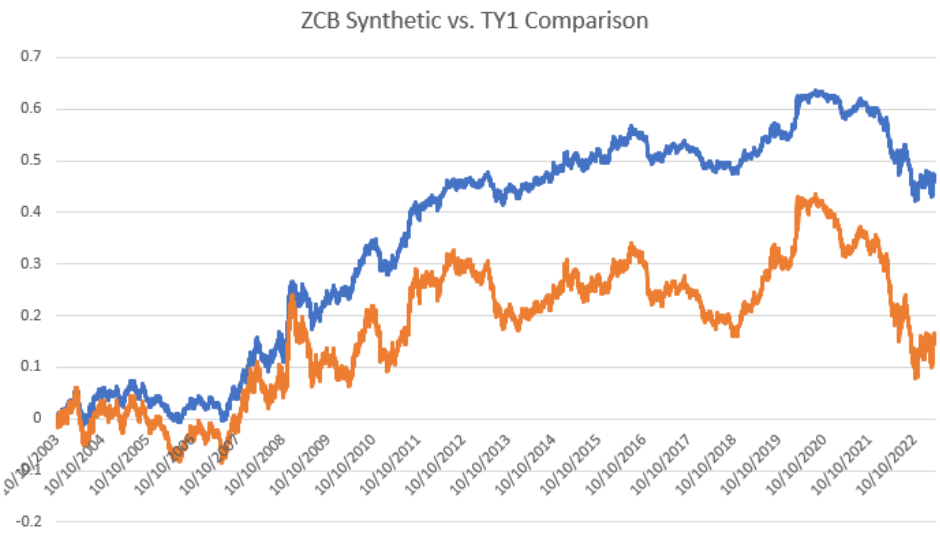
FUTURE BUND

Summary Stats	
Return	0.030397
Volatility	0.057515
Info Sharp	0.528508
Skew	0.157307
Kurt	3.521646
Maximum	-1.82%

SYNTHETIC SPOT BUND BEFORE ADJUSTEMENT

Summary Stats	
Return	0.011974
Volatility	0.069712
Info Sharp	0.171768
Skew	0.060921
Kurt	2.902159
Maximum	-2.21%

Appendix 2: Statistics - Future RX1 vs. ZCB Synthetic Bund



Appendix 3: ZCB Synthetic (Orange) vs. TY1 (Blue) Comparison

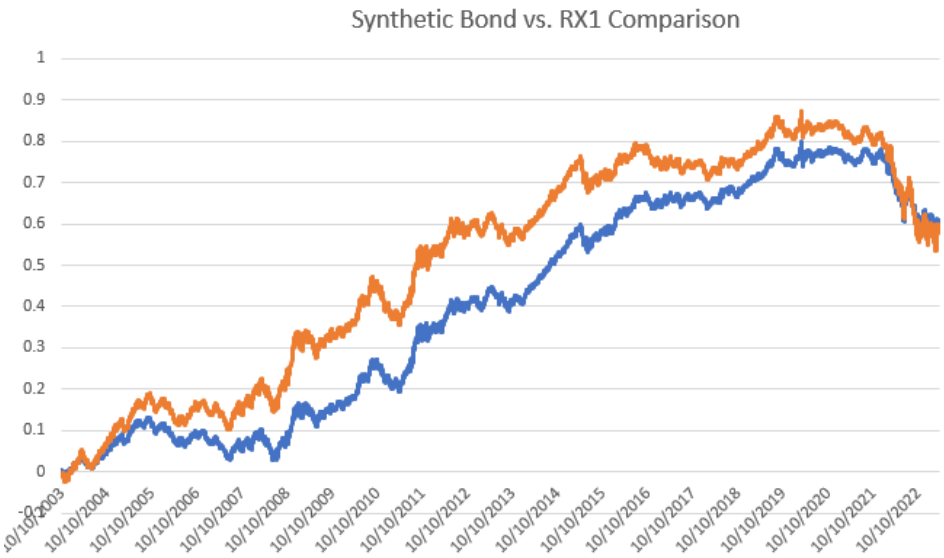
FUTURE TREASURY

Summary Stats	
Return	0.023446
Volatility	0.057309
Info Sharp	0.409108
Skew	0.194077
Kurt	4.735835
Maximum	-2.59%

SYNTHETIC SPOT TREASURY BEFORE ADJUSTEMENT

Summary Stats	
Return	0.00758
Volatility	0.089489
Info Sharp	0.084707
Skew	0.188114
Kurt	3.363253
Maximum	-3.51%

Appendix 4: Statistics - Future TY1 vs. ZCB Synthetic US



Appendix 5: Synthetic Bond (Orange) vs. RY1 (Blue) Comparison

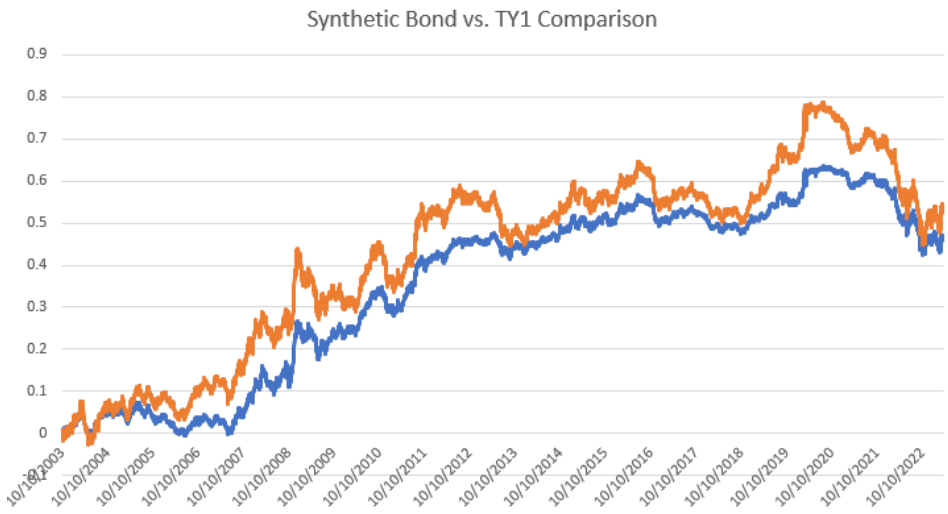
FUTURE BUND

Summary Stats	
Return	0.030397
Volatility	0.057515
Info Sharp	0.528508
Skew	0.157307
Kurt	3.521646
Maximum	-1.82%

SYNTHETIC SPOT BUND AFTER ADJUSTEMENT

Summary Stats	
Return	0.029679
Volatility	0.063331
Info Sharp	0.468632
Skew	0.110913
Kurt	3.323708
Maximum	-1.98%

Appendix 6: Statistics - Future RX1 vs. Synthetic Bund



Appendix 7: Synthetic Bond (Orange) vs. RY1 (Blue) Comparison

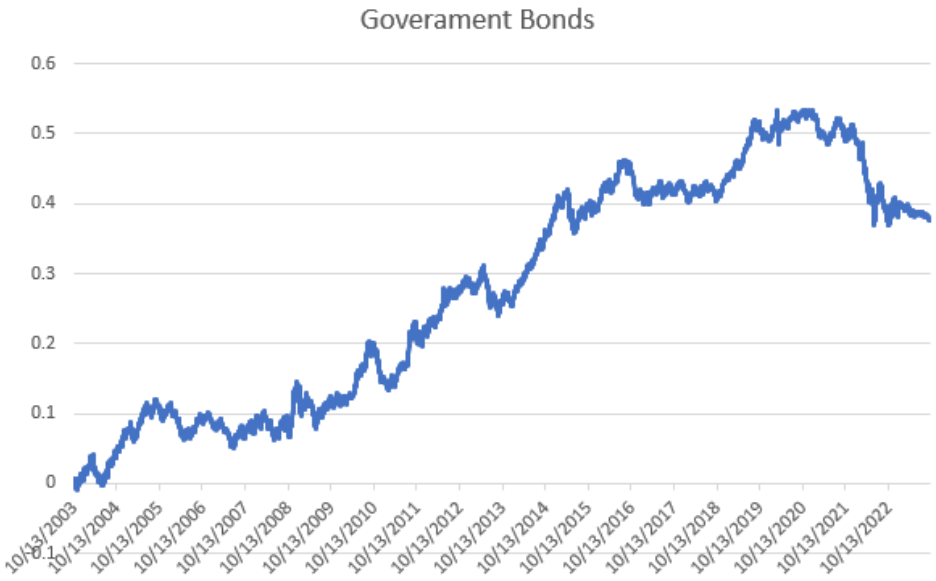
FUTURE TREASURY

Summary Stats	
Return	0.023446
Volatility	0.057309
Info Sharp	0.409108
Skew	0.194077
Kurt	4.735835
Maximum	-2.59%

SYNTHETIC SPOT TREASURY AFTER ADJUSTEMENT

Summary Stats	
Return	0.02703
Volatility	0.081188
Info Sharp	0.332929
Skew	0.197586
Kurt	3.252706
Maximum	-2.94%

Appendix 8: Statistics - Future TY1 vs. Synthetic US



Appendix 9: Government Bonds Returns

Summary Stats	
Return	0,0185535
Volatility	0,03862952
Info Sharpe	0,48029327
Skew	-0,01556725
Kurt	1,92199658
Maximum DD (annual)	-1,17%
Correlation with the market	-0,20505432

Appendix 10: Government Bond Statistics

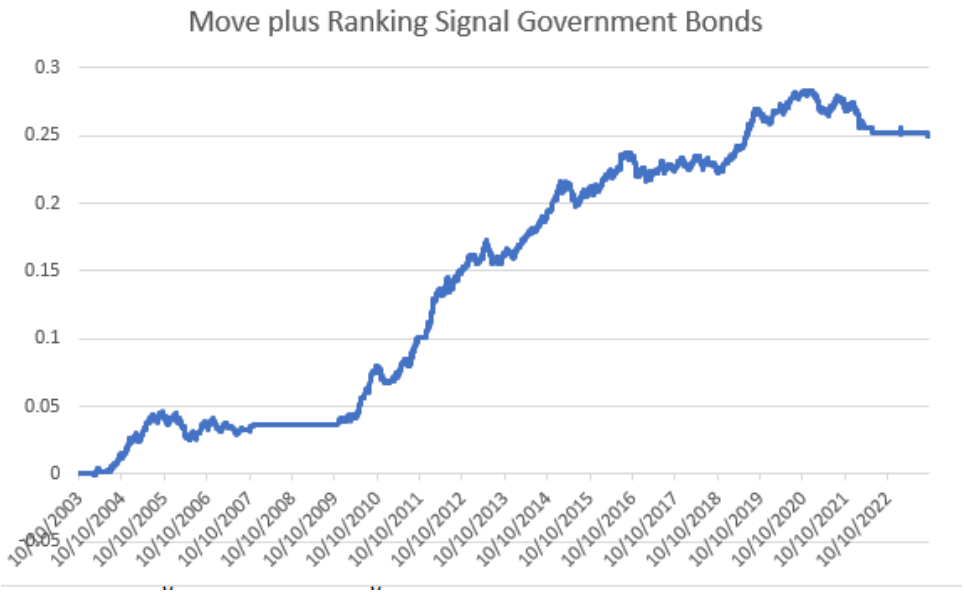
Appendix 11: Ranking Government Bonds

Summary Stats	
Return	0,010896
Volatility	0,015362
Info Sharpe	0,709253
Skew	0,092007
Kurt	3,805661
Maximum DD (annual)	-0,72%
Correlation with the market	-0,10865

Appendix 12: Statistics Ranking Governative Bond

Summary Stats	
Return	0,028267131
Volatility	0,029061215
Info Sharpe	0,972675474
Skew	-0,131360105
Kurt	3,0402845
Maximum DD (annual)	-1,15%
Correlation with the market	-0,118192632

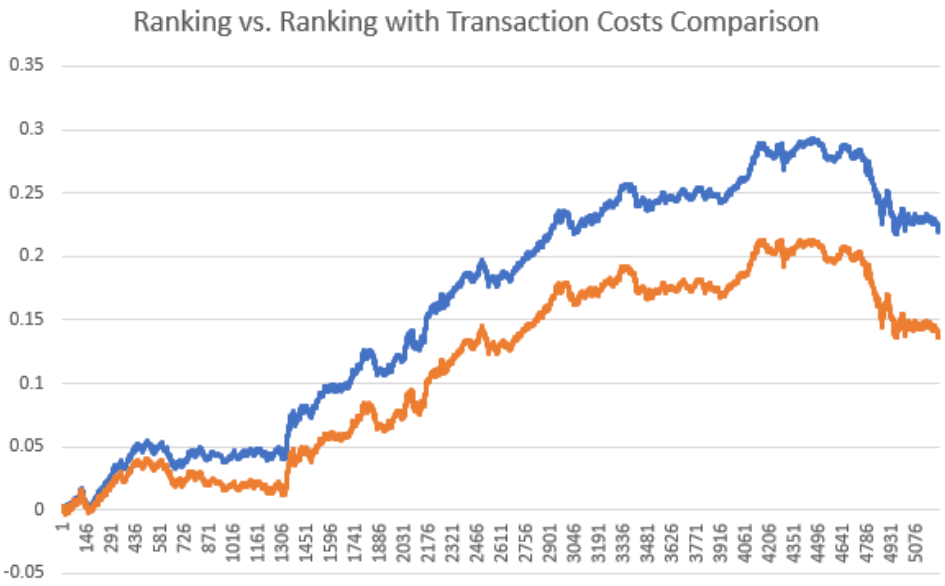
Appendix 13: Statistics Move signal on Government Bond



Appendix 14: Returns of Government Bonds with MOVE and Ranking Strategy

Summary Stats	
Return	0,012471633
Volatility	0,011326287
Info Sharpe	1,101122877
Skew	0,113972808
Kurt	4,155826259
Maximum DD (annual)	-0,40%
Correlation with the market	-0,04599764

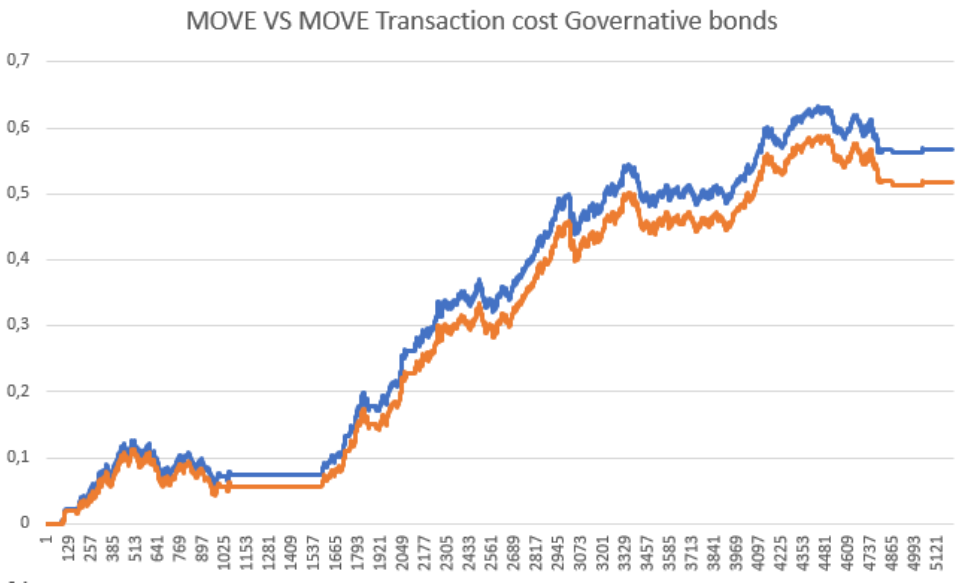
Appendix 15: Statistical Analysis of MOVE plus Ranking Government Bonds Strategy nd



Appendix 16: Ranking of Government Bond Returns (Blue) vs. Government Bond Returns with Transaction Costs (Orange)

Summary Stats	
Return	0,006707
Volatility	0,015364
Info Sharpe	0,436585
Skew	0,093985
Kurt	3,801425
Maximum DD (annual)	-0,72%
Correlation with the market	-0,1094

Appendix 17: Statistics on Ranking Transaction Costs for Government Bonds



Appendix 18: Government Bonds Returns MOVE Strategy (Blue) Vs Government Bonds Returns MOVE Strategy with Transaction Costs (Orange)

Summary Stats	
Return	0,025787743
Volatility	0,029059267
Info Sharpe	0,887418905
Skew	-0,157046084
Kurt	3,026253624
Maximum DD (annual)	-1,15%
Correlation with the market	-0,118242677

Appendix 19: Statistics for MOVE Strategy with Transaction Costs on Government Bonds

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.694128085
R Square	0.481813798
Adjusted R Square	0.481714357
Standard Error	0.433226624
Observations	5213

ANOVA

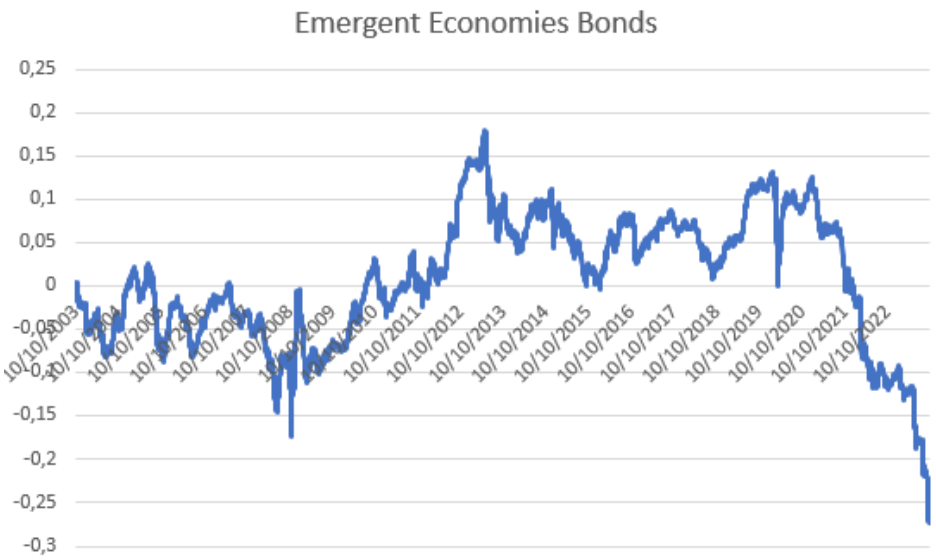
	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	909.3786175	909.3786175	4845.230712	0
Residual	5211	978.0281388	0.187685308		
Total	5212	1887.406756			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*ower 95.0%*	*pper 95.0%*
Intercept	1.381805478	0.008132837	169.9044944	0	1.365861708	1.397749	1.365862	1.397749
X Variable 1	-0.246625241	0.003543075	-69.60769147	0	-0.253571153	-0.23968	-0.25357	-0.23968

Appendix 20: Linear Regression Analysis of Government Bonds and Federal Reserve Rates

Summary Stats	
Return	-0,01258
Volatility	0,052012
Info Sharpe	-0,24195
Skew	-1,76122
Kurt	31,60394
Maximum DD (annual)	-4,72%
Correlation with the market	0,007949

Appendix 21: Statistics for Emerging Economies Bond Returns



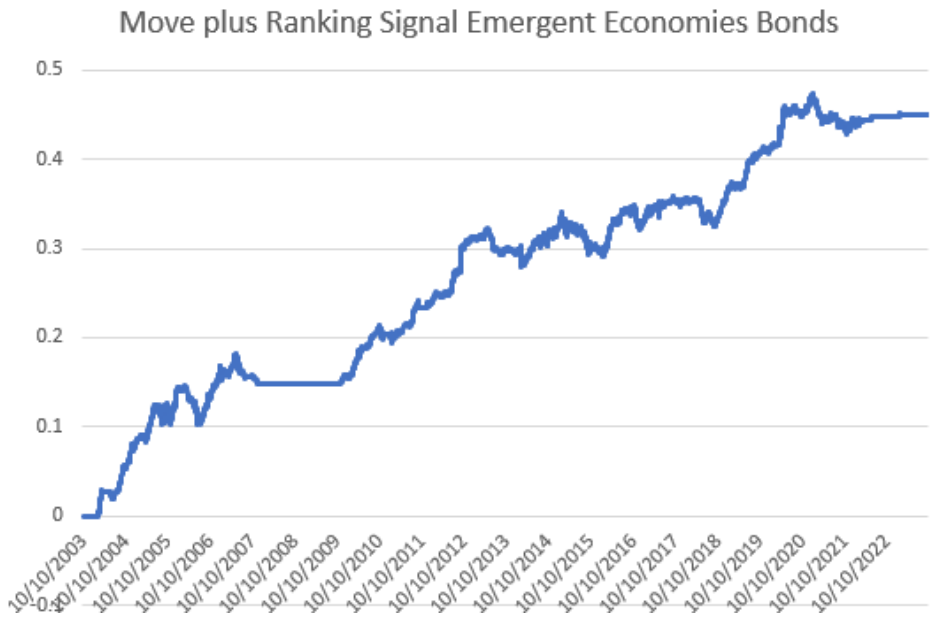
Appendix 22: Emerging Economies Bond Returns

Summary Stats	
Return	0,008496
Volatility	0,036289
Info Sharpe	0,234126
Skew	-3,18405
Kurt	74,93465
Maximum DD (annual)	-4,96%
Correlation with the market	-0,03342

Appendix 23: Statistics for Emerging Economies Bond Returns Ranking Signal

Summary Stats	
Return	0,022423138
Volatility	0,023175376
Info Sharpe	0,967541523
Skew	0,629141286
Kurt	43,48364727
Maximum DD (ani	-2,19%
Correlation with t	-0,005297843

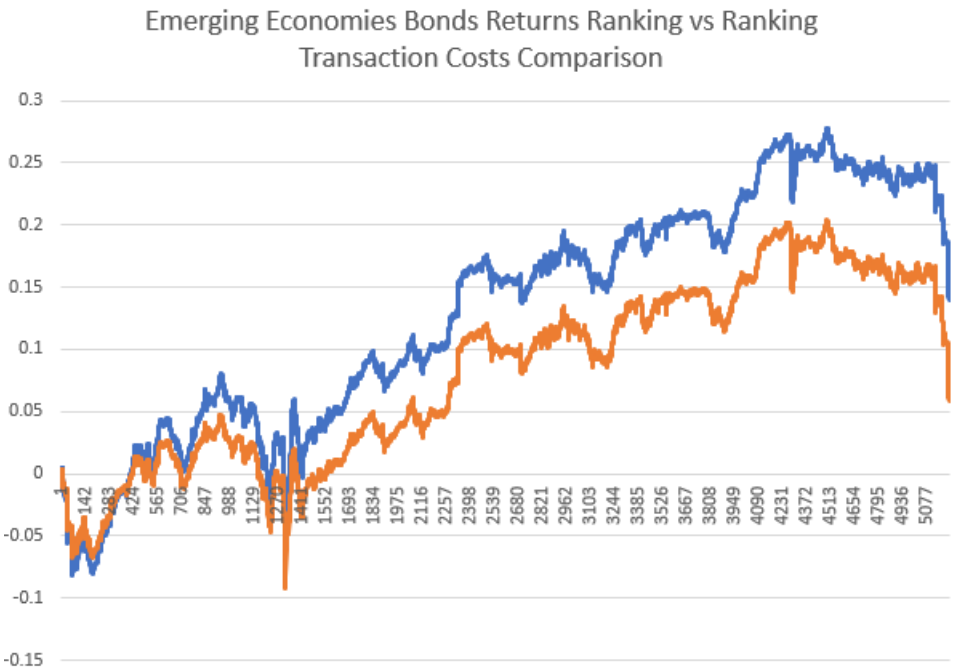
Appendix 24: Statistics for Emerging Economies Bond Returns with MOVE Strategy



Appendix 25: Move plus Ranking – Emerging Economies Bonds

Summary Stats	
Return	0.022393887
Volatility	0.0231735
Info Sharpe	0.966357562
Skew	0.629241174
Kurt	43.49820742
Maximum DD (annual)	-2.19%
Correlation with the market	-0.005257567

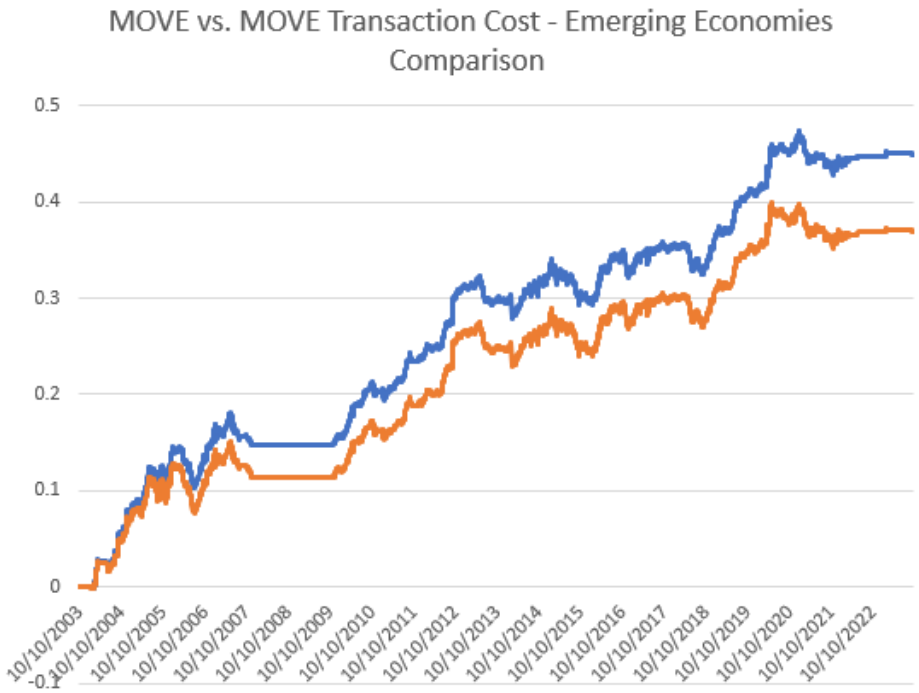
Appendix 26: Statistics Move plus Ranking – Emerging Economies



Appendix 27: Emerging Economies Bonds Returns Ranking vs Ranking Transaction Costs Comparison

Summary Stats	
Return	0.00299297
Volatility	0.033986025
Info Sharpe	0.088064732
Skew	-3.27082642
Kurt	67.99379965
Maximum DD (annual)	-4.34%
Correlation with the market	-0.030529604

Appendix 28: Statistics of Ranking Transaction Costs for Emerging Economies Bonds



Appendix 29: MOVE vs. MOVE Transaction Cost - Emerging Economies Comparison

Summary Stats	
Return	0.01843505
Volatility	0.023162702
Info Sharpe	0.795893754
Skew	0.609329583
Kurt	43.4095539
Maximum DD (annual)	-2.19%
Correlation with the market	-0.004601817

Appendix 30: Statistics Emergent Economies MOVE with Transaction Costs

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.602027281
R Square	0.362436847
Adjusted R Square	0.362314521
Standard Error	0.347913728
Observations	5214

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	358.6383043	358.6383043	2962.876438	0
Residual	5212	630.8811324	0.121043962		
Total	5213	989.5194367			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.361305339	0.006530709	208.446788	0	1.348502412	1.374108267	1.348502412	1.374108267
X Variable 1	-0.154877776	0.002845328	-54.4323106	0	-0.160455812	-0.149299741	-0.160455812	-0.149299741

Appendix 31: Linear regression Emergent Economies Bonds and FED rate

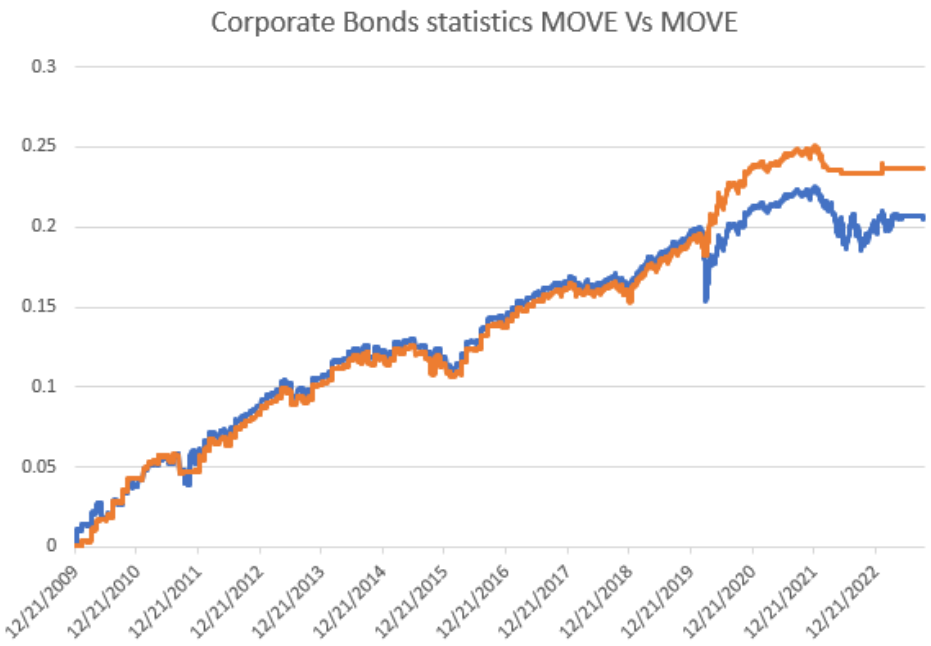
Appendix 32: Corporate Bonds Return

Summary Stats	
Return	0,014777887
Volatility	0,017577837
Info Sharpe	0,840711326
Skew	1,3698103
Kurt	55,49960047
Maximum DD (annual)	-1,44%
Correlation with the market	-0,009755598

Appendix 33: Corporate Bonds statistics

Summary Stats	
Return	0,017084051
Volatility	0,01398947
Info Sharpe	1,221207918
Skew	2,547648929
Kurt	51,5767314
Maximum DD (annual)	-1,15%
Correlation with the market	0,01265037

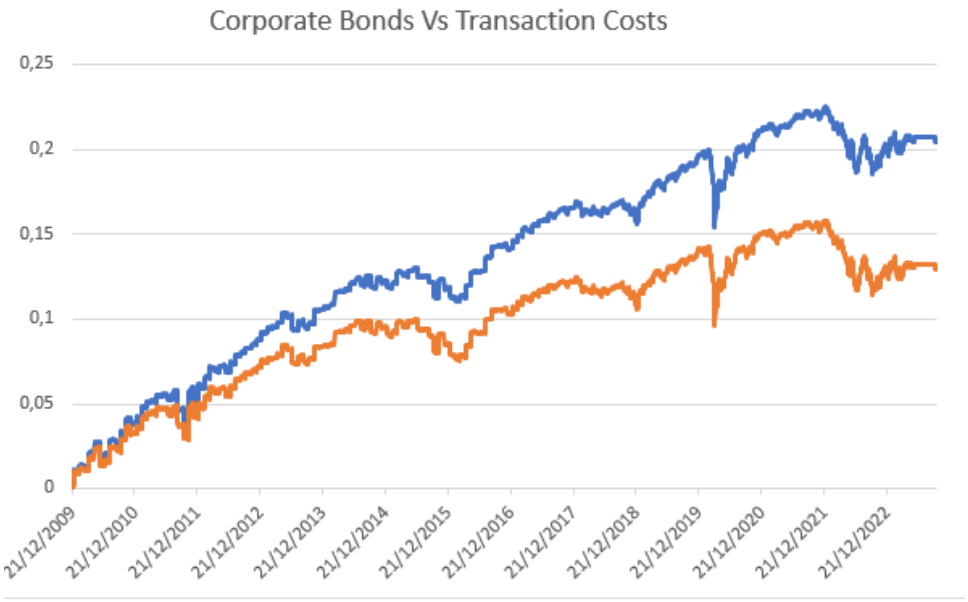
Appendix 34: Corporate Bonds statistics MOVE



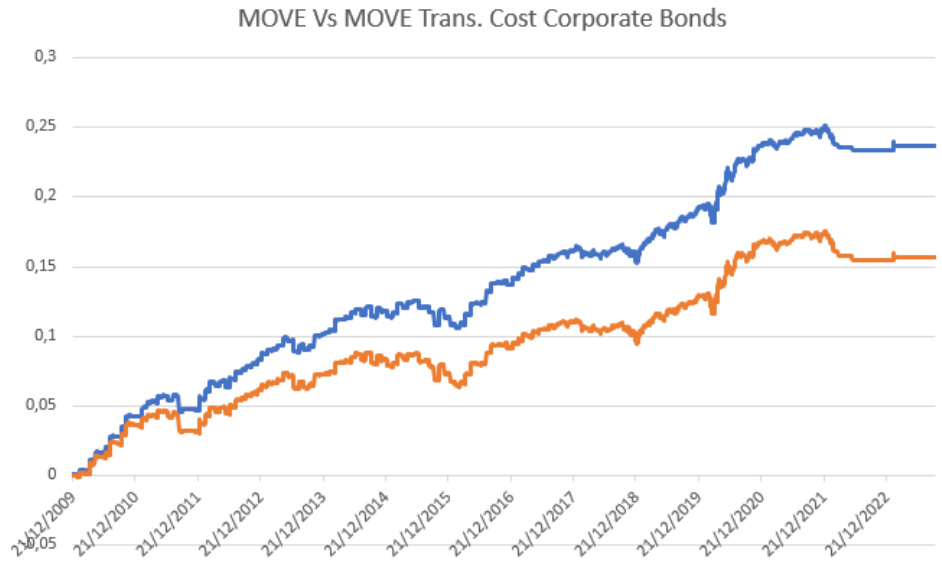
Appendix 35: Corporate Bonds statistics MOVE(Orange) Vs MOVE (Blue)

Summary Stats	
Return	0,009327412
Volatility	0,01765209
Info Sharpe	0,528402693
Skew	1,377464969
Kurt	54,63460462
Maximum DD (annual)	-1,44%
Correlation with the market	-0,010041773

Appendix 36: Corporate Bonds Transaction costs statistics



Appendix 37: Corporate Bonds Vs Transaction Costs Comparison



Appendix 38: MOVE Vs MOVE Transaction Costs Comparison

Summary Stats	
Return	0.01135
Volatility	0.014098
Info Sharpe	0.80509
Skew	2.430802
Kurt	50.45156
Maximum DD (annual)	-1.15%
Correlation with the market	0.012088

Appendix 39: Statistics Transaction Cost Corporate Bonds with Move Signal

SUMMARY OUTPUT

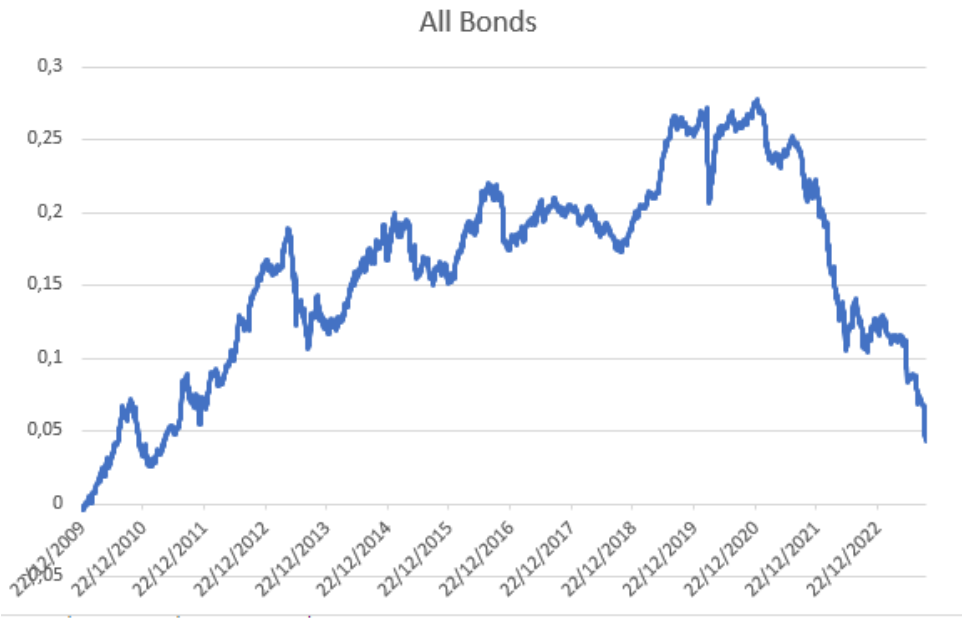
Regression Statistics	
Multiple R	0.775894956
R Square	0.602012983
Adjusted R Square	0.60190237
Standard Error	0.620176585
Observations	3600

ANOVA

	df	*SS*	*MS*	*F*	*gnificance F*
Regression	1	2093.287	2093.2873	5442.496	0
Residual	3598	1383.859	0.384619		
Total	3599	3477.146			

	Coefficients	*ɔndard Err*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2.602097172	0.013086	198.85216	0	2.576441	2.62775308	2.576441262	2.627753081
X Variable 1	-0.58783611	0.007968	-73.773274	0	-0.60346	-0.5722136	-0.60345864	-0.57221358

Appendix 40: Linear Regression Corporate Bonds and FED Rate



Appendix 41: All Bonds Return

Summary Stats	
Return	0,003122222
Volatility	0,027798604
Info Sharpe	0,112315795
Skew	-1,106740354
Kurt	12,71188873
Maximum DD (annual)	-1,60%
Correlation with the market	-0,052484421

Appendix 42: Statistics All Bonds

Summary Stats	
Return	-0,002280448
Volatility	0,013584304
Info Sharpe	-0,16787372
Skew	-3,983325079
Kurt	67,04704539
Maximum DD (annual)	-1,47%
Correlation with the market	0,008718517

Appendix 43: Statistics all bond with Ranking Signal

Summary Stats	
Return	0,009166779
Volatility	0,028885826
Info Sharpe	0,317345209
Skew	-0,510188832
Kurt	22,94618924
Maximum DD (annual)	-2,21%
Correlation with the market	-0,030376725

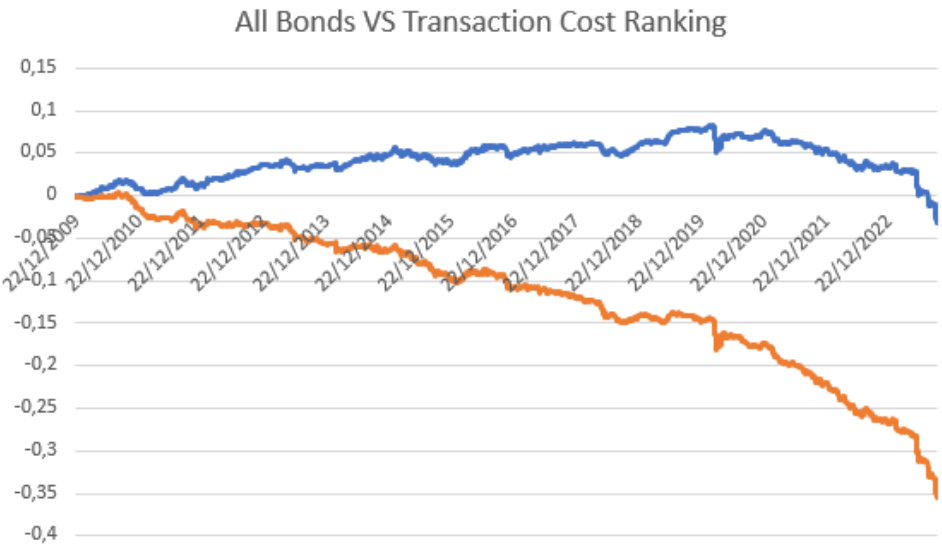
Appendix 44: Statistics all bond with Move Signal

Summary Stats	
Return	0,003223662
Volatility	0,010880565
Info Sharpe	0,29627705
Skew	-2,744162319
Kurt	76,24526091
Maximum DD (annual)	-1,22%
Correlation with the market	0,005817749

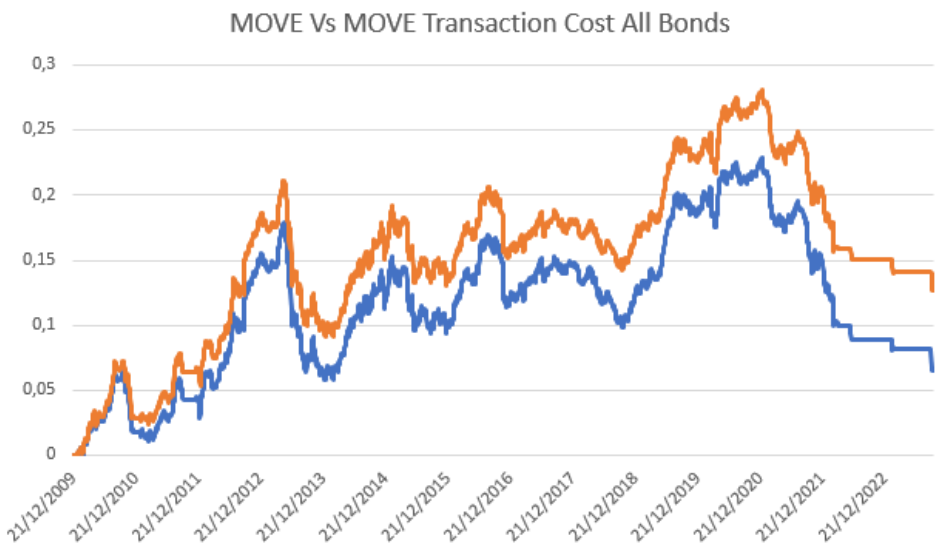
Appendix 45: Statistics MOVE plus Ranking Statistics

Summary Stats	
Return	-0,025687593
Volatility	0,014723996
Info Sharpe	-1,744607459
Skew	-3,984740113
Kurt	66,97801473
Maximum DD (annual)	-1,60%
Correlation with the market	0,008169184

Appendix 46: Statistics Transactions Cost All Bond



Appendix 47: All Bonds Ranking (Blue) Vs All Bonds Ranking Transaction cost (Orange)



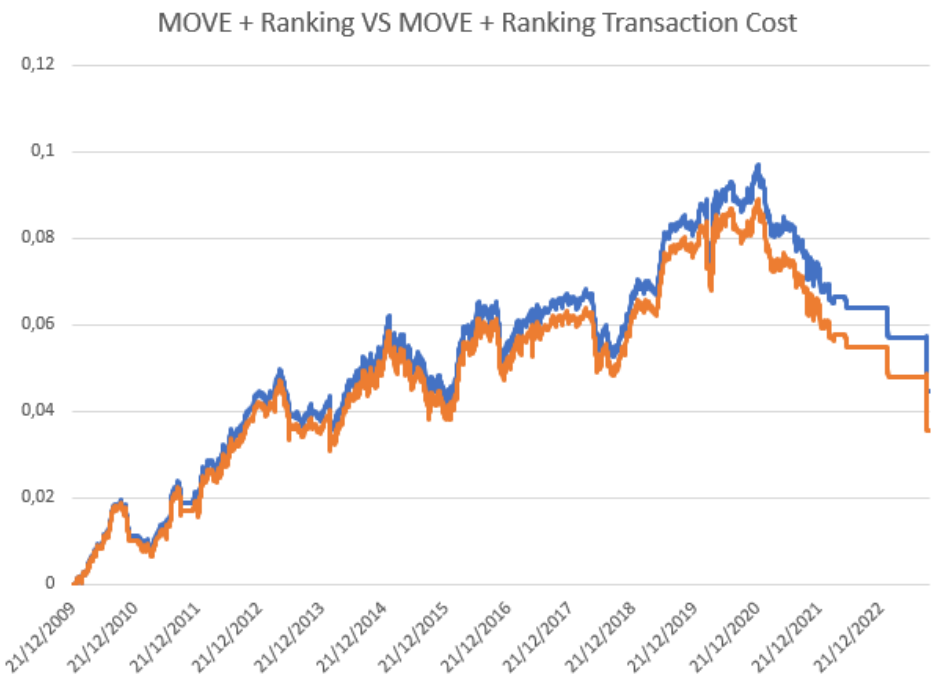
Appendix 48: MOVE Vs MOVE Transaction Cost All Bond Comparison

Summary Stats	
Return	0,004728521
Volatility	0,028554334
Info Sharpe	0,165597329
Skew	-0,873132136
Kurt	21,65363965
Maximum DD (annual)	-2,22%
Correlation with the market	-0,04597815

Appendix 49: Statistics Transaction Costs MOVE All Bonds

Summary Stats	
Return	0,002570691
Volatility	0,01088702
Info Sharpe	0,236124402
Skew	-2,763744965
Kurt	76,47885395
Maximum DD (annual)	-1,22%
Correlation with the market	0,005693089

Appendix 50: Statistics MOVE plus Ranking with Transaction Costs All Bonds



Appendix 51: Move plus Ranking (Blue) Vs Move plus Ranking and transaction Cost (Orange) Comparison