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ANALYSING DRIVERS AND DETERMINANTS OF THE CROSS-CURRENCY BASIS: A POST GLOBAL FINANCIAL CRISIS PERSPECTIVE

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Abstract

Post-GFC, global financial markets have seen notable deviations from the covered interest parity. This thesis focuses on divergent monetary policies and market dynamics in the US, Eurozone, the UK, and Japan, finding evidence that higher US interest rates tend to lead to a wider cross-currency basis, highlighting the dollar's role in attracting foreign investments. Contrary to previous studies, it is evidenced that the VIX is a significant driver, emphasising the need for an adaptive approach in global finance, integrating traditional economic indicators and nuanced aspects of market sentiments in an evolving financial landscape.

Keywords: Cross-Currency Basis, Covered Interest Parity, Monetary Policy, FX Swap Market, Global Financial Crisis

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1. Introduction

This thesis aims to answer the research question of the main drivers and determinants of cross-currency swaps (XCCY) and how they have evolved in response to the shifting landscape in the wake of the Global Financial Crisis (GFC). This research delves into the EURUSD, GBPUSD, and USDJPY XCCY basis for 1-year to 10-year maturity. It examines the basis fluctuations by analysing the impact of the representative floating, exchange, and forward rates in light of market dynamics, market risk, and economic performance. Through this analysis, I gained valuable insights into the evolving nature of the XCCY basis in the post-GFC era.

The XCCY basis, which measures the deviation from the covered interest parity (CIP), is one of the cornerstones in international finance, as Keynes introduced the concept of CIP in 1923, during the era of fluctuating exchange rates after World War I (Keynes 1923). When there is no risk from the other party, CIP connects the premium of a currency's forward rate to its spot rate with its interest rate advantage over a foreign currency. Essentially, CIP is the main link between money and foreign exchange in a global financial market (Cerutti, Obstfeld and Zhou 2021).

The basis seemed consistent for nearly 30 years leading up to the GFC. Studies by Akram, Rime and Sarno (2008) identified minor, short-lived, yet economically relevant deviations from CIP. But even then, CIP was a reliable indicator of the relationship between forward and spot exchange and interest rates. Post-GFC, the CIP no longer holds, implying that arbitrage is theoretically possible due to market friction in arbitrage activities.

In the first part, I explore the existing literature, starting with a general overview of XCCY and the CIP. Subsequently, I delve deeper into the literature covering the primary factors influencing the basis. Following this review, I outline the hypotheses for the upcoming statistical analysis. The results are analysed considering the literature and compared against the initial theoretical expectations, aiming to provide explanations and insights into any discrepancies observed.

1. Literature Review on Applicable Economic Theories

1.1 Overview

Over the past decade, global financial markets have experienced a significant transformation, particularly with the disruption of the CIP. Long regarded as a cornerstone in international finance, the CIP experienced a significant violation after the GFC of 2008. This period saw the interplay of various macroeconomic and regulatory forces that disrupted the traditional minor violations pre-GFC. Post-2008, the divergence in monetary policies across major economies, coupled with the impacts of market dynamics such as evolving market risk, supply dynamics, and economic performance, has significantly impacted foreign exchange hedging demand and balance sheet costs, thereby affecting the basis dynamics.

1.2 Cross-Currency Basis Swaps

Unlike traditional interest rate swaps, an XCCY involves the parties agreeing to exchange specified amounts of two different currencies at the outset and then re-exchange these amounts at the end of the swap term. During the swap, each party will make interest payments to the other in the received currency. The interest payments can be fixed, floating, or a combination of both, depending on the terms of the agreement (Ibhagui 2021). Due to its structure, XCCY effectively serves as a mechanism to hedge against FX risk in longer-term debt securities issued in foreign currencies and to gain access to foreign capital markets (Arsov, et al. 2013).

The XCCY basis refers to the discrepancy between the dollar interest rate in the cash market and the dollar interest rate implied from the swap market when converting foreign currency into dollars, where the basis measures deviations from the CIP (Avdjiev, et al. 2017). Essentially, the basis is the additional cost of borrowing dollars synthetically via an XCCY instead of directly borrowing from the dollar cash market. When the cost of borrowing dollars

synthetically via a swap exceeds the costs of direct dollar borrowing, the foreign currency has a negative basis, which is the trend among major currencies (Figure 2, Figure 3, and Figure 4).

1.3 Covered Interest Parity

The CIP implies that interest rate differentials between currencies should be perfectly reflected in the foreign exchange forward discount rates. Otherwise, a market participant can arbitrage in interest and exchange markets for a risk-free profit (Fama 1984). The essence of CIP is often shown through the XCCY, where the basis should theoretically be zero. However, deviations from this parity have been significant, especially post-2008 GFC, reflecting a break in the traditional arbitrage relationships (Du, Tepper and Verdelhan 2018).

The CIP is a no-arbitrage condition, stating that given two currencies, Currency A and Currency B, the income realised when a Currency A holder invests in a Currency B fixed income security and exchanges the Currency B proceeds to Currency A must be equal to the income generated had the Currency A holder invested in a similar Currency A security domestically. This also implies that when a Currency B entity issues in Currency A and exchanges the cost of the Currency A funds to Currency B, this cost must be equal to if the Currency B entity issued a similar product domestically in Currency B. Otherwise, it would be possible to raise cheaper Currency B funds via issuing in Currency A or to obtain a higher income in Currency A via investing in Currency B bonds, with currency risk fully hedged (Ibhagui 2021).

1.4 The Cross-Currency Basis Pre-2008

Pre-GFC, CIP deviations were minimal and fluctuated around zero. Detailed tick-frequency studies showed minor and transient departures from CIP, showing that violations of CIP were often short-lived pre-2008 but economically significant (Cerutti, Obstfeld and Zhou 2021). On average, the duration was not long enough for individuals to exploit them but short enough that studies pre-2008 using lower-frequency data might have overlooked the violation (Akram,

Rime and Sarno 2008). The violation of CIP before 2008 was influenced by various market imperfections and frictions, such as transaction costs, credit risk, and liquidity constraints, which hindered arbitrage operations necessary to uphold CIP (Akram, Rime and Sarno 2008).

1.5 The Cross-Currency Basis Post-2008

From the onset of the GFC, CIP began to be violated, resulting in a significant XCCY disparity (Figure 2, Figure 3, and Figure 4). During the GFC, short-term deviations surged to -200 bps and exceeded -50 bps for major currency pairs over five years. Although the basis gradually returned to near-zero by 2013, it expanded again after 2014 (Cerutti, Obstfeld and Zhou 2021).

The literature on CIP deviations has identified several key drivers post-GFC. Baba and Packer (2009), Du, Tepper and Verdelhan (2018), and Avdjiev et al. (2017) argue that turbulence from the GFC led to dollar shortages, influencing CIP deviations. As Avdjiev et al. (2017) discussed, CIP deviations can also be affected by the dollar's strength. The study proved that a stronger dollar is associated with more significant CIP deviations and a contraction of cross-border dollar bank lending, where the dollar acts as a barometer for global risk-taking, affecting the supply of dollar hedging activities. Ivashina, Scharfstein and Stein (2015), Du, Tepper and Verdelhan (2018), and Rime, Schrimpf and Syrstad (2022) argue that limits to arbitrage, balance sheet costs and asymmetric monetary policy shocks are pivotal in driving CIP deviations. Liao (2020) links corporate issuance patterns and arbitrage in funding activities, suggesting that the demand and supply of hedging activities affect the deviations. Further, Lida, Kimura and Sudo (2016) and Du, Tepper, and Verdelhan (2018) suggest monetary policy divergences have contributed to the violations, and research by Borio et al. (2016) and Dedola et al. (2021) argue that monetary actions (e.g. QE) influence the basis.

To delve deeper, my focus will be on the impacts of market dynamics, evolving market risk and supply dynamics, as well as differing monetary policies and economic performance measures.

1.6 The Impact of Market Dynamics and Credit Risk on the XCCY Basis

Studies by Avdjiev et al. (2017) and Cerutti, Obstfeld and Zhou (2021) present data showing that a rising dollar correlates with increased basis deviations. Avdjiev et al. (2017) show evidence that dollar strengthening reduces cross-border dollar lending and restricts hedging options, leading to more negative discrepancies. Furthermore, the study indicates that the sensitivity to the dollar can explain the deviations. The currencies with more significant exposure to the dollar factor, like traditional safe-haven currencies like the Yen and Swiss Franc, have larger deviations, indicating substantial arbitrage opportunities. The study suggests that the dollar's strength influences capital market intermediation spreads due to the financial channel of exchange rates. Unlike the traditional net exports channel, where a domestic currency's depreciation boosts real economic activity, the financial channel operates inversely. When a domestic currency appreciates, financial conditions in the country ease, and CIP deviations shrink. Essentially, a dollar depreciation is tied to increased dollar borrowing by non-residents, forming a triangle between the dollar, the XCCY basis, and cross-border bank lending (Avdjiev, et al. 2017).

Further, studies by Cerutti, Obstfeld, and Zhou (2021) have focused on the effect of the VIX, the implied volatility of S&P 500 index options, as an additional explanation for the dollar strength. Their findings suggest that the VIX are large and negative, indicating that a VIX increase is correlated with a more negative basis. Still, their results are statistically insignificant. This is also consistent with other literature by Cerutti, Claessens and Ratnovski (2017), Avdjiev et al. (2020), and Forbes and Warnock (2021), documenting a weaker post-GFC relationship between VIX and cross-border capital flows. Conversely, Bruno and Shin (2015) suggest a link between bank leverage and the VIX, where a decrease in dollar funding costs raises bank leverage by mitigating volatility risk. The reduced costs and increased leverage lead to greater demand for dollar-denominated assets, impacting the basis.

While most research has indicated that the dollar's strength drives the XCCY basis, it is also important to note that other factors can drive it, such as a more favourable economic performance. Ibhagui (2021) found evidence that for the EURUSD XCCY, the dollar will only be dominant and exert the most influence on the basis spreads when other financial and economic indicators are much less benign. The study observed that an increase in the Eurozone (EZ) real output relative to the US tightens the basis. In contrast, an increase in the EZ money supply leads to an exchange rate depreciation, which widens the basis. These findings suggest that deviations from CIP are also influenced by exchange rates and the scale of money supply (Ibhagui 2021).

Further, Lida, Kimura and Sudo (2016) and Baba and Packer (2009) have conducted studies on how the default probability reflected by Credit Default Spread (CDS) impacts the basis by focusing on the role of financial institutions' counterparty risk. Lida, Kimura, and Sudo (2016) found evidence that CIP deviations are linked to non-US banks' default risk. However, this influence has diminished due to global interest rate differentials. Baba and Packer (2009) introduce the counterparty-risk hypothesis, arguing that asymmetries between European and US financial institutions contribute to CIP deviations, where an increased counterparty risk in European institutions leads to a premium of obtaining dollars in the swap market, negatively impacting CIP deviations. A later study by Ibhagui (2020) argues that studying sovereign CDS rather than corporate risk provides a more general measure of default likelihood or counterparty risk at the sovereign level, providing a better macro picture of the overall credit risk on an ongoing basis. Ibhagui's (2020) findings indicate a dynamic relationship between CDS and basis spreads. Generally, an expansion in CDS spreads is associated with a widening basis, meaning foreign entities face higher costs to obtain dollars, with the most significant impacts observed in the EZ and Japan (Ibhagui 2020). Several studies show the relevance of looking at sovereign CDS spreads rather than corporates. Bedendo and Colla (2015) show a spillover of

credit risks from sovereign to corporates, while Heinz and Sun (2014) view sovereign CDS as direct measures of a country's default risk, reflecting better financial markets' perception of the country's risk.

1.7 Monetary Policy and Economic Performance's Impact on the XCCY Basis

The divergence in monetary policies among major economies has been a significant factor since 2008. The FED adopted a loose policy post-2008, with low-interest rates and QE (Eberly, Stock and Wright 2020), but gradually shifted to tightening measures, raising short-term rates by over 500 bps since early 2022 to control inflation (D'Amico and King 2023). The ECB also pursued a loose policy post-2008 to stimulate growth and counter deflation, maintaining low rates and asset purchases. Despite these efforts, the EZ faced deflationary risks around 2013, facing a prolonged loose policy to achieve the ECB's 2% inflation target (European Central Bank 2021), before tightening to tame an elevated inflation after the energy crisis seen in Europe post the Covid-19 pandemic (Favero and Fernández-Fuertes 2023). Similarly, the BoE implemented low rates and asset purchases post-2008 (Braun, Miranda-Agrippino and Saha 2023), and later on, tightened by raising the interest rate from 0.1% in December 2021 to 5.25% (UK Government 2023). In Japan, BOJ adopted unconventional monetary policies such as QE and negative interest rates in response to deflation and the banking crisis in the late 1990s and early 2000s to address deflation and stimulate economic growth. Their yield curve control policy, with short-term rates at -0.1%, is a testament to their persistent loose policy stance (Westelius 2020). The varying approaches have impacted currency demand and supply, influencing currency values and the basis, as Amador et al. (2020) and Fukuda and Tanaka (2017) noted.

Evidence from Lida, Kimura and Sudo (2016) indicates that monetary policy divergence between the FED and other central banks widens the CIP deviations. As the interest margin (the difference between the interest rate on lending and that on borrowing) in the US becomes larger than that of the foreign currency, foreign investors increase their investment in dollar-

denominated assets. This suggests that interest margin differentials between US and non-US countries depend on the divergence between monetary policy and that a divergent monetary policy can be crucial in driving the basis (Lida, Kimura and Sudo 2016).

Further, Borio et al. (2016) analysed the impact of QE on the XCCY for the dollar, Euro, and Yen. They found that QE policies, by lowering yields, prompt investors to seek higher returns in foreign currency bonds, increasing hedging demand. This effect intensified with large-scale asset purchases by central banks like the ECB and BOJ, which reduced the availability of securities in the market (Borio, et al. 2016). Furthermore, adopting negative interest rates pushes investors towards foreign currencies, heightening the demand for FX swaps or XCCY. The widening of the dollar basis against the Euro and Yen aligns with QE announcements by the BOJ and the ECB, with significant impacts observed after key announcements such as the ECB's introduction of negative interest rates in 2014 and the QE announcement in 2015 (Borio, et al. 2016). Studies by Dedola et al. (2021) support these findings and find evidence that expansionary QE shock increases limits to arbitrage in FX markets as it widens CIP deviations.

2. Research Design

This section describes the research approach adopted for this thesis. It encompasses formulating the research question and hypothesis, a detailed account of the variables extracted from the dataset, and a summary of anticipated outcomes.

2.1 Data

This part of the research design focuses on the dataset utilised to examine the drivers and determinants of the XCCY. The key data sources for this analysis are weekly data points dating back to 2008. If weekly data to 2008 is unavailable, the most recent data point is used for the following periods until a new one is available. The choice of 2008 as the starting point is significant due to the XCCY basis association with the GFC.

2.2 Baseline Regression Models

I examine the relationship between the XCCY basis and its drivers by performing Ordinary-Least Square (OLS) regressions based on the standard model:

$$y = \beta_0 + \beta_1 X_1 + \ldots + \beta_n X_n + \varepsilon_i$$

The dependent variables are the basis of the XCCY basis swap, while $X_1 - X_n$ represents the explanatory variables, each with their corresponding coefficients $\beta_1 - \beta_n$. The objective is to examine how components of the CIP, the impact of market dynamics and credit risk, and monetary policy and economic performance impact the basis fluctuations.

2.3 Research Question and Hypothesis

H1: The CIP Components Significantly Explains the XCCY Basis Fluctuations

In the regression analysis, the dependent variables are the XCCY basis of three currency pairs: EURUSD, GBPUSD, and USDJPY. They are analysed across maturities ranging from 1-year to 10-year due to the availability of forward points data only up to 10 years. For the dependent variable (XCCY basis), different floating rates are used before and after 2021. Since 2021, the basis for the EURUSD currency pair has shifted from the pre-2021 3M EURIBOR vs 3M LIBOR to ESTR vs SOFR. Similarly, the GBPUSD pair has transitioned from the pre-2021 of 3M GBP LIBOR vs 3M USD LIBOR to SONIA versus SOFR. The current rates for the USDJPY pair are TONAR versus SOFR, replacing the pre-2021 3M USD LIBOR vs 3M JPY LIBOR. The floating rates' independent variables are based on the 1-year to 10-year swap rates, with equal floating rates as the XCCY, following the transition from LIBOR. Additionally, the models include the respective exchange rates for each currency pair and their forward points as independent variables to capture the currencies' immediate and forward-looking market expectations. The following regression model is thus structured to explore how the interest rates and market expectations for each currency reflect the XCCY basis deviations:

$$XCCY_{EURUSD_i} = \beta 0 + \beta 1 \cdot USD_{Floating_i} + \beta 2 \cdot EUR_{Floating_i} + \beta 3 \cdot EURUSD_{FXRate} + \beta 4 \cdot EURUSD_{FWD_i} + \varepsilon_i$$

$$XCCY_{GBPUSD_i} = \beta 0 + \beta 1 \cdot USD_{Floating_i} + \beta 2 \cdot GBP_{Floating_i} + \beta 3 \cdot GBPUSD_{FXRate} + \beta 4 \cdot GBPUSD_{FWD_i} + \varepsilon_i$$

$$XCCY_{USDJPY_i} = \beta 0 + \beta 1 \cdot USD_{Floating_i} + \beta 2 \cdot JPY_{Floating_i} + \beta 3 \cdot USDJPY_{FXRate} + \beta 4 \cdot USDJPY_{FWD_i} + \varepsilon_i$$

I expect that the components of CIP itself can explain a large part of the basis fluctuations. Specifically, I anticipate fluctuations in the floating interest rates, the spot FX rate, and the corresponding forward rates have been significant post-GFC drivers. I hypothesise, based on the formula for estimating the basis (Figure 1), that a higher relative dollar floating rate (SOFR) leads to a more positive basis, while a higher observed floating rate (ESTR, SONIA, and TONAR) leads to a more negative basis, everything else equal. The spot FX rate is expected to react to adjustments in currency valuations. Therefore, I expect an appreciation of the dollar to drive the basis more negatively, meaning positive coefficients for EURUSD and GBPUSD and a negative coefficient for USDJPY. However, these adjustments do not always mirror the movements in forward rates. The forward rates may diverge from the actual movements of spot rates and the interest differential. I expect that increased future expectations of the Euro, Sterling and Yen will drive the basis more negatively, showing negative coefficients for the forward points of EURUSD and GBPUSD and positive coefficients for USDJPY.

H2: Dollar Strength, Risk Perception, and Money Supply Significantly Influence the Basis

The hypothesis builds on the premise that the basis is sensitive to market dynamics and credit risk changes. The dependent variables are the basis for EURUSD, GBPUSD, and USDJPY. The Broad Trade-Weighted US dollar index is added as an independent variable, measuring the US

dollar's value against a basket of foreign currencies. Further, VIX, the implied volatility of S&P 500 index options, is added to measure the market's expectation of volatility. Alongside, sovereign CDS spreads are incorporated to gauge the credit risk associated with the 5-year sovereign CDS spread of the US (US Treasuries), EU (German bunds), UK (UK Gilts), and Japan (Japanese governments bonds) to understand the perceived creditworthiness tied to the sovereign debts. Additionally, the variable for the money supply is represented by the logarithm of the M1 money supply, which encompasses the most liquid financial assets, including cash and checking accounts (FRED 2023). For the Euro, Sterling, and Yen, I have converted their respective M1 money supply figures into dollars. This conversion ensures a consistent and comparable metric across the currencies, allowing for a more accurate assessment.

The regression is based on the following model:

$$XCCY_{EURUSD_i} = \beta 0 + \beta 1 \cdot DollarIndex + \beta 2 \cdot VIX + \beta 3 \cdot CDS_{US} + \beta 4 \cdot CDS_{EU} + \beta 5 \cdot log(Supply_{USD}) + \beta 6 \cdot log\,(Supply_{EUR}) + \varepsilon_i$$

$$XCCY_{GBPUSD_i} = \beta 0 + \beta 1 \cdot DollarIndex + \beta 2 \cdot VIX + \beta 3 \cdot CDS_{US} + \beta 4 \cdot CDS_{UK} + \beta 5 \cdot log(Supply_{USD}) + \beta 6 \cdot log\,(Supply_{GBP}) + \varepsilon_i$$

$$XCCY_{USDJPY_i} = \beta 0 + \beta 1 \cdot DollarIndex + \beta 2 \cdot VIX + \beta 3 \cdot CDS_{US} + \beta 4 \cdot CDS_{JP} + \beta 5 \cdot log(Supply_{USD}) + \beta 6 \cdot log\,(Supply_{JPY}) + \varepsilon_i$$

I expect that the dollar's strength has a substantial and direct impact on the deviations of the XCCY basis, with greater dollar strength corresponding to a more negative basis. Furthermore, there is different sensitivity to the dollar variations in CIP deviations across different currencies. I expect currencies with higher sensitivity to the dollar factor, such as the JPY, to exhibit more significant CIP deviations. This expectation is grounded in the study from Avdjiev et al. (2017) and Cerutti, Obstfeld and Zhou (2021). Further, I expect a rise in the VIX, which serves as a barometer for heightened market volatility and uncertainty, to affect the XCCY basis negatively.

However, drawing from the insights of the study conducted by Cerutti, Obstfeld, and Zhou (2021), I expect the impact to be insignificant.

By incorporating CDS spreads into my analysis, I aim to explore the impact of credit risk perceptions on the XCCY basis. I expect that wider CDS spreads, signalling increased credit risk, will correlate with a more negative XCCY basis, reflecting the impact of creditworthiness concerns on currency valuations and interest rate differentials. My analysis is anticipated to align with Ibhagui's (2020) insights on the negative effect of wider sovereign CDS spreads.

The integration of monetary supply data is poised to offer insights into the influence of central banks' monetary policies on the XCCY basis. Based on the study from Ibhagui (2021), I expect that a relative increase in money supply by the FED would lead to a more positive basis, while a relative increase in money supply from ECB, BoE, or BOJ would negatively affect the basis. When the FED adopts an expansionary policy, it increases the dollar supply, potentially devaluing the dollar relative to the other currencies. Then, dollar borrowing will be cheaper in relative terms, which makes it more favourable for foreign investors to obtain dollar funding.

H3: Interest Margin Differentials Significantly Impact the XCCY Basis in the Context of Monetary Policy and Economic Divergence

This hypothesis examines the impact of interest margin differentials between the FED, ECB, BoE, and BOJ on the XCCY basis, particularly in the context of monetary policy divergence and economic divergence. Ibhagui's (2021) study underscores the importance of broadening the focus beyond the dollar. To address this, I am including the effect of the real GDP on the basis.

The regression is based on the following model:

$$XCCY_{EURUSD_i} = \beta 0 + \beta 1 \cdot \left(FED_{Margin} - ECB_{Margin}\right) + \beta 2 \cdot log(FED_{BS}) + \beta 3 \cdot log(ECB_{BS}) + \beta 4 \cdot log(GDP_{US}) + \beta 5 \cdot log(GDP_{EZ}) + \sum_{j=1}^{l} \beta 5 + j \cdot Dummy_{FED_j} + \sum_{k=1}^{m} \beta 6 + k \cdot Dummy_{ECB_k} + \varepsilon_i$$

$$XCCY_{GBPUSD_i} = \beta 0 + \beta 1 \cdot \left(FED_{Margin} - BOE_{Margin}\right) + \beta 2 \cdot \log\left(FED_{BS}\right) + \beta 3 \cdot \log\left(BOE_{BS}\right) + \beta 4 \cdot log(GDP_{US}) + \beta 5 \cdot log(GDP_{UK}) + \sum_{j=1}^{l} \beta 5 + j \cdot Dummy_{FED_j} + \sum_{k=1}^{m} \beta 6 + k \cdot Dummy_{BOE_k} + \varepsilon_i$$

$$XCCY_{USDJPY_i} = \beta 0 + \beta 1 \cdot \left(FED_{Margin} - BOJ_{Margin}\right) + \beta 2 \cdot \log\left(FED_{BS)}\right. + \beta 3 \cdot \log\left(BOJ_{BS}\right) + \beta 4 \cdot log(GDP_{US}) + \beta 5 \cdot log\left(GDP_{JP}\right) + \sum_{j=1}^{l} \beta 5 + j \cdot Dummy_{FED_j} + \sum_{k=1}^{m} \beta 6 + k \cdot Dummy_{BOJ_k} + \varepsilon_i$$

For each currency pair, the dependent variable is the XCCY basis. The first independent variable is the interest margin differential, which is calculated differently for each currency pair. For EURUSD, the differential is between the FED's Discount Rate and Interest on Excess Reserves (IOER) and the ECB's Marginal Lending Facility Rate and Deposit Facility Rate. For GBPUSD, it's the differential between the FED rates and the BoE's Borrowing Facility and Deposit Facility rates. For BOJ, the differential is between the FED's rates and the BOJ's Policy Rate and Overnight Call Rate (unsecured overnight money market rates). This would give a sense of the margin between the interbank lending rates and the rate set by the central banks. The hypothesis draws theoretical support from Lida, Kimura and Sudo (2016) and Du, Tepper and Verdelhan (2018) and anticipates that as the interest margin in the US becomes larger than that of the foreign currency, foreign investors increase their investment in dollar-denominated assets, resulting in a higher demand for dollars in the FX swap market and a more negative basis.

Furthermore, the hypothesis incorporates additional variables such as the logarithms of the balance sheets of these central banks, as well as the logarithms of the GDP figures of the US, EZ, UK, and Japan. These variables are included to provide a comprehensive view of the economic backdrop to focus beyond the dollar effect. Based on the research by Borio et al. (2016), Dedola et al. (2021), and Ibhagui (2021), I expect that the size of the balance sheets plays a vital role in influencing the basis, where an increased FED balance sheet will drive the basis more positive by lowering US yield. This influence stems from the impact of QE policies on yields and investor behaviour. Borio et al. (2016) discussed that the expansive QE measures undertaken by the ECB and BOJ lower domestic yields, so investors seek higher returns in foreign currency bonds, which increase demand for dollar assets and make the basis more negative. Based on the findings from Ibhagui (2021) from the EZ, I expect that when the real GDP output in the EZ, the UK, or Japan outperforms that of the US, it will have a positive effect on the basis. This implies that a more robust economic performance in these regions relative to the US will lead to tighter basis spreads.

A notable aspect of this research involves integrating dummy variables to analyse the effects of different QE and QT periods post-GFC. These periods represent significant shifts in monetary policy, which could profoundly impact the XCCY basis. Incorporating these dummy variables is expected to shed light on the nuanced effects of monetary policy shifts over time.

3. Regression Analysis

In this section, I will go into a detailed discussion of my findings, addressing and evaluating my proposed hypotheses regarding the drivers and determinants of the XCCY basis. This analysis will discuss the validity and influence of the hypothesised factors and aim to integrate these insights into understanding the XCCY basis dynamics. Finally, I will present some potential implications of the analysis and conclude based on my findings.

3.1 Discussion of Results

Hypothesis 1

The regression shows strong explanatory power for all maturities, generally exceeding 70% (Table 5, Table 6, and Table 7). The USDJPY pair exhibited the highest explanatory effect, surpassing 80% for most maturities. The constants reveal a negative baseline across all pairs.

The analysis indicates a significant and positive relationship between dollar floating rates and the XCCY basis across all three currency pairs (see Table 5, Table 6, and Table 7). A higher floating rate for dollars implies a higher expected return for dollar investments, increasing the demand for the dollar and strengthening its forward rate relative to its spot rate. This adjustment leads to a less negative basis under the CIP framework and corresponds with the hypothesis. For the EURUSD and GBPUSD basis, the effect stabilises from the medium to the long term. The stabilising effect could be due to market expectations stabilising in the long end, reflecting that long-term economic and policy outlooks have been incorporated into market expectations. Further, the dollar floating rate effect for the USDJPY basis increases progressively from the short end to the long end. This may indicate the increasing importance of dollar rates in driving investment and hedging decisions for longer maturities in the USDJPY pair.

Conversely, the Euro, Sterling, and Yen floating rates negatively contribute to their respective XCCY basis, corresponding with the hypothesis. When the floating interest rate for the Euro, Sterling, and Yen increases, holding or investing in assets denominated in these currencies becomes more attractive due to the potential for higher returns. This increased attractiveness can lead to a greater demand for these assets since the forward rate is now stronger than the spot rate. For the EURUSD and GBPUSD basis, there is quite a stable relationship over the maturities, while for the USDJPY basis, there is an increased negative impact at longer

maturities. This suggests that the interest rate outlook is expected to have a more pronounced impact on Yen rates, aligning closely with Japan's existing negative interest rate environment.

The positive coefficients for the EURUSD and GBPUSD pair indicate that when the EURUSD and GBPUSD exchange rates decrease (dollar appreciation), the basis gets more negative. This aligns with the initial hypothesis. Everything else equal, if the dollar appreciates, the basis will become more negative because the unchanged forward rate is now relatively higher than the new, lower spot rate. For both EURUSD and GBPUSD, this effect increases with longer maturities. This might reflect that market participants form expectations about future exchange rates based on current economic outlooks, and over longer periods, these expectations can lead to more significant adjustments. Contrary to the initial hypothesis, the USDJPY exchange rate shows a positive coefficient that is increasing for longer maturities. Everything else being equal, this positive effect could reflect sustained divergence expectations in the US and Japan's policies and their economic outlook. This is especially relevant considering Japan's prolonged battle with deflation and the relatively more aggressive policy in the US.

Aligning with the initial hypothesis, increasing forward points for EURUSD and GBPUSD show negative coefficients and positive coefficients for USDJPY. If the Euro, Sterling, and Yen are expected to strengthen against the dollar, the forward rate will be higher for EURUSD and GBPUSD and lower for USDJPY than the unchanged spot rate, and the basis would become more negative. This can be explained by the fact that if the dollar is expected to continue to weaken, the cost of hedging, or the premium for swapping the foreign currency into dollars, will be lower, leading to a more negative basis. For all three XCCY pairs, this effect is most substantial in the short end. The decreasing effect over longer maturities for all three currency pairs could imply that long-term market expectations are influenced by broader economic outlooks rather than short-term expectations, consistent with the theoretical understanding that current interest rate differentials and currency expectations influence forward rates.

Hypothesis 2

The regressions reveal strong explanatory effects (Table 8, Table 9, and Table 10). When looking at longer terms, EURUSD exhibits a lower effect, suggesting that other factors influence long-term trends. In contrast, the explanatory power of the GBPUSD and USDJPY basis increases at longer maturities. Across all maturities, the constants are negative, revealing a negative baseline for the basis.

For a strengthening of the dollar, the results for the EURUSD and GBPUSD contrast with the initial hypothesis. The coefficients show that an increase in the dollar index leads to a more positive basis, which also increases for longer maturities. This observation could indicate different perceptions in the long-term outlook of the representative economies and currencies, where the actual market dynamics, including interest rate differentials, risk perceptions, and liquidity considerations, could have differing trends from the dollar strength, preferring Euro or Sterling assets. In contrast, for USDJPY, the results align with the initial hypothesis. Yen, which has historically been observed to be more sensitive to the dollar effect, has a more substantial negative impact on the basis, which is increasing for longer maturities. This could be due to the historically differing monetary policy stances of the US and Japan, with the US having higher interest rates than Japan. A stronger dollar could indicate an increase in these differentials, making it more expensive to swap from Yen to dollars or be perceived as a sign of broader economic strength in the US compared to Japan in the longer term.

In contrast to my initial hypothesis, the effect of the VIX is significant for all three XCCY pairs, indicating that volatility potentially drives the basis. The effect differs across the three pairs, where an increase in volatility leads to a more negative EURUSD and GBPUSD basis, corresponding with the insignificant variable of the study from Cerutti, Obstfeld and Zhou (2021). This phenomenon can be understood in the context of a flight-to-quality, where investors reach towards the safety of dollar assets amid uncertainty. This investor behaviour

reflects the post-GFC landscape, characterised by pronounced sensitivity to risk and volatility. On the other hand, for the USDJPY basis, an increase in volatility indicates a more positive basis that is increasing for longer maturities. This could be attributed to the position of the Yen as a safe haven currency, where Japan's position as a major creditor nation could contribute to a flow into Japanese assets in risk-off scenarios. This could be explained by the fact that due to market stress, the flow of Japanese investment funds into higher-yielding foreign currencies like the dollar has tended to reverse, appreciating the Yen against the dollar (Ganti 2022). The differing signs of the coefficients for the VIX and the dollar index show that a dollar strength and an increase in volatility may be inversely related, which may seem counterintuitive. The contrasting signs of the coefficients could reflect different market sentiments and reactions, where the dollar index is driven more by economic strength and policy expectations, impacting interest rate differentials and investment flows, while the VIX reflects market fear and risk aversion, influencing safe-haven flows and liquidity preferences.

The effect of the CDS spread mostly aligns with my initial hypothesis. When the CDS of the US increases in contrast to the EZ and the UK, and vice versa, the increased credit spread negatively impacts the EURUSD and GBPUSD basis in both cases. The USDJPY basis is the exception, indicating that an increased credit risk in the US indicates a more positive basis. This could potentially be due to Japan's role as a safe-haven currency. On the contrary, when the credit risk in Japan rises, it leads to a more negative basis, especially in the long end. This could imply that for Yen-denominated assets, the liquidity is generally lower in the long term, and in times of stress or perceived higher risk, the liquidity premium demanded by investors for holding longer-dated securities increases due to low liquidity. Japanese institutions are also significant holders of foreign assets, and changes in Japan's credit risk could alter hedging demands, contributing to the basis being more negative. Further, when the US credit spread increases, the effect across the three XCCY pairs generally diminishes for longer maturities.

The same relation is observed for credit risk in Europe, but for the UK, this adverse effect is only significant in the long end. This may be due to the credit risk playing a more substantial role in the short end of the curve than the long end.

For the money supply, the results are partly supported by the hypothesis. For the GBPUSD and USDJPY basis, an increase in the dollar supply has a negative impact on the basis, potentially reflecting a relative weakening of the dollar, increasing demand for dollar-denominated assets as they get more favourable for foreign investors. On the other hand, an increase in the dollar supply is associated with a positive effect on the EURUSD basis – corresponding with the initial hypothesis. Further, an increase in the supply of Euro and Sterling corresponds with the initial hypothesis and contributes negatively to the basis. However, the supply of Sterling has a positive coefficient only for the 1-year and 2-year maturities. It could indicate a Euro depreciation against the dollar due to the ECB's expansive monetary policies, particularly over longer time horizons. On the contrary, positive coefficients are observed for the Yen supply and the long end of the Sterling supply. For the GBPUSD basis, this pattern could reflect long-term concerns about the implications of an expansive monetary policy in the UK. For the Yen supply, the positive coefficient might indicate the Yen's depreciation against the dollar in response to Japan's historical monetary expansion in response to stagnation and deflation.

Hypothesis 3

The analysis indicates that there is a relationship between the XCCY basis and interest margin differentials in the context of monetary policy and economic divergence. The model effectively explains EURUSD trends (over 80%, see Table 11) and holds true for GBPUSD and USDJPY, with increased accuracy for longer maturities (Table 12 and Table 13). A negative constant across all maturities suggests a generally negative baseline.

The regressions for the interest margin differential partly support the hypothesis. An increase in the differential between the US and the ones of Europe and the UK results in a more negative EURUSD and GBPUSD basis. This aligns with the results from Lida, Kimura and Sudo (2016) and Du, Tepper and Verdelhan (2018) that as the interest in the US becomes larger than that of the foreign currency, foreign investors increase their investment in dollar-denominated assets, resulting in a higher demand for dollars in the FX swap market. In contrast, an increase in the interest margin differential between the US and Japan leads to a more positive basis, suggesting that the market dynamics and investor behaviours in the USDJPY pairing are distinct from those observed in EURUSD and GBPUSD. One potential explanation could be the role of the Yen as a safe-haven currency, leading to a sustained demand for the Yen, even when US rates are higher. Additionally, the longstanding policies of ultra-low interest rates and extensive QE in Japan might create a situation where significant interest rate differentials do not shift investor preference due to a considerable differential for most of the post-GFC period.

The analysis partially confirms that expanding the FED balance sheet will positively drive the basis. If the FED increase the balance sheet (e.g. QE) relative to the ECB and BoE, the analysis shows that this positively affects the EURUSD and GBPUSD basis, increasing for longer maturities. This corresponds with the fact that QE often targets long-term yield by buying bonds in the long end, lowering long-term yields. At the same time, when the ECB expands its balance sheet relative to the FED, a positive effect on the basis is observed. This aligns with the initial hypothesis. Meanwhile, for BoE, the results show that a BoE increase relative to the FED leads to a more negative basis. This could be explained by the expectation that the interest rate expectations from the BoE will be lower than those of the FED in the longer term. Regarding the USDJPY XCCY, the basis gets more negative when the FED increases its balance sheet relative to BOJ. When BOJ relatively increases their balance sheet to the FED, the effect is positive and aligns with the hypothesis, but only significant from 4-year maturity.

Consistent with the hypothesis, an expansion in real GDP in EZ, the UK, and Japan is related to a positive effect for all three XCCY basis, implying that a more robust economic performance in these regions relative to the US leads to a less negative basis. This relationship is also supported in Japan but is only significant in the long term from 7-year maturity onwards. The fact that the Japanese GDP significantly influences the USDJPY basis only at the long end could suggest that the Japanese economic strength becomes a more dominant factor in shaping the long-term basis. Further, the effect of relatively expanded growth in the US shows mixed effects. For the EURUSD and USDJPY basis, US growth is associated with a positive impact. In contrast, it has a negative effect on the GBPUSD basis. The adverse impact might imply that a US growth expansion relative to the UK is not only influenced by current economic conditions but also by market expectations about future growth and stability, such as uncertainty about the long-term effects of Brexit affecting investor confidence and risk perception.

Regarding FED's QE and QT initiatives, particularly the initial phase post-GFC, led to a more negative EURUSD basis, indicating that US monetary expansion had a more pronounced effect, affecting the attractiveness of Euro assets. In contrast, the GBPUSD basis got more positive during the same phase, likely reflecting the relative efficacy of the UK's monetary policies or the Sterling's strength. Subsequent QE measures, including QE3, resulted in a uniformly negative impact across GBPUSD and USDJPY pairs, suggesting varied market expectations of US in relation to the UK and Japan. Interestingly, Operation Twist led to a consistent negative effect across all pairs, likely due to a shift in the US yield curve by the FED selling near-term Treasuries to buy longer ones. All three XCCY pairs saw positive effects during the normalisation period, particularly at longer maturities for EURUSD and GBPUSD. This is consistent with the FED's tightening relative to the BOJ, BoE, and ECB. For the post-pandemic QT phase, the effect is negative for all three pairs, potentially due to QT driving the US yield higher, leading to a change in demand and rebalancing of capital flows into US assets.

For the ECB, most QE periods have shown a negative impact on the basis, aligning with the expectation that if ECB is engaged in more aggressive QE than the FED, it would lead to lower interest rates in the EZ compared to the US. This might increase the demand for dollar-denominated assets as investors seek markets to gain the highest yields. The exception is the ECB period of Outright Monetary Transactions (OMT) in 2012 during the European debt crisis, having a positive coefficient. This might indicate that the announcement and the potential implementation of the OMT program significantly improved market confidence in the EZ, reducing the perceived risk of holding and investing in euro-denominated assets. Additionally, by committing to purchase sovereign bonds of troubled countries, the ECB reduced the risk premiums on these bonds, making them more attractive to investors. Furthermore, the Asset Purchase Program announcement in 2015 lead to a negative effect on the basis, which is consistent with research by Borio et al. (2016). Lastly, the 2023 QT period indicates a positive effect, aligning with expectations by conducting QT.

The BoE periods show varying results. Both post-Brexit QE and Covid-19 Response QE show a negative effect on the basis, corresponding with lower yields and less demand for Sterling-denominated assets. The additional QE rounds show a positive effect, potentially due to FED's approach being generally considered more aggressive in scale and speed in this period, lowering US yields. For the QT period post-Covid, it shows a negative effect on the basis, aligning with the finding from the FED Post-Pandemic QT Phase.

For the BOJ, the QE policies post-GFC have mainly shown a positive effect, while a general trend shows that the effect is diminishing for longer maturities. The impact on longer-term maturities potentially underscores the effectiveness of the BOJ's Yield Curve Control policy in stabilising long-term interest rates. Further, the QE following the Covid-19 pandemic has had a negative impact, aligning with the fact that a QE intervention will depress domestic yields.

3.2 Limitations and Suggestions for Further Research

There are limitations to this study that should be addressed for future research. Firstly, the analysis primarily focuses on specific currency pairs, which may not fully capture the complexities of global currency markets. Future research could broaden the scope to include more currency pairs, particularly AUD and NZD, that historically had a positive basis, and high-yielding currencies such as emerging markets economies. Additionally, further research could investigate the implications of balance sheets costs due to changes in the cost of capital and analyse the effect of how post-GFC regulations have increased the capital and liquidity requirements for banks, such as the Basel III framework, Liquidity coverage Ratio (LCR), and effect of stress testing and capital surcharge. This would provide a more comprehensive understanding of the XCCY dynamics. Further research should also explore the potential impact of geopolitical events. Understanding how political turmoil, trade agreements, and regulatory changes impact the basis could provide crucial insights into the basis drivers.

3.3 Conclusion

In the last decade, a major shift in global financial markets has been the breakdown of the CIP. Post-GFC has given rise to significant violations of CIP, leading to arbitrage opportunities across currencies due to the interplay of various macroeconomic and regulatory forces that disrupted the traditional minor violations pre-GFC. Divergence in monetary policies, coupled with the impacts of market dynamics such as evolving market risk, supply dynamics, and economic performance, has significantly impacted foreign exchange hedging demand and balance sheet costs, affecting the basis dynamics.

Understanding the drivers and determinants of the XCCY basis is crucial for policymakers, central banks, institutions, and other entities involved in managing foreign exchange risk. This understanding is vital for optimal management of reserves and liquidity, allowing these institutions to effectively manage and mitigate risks, preparing them for shifts in the economic

landscape. Gaining a deeper comprehension makes it possible for corporations and institutions to access capital across borders under more favourable terms, which can help boost domestic growth, which is particularly important for emerging markets and more vulnerable economies.

This thesis proves that the XCCY basis fluctuations post-GFC are directly influenced by interest rate differentials, market volatility, credit conditions, and economic growth discrepancies between regions. The primary finding is that the XCCY basis typically widens in response to growing interest rate differentials. This phenomenon aligns with higher US interest rates attracting foreign investments into dollar-denominated assets, consequently impacting the demand for dollars in the FX swap market. The research underscores how diverse elements, including market risk perceptions and sovereign credit risk, affect the dollar's value and shape global liquidity conditions. The key implications are that market volatility that can affect investor behaviour, as evidenced by the VIX and CDS spreads, are critical in understanding currency market dynamics. Contrary to other studies that have shown that the VIX is not a significant driver of the basis, this analysis reveals that the VIX is indeed an important driver across all three XCCY pairs examined, aligning with the flight-to-quality trend towards dollar assets and the Yen's status as a safe haven in times of market stress and risk-off scenarios.

The main implications of this study are twofold. Firstly, it highlights the necessity for market participants and policymakers to adapt continuously to the evolving nature of global financial markets, indicating a shift from a sole reliance on traditional economic indicators to a more holistic approach considering broader market sentiments and developments. Secondly, this thesis suggests that a comprehensive understanding of the XCCY basis requires familiarity with traditional economic measures and the often overlooked aspects of market behaviour and market sentiment, which are increasingly becoming more important in shaping market dynamics in the modern financial landscape post-GFC.

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Appendix:

Table 1: Explanation of abbreviations

XCCY	Cross-Currency Basis Swap
FX	Foreign Exchange
Basis	Cross-Currency Basis
CDS	Credit Default Swap
EURUSD	Euro/US Dollar Currency Pair
GBPUSD	Pound Sterling/US Dollar Currency Pair
USDJPY	US Dollar/Japanese Yen Currency Pair
SOFR	Secured Overnight Financing Rate
ESTR	Euro Short-Term Rate
SONIA	Sterling Overnight Index Average
TONAR	Tokyo Overnight Average Rate
LIBOR	London Interbank Offer Rate
CIP	Covered Interest Parity
GFC	The 2008 Global Financial Crisis
FED	The US Federal Reserve
ECB	The European Central Bank
BoE	Bank of England
BOJ	Bank of Japan
US	The United States
EZ	The Eurozone
UK	The United Kingdom
QE	Quantitative Easing

QT	Quantitative Tightening

Table 2: Dependent variables

Variable	Explanation
$XCCY_{EURUSD_i}$	Cross-currency basis for 1-year to 10-year maturity for EURUSD. Based on ESTR vs. SOFR, and before 2021 3M EURIBOR vs. 3M LIBOR was applied.
$XCCY_{GBPUSD_i}$	Cross-currency basis for 1-year to 10-year maturity for GBPUSD based on SONIA vs. SOFR, and before 2021 3M GBP LIBOR vs. 3M USD LIBOR was applied.
$XCCY_{USDJPY_i}$	Cross-currency basis for 1-year to 10-year maturity for USDJPY based on TONAR vs. SOFR, and before 2021 3M USD LIBOR vs. 3M JPY LIBOR was applied.

Table 3: Independent variables

Variable	Explanation
$USD_{floating_i}$	SOFR swap rate for 1-year to 10-year, and before 2021 USD LIBOR with 3M fixing was applied.
$EUR_{Floating_i}$	ESTR swap rate for 1-year to 10-year, and before 2021 EURIBOR with 3M fixing was applied.
$GBP_{Floating_i}$	SONIA swap rate for 1-year to 10-year, and before 2021 GBP LIBOR 3M fixing was applied.
$JPY_{Floating_i}$	TONAR swap rate for 1-year to 10-year, and before 2021 JPY LIBOR with 3M fixing was applied.

$EURUSD_{FXRate}$	Exchange rate for EURUSD.
$GBPUSD_{FXRate}$	Exchange rate for GBPUSD.
$USDJPY_{FXRate}$	Exchange rate for USDJPY.
$EURUSD_{FWD_i}$	EURUSD forward points for 1-year to 10-year maturity.
$GBPUSD_{FWD_i}$	GBPUSD forward points for 1-year to 10-year maturity.
$USDJPY_{FWD_i}$	USDJPY forward points for 1-year to 10-year maturity.
$Dollar\ Index$	The Broad Trade-Weighted US dollar index.
VIX	The Chicago Board Options Exchange (CBOE) Volatility Index, measuring the stock market's expectation of volatility based on options of the S&P 500 index.
CDS_{US}	5-year CDS that is based on the credit risk of the United States government, specifically tied to its sovereign debt such as US Treasury bonds.
CDS_{EU}	5-year CDS that is based on the credit risk of the German government, specifically tied to its sovereign debt such as German bunds.
CDS_{UK}	5-year CDS that is based on the credit risk of United Kingdoms' government, specifically tied to its sovereign debt such as UK Gilts.
CDS_{JP}	5-year CDS that is based on the credit risk of Japan's government, specifically tied to its sovereign debt such as Japanese government bonds
$\log(Supply_{USD})$	The logarithm of M1 money supply in the United States (total amount of liquid or near-liquid assets, including cash, checking accounts, and other easily accessible money).
$\log(Supply_{EUR})$	The logarithm of M1 money supply in the EZ (total amount of liquid or near-liquid assets, including cash, checking accounts, and other easily accessible money).

$\log(Supply_{GBP})$	The logarithm of M1 money supply in the UK (total amount of liquid or near-liquid assets, including cash, checking accounts, and other easily accessible money).
$\log(Supply_{JPY})$	The logarithm of M1 money supply in Japan (total amount of liquid or near-liquid assets, including cash, checking accounts, and other easily accessible money).
FED_{Margin}	FED's Discount Rate subtracted with the IOER (Interest on Excess Reserves).
ECB_{Margin}	ECB's Marginal Lending Facility Rate subtracted with the Deposit Facility Rate.
BOE_{Margin}	BoE's Borrowing Facility Rate subtracted with the Deposit Facility Rate.
BOJ_{Margin}	BOJ's Policy Rate subtracted for the Overnight Call Rate (unsecured overnight money market rates).
$\log(FED_{BS})$	Thee logarithm of the portfolio of securities (Treasury securities holdings) of the FED.
$\log(ECB_{BS})$	The logarithm of the portfolio of bonds of ECB converted to dollar.
$\log(BOE_{BS})$	The logarithm of the holdings of bonds from Bank of England converted to dollar.
$\log(BOJ_{BS})$	The logarithm of the holdings of bonds from Bank of Japan converted to dollar.
$\log(GDP_{US})$	The logarithm of the Real Gross Domestic Product of the US.
$\log(GDP_{EZ})$	The logarithm of the Real Gross Domestic Product of the EZ converted to dollar.
$\log(GDP_{UK})$	The logarithm of the Real Gross Domestic Product of the UK converted to dollar.

$\log(GDP_{JP})$	The logarithm of the Real Gross Domestic Product of Japan converted to dollar.
$DUMMY_{FED_j}$	Represents the dummy variables for the different FED QE and QT periods. Each $DUMMY_{FED_j}$ takes a value of 1 for the dates falling within the respective period and 0 otherwise.
$DUMMY_{ECB_k}$	Represents the dummy variables for the different ECB QE and QT periods. Each $DUMMY_{ECB_k}$ takes a value of 1 for the dates falling within the respective period and 0 otherwise.
$DUMMY_{BOE_k}$	Represents the dummy variables for the different BoE QE and QT periods. Each $DUMMY_{BOE_k}$ takes a value of 1 for the dates falling within the respective period and 0 otherwise.
$DUMMY_{BOJ_k}$	Represents the dummy variables for the different BOJ QE and QT periods. Each $DUMMY_{BOJ_k}$ takes a value of 1 for the dates falling within the respective period and 0 otherwise.

Figure 1: Estimating the Cross-Currency Basis

$$F = S \cdot \frac{1 + \ USD\ Rate}{1 + Implied\ Foreign\ Rate}$$

$$Implied\ Foreign\ Rate = \frac{S}{F} \cdot (1 + USD\ Rate) - 1$$

$$Basis = Implied\ Foreign\ Rate - Observed\ Foreign\ Rate$$

Where,

F = Forward Exchange Rate

S = Spot Exchange Rate

USD Rate = Floating Interest Rate USD (e.g. SOFR)

Observed Foreign Rate = Floating Interest Rate Foreign Currency (e.g. ESTR, SONIA, TONAR)

Figure 2: EURUSD Cross-Currency Basis Post-GFC

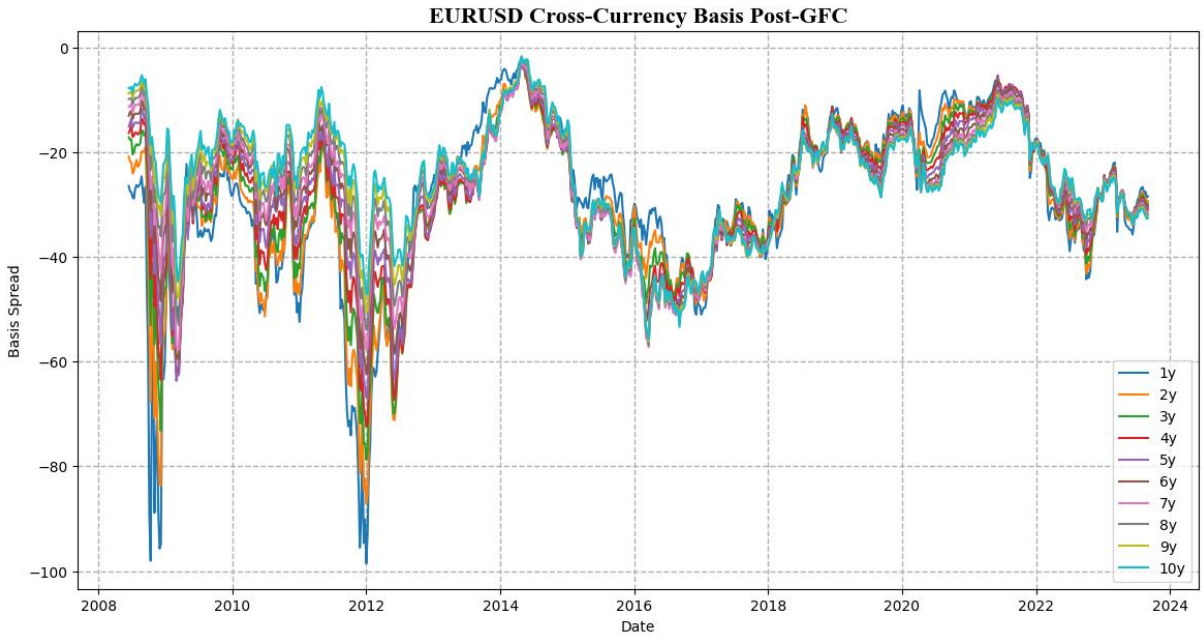

Figure 3: GBPUSD Cross-Currency Basis Post-GFC

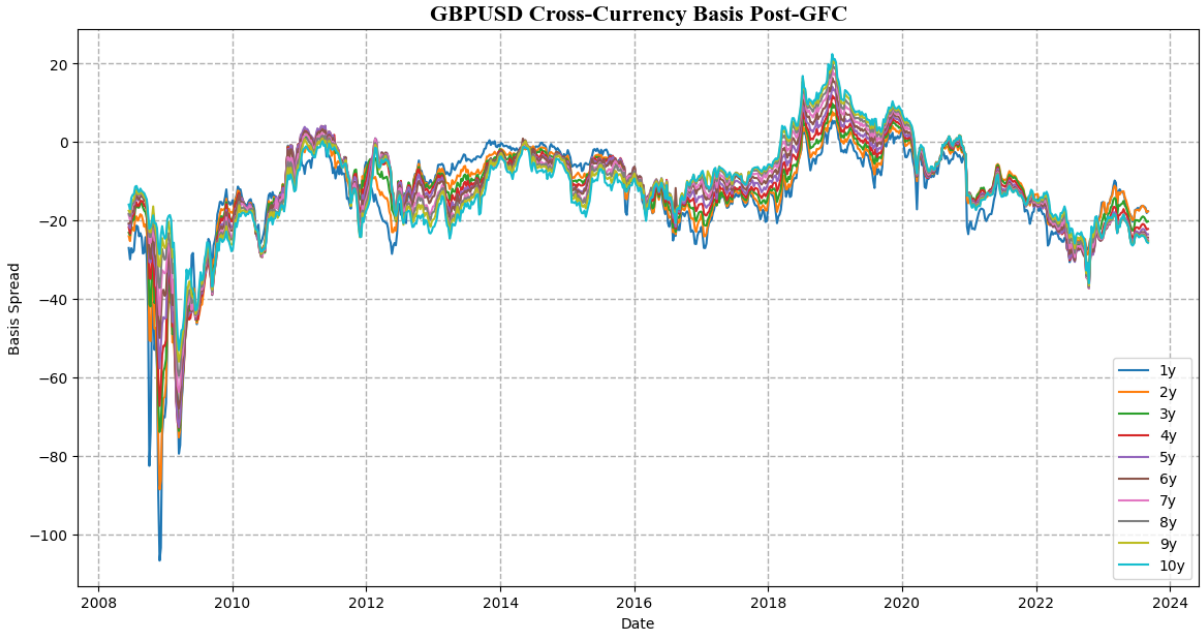

Figure 4: USDJPY Cross-Currency Basis Post-GFC

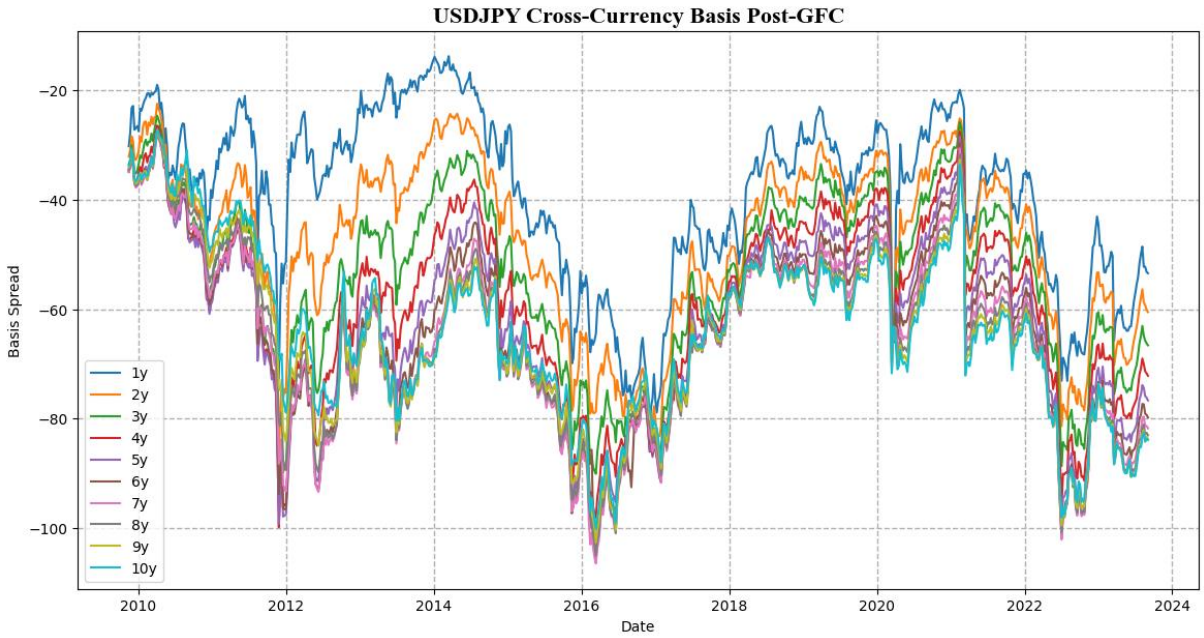

Table 4: FED, ECB, BoE, and BOJ QE and QT periods

Name	Period
FED Initial QE Post-Financial Crisis	November 1, 2008 - June 30, 2010
FED Additional QE Phase	November 1, 2010 - June 30, 2011
FED Operation Twist	September 1, 2011 - December 31, 2012
FED QE3 Expansion	September 1, 2012 - October 31, 2014
FED Balance Sheet Normalization	October 1, 2017 - August 31, 2019
FED Pandemic Response QE	March 1, 2020 - March 31, 2021
FED Post-Pandemic QT Phase	June 1, 2022 – Ongoing
ECB Securities Markets Programme	May 1, 2010 - September 6, 2012
ECB Long-Term Refinancing Operations	December 1, 2011 - February 29, 2012.

ECB Outright Monetary Transactions	September 6, 2012 - January 21, 2015
ECB Asset Purchase Programme	March 1, 2015 - December 31, 2018
ECB Resumption of QE	November 1, 2019 - March 31, 2020
ECB Pandemic Emergency Purchase Programme (PEPP)	March 1, 2020 - March 31, 2022
ECB Post-Pandemic QE	April 1, 2022 - March 1, 2023
ECB QT 2023	March 1, 2023 – Ongoing
BoE QE Response to Financial Crisis	March 1, 2009 - January 31, 2010
BoE Additional QE Rounds	October 1, 2011 - July 31, 2012
BoE Post-Brexit QE	July 1, 2016 - February 28, 2017
BoE Covid-19 Response QE	March 1, 2020 - December 31, 2021
BoE QT Transition	February 1, 2022 – Ongoing
BOJ Pre-QQE Expansion	October 1, 2010 - January 1, 2013
BOJ Introduction of QQE	January 2, 2013 - October 1, 2014
BOJ QQE Additional Expansion	October 2, 2014 - February 27, 2014
BOJ Pandemic Response QE	March 1, 2020 - May 31, 2022
BOJ Ongoing QE Post-Pandemic	January 1, 2022 - Ongoing

Table 5: EURUSD CIP Components

Maturity	Const.	USD Floating	EUR Floating	EURUSD FX Rate	Forward Points	Obs.	R2
1y	-29.010***	6.515***	-7.021***	4.303***	-0.540***	795	0.784
	-0.359	-0.253	-0.26	-0.439	-0.022		
2y	-29.365***	6.616***	-6.956***	5.256***	-0.265***	795	0.768
	-0.329	-0.242	-0.251	-0.391	-0.01		
3y	-28.821***	6.803***	-7.045***	6.542***	-0.177***	795	0.753
	-0.312	-0.237	-0.248	-0.377	-0.007		
4y	-28.320***	7.000***	-7.181***	7.386***	-0.134***	795	0.749
	-0.295	-0.236	-0.247	-0.359	-0.005		
5y	-27.908***	7.069***	-7.198***	7.907***	-0.106***	795	0.741
	-0.288	-0.236	-0.244	-0.358	-0.004		
6y	-27.168***	5.747***	-5.802***	7.918***	-0.068***	795	0.631
	-0.322	-0.939	-0.96	-0.385	-0.013		
7y	-26.775***	7.121***	-7.202***	8.514***	-0.073***	795	0.730
	-0.268	-0.241	-0.247	-0.347	-0.003		
8y	-25.912***	5.964***	-5.991***	8.185***	-0.052***	795	0.661
	-0.289	-0.904	-0.918	-0.493	-0.009		
9y	-25.225***	6.988***	-7.004***	8.670***	-0.055***	795	0.745
	-0.245	-0.247	-0.25	-0.322	-0.002		
10y	-24.739***	6.751***	-6.776***	8.747***	-0.047***	795	0.746
	-0.242	-0.266	-0.268	-0.321	-0.002		

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.
*** p<0.01, ** p<0.05, * p<0.1

Table 6: GBPUSD CIP Components

Maturity	Const.	USD Floating	GBP Floating	GBPUSD FX Rate	Forward Points	Obs.	R2
1y	-13.745***	3.770***	-4.113***	0.347	-0.249***	795	0.446
	-0.49	-0.534	-0.539	-0.399	-0.041		
2y	-12.729***	5.276***	-5.435***	-0.724**	-0.191***	795	0.762
	-0.288	-0.317	-0.299	-0.3	-0.012		
3y	-12.271***	5.372***	-5.515***	-0.217	-0.128*	795	0.772
	-0.269	-0.309	-0.292	-0.28	-0.008		
4y	-12.069***	5.519***	-5.640***	0.461*	-0.097***	795	0.770
	-0.27	-0.321	-0.301	-0.274	-0.006		
5y	-11.795***	5.815***	-5.882***	0.884***	-0.081***	795	0.802
	-0.247	-0.299	-0.278	-0.25	-0.005		
6y	-11.446***	5.358***	-5.405***	1.678***	-0.058***	795	0.76
	-0.276	-0.291	-0.278	-0.258	-0.004		
7y	-11.385***	5.221***	-5.255***	1.884***	-0.049***	795	0.732
	-0.287	-0.325	-0.306	-0.259	-0.004		
8y	-11.104***	5.343***	-5.316***	2.089***	-0.042***	795	0.755
	-0.272	-0.287	-0.272	-0.243	-0.003		
9y	-11.062***	5.457***	-5.391***	2.099***	-0.038***	795	0.760
	-0.267	-0.281	-0.266	-0.24	-0.002		
10y	-11.227***	5.680***	-5.601***	2.183***	-0.036***	795	0.752
	-0.264	-0.314	-0.292	-0.252	-0.002		

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.

*** p<0.01, ** p<0.05, * p<0.1

Table 7: USDJPY CIP Components

Maturity	Const.	USD Floating	JPY Floating	USDJPY FX Rate	Forward Points	Obs.	R2
1y	-38.805***	4.903***	0.464	0.427***	0.404***	721	0.626
	-0.487	-0.316	-0.46	-0.062	-0.026		
2y	-47.341***	5.207***	-1.537***	0.677***	0.230***	721	0.674
	-0.442	-0.261	-0.378	-0.058	-0.012		
3y	-53.645***	5.739***	-3.299***	0.899***	0.176***	721	0.747
	-0.399	-0.217	-0.322	-0.057	-0.007		
4y	-58.592***	5.936***	-4.202***	1.082***	0.142***	721	0.775
	-0.385	-0.196	-0.282	-0.061	-0.005		
5y	-62.165***	6.293***	-5.121***	1.234***	0.125***	721	0.811
	-0.352	-0.18	-0.238	-0.061	-0.004		
6y	-64.049***	6.465***	-5.623***	1.316***	0.111***	721	0.811
	-0.345	-0.167	-0.203	-0.063	-0.003		
7y	-65.318***	6.642***	-5.924***	1.415***	0.100***	721	0.853
	-0.3	-0.152	-0.168	-0.058	-0.003		
8y	-65.228***	6.472***	-5.827***	1.375***	0.087***	721	0.839
	-0.305	-0.162	-0.175	-0.065	-0.003		
9y	-64.694***	6.292***	-5.663***	1.326***	0.077***	721	0.84
	-0.293	-0.181	-0.18	-0.075	-0.003		
10y	-63.967***	6.152***	-5.569***	1.270***	0.070***	721	0.845
	-0.285	-0.16	-0.163	-0.065	-0.002		

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.
*** p<0.01, ** p<0.05, * p<0.1

Table 8: EURUSD: Dollar Index, VIX, CDS, and Supply

Maturity	Const.	Dollar Index	VIX	CDS US	CDS EU	log(Supply_USD)	log(Supply_EUR)	Obs.	R2
1y	-24.810***	0.294***	-0.110***	-0.257**	-0.416***	2.610***	-8.476***	4797	0.534
	-0.101	-0.031	-0.013	-0.075	-0.045	-0.451	-1.891		
2y	-25.583***	0.256***	-0.102***	-0.221***	-0.380***	2.565***	-6.905***	4797	0.576
	-0.088	-0.026	-0.011	-0.058	-0.034	-0.363	-1.548		
3y	-25.769***	0.243***	-0.101***	-0.206***	-0.326***	2.783***	-6.850***	4797	0.542
	-0.085	-0.024	-0.01	-0.047	-0.031	-0.337	-1.455		
4y	-25.936***	0.239***	-0.101***	-0.200***	-0.274***	2.999***	-7.101***	4797	0.489
	-0.086	-0.024	-0.01	-0.044	-0.031	-0.331	-1.443		
5y	-26.070***	0.237***	-0.101***	-0.206***	-0.222***	3.197***	-7.515***	4797	0.437
	-0.087	-0.025	-0.011	-0.042	-0.031	-0.328	-1.447		
6y	-26.219***	0.241***	-0.103***	-0.176***	-0.183***	3.385***	-8.184***	4797	0.378
	-0.087	-0.025	-0.011	-0.041	-0.03	-0.329	-1.455		
7y	-26.368***	0.235***	-0.101***	-0.170***	-0.136***	3.439***	-7.995***	4797	0.342
	-0.088	-0.025	-0.011	-0.041	-0.03	-0.328	-1.453		
8y	-26.502***	0.249***	-0.105***	-0.138***	-0.106***	3.602***	-8.705***	4797	0.322
	-0.088	-0.025	-0.011	-0.04	-0.029	-0.33	-1.461		
9y	-26.624***	0.259***	-0.108***	-0.120**	-0.074*	3.689***	-9.119***	4797	0.315
	-0.088	-0.025	-0.011	-0.039	-0.029	-0.332	-1.464		
10y	-26.804***	0.263***	-0.109***	-0.112**	-0.041	3.695***	-9.209***	4797	0.317
	-0.088	-0.024	-0.011	-0.038	-0.029	-0.333	-1.461		

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.
*** p<0.01, ** p<0.05, * p<0.1

Table 9: GBPUSD: Dollar Index, VIX, CDS, and Supply

Maturity	Const.	Dollar Index	VIX	CDS US	CDS UK	log(Supply_USD)	log(Supply_GBP)	Obs.	R2
1y	-18.515***	0.110***	-0.014	-0.547***	-0.075***	-0.953**	-3.863***	4797	0.411
	-0.066	-0.019	-0.008	-0.041	-0.02	-0.336	-1.009		
2y	-17.388***	0.111***	-0.022**	-0.527***	-0.074***	-0.553	-2.910**	4797	0.414
	-0.062	-0.018	-0.008	-0.037	-0.019	-0.306	-0.947		
3y	-17.007***	0.112***	-0.023**	-0.520***	-0.038*	-1.023***	1.877*	4797	0.423
	-0.061	-0.016	-0.007	-0.035	-0.018	-0.292	-0.896		
4y	-17.645***	0.126***	-0.029***	-0.548***	-0.012	-1.093***	3.174***	4797	0.466
	-0.062	-0.017	-0.007	-0.034	-0.018	-0.294	-0.905		
5y	-17.365***	0.126***	-0.029***	-0.547***	0.005	-1.333***	5.895***	4797	0.511
	-0.062	-0.016	-0.007	-0.034	-0.017	-0.291	-0.893		
6y	-17.650***	0.140***	-0.036***	-0.558***	0.018	-1.180***	5.802***	4797	0.542
	-0.062	-0.016	-0.007	-0.033	-0.017	-0.289	-0.893		
7y	-17.293***	0.129***	-0.035***	-0.541***	0.028	-1.189***	7.391***	4797	0.566
	-0.061	-0.016	-0.007	-0.033	-0.016	-0.284	-0.883		
8y	-17.515***	0.140***	-0.041***	-0.544***	0.036*	-0.935**	6.675***	4797	0.575
	-0.061	-0.017	-0.007	-0.034	-0.016	-0.28	-0.884		
9y	-17.504***	0.139***	-0.043***	-0.534***	0.041**	-0.789**	6.805***	4797	0.58
	-0.061	-0.017	-0.007	-0.035	-0.016	-0.275	-0.879		
10y	-17.239***	0.125***	-0.041***	-0.509***	0.047**	-0.774**	7.982***	4797	0.587
	-0.061	-0.017	-0.007	-0.036	-0.015	-0.271	-0.874		

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.
*** p<0.01, ** p<0.05, * p<0.1

Table 10: USDJPY: Dollar Index, VIX, CDS, and Supply

Maturity	Constant	Dollar Index	VIX	CDS US	CDS JP	log(Supply_USD)	log(Supply_JPY)	Obs.	R2
1y	-31.530***	-0.230***	0.096***	-0.013	0.050*	-6.242***	28.472***	4788	0.241
	-0.119	-0.029	-0.011	-0.041	-0.022	-0.58	-2.765		
2y	-34.444***	-0.239***	0.104***	0.131**	-0.094***	-6.957***	30.961***	4788	0.423
	-0.124	-0.031	-0.012	-0.048	-0.024	-0.665	-3.111		
3y	-36.534***	-0.262***	0.116***	0.235***	-0.183***	-7.944***	34.938***	4788	0.541
	-0.131	-0.034	-0.014	-0.055	-0.025	-0.734	-3.394		
4y	-38.069***	-0.293***	0.129***	0.330***	-0.236***	-8.922***	39.274***	4788	0.612
	-0.136	-0.035	-0.015	-0.06	-0.026	-0.791	-3.619		
5y	-38.972***	-0.327***	0.143***	0.410***	-0.262***	-9.850***	43.540***	4788	0.655
	-0.14	-0.036	-0.016	-0.064	-0.027	-0.835	-3.788		
6y	-39.302***	-0.357***	0.155***	0.467***	-0.259***	-10.559***	46.952***	4788	0.675
	-0.142	-0.037	-0.017	-0.065	-0.027	-0.861	-3.888		
7y	-39.540***	-0.380***	0.163***	0.516***	-0.252***	-11.053***	49.429***	4788	0.694
	-0.142	-0.037	-0.017	-0.066	-0.027	-0.869	-3.911		
8y	-39.158***	-0.397***	0.170***	0.549***	-0.226***	-11.425***	51.207***	4788	0.703
	-0.14	-0.037	-0.017	-0.067	-0.026	-0.877	-3.938		
9y	-38.693***	-0.410***	0.175***	0.569***	-0.198***	-11.685***	52.472***	4788	0.711
	-0.137	-0.037	-0.017	-0.067	-0.026	-0.879	-3.937		
10y	-38.317***	-0.421***	0.180***	0.578***	-0.165***	-11.893***	53.528***	4788	0.718
	-0.134	-0.036	-0.018	-0.067	-0.025	-0.874	-3.903		

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction
*** p<0.01, ** p<0.05, * p<0.1

Table 11 – part 1: EURUSD: Interest margin, Balance Sheet, GDP

	1y	2y	3y	4y	5y	6y	7y	8y	9y	10y
Const.	-27.510***	-28.431***	-28.233***	-28.009***	-27.767***	-27.282***	-27.066***	-26.425***	-25.917***	-25.568***
	-0.343	-0.284	-0.268	-0.262	-0.259	-0.256	-0.253	-0.249	-0.245	-0.244
Interest Margin Differential	-23.634***	-24.593***	-25.357***	-26.131***	-26.431***	-26.216***	-25.981***	-25.839***	-25.740***	-25.766***
	-3.758	-3.404	-3.299	-3.292	-3.253	-3.211	-3.16	-3.135	-3.112	-3.116
log(FED bs)	2.788	3.882	4.465**	4.474**	4.327**	5.009**	5.515***	6.519***	7.358***	8.274***
	-3.051	-2.418	-2.243	-2.141	-2.07	-1.984	-1.883	-1.798	-1.714	-1.644
log(ECB bs)	-8.143***	-5.701***	-5.485***	-5.760***	-6.028***	-6.535***	-6.282***	-6.763***	-7.031***	-6.885***
	-1.575	-1.398	-1.332	-1.323	-1.329	-1.327	-1.354	-1.341	-1.343	-1.358
log(GDP us)	2.425	3.426**	3.852***	4.073***	4.275***	4.233***	4.192***	4.035***	4.006***	4.074***
	-1.598	-1.463	-1.437	-1.415	-1.395	-1.337	-1.301	-1.247	-1.213	-1.197
log(GDP eu)	7.054***	7.660***	8.069***	8.199***	8.048***	7.600***	7.092***	6.611***	6.221***	5.868***
	-1.357	-1.068	-0.962	-0.907	-0.865	-0.837	-0.812	-0.794	-0.777	-0.769
FED Initial QE Post-GFC	-2.806	-1.23	0.735	2.557	3.729**	3.604***	3.657***	3.561***	3.583***	4.038***
	-1.964	-1.915	-1.769	-1.609	-1.538	-1.356	-1.349	-1.179	-1.127	-1.207
FED Additional QE Phase	5.330**	4.324**	3.591**	2.987**	2.234*	1.828	1.946*	1.777	1.909*	2.488**
	-2.633	-1.864	-1.584	-1.398	-1.317	-1.229	-1.174	-1.088	-1.015	-0.987
FED Operation Twist	-12.887***	-13.178***	-13.087***	-12.607***	-12.032***	-11.388***	-10.234***	-9.842***	-9.219***	-8.280***
	-2.012	-1.483	-1.334	-1.279	-1.276	-1.258	-1.204	-1.169	-1.121	-1.057
FED QE3 Expansion	0.568	-0.835	-1.42	-1.641	-1.306	-0.716	-0.27	-0.119	-0.09	-0.093
	-1.499	-1.313	-1.279	-1.259	-1.251	-1.223	-1.205	-1.178	-1.163	-1.18
FED BS Normalisation	-0.154	-0.756	-0.408	-0.053	0.52	1.21	1.879	2.237*	2.756**	3.258**
	-1.563	-1.319	-1.274	-1.296	-1.311	-1.328	-1.344	-1.353	-1.363	-1.384
FED Pandemic Response QE	4.320***	4.597***	2.897**	1.545	0.334	-0.871	-1.423	-1.811*	-1.943**	-1.634*
	-1.338	-1.147	-1.161	-1.133	-1.089	-1.049	-0.996	-0.957	-0.925	-0.901
FED Post-Pandemic QT Phase	-0.196	-0.389	-0.34	-0.21	-0.092	-0.143	-0.202	-0.237	-0.352	-0.495
	-1.548	-1.466	-1.436	-1.424	-1.407	-1.376	-1.362	-1.348	-1.348	-1.361
ECB Sec. Markets Programme	-29.354***	-22.287***	-16.947***	-12.973***	-8.818***	-5.026*	-1.117	1.607	4.193	6.853**
	-4.722	-3.792	-3.398	-3.187	-3.062	-2.986	-2.895	-2.828	-2.767	-2.709
ECB Long-Term Ref. Oper.	-21.034***	-15.608***	-12.497***	-10.787***	-9.835**	-9.397**	-8.670**	-8.210**	-7.706**	-7.224**
	-5.74	-4.727	-4.373	-4.164	-3.992	-3.887	-3.692	-3.608	-3.494	-3.367
ECB Outright Monetary Trans.	-1.237	0.984	2.284	3.375*	4.662***	5.738***	7.102***	7.979***	8.835***	9.841***
	-2.596	-2.174	-1.93	-1.797	-1.733	-1.703	-1.701	-1.688	-1.695	-1.728
ECB Asset Purchase Progr.	-6.306***	-5.479***	-5.150***	-4.892***	-4.575***	-4.293***	-3.960***	-3.743***	-3.534***	-3.283***
	-1.554	-1.414	-1.321	-1.27	-1.222	-1.202	-1.189	-1.185	-1.187	-1.194

Table 11 – part 2: EURUSD: Interest margin, Balance Sheet, GDP

ECB Resumption of QE	11.022***	12.139***	13.136***	13.893***	14.522***	14.669***	14.720***	14.353***	14.150***	13.920***
	-2.361	-2.169	-2.224	-2.278	-2.288	-2.252	-2.224	-2.182	-2.16	-2.167
ECB PEPP	0.0731	-3.506	-2.8809	-1.804	-0.5537	0.3244	0.682	0.554	0.275	-0.6731
	-3.2103	-2.449	-2.2932	-2.236	-2.2026	-2.1524	-2.097	-2.0402	-1.996	-1.9748
ECB Post-Pandemic QE	-13.223***	-15.421***	-14.803***	-13.313***	-11.498***	-10.131***	-9.153***	-8.878***	-8.850***	-9.401***
	-3.4315	-2.705	-2.5119	-2.441	-2.401	-2.3541	-2.304	-2.2488	-2.207	-2.1865
ECB QT 2023	-17.451***	-19.961***	-20.239***	-19.670***	-18.504***	-17.555***	-17.006***	-17.103***	-17.256***	-17.904***
	-3.862	-3.078	-2.8623	-2.777	-2.7236	-2.6539	-2.6	-2.5419	-2.506	-2.4931
R2	0.826	0.856	0.855	0.847	0.838	0.828	0.82	0.815	0.813	0.81
Obs.	691	691	691	691	691	691	691	691	691	691

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.

*** p<0.01, ** p<0.05, * p<0.1

Table 12: GBPUSD: Interest margin, Balance Sheet, GDP

	1y	2y	3y	4y	5y	6y	7y	8y	9y	10y
Const.	-10.392***	-9.314***	-8.929***	-8.732***	-8.532***	-8.265***	-8.390***	-8.201***	-8.289***	-8.619***
	-0.256	-0.228	-0.226	-0.233	-0.239	-0.242	-0.246	-0.251	-0.257	-0.259
Interest Margin Differential	-6.816***	-8.443***	-8.991***	-9.039***	-9.021***	-9.159***	-9.652***	-9.861***	-10.310***	-10.931***
	-0.987	-0.895	-0.921	-0.967	-0.988	-1.003	-1.009	-1.026	-1.041	-1.029
log(FED bs)	6.981***	6.406***	6.784***	6.804***	6.553***	7.386***	8.354***	9.394***	10.218***	10.622***
	-1.956	-1.883	-1.982	-2.182	-2.255	-2.212	-2.221	-2.214	-2.223	-2.209
log(BOE bs)	-18.872***	-18.667***	-18.905***	-18.128***	-17.850***	-18.912***	-21.060***	-21.951***	-23.384***	-25.135***
	-3.03	-2.605	-2.881	-3.301	-3.562	-3.69	-3.767	-3.906	-3.983	-4.027
log(GDP us)	-6.068***	-7.856***	-8.742***	-8.685***	-8.256***	-8.008***	-7.842***	-7.890***	-7.992***	-8.218***
	-1.974	-1.851	-1.904	-1.957	-1.948	-1.947	-1.941	-1.971	-2.004	-1.997
log(GDP uk)	3.622***	4.486***	4.771***	4.668***	4.446***	4.300***	4.206***	3.988***	3.903***	3.886***
	-0.68	-0.587	-0.597	-0.622	-0.64	-0.654	-0.66	-0.669	-0.68	-0.682
FED Initial QE Post-GFC	-12.651***	-15.629***	-16.429***	-16.378***	-16.361***	-15.818***	-15.128***	-13.862***	-13.019***	-12.304***
	-1.621	-1.562	-1.639	-1.826	-1.897	-1.987	-1.869	-1.906	-1.86	-1.696
FED Add. QE Phase	2.932**	5.553***	6.827***	7.605***	7.978***	7.262***	6.911***	6.452***	6.284***	5.934***
	-1.15	-1.129	-1.213	-1.356	-1.396	-1.371	-1.367	-1.368	-1.378	-1.321
FED Oper._Twist	-3.389***	-0.89	-0.067	-0.065	-0.298	-1.3	-1.661**	-2.324***	-2.640***	-2.675**
	-0.933	-0.833	-0.794	-0.828	-0.826	-0.826	-0.841	-0.897	-0.976	-1.062
FED QE3 Expansion	9.663***	7.352***	5.894***	4.717***	3.908***	4.109***	3.865***	4.326***	4.705***	4.701***
	-1.211	-1.073	-1.083	-1.141	-1.183	-1.205	-1.224	-1.256	-1.29	-1.304
FED BS Normaliz.	-1.137	-0.397	0.847	1.951	3.020**	4.038***	5.095***	6.030***	6.848***	7.534***
	-1.329	-1.26	-1.284	-1.307	-1.296	-1.297	-1.284	-1.303	-1.325	-1.32
FED Pand. Resp. QE	4.731**	4.636***	5.512***	6.346***	6.860***	7.046***	6.900***	6.745***	6.471***	6.050***
	-2.119	-1.715	-1.741	-1.857	-1.948	-1.99	-1.992	-1.997	-1.995	-1.976
FED Post-Pand. QT	-0.049	-2.873**	-4.631***	-5.734***	-6.578***	-7.278***	-8.037***	-8.418***	-8.839***	-9.317***
	-1.506	-1.294	-1.195	-1.151	-1.137	-1.14	-1.153	-1.16	-1.16	-1.164
BOE QE Response to GFC	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.0000***
	0	0	0	0	0	0	0	0	0	0
BOE Add. QE Rounds	-1.399	-0.282	1.049	1.756	2.32	2.497	3.381*	3.643**	4.195**	5.091**
	-1.372	-1.137	-1.156	-1.376	-1.545	-1.646	-1.734	-1.829	-1.916	-2.024
BOE Post-Brexit QE	-10.126***	-7.118***	-5.493***	-4.395***	-3.600***	-2.510**	-2.345*	-1.85	-1.088	-1.031
	-1.182	-1.067	-1.072	-1.082	-1.123	-1.125	-1.255	-1.325	-1.437	-1.466
BOE Covid-19 Response QE	-8.999***	-7.405***	-8.588***	-10.396***	-11.725***	-12.920***	-13.470***	-14.199***	-14.547***	-14.367***
	-2.279	-2.15	-2.348	-2.624	-2.776	-2.835	-2.851	-2.892	-2.89	-2.803
BOE QT Transition	-17.270***	-15.864***	-16.905***	-18.486***	-19.299***	-19.843***	-19.776***	-19.877***	-19.549***	-18.714***
	-2.214	-2.115	-2.317	-2.596	-2.752	-2.815	-2.846	-2.882	-2.879	-2.793
R-squared	0.643	0.671	0.704	0.714	0.725	0.734	0.744	0.747	0.75	0.759
Obs.	670	670	670	670	670	670	670	670	670	670

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.

*** p<0.01, ** p<0.05, * p<0.1

Table 13: USDJPY: Interest margin, Balance Sheet, GDP

	1y	2y	3y	4y	5y	6y	7y	8y	9y	10y
Const.	-39.245***	-47.984***	-54.447***	-59.523***	-63.184***	-65.117***	-66.417***	-66.321***	-65.761***	-65.003***
	-0.483	-0.469	-0.47	-0.465	-0.458	-0.45	-0.441	-0.427	-0.411	-0.39
Interest Margin Differential	31.134***	36.888***	41.449***	45.527***	48.547***	49.697***	50.798***	49.914***	48.137***	45.747***
	-3.956	-3.821	-3.981	-4.162	-4.333	-4.36	-4.677	-4.656	-4.628	-4.6
log(FED bs)	-14.850***	-24.557***	-31.324***	-34.659***	-36.079***	-35.860***	-34.821***	-33.036***	-30.940***	-29.036***
	-5.676	-5.424	-5.368	-5.206	-5.036	-4.899	-4.68	-4.463	-4.232	-3.99
log(BOJ bs)	-5.611	8.234	18.865	26.679**	32.075**	33.427***	34.712***	32.990***	29.863***	26.478***
	-14.032	-13.622	-13.502	-13.202	-12.725	-12.266	-11.79	-11.13	-10.554	-10.1
log(GDP us)	23.004***	22.728***	22.208***	20.984***	19.060***	17.316***	16.018***	14.173**	13.083**	12.177**
	-7.507	-7.164	-7.015	-6.803	-6.563	-6.378	-6.09	-5.773	-5.479	-5.21
log(GDP JP)	-1.397	-3.466	-0.332	7.1	14.774	20.276	28.716**	32.393***	35.017***	35.472***
	-16.628	-15.493	-14.916	-14.333	-13.744	-13.567	-12.75	-12.08	-11.469	-10.8
FED Initial QE Post-GFC	-3.886	-0.568	1.726	3.118	3.474	2.88	2.386	1.1	0.027	-0.64
	-2.619	-2.51	-2.719	-2.829	-2.849	-2.946	-2.758	-2.717	-2.602	-2.34
FED Add. QE Phase	-1.804	-3.418	-4.747	-5.132*	-5.608**	-6.360**	-6.431**	-7.013***	-7.128***	-7.132***
	-3.194	-2.999	-3.076	-2.97	-2.843	-2.711	-2.568	-2.446	-2.323	-2.19
FED Operation Twist	-1.043	-7.259**	-12.213***	-15.631***	-18.308***	-20.196***	-20.293***	-20.549***	-19.790***	-18.263***
	-3.299	-2.997	-3.016	-2.824	-2.664	-2.507	-2.339	-2.258	-2.155	-2.01
FED QE3 Expansion	13.211***	17.005***	18.759***	18.662***	17.654***	15.957***	14.067***	11.848***	9.486***	7.248***
	-1.841	-1.737	-1.771	-1.748	-1.741	-1.753	-1.837	-1.884	-1.877	-1.86
FED BS Normalisation	6.394***	5.114**	4.873**	4.516**	4.914***	5.094***	4.982***	5.097***	5.066***	5.205***
	-2.263	-2.13	-2.045	-1.925	-1.894	-1.886	-1.826	-1.797	-1.741	-1.66
FED Pandemic Response QE	14.659***	10.001***	9.586***	8.889**	8.458**	8.305**	7.934**	7.623**	7.513**	7.550**
	-3.762	-3.663	-3.686	-3.644	-3.57	-3.512	-3.399	-3.293	-3.191	-3.11
FED Post-Pand. QT	-20.429***	-16.870***	-15.350**	-14.242**	-13.126**	-12.422**	-12.235**	-11.812**	-12.216**	-12.608***
	-6.896	-6.531	-6.337	-6.117	-5.902	-5.738	-5.481	-5.231	-5	-4.76
BOJ Pre-QQE Exp.	8.654**	7.932**	8.117**	7.278**	6.654**	6.567*	5.422*	5.119*	4.757	5.043*
	-3.834	-3.402	-3.441	-3.386	-3.339	-3.359	-3.151	-3.089	-2.98	-2.78
BOJ Intro. of QQE	13.986***	9.443***	6.126**	2.971	0.264	-1.727	-3.41	-4.312*	-4.756*	-4.632*
	-3.069	-2.834	-2.891	-2.898	-2.903	-2.93	-2.923	-2.91	-2.832	-2.72
BOJ QQE Add. Exp.	-0.000**	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	0	0	0	0	0	0	0	0	0	0
BOJ Pandemic Response QE	2.763	7.903*	9.451**	9.863**	9.966**	9.607**	8.143**	7.352**	6.098*	5.033
	-4.986	-4.675	-4.493	-4.296	-4.123	-4.034	-3.85	-3.684	-3.546	-3.38
BOJ Ongoing QE	-13.612***	-14.507***	-13.780***	-13.180***	-12.132***	-11.132***	-9.675***	-8.435***	-7.287***	-6.310***
	-3.093	-2.898	-2.724	-2.555	-2.391	-2.278	-2.107	-1.99	-1.88	-1.8
R2	0.653	0.653	0.67	0.69	0.705	0.71	0.711	0.714	0.718	0.727
Obs.	683	683	683	683	683	683	683	683	0.718	0.727

Robust standard errors in parentheses, adjusted for heteroskedasticity and serial correlation using the Newey-West correction.
*** p<0.01, ** p<0.05, * p<0.1