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Unveiling the Global Ripple Effect: How the Fed's Monetary Policy Shaped Foreign Financial Markets in the Pre and Post Global Financial Crisis Era

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Abstract

The limitations demonstrated by conventional monetary policy instruments during the financial crisis prompted central banks to adopt unconventional monetary policies. These measures aimed to address economic challenges but they also had a spillover effect on foreign financial markets, emphasizing the interconnected nature of the global financial system. As so, this dissertation is a continuation of the several studies that have been done in the past regarding the impact of the Federal Reserve's monetary policy on international financial markets. In contrast with the majority of the previous literature that focused on studying the impact of conventional and unconventional monetary policies separately, in this dissertation the analysis focused on the impact of both sides of the monetary policy and was made by employing a VEC model that takes into consideration the shadow Federal funds rate from Wu & Xia (2016). This study focus upon the stock and bond markets of Germany, United Kingdom, Japan, Australia and Mexico and the time period considered goes from January 1997 to January 2020. The results of this study indicate that the conventional and the unconventional monetary policies had similar impacts on foreign bond yields, with a 100 bps increase in the shadow federal funds rate leading to an increase between 4 bps to 33 bps in the 3 month yields and between 9 bps to 35 bps in the 10 year yields. As for the impact on foreign stock markets, the two policies exhibited different consequences. While the conventional policy showed a positive impact, explained by the structural shift in the markets provoked by the financial crisis, with a 100 bps increase in the shadow federal funds rate leading to increases in the returns of the stock markets between 1.7% and 3.1%, the unconventional policy exhibited a negative impact, with a 100 bps increase in the shadow federal funds rate leading to decreases in the returns of the stock markets that ranged from -1% and -6.7%.

JEL Codes: E52, E58, G12, G15

Keywords: International financial markets; Conventional monetary policy; Unconventional monetary policy; Shadow federal funds rate

Resumo

As limitações demonstradas pelos instrumentos convencionais de política monetária durante a crise financeira levaram os bancos centrais a adotarem políticas monetárias não convencionais. Essas medidas tinham como objetivo enfrentar os desafios económicos, mas acabaram por ter um efeito de *spillover* nos mercados financeiros estrangeiros. Desta forma, esta dissertação é uma continuação dos vários estudos realizados anteriormente sobre o impacto da política monetária da Reserva Federal dos Estados Unidos nos mercados financeiros internacionais. Ao contrário da maioria dos estudos anteriores, que se concentrou em estudar o impacto de políticas monetárias convencionais e não convencionais separadamente, nesta dissertação, a análise concentrou-se no impacto que ambos os lados da política monetária tiveram e essa análise foi feita utilizando um modelo VEC que leva em consideração a *shadow rate* de Wu & Xia (2016). Este estudo concentra-se nos mercados de ações e de títulos de dívida pública da Alemanha, Reino Unido, Japão, Austrália e México, e o período considerado vai de janeiro de 1997 a janeiro de 2020. Os resultados deste estudo indicam que as políticas monetárias convencionais e não convencionais tiveram impactos semelhantes nas *yields* dos títulos estrangeiros, sendo que aumentos de 100 bps na *shadow rate* levaram a aumentos entre 4 bps e 33 bps nos títulos de 3 meses e entre 9 bps e 35 bps nos títulos de 10 anos. Quanto ao impacto nos mercados de ações estrangeiros, as duas políticas apresentaram consequências diferentes. Se por um lado a política convencional teve um impacto positivo, explicado pela mudança estrutural nos mercados provocada pela crise financeira, sendo que aumentos de 100 bps na *shadow rate* levaram a aumentos no retorno dos mercados acionista entre 1.7% a 3.1%, a política não convencional teve um impacto negativo, em que aumentos de 100 bps na *shadow rate* levaram a uma queda nos mercados acionistas entre -1% a -6.7%.

Classificação JEL: E52, E58, G12, G15

Palavras-chave: Mercados financeiros internacionais; Política monetária convencional; Política monetária não convencional; *Shadow rate*.

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List of Abbreviations

ADF – Augmented Dickey-Fuller

AIC – Akaike Information Criterion

ECMs – Error correction models

ECT – Error correction term

Fed – Federal Reserve System

FOMC – Federal Open Market Committee

GFC – Global Financial Crisis

JGBs – Japanese bonds

LSAP – Large scale asset purchases

QE – Quantitative easing

QT – Quantitative tightening

SRTSM – Shadow Rate Term Structure Model

U.S. – United States

UMP's – Unconventional monetary policies

VECM – Vector Error Correction Model

YCC – Yield curve control

1. Introduction

Globalization has been evolving through time and the interdependence of the world's economies has been increasing due to it. Recent events, like the war in Ukraine, demonstrate how deeply interconnected countries are, both economically and financially. With this, the subject of monetary policies has gained increased relevance – even more so when the policies being discussed are the ones implemented by the Federal Reserve System (Fed).

The U.S. struggled with high inflation in the last decades of the 20th century. At the time, the Fed hiked the federal funds rate to a peak of 20% (interestingly, Paul Volcker, who served as chairman for the Fed in that time, has been frequently quoted by economists, due to the similarities from his time and what is happening in the economy now) which eventually led to inflation coming down. In result, the Fed was able to maintain well-anchored inflation expectations and provided critical support for economic growth. (Bernanke, 2020).

The 2007-2009 financial crisis forced central banks to adopt unconventional monetary policies (UMPs), as a consequence of the inefficiency demonstrated by the usual instruments (denominated conventional policy) to fight against the deterioration of economic conditions and the perceived risks of deflation (Baumeister & Benati, 2013). These UMPs affected not only the U.S. but also foreign economies – the spillover effect (Fratzscher et al., 2016; Rey, 2015).

Taking this into account, it becomes clear that comprehending the effects of both conventional and unconventional monetary policies is essential for supporting future monetary policy decisions (Chiang et al., 2019), as well as assisting investors in making informed decisions about their investments in the face of central bank actions.

As so, this dissertation serves as an attempt to better understand the impact of conventional and unconventional policies from the Fed in international markets, namely, in the stock markets of Germany, United Kingdom, Mexico, Japan and Australia as well as on their corresponding sovereign bond yields. The objective is to analyze if both policies produce the same effects on foreign markets and, on top of that, to quantify those effects in case they exist. To achieve that, two procedures were conducted: a VEC model, which is divided into two sections – this model represents the main analysis of the dissertation; the variance decomposition of the variables of the VEC model – which serves as a complementary analysis to the VEC model.

In order to perform these analyses, an artificial indicator that indicates the stance of the monetary policy was chosen - the shadow rate from Wu and Xia (2016). This shadow rate was used due to its efficacy but also due to its availability over the time period considered: January 1990 – August 2019. Many authors have used different shadow rates to study the effects of unconventional monetary policies on key economic variables such as output growth, inflation and asset prices. Among them we can find Claus and Krippner (2014) and Damjanović and Masten (2016) for the Euro-area, Lombardi and Zhu (2014) and Wu and Xia (2015) for the US. However, in the conducted literature review, I have not found any author who has used the Wu and Xia (2016) shadow interest rates to analyze and compare the effects of both conventional and unconventional monetary tools on international stock and bond markets. Therefore, I believe this is a novelty element of this dissertation.

This dissertation is divided into six chapters. The first one introduces the objective of this study and serves as a starting point for the rest of the sections. As for chapter 2, it explores the importance of the U.S. monetary policy and the Fed as a major global player, as well as, the different impacts that the conventional and the unconventional monetary policies have on stock and bond markets internationally, based on previous research literature. The methodology used for the econometric study and the data specifications are covered in chapter 3. After that, chapter 4 exhibits the several tests that were conducted, as well as, the main results from the VEC model and the variance decomposition analysis. Following that, Chapter 5 presents the discussion of those results. Lastly, the main conclusions that can be extracted from this study, in addition to the potential future research that can be considered for this subject, are presented in chapter 6.

2. Literature review

2.1 The U.S. monetary policy and the importance of the Fed

The U.S. monetary policy, formulated and implemented by the Fed, holds great significance both within the U.S. and on the global stage. Its impact can be observed in various aspects of the economy, financial markets and international relations (Federal Reserve System, 2022). With that being said, changes in U.S. interest rates and monetary policy decisions can have ripple effects worldwide. This can lead central banks in other countries to adjust their policies in response to the Fed's actions, in order to manage their own economies and exchange rates (Rey, 2015).

Internally, the U.S. monetary policy plays a crucial role in shaping economic growth. Through the implementation of easing measures, such as lowering interest rates, the Fed aims to stimulate economic activity. By reducing borrowing costs, individuals and businesses are encouraged to take loans, make investments, and spend more. This boost in consumption and investment can lead to increased job creation, business expansions and overall economic growth (Labonte, 2019; Federal Reserve System, 2022).

Additionally, the Fed's monetary policy is instrumental in maintaining price stability. During periods of economic slowdown, the Fed may opt for an easing policy to combat deflationary pressures and stimulate demand. By making credit more accessible, the Fed seeks to prevent a downward spiral of prices and economic activity. However, it is essential to strike a balance, as excessive easing can potentially fuel inflationary pressures, eroding purchasing power and undermining economic stability (Labonte, 2019; Federal Reserve System, 2022).

Externally, the U.S. monetary policy holds significant influence over global financial markets. As the world's primary reserve currency, changes in U.S. interest rates can attract or repel foreign investors. When the Fed eases its policy, seeking higher returns elsewhere, capital outflows from the U.S. may occur. Such shifts in investment patterns affect exchange rates, stock markets, and bond yields worldwide. Consequently, the U.S. monetary policy has the potential to influence global financial stability and investor sentiment (Rey, 2015; Miranda-Agrippino & Rey, 2020).

All in all, the US monetary policy ease or tightening holds immense importance both domestically and internationally. Its implementation by the Federal Reserve shapes economic growth, price stability, and employment prospects within the United States. Moreover, it influences global financial markets, capital flows, and trade dynamics, impacting economies and financial systems worldwide. As such, the decisions made by the Federal Reserve regarding monetary policy have far-reaching consequences and require careful consideration of their potential implications (Rey, 2015; Miranda-Agrippino & Rey, 2020). With that being said, it is important to distinguish all of the tools used by the Fed, as well as, the different impacts that those tools have. That discussion is presented in the following chapter.

2.2. Defining Monetary Policy

Monetary policy may achieve a number of economic goals, but its two major objectives are to support full employment and keep inflation under control. In order to achieve these goals, the Fed uses a variety of tools, including regulating interest rates, buying and selling government assets, and controlling the money supply, which impact the availability and cost of money and credit. Although this is the usual description for monetary policy, economists often use a broader definition which includes all of the directives, policies, statements, forecasts and other Fed actions (Labonte, 2019)

In order to change the general level of interest rates in the economy, the Fed can raise or reduce the Federal funds rate, which is the overnight interest rate that banks charge one another to borrow or lend excess reserves. Despite being a short-term interest rate, it affects rates that are set for longer periods of time. Nonetheless, both the Fed's current actions and the market's expectations for the Fed's future actions have an impact on longer-term rates. As a result, there is a growing body of literature that argues that the Fed should be very explicit in articulating what its policy is, will be, and in committing to implement that policy (see Ascari et al., 2017 and Ehrmann & Fratzscher, 2005). Generally, lower interest rates produce faster economic growth and greater inflation, while higher interest rates frequently cause slower economic growth and lower inflation (Federal Reserve System, 2022).

Another tool of monetary policy is the buying and selling of government securities. Banks and other financial organizations can sell government assets to the Fed, which expands the money supply and brings down interest rates. On the other hand, the Fed has the option to sell government assets, which would cause the money supply to fall and interest rates to rise (Federal Reserve System, 2022). These operations are done in the interbank money market and the adjustment of the money supply to the corresponding target of the Federal funds rate is done through open market operations (purchasing or selling government assets on the open market). All liquidity-providing operations typically take place in the form of reverse transactions against a menu of suitable collateral in order to reduce the risk exposure of the Fed's balance sheet (Jarocinski & Karadi, 2018). In other words, the Fed does not directly lend to the government or the private sector during normal times, nor does it buy government bonds, corporate debt, or other forms of debt instruments outright. The Fed efficiently administers the liquidity constraints in the money markets and pursues its major goal of preserving price stability over the medium term by controlling the level of the key interest rates (Labonte, 2019). By decreasing interest rates, expanding the money supply, and giving loans to banks and other financial institutions, the monetary policy is also employed to stabilize the economy during a financial crisis or recession (Federal Reserve System, 2022).

Ultimately, monetary policy aims to foster long-term economic growth, maintain price stability, preserve the integrity of the financial system, and ensure that there is sufficient money in circulation to sustain economic activity (Federal Reserve System, 2022).

2.3. Conventional Monetary Policy

The Fed's principal instrument for influencing the economy is conventional monetary policy. The Fed conducts conventional monetary policy using a variety of measures, including establishing the Federal Funds Rate. As previously stated, this is the overnight interest rate at which banks can borrow and lend their reserve balances held at the Fed to meet their daily reserve requirements. It serves as a benchmark for short-term interest rates in the broader financial market lend to one another (Mishkin, 2007). Depository institutions must determine how much reserves they want or need to hold against their obligations (deposits) at the end of a particular time period, usually a day. While some institutions may uncover a reserve shortfall, others may find themselves on the other side of the coin. The Federal funds market allows these reserves to be borrowed and loaned overnight, and the Federal funds rate is the interest rate in this market. If the Fed wants to increase the money supply, it will reduce the target, encouraging more lending activity and, as a result, higher demand in the economy. Essentially, the Fed raises or lowers the Federal funds rate to affect the overall level of interest rates in the economy (Mishkin, 2007; Labonte, 2019)

The Fed also sets the interest rate that charges the commercial banks for loans, the discount rate. In essence, the commercial banks can discount some of their own assets at the Fed in order to acquire temporary reserves. This discount rate is determined by the Fed at a slight premium above the Federal funds rate. If this rate changes, it may have an impact on the cost of borrowing for banks, which, in return, may affect the level of interest rates across economy (Mishkin, 2007). The Fed is known as the last resort lender because direct lending is minimal in normal financial conditions, but was a critical source of liquidity during the financial crisis and, more recently, during the Covid-19 pandemic (Federal Reserve System, 2022).

In addition, the reserve requirements are another instrument the Fed employs in its monetary policy. Since a certain portion of bank deposits must be held in reserve, the amount of money that banks have available for lending might alter depending on how the Federal Reserve changes this proportion. (Labonte, 2019). Currently, banks are required to maintain 0% to 10% of net transaction account customer deposits in reserves, depending on the amount of the bank's deposits (Federal Reserve System, 2022). The Federal Reserve began paying interest on reserves held by banks at the Fed in October 2008. This has been the major strategy for preserving the Federal funds rate target since 2008. Lowering the opportunity cost for banks for retaining money as reserves at the Fed rather than lending it out has an impact on the rates at which banks lend reserves to each other, such as the Federal funds rate (Federal Reserve System, 2022).

It's worth noting that while conventional monetary policy is the primary tool used by the Federal Reserve, it is not the only one. The Fed also has other tools like forward guidance, quantitative easing, and credit facilities which are used to deal with specific economic conditions. These measures are the so called unconventional side of the monetary policy. The distinction between the conventional and the unconventional policies is based on what was considered normal policy before the Global Financial Crisis (GFC) – conventional policy. All of the other measures that came afterwards were labelled as unconventional, simply because they had not been used up until that point (Bernanke, 2020).

2.4. Unconventional Monetary Policy

In atypical circumstances, the Fed might not be able to accomplish its goals using traditional monetary policy techniques. Normally, there are two causes for this.

First, there might be an economic shock that is so severe that the Fed finds itself in a situation where it needs to bring nominal interest rates down to zero. At such point, further policy rate cuts are out of the question (Bernanke, 2009). Thus, any further monetary stimulus can only be implemented through unconventional monetary policy methods. In general, there are three complementary ways to increase monetary stimulus when the policy interest rate is at zero: by influencing expectations for medium to long term interest rates; by reshaping the balance sheet's composition; and by increasing the size of the balance sheet. These strategies are used to enhance funding conditions outside the realm of extremely short-term interbank interest rates (Bernanke, 2009).

Second, if the transmission of monetary policy is seriously compromised, unconventional measures may still be necessary even though the policy interest rate is above zero. In this situation, the Fed has two (not necessarily mutually incompatible) options: either lower the short-term nominal interest rate even more than under normal circumstances or intervene directly in the transmission process by deploying unconventional measures (Bernanke, 2009).

Unconventional policies are often used to alter the cost and accessibility of external financing for banks, individuals, and non-financial businesses. They may be viewed as an effort to reduce the spreads between various forms of external finance, which would have an impact on asset prices and the flow of funds in the economy. This is because the cost of external finance is typically higher than the short-term interbank rate on which monetary policy typically leverages. (Eggertsson & Woodford, 2003; Bernanke, 2009).

In order to influence the cost of lending, the Fed might try to control real long-term interest rates by shaping the market's expectations. For instance, if the public is persuaded to anticipate greater prices in the future, the Fed can reduce the real interest rate. Alternatively, by making a conditional commitment to keep policy rates at the lower bound for an extended length of time, policymakers can directly affect expectations about future interest rates (Bernanke & Reinhart, 2004). Since long-term rates are essentially averages of predicted short-term rates, when policymakers commit to maintaining the lower bound, the expectation channel will tend to flatten the whole yield curve. In addition, a conditional commitment to maintain the very short-term rate at the lower bound for a sufficient amount of time should help prevent declining inflation expectations, which would otherwise increase real interest rates and reduce expenditure. In either scenario, managing expectations successfully would, ceteris paribus, result in a decrease in the actual long-term rate, which would encourage borrowing and overall demand (Eggertsson & Woodford, 2003; Bernanke, 2009).

The Fed might also try to change the market conditions of assets with different maturities, in order to affect the cost of credit. To achieve this, it can consider two strategies. The first one is to change the overall level of longer-term interest rates on financial assets, regardless of their risk. Such strategy would primarily influence the market for risk-free investments, which are often government bonds. This strategy is usually referred to as quantitative easing (QE). The second one is to affect the risk spread between assets that are inserted in severely impaired markets and those whose markets are more functional. Such a strategy is often called credit easing. The two types of policies have differing effects on the balance sheet's composition. Credit easing may often be used when the short-term nominal interest rate is at levels over zero, in contrast to quantitative easing, which should only be utilized when the rate is at or very close to zero. The Fed's balance sheet will expand due to these measures, which will raise its monetary obligations (Eggertsson & Woodford, 2003; Bernanke, 2009).

The unconventional monetary policy is usually implemented through diverse routes, them being the portfolio rebalancing, signaling, liquidity, confidence, and bank-lending channels (Papadamou et al., 2019). These channels tend to reduce long-term rates and encourage investment. Due to the imperfect nature of asset substitutability, portfolio rebalancing specifically occurs through the credit easing policy and operates by affecting local supply, which in return causes changes in the composition of portfolios. In the case of the signaling channel, it operates through the expectations related to short term rates. Additionally, the liquidity channel enables more liquidity to investors, which lowers the liquidity premium. The improvement in economic circumstances and aggregate demand works as a confidence booster for economic outlook. As for the bank-lending channel, it encourages lending by offering lower interest rates on loans (Papadamou et al., 2019).

2.4.1. The Fed's reaction to the financial crisis

In reaction to the financial crisis, the Fed decided in December 2008 to decrease the Federal funds target to a range of 0% to 0.25%, down from 5.25%. This was the first time interest rates were ever dropped to what is known as the zero lower bound. The recession ended in 2009, but the persistently slower than predicted economic growth in the years that followed led the Fed to delay hiking interest rates. As a result, the economic expansion was in its seventh year, and the unemployment rate was already close to the Federal Reserve's assessment of full employment when it began hiking interest rates on December 16, 2015. This was a break from prior policy—in the previous two economic expansions, the Fed began hiking interest rates three years after the previous recession ended.

The Fed conducted three rounds of QE between 2009 and 2014. The third cycle ended in October 2014, when the Fed's balance sheet had grown to $4.5 trillion, five times its pre-crisis level - see **Table 1**

Table 1 – The Federal Reserve's Large-Scale Asset Purchase Programs

Change in Asset Holdings (billions of dollars)			
	Treasury Security Holdings	Agency MBS and Debt Holdings	Total Assets
QE1 (Mar.2009 - May 2010)	+$302	+$1297	+$451
QE2 (Nov. 2010 - July 2011)	+$788	-$177	+$578
QE3 (Oct.2012 - Oct. 2014)	+$810	+$826	+$1663
Total (Mar.2009 - Oct. 2014)	+$1987	+$1758	+$2587

Note: The final column does not equal the sum of the first two columns because of changes in the items (not shown) on the Fed's balance sheet; .**Source:** Labonte (2019)

Following the end of QE, the Fed kept the balance sheet at the same size until September 2017, when it began to gradually shrink it. In August 2019, the Fed ceased shrinking the balance sheet and, two months later, in October 2019, decided to re-expand its balance sheet in reaction to unrest in the repo market.

By using the two tools described in the previous chapter — paying banks interest on reserves maintained at the Fed and engaging in reverse repurchase agreements (reverse repos) through a new overnight facility — the Fed has boosted interest rates despite having a sizable balance sheet. The Fed declared in January 2019 that it would keep using these instruments to set interest rates indefinitely.

The expansion that began in 2009 became the longest in US history in July 2019. The Fed decreased the Federal funds target by 0.25 percentage point in July 2019. When the Fed starts decreasing interest rates, it usually does so over a period of months in reaction to the onset of a recession, though sometimes the rate cuts are more moderate and temporary mid-cycle corrections.

That expansion cycle ended in 2020 and in that period the Federal funds rate range peaked at a maximum of 2.25%-2.5%, which was substantially lower than at the pinnacle of prior expansions in either nominal or inflation-adjusted terms, as indicated in **Table 2.**

Table 2 – The Federal Funds Rate at the Peak of Expansions

1957-2023

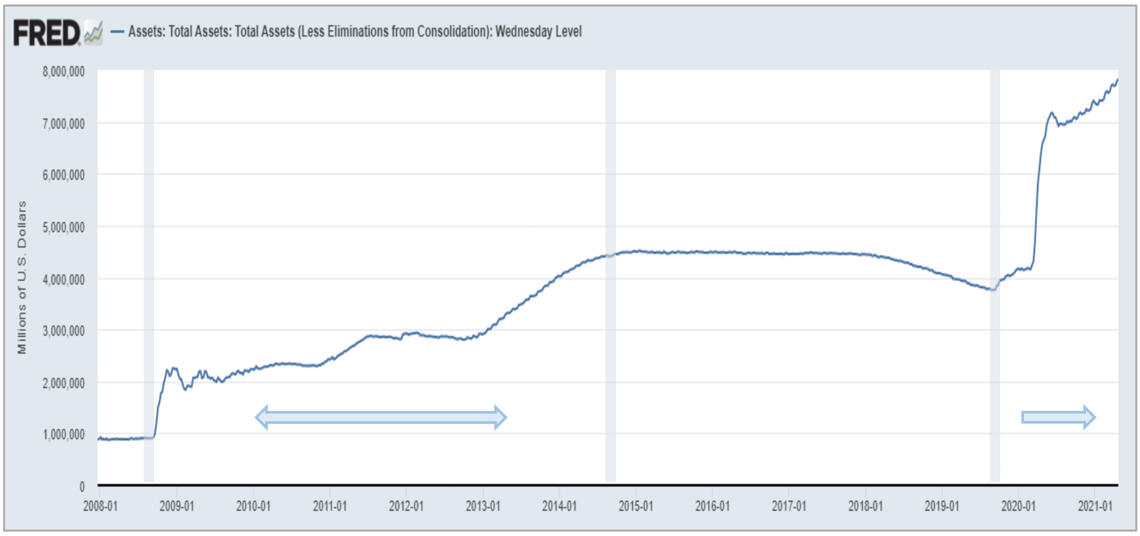
Date of Peak Rate	Peak Rate (Nominal)	Peak Rate (Inflation-Adjusted)	Cumulative Subsequent Reduction in Nominal Rate (Percentage Points)
October 1957	3.5%	0.6%	2.9
February 1960	4.0%	2.6%	2.8
September 1960	9.2%	3.5%	5.5
July 1974	12.9%	1.4%	7.7
April 1980	17.6%	3.0%	4.8
June 1981	19.1%	9.4%	10.4
May 1989	9.8%	4.5%	5.3
November 2000	6.5%	3.1%	4.8
July 2007	5.3%	2.9%	5.1
July 2019	2.4%	0.6%	2.4
As of: June 2023	5.25%	1.25%	Potential Max 5.25%

Source: Own calculations based on Fed's Economic Data; Board of Governors.

2.5. Division of the monetary policies

There is no universally accepted division of the periods that constituted unconventional monetary policy in the United States. On the one hand, some economists argue that the period from November 2014 to August 2019 involved unconventional monetary policy, as the Fed began to unwind its balance sheet by gradually reducing its holdings of Treasury and mortgage-backed securities (see Trifonova & Kolev, 2021). The goal of this process, known as quantitative tightening (QT), was to normalize the size of the Fed's balance sheet and lower the Fed's holdings of long-term assets. Other economists say that in order to be termed unconventional policy, the Fed's balance sheet must be expanded by net purchases of assets such as government bonds or mortgage-backed securities, which increase the money supply in the economy (see Kuttner, 2018; Bernanke, 2020). In this dissertation, the net asset purchase approach was followed. As so, the unconventional monetary policy periods considered go from December 2008 to October 2014 and from September 2019 onward – see **Figure 1.**

Figure 1 – Fed's Total Assets



Source: Board of Governors of the Federal Reserve System

2.6. The impact on financial markets

The study of the effects of both conventional and unconventional monetary policies is not something new. However, most of the articles tend to focus on the domestic effects of such policies (Cook, T., 1989; Kuttner, K., 2000; Wright, J., 2011) and leave aside the impacts on foreign assets and economies – the spill-over effect (Bowman et al., 2015; Neely, C., 2015; Georgiadis, G., 2015; Fratzscher et al., 2016; Curcuru et al., 2018).

The financial crisis that started in 2007 brought a different set of complex challenges for central banks, which made conventional policy no longer effective and forced the use of new monetary tools. Generally, central banks are reluctant to make quick decisions. With that being said, unconventional monetary practices, such as portfolio expansions and balance sheet rebalancing, are usually seen as the ultimate strategy that central banks employ in order to achieve their goals. Papadamou et al. (2019) mentions that most of the research suggest that unconventional actions taken by financial regulators tend to lower long-term interest rates by affecting both expectations and risk premium. The latter is in charge of the channel known as portfolio rebalancing, which has been determined to have the greatest impact on long-term bonds.

The ever-changing monetary conditions have led to the implementation of new ways of gauging the direction of monetary policy. One method that has been used is to directly measure the size of the central bank's balance sheet (Gambacorta et al., 2012; Haldane et al., 2016; Pattipeilohy et al., 2013). The issue with research using the balance sheet as a proxy for monetary policy is that when the pattern of changes in the balance sheet becomes predictable, the policy ceases to produce shocks and economic agents start to adapt before and gradually in a way that the effects are not identifiable anymore (Hansen et al., 1991).

A solution to this bias is to use event studies, which concentrate on the examination of a single monetary policy measure but are less suitable to capture persistent impacts (Haldane et al., 2016). An additional method for evaluating the direction of unconventional monetary policy is to use shadow rates. When the zero lower bound (ZLB) takes place and non-interest rate policies are implemented, this artificial indicator, which simulates the policy interest rate in normal times, can be used to gather data regarding the stance of the monetary policy (Lombardi & Zhu, 2014).

Initially, these shadow rates were introduced by Fischer (1995) through its Shadow Rate Term Structure Model (SRTSM) but, as noted by Kim and Singleton (2012), this tool was model-specific and hence unsuitable for use in other contexts. The following literature made an effort to address this problem by developing shadow rates that can be used directly in models that use discrete-time data and at the same time provide an accurate estimate of the rates used for monetary policy (Wu & Xia, 2015). The ability of this technique to capture the impacts of monetary policy on the current state of the economy and market expectations for future policy actions is one of its key characteristics (Mouabbi & Sahuc, 2019).

Through various approaches, several author have created different models that make an estimation for these shadow rates (Bauer & Rudebusch, 2013). Even if the model selections affect the degree of shadow rates, the common dynamics among the various shadow rates all point in the same direction. The authors Wu and Xia (2015) created an approximation of the shadow rate using an analytical approximation of the forward rate and applied it to discrete time data to calculate the effects of the US monetary policy actions, while Lombardi & Zhu (2014) created a shadow interest rate based on dynamic factor modeling.

When it comes to spillover effects from developed economies to emerging and developing ones, unconventional monetary policy is crucial. This is the rationale for the limitations on capital flows in countries like Brazil, Colombia, India, Indonesia, Thailand and many others – these countries apply capital restrictions to shield their economies from potential risks associated with volatile capital flows (Belke & Volz, 2019). However, Belke and Volz (2019) suggest that, contrary to popular belief, macroeconomic policies that are developed as a result of foreign unconventional monetary practices actually encourage capital flows as opposed to blocking them. This occurs because it fosters greater levels of confidence in domestic institutions and gives rise to hopes that a potential future crisis will be successfully handled. As a result, it is mostly used in Asian economies as a proxy for excellent institutional quality.

Since the GFC, the literature has mainly focused on studying the effectiveness of unconventional tools, as well as, the different transmission channels through which those monetary policies affected the economies. As so, the majority of the papers do not explicitly compare the effects of the unconventional policies to those that arise from the conventional side (see, among others, Tillmann, 2016; Bernanke, 2020; Andreou et. al, 2021). Nonetheless, there are some studies that try to compare spillovers from conventional and unconventional policy. For example, Bu et al. (2020) produced a U.S. monetary policy shock series that crosses periods of conventional and unconventional policy and has realistic impacts on the yield curve. On days when the FOMC makes a statement, this series acts as a summary indicator of all monetary policy activities. As long as one of two conditions is true - either information effects in long-term interest rates are very small or the information effects in short and long yields are present but different — the authors show that their approach extracts a monetary policy shock without significant Fed information effects[1]. Another example is the paper from Alpanda & Kabaca (2015), where the authors use a DSGE model to demonstrate that U.S. asset purchases that have the same output impacts as conventional policies end up having bigger portfolio balance effects that result in greater overseas spillovers.

To determine if announcements of conventional policy measures have different impacts on market variables than announcements of unconventional policies, one strategy is to employ event studies, which often examine the impact of FOMC announcements. The article from Neely (2015) shows how unconventional monetary policy announcements, such as long-term asset purchases and forward guidance, decreased predicted long-term real and nominal rates on U.S. bonds, long-term dollar-denominated yields on foreign bonds, and the value of the dollar. The author also found that non-QE announcements had smaller effects on the dollar and foreign currencies when compared to the QE announcements. However, this article did not account for the size of those announcements. In that regard, by evaluating the scale of the monetary policy action being announced, Rogers et al. (2016), Ferrari et al. (2021), and Curcuru et al. (2018) evaluate the sensitivity of foreign market variables to changes in the U.S. sovereign yields. These studies conclude that there is scarce evidence that support the idea that there is a significant change in the dollar and foreign yields in response to the movements in the U.S. yields.

The fact that there have been so few unconventional monetary policy statements raises some doubts about the validity of the estimates of event studies regarding that side of the monetary policy. Glick and Leduc (2015) employ all FOMC meeting remarks, even those without any explicit policy announcements, in an alternative strategy. They contrast the consequences of FOMC remarks in the post-GFC era, which contained QE and forward guidance, with the effects of statements made previous to the GFC, which, by definition,

[1] The term "Fed information effects" refers to the impact of Fed's statements or communications on long-term interest rates. Bu et al. (2020) aimed to extract the monetary policy shock from the series they created by isolating the impact of monetary policy actions from the influence of any additional information effects generated by the Fed's statements. By doing so, they can evaluate the specific effects of the monetary policy actions alone, separate from any informational content provided by the Fed.

were conventional, and demonstrate that the dollar's value was far more affected by monetary policy shocks in the post-GFC era.

Overall, there are several different identification problems that make the analysis of the effects of conventional and unconventional policies difficult (Kozicki et al., 2011). The first one has to do with the fact that there is a lag between macroeconomic activity and financial developments. The second issue is that there is no clear way to differentiate the impact of monetary policy and fiscal policy. Since both are being implemented at the same time, the same monetary policy might have different effects depending on what the fiscal policy is. Lastly, Kozicki et al. (2011) explains that the monetary policy is mostly transmitted through the announcements, rather than the more direct channels, which makes the quantification of the impact of the unconventional monetary policy even harder.

2.6.1. Monetary policy and bond yields

Addressing the relationship between both conventional and unconventional policy actions and bond yields has been one of the focal points when it comes to estimating the effectiveness of the policies being implemented. D'Amico et al. (2012) emphasize that the real term premium has a negative reaction to large scale asset purchases (LSAP) actions on longer-term U.S. Treasury rates. According to Neely (2015), statements of unconventional monetary policy tend to lower nominal and real rates on long-term U.S. bonds, as well as, on international bonds that are priced in U.S. dollars. In line with the conclusions from Neely (2015), Liu et al. (2017) argue that US LSAPs reduced the 10-year interest rate spread by an average of 90 basis points during the crisis. Additionally, Bauer and Rudebusch (2013) offer model-free proof that US QE1 (generally speaking, there were three main periods of quantitative easing in the years following the 2007–2008 financial crisis, which are often referred to as QE1, QE2, and QE3) significantly lowered yields by changing expectations, whereas later QE rounds had less of an impact on expectations. Krishnamurthy and Vissing-Jorgensen (2011) looked at both corporate and mortgage-backed securities (MBS) yields in their investigation and found a negative correlation between MBS purchases and corporate yields (Guidolin et al., 2017, documented the same effects for the corporate yields).

Wright (2011), besides showing that the adverse impacts of unconventional monetary policies on the U.S. private sector are less severe and last less time than those on Treasury yields, also illustrates that U.S. monetary policy surprises significantly decrease Canadian, UK, and German long-term yields by using an SVAR and event research methodology. Contrarily, by using a cointegrated-VAR (CVAR), Belke et al. (2018) contend that US QE1 did not cause the instability of the transatlantic interest-rate relationship since there were no substantial structural breakdowns as a result of QE.

2.6.2. Monetary policy and stock prices

The relationship between stock prices and monetary policies is another key factor in determining how effective a policy is during turbulent times. It helps policymakers to evaluate the wealth channel in the transmission of monetary policy, by providing evidence of the impact of the monetary policy in the portfolio valuations of the market participants (Kishor & Marfatia, 2013). Anaya et al. (2017) present proof that a QE shock in the US causes greater stock market returns. Similar to this, Liu et al. (2017) report that the return in stock prices in 2008 would have been 15% lower without the spread shock[2] prior to the launch of the US non-conventional program. According to Hattori et al. (2016), US unconventional monetary policies reduce both interest rate and stock market tail risks. Furthermore, the authors describe that forward guidance measures have a much greater impact than statements concerning asset acquisitions.

Evidence from Bernanke and Kuttner (2005) shows that the S&P 500 index returns rise by around 1 percentage point following an unforeseen Fed rate cute of 25 basis points. They contend that the favorable effects on future dividend streams, decreased discount rate, and increased stock market premium result in a favorable response to such a policy measure. Notably, Kiley (2014) uncover that extraordinary policy shocks bring positive effects on US stock prices. Interestingly, he detects that this impact works through forward guidance and consequently by lower long-term rates.

Regarding the impact of the US monetary policies in foreign stock market, Lubys & Panda (2020) examined whether the U.S. monetary policy announcements caused statistically significant abnormal returns in the stock markets of international countries by comparing

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[2] The spread shock refers to the difference between the 10 year yield and the yields on shorter term bonds. Essentially, Liu et al. (2017) reports that QE led to a compression of this spread, which avoided a 15% downfall in stock prices.

the returns that their model would have predicted in the absence of the event with the observed returns. In summary, the study reported that, around the time of the events, the BRICS stock market sector indexes deviated significantly from their usual patterns. Similarly, Ehrmann and Fratzscher (2009) and Hausman and Wongswan (2011) find that foreign equity returns respond positively to an unanticipated interest rate cut by the Fed. They attribute the cross country variation in responses to the level of financial market integration and the degree of exchange rate flexibility of the country.

3. Data and methodology

This dissertation is an attempt to further develop the understanding of the impact that conventional and unconventional monetary policies from the Fed produce in foreign financial markets. In order to do that, there was the need to identify and measure both policies, which in return allowed to estimate their impact. With that being said, in this section it will be discussed the applied methodology in this dissertation, as well as, the characteristics and specifications of the data that was collected. On top of that, this section also includes a brief description of the VAR/VEC model, which was used to conduct the empirical analysis and the econometric research.

3.1. Data and sources

In order to study the spillover effect of the Fed's monetary policy on foreign financial markets, monthly data for the period from January 1997 to January 2020 was collected regarding the stock and bond markets of Japan, Germany, United Kingdom, Australia and Mexico (important to note that Mexico only had information available from January 2001 onward). These countries were chosen based on their economic significance and structure – they are among the largest economies in the world – and also due to the fact that they have different economic structures, which may react differently to changes in U.S. monetary policy. For example, Japan and Germany are major exporters, while the UK and Australia are more service-oriented economies. As for Mexico, it is highly dependent on the U.S. economy, which makes it an interesting case study. On top of that, the availability of the data was also a crucial factor. Initially, the analysis was supposed to be extended to Brazil and China, but these countries did not have the sufficient data available.

The stock indices selected for each country were the Nikkei 225 for Japan, the DAX for Germany, the FTSE 100 for the UK, the S&P/ASX 200 for Australia and the S&P/BMV IPC for Mexico. As for the bond markets, 3 month and 10 year government bonds were selected in order to allow the analysis of the short and long term impact (Mexico and Australia did not have 3 month government bonds for the period selected, so these securities were substituted for the 3 month interbank rate).

The information related with the indices was obtained from Refinitiv Workspace. From this platform, the price series were extracted and the monthly returns were calculated on the basis of total return. Regarding the government bonds, the information was collected using different datasets – the IMF dataset for Japan, the OECD dataset for Australia, the Deutsche Bundesbank dataset for Germany, the FRED dataset for Mexico and the Bank of England dataset for the UK[3]. Unlike the stock indices, where the percentage monthly changes were calculated, for the interest rates it was opted to use the absolute monthly changes. The reason behind that is because some of the interest rates had negative values, which could lead to misleading results when calculating the percentage change. With that in mind, using absolute changes allows for a more accurate representation of the magnitude of the interest rate changes.

As explained before, evaluating the stance of the monetary policy is something subjective and arbitrary, especially when we are considering the unconventional side. This is because the conventional monetary policy is much easier to assess than the unconventional monetary policy. The papers that try to evaluate them collectively usually do so by measuring a policy surprise or by measuring the persistent effects – see Curcuru et al. (2018) and Bu et al. (2020). As for this dissertation, the latter approach was taken.

In order to measure both policies simultaneously, while making sure that they are being analyzed on the same basis, i.e. using the same model, there was the need to choose a single policy indicator variable that could gauge both sides of the monetary policy – the shadow Federal funds rate from Wu & Xia (2016). The dynamics of the US Federal funds rate and the respective trends of the shadow rate as calculated by Wu and Xia (2016) are represented in **Figure 2.**

[3] **Annex A** exhibits the sources for all of the variables used in the models.

Figure 2 – Wu & Xia Shadow Federal Funds Rate

Source: Board of Governors of the Federal Reserve System and Wu & Xia (2016)

3.2. Description of the VEC model

As explained in the literature review, one of the most used approaches when it comes to evaluating monetary policy is event studies. This technique revolves around limiting the time span evaluated in order to try to restrict the impact of external forces on the variables that are being studied. On top of that, event studies usually examine a single monetary policy measure, leaving aside the cumulative effect of the monetary policy as a whole. With that being said, event studies, as any other method, have their merit, but the fact that they are unable to capture persistent effects makes them a biased approach (Haldane et al., 2016).

Another common approach is using vector autoregressive (VAR) models (see Belke et al., 2018; Elif et al., 2022). In a VAR model, each variable in the system is considered as a function of its own past values and the past values of the other variables in the system. This allows the model to capture the interdependence between the variables and how they change over time. The VAR model is usually specified as a set of linear equations, where the coefficients of the equations represent the strength and direction of the relationships between the variables. In addition to forecasting, the VAR model can be used for impulse response analysis, which helps to understand how a shock in one variable affects the other variables in the system, and for causal analysis, which helps to determine the direction of causality between the variables. Essentially, event studies try to isolate the effects, while the VAR model tries to capture the full impact of the policy.

When evaluating the conventional monetary policy, researchers can compare the Federal funds rate expectations (Bloomberg and Reuters provide estimates) with the real value and see the impact that the difference had on the markets (see Kuttner, 2001; Hausman & Wongswan, 2011). As so, event studies tend to be the choice when evaluating the conventional side. As for the unconventional side of the monetary policy, researchers must be more cautious, since there are several identification problems (Kozicski, 2011). The fact that unconventional tools are much more recent than the conventional ones makes it harder to judge their expected impact. On top of that, there is no clear way to evaluate the markets expectations when measuring tools like the QE. Therefore, VAR models tend to be chosen when evaluating unconventional monetary policy.

As mentioned before, the majority of the papers on this subject do not explicitly compare the effects of the unconventional policies to those that arise from the conventional side, because they are usually measured using different models. The papers that do compare the two sides of the monetary policy tend to follow two approaches: either measure the policy surprise of both sides of the monetary policy, ignoring the persistent effects (Gilchrist et al. 2014; Curcuru et al., 2018); or measure the persistent effects and ignore the surprise reaction (Fausch & Sigonius, 2017; Bu et al., 2020). As for this dissertation, the focus was on the persistent effects.

As so, a similar approach to the one implemented in Trifonova & Kolev (2021) was followed. In their paper, the authors use the Wu and Xia (2016) shadow federal funds rate to analyze the impact of changes in the stance of unconventional monetary policy on the US financial market. The shadow federal funds rate is a synthetic indicator that was created to quantify the stance of the unconventional monetary policy, i.e., when the Fed is implementing non-traditional measures and the federal funds rate is near zero (Wu & Xia 2016). Nonetheless, this indicator is available throughout both conventional and unconventional periods – when the federal funds rate is above zero, the shadow rate follows closely the path of the effective Fed funds rate (Kuusela & Hännikäinen, 2017), which makes it a good indicator for the stance of monetary policy in both conventional and unconventional times. As so, this indicator was used to measure and compare the both sides of the monetary policy. In order to do this, a dummy (D_t) variable was created that takes the value 0 when the policy that is being implemented is conventional and value 1 when the policy in place is unconventional. This dummy variable was incorporated into the shadow rate, leading to the creation of two distinct variables – the shadow rate in the conventional periods and the shadow rate in the unconventional periods.

The authors Trifonova and Kolev (2021) utilized a VEC model, which is a subset of the VAR model that is used when the model's variables are cointegrated. By using differences and error correction terms, any VAR model can be written in the form of VECM. As for this dissertation, these were the models that were implemented and several tests were conducted in order to decide which one was the better fit considering the data. For the implementation of the models, the software package Eviews was used.

The Vector Error Correction Model (VECM) is preferable to the VAR model when there are several cointegrating relationships. This is because the VECM includes an error correction component that reflects the variables' short-run dynamics while still accounting for their long-run connection - in the VAR model, the relationships between the variables are considered to remain stable over time.

The error correction models (ECMs) are a theoretically-driven approach for evaluating the short-term and long-term impacts of one time series on another. The term error-correction refers to the notion that the error, or divergence from a long-run equilibrium, impacts the short-run dynamics of the previous period.

As stated earlier, every VAR model can be expressed in the form of VECM using differences and error correction terms. This also implies that every VEC model has an underlying VAR model. To understand the VECM framework, it is important to look at the underlying model specification:

$$\Delta Y_t = v + \prod Y_{t-1} + \sum_{\delta=1}^{p-1} \theta_\delta \, \Delta y_{t-\delta} + \varphi C_t + \mu_t \tag{1}$$

Where Y_t represents the returns on month t of the stock index of each country and also the returns of the associated government bond yields, $\Delta Y_t = \begin{bmatrix} y_{1,t} - y_{1,t-1} \\ \vdots \\ y_{n,t} - y_{n,t-1} \end{bmatrix}$ is the first difference of those variables[4], v is the vector of constants, $\prod = \alpha\beta'$ with α being the vector of adjustments coefficients which represent the short run adjustments and β' being the matrix of the cointegrating relationships which represent the cointegrating vector (long run relationship), θ_δ represents the short run coefficients, $\Delta y_{t-\delta}$ are the lagged differences for the short run impact of the endogenous variables, C_t is the vector of the control variables and μ_t is the vector of impulses. The chosen control variables were the VIX and the U.S. 10 year treasury yield. The VIX index is used to gauge global risk aversion by measuring the implied volatility of the S&P 500 index options. The U.S. 10 year yield is frequently used as a proxy for the risk-free rate, indicating the lowest return on investments that investors can earn without taking on additional risk. As a result, changes in the risk-free rate may have an impact on asset prices in different markets.

Overall, the VEC model gives short-run behavior estimates, long-run cointegrating relationship estimates, and short-run adjustment coefficients. The adjustment coefficients reflect the speed at which the short-run deviations from long-run equilibrium are adjusted.

With that being said, **equation 1** represents the starting point for the econometric study, but, in order to improve the model's accuracy, some adjustments had to be made. Depending on the data, the VEC model allows for the inclusion of various sorts of trends and constants in the short run equations as well as in the cointegrating relationships. As a result, preliminary analysis was performed to define the proper trend specifications.

After inspecting the graphs of the variables, it was determined that the best solution was to incorporate a restricted constant. This specification is used when there is no trend in the levels of the variables. As so, it only enables a constant in the cointegrating relationships, but it does not include a constant or a trend in first differences. With that being said, the VEC model, after implementing the restricted constant specification, has the following structure:

$$\Delta Y_t = \alpha(\beta' Y_{t-1} + \mathcal{E}) + \sum_{\delta=1}^{p-1} \theta_\delta \, \Delta y_{t-\delta} + \varphi C_t + \mu_t \quad \textbf{(2)}$$

[4] The two shadow rates that were created by using the dummy variable are not specified in the model. As it will be explained further ahead, in some of the variations, these shadow rates are treated as endogenous variables and in the other variations they are treated as exogenous variables. That varies in accordance to the results of the Granger causality test. Nonetheless, it is important to note that they are present in the model, either as a part of the endogenous variables (Y_t) or as a part of the exogenous variables (C_t).

Where Ɛ represents the constant in the cointegrating relationships. The difference between **equation 1** and **equation 2** is that the vector of constants was incorporated into the cointegrating relationship. As for the other variables, they remained the same.

The model represented in **equation 2** allows for the identification of the coefficients that express the relationship between the variables, either in the short run or in the long run. However, that by itself does not answer the main question of this dissertation, which is if the conventional and the unconventional monetary policies produce different impacts on foreign financial markets. In order to do that, there was the need to create a separate model, where the focus was on the significance of the dummy variable. As explained before, the dummy variable was used to divide the conventional and the unconventional periods. By using it as a separate variable (and not incorporated in the shadow rate, as it was done in **equation 2**), it was possible to test if the conventional and the unconventional monetary policies had significantly different impacts on the international financial markets. With that being said, these modifications led to a VEC model with the following form:

$$\Delta Y_t = \alpha(\beta' Y_{t-1} + \mathcal{E}) + \sum_{\delta=1}^{p-1} \theta_\delta \, \Delta y_{t-\delta} + \eta D_t + \varkappa S_t + \varphi C_t + \mu_t \qquad \textbf{(3)}$$

Where D_t represents the dummy variable and S_t represents the shadow rate for the whole period (without separating between the conventional and the unconventional periods). The other variables remain the same as in **equation 2.**

All in all, the models from **equation 3** and **equation 2** have different purposes. While the model from **equation 3** tests directly if the two monetary policies produced different impacts on foreign financial markets, **equation 2** quantifies the effects from both policies. Essentially, the two models complement each other.

4. Results

The first model that was tested was the VAR model, since it is the most generic one. It is important to note that before fitting a VAR model, it is essential to ensure that the variables are stationary, meaning that their mean and variance do not change over time. As so, an Augmented Dickey-Fuller (ADF) test was conducted – **Annex B**

The ADF unit root test indicated that all of the variables were found to be stationary in the level form, with no evidence of a unit root. This suggested that the variables could be modeled using standard time series techniques and that they could be used for further analysis.

After establishing that the variables were stationary, the next step was to select the ideal lag length of the VAR model that would best represent the interactions between the variables. The number of past observations that are included in the model is determined by the lag length, which is critical in determining the accuracy of the model's estimates. Information criteria tests, residual-based testing, and specification tests are different ways for determining the suitable lag lenght. In this dissertation, the Akaike Information Criterion (AIC) was utilized, which is a measure of a statistical model's relative goodness of fit that balances the tradeoff between model complexity and goodness of fit. The main benefit of AIC over the coefficient of determination R^2 is that it prevents the inclusion of extraneous components or degrees in a given model. The results are presented in **Table 3.**

Table 3 – VAR Lag Order Selection Criteria

Lag	LogL	AIC	SC	HQ
0	3619.631	-33.42377	**-32.47693***	-33.04112
1	4003.382	**-34.91438***	-30.41688	**-33.09679***
2	4184.593	-34.50322	-26.45506	-31.25069
3	4362.101	-34.05729	-22.45846	-29.36981
4	4554.712	-33.75316	-18.60368	-27.63075
5	4750.658	-33.48036	-14.78021	-25.92301
6	4962.971	-33.36123	-11.11042	-24.36894
7	5202.359	-33.49633	-7.694863	-23.06910
8	5516.591	-34.33418	-4.982055	-22.47201

Note: * indicates lag order selected by the criterion; Since the criterion used was the AIC, the optimal lag lenght is 1.

When analyzing time series data, one important consideration is whether the series are cointegrated. Cointegration refers to the existence of a long run relationship between two or more variables. If two or more series are cointegrated, they tend to move together over the long run despite potentially showing different short-run dynamics. With that being said, a Johansen test was performed in order to check for the existence of cointegration – **Table 4**

Table 4 – Johansen Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.752388	1799.274	496.9099	0.0000
At most 1 *	0.578468	1493.574	442.9227	0.0000
At most 2 *	0.534484	1304.389	388.8549	0.0000
At most 3 *	0.513015	1136.940	334.9837	0.0000
At most 4 *	0.495120	979.3641	285.1425	0.0000
At most 5 *	0.453163	829.6918	239.2354	0.0000
At most 6 *	0.432215	697.5022	197.3709	0.0000
At most 7 *	0.404363	573.5456	159.5297	0.0000
At most 8 *	0.375622	460.0763	125.6154	0.0000
At most 9 *	0.328791	356.9273	95.75366	0.0000
At most 10 *	0.288869	269.6174	69.81889	0.0000
At most 11 *	0.270246	194.9607	47.85613	0.0000
At most 12 *	0.227962	125.9653	29.79707	0.0000
At most 13 *	0.167892	69.30530	15.49471	0.0000
At most 14 *	0.124245	29.05450	3.841465	0.0000

Note: Trace test indicates 15 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

The p-value for the "At most 14" hypothesis was below the 0.05 level, which suggests that there are 15 linearly independent combinations of the variables that exhibit a long-term relationship. This implies that there are multiple cointegrating vectors among the variables, indicating a high-dimensional cointegration relationship.

As explained before, when cointegration is present amongst the variables, the VEC model is preferable, in comparison to the VAR model. As so, from this chapter onwards the tests that will be presented were executed on the VEC model.

4.1. Granger Causality Test

Understanding the specific characteristics and dynamics of the financial markets that are being examined is crucial to avoid problems such as over specification, which can lead to overfitting, loss of interpretability or multicollinearity among the variables. The objective is to avoid a situation where the model includes more explanatory variables than necessary for accurately capturing the relationships within the data.

With that being said, it is important to carefully consider the theoretical framework and assess the significance and contribution of each variable in explaining the dependent variables. The goal is to strike a balance between model simplicity and the ability to capture the essential relationships in the data accurately.

If the financial markets in each country are highly interdependent it is more appropriate to estimate a single VEC model for all countries together. However, if the financial markets in each country have very different characteristics and exhibit unique dynamics, it is more appropriate to estimate a separate VEC model for each country. Having that in mind, a Granger causality test was performed to see if there was a significant causal relationship between the variables of each country – see **Annex C**.

Another important specification is whether to include the shadow Federal funds rate as an exogenous or endogenous variable. This differentiation is important because, in the VEC model, the interpretation of the results varies if the variables are exogenous or endogenous (this will be explained further ahead).

With that being said, the Granger causality test was utilized to assess the potential causal links between the shadow rate and the variables in international financial markets (see **Annex D)**. If the test indicates that the shadow Federal funds rate Granger causes the variables in the international financial markets, and those variables Granger cause the shadow rate simultaneously, it shows that they have a bidirectional interaction. The shadow rate should be treated as an endogenous variable, in this case. If, on the other hand, the Granger causality test shows that the shadow Federal funds rate Granger causes the foreign financial market variables but there is no evidence of reverse causality, then the relationship is unidirectional. In this case, the shadow rate should be considered as an exogenous variable in the model.

The results of the Granger test (see **Table 5**) provided valuable insights into the interconnections amongst the variables within the financial markets that were examined. Essentially, it enabled the identification of the most significant connections.

With that in mind, the creation of three separate VEC models, one for Mexico, one for Australia, and one for the group of Germany, the UK, and Japan, was considered.

This differentiation is justified based on the following reasons: firstly, the economic and financial structures of the countries under study differ significantly. Each country possesses unique characteristics, including their monetary policy frameworks, banking systems, financial regulations, and market participants. These structural differences can lead to variations in the transmission mechanisms of the U.S. monetary policy and its impact on the financial markets. By creating separate VEC models, it becomes easier to capture and analyze the distinct structural dynamics of each country.

Secondly, capital flows play a vital role in understanding the spillover effects of the U.S. monetary policy. Countries that have a greater volume of capital flow exchanges with the U.S. are more susceptible to the impact of U.S. monetary policy changes (Ghosh et al., 2012).

Additionally, the level of market integration among the countries is an important factor to consider. Higher levels of market integration suggest stronger cross-country linkages, while lower integration implies more idiosyncratic market behavior. Considering the Granger causality test, Mexico and Australia exhibited relatively lower integration with the group of Germany, the UK and Japan, which justified the creation of separate VEC models.

As for the shadow rate, it will be treated as an exogenous variable in the models for Mexico and Australia and as an endogenous variable for the model of the group Germany, the UK and Japan. This is due to the fact that, as seen in **Table 5**, in the models for Mexico and Australia the shadow rate only showed a unidirectional causal relationship with the variables that are being examined in those countries. As for the model of the group Germany, the UK and Japan, this relationship was bidirectional with some of the variables, which justifies the inclusion of the shadow rate as an endogenous variable.

Table 5 – Granger Causality Test

	Conventional	Unconventional	Aus_3_month	Aus_10_year	S&P_Aust	Ger_3_month	DAX	Ger_10_year	UK_3_month	UK_10_year	FTSE	Jap_3_month	Jap_10_year	NIKKEI	Mex_3_month	Mex_10_year	S&P_Me
Conventional	-	-	x	-	x	x	O	O	x	-	x	x	O	-	-	x	-
Unconventional	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Aus_3_month	-	-	-	-	-	-	-	-	O	-	-	-	-	-	-	x	-
Aus_10_year	-	-	x	-	O	-	-	-	-	x	-	-	-	-	-	-	-
S&P_Aust	-	-	-	O	-	-	-	-	-	-	-	-	-	-	-	-	-
Ger_3_month	-	-	-	-	-	-	-	-	O	-	-	-	-	-	-	O	-
Ger_10_year	O	-	-	-	-	x	O	-	-	-	O	-	-	x	x	-	-
DAX	O	-	-	x	-	-	-	O	-	-	O	-	-	O	-	-	-
UK_3_month	-	x	O	-	-	O	-	-	-	-	-	-	-	-	-	x	-
UK_10_year	-	-	-	-	x	-	x	x	-	-	O	-	-	x	-	-	-
FTSE	-	-	-	x	-	x	O	O	x	O	-	-	-	O	-	-	O
Jap_3_month	-	-	-	-	-	-	-	x	-	-	-	-	-	-	-	-	-
Jap_10_year	O	-	-	x	x	x	x	x	x	-	-	-	-	-	x	-	x
NIKKEI	-	-	-	-	-	-	O	-	-	-	O	-	-	-	-	-	-
Mex_3_month	-	-	-	x	-	-	-	-	-	-	-	-	-	-	-	O	O
Mex_10_year	-	-	-	-	-	O	-	-	-	x	-	-	-	x	O	-	-
S&P_Mex	x	-	-	-	x	-	x	x	-	-	O	-	-	-	O	x	-

Note: Read the table horizontally, row by row;

x indicates that the variables listed in the rows Granger cause the variables in the columns;

O indicates that both variables Granger cause each other

In conclusion, based on the different economic and financial structures, trade relationships and market integration levels, it is justified to differentiate the VEC models for Mexico, Australia, and the group of Germany, the UK, and Japan. This approach enables the capture of specific dynamics and relationships within and across the financial markets of these countries, providing a comprehensive analysis of the impact of the US monetary policy on their respective markets.

4.2. Fitness Tests

As explained before, the VEC model can be derived from its VAR counterpart. Usually, the process is done by removing one lag from the VAR (p – 1 lags), since the VEC differentiates the variables of the model. However, that does not guarantee that the originated VEC will have the appropriate lag length since it depends on several factors, including the data characteristics, the underlying economic theory, the purpose of the analysis and model diagnostics. With that in mind, several tests were performed to guarantee that the three VEC models had the optimal lag length selection. It is important to note that these tests assume a normal distribution, which can be justified by the Central Limit Theorem. Essentially, when the sample size is sufficiently large (usually considered to be 30 or more observations), the Central Limit Theorem states that the sampling distribution of the sample mean or sum will approximate a normal distribution, regardless of the shape of the original population distribution. This means that even if the data does not follow a normal distribution, it is still possible to rely on the normality assumption for the statistical tests that require it. Since in this dissertation the VEC model contains 271 observations, it will be assumed that this theorem holds.

4.2.1. Lag Exclusion Test

The lag exclusion test, also known as the Wald test, is used to test the null hypothesis that all of the coefficients on the lags beyond a certain order are zero, indicating that these lags do not contribute significantly to the model. As so, the lag of highest order where the null hypothesis cannot be rejected at the 0.05 significance level was selected – **Table 6**.

Table 6 – VEC Lag Exclusion Wald Tests

Lag	Australia	Mexico	Ger/Jap/UK
1	[0.0000]	[0.0000]	[0.0000]
2	[0.0000]	[0.0000]	[0.0000]
3	[0.0000]	[0.0000]	[0.0079]
4	[0.0000]	[0.0094]	**[0.0862]**
5	**[0.1007]**	[0.0073]	-
6	-	**[0.1388]**	-

Note: Numbers in [ ] are p-values; The results indicate that the optimal lag lenght for the models for Australia, Mexico and the group Germany/Japan/UK is 5, 6 and 4, respectively.

4.2.2. Residual Serial Correlation LM Test

On top of the lag exclusion test, a Breusch-Godfrey test was also performed. The Breusch-Godfrey test is an extension of the Durbin-Watson test and is designed to detect serial correlation up to a certain lag order. It's typically used when dealing with time series data or panel data, where observations are correlated over time or across different entities. It examines whether there is residual serial correlation in the model by regressing the residuals on their lagged values, along with the original independent variables.

The results that are presented in **Table 7** indicate that the lags that were chosen, given the lag exclusion test, do not exhibit serial correlation in the residuals.

Table 7 – Residual Serial Correlation LM Test

Lag	Australia	Mexico	Ger/Jap/UK
1	[0.0028]	[0.0001]	[0.0190]
2	[0.9663]	[0.0487]	{0.2962]
3	[0.0045]	[0.1629]	[0.0054]
4	[0.1792]	[0.0000]	**[0.1359]**
5	**[0.4195]**	[0.0076]	-
6	-	**[0.5370]**	-

Note: Numbers in [ ] are p-values; As the results indicate, all of the lags that were chosen for each model due to the lag exclusion test showed no residual serial correlation.

4.3. VEC Model

Having concluded the diagnostic tests to the variables and to the models, this section continues with the econometric study for identifying and assessing the effects of the Fed's conventional and unconventional monetary policies on foreign financial markets.

One of the main goals of this model is to check, in different periods, the influence of the Fed's monetary policy stance on international 3-month and 10-year government bond yields, as well as, on their corresponding stock indexes. This was possible by incorporating into the model the dummy variable that was created, which separates the conventional and the unconventional periods.

In the chapter 'Data and Methodology', it was explained that the VEC model comprises three different types of coefficients – one for the long term trend, another for the short term trend and the last one for the speed at which the short term trend corrects itself to the long term trend. Subsequently, in the chapter 'Granger Causality Test' it was clarified that the shadow Federal funds rate would be considered as an endogenous variable in the model for the group of Germany, the UK and Japan, and as an exogenous variable in the models for Mexico and Australia. This is important because in a VEC model the estimated coefficients are typically associated with the endogenous variables in the system, since these are the variables that are influenced by all of the other variables in the model. With that being said, in the models where the shadow rate is treated as an exogenous variable, its impact is only observable in the short run, since it is assumed that there is no feedback from the endogenous variables to the exogenous variables. On the other hand, in the model for the group of Germany, the UK and Japan, where the shadow rate is treated as an endogenous variable, the three coefficients that were described above could be considered, which means it was possible to analyze the long term and the short term impact. However, predicting long-term relationships can be extremely challenging due to various factors such as changing economic conditions, policy changes and also structural shifts in markets. This challenges are much less relevant in short-term dynamics, which are more immediate and observable, allowing for more reliable and practical insights. Conversely, in the model for Germany, the UK and Japan the coefficients that will be analyzed are the short-term coefficient, as well, the error correction term (ECT), which represents the speed of adjustment after the initial shock. Since this model is multivariate, the importance of the ECTs is associated with the total sum of the coefficients. For each variable, the sum of the ECTs must be negative, indicating that the deviation from the equilibrium was corrected. In case it is positive, it indicates an explosive reaction to the short-term shock, meaning that the long-term relationship is no longer achievable.

The three VEC models that were previously explained were divided into two separate models each, in order to perform two distinctive tests. The first test intends to answer the main question of this dissertation: 'Do conventional and unconventional monetary policies from the Fed produce different results in foreign financial markets?' - to answer this a VEC model containing the dummy variable as an exogenous variable was created, where its statistical significance was evaluated. The second test is a follow up procedure that intends to measure, separately, the impact of both policies in the foreign markets – to do this, a VEC model was created where the dummy variable was incorporated in the shadow rate, separating the shadow rate into the conventional policy and the unconventional policy. This model is the one that allows for the interpretation of the coefficients that were explained previously in this chapter. To facilitate interpretation, the first test for each model will be named 'Part I' and the second test will be named 'Part II'. Since the models have a great number of coefficients, a table containing only the relevant information will be presented for each model. With that being said, the analytical representation of the VEC model for Australia with the values of the coefficients, including the significance levels, is summarized in **Table 8** and **Table 9** (see the complete models in **Annex E** and **Annex F**)

The results from the Part I of the estimated VEC model showed that the dummy is statistically significant for the Australian benchmark stock index at the 5% level. As for the 3 month and the 10 year bond yields, the dummy was not statistically significant. This indicates that there is evidence that the conventional and the unconventional U.S. monetary policies had different impacts in the Australian benchmark stock index. Ceteris paribus, the expected difference in the Australian benchmark stock index returns between those with 1 (unconventional) and those with 0 (conventional) values of the dummy variable is +0.8%.

Regarding Part II, the VEC model showed that the conventional and the unconventional monetary policies had positive impacts on the Australian 3 month bond yield, but with no statistical significance for either policy. As for the 10 year bond yield, both policies exhibited a positive relationship, with the conventional policy showing statistical significance at the 10% level.

Table 8 – VEC Model for Australia – Part I

Variables	Aus_3_month	Aus_10_year	S&P_Aus
Dummy	0.030176 (0.01838) [0.7703]	-0.005518 (0.01889) [0.1010]	0.008233 (0.00377) **[0.0293**]**
R-squared	0.247994	0.781397	0.622073
Adj. R-squared	0.216422	0.772219	0.606206
S.E. equation	0.154531	0.158831	0.031698
F-statistic	7.854691	85.13813	39.20501
Akaike AIC	-0.854031	-0.799138	-4.022334
Schwarz SC	-0.695792	-0.640899	-3.864095

Note: Numbers in ( ) are the standard errors & in [ ] are the p-values; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.

Table 9 – VEC Model for Australia – Part II

Variables	Coefficient - Error correction term		
	Aus_3_month	Aus_10_year	S&P_Aus
Conventional Policy	0.045529 (0.04917) [0.3548]	0.095883 (0.05196) **[0.0654*]**	0.000807 (0.01082) [0.9406]
Unconventional Policy	0.156617 (0.10901) [0.1512]	-0.024152 (0.11521) [0.8340]	-0.064327 (0.02399) **[0.0075***]**
R-squared	0.338538	0.798860	0.623982
Adj. R-squared	0.285621	0.782769	0.593900
S.E. equation	0.146831	0.155181	0.032311
F-statistic	6.397525	49.64571	20.74307
Akaike AIC	-0.924748	-0.814131	-3.952518
Schwarz SC	-0.645617	-0.535000	-3.673387

Note: Numbers in ( ) are the standard errors & in [ ] are the p-values; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.

Everything else constant, a 1 percentage point increase in the U.S. shadow rate, during conventional times, leads to an increase of 6.5 basis points (bps) on the Australian 10 year bond yield. In regards to the impact on the Australian benchmark stock index, the unconventional policy exhibited statistical significance at the 5% level, with a 1 percentage point change in the U.S. shadow rate leading to a -6.4% change in the Australian benchmark stock index. The conventional policy showed a positive relationship, but with no statistical significance.

Regarding the VEC model for Mexico, the relevant information is presented in **Table 10** and **Table 11** (see the complete models in **Annex G** and **Annex H**)

In the VEC model for Mexico – Part I, the dummy variable exhibited statistical significance at the 5% level for the 3 month Mexican bond yield, indicating that there is evidence that the conventional and the unconventional US monetary policies had different impacts in the 3 month Mexican bond yield. Everything else constant, the expected difference in the change of the 3 month yield, between the unconventional periods and the conventional periods is -7 bps. As for the 10 year Mexican bond yield and the Mexican benchmark stock index the dummy showed no statistical significance.

Table 10 – VEC Model for Mexico – Part I

Variables	Mex_3_month	Mex_10_year	S&P_Mex
Dummy	-0.069441 (0.03507) **[0.0481**]**	-0.039745 (0.04045) [0.3263]	0.001072 (0.00520) [0.8368]
R-squared	0.472422	0.660612	0.601507
Adj. R-squared	0.408558	0.619528	0.553268
S.E. equation	0.279464	0.322408	0.041442
F-statistic	7.397239	16.07959	12.46940
Akaike AIC	0.393463	0.679352	-3.423676
Schwarz SC	0.770956	1.056845	-3.046183

Note: Numbers in ( ) are the standard errors & in [ ] are the p-values; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.

Table 11 – VEC Model for Mexico – Part II

Variables	Coefficient - Error correction term		
	Mex_3_month	Mex_10_year	S&P_Mex
Conventional Policy	0.201474 (0.12307) [0.1022]	0.147353 (0.15424) [0.3398]	0.025093 (0.01972) [0.2037]
Unconventional Policy	0.205162 (0.19409) [0.1972]	0.351719 (0.24324) [0.1488]	-0.042996 (0.03109) **[0.0714*]**
R-squared	0.501601	0.692890	0.647148
Adj. R-squared	0.401348	0.631115	0.576172
S.E. equation	0.252452	0.316385	0.040444
F-statistic	5.003367	11.21633	9.117831
Akaike AIC	0.239617	0.691090	-3.423000
Schwarz SC	0.813407	1.264880	-2.849210

Note: Numbers in ( ) are the standard errors & in [ ] are the p-values; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.

Regarding Part II, the model exhibited a positive relationship between both policies and the 3 month Mexican bond yield. However, none of the policies exhibited statistical significance. In regards to the long end of the curve, both policies evidenced a positive relationship with the 10 year bond yield, but neither of the monetary policies exhibited statistical significance. As for the impact on the Mexican benchmark stock index, the unconventional policy showed statistical significance at the 10% level, with a 1 percentage point increase in the U.S. shadow rate leading to a -4.3 bps change in the benchmark stock index. On the other hand, the conventional policy exhibited a positive relationship, but with no statistical significance.

As for the VEC model for Germany/UK/Japan, the relevant information is presented in **Table 12** and **Table 13** (see the complete models in **Annex I** and **Annex J**).

Part I of the model for Germany, the UK and Japan indicates that the conventional and the unconventional monetary policies had different effects on the German 10 year yield, as well as, on the benchmark stock index for Germany and the UK – with the expected difference between the unconventional and the conventional periods being -3 bps, +1.1%

and +0.4%, respectively. As for the other variables, the dummy variable had no statistical significance, indicating no difference.

Table 12 – VEC Model for Germany/UK/Japan –

Variables	Ger_3_month	Ger_10_year	DAX	UK_3_month	UK_10_year	FTSE 100	Jap_3_month	Jap_10_year	NIKKEI
Dummy	-0.013360 (0.01479) [0.3663]	-0.028595 (0.01618) **[0.0772*]**	0.010967 (0.00653) **[0.0932*]**	-0.001150 (0.02143) [0.9572]	-0.015046 (0.01850) [0.4162]	0.003815 (0.00430) **[0.0032***]**	0.004507 (0.00719) [0.5309]	-0.019496 (0.01492) [0.1915]	0.009078 (0.00623) [0.1454]
R-squared	0.348500	0.832565	0.735570	0.380910	0.839685	0.737395	0.692215	0.656609	0.704411
Adj. R-squared	0.214710	0.798181	0.681267	0.253776	0.806764	0.683467	0.629009	0.586092	0.643710
S.E. equation	0.109525	0.119823	0.048369	0.158766	0.137077	0.031870	0.053264	0.110522	0.046173
F-statistic	2.604825	24.21379	13.54574	2.996119	25.50547	13.67375	10.95176	9.311268	11.60455
Akaike AIC	-1.428940	-1.249211	-3.063507	-0.686378	-0.980163	-3.897898	-2.870723	-1.410811	-3.156450
Schwarz SC	-0.804218	-0.624489	-2.438786	-0.061657	-0.355442	-3.273176	-2.246001	-0.786089	-2.531729

Note: Numbers in ( ) are the standard errors & in [ ] are the p-values; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.

Table 13 – VEC Model for Germany/UK/Japan – Part II

Variables	Coefficients								
	Ger_3_month	Ger_10_year	DAX	UK_3_month	UK_10_year	FTSE 100	Jap_3_month	Jap_10_year	NIKKEI
Conventional Policy (t-1)	0.148032 (0.05161) **[0.0042***]**	0.263590 (0.05678) **[0.0000***]**	-0.022397 (0.02323) [0.3352]	0.197176 (0.07529) **[0.0089***]**	0.183155 (0.06565) **[0.0053***]**	-0.013033 (0.01514) [0.3895]	0.080846 (0.02493) **[0.0012***]**	0.087403 (0.05318) **[0.1004*]**	-0.020568 (0.02195) [0.3489]
Conventional Policy (t-2)	-0.030690 (0.05787) [0.5960]	0.217832 (0.06367) **[0.0006***]**	0.029093 (0.02605) [0.2643]	0.055488 (0.08442) [0.5111]	0.160413 (0.07362) **[0.0294**]**	-0.004998 (0.01698) [0.7685]	0.052311 (0.02796) **[0.0615*]**	0.022387 (0.05963) [0.7074]	-0.018039 (0.02462) [0.4638]
Conventional Policy (t-3)	-0.045005 (0.05658) [0.4265]	0.104775 (0.06225) **[0.0925*]**	0.006437 (0.02547) [0.8005]	0.074850 (0.08254) [0.3646]	0.040416 (0.07198) [0.5745]	0.015504 (0.01660) [0.3505]	0.064099 (0.02734) **[0.0191**]**	-0.028418 (0.05830) [0.6260]	0.017858 (0.02407) [0.4582]
Conventional Policy (t-4)	0.044032 (0.04851) [0.3642]	0.015150 (0.05337) [0.7765]	0.007693 (0.02184) [0.7247]	0.053459 (0.07077) [0.4501]	0.048511 (0.06171) [0.4319]	0.016925 (0.01423) [0.1301]	0.043372 (0.02344) **[0.0644*]**	0.039672 (0.04998) [0.4275]	0.031874 (0.02064) [0.1226]
Unconventional Policy (t-1)	0.283374 (0.12651) **[0.0252**]**	0.043860 (0.13917) [0.7527]	-0.066593 (0.05695) **[0.0953*]**	0.316428 (0.18455) [0.0865]	0.122523 (0.16093) [0.4465]	-0.013655 (0.03712) [0.4130]	0.049047 (0.06112) [0.4223]	-0.196272 (0.13035) **[0.0832*]**	0.004233 (0.05381) [0.9373]
Unconventional Policy (t-2)	0.257603 (0.12132) **[0.0338**]**	0.031761 (0.13347) [0.8119]	-0.041739 (0.05462) [0.1248]	0.329206 (0.17698) **[0.0630*]**	0.071402 (0.15433) [0.6437]	-0.010083 (0.03560) **[0.0489**]**	0.051924 (0.05861) [0.3758]	-0.041750 (0.12500) [0.7384]	-0.093922 (0.05161) **[0.0689**]**
Unconventional Policy (t-3)	0.182595 (0.10551) **[0.0837*]**	-0.011976 (0.11607) [0.9178]	-0.009217 (0.04750) [0.3462]	0.267536 (0.15391) **[0.0823*]**	-0.016264 (0.13422) [0.9036]	-0.016268 (0.03096) **[0.0640*]**	-0.042223 (0.05097) [0.4076]	-0.013947 (0.10871) [0.8979]	-0.041795 (0.04488) [0.3518]
Unconventional Policy (t-4)	0.102312 (0.08329) [0.2194]	0.192237 (0.09163) **[0.0360**]**	0.001688 (0.03750) [0.5641]	0.126478 (0.12150) [0.2980]	0.010930 (0.10595) [0.9178]	0.007291 (0.02444) [0.29836]	0.000267 (0.04024) [0.9995]	0.013312 (0.08582) [0.8767]	-0.003804 (0.03543) [0.9145]
R-squared	0.395556	0.842926	0.745059	0.418326	0.846339	0.752302	0.718191	0.667851	0.720777
Adj. R-squared	0.244445	0.803657	0.681324	0.272907	0.807923	0.690377	0.647739	0.584813	0.650971
S.E. equation	0.107431	0.118186	0.048365	0.156718	0.136665	0.031520	0.051902	0.110693	0.045700
F-statistic	2.617654	21.46563	11.68990	2.876700	22.03127	12.14869	10.19401	8.042779	10.32545
Akaike AIC	-1.444868	-1.254044	-3.041012	-0.689677	-0.963510	-3.897297	-2.899854	-1.385055	-3.154368
Schwarz SC	-0.713811	-0.522987	-2.309955	0.041380	-0.232453	-3.166240	-2.168797	-0.653997	-2.423310

Note: Numbers in ( ) are the standard errors & in [ ] are the p-values; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.

The estimates concerning the Part II of the model showed an overall positive response from the 3 month bond yields of the three countries and the conventional policy. While for Germany and the UK that response was significant in the prior month, for Japan the effect extended back to the prior four months. The effect ranged from 4bps to 20bps. Regarding the unconventional policy, the impact on the 3 month bond yields was also mostly positive, but only affecting Germany and the UK. On top of that, the impact was larger, going from 18 bps to 33 bps, and more prolonged.

As for the 10 year yields, the effects varied significantly. While the conventional policy had a similar impact as in the 3 month yields, showing a positive relationship in the three countries and ranging from 9 bps to 26 bps, the unconventional policy exhibited opposing effects. For Germany, despite the fact that the reaction was only statistically significant 4 months after the implementation of the unconventional policy, the impact was still positive and around 19 bps. However, in the case of Japan, the relationship was negative. Lastly, the effects on the benchmark stock indexes also varied between the conventional and the unconventional monetary policies. During the conventional policies, the stock indexes had mixed reactions, with positive effects in some of the prior months and negative reactions in others. However, none of the stock indexes showed statistical significance.

On the other hand, unconventional monetary policies showed a negative impact in the benchmark stock indexes of the three countries, with the effects ranging between -1% and -6.7%.

Regarding the ECTs, their importance relies on the total sum of their coefficients for each variable, as explained before. In this model, all of the variables exhibited a negative total sum, which further confirms the stability of the model and the convergence of the variables to their long term relationship – see **Annex K**.

4.4. Variance Decomposition

After examining the coefficients and discussing the relationships among the variables in the VEC model, it is crucial to examine how each variable contributes to the forecast error variance of the system. As so, the variance decomposition of the variables will be provided in this chapter, allowing the dissection of the sources of variability in the model and offering useful insights into the relative relevance and impact of each variable.

By quantifying the contributions of each variable, it becomes easier to comprehend the underlying dynamics, assess the significance of different factors and refine the analysis. Since the variance decomposition can only be done for endogenous variables, this analysis is only possible for the model of Germany, the UK and Japan. With that being said, the variance decomposition breakdown is presented in **Table 14**.

As expected, the variance decompositions show that the past values of each variable have the most prominent impact on its volatility across time. By capturing the autocorrelation and the time dependence in the data, it indicates that the past values of the variables have a persistent influence on the current values.

As the number of periods increases, the influence of the lagged values decreases relative to the other variables. It suggests that other factors beyond the immediate lagged values start to play a more relevant role in explaining the variability of the dependent variable, which indicates a shift in the dynamics in the system. A plausible reason for this shift is the presence of long term trends, which corroborates the findings of the VEC model.

When analyzing each variable independently and excluding its own past values, both the conventional and the unconventional monetary policy exhibit overall substantial impacts when compared to the other variables in the model. In some of the cases (see the German 10 year yield, for example), this influence is even higher than the one exhibited by the variables from the same country as the one under consideration, which further strengthens the idea that the U.S. monetary policy has significant effects in these variables.

Another conclusion that can be extracted is that, for the majority of the bond yields, the conventional and the unconventional monetary policies have similar impacts on the variance of those yields across time, which was also suggested by the VEC model results.

Table 14 – Variance Decomposition

GER_3_MONTH

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,104	100,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
2	0,127	91,837	0,010	0,126	2,688	0,645	1,399	1,248	0,039	1,129	0,859	0,020
3	0,138	84,763	1,272	1,158	2,524	0,980	1,223	2,779	0,130	3,724	1,281	0,166
4	0,145	78,079	2,940	2,302	2,798	0,891	1,107	4,353	0,292	5,906	1,180	0,152
5	0,149	74,843	3,749	2,726	3,188	0,871	1,235	4,963	0,278	5,899	1,931	0,316
6	0,153	70,940	4,750	3,745	3,127	1,058	1,769	6,076	0,644	5,601	1,979	0,311
7	0,159	65,548	5,463	4,182	3,055	1,860	1,988	8,009	0,749	5,196	2,928	1,023
8	0,163	63,871	5,604	4,263	3,841	1,859	1,907	8,905	0,719	5,107	2,831	1,094
9	0,166	62,856	5,439	4,238	5,012	1,786	1,840	9,041	0,736	5,262	2,731	1,058
10	0,169	61,461	5,623	4,274	5,128	1,845	1,779	9,899	0,719	5,393	2,666	1,215

GER_10_YEAR

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,112	2,210	97,790	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
2	0,114	2,356	95,109	0,288	0,700	0,497	0,000	0,096	0,286	0,264	0,401	0,003
3	0,117	2,296	89,935	0,276	1,180	0,631	0,876	1,317	0,318	2,592	0,416	0,161
4	0,121	2,132	85,957	0,269	2,848	0,987	1,358	1,825	0,407	2,572	1,342	0,302
5	0,128	2,610	77,148	1,179	4,027	1,248	1,231	1,794	0,380	2,577	5,087	2,719
6	0,132	2,486	72,905	1,917	4,511	1,262	3,401	1,694	0,724	2,534	5,446	3,120
7	0,134	2,486	70,610	2,086	4,381	1,222	3,319	2,244	0,766	2,650	5,677	4,560
8	0,139	2,463	66,646	2,164	5,606	1,747	3,824	2,120	0,771	2,648	5,379	6,632
9	0,140	2,868	65,763	2,144	5,620	1,732	3,913	2,655	0,769	2,619	5,365	6,551
10	0,141	3,868	64,404	2,122	5,538	1,718	3,884	2,772	0,807	2,935	5,361	6,590

DAX

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,045	0,019	0,013	99,968	0,000	0,000	0,000	0,000	0,000	0,000	0,000	0,000
2	0,046	0,278	0,091	95,483	0,087	0,187	1,525	0,891	0,299	0,059	1,059	0,041
3	0,047	0,683	0,117	93,254	0,094	0,254	1,606	1,154	1,569	0,065	1,041	0,162
4	0,049	5,171	0,131	85,905	0,915	0,259	1,494	1,080	1,488	0,531	0,957	2,070
5	0,050	4,984	0,286	81,743	0,934	2,269	1,452	2,318	2,049	0,729	1,250	1,986
6	0,051	4,918	0,637	78,350	0,894	4,107	1,389	2,885	2,012	1,265	1,621	1,923
7	0,052	4,882	1,765	76,156	0,890	3,970	1,342	2,793	1,996	1,823	2,526	1,857
8	0,054	4,860	1,830	72,170	2,757	3,757	2,670	2,771	2,234	1,742	3,171	2,038
9	0,054	4,876	1,904	71,687	2,792	3,731	2,751	2,894	2,232	1,773	3,181	2,179
10	0,054	4,819	2,033	70,799	3,086	3,810	2,839	3,007	2,230	1,894	3,140	2,342

UK_3_MONTH

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,155	50,993	0,219	0,007	48,781	0,000	0,000	0,000	0,000	0,000	0,000	0,000
2	0,179	45,441	0,221	0,690	46,635	1,839	1,346	0,645	0,137	1,808	1,060	0,178
3	0,191	42,849	1,775	0,661	41,338	2,097	1,496	3,638	0,171	4,637	0,985	0,353
4	0,200	39,253	2,201	0,618	39,572	1,954	1,557	6,610	0,380	5,550	1,974	0,332
5	0,207	36,931	2,294	0,738	39,009	1,853	1,751	8,357	1,022	5,572	2,164	0,310
6	0,213	34,955	2,510	1,302	38,108	1,809	1,837	9,967	1,044	5,792	2,378	0,297
7	0,219	33,968	2,770	1,262	37,087	2,372	1,738	10,708	1,010	5,513	2,965	0,608
8	0,224	33,631	2,844	1,309	37,210	2,308	1,684	10,951	0,965	5,504	2,866	0,728
9	0,228	33,111	2,756	1,268	37,116	2,320	1,703	10,996	0,943	5,938	3,012	0,837
10	0,233	32,425	2,852	1,260	36,282	2,492	1,638	11,578	1,127	6,372	3,031	0,942

UK_10_YEAR

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,135	1,463	32,828	3,418	1,814	60,476	0,000	0,000	0,000	0,000	0,000	0,000
2	0,146	2,568	28,203	4,229	7,084	54,056	0,229	0,923	0,080	0,048	0,008	2,571
3	0,154	2,511	25,910	3,920	6,687	49,081	2,362	5,632	0,699	0,845	0,015	2,338
4	0,155	2,547	26,257	3,985	6,682	48,381	2,440	5,757	0,686	0,909	0,031	2,324
5	0,158	2,725	25,430	3,890	6,461	46,890	2,382	7,370	0,676	0,923	0,973	2,280
6	0,162	2,628	24,313	4,859	6,310	44,811	2,760	7,062	1,358	1,004	2,716	2,179
7	0,163	2,691	23,831	5,026	6,286	43,915	2,774	7,357	1,580	1,341	2,775	2,425
8	0,166	2,617	23,538	4,881	7,898	42,663	2,717	7,155	1,837	1,528	2,796	2,371
9	0,167	2,809	23,235	4,838	8,154	42,114	2,764	7,068	2,263	1,568	2,762	2,426
10	0,167	2,924	23,076	4,812	8,119	41,866	2,787	7,030	2,559	1,573	2,801	2,450

FTSE_100

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,031	0,008	0,028	27,062	0,810	2,140	69,952	0,000	0,000	0,000	0,000	0,000
2	0,034	0,263	0,133	26,281	2,096	1,836	63,005	5,786	0,015	0,536	0,042	0,008
3	0,034	0,975	0,272	26,156	2,148	1,805	62,081	5,701	0,023	0,729	0,064	0,045
4	0,035	2,703	0,501	25,175	2,346	1,983	58,846	5,371	0,063	0,699	0,217	2,097
5	0,036	3,081	0,531	24,705	2,262	2,953	57,596	5,157	0,068	1,000	0,610	2,037
6	0,037	3,464	0,589	23,729	2,798	4,080	55,235	5,042	1,438	1,047	0,625	1,952
7	0,037	3,617	0,579	23,287	2,768	4,814	54,133	4,942	2,101	1,159	0,681	1,918
8	0,038	3,520	0,693	22,612	3,413	4,680	52,477	5,151	2,036	1,370	2,153	1,894
9	0,038	4,042	0,956	22,333	3,397	4,623	51,860	5,192	2,193	1,357	2,126	1,922
10	0,038	4,124	0,953	22,221	3,374	4,646	51,465	5,240	2,209	1,599	2,259	1,910

JAP_3_MONTH:

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,052	1,906	1,809	0,497	1,265	0,185	0,375	93,964	0,000	0,000	0,000	0,000
2	0,055	1,990	2,046	1,076	1,748	0,605	0,356	85,513	2,797	0,086	3,703	0,080
3	0,060	5,837	2,209	0,935	5,367	1,491	3,082	72,970	2,604	1,706	3,727	0,070
4	0,061	5,596	2,197	0,902	5,711	1,479	3,010	70,390	3,201	1,995	5,300	0,219
5	0,063	5,687	2,167	1,468	5,445	1,422	3,883	67,594	3,345	1,899	6,880	0,209
6	0,064	6,366	2,572	1,453	5,302	1,445	3,843	66,203	3,369	2,395	6,700	0,352
7	0,065	7,105	2,503	1,625	5,665	1,405	4,435	64,211	3,468	2,325	6,517	0,741
8	0,066	6,887	2,568	1,574	6,193	1,793	4,295	63,613	3,364	2,318	6,571	0,824
9	0,066	6,840	2,545	1,578	6,185	1,784	4,277	63,293	3,600	2,304	6,592	1,002
10	0,067	6,781	2,976	1,665	6,134	2,003	4,427	62,517	3,540	2,266	6,503	1,189

JAP_10_YEAR

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,109	0,831	4,292	0,331	0,470	0,478	1,256	3,589	88,753	0,000	0,000	0,000
2	0,111	1,078	4,268	1,450	0,465	0,732	1,294	3,702	85,557	0,338	0,937	0,178
3	0,117	4,805	4,009	1,928	0,489	0,688	4,470	3,370	77,149	0,428	1,493	1,171
4	0,121	4,670	3,950	3,329	0,493	1,028	5,118	3,898	73,870	1,028	1,447	1,168
5	0,124	4,397	3,719	3,130	1,593	1,026	5,310	3,676	72,468	1,759	1,817	1,103
6	0,125	4,657	3,666	3,320	1,630	1,223	5,271	4,054	71,300	1,761	1,792	1,327
7	0,129	4,482	3,749	4,090	2,111	1,498	5,181	3,884	69,219	2,263	1,725	1,796
8	0,130	4,654	3,669	4,196	2,229	1,559	5,144	4,762	67,939	2,342	1,709	1,798
9	0,132	4,556	3,847	4,164	2,556	2,078	4,995	4,724	65,988	2,678	1,925	2,489
10	0,133	4,534	3,801	4,108	2,983	2,078	5,453	4,696	65,138	2,641	2,103	2,466

NIKKEI_225

Period	S.E.	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONVENTIONAL	UNCONVENTIONAL
1	0,046	1,021	0,476	14,437	1,221	1,678	0,680	0,001	9,236	71,250	0,000	0,000
2	0,047	1,050	1,013	15,988	1,168	1,604	0,657	0,226	9,308	68,103	0,000	0,884
3	0,048	0,996	1,507	15,174	1,109	1,524	0,702	0,474	9,183	65,177	0,027	4,128
4	0,050	1,109	2,246	14,140	2,790	1,420	0,764	1,182	10,188	60,784	1,012	4,363
5	0,051	1,553	2,115	15,234	2,625	2,916	1,417	2,125	9,588	57,187	1,128	4,111
6	0,053	1,502	2,014	15,037	5,083	3,121	1,377	2,909	9,268	54,615	1,105	3,970
7	0,054	1,467	2,198	14,567	5,237	3,079	2,281	2,822	8,972	53,068	1,687	4,621
8	0,054	2,075	2,144	14,362	5,116	3,037	3,393	3,158	8,808	51,714	1,670	4,523
9	0,055	2,336	2,292	14,241	5,047	2,999	3,351	3,246	8,826	51,022	2,061	4,580
10	0,055	2,358	2,296	14,276	5,082	3,017	3,341	3,235	8,863	50,816	2,106	4,609

Note: This table represents the variance decomposition of each endogenous variable for the model of the group Germany/UK/Japan. The analysis is performed for an interval of 10 months. The Cholesky decomposition was used to factorize the data and the standard errors (S.E.) for each period were obtained through Monte Carlo simulation.

5. Discussion

Having analyzed in detail the three models, it becomes relevant to extract more general conclusions about the monetary policies and their impact. The analysis of the dummy variable, which represents the distinction between the conventional and the unconventional monetary policies, revealed consistent results across the majority of the countries in regards to the 3 month yields and the stock markets. Specifically, while there was no significant differentiation observed between the two policies regarding the 3 month yields, distinctions emerged when examining the stock markets (the only exception to this was Mexico). As for the 10 year yields, the results were less uniform. While the UK, Japan and Mexico showed no differentiation between the policies, Germany and Australia exhibited the opposite. There are a few possible explanations for this, which would require a deeper analysis of the individual situation of each country: macroeconomic conditions - different countries may have distinct macroeconomic conditions, including inflation rates, interest rates, exchange rates, and overall economic growth; economic and financial environment - each country has its unique economic and financial characteristics, such as the structure of its markets, regulatory environment, monetary policy framework and level of integration with global financial markets; policy responses: countries may respond differently to changes in the U.S. monetary policy through their own domestic policy actions. On top of that, long-term interest rates, such as the 10 year yields are influenced by a wide range of factors beyond just monetary policy, which make them harder to control for central banks. These factors may include market expectations, inflation outlook and fiscal policies.

With that said, it is also important to understand what type of outcomes the policies produced. Overall, the effects exhibited in the models are in line with the findings of previous research. Regarding bond yields, the conventional and the unconventional monetary policies had similar impacts in the short-end and in the long-end of the curve. Except for the 10 year Japanese yield, which saw a negative impact during the unconventional monetary policies, all of the other bond yields showed a positive relationship with the U.S. monetary policy. In order to understand why Japan's 10 year yield reacts differently to U.S. unconventional monetary policy when compared to the other countries, it is important to consider Japan's domestic monetary policy. Since the financial crisis, Japan has been implementing what is called as yield curve control (YCC) with the intent of managing and controlling the yield curve of Japanese bonds (JGBs). Essentially, the Bank of Japan tries to provide stability and predictability to financial markets, by setting target levels for these JGBs, with a special focus on the 10 year bonds. With that said, this type of framework might be the reason why the 10 year Japanese yield has an opposing reaction to the US unconventional monetary policy.

This relationship between bond yields and monetary policies is also observed domestically and represents an illustration of two of the major transmission channels through which the U.S. monetary policy is spread: the interest rate transmission channel – changes in the interest rates, particularly the short-term rates, influence the yields and pricing of bonds; the portfolio balance channel – unconventional policies such as QE impact the bond market by altering investors' portfolio allocation. Domestically, these transmission channels were documented by several studies like D'Amico et al. (2012) and Liu et al. (2017). As for the spillovers to international markets, Neely (2015) found that QE in the U.S. significantly reduced the yield on the 10 year government bonds of other developed economies by between 20 to 80 bps. Another study, Curcuru et al. (2018) analyzed the impact of the U.S. monetary policy on foreign yields in the post 2008 crisis period and found that interest rate and balance sheet monetary policies had similar spillover effects. Also, Gilchrist et al. (2019) suggests that an expansionary U.S. monetary policy tends to steepen the foreign yield curve during the conventional policy and flattens the curve during the unconventional period. As for the magnitude of the impact, the study indicates that the two policies produce roughly comparable effects.

As for the impact on foreign stock markets, Kishor et al. (2013) results show that the responses of the global equity markets to U.S. monetary policy varied substantially in the pre and the post 2007-2008 financial crisis eras. The expected response is that an unanticipated interest rate cut leads to an increase in stock returns. However, as the study indicates, that was not the case during the financial crisis. In fact, unanticipated interest rate cuts led to negative responses from international stock markets. This is corroborated by Kontonikas et al. (2013), a study that suggests that a structural shift took place during the financial crisis, which changed the stock market's reaction to shocks in the Fed funds rate. These studies highlight the severity of the 2007-2008 financial turmoil and how ineffective the conventional monetary policy became when the nominal interest rates were close to the zero lower bound. As for the results of the models in this dissertation, they suggest that the conventional policy had an early positive relationship with the stock markets' returns, which might seem counterintuitive. However, the findings from Kontonikas et al. (2013) and Kishor et al. (2013) are a plausible explanation to this, since the period considered for the conventional policy in this dissertation includes years before and after the financial crisis. To get a better understanding of the impact of conventional policy, another model could have been made where the conventional period was divided in two and instead of studying two monetary policies, the model would include three monetary policies – the conventional policy before the financial crisis, the conventional policy after the financial crisis and the unconventional policy.

Other papers, like Ferreira and Serra (2019) and Lubys and Panda (2020) explored the specific effects of the unconventional monetary policies from different central banks, including the Fed, and found that the introduction of measures such as QE leads to an increase in stock prices as investors anticipate higher corporate profits and economic growth, which is in line with the results found in this dissertation.

6. Conclusion

The 2007-2008 financial crisis spurred central banks throughout the world to implement unconventional monetary policies due to the limitations of conventional policy instruments. These conventional tools, which essentially involve adjusting interest rates were insufficient to confront the severity of the economic downturn and the possibility of deflation. As so, other measures had to be implemented by central banks to provide additional monetary stimulus and stabilize financial markets.

This dissertation sought to enhance the understanding of the impact of conventional and unconventional monetary policies from the U.S. Federal Reserve on international financial markets, by investigating the spillover effects of such policies in other countries. As so, monthly data for the period from January 1997 to January 2020 was collected regarding the 3 month and the 10 year government bond yields of Japan, Germany, United Kingdom, Australia and Mexico, as well as, stock indexes that serve as benchmark for each country.

With that being said, the results exhibited in this dissertation are largely in line with the findings from past literature: the conventional and the unconventional policies had similar impacts on foreign bond yields. During the conventional period, an increase of 1 percentage point in the shadow rate corresponded to an increase between 4 bps to 20 bps in the 3 month yields and of 9 bps to 26 bps in the 10 year yields. As for the unconventional period, the impact was between 18 bps to 33 bps in the 3 month yields and of 19 bps to 35 bps in the 10 year yields (excluding Japan, which saw a negative impact due to its domestic monetary policy that controls the yield curve). Regarding the impact on the stock markets, the two policies exhibited different consequences. While the conventional policy showed a positive impact, explained by the structural shift in the markets provoked by the financial crisis, with the effects going from 1.7% and 3.1%, the unconventional policy exhibited a negative impact that ranged from -1% and -6.7%.

As explained in chapter 3, this dissertation had a couple of limitations: identification issues – unconventional policies, besides being much more recent than the conventional ones, are harder to evaluate and to identify. As so, in this dissertation the method used to analyze both sides of the monetary policy was a VEC model, which focuses on the cumulative effect of the monetary tools. However, there are a great number of external variables that have an impact on both bond yields and stock markets, which impact the evaluation of the relationship between monetary tools and financial markets; another limitation was identified in chapter 5 and it is related to the fact that the conventional monetary policy period includes intervals before and after the financial crisis. Prior research indicates that there was a shift in the impact of the conventional tools on financial markets due to the financial crisis. As so, and although the focus of this dissertation was to compare the conventional and the unconventional policies, the conventional side could have been divided into its pre and post financial crisis periods; lastly, the study was supposed to include 7 countries initially, but the lack of necessary data only made the analysis possible for 5 of them. With more time, this work should be extended to more countries, in order to provide a better understanding of the global implications of monetary policies on financial markets.

In terms of future research, an examination of the tools adopted by the U.S. Federal Reserve to combat the Covid-19 epidemic and their consequences on global financial markets might be pursued. Future studies might include a comparison of the influence of the unconventional monetary policy measures before and after the Covid-19 outbreak. Adding to that, the recent rise in inflation around the world and the inability of some central banks to interfere in order to stabilize the economies might cause even more economic uncertainty and could potentially lead to the central banks applying new monetary policy measures.

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Annexes

Annex A – Data Sources

Variables	Source
German bond yields	**Deutsche Bundesbank** https://www.bundesbank.de/dynamic/action/en/statistics/time-series-databases/time-series-databases/743796/743796?treeAnchor=GELD&statisticType=BBK_ITS
UK bond yields	**Bank of England** https://www.bankofengland.co.uk/boeapps/database/index.asp?Travel=NIxIRx&levels=2&XNotes=Y&A3687XNode3687.x=8&A3687XNode3687.y=5&Nodes=&SectionRequired=I&HideNums=-1&ExtraInfo=true
Japan bond yields	**IMF** https://data.imf.org/regular.aspx?key=61545855
Australian bond yields	**OECD** https://data.oecd.org/interest/short-term-interest-rates.htm
Mexican bond yields	**FRED** https://fred.stlouisFed.org/tags/series?t=mexico%3Byield
Wu & Xia shadow rate	**FRED** https://www.atlantafed.org/cqer/research/wu-xia-shadow-federal-funds-rate?panel=2
Stock Indexes	**Refinitiv Workspace**

Annex B – ADF Unit Root Test

Variables		Level	Order of Integration
Description	**Label**	**Probability value**	
Australian 3 month Yield	Aus_3_month	0.0000	I(0)
Australian 10 year Yield	Aus_10_year	0.0000	I(0)
German 3 month Yield	Ger_3_month	0.0000	I(0)
German 10 year Yield	Ger_10_year	0.0000	I(0)
UK 3 month Yield	UK_3_month	0.0000	I(0)
UK 10 year Yield	UK_10_year	0.0000	I(0)
Japan 3 month Yield	Jap_3_month	0.0000	I(0)
Japan 10 year Yield	Jap_10_year	0.0000	I(0)
Mexico 3 month Yield	Mex_3_month	0.0000	I(0)
Mexico 10 year Yield	Mex_10_year	0.0000	I(0)
US 10 year Yield	US_10_year	0.0000	I(0)
VIX index	VIX	0.0000	I(0)
DAX index	DAX	0.0000	I(0)
FTSE_100 index	FTSE	0.0000	I(0)
NIKKEI_225 index	NIKKEI	0.0000	I(0)
S&P_BMV	S&P_Mex	0.0000	I(0)
S&P_ASX	S&P_Aust	0.0000	I(0)
US shadow rate	Shadow_rate	0.0000	I(0)

Annex C – Granger Causality test – endogenous variables

Dependent variable: D(S_P_ASX_200_AUSTR)	Prob.	Granger-Cause
D(_10_YEAR_AUSTRALIA)	0.0021	Yes
D(_3_MONTH_AUSTRALIA)	0.9862	No
D(S_P_BMV_IPC_MEXICO)	0.0006	Yes
D(_3_MONTH_MEXICO)	0.5833	No
D(MEXICO_10_YEAR)	0.4838	No
D(DAX)	0.3781	No
D(GER_10_YEAR)	0.5820	No
D(GER_3_MONTH)	0.1063	No
D(JAP_10_YEAR)	0.0163	Yes
D(JAP_3_MONTH)	0.4952	No
D(NIKKEI_225)	0.4871	No
D(UK_10_YEAR)	0.0491	Yes
D(UK_3_MONTH)	0.3813	No
D(FTSE_100)	0.5832	No

Dependent variable: D(10_YEAR_AUSTRALIA)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.0481	Yes
D(_3_MONTH_AUSTRALIA)	0.7167	No
D(S_P_BMV_IPC_MEXICO)	0.0959	No
D(_3_MONTH_MEXICO)	0.0155	Yes
D(MEXICO_10_YEAR)	0.2371	No
D(DAX)	0.0342	Yes
D(GER_10_YEAR)	0.0911	No
D(GER_3_MONTH)	0.4100	No
D(JAP_10_YEAR)	0.0116	Yes
D(JAP_3_MONTH)	0.5872	No
D(NIKKEI_225)	0.6928	No
D(UK_10_YEAR)	0.6932	No
D(UK_3_MONTH)	0.5889	No
D(FTSE_100)	0.0084	Yes

Dependent variable: D(3_MONTH_AUSTRALIA)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.9710	No
D(_10_YEAR_AUSTRALIA)	0.0400	Yes
D(S_P_BMV_IPC_MEXICO)	0.3370	No
D(_3_MONTH_MEXICO)	0.7086	No
D(MEXICO_10_YEAR)	0.3085	No
D(DAX)	0.0878	No
D(GER_10_YEAR)	0.5602	No
D(GER_3_MONTH)	0.2120	No

D(JAP_10_YEAR)	0.1603	No
D(JAP_3_MONTH)	0.4044	No
D(NIKKEI_225)	0.6419	No
D(UK_10_YEAR)	0.6204	No
D(UK_3_MONTH)	0.0244	Yes
D(FTSE_100)	0.4846	No

Dependent variable: D(S_P_BMV_IPC_MEXICO)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.6109	No
D(_10_YEAR_AUSTRALIA)	0.0725	No
D(_3_MONTH_AUSTRALIA)	0.2519	No
D(_3_MONTH_MEXICO)	0.0002	Yes
D(MEXICO_10_YEAR)	0.1584	No
D(DAX)	0.4505	No
D(GER_10_YEAR)	0.5920	No
D(GER_3_MONTH)	0.2827	No
D(JAP_10_YEAR)	0.0310	Yes
D(JAP_3_MONTH)	0.4265	No
D(NIKKEI_225)	0.5767	No
D(UK_10_YEAR)	0.9360	No
D(UK_3_MONTH)	0.4685	No
D(FTSE_100)	0.0331	Yes

Dependent variable: D(3_MONTH_MEXICO)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.2937	No
D(_10_YEAR_AUSTRALIA)	0.5324	No
D(_3_MONTH_AUSTRALIA)	0.1099	No
D(S_P_BMV_IPC_MEXICO)	0.0094	Yes
D(MEXICO_10_YEAR)	0.0118	Yes
D(DAX)	0.9733	No
D(GER_10_YEAR)	0.0203	Yes
D(GER_3_MONTH)	0.7767	No
D(JAP_10_YEAR)	0.0000	Yes
D(JAP_3_MONTH)	0.2785	No
D(NIKKEI_225)	0.4634	No
D(UK_10_YEAR)	0.1981	No
D(UK_3_MONTH)	0.6225	No
D(FTSE_100)	0.2007	No

Dependent variable: D(MEXICO_10_YEAR)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.1075	No
D(_10_YEAR_AUSTRALIA)	0.8406	No
D(_3_MONTH_AUSTRALIA)	0.0632	Yes
D(S_P_BMV_IPC_MEXICO)	0.9373	Yes
D(_3_MONTH_MEXICO)	0.0000	Yes
D(DAX)	0.6090	No
D(GER_10_YEAR)	0.2579	No
D(GER_3_MONTH)	0.0211	Yes
D(JAP_10_YEAR)	0.4627	No
D(JAP_3_MONTH)	0.8654	No
D(NIKKEI_225)	0.8879	No
D(UK_10_YEAR)	0.7789	No
D(UK_3_MONTH)	0.0361	Yes
D(FTSE_100)	0.5475	No

Dependent variable: D(DAX)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.1966	No
D(_10_YEAR_AUSTRALIA)	0.2287	No
D(_3_MONTH_AUSTRALIA)	0.7060	No
D(S_P_BMV_IPC_MEXICO)	0.0134	Yes
D(_3_MONTH_MEXICO)	0.0901	No
D(MEXICO_10_YEAR)	0.2686	No
D(GER_10_YEAR)	0.0016	Yes
D(GER_3_MONTH)	0.2140	No
D(JAP_10_YEAR)	0.0013	Yes
D(JAP_3_MONTH)	0.1648	No
D(NIKKEI_225)	0.0147	Yes
D(UK_10_YEAR)	0.0498	Yes
D(UK_3_MONTH)	0.6232	No
D(FTSE_100)	0.0026	Yes

Dependent variable: D(GER_10_YEAR)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.1720	No
D(_10_YEAR_AUSTRALIA)	0.0885	No
D(_3_MONTH_AUSTRALIA)	0.6175	No
D(S_P_BMV_IPC_MEXICO)	0.0015	Yes
D(_3_MONTH_MEXICO)	0.3171	No
D(MEXICO_10_YEAR)	0.1383	No
D(DAX)	0.0068	Yes
D(GER_3_MONTH)	0.8535	No
D(JAP_10_YEAR)	0.0100	Yes
D(JAP_3_MONTH)	0.0007	Yes

D(NIKKEI_225)	0.8244	No
D(UK_10_YEAR)	0.0409	Yes
D(UK_3_MONTH)	0.1554	No
D(FTSE_100)	0.0203	Yes

Dependent variable: D(GER_3_MONTH)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.1281	No
D(_10_YEAR_AUSTRALIA)	0.8894	No
D(_3_MONTH_AUSTRALIA)	0.1143	No
D(S_P_BMV_IPC_MEXICO)	0.1787	No
D(_3_MONTH_MEXICO)	0.2291	No
D(MEXICO_10_YEAR)	0.0330	Yes
D(DAX)	0.4598	No
D(GER_10_YEAR)	0.1713	Yes
D(JAP_10_YEAR)	0.0253	Yes
D(JAP_3_MONTH)	0.8668	No
D(NIKKEI_225)	0.2212	No
D(UK_10_YEAR)	0.7938	No
D(UK_3_MONTH)	0.0003	Yes
D(FTSE_100)	0.0166	Yes

Dependent variable: D(JAP_10_YEAR)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.7306	No
D(_10_YEAR_AUSTRALIA)	0.2109	No
D(_3_MONTH_AUSTRALIA)	0.7648	No
D(S_P_BMV_IPC_MEXICO)	0.8526	No
D(_3_MONTH_MEXICO)	0.0518	No
D(MEXICO_10_YEAR)	0.1983	No
D(DAX)	0.6709	No
D(GER_10_YEAR)	0.5589	No
D(GER_3_MONTH)	0.6473	No
D(JAP_3_MONTH)	0.9261	No
D(NIKKEI_225)	0.7709	No
D(UK_10_YEAR)	0.4609	No
D(UK_3_MONTH)	0.5771	No
D(FTSE_100)	0.9521	No

Dependent variable: D(JAP_3_MONTH)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.3251	No
D(_10_YEAR_AUSTRALIA)	0.7238	No
D(_3_MONTH_AUSTRALIA)	0.6920	No
D(S_P_BMV_IPC_MEXICO)	0.8587	No

D(_3_MONTH_MEXICO)	0.8744	No
D(MEXICO_10_YEAR)	0.8594	No
D(DAX)	0.5863	No
D(GER_10_YEAR)	0.5801	No
D(GER_3_MONTH)	0.5350	No
D(JAP_10_YEAR)	0.1132	No
D(NIKKEI_225)	0.7676	No
D(UK_10_YEAR)	0.6653	No
D(UK_3_MONTH)	0.0938	No
D(FTSE_100)	0.2524	No

Dependent variable: D(NIKKEI_225)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.4942	No
D(_10_YEAR_AUSTRALIA)	0.3088	No
D(_3_MONTH_AUSTRALIA)	0.2290	No
D(S_P_BMV_IPC_MEXICO)	0.8901	No
D(_3_MONTH_MEXICO)	0.0960	No
D(MEXICO_10_YEAR)	0.0495	Yes
D(DAX)	0.0355	Yes
D(GER_10_YEAR)	0.0020	Yes
D(GER_3_MONTH)	0.1270	No
D(JAP_10_YEAR)	0.2906	No
D(JAP_3_MONTH)	0.5538	No
D(UK_10_YEAR)	0.0429	Yes
D(UK_3_MONTH)	0.8784	No
D(FTSE_100)	0.0381	Yes

Dependent variable: D(UK_10_YEAR)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.8736	No
D(_10_YEAR_AUSTRALIA)	0.0357	Yes
D(_3_MONTH_AUSTRALIA)	0.4062	No
D(S_P_BMV_IPC_MEXICO)	0.0905	No
D(_3_MONTH_MEXICO)	0.2873	No
D(MEXICO_10_YEAR)	0.0000	Yes
D(DAX)	0.9883	No
D(GER_10_YEAR)	0.0005	Yes
D(GER_3_MONTH)	0.0364	Yes
D(JAP_10_YEAR)	0.0194	Yes
D(JAP_3_MONTH)	0.0008	Yes
D(NIKKEI_225)	0.6457	No
D(UK_3_MONTH)	0.0010	Yes
D(FTSE_100)	0.0237	Yes

Dependent variable: D(UK_3_MONTH)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.6339	No
D(_10_YEAR_AUSTRALIA)	0.7081	No
D(_3_MONTH_AUSTRALIA)	0.0005	Yes
D(S_P_BMV_IPC_MEXICO)	0.4549	No
D(_3_MONTH_MEXICO)	0.1613	No
D(MEXICO_10_YEAR)	0.4206	No
D(DAX)	0.5298	No
D(GER_10_YEAR)	0.7134	No
D(GER_3_MONTH)	0.0092	Yes
D(JAP_10_YEAR)	0.0337	Yes
D(JAP_3_MONTH)	0.7936	No
D(NIKKEI_225)	0.5419	No
D(UK_10_YEAR)	0.7853	No
D(FTSE_100)	0.0297	Yes

Dependent variable: D(FTSE_100)	Prob.	Granger-Cause
D(S_P_ASX_200_AUSTR)	0.3484	No
D(_10_YEAR_AUSTRALIA)	0.9971	No
D(_3_MONTH_AUSTRALIA)	0.9990	No
D(S_P_BMV_IPC_MEXICO)	0.0460	Yes
D(_3_MONTH_MEXICO)	0.6089	No
D(MEXICO_10_YEAR)	0.1471	No
D(DAX)	0.0160	Yes
D(GER_10_YEAR)	0.0324	Yes
D(GER_3_MONTH)	0.0557	No
D(JAP_10_YEAR)	0.0857	No
D(JAP_3_MONTH)	0.4773	No
D(NIKKEI_225)	0.0431	Yes
D(UK_10_YEAR)	0.0082	Yes
D(UK_3_MONTH)	0.1991	No

Annex D – Granger Causality test – shadow rate

Variables	Prob.
CONVENTIONAL_POLICY does Granger Cause S_P_ASX_200_AUSTR	**0.0327**
S_P_ASX_200_AUSTR does not Granger Cause CONVENTIONAL_POLICY	0.2002
UNCONVENTIONAL_POLICY does not Granger Cause S_P_ASX_200_AUSTR	0.7241
S_P_ASX_200_AUSTR does not Granger Cause UNCONVENTIONAL_POLICY	0.2277
CONVENTIONAL_POLICY does not Granger Cause _10_YEAR_AUSTRALIA	0.2515
_10_YEAR_AUSTRALIA does not Granger Cause CONVENTIONAL_POLICY	0.4389
UNCONVENTIONAL_POLICY does not Granger Cause _10_YEAR_AUSTRALIA	0.4228
_10_YEAR_AUSTRALIA does not Granger Cause UNCONVENTIONAL_POLICY	0.9074
CONVENTIONAL_POLICY does Granger Cause _3_MONTH_AUSTRALIA	**0.0016**
_3_MONTH_AUSTRALIA does not Granger Cause CONVENTIONAL_POLICY	0.1172
UNCONVENTIONAL_POLICY does not Granger Cause _3_MONTH_AUSTRALIA	0.9887
_3_MONTH_AUSTRALIA does not Granger Cause UNCONVENTIONAL_POLICY	0.1245

CONVENTIONAL_POLICY does not Granger Cause S_P_BMV_IPC_MEXICO	0.1123
S_P_BMV_IPC_MEXICO does Granger Cause CONVENTIONAL_POLICY	**0.0339**
UNCONVENTIONAL_POLICY does not Granger Cause S_P_BMV_IPC_MEXICO	0.7167
S_P_BMV_IPC_MEXICO does not Granger Cause UNCONVENTIONAL_POLICY	0.2681
CONVENTIONAL_POLICY does not Granger Cause _3_MONTH_MEXICO	0.6453
_3_MONTH_MEXICO does not Granger Cause CONVENTIONAL_POLICY	0.4493
UNCONVENTIONAL_POLICY does not Granger Cause _3_MONTH_MEXICO	1.0000
_3_MONTH_MEXICO does not Granger Cause UNCONVENTIONAL_POLICY	1.0000
CONVENTIONAL_POLICY does Granger Cause MEXICO_10_YEAR	**0.0186**
MEXICO_10_YEAR does not Granger Cause CONVENTIONAL_POLICY	0.5500

UNCONVENTIONAL_POLICY does not Granger Cause MEXICO_10_YEAR	0.7267
MEXICO_10_YEAR does not Granger Cause UNCONVENTIONAL_POLICY	0.6445

CONVENTIONAL_POLICY does Granger Cause DAX	**0.0209**
DAX does Granger Cause CONVENTIONAL_POLICY	**0.0286**
UNCONVENTIONAL_POLICY does not Granger Cause DAX	0.8986
DAX does not Granger Cause UNCONVENTIONAL_POLICY	0.7445
CONVENTIONAL_POLICY does not Granger Cause GER_10_YEAR	**0.0089**
GER_10_YEAR does not Granger Cause CONVENTIONAL_POLICY	**0.0341**
UNCONVENTIONAL_POLICY does Granger Cause GER_10_YEAR	**1.E-05**
GER_10_YEAR does not Granger Cause UNCONVENTIONAL_POLICY	0.6324
CONVENTIONAL_POLICY does not Granger Cause GER_3_MONTH	0.4050
GER_3_MONTH does not Granger Cause CONVENTIONAL_POLICY	0.2841
UNCONVENTIONAL_POLICY does not Granger Cause GER_3_MONTH	0.2354
GER_3_MONTH does Granger Cause UNCONVENTIONAL_POLICY	**0.0107**

CONVENTIONAL_POLICY does Granger Cause JAP_10_YEAR	**0.0031**
JAP_10_YEAR does Granger Cause CONVENTIONAL_POLICY	**0.0062**
UNCONVENTIONAL_POLICY does not Granger Cause JAP_10_YEAR	0.9461
JAP_10_YEAR does not Granger Cause UNCONVENTIONAL_POLICY	0.9212
CONVENTIONAL_POLICY does Granger Cause JAP_3_MONTH	**4.E-07**
JAP_3_MONTH does not Granger Cause CONVENTIONAL_POLICY	0.4986
UNCONVENTIONAL_POLICY does not Granger Cause JAP_3_MONTH	0.9952
JAP_3_MONTH does not Granger Cause UNCONVENTIONAL_POLICY	0.9671
CONVENTIONAL_POLICY does not Granger Cause NIKKEI_225	0.1598
NIKKEI_225 does not Granger Cause CONVENTIONAL_POLICY	0.0765

UNCONVENTIONAL_POLICY does not Granger Cause NIKKEI_225	0.8215
NIKKEI_225 does not Granger Cause UNCONVENTIONAL_POLICY	0.0617

CONVENTIONAL_POLICY does not Granger Cause UK_10_YEAR	0.7015
UK_10_YEAR does not Granger Cause CONVENTIONAL_POLICY	0.1884
UNCONVENTIONAL_POLICY does not Granger Cause UK_10_YEAR	0.1222
UK_10_YEAR does not Granger Cause UNCONVENTIONAL_POLICY	0.3676
CONVENTIONAL_POLICY does Granger Cause UK_3_MONTH	**0.0049**
UK_3_MONTH does not Granger Cause CONVENTIONAL_POLICY	0.1431
UNCONVENTIONAL_POLICY does not Granger Cause UK_3_MONTH	0.9124
UK_3_MONTH does Granger Cause UNCONVENTIONAL_POLICY	**6.E-10**
CONVENTIONAL_POLICY does Granger Cause FTSE_100	**0.0074**
FTSE_100 does not Granger Cause CONVENTIONAL_POLICY	0.3764
UNCONVENTIONAL_POLICY does not Granger Cause FTSE_100	0.8439
FTSE_100 does not Granger Cause UNCONVENTIONAL_POLICY	0.1310

Annex E – VEC Model for Australia – Part I

Cointegrating Eq:	CointEq1	CointEq2	
_3_MONTH_AUSTRALIA(-1)	1.000000	0.000000	
_10_YEAR_AUSTRALIA(-1)	0.000000	1.000000	
S_P_ASX_200_AUSTR(-1)	-1.534799 (2.17151)	-0.872717 (0.55784)	
C	0.123534 (0.04439)	0.014221 (0.01066)	
Error Correction:	**D(_3_MONTH_AUSTRALIA)**	**D(_10_YEAR_AUSTRALIA)**	**D(S_P_ASX_200_AUSTR)**
CointEq1	-0.123380 (0.03925)	0.038997 (0.04098)	0.049928 (0.00847)
CointEq2	0.085428 (0.10064)	-1.064812 (0.10507)	-0.033825 (0.02173)
D(_3_MONTH_AUSTRALIA(-1))	-0.430301 (0.06952)	-0.039662 (0.07258)	-0.024074 (0.01501)
D(_3_MONTH_AUSTRALIA(-2))	-0.415458 (0.07424)	0.112180 (0.07751)	-0.023713 (0.01603)
D(_3_MONTH_AUSTRALIA(-3))	-0.118089 (0.07814)	0.126952 (0.08158)	0.016641 (0.01687)
D(_3_MONTH_AUSTRALIA(-4))	-0.198428 (0.07103)	0.009872 (0.07416)	0.007692 (0.01533)
D(_3_MONTH_AUSTRALIA(-5))	-0.116902 (0.06429)	0.006475 (0.06713)	-0.008051 (0.01388)
D(_10_YEAR_AUSTRALIA(-1))	0.012763 (0.09100)	0.034711 (0.09500)	0.029125 (0.01964)
D(_10_YEAR_AUSTRALIA(-2))	0.095937 (0.07963)	0.084216 (0.08313)	0.028247 (0.01719)
D(_10_YEAR_AUSTRALIA(-3))	0.097161 (0.06750)	0.069220 (0.07047)	0.010768 (0.01457)
D(_10_YEAR_AUSTRALIA(-4))	0.083668 (0.05461)	0.024934 (0.05701)	0.011564 (0.01179)
D(_10_YEAR_AUSTRALIA(-5))	0.060714 (0.03968)	0.007946 (0.04143)	-0.000148 (0.00857)
D(S_P_ASX_200_AUSTR(-1))	-1.269554 (0.56143)	-0.629544 (0.58615)	-0.222601 (0.12120)
D(S_P_ASX_200_AUSTR(-2))	-1.051398 (0.50905)	-0.353162 (0.53146)	-0.170865 (0.10989)
D(S_P_ASX_200_AUSTR(-3))	-1.005958 (0.45535)	0.074870 (0.47540)	-0.089288 (0.09830)
D(S_P_ASX_200_AUSTR(-4))	-0.466741 (0.37570)	-0.085254 (0.39224)	-0.044828 (0.08110)
D(S_P_ASX_200_AUSTR(-5))	-0.022312 (0.26835)	-0.373865 (0.28016)	-0.010536 (0.05793)
VIX	-0.072211 (0.04366)	-0.056361 (0.04559)	-0.078631 (0.00943)
US_10_YEAR	0.026217 (0.04078)	0.755584 (0.04258)	0.023347 (0.00880)
Absolute_change_shadow_rate	0.011798 (0.04645)	-0.100350 (0.04850)	-0.005582 (0.01003)
Dummy	0.030176 (0.01838)	-0.005518 (0.01889)	0.008233 (0.00377)
R-squared	0.247994	0.781397	0.622073
Adj. R-squared	0.216422	0.772219	0.606206
Sum sq. resids	6.256551	6.609589	0.263244
S.E. equation	0.154531	0.158831	0.031698
F-statistic	7.854691	85.13813	39.20501
Log likelihood	129.0022	121.4820	563.0597
Akaike AIC	-0.854031	-0.799138	-4.022334
Schwarz SC	-0.695792	-0.640899	-3.864095
Mean dependent	-0.000547	-0.002664	8.35E-05
S.D. dependent	0.174572	0.332796	0.050512
Determinant resid covariance (dof adj.)		4.72E-07	
Determinant resid covariance		3.71E-07	
Log likelihood		852.9097	
Akaike information criterion		-5.785311	
Schwarz criterion		-4.868167	
Number of coefficients		71	

Note: Numbers in ( ) are the standard errors.

Annex F – VEC Model for Australia – Part II

Cointegrating Eq:	CointEq1	CointEq2
_3_MONTH_AUSTRALIA(-1)	1.000000	0.000000
_10_YEAR_AUSTRALIA(-1)	0.000000	1.000000
S_P_ASX_200_AUSTR(-1)	-1.66307 (1.68676)	0.107500 (0.55896)
C	0.089863 (0.03078)	0.012232 (0.00913)

Error Correction:	D(_3_MONTH_AUSTRALIA)	D(_10_YEAR_AUSTRALIA)	D(S_P_ASX_200_AUSTR)
CointEq1	-0.207526 (0.05122)	-0.027009 (0.05413)	0.055263 (0.01127)
CointEq2	0.058044 (0.09299)	-1.013552 (0.09827)	-0.055964 (0.02046)
D(_3_MONTH_AUSTRALIA(-1))	-0.376659 (0.07313)	0.008820 (0.07729)	-0.030648 (0.01609)
D(_3_MONTH_AUSTRALIA(-2))	-0.334571 (0.07554)	0.134877 (0.07984)	-0.016122 (0.01662)
D(_3_MONTH_AUSTRALIA(-3))	-0.076216 (0.07827)	0.151808 (0.08272)	0.015645 (0.01722)
D(_3_MONTH_AUSTRALIA(-4))	-0.162516 (0.07068)	0.027331 (0.07470)	0.008402 (0.01555)
D(_3_MONTH_AUSTRALIA(-5))	-0.110881 (0.06431)	0.023238 (0.06797)	-0.012864 (0.01415)
D(_10_YEAR_AUSTRALIA(-1))	0.029936 (0.08520)	-0.010378 (0.09004)	0.047249 (0.01875)
D(_10_YEAR_AUSTRALIA(-2))	0.096815 (0.07568)	0.049342 (0.07999)	0.039844 (0.01665)
D(_10_YEAR_AUSTRALIA(-3))	0.092146 (0.06495)	0.042115 (0.06864)	0.018700 (0.01429)
D(_10_YEAR_AUSTRALIA(-4))	0.078751 (0.05301)	0.005981 (0.05603)	0.016876 (0.01167)
D(_10_YEAR_AUSTRALIA(-5))	0.065568 (0.03904)	-0.004265 (0.04126)	0.004979 (0.00859)
D(S_P_ASX_200_AUSTR(-1))	-1.677891 (0.51442)	-0.498954 (0.54367)	-0.357280 (0.11320)
D(S_P_ASX_200_AUSTR(-2))	-1.378616 (0.47772)	-0.271637 (0.50489)	-0.271878 (0.10512)
D(S_P_ASX_200_AUSTR(-3))	-1.263151 (0.43452)	0.128044 (0.45923)	-0.165229 (0.09562)
D(S_P_ASX_200_AUSTR(-4))	-0.662092 (0.36389)	-0.058587 (0.38459)	-0.097747 (0.08008)
D(S_P_ASX_200_AUSTR(-5))	-0.123706 (0.26263)	-0.363742 (0.27756)	-0.037050 (0.05779)
US_10_YEAR	0.035038 (0.04091)	0.750601 (0.04324)	0.026790 (0.00900)
VIX	-0.068824 (0.04319)	-0.057849 (0.04565)	-0.077624 (0.00950)
CONVENTIONAL_POLICY	0.045529 (0.04917)	0.095883 (0.05196)	0.000807 (0.01082)
UNCONVENTIONAL_POLICY	0.156617 (0.10901)	-0.024152 (0.11521)	-0.064327 (0.02399)
R-squared	0.338538	0.798860	0.623982
Adj. R-squared	0.285621	0.782769	0.593900
Sum sq. resids	5.389820	6.020250	0.260994
S.E. equation	0.146831	0.155181	0.032311
F-statistic	6.397525	49.64571	20.74307
Log likelihood	146.3034	131.3148	556.5661
Akaike AIC	-0.924748	-0.814131	-3.952518
Schwarz SC	-0.645617	-0.535000	-3.673387
Mean dependent	0.001882	-7.38E-05	0.000171
S.D. dependent	0.173721	0.332948	0.050702

Determinant resid covariance (dof adj.)	4.65E-07
Determinant resid covariance	3.65E-07
Log likelihood	855.0449
Akaike information criterion	-5.801069
Schwarz criterion	-4.883925
Number of coefficients	69

Note: Numbers in ( ) are the standard errors.

Annex G – VEC Model for Mexico – Part I

Cointegrating Eq:	CointEq1	CointEq2	
_3_MONTH_MEXICO(-1)	1.000000	0.000000	
MEXICO_10_YEAR(-1)	0.000000	1.000000	
S_P_BMV_IPC_MEXICO(-1)	0.172818 (1.25721)	2.986414 (0.82892)	
C	-0.037689 (0.03407)	-0.033236 (0.02246)	
Error Correction:	**D(_3_MONTH_AUSTRALIA)**	**D(_10_YEAR_AUSTRALIA)**	**D(S_P_ASX_200_AUSTR)**
CointEq1	-0.854202 (0.13035)	0.064320 (0.15038)	-0.007515 (0.01933)
CointEq2	0.370884 (0.18164)	-1.167633 (0.20955)	-0.026047 (0.02694)
D(_3_MONTH_MEXICO(-1))	0.170757 (0.12196)	0.293769 (0.14070)	-0.021844 (0.01809)
D(_3_MONTH_MEXICO(-2))	0.097423 (0.11443)	0.233845 (0.13202)	-0.019477 (0.01697)
D(_3_MONTH_MEXICO(-3))	0.225287 (0.10354)	0.179655 (0.11945)	-0.031517 (0.01535)
D(_3_MONTH_MEXICO(-4))	0.241354 (0.09430)	0.110825 (0.10879)	-0.014252 (0.01398)
D(_3_MONTH_MEXICO(-5))	0.169859 (0.07936)	0.259687 (0.09156)	-0.019615 (0.01177)
D(_3_MONTH_MEXICO(-6))	0.074082 (0.06737)	0.080577 (0.07773)	-0.001117 (0.00999)
D(MEXICO_10_YEAR(-1))	-0.438553 (0.16618)	0.167574 (0.19171)	0.020641 (0.02464)
D(MEXICO_10_YEAR(-2))	-0.356815 (0.14896)	0.157320 (0.17185)	0.011499 (0.02209)
D(MEXICO_10_YEAR(-3))	-0.299848 (0.12777)	0.148004 (0.14740)	0.009834 (0.01895)
D(MEXICO_10_YEAR(-4))	-0.159133 (0.11068)	0.037814 (0.12769)	-0.002720 (0.01641)
D(MEXICO_10_YEAR(-5))	-0.102585 (0.08547)	0.047718 (0.09860)	-0.006805 (0.01267)
D(MEXICO_10_YEAR(-6))	-0.042576 (0.05955)	0.089189 (0.06870)	0.002875 (0.00883)
D(S_P_BMV_IPC_MEXICO(-1))	-0.979735 (0.63580)	3.097545 (0.73351)	-0.744829 (0.09428)
D(S_P_BMV_IPC_MEXICO(-2))	-0.291199 (0.68785)	3.089531 (0.79355)	-0.665981 (0.10200)
D(S_P_BMV_IPC_MEXICO(-3))	0.251026 (0.69178)	2.688272 (0.79809)	-0.491341 (0.10259)
D(S_P_BMV_IPC_MEXICO(-4))	0.644730 (0.66309)	1.799038 (0.76499)	-0.260787 (0.09833)
D(S_P_BMV_IPC_MEXICO(-5))	0.913290 (0.58563)	1.262388 (0.67562)	-0.251199 (0.08684)
D(S_P_BMV_IPC_MEXICO(-6))	0.170725 (0.43670)	1.142038 (0.50381)	-0.159155 (0.06476)
US_10_YEAR	-0.006334 (0.09012)	0.560849 (0.10397)	-0.002771 (0.01336)
VIX	0.109286 (0.09369)	0.326266 (0.10809)	-0.105497 (0.01389)
ABSOLUTE_CHANGE_SHADOW_FUNDS_R/	0.148520 (0.11158)	0.229724 (0.12873)	-0.002067 (0.01655)
DUMMY	-0.069441 (0.03507)	-0.039745 (0.04045)	0.001072 (0.00520)
R-squared	0.472422	0.660612	0.601507
Adj. R-squared	0.408558	0.619528	0.553268
Sum sq. resids	14.83906	19.74997	0.326320
S.E. equation	0.279464	0.322408	0.041442
F-statistic	7.397239	16.07959	12.46940
Log likelihood	-18.10058	-48.69068	390.3333
Akaike AIC	0.393463	0.679352	-3.423676
Schwarz SC	0.770956	1.056845	-3.046183
Mean dependent	0.006308	-0.000327	-0.000371
S.D. dependent	0.363388	0.522691	0.062004
Determinant resid covariance (dof adj.)		1.05E-05	
Determinant resid covariance		7.35E-06	
Log likelihood		353.9077	
Akaike information criterion		-2.559885	
Schwarz criterion		-1.301577	
Number of coefficients		80	

Note: Numbers in ( ) are the standard errors.

Annex H – VEC Model for Mexico – Part II

Cointegrating Eq:	CointEq1	CointEq2	
_3_MONTH_MEXICO(-1)	1.000000	0.000000	
MEXICO_10_YEAR(-1)	0.000000	1.000000	
S_P_BMV_IPC_MEXICO(-1)	0.057777 (1.18256)	2.600327 (0.79985)	
C	-0.001487 (0.03109)	-0.023266 (0.01936)	
Error Correction:	**D(_3_MONTH_AUSTRALIA)**	**D(_10_YEAR_AUSTRALIA)**	**D(S_P_ASX_200_AUSTR)**
CointEq1	-0.742546 (0.16389)	0.064226 (0.20539)	-0.035064 (0.02626)
CointEq2	0.203662 (0.26857)	-1.079947 (0.33659)	-0.041729 (0.04303)
D(_3_MONTH_MEXICO(-1))	0.094746 (0.15424)	0.369818 (0.19330)	0.005512 (0.02471)
D(_3_MONTH_MEXICO(-2))	0.230726 (0.14468)	0.254047 (0.18131)	-0.003214 (0.02318)
D(_3_MONTH_MEXICO(-3))	0.340197 (0.13173)	0.159554 (0.16509)	-0.012673 (0.02110)
D(_3_MONTH_MEXICO(-4))	0.159418 (0.12027)	0.188745 (0.15072)	-0.000176 (0.01927)
D(_3_MONTH_MEXICO(-5))	0.071566 (0.11084)	0.391580 (0.13891)	-0.004598 (0.01776)
D(_3_MONTH_MEXICO(-6))	0.120784 (0.10486)	0.194226 (0.13142)	0.003378 (0.01680)
D(MEXICO_10_YEAR(-1))	-0.301284 (0.25103)	0.076928 (0.31460)	0.039864 (0.04022)
D(MEXICO_10_YEAR(-2))	-0.265484 (0.22844)	0.083652 (0.28629)	0.029684 (0.03660)
D(MEXICO_10_YEAR(-3))	-0.180108 (0.21163)	0.082596 (0.26522)	0.027334 (0.03390)
D(MEXICO_10_YEAR(-4))	-0.002459 (0.19428)	-0.081984 (0.24348)	0.014417 (0.03112)
D(MEXICO_10_YEAR(-5))	0.034969 (0.17470)	-0.044112 (0.21894)	0.008768 (0.02799)
D(MEXICO_10_YEAR(-6))	-0.001733 (0.15036)	0.020474 (0.18843)	0.018172 (0.02409)
D(S_P_BMV_IPC_MEXICO(-1))	-0.775779 (0.74239)	2.810077 (0.93039)	-0.792932 (0.11893)
D(S_P_BMV_IPC_MEXICO(-2))	-0.405421 (0.79725)	3.214531 (0.99915)	-0.773137 (0.12772)
D(S_P_BMV_IPC_MEXICO(-3))	0.150059 (0.84007)	2.793886 (1.05281)	-0.618040 (0.13458)
D(S_P_BMV_IPC_MEXICO(-4))	0.589804 (0.83839)	2.066500 (1.05071)	-0.434903 (0.13431)
D(S_P_BMV_IPC_MEXICO(-5))	0.463981 (0.81303)	1.701716 (1.01892)	-0.429833 (0.13025)
D(S_P_BMV_IPC_MEXICO(-6))	-0.334237 (0.76675)	1.984052 (0.96093)	-0.371150 (0.12284)
US_10_YEAR	-0.026637 (0.08722)	0.592362 (0.10930)	-0.001000 (0.01397)
VIX	0.093824 (0.08837)	0.280471 (0.11074)	-0.100383 (0.01416)
CONVENTIONAL_POLICY	0.201474 (0.12307)	0.147353 (0.15424)	0.025093 (0.01972)
UNCONVENTIONAL_POLICY	0.205162 (0.19409)	0.351719 (0.24324)	-0.042996 (0.03109)
R-squared	0.501601	0.692890	0.647148
Adj. R-squared	0.401348	0.631115	0.576172
Sum sq. resids	11.08940	17.41729	0.284613
S.E. equation	0.252452	0.316385	0.040444
F-statistic	5.003367	11.21633	9.117831
Log likelihood	10.84025	-36.56447	395.4150
Akaike AIC	0.239617	0.691090	-3.423000
Schwarz SC	0.813407	1.264880	-2.849210
Mean dependent	0.003048	-0.001810	0.000392
S.D. dependent	0.326281	0.520919	0.062124
Determinant resid covariance (dof adj.)		7.37E-06	
Determinant resid covariance		4.19E-06	
Log likelihood		406.2351	
Akaike information criterion		-2.783192	
Schwarz criterion		-0.966190	
Number of coefficients		80	

Note: Numbers in ( ) are the standard errors.

Annex I – VEC Model for Germany/UK/Japan – Part I

Cointegrating Eq:	CointEq1	CointEq2	CointEq3	CointEq4	CointEq5	CointEq6	CointEq7	CointEq8
GER_3_MONTH(-1)	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
GER_10_YEAR(-1)	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
DAX(-1)	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
UK_3_MONTH(-1)	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000
UK_10_YEAR(-1)	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
FTSE_100(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
JAP_3_MONTH(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
JAP_10_YEAR(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
NIKKEI_225(-1)	-1.812418	-1.233983	2.956882	-2.520911	-0.720165	2.229468	-2.297219	-0.851158
	(2.34549)	(1.26238)	(0.29034)	(4.26016)	(0.48481)	(0.33718)	(0.36553)	(0.17409)
C	0.064551	0.015521	-0.001158	0.061160	0.015428	2.64E-05	0.010512	0.005970
	(0.07461)	(0.01666)	(0.00697)	(0.05469)	(0.01287)	(0.00333)	(0.01150)	(0.00485)

Error Correction:	D(GER_3_MONTH)	D(GER_10_YEAR)	D(DAX)	D(UK_3_MONTH)	D(UK_10_YEAR)	D(FTSE_100)	D(JAP_3_MONTH)	D(JAP_10_YEAR)	D(NIKKEI_225)
CointEq1	-0.273677	0.227567	0.073661	-0.151819	-0.146992	0.015771	0.214470	0.222059	0.079192
	(0.08013)	(0.08767)	(0.03539)	(0.11616)	(0.10029)	(0.02332)	(0.03897)	(0.08086)	(0.03378)
CointEq2	0.093171	-0.898421	-0.038955	-0.090714	0.427216	-0.127942	-0.060633	-0.145991	-0.121666
	(0.18464)	(0.20200)	(0.08154)	(0.26765)	(0.23108)	(0.05373)	(0.08979)	(0.18632)	(0.07784)
CointEq3	-0.826208	0.279531	-0.984742	-0.458215	-0.244449	0.261889	0.048935	-0.388354	0.018349
	(0.50364)	(0.55100)	(0.22242)	(0.73007)	(0.63034)	(0.14655)	(0.24493)	(0.50823)	(0.21232)
CointEq4	-0.003929	-0.203911	0.004528	-0.206759	0.057173	0.033402	-0.050127	-0.155928	-0.082310
	(0.06494)	(0.07104)	(0.02868)	(0.09413)	(0.08127)	(0.01890)	(0.03158)	(0.06553)	(0.02738)
CointEq5	-0.039343	0.001474	-0.051749	0.080417	-1.221610	0.001444	0.048532	0.199455	0.103507
	(0.17083)	(0.18690)	(0.07545)	(0.24764)	(0.21381)	(0.04971)	(0.08308)	(0.17239)	(0.07202)
CointEq6	0.284928	-1.157801	0.215300	-3.087289	0.045620	-0.948556	-0.008653	0.549236	-0.568086
	(0.72302)	(0.79100)	(0.31931)	(1.04808)	(0.90490)	(0.21039)	(0.35162)	(0.72960)	(0.30481)
CointEq7	-0.803558	0.326959	0.309613	1.017753	0.646228	0.058000	-1.278361	-0.532525	0.053841
	(0.34136)	(0.37345)	(0.15075)	(0.49483)	(0.42723)	(0.09933)	(0.16601)	(0.34446)	(0.14391)
D(GER_3_MONTH(-1))	-0.235859	-0.144257	0.000638	0.042188	-0.341028	0.020117	-0.205581	-0.282834	-0.088563
	(0.11157)	(0.12206)	(0.04927)	(0.16173)	(0.13964)	(0.03247)	(0.05426)	(0.11259)	(0.04704)
D(GER_3_MONTH(-2))	-0.203102	-0.003489	-0.062730	0.253379	-0.077840	0.009090	-0.192631	-0.057879	-0.050407
	(0.10929)	(0.11957)	(0.04827)	(0.15843)	(0.13679)	(0.03180)	(0.05315)	(0.11029)	(0.04608)
D(GER_3_MONTH(-3))	-0.201287	-0.120309	0.045196	-0.074920	-0.189507	0.068589	-0.111093	-0.223210	-0.074719
	(0.10508)	(0.11496)	(0.04640)	(0.15232)	(0.13151)	(0.03058)	(0.05110)	(0.10603)	(0.04430)
D(GER_3_MONTH(-4))	-0.094690	-0.075988	-0.034920	-0.059552	0.003945	0.029330	-0.090171	-0.039042	-0.038825
	(0.09118)	(0.09976)	(0.04027)	(0.13218)	(0.11412)	(0.02653)	(0.04434)	(0.09201)	(0.03844)
D(GER_10_YEAR(-1))	-0.118883	-0.118594	0.019344	0.202679	-0.251446	0.087313	0.038165	0.069569	0.076904
	(0.16212)	(0.17736)	(0.07160)	(0.23501)	(0.20290)	(0.04718)	(0.07884)	(0.16360)	(0.06835)
D(GER_10_YEAR(-2))	0.043530	-0.137350	0.067112	0.382889	-0.226085	0.079651	0.077571	0.164701	0.113464
	(0.13857)	(0.15160)	(0.06120)	(0.20087)	(0.17343)	(0.04032)	(0.06739)	(0.13983)	(0.05842)
D(GER_10_YEAR(-3))	0.081766	0.042617	0.068319	0.347129	-0.049444	0.032302	0.056346	0.083216	0.052475
	(0.10846)	(0.11865)	(0.04790)	(0.15722)	(0.13574)	(0.03156)	(0.05274)	(0.10944)	(0.04572)
D(GER_10_YEAR(-4))	0.027880	-0.055487	0.117683	0.103391	-0.090498	0.025680	0.020333	0.055313	0.071803
	(0.07328)	(0.08017)	(0.03236)	(0.10622)	(0.09171)	(0.02132)	(0.03564)	(0.07394)	(0.03089)
D(DAX(-1))	-0.881536	-0.136692	-0.084408	0.374542	-0.022300	-0.049629	0.063961	0.538536	0.111785
	(0.44839)	(0.49055)	(0.19802)	(0.64998)	(0.56118)	(0.13048)	(0.21806)	(0.45247)	(0.18903)
D(DAX(-2))	-0.758308	-0.335354	-0.113394	-0.133855	-0.459928	-0.032618	0.130036	0.880035	0.045419
	(0.37936)	(0.41503)	(0.16754)	(0.54992)	(0.47480)	(0.11039)	(0.18449)	(0.38282)	(0.15993)
D(DAX(-3))	-0.491613	-0.494160	-0.014460	-0.149170	-0.347992	0.027907	0.204193	0.555223	0.088725
	(0.29252)	(0.32003)	(0.12919)	(0.42404)	(0.36611)	(0.08512)	(0.14226)	(0.29519)	(0.12332)
D(DAX(-4))	-0.270548	-0.257443	7.02E-05	-0.124905	-0.225774	0.042429	0.117302	0.188939	0.134203
	(0.17608)	(0.19264)	(0.07776)	(0.25525)	(0.22038)	(0.05124)	(0.08563)	(0.17768)	(0.07423)
D(UK_3_MONTH(-1))	0.152242	0.249053	-0.032642	-0.276558	0.294266	-0.068336	0.034160	0.133621	0.068701
	(0.08236)	(0.09010)	(0.03637)	(0.11939)	(0.10308)	(0.02396)	(0.04005)	(0.08311)	(0.03472)
D(UK_3_MONTH(-2))	0.096579	0.052093	0.011978	-0.387035	0.123297	-0.032492	0.130381	0.173368	0.041175
	(0.08495)	(0.09294)	(0.03752)	(0.12314)	(0.10632)	(0.02472)	(0.04131)	(0.08572)	(0.03581)
D(UK_3_MONTH(-3))	0.086098	0.125779	0.011909	-0.144462	0.243628	-0.034242	0.006955	0.112173	0.093841
	(0.08232)	(0.09006)	(0.03635)	(0.11933)	(0.10303)	(0.02395)	(0.04003)	(0.08307)	(0.03470)
D(UK_3_MONTH(-4))	0.074741	0.132190	0.039792	-0.057860	-0.017210	-0.015919	0.018787	-0.036962	0.083305
	(0.06994)	(0.07651)	(0.03089)	(0.10138)	(0.08753)	(0.02035)	(0.03401)	(0.07058)	(0.02948)
D(UK_10_YEAR(-1))	0.020625	-0.046836	0.050110	-0.166032	-0.014585	0.003538	-0.047078	-0.135089	-0.060489
	(0.14969)	(0.16376)	(0.06611)	(0.21699)	(0.18735)	(0.04356)	(0.07280)	(0.15105)	(0.06311)
D(UK_10_YEAR(-2))	-0.035110	0.006476	0.013043	-0.223845	-0.035319	0.004811	-0.046096	-0.190318	-0.063160
	(0.12530)	(0.13708)	(0.05533)	(0.18163)	(0.15682)	(0.03646)	(0.06093)	(0.12644)	(0.05282)
D(UK_10_YEAR(-3))	-0.018767	-0.058041	-0.002162	-0.176502	-0.072651	0.015414	-0.020270	-0.102163	-0.031693
	(0.09556)	(0.10454)	(0.04220)	(0.13852)	(0.11960)	(0.02781)	(0.04647)	(0.09643)	(0.04029)
D(UK_10_YEAR(-4))	0.024909	0.053357	-0.064846	-0.032235	0.047877	-0.004303	-0.007828	-0.077170	-0.063874
	(0.06199)	(0.06782)	(0.02738)	(0.08986)	(0.07759)	(0.01804)	(0.03015)	(0.06256)	(0.02613)
D(FTSE_100(-1))	0.164649	1.052063	0.101948	-2.189625	-0.214037	-0.255836	0.095739	-0.332200	-0.456654
	(0.65042)	(0.71157)	(0.28724)	(0.94284)	(0.81403)	(0.18926)	(0.31631)	(0.65634)	(0.27420)
D(FTSE_100(-2))	-0.107844	1.213828	0.079617	-1.806640	0.391813	-0.297032	-0.240386	-0.820147	-0.374392
	(0.54732)	(0.59878)	(0.24171)	(0.79339)	(0.68500)	(0.15926)	(0.26617)	(0.55230)	(0.23074)
D(FTSE_100(-3))	-0.354754	0.844865	0.128071	-1.321625	0.087811	-0.279129	-0.360524	-0.689136	-0.272722
	(0.42823)	(0.46849)	(0.18912)	(0.62076)	(0.53595)	(0.12461)	(0.20826)	(0.43213)	(0.18053)
D(FTSE_100(-4))	-0.190550	0.590941	0.045572	-0.434784	0.088548	-0.138054	-0.109828	-0.058874	-0.145729
	(0.25674)	(0.28088)	(0.11338)	(0.37217)	(0.32133)	(0.07471)	(0.12486)	(0.25908)	(0.10824)
D(JAP_3_MONTH(-1))	-0.537929	-0.551038	-0.201273	-0.806638	-1.020539	0.102080	0.080248	0.621413	-0.055268
	(0.30205)	(0.33045)	(0.13339)	(0.43785)	(0.37803)	(0.08789)	(0.14689)	(0.30480)	(0.12734)
D(JAP_3_MONTH(-2))	-0.334235	-0.494157	-0.153741	-0.414899	-0.579858	0.126042	0.101511	0.625173	-0.106318
	(0.26633)	(0.29138)	(0.11762)	(0.38607)	(0.33333)	(0.07750)	(0.12952)	(0.26876)	(0.11228)
D(JAP_3_MONTH(-3))	-0.076416	-0.286005	-0.104272	-0.152673	-0.390651	0.091098	0.215704	0.404186	-0.076887
	(0.21421)	(0.23435)	(0.09460)	(0.31052)	(0.26810)	(0.06233)	(0.10417)	(0.21616)	(0.09031)
D(JAP_3_MONTH(-4))	-0.069598	-0.032376	-0.053165	0.003959	0.010371	0.040686	0.090727	0.291174	0.006615
	(0.14189)	(0.15523)	(0.06266)	(0.20569)	(0.17759)	(0.04129)	(0.06901)	(0.14318)	(0.05982)
D(JAP_10_YEAR(-1))	0.207716	0.266207	0.038439	-0.179881	0.226819	-0.126241	-0.050434	0.455167	0.027615
	(0.14786)	(0.16176)	(0.06530)	(0.21434)	(0.18506)	(0.04303)	(0.07191)	(0.14921)	(0.06234)
D(JAP_10_YEAR(-2))	0.123189	0.261314	-0.009704	-0.163968	0.322481	-0.110331	-0.058388	0.390827	-0.013589
	(0.12364)	(0.13526)	(0.05460)	(0.17923)	(0.15474)	(0.03598)	(0.06013)	(0.12476)	(0.05212)
D(JAP_10_YEAR(-3))	0.032355	0.167250	-0.029035	-0.133213	0.254821	-0.069532	-0.104124	0.203432	0.030138
	(0.09800)	(0.10722)	(0.04328)	(0.14207)	(0.12266)	(0.02852)	(0.04766)	(0.09890)	(0.04132)
D(JAP_10_YEAR(-4))	0.062477	0.077644	0.005070	0.028681	0.116314	-0.038386	-0.036289	0.061138	0.025461
	(0.06676)	(0.07303)	(0.02948)	(0.09677)	(0.08355)	(0.01942)	(0.03246)	(0.06736)	(0.02814)
D(NIKKEI_225(-1))	-0.039115	-0.867756	-0.156661	0.373537	-0.258323	0.138446	-0.079652	-0.622389	-0.011665
	(0.37998)	(0.41571)	(0.16781)	(0.55081)	(0.47556)	(0.11057)	(0.18479)	(0.38344)	(0.16019)
D(NIKKEI_225(-2))	0.243608	-0.570596	-0.114903	0.590845	0.028062	0.106243	0.004833	-0.599851	0.041427
	(0.32602)	(0.35667)	(0.14398)	(0.47259)	(0.40803)	(0.09487)	(0.15855)	(0.32898)	(0.13744)
D(NIKKEI_225(-3))	0.370635	-0.231316	-0.147345	0.381996	-0.011254	0.068939	0.016588	-0.413325	-0.016169
	(0.25709)	(0.28127)	(0.11354)	(0.37268)	(0.32177)	(0.07481)	(0.12503)	(0.25944)	(0.10838)
D(NIKKEI_225(-4))	0.157160	-0.072035	-0.135333	0.078826	0.041375	0.012051	-0.070503	-0.182304	-0.032206
	(0.16794)	(0.18373)	(0.07417)	(0.24344)	(0.21018)	(0.04887)	(0.08167)	(0.16947)	(0.07080)
VIX	-0.033425	-0.062424	-0.147630	-0.063758	-0.026811	-0.081760	-0.031218	-0.034260	-0.111602
	(0.03430)	(0.03753)	(0.01515)	(0.04972)	(0.04293)	(0.00998)	(0.01668)	(0.03461)	(0.01446)
US_10_YEAR	0.006047	0.586908	0.051189	0.013878	0.649644	0.028414	-0.026707	0.168889	0.046423
	(0.03304)	(0.03615)	(0.01459)	(0.04789)	(0.04135)	(0.00961)	(0.01607)	(0.03334)	(0.01393)
ABSOLUTE_CHANGE_SHADOW_FUNDS_RATE	-0.033884	-0.075308	-0.013812	0.017471	-0.073185	-0.007639	0.015131	-0.031603	0.028781
	(0.03715)	(0.04065)	(0.01641)	(0.05386)	(0.04650)	(0.01081)	(0.01807)	(0.03749)	(0.01566)
DUMMY	-0.013360	-0.028595	0.010967	-0.001150	-0.015046	0.003815	0.004507	-0.019496	0.009078
	(0.01479)	(0.01618)	(0.00653)	(0.02143)	(0.01850)	(0.00430)	(0.00719)	(0.01492)	(0.00623)
R-squared	0.348500	0.832565	0.735570	0.380910	0.839685	0.737395	0.692215	0.656609	0.704411
Adj. R-squared	0.214710	0.798181	0.681267	0.253776	0.806764	0.683467	0.629009	0.586092	0.643710
Sum sq. resids	2.687035	3.216094	0.524071	5.646298	4.208957	0.227519	0.635499	2.736192	0.477557
S.E. equation	0.109525	0.119823	0.048369	0.158766	0.137077	0.031870	0.053264	0.110522	0.046173
F-statistic	2.604825	24.21379	13.54574	2.996119	25.50547	13.67375	10.95176	9.311268	11.60455
Log likelihood	240.6214	216.2681	462.1052	140.0043	179.8121	575.1652	435.9830	238.1649	474.6990
Akaike AIC	-1.428940	-1.249211	-3.063507	-0.686378	-0.980163	-3.897898	-2.870723	-1.410811	-3.156450
Schwarz SC	-0.804218	-0.624489	-2.438786	-0.061657	-0.355442	-3.273176	-2.246001	-0.786089	-2.531729
Mean dependent	-6.53E-05	1.85E-05	-0.000297	-0.001024	-0.000745	-0.000280	-0.000173	0.000347	-0.000158
S.D. dependent	0.123594	0.266722	0.085676	0.183791	0.311831	0.056647	0.087448	0.171790	0.077355

Determinant resid covariance (dof adj.)	1.74E-21
Determinant resid covariance	3.13E-22
Log likelihood	3248.709
Akaike information criterion	-20.38900
Schwarz criterion	-13.92911
Number of coefficients	512

Note: Numbers in () are the standard errors.

Annex J – VEC Model for Germany/UK/Japan – Part II

Cointegrating Eq:	CointEq1	CointEq2	CointEq3	CointEq4	CointEq5	CointEq6	CointEq7	CointEq8	CointEq9
GER_3_MONTH(-1)	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
GER_10_YEAR(-1)	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
DAX(-1)	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
UK_3_MONTH(-1)	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
UK_10_YEAR(-1)	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000	0.000000
FTSE_100(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000	0.000000
JAP_3_MONTH(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000	0.000000
JAP_10_YEAR(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000	0.000000
NIKKEI_225(-1)	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1.000000
CONVENTIONAL_POLICY(-1)	0.086034 (0.15892)	0.201392 (0.06671)	-0.035768 (0.03067)	-0.048454 (0.15241)	0.165513 (0.06869)	-0.034302 (0.01710)	0.011712 (0.02795)	0.006102 (0.03431)	-0.065298 (0.02283)
UNCONVENTIONAL_POLICY(-1)	-1.665111 (0.46034)	-0.305112 (0.19325)	-0.034809 (0.08885)	-1.540838 (0.44147)	-0.060056 (0.19896)	-0.037589 (0.04954)	-0.232067 (0.08097)	-0.098371 (0.09940)	0.038252 (0.06614)
C	-0.039487 (0.02557)	0.000291 (0.01001)	-0.013490 (0.00409)	-0.020388 (0.02325)	0.006144 (0.00988)	-0.005836 (0.00232)	-0.005520 (0.00442)	0.002822 (0.00500)	-0.005338 (0.00315)

Error Correction:	D(GER_3_MONTH)	D(GER_10_YEAR)	D(DAX)	D(UK_3_MONTH)	D(UK_10_YEAR)	D(FTSE_100)	D(JAP_3_MONTH)	D(JAP_10_YEAR)	D(NIKKEI_225)	D(CONVENTIONAL)	D(UNCONVENTIONAL)
CointEq1	-0.401779 (0.11469)	0.149172 (0.12617)	0.007089 (0.05163)	-0.086519 (0.16730)	-0.189889 (0.14589)	0.029926 (0.03365)	0.204235 (0.05541)	0.304972 (0.11817)	0.052597 (0.04879)	0.043656 (0.16390)	-0.014279 (0.08392)
CointEq2	0.254592 (0.18805)	-0.782586 (0.20687)	-0.022632 (0.08466)	0.237577 (0.27432)	0.498471 (0.23922)	-0.061012 (0.05517)	-0.015099 (0.09085)	-0.048878 (0.19375)	-0.151669 (0.07999)	-0.369519 (0.26874)	0.062409 (0.13761)
CointEq3	-0.637265 (0.52372)	0.014355 (0.57615)	-1.023288 (0.23578)	-0.684569 (0.76399)	-0.066432 (0.66623)	0.278696 (0.15366)	-0.084343 (0.25302)	-0.231977 (0.53962)	-0.066178 (0.22278)	-0.334234 (0.74846)	-0.715560 (0.38324)
CointEq4	-0.020383 (0.10819)	-0.067430 (0.11902)	0.020707 (0.04871)	-0.405819 (0.15783)	0.153501 (0.13763)	-0.013919 (0.03174)	-0.066993 (0.05227)	-0.276464 (0.11148)	-0.089594 (0.04602)	0.019204 (0.15462)	0.168769 (0.07917)
CointEq5	-0.108189 (0.17287)	-0.062258 (0.19017)	-0.062701 (0.07782)	-0.138759 (0.25217)	-1.257249 (0.21991)	-0.035177 (0.05072)	0.019225 (0.08351)	0.184675 (0.17811)	0.102838 (0.07354)	0.086843 (0.24705)	-0.128445 (0.12650)
CointEq6	-0.363323 (0.79536)	-0.575313 (0.87499)	0.173649 (0.35807)	-2.462725 (1.16025)	0.567146 (1.01179)	-1.162581 (0.23336)	0.037335 (0.38425)	0.169668 (0.81951)	0.648067 (0.33834)	-0.132670 (1.13668)	-1.897625 (0.58202)
CointEq7	0.235064 (0.36078)	0.580939 (0.39690)	0.227271 (0.16242)	1.442830 (0.52630)	-0.867290 (0.45895)	0.106399 (0.10585)	-1.180948 (0.17430)	-0.373534 (0.37173)	-0.010123 (0.15347)	-0.774057 (0.51560)	0.100844 (0.26401)
CointEq8	-0.215041 (0.18119)	-0.270285 (0.19933)	-0.066074 (0.08157)	0.013762 (0.26431)	-0.225448 (0.23049)	0.085163 (0.05316)	0.103125 (0.08753)	-1.545890 (0.18669)	-0.065425 (0.07708)	0.294865 (0.25894)	0.091289 (0.13259)
CointEq9	0.001757 (0.43921)	0.646375 (0.48318)	0.288554 (0.19773)	0.338985 (0.64071)	0.250913 (0.55873)	-0.017921 (0.12887)	0.096134 (0.21219)	0.677993 (0.45254)	-0.941740 (0.18684)	1.017428 (0.62769)	-0.417087 (0.32140)
D(GER_3_MONTH(-1))	-0.104738 (0.12774)	-0.088820 (0.14053)	0.044755 (0.05751)	0.085413 (0.18635)	-0.311690 (0.16250)	0.007589 (0.03748)	-0.149059 (0.06171)	-0.333814 (0.13162)	-0.038634 (0.05434)	0.359586 (0.18256)	-0.025011 (0.09348)
D(GER_3_MONTH(-2))	-0.184433 (0.12397)	-0.040853 (0.13638)	-0.014365 (0.05581)	0.148728 (0.18084)	-0.074652 (0.15770)	0.001064 (0.03637)	-0.204002 (0.05989)	-0.149532 (0.12773)	-0.027775 (0.05274)	0.311121 (0.17717)	-0.075863 (0.09072)
D(GER_3_MONTH(-3))	-0.155169 (0.10895)	-0.189368 (0.11986)	0.081437 (0.04905)	-0.078724 (0.15894)	-0.253834 (0.13860)	0.060149 (0.03197)	-0.097967 (0.05264)	-0.285948 (0.11226)	-0.044745 (0.04635)	0.404237 (0.15571)	-0.025858 (0.07973)
D(GER_3_MONTH(-4))	-0.065383 (0.09623)	-0.133425 (0.10587)	-0.005101 (0.04332)	-0.112062 (0.14038)	0.025343 (0.12242)	0.031452 (0.02824)	-0.116827 (0.04649)	-0.060681 (0.09916)	-0.043192 (0.04094)	0.088794 (0.13753)	-0.154338 (0.07042)
D(GER_10_YEAR(-1))	-0.238873 (0.16420)	-0.207558 (0.18063)	0.004725 (0.07392)	-0.076776 (0.23952)	-0.310329 (0.20888)	0.034796 (0.04818)	-0.011891 (0.07933)	-0.005695 (0.16918)	0.097022 (0.06985)	0.208767 (0.23466)	-0.075184 (0.12015)
D(GER_10_YEAR(-2))	-0.039023 (0.14069)	-0.179400 (0.15478)	0.049906 (0.06334)	0.179493 (0.20524)	-0.276220 (0.17898)	0.042014 (0.04128)	0.041609 (0.06797)	0.113746 (0.14496)	0.129611 (0.05985)	0.160425 (0.20107)	0.012018 (0.10295)
D(GER_10_YEAR(-3))	0.005060 (0.10917)	0.025823 (0.12010)	0.050649 (0.04915)	0.203262 (0.15926)	-0.055177 (0.13888)	0.009396 (0.03203)	0.030566 (0.05274)	0.050785 (0.11249)	0.051792 (0.04644)	0.140276 (0.15602)	-0.043649 (0.07989)
D(GER_10_YEAR(-4))	-0.014566 (0.07384)	-0.062312 (0.08123)	0.111641 (0.03324)	0.041462 (0.10772)	-0.125734 (0.09393)	0.015578 (0.02166)	0.012359 (0.03567)	0.020428 (0.07608)	0.086922 (0.03141)	0.156291 (0.10553)	-0.029513 (0.05403)
D(DAX(-1))	-0.850623 (0.46784)	0.029597 (0.51468)	-0.050321 (0.21062)	0.487834 (0.68247)	0.162396 (0.59515)	-0.067027 (0.13726)	0.172766 (0.22602)	0.330605 (0.48204)	0.204966 (0.19901)	0.723759 (0.66861)	0.664833 (0.34235)
D(DAX(-2))	-0.840597 (0.39518)	-0.382301 (0.43474)	-0.081695 (0.17791)	-0.069534 (0.57648)	-0.427846 (0.50272)	-0.057039 (0.11595)	0.216120 (0.19092)	0.656364 (0.40718)	0.137885 (0.16811)	1.148112 (0.56477)	0.375358 (0.28918)
D(DAX(-3))	-0.608453 (0.30151)	-0.652097 (0.33169)	0.010342 (0.13574)	-0.218204 (0.43983)	-0.343008 (0.38355)	0.000426 (0.08846)	0.208784 (0.14566)	0.390562 (0.31066)	0.150711 (0.12826)	0.496073 (0.43089)	0.121875 (0.22063)
D(DAX(-4))	-0.265901 (0.17674)	-0.314486 (0.19444)	0.019973 (0.07957)	-0.096535 (0.25783)	-0.260007 (0.22484)	0.035232 (0.05186)	0.123665 (0.08539)	0.133933 (0.18211)	0.165563 (0.07519)	0.110772 (0.25259)	-0.043918 (0.12934)
D(UK_3_MONTH(-1))	0.120600 (0.10993)	0.120226 (0.12093)	-0.043858 (0.04949)	-0.149513 (0.16036)	0.200528 (0.13984)	-0.030747 (0.03225)	0.026049 (0.05311)	0.223939 (0.11326)	0.063332 (0.04676)	-0.119666 (0.15710)	-0.122433 (0.08044)
D(UK_3_MONTH(-2))	0.101078 (0.10502)	-0.030449 (0.11553)	-0.008747 (0.04728)	-0.250650 (0.15320)	0.049018 (0.13359)	-0.008026 (0.03081)	0.136388 (0.05074)	0.259731 (0.10820)	0.053745 (0.04467)	-0.076662 (0.15008)	0.109719 (0.07685)
D(UK_3_MONTH(-3))	0.077634 (0.09273)	0.101326 (0.10201)	-3.82E-05 (0.04175)	-0.069639 (0.13527)	0.274683 (0.11796)	-0.014222 (0.02721)	-0.003310 (0.04480)	0.171385 (0.09554)	0.081920 (0.03945)	-0.306040 (0.13252)	-0.045552 (0.06785)
D(UK_3_MONTH(-4))	0.131922 (0.07795)	0.146775 (0.08575)	0.031092 (0.03509)	0.065399 (0.11371)	-0.041621 (0.09916)	-0.004898 (0.02287)	0.043144 (0.03766)	-0.001041 (0.08032)	0.111581 (0.03316)	-0.090795 (0.11140)	0.020085 (0.05704)
D(UK_10_YEAR(-1))	0.070931 (0.15174)	-0.002912 (0.16693)	0.054135 (0.06831)	0.014419 (0.22136)	0.059435 (0.19303)	0.031264 (0.04452)	-0.017066 (0.07331)	-0.104353 (0.15635)	-0.074242 (0.06455)	-0.035747 (0.21686)	0.083990 (0.11104)
D(UK_10_YEAR(-2))	-0.005365 (0.12693)	0.047299 (0.13963)	0.017425 (0.05714)	-0.086435 (0.18516)	0.023950 (0.16147)	0.025389 (0.03724)	-0.020710 (0.06132)	-0.182876 (0.13078)	-0.066316 (0.05399)	0.060144 (0.18140)	-0.033378 (0.09288)
D(UK_10_YEAR(-3))	0.002463 (0.09658)	-0.019473 (0.10625)	0.010153 (0.04348)	-0.087485 (0.14089)	-0.061119 (0.12286)	0.032452 (0.02834)	-0.001770 (0.04666)	-0.106635 (0.09951)	-0.025237 (0.04109)	0.049586 (0.13803)	-0.007629 (0.07068)
D(UK_10_YEAR(-4))	0.039733 (0.06285)	0.042324 (0.06914)	-0.058474 (0.02829)	0.011588 (0.09168)	0.058188 (0.07995)	0.002855 (0.01844)	-0.002292 (0.03036)	-0.070851 (0.06476)	-0.074600 (0.02673)	-0.014246 (0.08982)	-0.006419 (0.04599)
D(FTSE_100(-1))	0.185839 (0.71354)	0.614835 (0.78497)	0.139573 (0.32123)	-1.667421 (1.04089)	-0.713375 (0.90770)	-0.075213 (0.20935)	0.044849 (0.34472)	0.044211 (0.73520)	-0.521780 (0.30353)	0.140164 (1.01974)	-1.670569 (0.52214)
D(FTSE_100(-2))	-0.014726 (0.59332)	0.926846 (0.65272)	0.127492 (0.26711)	-1.437455 (0.86552)	0.026663 (0.75477)	-0.151835 (0.17408)	-0.314911 (0.28664)	-0.491493 (0.61133)	-0.481659 (0.25239)	-0.256065 (0.84793)	-1.535459 (0.43417)
D(FTSE_100(-3))	-0.147537 (0.45812)	0.757017 (0.50399)	0.164210 (0.20625)	-0.983825 (0.66830)	-0.224245 (0.58279)	-0.189416 (0.13441)	-0.371477 (0.22133)	-0.433438 (0.47203)	-0.317384 (0.19488)	-0.205895 (0.65472)	-0.824767 (0.33524)
D(FTSE_100(-4))	-0.046986 (0.26561)	0.631071 (0.29220)	0.051128 (0.11958)	-0.275925 (0.38747)	0.023451 (0.33789)	-0.104256 (0.07793)	-0.097582 (0.12832)	0.110870 (0.27367)	-0.182777 (0.11299)	0.027798 (0.37959)	-0.280166 (0.19436)
D(JAP_3_MONTH(-1))	-0.442655 (0.32317)	-0.776441 (0.35553)	-0.132472 (0.14549)	-1.164454 (0.47144)	-1.231007 (0.41111)	0.048694 (0.09482)	-0.007629 (0.15613)	0.478326 (0.33299)	-0.001773 (0.13747)	0.713218 (0.46186)	0.026663 (0.23649)
D(JAP_3_MONTH(-2))	-0.286915 (0.28630)	-0.662024 (0.31496)	-0.119758 (0.12889)	-0.764957 (0.41765)	-0.637728 (0.36421)	0.073237 (0.08400)	0.003977 (0.13832)	0.502958 (0.29499)	-0.081975 (0.12179)	0.738850 (0.40916)	0.092038 (0.20951)
D(JAP_3_MONTH(-3))	-0.086591 (0.22684)	-0.341976 (0.24955)	-0.075836 (0.10212)	-0.381074 (0.33091)	-0.412972 (0.28857)	0.063447 (0.06656)	0.139242 (0.10959)	0.266452 (0.23373)	-0.056807 (0.09650)	0.411583 (0.32419)	0.097809 (0.16599)
D(JAP_3_MONTH(-4))	-0.054680 (0.14516)	-0.072385 (0.15969)	-0.035852 (0.06535)	-0.091425 (0.21176)	0.033956 (0.18466)	0.022845 (0.04259)	0.055000 (0.07013)	0.227654 (0.14957)	0.011472 (0.06175)	0.014945 (0.20745)	0.028713 (0.10622)
D(JAP_10_YEAR(-1))	0.223011 (0.15389)	0.287904 (0.16929)	0.043381 (0.06928)	0.014557 (0.22449)	0.214155 (0.19576)	-0.094340 (0.04515)	0.000207 (0.07435)	0.506321 (0.15856)	0.053477 (0.06546)	-0.213319 (0.21993)	-0.001186 (0.11261)
D(JAP_10_YEAR(-2))	0.113491 (0.12673)	0.259252 (0.13941)	-0.009667 (0.05705)	-0.052079 (0.18487)	0.334433 (0.16121)	-0.088801 (0.03718)	-0.029428 (0.06122)	0.427549 (0.13057)	0.000425 (0.05391)	-0.105812 (0.18111)	-0.007799 (0.09273)
D(JAP_10_YEAR(-3))	0.025208 (0.09990)	0.160465 (0.10990)	-0.017352 (0.04498)	-0.061780 (0.14574)	0.226777 (0.12709)	-0.051909 (0.02931)	-0.090737 (0.04827)	0.201360 (0.10294)	0.050720 (0.04250)	-0.056396 (0.14278)	-0.059647 (0.07311)
D(JAP_10_YEAR(-4))	0.073604 (0.06718)	0.063995 (0.07390)	0.015669 (0.03024)	0.065268 (0.09800)	0.082961 (0.08546)	-0.029994 (0.01971)	-0.030924 (0.03245)	0.060730 (0.06922)	0.038031 (0.02858)	-0.053324 (0.09600)	-0.017798 (0.04916)
D(NIKKEI_225(-1))	0.164461 (0.38947)	-0.613014 (0.42846)	-0.204304 (0.17534)	-0.010517 (0.56815)	-0.074498 (0.49545)	0.089057 (0.11427)	-0.119135 (0.18816)	-0.558689 (0.40129)	-0.114360 (0.16568)	-0.873289 (0.55661)	0.096686 (0.28500)
D(NIKKEI_225(-2))	0.401596 (0.32676)	-0.292972 (0.35947)	-0.148151 (0.14710)	0.356309 (0.47666)	0.121319 (0.41567)	0.085570 (0.09587)	-0.010405 (0.15786)	-0.564470 (0.33667)	-0.015507 (0.13900)	-0.996819 (0.46698)	0.403784 (0.23911)
D(NIKKEI_225(-3))	0.486657 (0.25943)	-0.091780 (0.28541)	-0.188362 (0.11680)	0.304544 (0.37845)	0.102190 (0.33003)	0.054516 (0.07612)	0.045164 (0.12534)	-0.344924 (0.26731)	-0.069521 (0.11036)	-0.288509 (0.37077)	0.375230 (0.18984)
D(NIKKEI_225(-4))	0.132418 (0.17341)	-0.091317 (0.19077)	-0.167399 (0.07807)	-0.045634 (0.25297)	0.121518 (0.22060)	-0.002609 (0.05088)	-0.089460 (0.08378)	-0.192283 (0.17868)	-0.056789 (0.07377)	-0.060900 (0.24783)	0.198540 (0.12690)
D(CONVENTIONAL_POLICY(-1))	0.148032 (0.05161)	0.263590 (0.05678)	-0.022397 (0.02323)	0.197176 (0.07529)	0.183155 (0.06565)	-0.013033 (0.01514)	0.080846 (0.02493)	0.087403 (0.05318)	-0.020568 (0.02195)	-0.585022 (0.07376)	0.065728 (0.03777)
D(CONVENTIONAL_POLICY(-2))	-0.030690 (0.05787)	0.217832 (0.06367)	0.029093 (0.02605)	0.055488 (0.08442)	0.160413 (0.07362)	-0.004998 (0.01698)	0.052311 (0.02796)	0.022387 (0.05963)	-0.018039 (0.02462)	-0.133581 (0.08271)	0.041436 (0.04235)
D(CONVENTIONAL_POLICY(-3))	-0.045005 (0.05658)	0.104775 (0.06225)	0.006437 (0.02547)	0.074850 (0.08254)	0.040416 (0.07198)	-0.015504 (0.01660)	0.064099 (0.02734)	-0.028418 (0.05830)	0.017858 (0.02407)	-0.229804 (0.08086)	0.056434 (0.04141)
D(CONVENTIONAL_POLICY(-4))	0.044032 (0.04851)	0.015150 (0.05337)	0.007693 (0.02184)	0.053459 (0.07077)	0.048511 (0.06171)	-0.016925 (0.01423)	0.043372 (0.02344)	0.039672 (0.04998)	0.031874 (0.02064)	-0.173231 (0.06933)	0.055618 (0.03550)
D(UNCONVENTIONAL_POLICY(-1))	0.283374 (0.12651)	0.043860 (0.13917)	-0.066593 (0.05695)	0.316428 (0.18455)	0.122523 (0.16093)	0.013655 (0.03712)	0.049047 (0.06112)	-0.196272 (0.13035)	0.004233 (0.05381)	-0.249394 (0.18080)	-0.539261 (0.09257)
D(UNCONVENTIONAL_POLICY(-2))	0.257603 (0.12132)	0.031761 (0.13347)	-0.041739 (0.05462)	0.329206 (0.17698)	0.071402 (0.15433)	0.010083 (0.03560)	0.051924 (0.05861)	-0.041750 (0.12500)	-0.093922 (0.05161)	-0.276397 (0.17338)	-0.587559 (0.08878)
D(UNCONVENTIONAL_POLICY(-3))	0.182595 (0.10551)	-0.011976 (0.11607)	-0.009217 (0.04750)	0.267536 (0.15391)	-0.016264 (0.13422)	-0.016268 (0.03096)	-0.042223 (0.05097)	-0.013947 (0.10871)	-0.041795 (0.04488)	-0.199818 (0.15079)	-0.384775 (0.07721)
D(UNCONVENTIONAL_POLICY(-4))	0.102312 (0.08329)	0.192237 (0.09163)	0.001688 (0.03750)	0.126478 (0.12150)	0.010930 (0.10595)	0.007291 (0.02444)	2.67E-05 (0.04024)	0.013312 (0.08582)	-0.003804 (0.03543)	-0.155699 (0.11903)	-0.161949 (0.06095)
VIX	-0.038524 (0.03427)	-0.061003 (0.03770)	-0.141505 (0.01543)	-0.072545 (0.04999)	-0.036408 (0.04359)	-0.079197 (0.01005)	-0.034862 (0.01655)	-0.047465 (0.03531)	-0.110053 (0.01458)	-0.003240 (0.04897)	0.026926 (0.02507)
US_10_YEAR	0.026126 (0.03371)	0.577308 (0.03709)	0.054978 (0.01518)	0.028334 (0.04918)	0.614741 (0.04289)	0.027293 (0.00989)	-0.022117 (0.01629)	0.166745 (0.03474)	0.053930 (0.01434)	-6.94E-05 (0.04818)	0.085135 (0.02467)
R-squared	0.395556	0.842926	0.745059	0.418326	0.846339	0.752302	0.718191	0.667851	0.720777	0.522314	0.681146
Adj. R-squared	0.244445	0.803657	0.681324	0.272907	0.807923	0.690377	0.647739	0.584813	0.650971	0.402892	0.601433
Sum sq. resids	2.492958	3.017092	0.505264	5.305056	4.034278	0.214604	0.581865	2.646619	0.451116	5.091674	1.334933
S.E. equation	0.107431	0.118186	0.048365	0.156718	0.136665	0.031520	0.051902	0.110693	0.045700	0.153534	0.078615
F-statistic	2.617654	21.46563	11.68990	2.876700	22.03127	12.14869	10.19401	8.042779	10.32545	4.373701	8.544937
Log likelihood	250.7796	224.9230	467.0572	148.4513	185.5556	583.0838	447.9302	242.6749	482.4168	154.0140	335.4114
Akaike AIC	-1.444868	-1.254044	-3.041012	-0.689677	-0.963510	-3.897297	-2.899854	-1.385055	-3.154368	-0.730731	-2.069457
Schwarz SC	-0.713811	-0.522987	-2.309955	0.041380	-0.232453	-3.166240	-2.168797	-0.653997	-2.423310	0.000326	-1.338400
Mean dependent	-6.53E-05	1.85E-05	-0.000297	-0.001024	-0.000745	-0.000280	-0.000173	0.000347	-0.000158	0.000109	7.31E-05
S.D. dependent	0.123594	0.266722	0.085676	0.183791	0.311831	0.056647	0.087448	0.171790	0.077355	0.198691	0.124524

Determinant resid covariance (dof adj.)	1.78E-25
Determinant resid covariance	1.47E-26
Log likelihood	3830.066
Akaike information criterion	-23.07059
Schwarz criterion	-13.71306
Number of coefficients	713

Note: Numbers in () are the standard errors.

Annex K – Error correction terms for the Model of Germany/UK/Japan

Error Correction:	GER_3_MONTH	GER_10_YEAR	DAX	UK_3_MONTH	UK_10_YEAR	FTSE_100	JAP_3_MONTH	JAP_10_YEAR	NIKKEI_225	CONV.	UNCONV.
CointEq1	**-0.401779*** **	-0.149172	0.007089	-0.086519	-0.189889	0.029926	**0.204235*** **	**0.304972** **	0.052597	0.043656	-0.014279
	(0.11469)	(0.12617)	(0.05163)	(0.16730)	(0.14589)	(0.03365)	(0.05541)	(0.11817)	(0.04879)	(0.16390)	(0.08392)
CointEq2	0.254592	**-0.782586*** **	-0.022632	0.237577	**0.498471* **	-0.061012	-0.015099	-0.048878	-0.151669	-0.369519	0.062409
	(0.18805)	(0.20687)	(0.08466)	(0.27432)	(0.23922)	(0.05517)	(0.09085)	(0.19375)	(0.07999)	(0.26874)	(0.13761)
CointEq3	-0.637265	0.014355	**-1.023288*** **	-0.684569	-0.066432	0.278696	-0.084343	-0.231977	-0.066178	-0.334234	-0.715560
	(0.52372)	(0.57615)	(0.23578)	(0.76399)	(0.66623)	(0.15366)	(0.25302)	(0.53962)	(0.22278)	(0.74846)	(0.38324)
CointEq4	-0.020383	-0.067430	0.020707	**-0.405819** **	0.153501	-0.013919	-0.066993	**-0.276464* **	-0.089594	0.019204	**0.168769* **
	(0.10819)	(0.11902)	(0.04871)	(0.15783)	(0.13763)	(0.03174)	(0.05227)	(0.11148)	(0.04602)	(0.15462)	(0.07917)
CointEq5	-0.108189	-0.062258	-0.062701	-0.138759	**-1.257249*** **	-0.035177	0.019225	0.184675	0.102838	0.086843	-0.128445
	(0.17287)	(0.19017)	(0.07782)	(0.25217)	(0.21991)	(0.05072)	(0.08351)	(0.17811)	(0.07354)	(0.24705)	(0.12650)
CointEq6	-0.363323	-0.575313	0.173649	**-2.462725* **	0.567146	**-1.162581*** **	0.037335	0.169668	0.648067	-0.132670	**-1.897625*** **
	(0.79536)	(0.87499)	(0.35807)	(1.16025)	(1.01179)	(0.23336)	(0.38425)	(0.81951)	(0.33834)	(1.13668)	(0.58202)
CointEq7	**0.235064* **	0.580939	0.227271	**1.442830** **	-0.867290	0.106399	**-1.180948*** **	-0.373534	-0.010123	-0.774057	0.100844
	(0.36078)	(0.39690)	(0.16242)	(0.52630)	(0.45895)	(0.10585)	(0.17430)	(0.37173)	(0.15347)	(0.51560)	(0.26401)
CointEq8	-0.215041	-0.270285	-0.066074	0.013762	-0.225448	0.085163	0.103125	**-1.545890*** **	-0.065425	0.294865	0.091289
	(0.18119)	(0.19933)	(0.08157)	(0.26431)	(0.23049)	(0.05316)	(0.08753)	(0.18669)	(0.07708)	(0.25894)	(0.13259)
CointEq9	0.001757	0.646375	0.288554	0.338985	0.250913	-0.017921	0.096134	0.677993	**-0.941740** **	1.017428	-0.417087
	(0.43921)	(0.48318)	(0.19773)	(0.64071)	(0.55873)	(0.12887)	(0.21219)	(0.45254)	(0.18684)	(0.62769)	(0.32140)

Note: Numbers in ( ) are the standard errors; ***, ** and * represent significance levels at 1%, 5% and 10%, respectively.