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Monetary Policy Spillovers:

The Impact of Advanced Central Banks' Decisions on Emerging Financial Markets

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List of Abbreviations

Abbreviation	Meaning
AE	Advanced economies (developed markets)
ARDL	Autoregressive Distributed Lag model
BoJ	Bank of Japan
COVID	COVID-19 pandemics (2020-2021)
ECB	European Central Bank
EM	Emerging markets
EUR	Euro
EZ	Eurozone
Fed	Federal Reserve, the central bank of the USA
FX	Foreign exchange (market)
GFC	Global Financial Crisis (2008-2009)
GMM	Generalized Methods of Moments
IMF	International Monetary Fund
JPM	JP Morgan
JPY	Japanese yen
NARDL	Nonlinear Autoregressive Distributed Lag model
QE	Quantitative Easing
QT	Quantitative Tightening
US, USA	United States of America
USD	United States Dollar
VAR	Vector Autoregression

1 Introduction

1.1 Financial markets in a globalized world

Globalization has exerted a profound impact on international relations, fundamentally shaping economic and political dynamics over recent decades. Despite this global phenomenon, the discourse around macroeconomic policies has predominantly centered on the national stage. Key financial policies, especially monetary strategies, are often perceived as the exclusive domain of individual states, entailing their responsibility to deploy effective stabilization mechanisms. These decisions constitute integral components of the economic policy mix within a specific country. Nonetheless, the complex network of economic interactions extends beyond national borders, demanding a more complex understanding of international economic relations. The interconnection of economies emphasizes the need for scholars and policymakers to delve into the intricate dynamics that define the global economic landscape.

Technological innovations, climate change, wars, and pandemics are among the key trends that undoubtedly influence the global economic environment, while international trade of goods, including commodities, services, and technology, is the traditional engine of international economic relations. Based on the logic of the balance-of-payment, which is a standard tool for accounting cross-border transactions, exchange of capital, reserve accumulation, and international transfers are inseparable from real-economy activities, and cross-border linkages have become more important than ever before.

The global financial landscape thrives on a rich tapestry of currencies, each crafted and conducted by entities responsible for financial matters within specific jurisdictions—predominantly overseen by central banks or other monetary authorities. These entities do not only issue currencies but they also fulfill various other roles and responsibilities related to financial markets, with the general aim of influencing the value of money in accordance with specified policy goals. Exchange rates articulate the relative value between currencies, while interest rates define the intertemporal value of money. Both parameters play crucial roles in characterizing the value of money. Generally, shaping the value of money constitutes a fundamental aspect of monetary policy.

Based on textbooks and according to the standard thinking about macroeconomics, money supply provided by central banks, and the demand from the real economy converge toward equilibrium in the financial market. External conditions – e.g. the monetary policy of foreign countries – may influence the domestic economy via several channels, highlighting the external demand, international trade, external funding costs, and the alternative cost of domestic investments vis-á-vis the foreign investment opportunities. In financial practice, these factors may be channeled into changes in the foreign exchange market or domestic asset prices.

The theory of the 'impossible trinity' (Mundell, 1963) explains that in case of free capital movement, sovereign monetary policy may be conducted at the price of unpegging the exchange rate. Therefore,

in case of floating exchange rates, the absorption of international shocks takes place primarily in the foreign exchange market as FX rates adjust accordingly. At the same time, however, globalized financial markets make it possible to connect savings and investments from any part of the world. Hence, financial instruments are – though not perfect - substitutes for each other. This means that these financial assets are indeed competitors, and their values are determined on the respective market, and be relatively independent from FX-markets. Prices mirror the market participants' expectations about future developments and discretionary judgment on the individual instrument. Though several theories describe a system of hypothetical relationships between current and future interest- and exchange rates, real-life experience suggests that the modern global financial markets are more complex. The transmission of financial shocks should be revisited by considering these facts. Therefore, by mostly acknowledging the fact that financial assets are sensitive to international developments, they consequently reevaluate the classic thinking about monetary policy and their transmission on the economy.

Several authors in the literature claimed that interest rates on domestic financial markets are significantly correlated, and asset price dynamics are impossible to analyze without understanding the international environment. (Rey, 2015; Takats & Vela, 2014) Since the Global Financial Crisis, intensive international capital flows have characterized the global economy. Large amounts of capital flew from advanced to emerging countries as the largest central banks applied aggressive monetary easing to stimulate the economy. (Anaya, Hachula, & Offermanns, 2017; Koepke, 2017; Ramírez & González, 2017) Many researchers have found that the post-crisis monetary policy of the largest central banks, especially the unconventional policy measures, such as the quantitative easing programs, had a sizable impact on the pricing of financial assets both domestically and internationally. While the domestic impact is regarded as monetary transmission and the direct result of the monetary policy decisions, the cross-border impact, so-called the 'spillover effect', is less intuitive.[1] The puzzling question for economists, investors, and policymakers is the following: to what extent do large central banks influence smaller financial markets? Though the literature regards the large central banks, such as the Federal Reserve and the European Central Bank, as shock originators, the nature of advanced monetary policy shocks is far from fully explored. Additionally, decades of financial crises and different paths that countries followed in financial policies suggest that some countries, or at least a certain type of countries, are more vulnerable, while others are more resilient to international shocks.

The efficiency and success of central banks may be measured by the fact whether they have fulfilled their legal goals, such as anchoring inflation or maintaining the smoothness of monetary policy transmission in the domestic economy. On the other hand, the central banks as their countries, could not be analyzed separately from the international environment. The global economy has become more

[1] For illustrating the popularity of this research question Thomas (2023) collected the articles from Scopus that has the expression „monetary policy spillover" in their title and found that the topic gained interest after 2014, and regained popularity after the COVID19 crisis parallel with interventions of central banks. (Thomas, 2023)

integrated, and countries have become more connected in many ways; financial markets and monetary policy decisions are no exception. Environment and global context are vital for better understanding the financial markets and monetary policy decisions.

This thesis deals with the international context of monetary policy decisions, focusing on a well-defined part of international financial transmission. Starting from a literature review that briefly explains the financial linkages between countries, a central research question is formed: how do monetary policy decisions of advanced countries affect the long-term bond yields in emerging countries? Previous papers referred to this relationship as 'monetary policy spillovers', expressing the international, cross-border impact of monetary policy decisions. 'Cross-border transmission' and 'monetary policy spillovers' are used interchangeably throughout the text.

A relatively large, panel-structured database is used in the research part of the thesis. A systematic study of financial market data reveals the impact of the different central banks, first on a global level, second on a regional level, and finally on an individual country level. The sensitivity to international shock is further examined in the final part of the thesis. Conclusions may help to understand the present and future of international financial markets.

1.2 Recent history of monetary policy in advanced and emerging countries

Following the Second World War, the so-called 'Bretton-Woods system' laid down the fundamentals of the international financial system, which was built on the dominance of the US dollar. It provided a stable, but barely flexible framework for countries. Bilateral payments, primarily between countries, could flow in a relatively organized way. While, cross-border financial investments were strictly controlled, and capital accounts were mainly closed for cross-border financial investors. The collapse of fixed exchange between gold, USD, and other currencies in 1971, when President Nixon announced the suspension of USD-gold convertibility, opened a new era in the economic history. Since then, the value of money depends on financial markets, influenced by central banks. Robert Mundell described the choices of policymakers a decade before: in his seminal theory on the classical trilemma paradigm, he explained that two of the following three may be chosen at the expense of the third. Thus, independent monetary policy (with setting up interest rates), fixed exchange rates, and freedom of capital movement cannot be maintained at the same time. (Mundell, 1963)

Then, financial liberalization paved the way for international capital movements, becoming a primary choice in the following decades. Moreover, newly industrialized countries with transforming economic and social systems, so-called 'emerging countries', were encouraged to open their economies and to use the capital inflow to boost growth. This process simplified the trilemma into a dilemma: fixed exchange rates or independent rate policies remained on the table to choose from. However, the whole international financial system remained resilient, many emerging countries suffered from currency crises in the 1990s and 2000s.

The interconnection of sovereign financial systems came into the spotlight during the Global Financial Crisis in 2008-2009. Central banks in advanced countries applied aggressive monetary stimulus and various unconventional measures to help to overcome the period of financial instability and weak growth. The most effective programs were the quantitative easing programs, when these central banks bought securities with the intention to reduce risk premia, the excess rate that market participants required to risk their money on the financial markets. The decade of 2010 was characterized by low inflation and low interest rate, which were beneficial for all countries and helped to regain growth. Apart from some minor episodes of financial turbulence, the next turning point in financial history did not show up until the outburst of the COVID-19 crisis. The pandemic presented an environment to use the previous experiences in monetary easing, though the outcome was notably different this time. As growth rebounded in a little bit more than a year after the pandemic, inflation started to pick up, bringing a new challenge for central banks. This following subchapter gives an overview on the history of monetary policy since the Bretton Woods system to the recent inflationary environment with the help of some introductory graphs[2] and stylized, commonly known facts.

From Bretton Woods to the Great Moderation

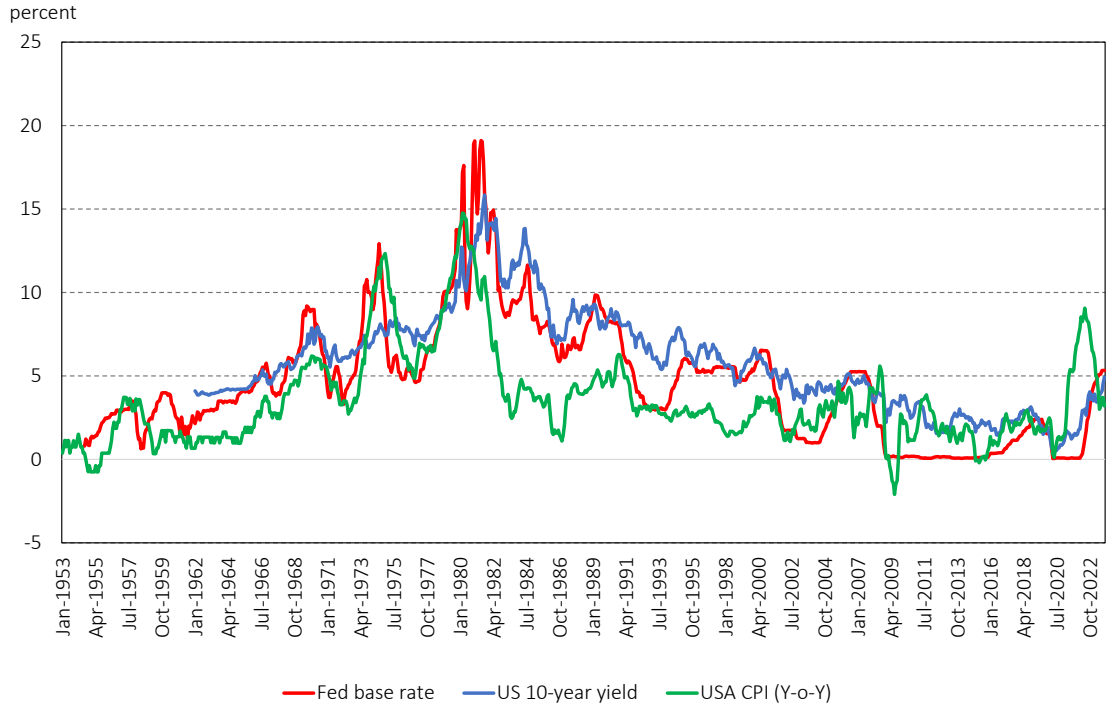
After the Second World War, the Bretton Woods system replaced the previous gold standard. The financial order had two fundamental elements. On one hand, the US government promised to exchange gold and the US dollar at a fixed rate, making the US currency the most important reserve currency. On the other hand, the rest of the currencies were pegged to the US dollar, and market interventions took place only by selling and buying US dollars. In 1971, the United States abandoned the mandatory exchange of currencies and gold, while they also devalued the US dollar. In the late 1970s, there was a persistent increase in prices, resulting in relatively elevated domestic interest rates. The Federal Reserve took decisive measures by significantly raising interest rates to counteract inflation. From 1972 to 1980, the base rate surged from 3.5 percent to 13.7 percent, and in the subsequent two years, it experienced further hikes, reaching the peak of 19 percent in early 1981. The Federal Reserve's response transitioned to a more assertive anti-inflationary strategy in the early 1980s. During the period from 1975 to 1980, average inflation stood at approximately 8 percent, with the average Fed rate hovering around 7 percent, resulting in a negative real rate. In the subsequent three years, from 1980 to 1983, average inflation rose to around 10 percent, while the base rate averaged approximately 13 percent.

The following period, the 1990s and the early 2000s, is called as “The Great Moderation” in the US economic history: a relatively low inflation paired with stable growth and with decrease in macroeconomic uncertainty. During this period, the Fed's monetary policy was characterized mainly by business cycle developments. The elevated inflation induced some increase in Fed rates, while long-term rates remained relatively stable. Yields of long-term US bonds showed a declining trend that reflects both domestic and international developments. The stable long-term macroeconomic

[2] For editing reasons some supplementary graphs were placed to the Appendix.

outlook decreased the risk of lending in USD for a longer period, contributing to the compression of the so-called 'term premia'. The great moderation coincides with the peak-time of globalization on the global financial markets. This is one reason why the collapse of the US housing credit market in 2007 could lead to the Global Financial Crisis (GFC), and synchronized steps of advanced central banks had a global impact on financial markets.

1. Figure US interest rates and inflation



Source: Bloomberg
Note: Base rate is the historical Fed fund (target) rate, yield reflects the benchmark government bond, CPI is the consumer price index.

The aftermath of the Global Financial Crisis

After the collapse of Lehmann Brothers in late 2008, the global financial crisis hit the world economy and caused a temporary freeze of capital markets in 2009. The following chain of events, and their underlying reasons, as well as the economic consequences have been described in depth in the literature. Before the crisis, the Federal Reserve in the USA, the European Central Bank in the Eurozone tightened the financial conditions via conventional tools: raising interest rates gradually to fight against the increasing inflation. The origin of the crisis was the US; therefore, the Federal Reserve took the first steps to stabilize the situation. The Fed reacted with three tools to handle the ongoing situation: firstly by providing liquidity, secondly using its standard policy tool to decrease interest rates in the economy, and thirdly by purchasing various types of financial assets. The origin of the financial crisis manifested in the drying out of interbank liquidity, and market participants were unwilling to lend funding even on the shortest maturities. (Aït-Sahalia, Andritzky, Jobst, Nowak, & Tamirisa, 2012) The liquidity crisis was managed by providing additional liquidity to the financial

system, and the decrease in the federal fund target rate also contributed to sounder financial conditions from the beginning. The rate cut was relatively quick and large; therefore, the Fed fund rate fell close to 0 percent by the end of 2008. The expected recession and decrease in inflation made the Fed maintain low rates for a prolonged time and promised the market that financial conditions would not be tightened any time soon. Some authors regarded this as an autonomous policy tool, called 'forward guidance', but others argued that this was not more than the extension of conventional communication formulas of the central banks. (Bihari, 2015; Bihari & Sztanó, 2015)

Asset purchase programs, or quantitative easing programs (QE), were targeted and aimed to restore the functionality of different submarkets at the beginning. Expanding the balance sheet was the direct result of these programs and a cornerstone of the 'unconventional monetary policy' toolkit. Asset purchase programs influenced the economy via several channels. The demand generated by the central bank pushed the asset prices up mostly, which meant that both government bond yields and corporate bond yields decreased, and this way, these purchases contributed to keeping the yields low in the medium term. (Krishnamurthy & Vissing-Jorgensen, 2011; Meegan, Corbet, & Larkin, 2018). Later, these programs were expanded, and large-scale programs contributed to maintaining and ensuring easy monetary conditions. These programs usually consisted of purchasing governmental and private securities on the secondary market. Looking at other central banks, most of the advanced central banks somehow eased the financial condition, but the introduction of the asset-purchasing program was delayed in the case of the ECB and BoE. (Babecká, Claeys, & Vašíček, 2016; Szczerbowicz, 2015)

Asset purchase programs and low rates became the fundamentals of monetary policy in the 2010s, supported by record-low inflation. The Federal Reserve experienced how difficult it was to exit from this framework, while the European Central Bank (ECB) and the Bank of Japan (BoJ) maintained monetary policy easing until the end of the decade. The Federal Reserve terminated the third round of asset purchases in 2014, but their earlier communication caused market turbulence, resulting in a much slower phasing out of asset purchases. However, interest rate hikes were started in 2015 in small steps, the significant deleveraging of the balance sheet never took place. The ECB also started to phase out its asset purchase program, but it did not raise the interest rates until the summer of 2022. The Bank of Japan shifted to a framework that maintains long-term interest rates at an extremely low level, and to achieve this, necessary asset purchases were conducted. Therefore, an open-ended quantitative easing period characterized the Japanese monetary policy in the 2010s.

As the coronavirus pandemic had a worldwide economic impact, the large central banks reacted in similar ways. The complete freezing of the real economy, the collapse of supply chains, and the growing uncertainty all made central banks to ease monetary conditions to overcome the difficulties of the economy. The tools were similar to those used after the Global Financial Crisis: interest rates were cut to technically zero, quantitative easing programs were launched, and communication reassured market participants that tools were used as long as needed. Almost 18 months later, processes seemed to be materially changed. The threat of low inflation was replaced by both supply

and demand side inflation, and economies regained their strength as the most severe waves of the pandemic ended. It is important to note that in size, the post-covid reactions were much stronger compared to the post-GFC period, and the sudden change in the inflationary environment resulted in a much quicker exit from unconventional easing. This overview of monetary history illustrates that over the past few decades, monetary policy has navigated through diverse economic situations, presenting distinct challenges for policymakers.[3]

Renewal of monetary policy in advanced markets

The dilemmas of monetary policy, the tradeoffs that policymakers need to face, and generally macroeconomics as a research discipline are deliberately connected to ongoing processes and relevant economic issues. It is an ambiguous claim that monetary policy has changed dramatically after the global financial crisis. Several authors examined the difference between the normal inflation targeting period and the new, low inflation – low interest rate environment, calling the latter the 'new normal'. Retrospectively, the new era of the financial market was rather a temporary phenomenon as a result of several factors. The post-covid high inflation and high interest rate environment, show similarities with previous periods in economic history, therefore, the main discussion in macroeconomics is centered around inflation and the classic interest rate transmission.

Two key features remained from the 2010s, partly as result of previous policies and partly as an old-new framework of monetary policy. On one hand, the monetary policy framework for inflation targeting central banks shifted towards a more flexible regime, which allowed them to consider other aspects and economically relevant factors than the inflation itself. One of these extensions is the importance of monetary stability and the consideration of the financial markets' soundness. On the other hand, the policy toolkit expanded with the widely used balance sheet policy measures: as many central banks applied monetary policy easing via expanding their balance sheet, mostly by purchasing financial assets, a new and powerful policy tool emerged. Several papers discussed how it changed the financial markets: for example, Kiley found that it is only effective in the low interest rate (low inflation rate) period, and his finding implies that the inflated central bank balance sheet requires no further actions at the time of tightening. (Kiley, 2018)

Emerging markets

A real-life motivated extension of any current economic theory to consider certain countries' characteristics, development, and institutional depth. While there are discernible patterns in the economic histories of specific countries, it is essential to discuss developed (advanced) and developing/emerging countries separately with their significantly various reactions to shocks and their roles in the global economy. The approach of examining and discussing advanced and emerging, developing countries is widely accepted in several research and policy papers.

[3] The analysis of the thesis covers the period from October 2008 to January 2023, with occasional shorter time spans for specific reasons.

The definition of emerging countries is more challenging than it originally seems. No official or single definition exists for these countries' groups, but several agencies, research, and financial market participants use working definitions to differentiate countries based on their maturity level. Following the International Monetary Fund's (IMF) approach, 39 economies are considered advanced, while the rest are considered as emerging and developing countries. The Fiscal Monitor (by the IMF) counts 40 countries as emerging and middle-income countries, and the IMF Finance & Development paper selects 20 emerging countries based on their nominal GDP, GDP per capita, population, share in world trade, and share of world external debt. These 20 countries account for 34 percent of global GDP and 46 percent if we consider purchasing power parity. They argue that these countries mostly appear in emerging market indices of large investment firms such as Bloomberg, Morgan Stanley and JP Morgan. (Duttagupta & Pazarbasioglu, 2021)[4] The latter approach is the most relevant for this thesis: the paper deals with countries involved in global financial matters but they are not yet considered as advanced economies.

The most important characteristic of emerging countries is the heterogeneity of the group. Generally, the institutional features lead to several economic and financial implications. From a general point of view, the convergence toward advanced economies and economic development produces higher growth in economic output, though this dynamic growth is often more volatile compared to advanced economies. This feature generally leads to a higher return and more risk for any kind of investment, and these factors also contribute to a higher natural inflation rate, though it may be offset by a monetary policy framework that imports financial conditions, mostly by pegging the exchange rate. As a result of these structural differences from developed markets, they react differently to external shocks; however, these reactions may also vary within emerging countries. (Karolyi, 2015)

Emerging countries have a special place in the global economy and they have been particularly important players in the last 40-50 years. The changing economic and political structure provided abundant opportunities for foreign investors and contributed to higher growth. As shown, the growth rate in emerging countries remained above the advanced economies. Before the GFC, emerging economies grew by 5 – 10 percent on average, giving a 2 – 6 percent advantage in growth compared to advanced economies. However, advanced economies had a larger recession around 2008, and the rebound was more vivid in emerging countries, where the growth rate and convergence slowed down visibly. Before the outburst of the coronavirus pandemic, the yearly growth was 4.4 percent on average in emerging countries and 2 percent in advanced economies. Similar to the GFC, the coronavirus crisis hit advanced economies to a larger extent: in the second quarter of 2020, the GDP fell by 4.2 percent in EM countries and 22.7 percent in the advanced countries. [5]

[4] Selected countries: Argentina, Brazil, Chile, China, Colombia, Egypt, Hungary, India, Indonesia, Iran, Malaysia, Mexico, the Philippines, Poland, Russia, Saudi Arabia, South Africa, Thailand, Turkey, and the United Arab Emirates.

[5] See Figure 4 in the Appendix.

While the Global Financial Crisis is considered as a major turning point in the history of the global economy, it is more difficult to measure how it affected emerging countries in general. Some countries benefited from the quicker recovery process, while others suffered from macroeconomic imbalances for several years after the global economy rebounded. (Didier, Hevia, & Schmukler, 2012) The common global shocks show the real diversity of emerging economies, as their development and natural economic conditions largely differ.

On the financial side, the major difference arises from two related factors. On one hand, as economies are developing more rapidly, the general risk of any kind of investment is supposed to be reflected in rates and financing costs. Though a local central bank may push down these rates temporarily, particularly in local currency, if the higher level of risk is not compensated, foreign investors, those who are vital for maintaining the growth, may invest less or even bring their capital to other markets. A more neutral and more observed fact is that local prices in developing and advancing economies tend to converge with global prices, and this phenomenon leads to a generally higher level of inflation compared to advanced economies (see Balassa, 1964 & Samuelson, 1964.) which also points to the way of higher interest rates in emerging countries, particularly in case of sovereign monetary policy with tools to set certain interest rates in the economy, most frequently an inflation targeting framework.

Regarding the dynamics, emerging countries had a similar experience in inflation as the advanced ones, but with a slightly different initial inflation level. After the Global Financial Crisis, a rebound occurred in inflation, but both inflation and interest rates remained moderate in the emerging countries in the 2010s. The COVID crisis also caused a negative inflation shock for emerging economies, while in the post-COVID period, inflation increased even more dynamically than in the US and the Eurozone on average. These trends and patterns can be misleading: as mentioned, the local monetary policy significantly impacts these variables and countries, and economic regions may have drastically different economic experiences in certain cases. On the monetary policy level, emerging economies could generally benefit from lower financing costs, but some economies experienced financial turmoil and sharp movement in financial markets. In these cases, local monetary policy authorities attempted to offset the international shock and the negative impact of capital flights.

Emerging countries have faced many crises in the last 40 years. The development process occurred hand-in-hand with difficulties of various kinds, most spectacularly in the financial markets. The financial market turbulences or more severe episodes of turmoil in the financial markets mostly arose from the fact that both policymakers and international investors were inexperienced, and the lack of trust quickly translated into sudden changes in the markets. Nonetheless, the financial ecosystem was usually underdeveloped and more sensitive to any negative news, but the open capital accounts and the lifting of capital controls did not allow policy makers to defend their currencies, and generally, the financial markets. Since the 1980s, several emerging countries had such negative experiences, with slightly different patterns.

The exploration of the reasons and conclusions behind emerging market crises extend beyond the confines of this thesis, encompassing the intricate history of financial market collapses in emerging economies. Claessens & Kose (2013) distinguish four primary types of emerging financial crises: currency crises, sudden stops, foreign and domestic debt crises, and banking crises. Importantly, these unfortunate events often occur in combinations. Building on earlier research, they categorize the history of currency crises in the late 20th century into three generations. In essence, the first generation pertains to crises in the late 1970s, the second generation elucidates financial crises of the 1980s and early 1990s, and the third generation typically characterizes the emerging market crises of the 1990s. A common thread among them is the basic cause: the attempts to sustain a fixed exchange rate that lacked support from fundamentals or was doubted by the markets. In subsequent episodes, the judgment of global investors gained prominence, with many scholars arguing for the self-fulfilling nature of these crises. Notably, the Asian crises in the 1990s and emerging market crises around the millennium were driven by currency mismatch, involving the accumulation of foreign debt in hard currencies, such as taking credits in foreign currencies. This latter was called the 'original sin' for emerging countries by Eichengreen et al in their 2002 paper. (Claessens & Kose, 2013; Eichengreen, Hausmann, & Panizza, 2002; Krugman, Obstfeld, & Melitz, 2018)

An interesting segment of the financial market development is the internationalization of the government bond markets, particularly those securities that are denominated in local currency. The market financing of sovereign debt is a great opportunity for emerging countries to expand their spending limits for various reasons, notably to finance public expenditures and smooth business cycle volatility. International investors first appeared on the sovereign debt market of securities with hard-currency denomination, which was perceived as relatively safer for investors, but riskier for the issuers. The involvement in unsustainable, foreign currency-denominated debt significantly heightens the risk of sovereign default, a phenomenon aptly termed the 'original sin' for emerging countries. (Eichengreen et al., 2002) The quick devaluation of the Mexican peso, the tequila crisis in 1994, was a great example of how foreign currency debt could be a dangerous choice for an emerging country. In the 2000s, and more spectacularly in the 2010s, local currency debt markets grew rapidly. As investment confidence increases in emerging countries, more countries can issue and sell bonds for international investors. These markets provided a great opportunity for investors, particularly when advanced rates fell to zero in the 2010s. This added an interesting angle to the emerging market puzzle: the local currency denominated bonds, particularly those that were issued by the sovereigns, were quickly matched with the international demand for more exotic portfolio investment, and issuers could increase their financing capacities or lower their financial costs. International investors enhance the liquidity and lower the yields on emerging bond markets, but it has two additional impacts. The risk of this process is that the more open a government bond market is for international investors, the higher the risk is that financing costs could dramatically increase when these investors stop financing the government debt. Second, as their constant demand continuously impacts the pricing, the effectiveness

of monetary policy may become more limited than previously anticipated. (Miyajima, Mohanty, & Chan, 2015; Moore, Nam, Suh, & Tepper, 2013)

The supply of government bonds, thus government debt, as a chart in the Appendix shows, remained moderate in emerging regions following the global financial crisis but advanced and emerging countries started to increase their debt in the low-rate environment of the 2010s. However, the increase was much more prominent in advanced economies, especially in the Eurozone, and refinancing risk increased in emerging countries. In other words: though it was easy to go into debt when rates were low, a general interest rate rise may cause challenges for certain sovereign issuers. It is important to note that, while in the pre-GFC period, particularly in the 1990s and early 2000s, emerging countries accumulated FX debt after GFC issuing local currency bonds gained popularity among emerging countries, and even foreign investors turned to debt denominated in local currencies. (Miyajima et al., 2015)

Who comprises the buyer base for government bonds? While there is no official high-frequency cross-country database tracking foreign holdings of government debt, estimates, such as those from the EPFR database, are widely employed in research papers to monitor these capital flows.[6] (Gudmundsson et al., 2022; Li, Haan, & Scholtens, 2018; Takats & Vela, 2014) The Chart below, based on the EPFR database, illustrates the international flow of bond investments, revealing a significant increase since the Global Financial Crisis. This chart provides a more nuanced perspective than an analysis of current account developments, as it is focusing exclusively on international bond market flows and offering a weekly frequency. Two notable remarks arise: firstly, these flows are believed to be closely linked to more developed, liquid, and stable government bond markets in larger emerging markets. Generally, government bond markets are more developed and trusted by international investors in the case of emerging countries. In regions where private-sector bond issuance is viable, successful government bond markets may facilitate capital flow to the private sector as well. Secondly, as argued by Miyajima et al. (2015), a substantial shift towards local currency debt issuance unfolded in emerging markets during the 2010s, suggesting that this market segment exerted significant influence on international flows.[7] The process, commonly known as the 'hunt for yield,' saw investors favoring international investments in emerging countries to seek better returns. However, an unexpected series of official communications in 2013-2014 about the termination of asset purchase programs by the Fed led to a sudden outflow of capital in the second half of 2013, termed the 'taper tantrum.' This incident serves as a case study, highlighting the significance of investors' sentiment on emerging financial opportunities and their strong ties to advanced markets' financing conditions. In the latter part of the 2010s, the Federal Reserve gradually tightened monetary conditions

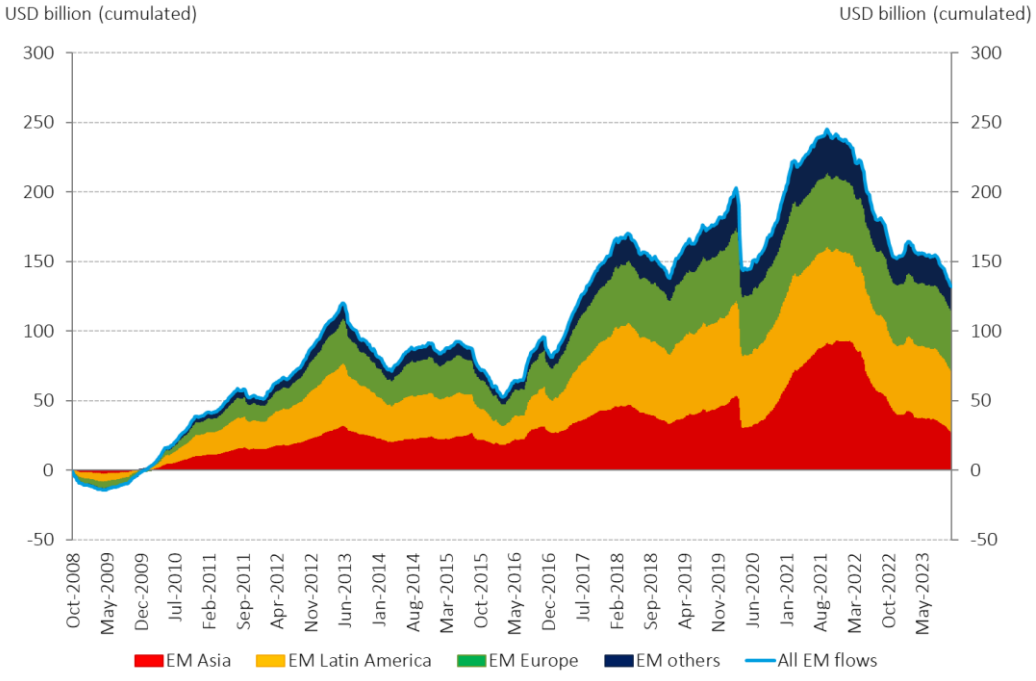
[6] EPFR database uses the portfolio allocation of large institutional investment firms and combines it with the amount of capital that flows into certain portfolios through a period under review. Several correctional methods, assumptions are used before reporting the data that was used for the chart.

[7] These remarks are necessary for the remaining part of the thesis, as the paper deals with government bonds issued by emerging countries in their local currencies. Admittedly, the chart is not granulated enough to show this market segment but believed to be a good proxy to introduce the underlying processes.

in a slow and well-communicated manner, resulting in market participants being less surprised than in 2013. Meanwhile, the ECB and the Bank of Japan maintained easy monetary conditions. Despite the Fed raising interest rates, investors' opinions on emerging markets remained broadly positive. A new, smaller wave approached emerging markets when the Fed started decreasing rates in 2019. Emerging market flows, amidst diverging advanced financial conditions, became more diverse. Some argued that balance sheet policies were the primary drivers of flows, and rate changes did not matter as much. (Koepke, 2017)

Concerning the recent past, the coronavirus era prompted an initial response of capital outflow from emerging markets. This was driven by the perception that these markets were more sensitive and likely to experience a larger contraction in economic output. However, as advanced central banks once again implemented monetary easing, restarting balance sheet expansions, capital inflows to emerging markets increased significantly despite the ongoing waves of COVID-19. Ultimately, the relatively rapid monetary tightening, both in balance sheet measures and interest rates, coupled with geopolitical tensions, jointly contributed to outflows from emerging markets. Regarding the regional inflows, one should be cautious as the bond markets largely differ, particularly in size. Generally, on nominal (USD) level, more capital flew to Latin American markets, while Asian markets experienced less of the investors' appetite until the coronavirus crisis. The emerging European markets experienced increased inflows in the second part of the 2010s when the ECB rate policy was accommodating. After 2020 flows became more balanced, and the large investment demand following the 2020 easing measures was nearly offset by the submission of the thesis.

2. Figure Cross-border bond flows



Source: EPFR Global (author's calculations).
Note: Cumulative flows in USD billion (thousand million) since the beginning of the time series.

How did these flows affect the pricing of financial assets? Monetary policy measures generally influence interest rates and the prices of fixed-income securities, as it is described as the first pillar of monetary policy transmission. (Mishkin, 1996) Empirical works revealed that this transmission worked well, and balance sheet policies in advanced countries during the early 2010s had an impact on asset prices as intended and led to lower rates. Cross-border investment demand may directly lower the government bond yields abroad, ceteris paribus. While long-term rates in emerging markets indeed decreased during the same period, local central banks generally decreased their rates, which is also associated with the general decrease in government bond yields. One of the key points of understanding the current issues of international finance is to determine what caused this simultaneous decrease in yields. It could be a viable argument that the price movements (or the scarcity of safe assets) increased the demand for riskier assets; hence, the decrease in yields spilled out of the advanced country and affected the pricing of emerging assets. Nevertheless, on the other hand, one may argue that the price movements were a result of a change in global (or local) prospects in terms of growth, inflation, or policy rate. BIS researchers found that not only yields of government securities decreased in emerging countries but also short-term rates and policy rates. (Takats & Vela, 2014) On the other hand, Füzesi et al. (2017) found mixed evidence of causal relationships in different cases: some EM countries were not affected by the Fed, and some were influenced by the change in the US rates, according to their research. (Füzesi, György, & Kutasi, 2017)

Therefore, understanding the relationship between the monetary conditions in advanced countries and the government bond yields in emerging markets is a subject of further research.

1.3 The expected contribution of the thesis

Though, emerging economies differ from advanced ones in many structural terms, their growing importance in the world economy is indisputable. According to the figures presented in this chapter, after the global financial crisis, advanced and emerging countries followed a very similar path in terms of monetary policy issues. However, it is subject of further research whether the visible movement was the result of independent factors and coincidental, or the large central banks in the advanced economies – by international capital flows – had a significant impact on financial conditions in emerging countries. Undoubtedly this leads to theoretical, practical and policy questions as well. Further understanding of international financial markets helps better understand the importance of external factors in domestic asset-pricing and gives an important input for policymakers to better understand the potential impacts of local monetary policy actions.

The aim of the thesis work is to present some parts of cross-border financial connections, particularly the impact of advanced central banks on emerging government bond markets. Based on the literature review and theoretical discussion, the rest of the thesis focuses on quantifying so-called ‘monetary policy spillovers’ with a brief discussion on the factors that relate to the sensitivity of emerging countries to changes in the external financial environment. Regarding the methodology, a relatively

large, panel-structured dataset is used to approach the research questions by employing various types of econometric methods.

The following contributions are expected from this thesis work. The general goal of the thesis is to provide a better understanding of the international financial markets, with a special focus on the interaction of advanced and emerging countries. Operatively, the paper seeks to quantify the so-called 'monetary policy spillovers', in the case of three large central banks. (Fed, ECB, BoJ) By doing so, the methodological problems shall be extensively discussed and aim to provide a solid framework for further analysis. As an extension of this framework, the next step is understanding the difference between emerging countries' reactions in different regions. The thesis aims to determine whether global or regional impacts are more important in case of the three advanced central banks concerned. For providing a comprehensive view on the matter, the thesis concludes by examining the sensitivity to global financial market shocks on a country-level. This sensitivity is attempted to explain with a wide variety of factors and particularly analyzes the importance of monetary policy framework. The ultimate goal of the thesis is to provide an overall view on the importance of large central banks in case of emerging bond markets.

The remaining of the thesis is structured as follows. The second chapter provides a review of the most prominent literature that is related to the thesis topic. In the literature review, the examined pieces are vary from textbook-like theories to the current grand theories of international finance. At the end of the second chapter, hypotheses are formed. The third chapter describes the methodology of the thesis, including the econometric methods and data sources. Chapters 4 to 7 discuss different approaches towards the research topic, with each chapter aiming to thoroughly examine a set of hypotheses. Chapter 8 concludes.

■

2 Literature review

This research contributes to the international finance literature, which closely intersects with various disciplines and explores the financial interactions among independent economies. It encompasses considerations in open-economy macroeconomics, dynamics within financial markets, and policy-related measures while generally relying on empirical contributions.

The linkage between economic production and monetary flows is inseparable in macroeconomic models. While the form of money has evolved over time, the fundamental concept of providing a durable product with a relatively stable value for exchange and value storing has endured. The money supply of a country is typically influenced by monetary authorities, generally central banks, as part of a broader financial policy mix. Additionally, an essential expansion of standard macroeconomic models involves incorporating the concept of open economies, thereby considering the impact of changes in foreign monetary policies. In broad terms, the cross-border relationship between two countries influences various aspects of economic activity.

The theoretical foundations for the policy framework in international finance trace back to the collapse of the Bretton Woods system, but inquiries into the interconnectedness of financial markets emerged even earlier. Mundell's seminal article, explaining the 'impossible trinity' and examining the relationship between exchange rates and interest rates, stands among the pioneering works. (Mundell, 1963) Over subsequent decades, these ideas gained paramount significance, driven by the liberalization of countries' capital accounts and the increasing prominence of cross-border financial flows.

The imperative role of financial development for emerging countries entering global markets became evident, accompanied by episodes of financial distress and crises, highlighting the necessity for sound financial policies. In the aftermath of the 2008 Global Financial Crisis, the response of emerging countries to monetary policy developments in advanced economies took center stage. Major economies deployed new 'unconventional' monetary policy tools to navigate recession fears, but the repercussions extended beyond borders. Numerous studies aimed to comprehend the reshaped landscape of global financial markets.

In this context, the contributions of J. Aizenman and H. Rey stand out, particularly their debate on the nature of financial market interconnectedness, providing a framework to grasp contemporary issues in international finance. Several other outstanding contributions offer insights from either a theoretical or empirical perspective. Papers falling into the latter category serve as indispensable predecessors to this thesis; the core of the research contribution is intricately connected to these seminal works.

This comprehensive literature review delves into the fundamental theoretical dimensions of financial markets and monetary policy, specifically focusing on challenges in open economies related to financial matters. The primary objective is to navigate through theoretical and empirical inquiries about cross-border financial relations, progressing from general to specific topics.

The following subchapter explores diverse perspectives on the research topic, illuminating the positioning of this research within conventional economic frameworks. Fo reach this goal, key concepts in international finance are scrutinized, encompassing a conventional, textbook-like approach, such as international parity conditions. Two additional dimensions augment the standard approaches: the distinctive attributes of emerging economies and recent insights into cross-border financial flows. The second subchapter introduces two predominant contemporary understandings of the global financial system. The third subchapter provides an overview of mainly empirical studies that serve as direct precursors to the thesis research. The fourth subchapter concentrates on the empirical trajectories of ongoing research in the field. The fifth subchapter synthesizes the literature review, aspiring to create a state-of-the-art compilation, offering a robust foundation for the theses formulated at the end of the chapter. The hypotheses are formulated based on these foundational pieces, and the methodology is crafted by following the path laid out by several articles. The results subsequently contribute additional perspectives to comprehend the cross-border impacts of monetary policy decisions.

2.1 An overview of the international financial theory

A meaningful exploration of the value of money and discussions around monetary policy necessitate a foundational understanding of the concept of money. Emphasizing the intricate relationship between specific securities, notably government bonds, and the interest rates that hold sway over the economy becomes crucial, with central banks playing a significant role in shaping these dynamics. Given the thesis's focus, it becomes imperative to extend this conceptual understanding to encompass international financial connections, distinctive features of emerging markets, and recent trends in cross-border financial flows within the global economy.

The history of money is intertwined with the evolution of society, witnessing significant transformations over the ages. The concept of money, designed to meet various societal needs, has manifested in diverse forms throughout history. Originating as a commodity-based system, particularly centered around gold, the global monetary landscape transitioned into a two-tier banking system overseen by central banks. In this evolved framework, central banks, operating within a specific jurisdiction bear the authority to regulate the value of money through a predefined set of tools aligned with their mandated objectives as dictated by legal frameworks. (Kürthy, 2018)

A more detailed introduction to the impact of money on economic history is provided by Blanchard (2016).[8] After the Great Depression of the early 1930s, prevailing macroeconomic theories, rooted in the business cycle theory, underwent a transformation with the advent of Keynes' 'General Theory.' Keynesian intervention, epitomized by the 'New Deal,' revolved around bolstering aggregate demand through state intervention and increased spending. Keynes also contributed to the monetary field by

[8] Chapter 24 in the cited book gives an overview on the history of economic thought after Keynes. The most important points of this chapter is summarized, therefore the original papers and books are not cited directly.

articulating the theory of liquidity preference, wherein interest rates influence the demand for money. Keynes' followers, such as Hicks and Hansen, further refined his original theory, leading to the formulation of the well-known LM curve within the IS-LM framework. In the post-war era, attention shifted to the impact of interest rates and asset returns. Notably, Franco Modigliani and Milton Friedman independently developed the theory of consumption, emphasizing the role of expectations. Concurrently, James Tobin and others delved into investment theory, establishing a link between investment value and the present value of future profits. Tobin's insights on liquidity, return, and risk continue to underpin fundamental principles in financial theory.

The prevailing positive stance on policy faced challenges from monetarists on three crucial fronts: the efficacy of monetary policy, the Phillips curve, and the role of policy. Foremost among monetarists, Milton Friedman contended that movements in money and output surprisingly coincided over the previous century, pointing toward the importance of monetary policy compared to the Keynesian preference for fiscal interventions. The Phillips curve, an extension of the Keynesian framework, established a link between inflation and unemployment. Monetarists questioned its validity, suggesting policymakers would exploit it if it existed, and argued for its disappearance if the rest of the theoretical framework held. Concerning policy importance, monetarists advocated for simple policy rules over focused efforts, citing the limited knowledge of the economy.

In the 1970s, the challenges in the US macroeconomic landscape sparked new discussions in the field, particularly surrounding stagflation—the simultaneous occurrence of low growth, high unemployment, and high inflation, unexplained by previous theories. Robert Lucas and Thomas Sargent introduced the 'Lucas critique,' emphasizing the inadequacy of existing models in handling agents' expectations about the future. The emergence of the rational expectations theory led to a reconsideration of the Phillips curve, asserting that only unanticipated policy measures have an impact. This shifted the policy recommendation towards viewing economic policy as a set of economic games rather than an effort for optimal control, considering agents' rational expectations. Rudiger Dornbusch's work highlighted that large swings in FX rates under floating exchange rates are rational responses, not necessarily speculative. In the 1980s, the focus shifted to explaining the monetary struggles of certain countries and the imperfections of credit markets, with contributions from Frederic Mishkin, Ben Bernanke, and Mark Gertler. The new Keynesian model and its special type, the DSGE models, gained prominence and became widely used for analysis. The 2008 financial crisis emphasized questions about market liquidity, financial market complexity, and the transmission of monetary policy tools. (Blanchard, 2016) Overall, since Keynes, the significance of interest rates and monetary policy has greatly increased, and financial markets, with their frictions, have become integral components of widely-used macroeconomic models by researchers and policymakers.

The challenge in comprehending the significance of the money market lies in the difficulty of rationalizing the impact of an asset whose value derives from the collective belief in its worth. Modern money's value is contingent on supply and demand, primarily regulated by its issuer. However, by

definition, money is created from nothing and possesses value only to the extent that it effectively fulfills its functions as a medium of exchange, unit of account, and store of value. (Krugman et al., 2018; Kürthy, 2018)

Modern monetary theory offers a contemporary perspective on the value of money. Randall illustrates the dynamics of money supply and demand using the analogy of bathtubs. In this analogy, constant inflows raise the water level when the stopper is in place, preventing outflow. Conversely, if the stopper is removed, allowing all the water to drain, the sink would be emptied over time, provided no inflow occurs. It is crucial to note that money creation involves introducing new credit into the economy or exchanging foreign currency, while money dissipation occurs when loans are repaid, or local currency is converted into foreign currency. Both processes occur continuously at a certain pace, with the inflows and drainage subject to influence based on the goals of monetary policymakers. (L. Randall, 2015)

The value of money can only be expressed in terms of other form of money. Traditional textbooks approach this issue through the lens of the intertemporal value of money, examining how much today's money is worth compared to money from previous or future years. A crucial factor in this analysis is the interest rates in financial markets. However, the concept of intertemporal value is only reasonable if concerns like liquidity risk do not apply. The value of money is typically observed in the interest rates of deposits, assuming the deposit can be withdrawn as agreed, the counterparty will not face bankruptcy or is at least insured, and, most importantly, the funds received at the end of the deposit contract can be used to a similar extent and will maintain a comparable value to today. This discussion leads to the question of riskless investment, which, by definition, does not exist. The lowest risk is arguably associated with a claim on the monetary system of a sovereign country, essentially the notes and coins in our wallets. Unfortunately, by their nature, they do not pay interest rates. [9] The aforementioned deposits align closely with this concept, especially when the counterparty is a trusted and insured participant in the money market. Given their widespread availability and minimal liquidity risk, deposit rates between banks typically serve as a base for investment returns. Securities play a crucial role in reallocating funds within financial markets.

The various types of securities and the risk associated with issuers create distinctions among investments, which vary in terms of both risks and return opportunities. See Mishkin & Eakins (2018) and Walsh (2017) for details. From an economic standpoint, fixed-income securities, bonds, and deposits with the same counterparty over the same investment period are virtually identical in terms of risk. Each entails an obligation of repayment, and short-term bonds and deposits can be considered close substitutes. Disregarding issuer risk, viewing short-term T-bills and deposits with similar maturities as comparable investments is common. Over the long term, the distinction lies in the time structure of the securities. Investors generally demand higher rates for longer periods, resulting in a

[9] The central bank digital currencies (CBDC) may address this question as the digital form may be revalued more easily, and therefore, it may pay interest if it aligns with the issuer central bank's goals.

positively sloped yield curve. However, in anticipation of decreasing interest rates, often due to changes in central bank policy, the yield curve may exhibit a negative slope or be completely flat. Forward rates, derived from spot rates or observed directly in the market, play a role in this scenario. Horváth et al. (2014) elucidated the value of forward rates by breaking them down into expected short rates and term premiums. The term premium encompasses factors such as uncertainty, risk, structural market changes during the investment period, and liquidity risk, where investors demand a premium for investing over an extended period based on liquidity preference theory. The riskiness of the investment stems from both general factors and the cumulative impact of various risk scenarios. (Horváth, Kálmán, Kocsis, & Ligeti, 2014b) Their theory essentially encapsulates the factors influencing interest rates and investment yields. In a broad sense, risks, encompassing liquidity and default risks, are typically compensated with higher returns.

Adding another dimension to the discussion of value, beyond the shift in internal value driven by intertemporal processes like interest rates, the external value—expressed in other currencies—complements these notions and elevates the comparison to a global level. The tradeoff between external and internal value forms a fundamental concept in international finance and, more generally, in international monetary policy coordination.

Fundamentals of monetary policy

The supply of money, especially in a credit-based monetary system, stands as one of the most impactful elements of economic policymaking and serves as the foundation for monetary policy. As several different types of monetary policy frameworks exist, countries may choose their own path and may deviate from a standard perspective on monetary policy. However, the core understanding of monetary policy intervention is understood in the following way. Typically, the local central bank, functioning as the monetary authority, operates with the objective of preserving a stable value for the domestic currency. This goal is commonly achieved by aiming for a predetermined inflation target. (Friedman & Woodford, 2011)

A prevalent monetary framework, inflation targeting involves setting interest rates and generally exerting influence on interest rates within the domestic economy. The primary aim is to primarily influence financial market assets and subsequently motivate real economy agents to make adjustments. This standard model of monetary transmission, as described by Mishkin (1996), is widely acknowledged. Other frameworks, either economically similar or not regarded as independent monetary policies reflecting the needs of the local real economy, include currency pegging or a currency board. These frameworks import monetary conditions from abroad, resulting in the external determination of the value of the money. (Blanchard, 2016; Mishkin, 1996)

The Global Financial Crisis, in 2008-2009 led to several new insights on the practice of monetary policy as central banks, first the ones in large and advanced economies, then emerging ones, applied new tools to combat the deep recession and the fact that interest rates may not be meaningfully or effectively decreased any further. (Ábel, Csortos, Lehmann, & Madarász, 2015; Balogh et al., 2013)

Concerning the domestic impact of unconventional monetary policy measures, there is a consensus that they proved effective in reducing risk premia as intended. (Hancock & Passmore, 2011, 2012; Krishnamurthy & Vissing-Jorgensen, 2011) The theory supporting the potential for further easing through balance sheet policy demonstrated practicality, offering policymakers additional flexibility. Horváth & Szini (2015) argued that the safety trap, reflecting a relative scarcity of safe assets, is a reality during times of distress, and quantitative easing policies can effectively address it by providing more room for safe asset issuers to supply the markets. (Horváth & Szini, 2015) In summary, monetary policy, which has evolved beyond simple interest rate setting with the inclusion of balance sheet policies, is viewed as an efficient tool for influencing interest rates in line with policy goals. The combined impact of these measures is believed to influence the real economy, contributing to economic growth.

In summary, monetary policy is a powerful instrument for shaping monetary conditions in alignment with policy objectives. Recent developments have seen its scope expand beyond conventional interest rate adjustments to include unconventional measures such as balance sheet policies. When considered collectively, these monetary tools are thought to profoundly influence the real economy, thereby influencing economic output.

International finance

Macroeconomics and the understanding of economic processes have traditionally focused on closed economies, where there are no external relationships in an economic sense. This perspective overlooks the potential impact of international trade, capital flows, cross-border investments, and international loans and reserves. An essential expansion of this closed economy concept involves relaxing this strong assumption to account for external factors that undeniably influence national economies in several ways. International finance specifically addresses financial connections between different countries. Considering different currencies and independent monetary policies, both external and internal rate environments influence currency value. The outcomes are reflected directly in FX exchange rates and the balance of payments, including a country's reserve levels. (Gandolfo & Federici, 2016; Kürthy, 2018)

On the policy level, Mundell's framework, outlined in his seminal paper, introduced the tradeoff later termed the 'impossible trinity.'(Mundell, 1963) This theoretical framework gained significance, particularly after the collapse of the Bretton-Woods system in 1971, and continues to shape international economics. The interaction between two economies is intricately tied to their monetary regimes. Countries adopting fixed exchange rates maintained through interventions may import or closely follow external monetary conditions, leading to a detachment from local business cycles. On the other hand, countries with floating exchange rates have more flexibility, adjusting interest rates to align with the local economy. According to IMF data, many countries presently adopt some form of fixed exchange system, with soft pegging being common. (International Monetary Fund, 2020) However, economically significant countries often opt for a combination of floating exchange rates

with minimal capital controls, representing a shift towards market-driven determination of FX rates based on supply and demand dynamics.

Parities and their critiques

In standard international finance textbooks, there are several explanations that aim to describe the relationship between financial markets on the international level. The most well-known explanations are the international parity conditions that seek to find a relationship between the spot and future exchange rates, inflation developments, and domestic interest rates.

The purchasing power parity explains a relationship between the expected spot rate and the difference in domestic inflation during a period. The static form is a generalization of the 'one-price law', which means that the same product shall cost the same amount of money in domestic currencies, therefore, exchange rates adjust accordingly. The dynamic (relative) form of the purchasing power parity explains that the currency with a positive inflation difference over another depreciates.

The Fisher effect is not an international parity but theoretically explains that, given that markets are efficient, the nominal rates compensate for future inflation and an expected real interest rate. In the short run, particularly in the case of securities with shorter maturities, there is some empirical proof that the nominal interest rate compensates for the expected inflation, but other types of financial risks exist at the same time. It is usually not listed among the international parities, but the idea of the Taylor rule also explains a similar relationship. There are several versions of this theoretical approach, but based on the well-known approximation, the optimal policy rate depends on the unemployment-gap and inflation-gap, compared to its optimal value, using weights that relate to the central bank's goal. The most important difference between the Fisher effect and the Taylor rule is that the latter is deliberately policy-orientated, while the Fisher effect explains a natural definition for interest rate.

The International Fisher effect, on the other hand, shows the relationship between exchange rate changes and interest rate differences: the currency with a lower interest rate on a given maturity shall appreciate against a currency with higher nominal interest rates during the respective time period. The logic behind this parity is that an international investor may only consider investing abroad for a lower interest rate if he believes that the foreign currency appreciates at the same time to compensate (or to gain) for the negative interest rate differential. In the context of the thesis, it was earlier explained that interest rate reactions are expected to be found other than predicted by the international Fisher effect: if the IFE worked perfectly, it would be impossible to find any other difference in rates after controlling for currency rates. It is important to note that the IFE takes into account actual changes in spot rates thus, it does not reflect to forward prices or expectations in any way.

Interest rate parity explains that the nominal interest rate difference equals the forward premium but with the opposite sign. As explained in Moffet et al. 2015 (p. 147): the difference in the national interest rates for securities of similar risk and maturity should be equal to, but opposite in sign to, the forward rate discount or premium for the foreign currency, except for transaction costs. Briefly, similar to the earlier argument at the IFE, the return of the same investment with the same risk shall be equal

in the same currency, given that the interest rate risk is hedged with a forward contract. This implies that the forward rate is determined by the interest rate differentials.

Finally, it may be remarked that the forward rate may be used as an unbiased predictor of future spot rates: all information from the market is expressed in a contract where participants agree upon a future term. However, the future spot rate may deviate from the forward rate of a given earlier point, the difference shall not be systematical and may not have been foreseen by market participants beforehand. (Gerber, 2014; Moffett, Stonehill, & Eiteman, 2016)

The problem with these theories is that international parity conditions imply that they are static, sometimes oversimplifying, and miss several other factors that should be considered. Variables that are connected to actual interaction between participants, such as interest rates and FX rates, are determined by market forces, and these markets are more volatile than theories suggest. This is the reason why these parities are suitable only as a rule of thumb instead of actual models.

The main idea behind the parities is that capital mobility, provided by an open capital and current account in the given country, enables investors to invest abroad to diversify their portfolios better. These external investments are crucial, especially for emerging countries. As argued, emerging countries differ in a range of characteristics from advanced economies. Therefore, two extensions are needed at least: to consider the special characteristics of emerging markets and to discuss the potential impact of cross-border financial flows.

Different characteristics of emerging markets

Jeffrey Frankel (p.1440) succinctly summarizes in the Handbook of Monetary Economics 3B (edited by Friedman & Woodford) the reasons behind the distinctiveness of monetary and economic policies in emerging markets. He highlights their heightened exposure to supply shocks and trade volatility, increased susceptibility to procyclicality in domestic fiscal policy and international finance, lower credibility of price stability, default risk, and imperfect institutional structures (Friedman & Woodford, 2011). This concise argument advocates for the utilization of separate models for emerging financial markets, underscoring the differences between the two country groups introduced in Chapter 1. The underdeveloped institutional background, coupled with more pronounced frictions in financial markets and the broader economy, renders assumptions less valid for emerging markets. The generally higher and more dynamic growth in these markets correlates with increased risks of various kinds, offset by the potential for higher returns. This economic landscape results in elevated domestic rates, a generally higher and more volatile inflationary environment. In a stylized representation, both the real economy and portfolio investments generally offer higher returns, with higher interest rates; however, risks are also heightened in the case of emerging countries.

A notable example illustrating the reactions of emerging economies is the aftermath of the global financial crisis in the late 2000s and early 2010s. At the outset of this period, signs of financial contagion were evident, with capital markets freezing, before the crisis management efforts of large economies, particularly the interventions of the Federal Reserve. In the most vulnerable emerging

economies, especially those heavily reliant on external funding, this financial contagion incurred immediate and substantial costs, primarily due to investor risk avoidance. The drying up of certain funding channels also led to liquidity concerns. Subsequent actions by the Federal Reserve had international repercussions, characterized not by the dramatic and intensive nature of the contagion itself, but by cross-border spillover effects resulting from central bank decisions (Bekiros, 2014), a relationship extensively discussed in Chapter 2.3.

In the subsequent years, as American and advanced economies achieved stable financing but faced lower demand and output globally, changes in the structure of international trade posed a threat to emerging countries. However, the supportive international financial conditions and the upward phase of the business cycle contributed to rapid recovery and strong growth cycles in many cases. Only a few vulnerable and overheated economies experienced painful adjustments and suffered from generally slow global demand. Raw data might suggest that emerging markets recovered faster and returned to the pre-crisis growth path, as indicated by empirical research conducted by Didier et al., 2012. Some analysts even referred to emerging countries as the new engines of global growth due to their faster recovery and more favorable growth patterns than advanced economies (Canuto, 2010; Gevorkyan & Otaviano, 2016). These authors primarily discuss whether the recovery of these countries is a result of the business cycle or if some could gain an advantage from the crisis and move on to a higher growth pattern under still sustainable conditions (Sztanó, 2018)

A rapidly growing segment within emerging markets comprises countries applying at least parts of Islamic financial principles. These countries significantly differ from other emerging nations in terms of their domestic financial sector, particularly the Islamic financial part. Although countries maintaining a Western financial system and deemed comparable from the standpoint of sovereign debt do not fall within the scope of this thesis, the operating mechanism and the relationship between the two types of financial systems are left for other authors to explore. (Hassan, 2017; Kim, Yu, & Hassan, 2018; Kovács-Szamosi, Kondor, & Varga, 2021; Rashid, Hassan, & Shah, 2020)

Bond yields in emerging markets

On one hand, as presented in Chapter 1, the category of emerging countries is not entirely homogeneous; different countries exhibit varying levels of resilience against external shocks, leading to distinct crisis management and recovery paths after global shocks such as the global financial crisis. These differences may also result in divergent growth trajectories.

From the thesis perspective, it is valuable to delve into papers that explore how these differences translate into domestic interest rates, bond yields, and overall funding costs for the economy. The surveyed papers primarily highlight the intriguing observations of the mid-2010s regarding the increasing popularity of the emerging market asset class, often underscoring the significance of international investors. Although these papers may not perfectly articulate the same process, they effectively contribute to discussions on emerging bond yields. It is essential to note that these papers focus on long-term yields, as international investors typically take positions in long-term government

bonds when investing in emerging asset classes. This segment of the yield curve is only indirectly related to local monetary policy actions. The articles are listed and summarized in chronological order.

Peiris' (2010) paper investigated the impact of foreign investors in local currency government bond markets. It found that these investors could decrease bond yields with their additional demand, and their presence did not necessarily lead to an increase in bond yield volatility; instead, it tended to stabilize these markets. While the primary focus of the paper was on this aspect, the reported regression suggested that domestic policy rates, inflation, fiscal deficit, and current account deficit significantly influenced long-term yields in emerging markets between 2000 and 2009, alongside the primary factors of foreign participation and US interest rates. (Peiris, 2010)

Jaramillo & Weber (2013) found that during peaceful times, when global investments were not burdened by risk avoidance, government bond yields in emerging markets were determined by inflation and GDP expectations. Conversely, when risk aversion rose, country-specific fiscal fundamentals came into the spotlight as investors became concerned about default risk. (Jaramillo & Weber, 2013)

Miyajima et al. (2015) argued that domestic factors predominantly influenced government bond yields in emerging markets in the decade preceding. They emphasized, however, that local currency bond markets were impacted by the extremely low rates in developing countries, indicating a slight shift in favor of global factors. This paper underscored the sensitivity of these models to country selection and the time period under investigation. (Miyajima et al., 2015)

Sensoy et al. (2016) adopted an intriguing correlation-network based approach and discovered that investors distinguish between emerging countries primarily based on key vulnerabilities such as budget deficits. They contended that geographical proximity also played a role in differentiation. Furthermore, they observed that the overall connectedness of the system stemmed from increased correlation within clusters, supporting the notion of potential segmentation among international investors. (Sensoy, Ozturk, Hacihasanoglu, & Tabak, 2016)

Özmen & Yasar (2016) elucidated this differentiation using credit ratings and potential speculation on future credit rating changes. They revealed that global investor sentiment (proxied by the VIX index) and credit ratings indeed determined a significant portion of sovereign debt spreads. However, the influence of credit ratings diminished after the Global Financial Crisis. (Özmen & Doğanay Yaşar, 2016)

Tebaldi et al. (2017) found that GDP growth, real effective exchange rate, and democracy played a decisive role in sovereign bond spreads in emerging countries. However, they found no evidence supporting the specific significance of financial openness or geographical location for yields. (Tebaldi, Nguyen, & Zuluaga, 2017)

Konopczak & Konopczak (2017) presented different results regarding the significance of international investors. They discovered a positive average impact of international investors, but the coefficient

associated with each country varied widely, even changing signs. Contrary to previous articles, they argued that the share of international investors may not be directly linked to yields, suggesting the existence of threshold-type or largely country-specific relationships. (Konopczak & Konopczak, 2017)

Cepni et al. (2021) identified that both global and local factors contribute to changes in yield curves in emerging markets, limiting the transmission of monetary policy in these countries. They found that the level of yields is associated with inflation or other financial variables, while curvature is influenced by local financial factors, and slope is mostly affected by global variables. (Cepni, Guney, Kucuksarac, & Hasan Yilmaz, 2021)

As emphasized multiple times, the heterogeneity of emerging markets is evident in their diverse responses to external shocks. This diversity influences domestic interest rates, bond yields, and overall funding costs, as explored in the reviewed papers. These studies primarily underscore the increasing popularity of emerging market assets and the role of international investors. The majority of the papers reveal shifts from domestic to global influences, with several highlighting the impact of foreign investors. However, standard factors originating domestically remain relevant, such as the role of inflation, GDP expectations, and fiscal fundamentals. The interconnectedness of emerging markets is confirmed in these papers, with differentiation linked to key vulnerabilities, credit ratings, and, in some cases, geographical proximity.

Cross-border flows

Finally, it is important to discuss how the actual flows developed in the last decades. As highlighted in Chapter 1, several types of investments may cross borders if capital mobility is provided, and the balance of payments provides well-known statistics for revealing the details of these flows. The thesis considers these flows a pivotal driver of emerging investments, particularly focusing on portfolio investments reaching local currency-denominated bond markets in emerging countries. The following articles are listed and summarized in chronological order.

Devereux & Southerland (2007) utilized a DSGE model to explore the impact of capital flows, contending that flows toward emerging markets could enhance international risk sharing, benefiting all participants. They argued that this benefit could be further amplified if monetary policy in advanced economies remains stable. (Devereux & Sutherland, 2007)

Forbes & Warnock (2012) introduced a new methodology and coherent analytic framework for gross international flows, departing from prior focus on net flows. They distinguished surges, when foreign investors increase their flow, and stops when they decrease their investment. The capital flight, a rapid increase in domestic investor outflows, was contrasted with retrenchment, its opposite. This differentiation proved to be significant, showing different responses to shocks between the two groups. The authors found that global factors, particularly risk perception, drove both foreign and domestic capital flows. Their analysis indicated strong associations with economic uncertainty, concerns about international growth, and contagion through financial linkages, trade flows, and geographic proximity. While they argued that local factors had limited influence, they asserted that these flows were less

associated with interest rate levels and liquidity, emphasizing the change in international investors' risk appetite. They also contended that direct influences, such as capital controls, were mostly ineffective in preventing sudden changes. (Forbes & Warnock, 2012)

Fratzscher et al. (2012) linked the surge in capital flows to changes in the Fed's monetary policy and argued that the Fed's QE2 program significantly contributed to the increased volume of capital, indicating that Fed policies have a portfolio rebalancing impact. (Fratzscher, Duca, & Staub, 2012)

Agosin & Huaita (2012) argued that the most likely cause of sudden capital outflows is increased inflows before. Controlling for several macroeconomic variables, they found that the relationship does not hold as firmly as with previous inflows. They raised two possible explanations: either they faced a market rumor resulting in a negative appearance for investors, unrelated to domestic factors, or the inflows themselves were not well absorbed and led to various types of problems, deviating from equilibrium, which is then considered a negative sign for investors. An interesting note to add is that this idea became familiar when different authors discussed the reason for the taper tantrum in 2013, later known as the 'in-and-out hypothesis.' (Agosin & Huaita, 2012)

Ahmed & Zlate (2014) found evidence that interest rate, growth differentials, and global risk aversion are primary drivers of net capital flows to emerging countries. They noted that interest rate differentials became more important since the crisis, while the growth differential remains significant for gross flows but not for net flows. They also observed that flows are more sensitive to interest rate differentials since the GFC. Regarding the offset of these international impacts, they suggested that some capital controls may be efficient to counteract them. They argued that the importance of quantitative easing at that time increased the significance of external factors on emerging market flows. (Ahmed & Zlate, 2014)

Lim & Mohapatra (2016) investigated the impact of quantitative easing on financial flows to emerging markets. They found that QE increased gross flows to EMs through liquidity, portfolio rebalancing, and the confidence channel. They also argued that these flows are mostly connected to portfolio flows rather than to FDI, which is more resilient to QE effects. They conclude that the same concerns that conventional monetary policy raises apply to unconventional easings, and they warned that poorly absorbed inflows may destabilize shallow (not well-developed) financial markets. (Lim & Mohapatra, 2016)

Cerutti et al. (2019) confirmed that global factors mostly drive gross flows toward emerging markets, particularly portfolio flows. They argued that the sensitivity of emerging markets to these flows differs significantly, and the main differentiating factor is the investor base—the entities that invest in the respective countries. Based on their findings, countries with a higher share of mutual funds exhibit greater sensitivity to global factors. On the other hand, they found little to no evidence for the significance of domestic macroeconomic and institutional factors. (Cerutti, Claessens, & Puy, 2019)

The last of these papers examines the changes from the post-global financial crisis (GFC) period up until the COVID crisis. Forbes & Warnock (2021) argued that after 2008, the occurrence of extreme

capital flows did not uniformly increase; in some categories, it even decreased. This shift is attributed to the implementation of macroprudential regulations and the enhanced preparedness of emerging countries to counter potential unwanted capital flows. This perspective contrasts with earlier views that correlated extreme capital flow episodes with global financial risk sentiment and perceived growth risks. (Forbes & Warnock, 2021)

The papers focusing on cross-border flows have underscored the motivations and potential impacts of such flows, particularly highlighting portfolio flows, which rely heavily on global investors' sentiment and advanced market rates. The occurrence of unwanted shifts in these flows remains ambiguous. While several countries experienced substantial inflows during quantitative easing (QE) programs, overall, it appears that emerging countries have learned to cope with these external factors, and unwanted, sudden changes are as rare as they were before the Global Financial Crisis in 2007.

Recognizing that sovereign economies are increasingly interconnected and that the perspectives of monetary policy in open economies are significantly influenced by various external factors, contemporary theories on the international financial system must not neglect the fact that emerging economies differ substantially from advanced ones and cross-border flows can have a substantial impact on domestic financial conditions.

2.2 Modern theories on the international financial system: the global financial cycle

Financial markets have witnessed increased integration in recent decades, and the constant interaction of the global pool of savers and investors has led to the cross-border development of financial matters. However, the question of whether sovereign countries should exert control over these international factors and, if so, to what extent, remains unclear. Over the past decade, numerous papers have engaged in discourse on this matter, giving rise to two predominant perspectives on the current state of the international financial system.

On one hand, Joshua Aizenman and other scholars contend that the Mundellian trilemma remains valid. Consequently, policy decisions rest in the hands of sovereign nations, allowing them to determine the primary channels for external adjustment. On the other hand, Helene Rey and her co-authors posit that cross-border flows generate the waves of the global financial cycle. Consequently, the room for maneuvering in case of smaller, less influential economies at the policy level is much lower than previously believed, particularly with FX rate policies. They argue that external factors establish a set of conditions mainly interest rates, and capital flows, that are challenging to influence unless some capital flow restrictions are used.

Aizenman argues that the Trilemma framework is still valid, though many changes in the last decades pointed toward rethinking the original setup. His view is summarized based on his 2019 paper.

As per Mundell's model, the policy tradeoff is still valid as the number of policy goals exceeds the number of policy tools. Let us consider the example of Denmark. As the financial policy mix is committed to maintaining the currency peg toward the euro and the capital movement is relatively free, the interest rate set up on the domestic market may not necessarily reflect neither the will of the local central bank, nor the domestic economic conditions. In case of a recession in Denmark, the local central bank could try to lower interest rates while keeping a quasi-pegged exchange rate, but it would result in either excess demand toward Eurobonds or capital outflows. Aizenman explains that the result would be a relative shortage in krone supply, winding up the local interest rates. In practice, the adjustment may take place on the FX market, and the shock may be absorbed via FX market interventions, thus, the level of international reserves serves as a limit for such Danish intervention. However, deleveraging international reserves actually shrinks the balance sheet of the central bank, which, on the liability side, means the necessary tightening via providing less krone, and this step is the other side of unwanted upward exchange rate pressure. Either way, capital mobility and fixed exchange rate determine domestic interest rates. This idea also aligns with the theories of parity conditions, explained earlier, though it is an extreme case where the FX rate does not change as per the central bank's legal mandate. Aizenman also explains the other policy choices via the example of the British pound. As the local central bank does not peg the exchange rate, the free capital flows provide that the interest rates set by the Bank of England remain effective by the necessary change in exchange rates. (Aizenman, 2019)

The trilemma framework relatively well explained the economic processes of the Bretton Woods era and remained relevant after its collapse. On the other hand, Aizenman points out three recent developments that significantly influenced the global financial system in the past decades.

First, the OECD countries, the most advanced economies, have chosen exchange rate flexibility and financial integration since the 1980s. As per the trilemma, this policy choice provides a larger influence on domestic financial conditions by enabling central banks to set up interest rates in the economy effectively. However, due to the free capital movement, certain countries accumulate large reserves while others become severely indebted, therefore, imbalances in current accounts have built up in the long run. As Bernanke explained in his 2005 speech, the increased level of global savings resulted in a significant current account deficit in the US and contributed to relatively low interest rates. (Bernanke, 2005) Among others, Kürthy argues that global imbalances result from the existence of one world money, and it is unlikely that a post-dollar international environment would be free of financial imbalances. (Kürthy, 2012) The adjustment in capital flows may happen via the exchange rate, but fundamentally different processes influence capital flows and foreign exchange markets, so these processes could not occur as perfectly as the theory suggests.

Aizenman's second remark is slightly connected to this phenomenon. The largest and most advanced European countries gave up their currencies when joining the Eurozone at the end of the 1990s. This was a game-changer in the global financial system: the euro is a reasonable candidate for being a significant reserve currency next to the USD, though the German mark had a similar role earlier. A potential candidate for world currency reshaped a financial landscape at the beginning of the 21st century, as Aizenman argues. However, the countries are well-developed, the Eurozone is far from being a perfect example of an optimal currency zone. A couple of years after the Global Financial Crisis, imbalances within the Eurozone caused financial market disturbances, and the Eurozone Crisis showed the problems of the common monetary policy. The adjustment is limited in the Eurozone, as the FX rate may not be aligned freely. (Benczes, 2013) Boros (2021) found that macro processes are able to converge toward an internal devaluation when labor costs vary. (Boros, 2021)

Aizenman's third remark relates to emerging countries' growing importance and their changing economic structure. After the collapse of the Bretton Woods system, many emerging countries experienced episodes of financial crisis due to imbalances in macroeconomic terms and the financial system. Several new countries became so-called 'market economies' at the beginning of the 1990s, and financial integration and opening of financial markets have continued. From an academic viewpoint, countless papers have been published on the matter of financial crises in emerging countries. The major root causes of these crises are excessive indebtedness in foreign currency (original sin, fear of floating) and/or large current account deficit that leads to adverse capital flows (sudden stops, capital flight) that hurt both domestic financial stability (banking crises) and external balance (exchange rate). (Eichengreen et al., 2002; Feldkircher et al., 2014; Felices & Wieladek, 2012;

Forbes & Warnock, 2012; Kenç, Erdem, & Ünalmış, 2016; Komulainen & Lukkarila, 2003; Lang, 2018; Thompson, 2012)

As a stylized fact, emerging countries have hoarded enormous reserves in the past decades. Aizenman argues that this is a result of the strategies followed by these countries as they tried to ensure themselves against unwanted capital flows, e.g., the central bank can defend its policy goals contrary to turbulences from abroad. Also, this is a direct consequence of the cross-border flows that Bernanke described as the global saving glut. This trend is particularly relevant and visible in the case of East-Asian economies. (Aizenman, Chinn, & Ito, 2017) Episodes of financial crises in the last decades did not pass without a trace in economic policy; thus, reserve management became an important policy tool, while financial stability emerged as one of the economic policy goals. This idea led to a renewal of the trilemma idea.

Financial stability means that financial markets are working properly and the transactional costs of asset sales are as low as possible. In practice, it means that the usual trade flow – even if asset prices are decreasing – creates a favorable environment for financial investments, while high and volatile spreads make investments more risky and uncertain. Emerging countries face financial stability concerns as a side effect of financial opening, mostly when capital markets are volatile or when significant capital leaves the economy in a short period (capital flight). This has a negative effect not only on other financial assets but also on the real economy; thus, financial policies aim to strengthen financial stability but are often contradictory to monetary policy goals.

Regarding the empirical assessment of trilemma concerns, several papers are known that successfully showed the existence of trilemma in a set of countries. Aizenman explains that financial stability is difficult to measure directly, thus, their contribution is also pointed at the trilemma concerns. They argued that the original framework is still valid with modifications: exposure to hard currency and currency regimes are still determinant factors for emerging countries. Also, he noted that countries usually do not use the pure version of policy choices, which leaves flexibility in assessment. As it was explained, countries choosing to peg their currency sometimes adjust the exchange rate, and it is quite rare that a strict version of pegging, such as a currency board, would work as a policy framework. Also, countries letting the exchange rate float sometimes intervene in the FX market, and certain types of capital flows are restricted. (Aizenman, 2019; Aizenman & It o, 2014) Recently, regarding the Central-Eastern European countries, Magas argued that euro adoption is a step toward exchange rate stability, but other successful patterns also exist in the region. For example, Czechia kept its monetary independence and the relative stability of the exchange rate, while capital movement restrictions are seriously limited due to its EU membership. (Magas, 2018)

Contrary to Aizenman, Réy argues that global comovement of asset prices is connected to capital flows and cross-border banking; thus interest rates are less likely to be influenced by trilemma choice but other factors that determine gross international flows such as capital controls. She first explained her views on the matter at the prestigious Jackson Hole Conference in 2013 and later published (with

coauthors) several papers explaining that international flows put trilemma in brackets in the post-GFC era. (Miranda-Agrippino, Nenova, & Rey, 2020; Miranda-Agrippino & Rey, 2020; Passari & Rey, 2015; Rey, 2015, 2016)

Her view became the lead chapter of the Handbook of International Economics, Volume VI, showing that this interpretation is among the most accepted. The following paragraphs follow the reasoning of this handbook chapter. (Miranda-Agrippino & Rey, 2022)

The original idea of Réy is that the international co-movement of asset prices could be and should be measured, and a relatively easy factor analysis helped to separate global factors in global rates and different types of flows. This common factor is examined thoroughly and contrasted with several measurements of changes in global financial markets. Their conclusion reveals that a relatively large share of changes is associated with core economies' financial policies. Réy points out eight stylized facts that are the cornerstone of her paradigm on the global financial system.

(1) *After applying factor analysis to a large set of asset prices around the globe, it turns out that 25 percent of the variance is explained by one factor associated with variables that measure the risk appetite of global investors.* Therefore, asset prices are significantly correlated, regardless of asset classes and geographical location, and the identified factor represents a significant part of the dynamics in global financial markets. Average factor loads grouped by countries and/or asset classes show that all of them are positive and broadly similar, though the common factor explains the movement of advanced markets to a larger extent compared to emerging countries.

In the paper, the global investor sentiment is measured by the VIX and VSTOXX indices which are implied volatility indices, meaning that the risk-taking behavior of market participants is derived from option contracts on respective equity markets. Using these indices is a standard practice to measure risk sentiment in the literature. The correlation between the global financial factor and the two indices are -0.65 and -0.7, respectively. Given that the higher value of these indices shows risk-avoiding behavior, it is possible to conclude that investors' risk-avoiding behavior is associated with a general drop in asset prices.

(2) *After applying a similar factor analysis, it was found that two factors explain 35 percent of the total variance in cross-border gross capital flows. The first factor is highly correlated with the abovementioned factor in global asset prices.*

(3) *The different types of cross-border flows are highly correlated with each other*. Another important part of Réy's argument is the connection between cross-border flows and asset prices. Portfolio flows – e.g. cross-border purchase of bonds and equities -, bank flows, and FDI are considered forms of cross-border flows in the research. An earlier paper by Barrot and Servén, cited by Réy, examined 85 countries between 1979 and 2015 and found that two common factors – one reflecting global and another country-type (advanced, emerging, and developing) explain half of the total variations in the cross-border capital flows. They noted that flows toward and out of advanced countries are explained in a larger share compared to those of emerging countries. Also, the difference

between out- and inflows suggests that large outflows usually originate from several countries flowing toward fewer markets. Also, they found that the global factor is explained mainly by variables such as US rates, VIX index, US real exchange rate, commodity prices, etc. In a slightly different way, Davis et al. used a factor model to jointly estimate inflows and outflows, but the timeframe was shorter: between 1996 and 2015. They found that two global factors account for 40 percent of the total variation in net flows, and the first factor strongly correlates with the factor identified by Rév and describes it as a global financial cycle. Rév used a similar methodology to Davis, and they were able to confirm their results. Though they used quarterly data from a completely different dataset, they found that two factors account for a third of total variation: the difference between the explained variation is the result of the different frequency as quarterly data is more volatile, as they explained. Also, Davis et al.'s remark on the relationship between flows and global variables has been confirmed by Rév. As they further explained, global factors for gross inflows and outflows correlate almost perfectly, which is similar to other authors' findings. (Broner, Didier, Erce, & Schmukler, 2013; Davis & Zlate, 2019; Forbes & Warnock, 2012) This means that similar factors drive net flows to gross flows, and the former has a closer association with domestic business cycles. Rév's other findings revealed that different types of flows are correlated with the same global factors.

(4) *The second global factor in global capital flows is associated with commodity prices, particularly oil prices. Thus, this global factor drives the global trade and commodity cycle.*

(5) *A third of the variance in global private liquidity may be explained by one factor, which is associated with the second global factor in capital flows*. Regarding the types and geographical breakdown of the flows, Asian emerging countries (particularly China) have the highest loadings for the second factor thus, generally, the Global Trade and Commodity Cycle is tied to emerging countries rather than to advanced ones. Banking flows are generally disconnected from the second factor, while FDI flows to emerging countries are significant and positively correlated to the commodity cycle.

(6) *The Federal Reserve has an important role in driving the global financial cycle via asset prices, flows, financial conditions, and credit supply.*

(7) *The ECB also has some role in driving the global financial cycle but to a smaller extent compared to the Fed. On the other hand, the ECB and the People's Bank of China greatly impact the global trade and commodity cycle.*

(8) *The asymmetry in international financial spillover between ECB and Fed has decreased in the post-GFC era.*

After reviewing several similar papers, Rév estimated a proxy VAR model with real economy and financial variables, incorporating data from the US, as shock originator, and global level data, such as world production, trade, asset prices, and capital flows. Based on the impulse response functions, an increase in US rates cools down the US economy and has significant international spillovers. Therefore, due to US interest rate hikes, global asset prices and capital flows (proxied by the two factors explained earlier) increase, while the VIX index also spikes. They concluded that the US economy not only has spillovers abroad but argued that Fed's monetary policy is a driver of the Global

Financial Cycle. Based on other papers, they concluded that ECB has a similar but smaller impact on the international financial system. Also, the ECB's policy is associated with the second factor, which is known as the trade and commodity cycle. A similar linkage is possible to note in the case of China, thus they concluded that the Federal Reserve is the primary in the Global Financial Cycle. Regarding the two large, they confirm others' views (Zorzi, Dedola, Georgiadis, & Jarociński, 2020) about the hierarchy: the influence of the Federal Reserve is larger than that of the European Central Bank, but the channels of spillovers are broadly similar. (Miranda-Agrippino & Rey, 2022)

Several authors contributed to this discussion over the years, thus, it is worth summarizing some of these papers. The main arguments of these articles and working papers were the importance of capital flows, the tradeoff between capital controls and FX rate policy, and monetary policy autonomy. For a general overview of reflecting papers, see Keskin, 2023.

Cerutti et al. (2017) disagreed with Rey, based on an empirical work that found far less importance of common shocks in cross-country capital flows than Rey. They also argued that the hypothesis of a central shock originator country (the US) is not plausible based on their results. (Cerutti, Claessens, & Rose, 2017) Reflecting on this paper, Batini & Durand (2021) argued that macroeconomically driven, 'warranted', adjustments and countries with high capital controls and macroprudential policies are indeed less exposed to the global financial cycle. (Batini & Durand, 2021) On the contrary, Adarov (2022) documented highly persistent and recurring financial cycles with lower frequency than business cycles and argued for intraregional synchronization of asset prices. (Adarov, 2022)

Arregui et al. (2018) created a financial condition index and argued that the majority of countries are able to manage their financial conditions mainly through monetary policy. On the other hand, they found that the common component, 'the global financial condition' accounts for 20 to 40 percent of the variation in domestic FCIs, but with large heterogeneity among countries. (Arregui, Elekdag, Gelos, Lafarguette, & Seneviratne, 2018)

Cheng & Rajan (2020) argued that periphery countries are able to maintain their monetary independence with floating rates and free capital flows when base countries ease their financial conditions, but they are unable to do so when base countries raise their rates. This is regarded as a fear of capital outflow, thus countries tend to follow tightening in order to counteract a potential capital reversal episode. (Cheng & Rajan, 2020)

Loipersberger & Matschke (2022) argued that floating exchange rates or mild capital controls are more beneficial than using both policies simultaneously. However, the parallel use of policy to mitigate international shock provides higher monetary independence but does not offset its cost on its own. In their paper, they argued that a potentially important channel may be the wages that firms can adjust more flexibly with floating exchange rates, while pegged currencies may be defended by mild capital control measures. (Loipersberger & Matschke, 2022)

In synthesizing the debate between Rey and Aizenman and contrasting their perspectives on the international economy, two central issues emerge as the focal points of their arguments. Firstly, there

is a divergence in their methodological approaches. Rey adopts an inductive approach, drawing from a broad spectrum of empirical results derived from modeling. In contrast, although he also uses quantitative arguments, Aizenman advocates for extending the theory-based Mundell-Fleming model, grounded in contemporary stylized facts and observations.

Secondly, Aizenman underscores the disparity between the two theories, attributing it to the hypothetical significance of foreign exchange (FX) rates and, more broadly, the efficacy of financial policies. According to Aizenman, the global financial cycle hypothesis dismisses the efficiency of FX policies in favor of advocating for capital controls. Furthermore, in Rey's work, financial policies and quantitative results are estimated on a global market level, with minimal regional breakdowns, offering limited room for differentiation based on policy measures. Consequently, this approach neglects the shock-absorbing capacity of the foreign exchange market, and this simplification is criticized by Aizenman. (Aizenman, 2019; Aizenman, Chinn, & Ito, 2015)

2.3 Empirical assessment of the cross-border impacts of monetary policy decisions

In the aftermath of the Global Financial Crisis, numerous studies sought to unravel the cross-border ramifications of newly introduced "unconventional monetary policy measures" by advanced central banks, with a particular focus on the Federal Reserve. While the primary emphasis of these papers lay on balance sheet policies, some also scrutinized other policy measures, and other shock originator central banks, including the ECB, were also considered. This segment of the literature constitutes a foundational source for the ideas presented in the thesis, as these articles closely align with the research contributions of the dissertation.

Concerning cross-border dynamics, the consensus among the majority of these papers is that the Federal Reserve's unconventional monetary policy tools had international influence, primarily affecting not only other advanced economies but also making an impact on emerging markets. An early working paper by C. Neely was published in 2011, three years after the Global Financial Crisis at the time of the second quantitative easing program of the Federal Reserve, and his analysis found that the early phase of the Fed's quantitative easing program had 'large international effects'. This work argued that the Fed not only eased monetary conditions successfully in the United States but also decreased long-term government bond yields in other advanced economies. He found that announcements of the programs had a significantly large impact on foreign yields, but other announcements, such as extensions and reductions, had only minor international impact. On the other hand, it is debated that this positive international impact lasted long enough in spring 2009 as long-term yields started to rise globally right after a significant drop. Neely argues that the program reached its purpose by reinstating investors' confidence, and the detected cross-border reaction should make central banks coordinate asset purchase programs in the future. (C. Neely, 2011; C. J. Neely, 2015) Later, in an article published in the Journal of International Money and Finance, Bauer and Neely found that German and Australian yields changed due to portfolio rebalancing and less due to the signaling channel. In Japan, they found a minimal impact of cross-border portfolio rebalancing but no proof of any signaling effect, which made Japan a possible candidate for shock originator country. In their conclusion, they argued that the signaling effect is larger in countries with generally stronger yield-response to conventional US policies, while portfolio balance effects are up to the substitutability of bonds. (Bauer & Neely, 2014)

Among several others, Bowman et al. (2015) focused on the impact that Fed had on emerging countries. They found that the initial announcements about the launch of the QE1 program and the 2013 'taper tantrum' had a significant, sizable, and persistent international impact, and sometimes the shock in emerging yields was greater than that on US yields. Their contribution focused on the factors determining the responsiveness of EM rates to Fed shocks. It was explained that countries with higher interest rates, larger CDS spread and current account deficits, lower GDP growth, less flexible exchange rate regimes, and economies with more vulnerable banking systems are more vulnerable to shocks. This type of vulnerability appeared to be a significant determinant: their theoretical model

broadly explains actual yield movements if these vulnerabilities are considered. (Bowman, Londono, & Sapriza, 2015)

Chen et al. (2012) had two important remarks in their early work. First, the quantitative easing programs of the Federal Reserve indeed had an international impact via the global asset price channel. Second, though the general impact appeared to be strong on emerging countries, it was also diverse as costs and benefits were distributed unevenly among those countries. Especially in the case of Hong Kong, Brazil, and Argentina, the Fed's easing led to strong capital inflow and rapid credit growth, raising the risk of inflation. (Chen, Filardo, He, & Zhu, 2012) Later, they found that in the case of Brazil and China, Fed QE programs contributed to the overheating of the economy in the years 2010 and 2011 but supported their recoveries in 2009 and 2012. Their analysis revealed that China tightened financial conditions due to the inflows from the QE programs, but Brazilian policymakers let further credit expansion increase in the economy, leading to overheating. (Chen, Filardo, He, & Zhu, 2016)

Similarly, a working paper by the ECB staff examined the Fed's first two rounds of quantitative easing programs. Based on other findings, they enumerated four channels in connection with asset purchase programs: (1) the portfolio rebalancing channel, (2) the signaling channel, (3) the dubbed confidence channel, and (4) the improvement of market stability. In the empirical part of their work, they found that substantial rebalancing of portfolio flows took place at the time of the first phase of the QE program, and capital had flown back to US stabilizing USD markets. On the other hand, the second QE program worked oppositely as capital flew toward emerging countries, leading to USD depreciation. Two other dimensions were highlighted: actual portfolio rebalancing is much more pronounced than announcements themselves, but the change in capital flows is not as dramatic as the changes in asset prices would imply. Regarding emerging markets, they found that policymakers failed to counteract these flows in emerging countries (they did not ease policy conditions), but sensitivity to country flows differed among emerging countries. It was found that flows affect those countries with better institutional quality with more active monetary policy to a significantly smaller extent, but fixed FX policies are less relevant. (Fratzscher, Duca, & Straub, 2013)

Similar results were found by Moore et al. (2013) as well. They argued that the Fed's quantitative easing programs are associated with an increase in foreign holdings of local currency denominated government debt, and their demand thus led to an overall decrease of long-term government bond yields in the countries regarded. Their panel regression analysis found that a 10-basis point decrease in US T-bond yields is associated with a 0.4 percentage point increase in foreign holdings of local debt, and this change in investor structure led to a 1.7 basis point decrease on average. In the case of the QE1 program, it meant a 100 basis point decrease in US treasuries and a 17 basis point decrease in EM yields on average, while during the QE2 program, an overall decrease of 13 basis points in the US and two basis point decrease in EM long-term yields. Regarding the distribution of this decrease, they also found that countries reacted heterogeneously to Fed's shocks. It was found that financial linkages to the US and the size of the government bond market made a difference between countries:

countries with larger markets experienced a relatively smaller shock during QE1 and QE2. (Moore et al., 2013)

Tillmann (2016) investigated the impact of the Fed announcement, but his methodology slightly differed from previous authors. He simultaneously used event studies and a VAR approach to create a so-called Qual VAR model. This model helped to reveal that Fed quantitative easing programs induced capital flows toward emerging countries, increased equity prices, made local currencies appreciate, and reduced bond spreads. As he compared these QE shocks to conventional Fed rate cuts, it was found that the impact on emerging countries is roughly similar in both cases. (Tillmann, 2016)

Georgiadis examined the sensitivity of different countries to Federal Reserve shocks by employing a modified VAR model, a so-called Global VAR. The reaction to Fed shocks proved to be different in emerging and advanced economies and the results were broadly in-line with the global financial cycle hypothesis. After testing several policy-related variables, he found that trade integration, better domestic financial development, and a more flexible exchange rate may help reduce vulnerability. (Georgiadis, 2016)

Füzesi et al. (2017) tested the hypothesis of whether the government bond yields in emerging countries, with particular regard to the government bond markets in the Central Eastern European region, are determined by the Federal Funds rate. They found that in the case of Turkey, the Czech Republic, Chile, and Poland, long-term bond yields are determined by the Fed rates, while in other cases, it is impossible to confirm. (Füzesi et al., 2017)

Gilchrist et al. examined the impact of Fed decisions on different maturities of foreign government bond yields. Using high-frequency data, they found that during conventional monetary policy regimes, Fed decisions influence short-term yields in advanced countries. In contrast, unconventional monetary policy steps, similarly to domestic transmission, are more likely to influence long-term bond yields. Thus, monetary easing conducted by Fed causes the local currency bond yield curve to steepen abroad when done by conventional measures and causes the curve to flatten during unconventional times. (Gilchrist, Yue, & Zakrajšek, 2019)

Hoffmann & Takáts (2015) found that both short- and long-term government bond yields in emerging and some of the small open advanced economies are affected by the changes in US bond yields, and they are associated with the Fed's monetary policy changes. They argue that financially more integrated countries' monetary policy is less independent of advanced monetary policy conditions as they intend to offset the changes in the external environment to avoid unwanted capital flows. (Hofmann & Takáts, 2015)

Takáts & Vela (2014) investigated the channels of monetary policy spillovers that affect foreign monetary conditions by employing a theoretical framework. They argued that portfolio rebalancing is the cause of changes in foreign government bond yields, meaning that international investors are adjusting their portfolios accordingly to a US monetary policy decision. They noted two other possible channels. On the one hand, they argued that advanced monetary policy decisions influence commodity

prices; thus, they indirectly influence commodity cycles, hence monetary policy decisions abroad. On the other hand, they argued that a market psychology channel might be active, which may cause sudden shifts in market sentiments occasionally. (Takats & Vela, 2014)

Iacoviello & Navarro examined 50 advanced and emerging countries in a panel framework. They found that responses to Fed rate changes are largely heterogeneous and investigated the factors influencing the responsiveness to such shocks. They argued that upon a Fed tightening cycle, the decrease in foreign GDP is approximately as large as in the US, though emerging countries show a larger decline. In emerging countries, the sensitivity to US shock does not depend on the exchange rate regime and trade openness but is definitely larger when a country shows signs of vulnerabilities. (Iacoviello & Navarro, 2018)

From the recent contributions, Eterovic et al. (2022) found that US monetary policy spillover to emerging policy rates (short-rates) is larger in times of Fed easings, which contradicts earlier papers. They found no macroeconomic root for the asymmetric reaction of emerging policy rates. (Eterovic, Sweet, & Eterovic, 2022)

However, most of the research papers focus on the cross-border impact of Fed policy changes, and several papers investigated the impact of other central banks. Aizenman and Rey also emphasized the importance of the European Central Bank, which started to employ asset purchase programs later than the Fed, but cross-border impacts have been found to be similar.

Colabella (2019) examined the impact of short-term rate changes on the real economy outside of the Eurozone. She applied a GVAR model, a complex vector autoregression,-- using observations from 31 economies (5 large non-European and seven from the CESEE region). This type of model uses data that describes the real economy of the respective economies as initial inputs, but the dynamic part works as a simplified, abstract model system without any feedback on actual variables. The described model system covers the countries that account for 80 percent of the world GDP and provides notable results on the impact of the ECB's monetary policy. The results suggest that an increase in euro short-term rates is associated with a persistent decrease in output in the case of Central-Eastern and South-Eastern European economies, while results outside the region are either insignificant or not persistent. (Colabella, 2019)

Regarding the spillovers of the ECB monetary policy, Varghese and Zhang explained that the transmission materially changed around 2014, when ECB asset purchase programs gained a much broader role in the Eurozone, providing additional stimulus to the whole economy, similarly to the QE program in the United States. On the one hand, they found that before the broad QE, the signaling channel was more influential. They argue that the signaling effect mainly has an impact on the investors' confidence in the central bank; thus, the overall impact is made up of the sum of two factors: 1) rising confidence may increase yields due to the credibility of reaching the inflation goal sooner 2) as quantitative easing program *per se* implies lower future rates, it may help decrease yields. After

2014, portfolio rebalancing became a more important channel, decreasing government bond yields in Central Eastern European countries. (Varghese & Zhang, 2018)

A comprehensive study by Fratzscher et al. investigated the domestic and international impacts and transmission channels of the ECB's monetary policy in the early 2010s. They found that early programs (SMP, OMT) had a positive impact on international processes, primarily via equity prices, but the impact on foreign government bond yields was marginal. Also, the positive impact was mainly attributable to the improvement of risk perception globally rather than actual flows, contrary to the findings in the case of the Fed. Overall, they argued that the impact of ECB decisions was limited, but they emphasized the importance of US monetary policy in global processes. (Fratzscher, Lo Duca, & Straub, 2014)

From recent contributions, Antal & Kaszab (2022) used an event-study approach and found that the nouvel asset-purchasing program of the ECB (PSPP, CSPP) led to a 1-6 basis point decrease in yields of non-Eurozone countries in the CEE region. (Antal & Kaszab, 2022)

Though monetary policy spillovers entered the spotlight during the quantitative easing programs of the large central banks, many authors examined the question more generally, while others considered the impact of potential quantitative tightening as well. A paper in IMF working paper series by Singh and Wang introduced a theoretical framework to discuss the future of monetary policy spillovers in the case of emerging countries. They found that countries employing fixed FX regimes may have difficulties offsetting external spillovers with one tool, as rate and balance sheet policies are likely to remain parallel in the advanced economies' monetary policy toolkit. They argue that additional tools such as capital controls and macroprudential policies may help absorb external shocks; therefore, emerging countries should expand their monetary policy toolkit. (Singh & Wang, 2017) This paper was published when the Fed was considering quantitative tightening thus to deleverage its balance sheet. The impact of the downsizing of the Fed balance sheet gained large interest, but a more cautious approach delayed this tightening method until it was no longer necessary for US monetary policy. Theoretically, the argument that FX flexibility may help absorb shock is valid, and other authors also propose the necessity of capital controls. However, the experience in the 2010s showed that FX markets could not absorb these shocks as they should have, and countries were unwilling to use capital controls as it would disadvantage international competition. However, the rise of macroprudential tools and the highlighting of financial stability gained some popularity indeed in emerging countries following the global financial crisis.

Several papers investigated the impact of the so-called 'taper tantrum'. When Fed Chairman S. Bernanke talked about the future decrease of asset purchases, in other words, about the tapering of the QE3 program, financial markets in the US and abroad reacted heavily. This event revealed that even small information on Fed easing policy might cause capital inflows and unwanted boost on foreign financial markets. The tightening of Fed policy can cause severe distress to the financial markets, with

reverse capital flows causing currency depreciation and yield increase abroad, especially in emerging countries.

Among many authors, Eichengreen and Gupta (2015) confirmed that tapering talks had a sizable negative impact on emerging financial markets, showing that countries with relatively large and liquid financial markets, particularly those that experienced larger inflows earlier, experienced heavier market reactions. They also showed that contrary to common market belief, better fundamentals did not provide shelter against market turbulence: though exchange rate movements and current account status were indeed significant differencing factors, these factors are associated with the previous inflows. That being said, investors indeed started to rebalance their portfolio upon the new information provided by the Fed, and they had an easier job on larger and more liquid markets, in general, thus leading to severe financial distress in some countries. (Eichengreen & Gupta, 2015)

Caceres et al. investigated the US monetary policy spillover effect via the glass of the tightening policy of the Federal Reserve. They had several remarks on the transmission of the US rate policy. First, they found that long rates are more affected and mostly reflect the synchronization of business cycles. Second, they noted that surprise rate hikes are more likely to be transmitted to other countries, and expected rate changes in rates are less significant. Thirdly, they differentiated the impact of expected future US rates from other components, the so-called term premium. They found that both are important, but each country reacts differently to these components. Fourth, they noted that some countries had limited monetary autonomy due to external factors. (Caceres, Carrière-Swallow, Demir, & Gruss, 2016)

Dedola et al. reflected on the Fed tightening cycle that was in progress then. They used a model-based approach to evaluate the impact of the interest rate hikes conducted by the Federal Reserve System. They found that tightening policies have significant cross-border macroeconomic and financial impacts. As a result of interest rate hikes, currencies depreciate vis-á-vis the USD, industrial production, real GDP, and inflation decrease, while unemployment rises abroad. Regarding emerging markets, macroeconomic volatility tends to increase, while financial market reactions are heterogeneous. Though bond premia mostly increases abroad in most cases, a decrease in equity and real estate prices occurs only in half of the countries. The most important result of their paper is that they found that none of the financial characteristics and policy approaches can be associated with the heterogeneity of the responses. They found no evidence that financial openness, exchange rate regimes, or capital controls explain the diversity in the reaction to Fed policies. (Dedola, Rivolta, & Stracca, 2017)

Some authors went beyond the simple quantification of monetary policy spillovers. In a data-rich panel data framework, Albagli et al. (2018) investigated the impact of the US monetary policy on both developed and emerging countries with an event study approach. They concluded that cross-border transmission of US policy became more important after the Global Financial Crisis and affected developed and emerging countries differently. They decomposed long-term bond yields into expected

short-term rates and term premiums and found that term premiums are more dominant in the case of emerging countries. Another decomposition method used different channels and found that the information channel, thus the information that FOMC delivers with its announcement, is less important as it is believed, but the exchange rate channel is a dominant transmitter. While developed markets are more likely to react in terms of rate with limited actual capital flows, in the case of emerging countries, capital flows are dominant, and exchange rate policies play a critical role in the absorption of US monetary policy shocks. (Albagli, Ceballos, Claro, & Romero, 2018)

Gagnon et al. (2017) primarily focused on the current account impact of quantitative easing, but in a part of their work, they set up a framework to understand how US monetary policy announcements and macro data releases impact foreign financial variables. In the case of the majority of emerging countries, they found that the relationship between US macro data and foreign bond yield is positive and significant, meaning that they are moving in the same direction. Interestingly, in some cases, the coefficient appeared to be negative and significant in countries with higher default risk. Their interpretation is that good news for the US is lowering the default risk in troubled countries. On the other hand, contrary to other papers, they found that the impact is smaller around Fed announcements because US rate changes associated with rate hikes, they argue, are not related to additional demand toward foreign countries' debt securities. (Gagnon, Saborowski, & Sapriza, 2017)

Instead of focusing on actual monetary policy decisions, Bhattarai et al. used a more sophisticated method to identify shocks originating from the US. A VAR model was used to identify so-called US uncertainty shocks. A separate panel VAR model concluded that adverse US uncertainty shocks decrease EME output and inflation and increases net export. Regarding the countries, significant heterogeneities have been identified in the sample. They found that Latin American countries experience stronger reactions in trade and capital flows, though negative impacts on output, exchange rate, and stock prices are weaker. Behind the difference between Latin American reactions from other EMs, they concluded that monetary authorities in Latin America are less keen on offsetting the impact of capital flows resulting from US monetary policy shocks. (Bhattarai, Mallick, & Yang, 2021)

Alipanah & Kiss (2023) focused on the volatility of emerging currencies and their determinants. They found that Fed and ECB monetary policy shocks explain some of the volatility of emerging market currencies, and those with closer ties to US and Eurozone are more vulnerable to financial spillovers. (Alipanah & Kiss, 2023)

Kang & Suh investigated a less frequently researched area, raising the question of whether financial turmoil, caused by advanced central banks (thus the monetary policy spillovers), could spill back to advanced economies or the whole global financial system level. This relation is called 'reverse spillovers'. They found that stress on emerging markets caused a decrease in portfolio flows to advanced markets, and the CDS premia increased simultaneously. They argued that emerging countries tend to influence global financial conditions at the time of financial stress to a larger degree. (Kang & Suh, 2015)

Several papers have aimed to compare the importance of large central banks, though there is still room for comparative analysis. Zorzi et al. compared the impact of the Federal Reserve and European Central Bank in a common framework to investigate whether a hierarchy exists between the central banks in terms of cross-border impacts. They found that both central banks efficiently control domestic variables, especially inflation, and their impact on financial markets is in line with their intention. The Federal Reserve has a small but significant impact on the euro financial markets, and to some extent, it also impacts European inflation. Regarding the cross-border impacts on the rest of the world, they found that the Fed has a significant spillover impact on emerging countries while the ECB does not. The authors argued that there is no need for coordination between the large central banks. (Zorzi et al., 2020)

Kearns et al. used high-frequency data to understand the channels and the importance of monetary policy spillovers. They argued that trade linkages do not have any impact, while different exchange rate regimes may react differently. Overall, the most important determinant of spillovers appeared to be financial openness: the more financial linkage a country has with the US or the Eurozone, the more likely it is to experience monetary policy spillovers. They also found that spillovers mainly affect long-term yields, while short-term yields remain relatively independent, governed by local monetary authorities. (Kearns, Schrimpf, & Xia, 2018)

Santis & Zimic found that US rates are the primary origin of international monetary policy spillovers, European monetary policy changes only have a sizable international effect at stressful times and when the ECB introduced more aggressive easing measures. (Santis & Zimic, 2019)

Curcuru et al. (2018) examined spillovers via decomposing long-term yields into expected short-term and to term premium components. They found that neither Fed's nor ECB's policy caused any shift in the other region's expected short rate thus the total shift considered as spillover is connected to the term premium component. In other words, it declines a common viewpoint that markets are pricing any coordinated actions of advanced central banks. Also, they rejected a popular view that balance sheet policies had unusually large spillovers after the Global Financial Crisis. (Curcuru, Kamin, Li, & Rodriguez, 2018)

Mehrotra et al. (2019) investigated the impact of the Fed's spillover associated with the expected future US rates or the term premium. They found that similarly to Curcuru (2018), EM rates are more connected to the future Fed rate component than the term premium. They explained that it also means that quantitative tightening may not be that severe for emerging countries. They also argued that macro vulnerabilities make EM countries more sensitive to US shocks. (Mehrotra, Moessner, & Shu, 2019)

Walerych & Wesołowski (2021) found that both Fed and ECB play a significant role in the global business cycle, mostly investigating macroeconomic variables, contrasted with anticipated and unanticipated international spillovers. They also documented that in the CEE region, the EUR's impact is larger than the Fed's. (Walerych & Wesołowski, 2021)

Miranda-Agrippino & Nenova (2022) found that the aggregate real spillover of the Fed is higher, but on the financial market, their impact is roughly similar in magnitude, sign, and shape. In other words, the international risk-taking channel is similar compared to the Fed. These latter findings differ from several earlier papers claiming that the ECB's impact on the financial markets is weaker. (Miranda-Agrippino & Nenova, 2022)

From recent contributions, Badics et al. (2023) used a network-based approach to analyze the impact of large central banks in other, smaller advanced economies, thus, their paper is somewhat different from the other Authors'. However, their finding is interesting enough to include in this review: they found that the dominance of the USD factor is primary in all subperiods, though, it differs in center periods. The importance of the USD influence is the largest when it hikes rates and the lowest when the ECB actively conducts easing programs. (Badics, Huszar, & Kotro, 2023)

Curcuru et al.'s (2023) paper was also published recently, but they used both emerging and advanced economies in the sample. The novelty of their paper relies on the rigorous decomposition of rates in a similar way as Horváth et al. (2014) did. Moreover, they empirically confirmed that conventional policies and forward guidance influence the expected short rate, while unconventional policies influence the term premia. Also, they documented that the two large central banks' unconventional policies indeed decreased each others' term premia in a significant extent. (Curcuru, Kamin, Li, & Rodriguez, 2023; Horváth, Kálmán, Kocsis, & Ligeti, 2014a)

Malliaropulos & Migiakis (2023) executed a large-scale data collection, revealing the relationship between 10 shock sender advanced economies that applied balance sheet policies and 45 shock recipient advanced and emerging countries. Their findings revealed that the aggregate additional liquidity was more influential than the Fed's balance sheet policy on its own, and particularly after the COVID19 crisis, the decrease in recipients' yields was mostly associated with the additional liquidity in the global financial system. (Malliaropulos & Migiakis, 2023)

Each of the reviewed papers consistently concludes that advanced central banks exert a quantifiable impact on the financial conditions of emerging countries. Many studies underscore the presence of real economy linkages, emphasizing that U.S. financial policies can influence foreign output. Among various scholars, Réy explains this transmission mechanism through the growing significance of cross-border financial flows and the dynamics of international investors' behavior.

The most thoroughly explicated relationship pertains to the spillover effects of the Federal Reserve's monetary policy on emerging countries. The easing and tightening of U.S. monetary policy have exhibited a significant, quantifiably measurable impact on emerging market rates. In contrast, the impact of other central banks is less explicit: several authors posit that the Eurozone has a comparable albeit smaller influence on emerging economies. As for the Bank of England, Bank of Japan, and People's Bank of China, the available information on the cross-border transmissions of their rate policies is limited.

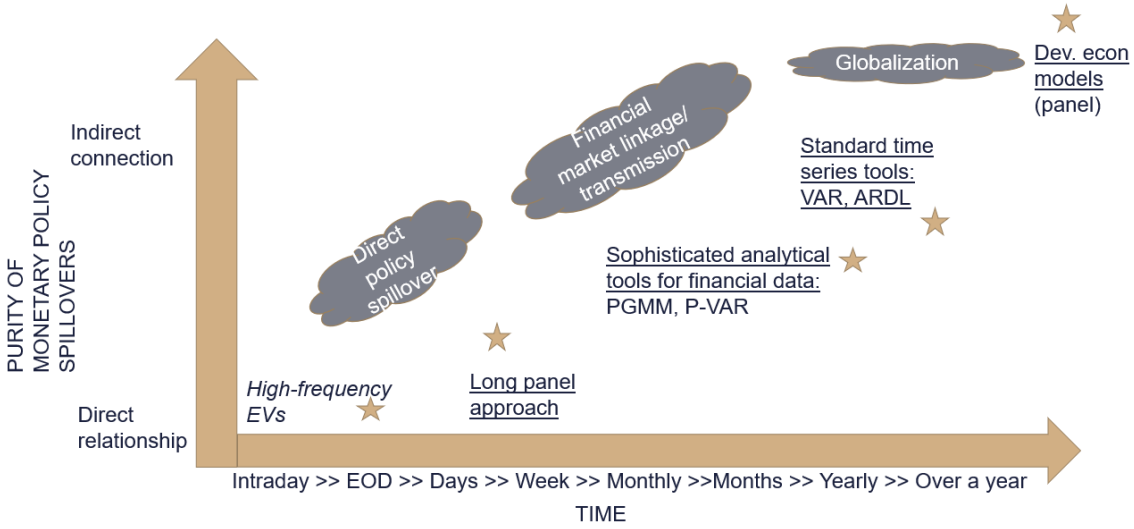
2.4 Survey of methodological approaches

This subchapter explores papers that influenced the development of the thesis methodology. Many of these papers, including those in the broader literature addressing the quantification of monetary policy spillovers, share a common objective: establishing a systematic, quantitatively valid relationship between the variables associated with the shock originator and those of the shock recipient. The diversity in methodologies stems from variations in approach, variable scope, data structure, and estimation techniques.

Numerous articles offer comprehensive insights into international financial shocks. Some of these models are extensions of macroeconomic models, where stylized facts are translated into equations outlining the trajectory of target variables. While certain parameters and variables incorporate factual data during calibration, these models lean towards theoretical constructs. They range from relatively simple models focusing on a limited part of the economy to extensive macro models (such as DSGE-type) that capture the entire economic system. Another distinguishing factor is the extent to which these models utilize actual data. Shaghil et al. (2021) and Zorzi et al. (2020) developed notably different models for a similar research question. Shaghil et al. emphasize rigorous economic arguments and equations in describing processes, using actual data for calibration as a mere illustration. In contrast, Zorzi et al. (2020) employ a substantial number of variables, with theoretical arguments more strongly supported by actual data. (Shaghil, Ozge, & Albert, 2021; Zorzi et al., 2020)

A simpler yet effective approach involves quantifying the influence of major central banks by employing past observations through a selected regression method. The concept is direct: observed data points are subjected to regression, often within a modified simple linear regression framework. This method strives to model processes based on historical values and developments, with the chosen econometric solution seeking a robust and quantitative model. In this case, the economic argument primarily informs variable selection, and the suitable quantitative model is chosen based on the available data.

3. Figure Advantages and disadvantages of certain quantitative models



The graph illustrates the tradeoff between estimating the direct impact of monetary policy decisions and the availability of suitable data. An event-study approach, similar to Falagiarda & Reitz (2015), often employed with daily or intraday data, is inclined to reveal the immediate effects of changes in foreign monetary policy. However, its generalizability is limited due to the model's inability to extend beyond short event windows. This approach struggles to capture the nuanced relationship between the originator and recipient markets of the shock. (Falagiarda & Reitz, 2015) Similarly, models reliant on yearly observations, commonly used in development economics, may inadequately grasp the essence of monetary policy shocks. Time series models, while potent in modeling the relationship between two variables, risk information loss by overlooking the heterogeneity of emerging countries and struggling to differentiate certain coinciding factors from the target process. ARDL models became popular recently due to their flexibility, and there are several good examples, for example, Moder (2021), of applying it on financial data. (Moder, 2021) A modified version of vector autoregression models is used by several authors, including Tilmann, and this approach may be regarded as classical. (Tillmann, 2016) The choice among panel models involves deciding between a long panel model, which is unconventional, and a more sophisticated panel model suitable for lower-frequency data. The empirical strategy is influenced by exemplary panel-GMM models, motivating the chosen approach. (Czeczeli, 2021; Georgiadis & Zhu, 2011; Shinagawa, 2014)

Each of these approaches holds validity when applied consistently and accurately, yet their suitability depends on the nature of the data describing the investigated processes. The dissertation aligns most closely with the last group of papers that utilized diverse regression models to estimate the historical impact of major central banks, relying on both observed and generated financial data. The execution of this strategy, stemming from papers that notably influenced the development of the empirical approach, is further elaborated in Chapter 3.

2.5 Synthesis of literature review: a state of art

In summary, the literature indicates that financial markets are globally connected, and achieving financial stability necessitates accounting for external impacts. These impacts include changing external interest rate conditions, external demand for domestic assets, and capital flows. The conventional understanding of the relationship between open economies and foreign countries' monetary policy is partially elucidated in textbooks. The connections between inflation, interest rates, and FX rates (both spot and forward) are articulated through so-called 'parity conditions' in these textbooks. Grand theories endeavor to apply these theoretical frameworks to the intricate dynamics of global financial markets.

The seminal contribution of Mundell and Fleming forms the foundation for policy choices and deduces the potential interconnections influencing the decisions of sovereign economic policymakers. However, the evolving international financial landscape and the frequent choice of countries do not adhere strictly to the policy trilemma calls for a reconsideration of the original explanation. Aizenman argues that financial stability became an important goal for emerging countries as a result of a decade-

long history of financial crises, even though the primary goal is expressed in a framework of inflation targeting or exchange rate peg. The policy tool for achieving financial stability is the hoarding of international reserves, broadly similar to the actual reserve management behavior of some emerging countries recently. Another empirically driven theory is the Global Financial Cycle, which has become popular in the last decade. This suggests that major players, notably some of the advanced central banks, especially the Federal Reserve in the US, generate waves in external financial conditions that impact all smaller, non-core countries. This theory not only elucidates the connection between financial markets at the price level, but it is also in line with specific capital flows scrutinized by the authors. Both approaches assume that global financial markets are interconnected, but the nature of this relationship is debated.

Several empirical papers focused on the actual relationship between advanced monetary policy decisions and the financial conditions in emerging countries. They found that the impact of the Federal Reserve is undeniable, though the European Central Bank is also an important player in the global financial markets. From the perspective of smaller, non-core, open economies, the ability of shock absorbing differs, and several factors may influence it. While external financial conditions can influence domestic financial markets in several ways, channels of adjustment (like flexible exchange rates) and policy choices may help mitigate these effects.

Journal articles, working papers, and book chapters from many authors examined the size and transmission of monetary policy spillovers: the monetary shocks that originate from (one or more) advanced countries and influence the interest rates in foreign, mostly emerging countries. However, these papers were mainly prepared and published after the Global Financial Crisis, when advanced central banks eased monetary conditions to a historically intensive extent due to low inflation and low demand in advanced economies. The ‘taper tantrum’ in 2013 showed that these generally positive spillovers may change into a capital flight situation in case international investors perceive the upcoming change in global financial conditions. Furthermore, this episode was investigated by several authors, and more general conclusions have not been drawn, even though the Fed stopped its extreme easing policy in 2014. Furthermore, many papers suggest that the impact of easing and tightening may be asymmetric, because negative news are priced into assets more intensely.

The second half of the 2010s saw a varied global monetary environment: while the Fed increased interest rates, deleveraging its balance sheet, thus the quantitative tightening did not take place substantially. The European Central Banks continued easy monetary policy due to low demand in the euro area in this period, and asset purchase programs were not even terminated, but extended to be rather a monetary policy than a financial stability tool. This divergence was reflected in the monetary policy of emerging countries: while central banks in Latin America tightened their policy, Central European central banks kept low interest rates due to low domestic inflation and extremely weak external inflationary pressure. The outburst of the COVID19 crisis at the beginning of 2020 reshaped the financial landscape again, and the reaction of central banks was the extreme easing again. These

changes in the global financial markets inspired reviewing the size of monetary policy spillovers and measuring them with several approaches.

The debate between Aizenman and Rév and the fact that asynchronous steps by the Fed and ECB lead to an increase in the heterogeneity of emerging financial markets raise the question about the power of the large players and a probable hierarchy between large advanced central banks. It is also arguable that tight real economy linkages are mirrored in financial relations, therefore, advanced central banks' impact should not be measured by overall influence on the global field only, but it is meaningful to consider regional impacts as well.

From the perspective of emerging countries, it is important to know to what extent external financial conditions may deteriorate local asset prices and rates. The sensitivity of local rates to global shock has a vast literature so far, but it is mainly examined from the aspect of financial stability. Therefore, the adverse reactions to negative shocks, as well as the nature of capital flights are extensively investigated by many authors, while it is rarely challenged what the rate of international monetary policy transmission is in regular times. Moreover, this transmission is meaningless without understanding of what makes an economy more sensitive to external shocks. A natural explanation would be that being an open economy is a risk in real and financial terms, but many authors discussed the adverse effects of capital control measures., It is also commonly explained that structural problems and imbalances are the root cause of external vulnerability. Revisiting the theories, it is also an adequate approach to assume that cross-border interest rate passthrough is in close connection with the FX rate regime and FX rate stability. Following Aizenman, it seems that higher FX rate stability may be associated with larger sensitivity to rate shocks, but based on the Global Financial Cycle hypothesis, the importance of the FX rate in absorbing monetary policy spillovers is nonexistent.

Reviewing the existing literature, a comprehensive understanding emerges of various perspectives on the intricate dynamics of global financial markets. The following paragraphs explain the logical steps and assumptions on which the subsequent chapter will be built. The prices of government securities are determined in financial markets based on supply and demand. In both advanced and emerging markets, several factors contribute to this price development, including but not limited to the influence of local monetary policy, expectations about the future rate path and macroeconomic processes, moreover, a set of technical factors such as liquidity, default risk, and risks associated with the security itself as an investment option.

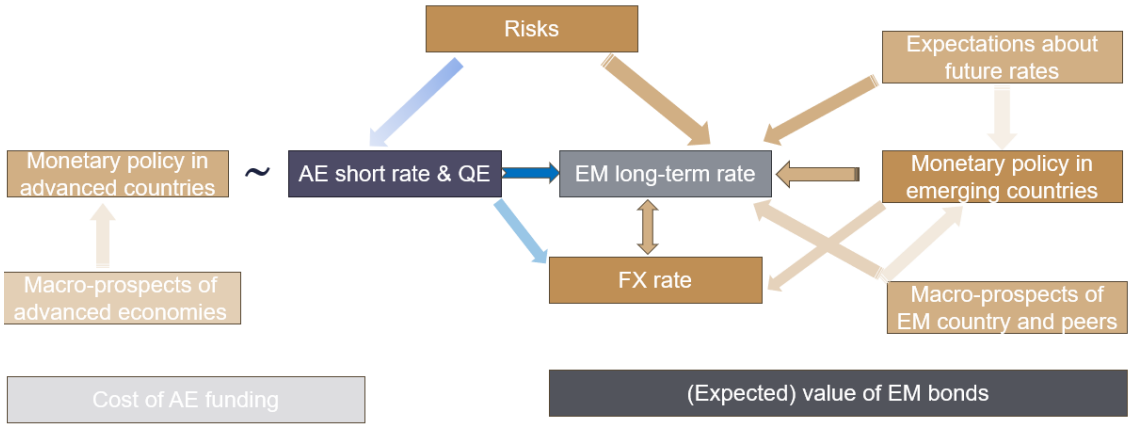
Regarding advanced markets, balance sheet policies, and interest rate changes, even forward guidance that successfully anchors expectations of market participants, are jointly regarded as advanced market financial conditions and they are considered as a price type variable. This concept is virtually the same as the short-term interest rates in advanced economies, thus the direct result of advanced central banks' monetary policy decisions. These decisions are made based on the cyclical position of the respective advanced economy, as the theory of inflation targeting framework describes.

In the case of emerging countries, similar factors, such as local monetary policy, expectations about future rates, and macroeconomic position, influence long-term bond yields. However, risks associated with emerging market investment are believed to be higher, and several external factors are also considered capable of deteriorating asset prices. It is important to note that on the shock sending side, we regard short rates, which are a direct result of monetary policy developments. While on the shock recipient side, we regard the long-term financing cost of an emerging country, which is deliberately influenced by more factors.

Balance sheet policies of emerging markets are not particularly elaborated, and the relationships between advanced central banks are also disregarded. The primary connection between advanced and emerging countries is the FX markets, particularly when the inflation-targeting framework with interest rate policies is applied, although the research is not narrowed down to such countries.

This research will specifically investigate the direct impact of large central banks' policies on emerging bond markets. This relationship is often unseen, but it is a direct and natural outcome of free capital flows. As international investors allocate their investments globally, these investments interact in certain ways, and their pricing can mutually influence each other based on the decisions of cross-border investors. Although various factors affect both advanced and emerging rates, the primary objective of the thesis is to quantify the direct impact of advanced rate policies, excluding certain factors such as the influence of local policies, global risk perception, and changes in FX rates. The rationale behind these exclusions merits further elaboration.

4. Figure Definition of monetary policy spillovers



One may argue that for an international investor, the overall return on the investment consists of the FX-rate change and the bond yield, making the FX-rate inseparable from rates. Nevertheless, excluding FX rate changes is perfectly sensible from the issuer's perspective if the security is denominated in the local currency. Since this framework relies on this type of financial instrument, the FX channel is gently disregarded for now. Changes in local monetary policy tend to be filtered out as well, as the cause of certain policy steps may vary and not necessarily be a result of international

developments. Finally, modeling certain types of risks is a broad and specific area in finance, and from an economic standpoint, it is reasonable to disregard them mostly, as from the perspective of the analysis, it is not much different from noise. This is particularly valid for short-lived disturbances in the market that are not directly related to monetary policy but rather a temporary shift in investors' perception. This latter exclusion is also supported by the fact that these twists generally influence the majority of the emerging market asset class; thus, this influence is spread equally across the market.

The underlying logic of this modeling framework can be summarized as follows. Short-term investments and interest rates in emerging countries are more susceptible to changes in local monetary policy. In contrast, cross-border investors typically hold long-term government bonds, thus, their demand can impact market prices, particularly long-term yields. The policy toolkit of emerging central banks is primarily suited to influence short-term rates; thus, managing long-term rates is generally a secondary aspect. These factors explain why the long end of the yield curve is more exposed to external shocks. Certainly, the significance of long-term rates for policymakers cannot be forgotten, though the potential policies of central banks to counteract international shocks are beyond the scope of this thesis.

In other words, building upon the work of H. Rév and others, a common, external, and regular impulse connected to the policies of advanced central banks, the so-called ‘monetary policy spillover’ is thoroughly examined on a theoretical basis. The implications and potential outcomes of this discussion may be extended to practical levels, offering an additional perspective for policymakers in emerging central banks, though their optimal decision and classical policy recommendation will not be explicitly addressed in this dissertation.

Acknowledging that long-term rates may not be entirely independent of certain external factors, such as conditions in advanced interest rates, raises an interesting dilemma regarding the value of local currency in emerging countries. The value of a long-term investment should not differ significantly whether it is in a (locally) risk-free security (government bond) or in other financial markets, such as deposits. Although minor and temporary differences between government bonds and deposit rates are not critical, and in the long run, they should converge: the financing of an asset may deviate only as much as the asset's riskiness warrants. Monostori (2014) defines this phenomenon as the liquidity premium of government bonds: a small premium may be required by investors in line with the riskiness of the bond market, practically, to compensate for a somewhat larger liquidity risk. Therefore, not only the long-term government bond yields but also the long end of the yield curve are generally influenced by a significant external factor that may not be related to the domestic business cycle.

This issue is particularly intriguing for countries utilizing an inflation-targeting framework and interest rate policies, as these policy setups imply a relatively close influence on rate conditions. Although these rate conditions are typically intended for short-term rates, it can be argued that efficiently guiding long rates is a part of independent monetary policy. The potential responsiveness of long rates to external shocks is an undesirable feature for the central bank, as it limits the effectiveness of the monetary policy transmission mechanism. In other words, at least one aspect of the money’s value,

which is supposed to be overseen by local policymakers, is potentially under governed by the central bank due to external influence.

On the other hand, it can be argued that, in the practice of monetary policymaking, this is less of a concern and more of a theoretical discussion. There are three main arguments explaining why international effects on long-term rates do not lead to policy collisions. First, the more harmonized the business cycles are, the less likely it is that a certain change in long rates goes against the will of local central banks. In the case of quantitative easing (QE), the compression of long-term rates supported growth in advanced economies, and emerging countries could benefit from cheaper financing, which also supported their monetary expansion following the crises. It is a valid concern that an emerging country with different characteristics may reach the point of being overheated earlier than the shock-sending advanced economies, as was the case for large emerging countries that experienced sudden capital outflows after the 'taper tantrum'. However, offsetting the influence may be costly, and it is far from evident that it is always necessary to intervene, or any drawbacks can be managed with small fine-tuning in the policy toolkit.

Secondly, the intertemporal value of money may not be the most critical aspect of monetary transmission, and generally, long rates are not the primary focus of interest rate policies. However, investment decisions are typically made based on the intertemporal value of money (long interest rates), and several other factors are associated with investment demand. Therefore, a temporary deviation in long rates may require no further actions. Thirdly, a prudent fiscal policy should leave enough room for rate increases; thus, interest rate changes should have no negative impact. In cases where the repayment or refinancing of budget deficit worsens dramatically due to a rate increase, by and large, the indebtedness was unsustainable. A positive shock, such as when bond yields are lower due to external factors, results in savings for the state on debt service. Overall, targeting the long-term rate or having a larger influence on it may not be the primary objective of emerging central banks and may not necessarily lead to policy collision. Hence, it is arguable that such external factors as monetary policy spillovers are practically neutral for monetary policy practice.

In contrast, identifying external factors, such as the risk environment or changes in the external financial environment, were a viable approach for policymakers in the last decade. Unsurprisingly, international factors influence various parameters of the economy, including aggregated demand, inflation, and domestic financial conditions, and therefore, the monetary policy decisions. It is debatable how explicitly a central bank should react to external forces and whether it is necessary to deliberately offset certain external impacts. The question could be whether local central banks need to intervene against international factors, but it is a question that will not be addressed this time. Instead, the existence, magnitude, and regional features of monetary policy spillovers will be discussed, along with an additional discussion on the general responsiveness of emerging countries to external financial shocks.

Overall, the literature review found the following research agenda. First, the size of monetary policy spillovers and the power of each central bank will be examined in a coherent framework while carefully considering methodological issues that may arise during the estimation. Second, shock recipients emerging countries are regarded in a geographical breakdown on a regional level. Thus, each central bank's power will be discussed at a regional level, followed by a discussion on the sensitivity of recipient countries. This requires a framework that assesses this feature of economies in a comparable and consistent way. Finally, this sensitivity is contrasted with macroeconomic factors, such as business cycle and external stability. The policy choices, including openness, monetary policy autonomy, and FX rate stability, are contrasted with the countries' sensitivity to external financial conditions.

These observations lead to the following hypotheses:

1. **Short-term rates in advanced markets influence long-term government bond yields in emerging markets.**

2. **Changes in advanced markets' short-term rates have a direct financial market impact on long-term government bond yields in emerging countries, thus, the so-called 'monetary policy spillover' exists in the case of certain central banks and emerging markets.**
    a. The changes in the monetary policy of the Federal Reserve have a systematic impact on the long-term government bond yields in emerging countries.
    b. The changes in the monetary policy of the European Central Bank have a systematic impact on the long-term government bond yields in emerging countries.
    c. The changes in the monetary policy of the Bank of Japan have a systematic impact on the long-term government bond yields in emerging countries.

3. **Advanced central banks have a larger impact on emerging markets, which are tied to them more directly and are proxied by regional groups.**

    a. The changes in Fed short rates have a larger impact on emerging markets in Latin America than on any other region.
    b. The changes in ECB short rates have a larger impact on emerging markets in the Central-Eastern European region than on any other.
    c. The changes in Japanese short rates have a larger impact on Asian emerging markets than others.

4. **Country-specific factors, including monetary policy framework, influence certain countries' sensitivity to global shocks.**
    a. Countries with weaker fundamentals are more exposed to international financial shocks.
    b. Institutional variables, such as policy risks and financial developments, influence the sensitivity to international financial shocks.
    c. The sensitivity to international shock is broadly similar to what the trilemma theory explains: countries with fixed exchange rates are more sensitive to interest rate shocks, while floaters are more sensitive to FX-rate changes.

■

3 Methodology

Verifying the hypotheses outlined in the previous chapter calls for a quantitative methodology with a carefully planned and executed empirical strategy. This chapter sheds light on several strategic and technical aspects of the research work, providing a solid background for the following chapters. One should keep in mind that this overview may be redundant, as the most important decision points are recalled in the respective chapters, and also, it does not follow a chronological order of the research process, instead, a summary of considerations is provided. Nonetheless, a comprehensive methodological overview is essential before the actual research steps are introduced.

This chapter is organized as follows. First, the research plan is outlined, with special emphasis on the aims, tools, and applied methods, and it generally provides an operationalization of the research question and hypotheses. Several remarks are made on previous authors who motivated certain parts of the calculations. The second subchapter discusses a wide array of questions regarding the data used in the thesis. The third subchapter explicitly explains certain points of the empirical strategy, including but not limited to the equations and the estimation methods. The last subchapter reflects on the empirical methodology and lists those important disclaimers which are necessary in any empirical research.

3.1 Research plan and goals

The aim of the thesis work is to reveal some parts of cross-border financial linkages, particularly the impact of advanced central banks on emerging government bond markets. Based on the previous literature review and theoretical discussion, the rest of the thesis focuses on quantifying so-called ‘monetary policy spillovers’ and generally the factors that relate to the sensitivity of emerging countries to changes in the external financial environment.

A technical definition of the term ‘monetary policy spillovers’ shall be made. Throughout the research chapters, it is used parallelly with the term ‘cross-border impact of large central banks’ and means a direct relationship between advanced monetary policy (and therefore the short-term interest rates in the respective countries) and the long-term government bond yields in emerging countries, therefore, a direct financial market transmission of the advanced financial conditions. Based on common definitions, the calculations attempt to offset the impact of occasional changes in investors’ risk sentiment, the impact of local (emerging) central banks’ simultaneous monetary policy changes, and any second-round impacts such as macroeconomic spillovers or trade linkages. However, it is not always feasible. In these cases, the arguments are either more general (in Chapter 4) or slightly different (in Chapter 7) and named accordingly.

In general, the empirical framework is designed to find a systematical relationship between variables of interest related to shock origins (mostly to advanced markets) and shock recipient countries. The analysis starts from a general perspective, a time-series method, then turns to a more specific panel approach, enabling account for the heterogeneity of countries. The last chapter uses a slightly different

dataset and follows the goals of the analysis to investigate some long-term features of individual countries in the sample further.

The main goal is to adequately analyze the dataset that was collected during the research phase, which is not necessarily easy and straightforward. Several additional steps were needed, such as data cleaning, verification, transformations of variables, tests, and checks. In general, we regard long-term government bond yields in emerging countries as the dependent variable and shock variables, mostly short-term rates or policy decisions of advanced markets, as a key independent variable, the variable of interest. This approach aims to find a systematical relationship between advanced and emerging markets. However, the measurement and the exact application of this guideline varies and fits in order to point to the most reasonable quantitative result and definitely not automatically assumed throughout the thesis. While certain parts of the analysis have a quite different econometrical model, the main goal remains to find a systematical relationship between the shock-sending and shock-recipient countries.

The empirical part of the thesis starts with the following chapter. **A time-series method is applied to aggregate data as an introductory approach in Chapter 4.** The examined dataset consists of a set of different time series with a certain frequency, but comparison is only made between emerging long yields and advanced short rates in line with the research plan. The first attempt is not even a time series method *per se*. A simple correlation matrix introduces the potential variables and the relationship between them. In the next subchapter, these choices will be explained further, but generally, the fourth chapter represents the dilemmas that the variable choice poses for this research. Correlations on their own say very little about the dynamics of the time series, but detecting the initial co-movement between the target variables may be done.

After the correlations, standard time series methods are used to find a statistically significant relationship between the respective variables. The variables used for this task are similar to the ones that were used for correlations, but further aspects are also taken into account considerations. Among others, the frequency and aggregation type differ in different time series. The strategy follows Shrestha & Bhatta (2018) and benefits from the general remarks outlined in Kiss et al. (2022). Briefly, variables are tested for stationarity, and the integration order is determined. Variable pairs are created (one advanced, one emerging time series with some considerations about comparability). These pairs are examined with the Johansen test, and if they are cointegrated, an ARDL/NARDL (Autoregressive Distributed Lag / Nonlinear Autoregressive Distributed Lag) model is developed, if not, a VAR approach is proposed. ARDL models have gained popularity recently because of their flexibility and nicely documented application in Mészáros & Kiss (2020). For illustrative purposes, 12 variable pairs are used, and four final models are introduced in detail. In an experimental attempt, 40 models are involved (including the initial 12), and their truncated average is used for each considered frequency. (Kiss, Mészáros, & Rácz, 2022; Mészáros & Kiss, 2020; Shrestha & Bhatta, 2018)

Two important caveats emerge from the time series analysis. The most significant advantage of the method is that it enables us to decide on the first hypothesis confidently. The drawback of such time series analysis is neglecting certain heterogeneities on both sides: shock senders and shock recipient economies are vastly different, which calls for a more sophisticated analysis of the dataset, a panel-approach is proposed in the following two chapters.

Chapter 5 discusses a panel-approach to quantify the cross-border impact of advanced central banks' monetary policy decisions. Panel dataset enables us to consider the diversity of each country, which appears to be necessary on both sides of the equation. As it was argued, emerging countries are different in economic development, depth of financial markets, macroeconomic performance, and several other factors that may now be exploited in the regressions. On the other hand, the difference between shock sender countries is how largely they can influence the monetary conditions abroad. At this point, this impact is hypothetical. Thus, an important result will be to prove the existence of the so-called 'monetary policy spillovers,' as in certain advanced countries, the cross-border impact may be nonexistent.

As an initial step, a benchmark model is designed to quantify the impact of certain internal and external conditions on long-term government bond yields in emerging markets. Operatively, it means that a panel model is created and tested, which involves the dependent variable (EM yields) and the control variables, which are significant but not the focus of our analysis. Discussion on panel features and generalizability takes place here. This benchmark model is later expanded with several target variables. In the first step, the impact of the Federal Reserve, via the USD conditions, is tested, and several attempts are considered for the correct variable that represents the change in the USD market. All attempts are also regarded as a robustness test: it would be unacceptable that a little change in the shock variable to cause controversial results or lead to a loss of significant results in general.

The benchmark model is further modified in several ways. An important extension of the model is incorporating variables reflecting the monetary policy of the European Central Bank and the Bank of Japan. Keeping an eye on comparability, virtually the same regressions are run in these two additional cases. Optimally, these three robust and accepted models show an average impact of certain central banks' monetary policy on emerging countries. However, a brief discussion is needed before comparing them. The comparison of the three advanced central banks in terms of impact on emerging countries is an essential part of the thesis work.

The baseline regressions are supported by additional attempts to provide a more nuanced picture with the use of available data. Beyond the baseline models, two alternative approaches are proposed and introduced. In both cases, the shock variable is changed into a binary (dummy) variable, which portrays a significant impulse from the respective central banks. This is a slightly different approach from the baseline model: instead of taking the quantity of certain and permanent impulses from the advanced economies, certain days, when a sizable monetary policy spillover is supposed, are flagged and evaluated distinctly. One of these dummy approaches uses the relative changes of the respective

shock variables and flags those days when an extreme negative (decrease in rates) or positive (increase in rates) change occurred. A similar idea is to use announcements of monetary policy decisions as a base. Similar to Falagiarda & Reitz (2015), an event set is selected, and a dummy variable represents those days when a significant monetary policy event occurred. (Falagiarda & Reitz, 2015)

A special type of panel data model is the dynamical panel model, and one of the most popular approaches is to use the generalized method of moments (GMM). In an alternative attempt, several GMM models are developed and tested to highlight the relationship between emerging and advanced market variables. However, GMM models are unsuitable for panels with many periods and few identities, thus, a decrease in frequency was needed to run the models. One good recent example is the work of Czeczeli (2021): she applied this method to find a relationship between ECB's monetary policy and wealth inequality. (Czeczeli, 2021)

Taking all into account the panel dataset and methods, the results of the previous regressions enable us to decide on the second set of hypotheses.

Chapter 6 is an extension of the previous chapter that seeks to answer the question of how different the monetary policy spillovers in certain regions are, with particular regard to the sensitivity to that large central bank (out of the Fed, ECB, an BOJ) which belongs to the same region as the respective emerging countries. Two different methods are used to find out the regional impact of certain central banks. One natural idea is to add a region-specific dummy interaction to the target variable (which is an advanced market rate), bearing in mind that only two of three regions may be flagged with a dummy variable. Another similarly correct idea is that subsamples are created based on the geographic location of each observation, and the original regression is redone. The discussion between the two approaches is done after the respective results.

A discussion concludes the chapter regarding the question of whether geographical region is, in fact, the best and most important differentiating factor among emerging countries. Nonetheless, the research question about the regional extent of monetary policy spillover remains valid many additional questions are aimed to be answered by investigating certain groups of countries in terms of the different perceptions of monetary policy spillovers. Chapter 6 concludes with the decision on the set of theses regarding the regional importance of certain advanced central banks, and the latter discussion on the differentiating factors motivates the following chapter. An important research step is to move from a generalized impact of a certain group of countries to individual countries and their unique responsiveness to external shocks.

Chapter 7 seeks to identify the country-specific determinants of emerging market responsiveness to external shocks. In this chapter, the dependent variable shifts from observed government bond yields of emerging countries to a custom variable that depicts the responsiveness of certain countries' long-term government bond yields with the composite advanced market short-term rate changes. This so-called 'sensitivity score' is discussed in the following subchapter and also in the respective chapter by explaining its origin, the method it is obtained, and certain limitations. On the

right side, the independent variables reflect to certain conditions of the emerging countries in accordance with the sub-hypothesis tested. As the sensitivity score is a yearly observation, a smaller panel-structured dataset is used, but the regressions do not use panel features at this time. Beyond basic macroeconomic and institutional conditions, discussing the monetary policy mix is an important finding of the paper. The analysis and the decisions on sub-hypotheses are centered around the significance and sign of the respective independent variables. A deeper understanding of country-specific characteristics allows us to decide on the fourth set of hypotheses at the end of the chapter.

3.2 Data

Several important remarks must be made in connection with the data used in the thesis. As no empirical research may be conducted without reliable and carefully handled data, this paper also faces several challenges that should be discussed to reach the thesis's final goals.

This subchapter sheds light on the structure of the dataset, the country choice of the empirical part, and certain issues related to the collection and transformation of the data, with special regard to those variables that were created individually.

An overview of the dataset

The research phase started with an extensive data collection process, resulting in a relatively large dataset with significantly more variables and countries than the final versions of the calculations used. This overview focuses on the data that are finally used, with some comments on those variables or country choices that are discarded in the final specification. For certain purposes, different datasets were used in accordance with the objectives of the research question and with the limitations of data availability.

The thesis uses one large database in the majority of the cases, but this database is sliced into appropriate subsets as the research tasks require. This database is a compilation of several data sources in a relatively strict structure. Hence, most empirical modeling relies on secondary data, meaning that market-observed or statistical data are used for analysis. The large panel is structured in the following way: daily observations of the chosen emerging countries are compiled into a panel structure; therefore, one observation (row) means one emerging country's data on a given workday. For technical reasons, the variables unrelated to emerging countries or country-independent are also merged into this data structure via the date of observations, as these rows will be read by the statistical software, which happens to be the R Studio version no. 454.

The final datasets are designed with the attention of two particular features: level of aggregation, thus aggregate values or panel structure is needed, and frequency of data. Therefore, aggregated analysis was conducted on a dataset where only one country's country-independent columns were set up as a criterion for subsampling. Similarly, the daily frequency was simply downgraded to lower when needed with a subsampling procedure.

For the last research question, a new dataset is compiled. Based on the description below, several new variables representing a country's responsiveness to international financial shock were created to obtain one data point for one emerging country yearly. Therefore, the new yearly dataset is also panel-structured, uses the constructed variables, and relevant variables are merged into the dataset from the large database explained earlier.

Country choice

The selection of countries was motivated by three factors. First, some papers introduced in the literature review gave hints on suitable emerging countries. Second, only those countries remained in the sample where the government debt in local currency is sizable, and the data for long-term government bond yield (at least five years, but preferably ten years) was available for the vast majority of the observations. Third, countries in the emerging panel are roughly considered to be a part of the emerging market asset class based on the portfolio allocation of large investment firms.

The chosen countries are independent economies with sovereign monetary policies. However, many of them use fixed or quasi-fixed exchange rate policies, but all of them provide more or less capital account openness for international investors. After careful consideration of some important, but from the perspective of the thesis less suitable, countries such as Argentina, South Africa, Russia, and India have been left out. Their debt structure did not allow for observing long-term government bond yields over the chosen time frame of the analysis. Due to data availability, Nigeria, India, Croatia, South Africa, and Vietnam were also excluded from the sample, which ultimately consists of daily observations from 19 countries over more than 13 years, thus, the total number of observations is over 68,000.

Collected and transformed data

All data series used in the thesis may be found in the Appendix with primary descriptive statistics. Some further remarks should be added to that table. Three major differences exist between the variables used in the following chapters. First, the origin and possible transformation that were done. Most of the variables are directly observed, mostly from Bloomberg or other websites. The vast majority of variables in the final specification are somehow transformed. The name, which was assigned by the Author, helps to navigate between these transformations. D usually means change, and the letter following hints at what kind of change is used. Similarly, L means log changes.

However, the weekly change of government bond data is the same (but transformed) version of the directly observed bond yield, in the table, they are separated to show the different characteristics of the level and differenced variables. The second major difference is the aggregation: many variables are in the panel structure, so it varies by emerging countries, while many variables are common. Admittedly, in the case of panel structure data, the descriptive statistics are not very meaningful. In the case of common variables, one single data source, most likely a Bloomberg ticker, could be named, while in the case of country-specific variables, there are as many as many countries in the sample, but the actual tickers used are available upon request, similarly to the original database used in the

calculations. The third difference is the frequency, which means two different things: the natural observation of the variable and, on the other hand, the frequency of the dataset where it is used.

Here, only the most important variables are discussed in detail to explain certain choices and considerations in the data selection process.

Government bond yields, particularly in emerging countries, are the general focus of this research. For the sake of clarity and following other papers in the literature, yields of benchmark papers were collected for all countries, including shock originators and shock recipients on several maturities. After several iterations and further considerations, a variable called 'Long_term_yield' was created for emerging countries, and the bond yields of advanced (shock originator) countries were only used to create the composite variable, as explained later. Usually, government bonds pay coupons, and the yield consists of the current price and the value of the remaining coupon payments. For all observations, yield means the annualized return on investing in the respective security, given that it is held until maturity. The standard practice of government debt management is that selected, larger issuance of the outstanding set of government securities are considered as benchmark papers that enable investors to compare investments in a longer time horizon and between countries. In other words, benchmark government bond rates are series built based on selected securities to represent the value of government debt on a given maturity. Technically, these data come from market observation and are calculated based on the last traded price of the securities on every day observed. It is important to note that local currency denominated bonds are used for emerging countries. Unfortunately, not all countries in the sample had securities with a remaining maturity of around ten years, so in some instances, the missing values were imputed with yields of shorter bonds.[10] Though the shift between the two maturities causes sudden jumps and falls, it happens rarely and does not change the overall picture. One should remember that when a benchmark paper is considered shorter than required to remain as a benchmark, a new paper is assigned, and a similar jump occurs in yields. These jumps are broadly accepted in the empirical literature, especially in the case of daily data.

Regarding the independent variables, the **foreign exchange rate** measures the amount of adjustment that does not take place in the securities market. The exchange rate has primary importance in interbank financial relations, though the volatility and the level of exchange rate management are largely different in certain countries, sometimes even within a country, through time. The rate is expressed versus the USD daily. As the nominal level does not have much to tell, changes in the exchange rate are used, as explained in the calculations later.

CDS means credit default swap is a contract that pays when the original security defaults; thus, the price of the CDS proxies the perceived probability of the default in the case of a given security. The dataset has 5-year sovereign CDS prices for all countries in the sample. Though 10-year CDS data would be more precise, it was not available for many countries, so for homogeneity, 5-year contracts

[10] 5-years bond yields were used in Brazil, between 07/26/11-04/03/12, 07/02/13-02/14/13, 03/26/20-06/08-2020, in Bulgaria until January 2010, in Peru after 2012, while in Chile UFC-denominated bonds are used

were used in all cases. Contrary to rates and bond yields, CDS prices are expressed in basis points: a CDS value of 100 basis points means one percentage point.

DEPO describes deposit rates in the country's currency. This independent variable is collected to proxy a short-term money market rate that is directly influenced (but not set up!) by local monetary authorities, therefore, this variable is the proxy for changes in local monetary policy.

CPI is a consumer price index, which is a widely used variable for measuring inflation. For comparability, year-on-year changes in the price of the consumer basket, in other words, the headline inflation is used as local statistical offices or central banks report it. Though the current inflation figure may not necessarily influence the coinciding monetary decisions as central banks' policies are usually forward-looking, it controls for general rates. In countries with higher inflation, local rates tend to be higher to compensate for inflation risk premiums.

Citi global surprise is an indicator of surprises in the macroeconomic data releases. One should note that, except CPI, no variables are used to describe the macroeconomic conditions, but the perception of macroeconomic development may be tracked using this variable. As it is monthly data, it is used as levels without transformations.

The VIX index is the option-implied volatility index of the Chicago stock exchange, commonly called the' fear index.' This indicator is widely followed to track the sentiment on the advanced central markets, and it largely correlates with the decisions of the large central banks, particularly the Federal Reserve. If the index rises, the market uncertainty generally means worsening economic sentiment. The index is observed as a daily closing price.

The balance sheets of large central banks have been collected to illustrate the impact of balance sheet policies implemented as a part of the unconventional monetary policy toolkit. These data are published monthly, stored in local currency units, and interpreted as monthly logarithmic changes.

A set of standard macroeconomic variables were also used mostly in the last part of the thesis. These data were retrieved from the Bloomberg terminal, and generally mean the default understanding of the variable. That way, the GDP is a year-on-year growth rate, as statistical offices report in almost every country. The unemployment rate is the share of people looking for a job compared to the sum of those who are employed and unemployed. The current account balance is meant as a share of GDP. Political risk is a survey-based indicator collected by Bloomberg.

The financial development variable was compiled from a data series published by the IMF and gives an aggregate overview of the development of financial markets in the respective countries. The well-known **'Trilemma indices,' including financial openness, monetary policy independence, and exchange rate stability,** were borrowed from Aizenman et al. (2019).

Created variables

Several variables were created for the research to facilitate the inclusion of certain factors into the equations and better express certain market features than the directly observed variables. There are three groups of created variables. A set of variables was created to depict the short rates in advanced markets and the long-term government bond yields in emerging markets. They were created with the help of factor analysis and may be regarded as a well-composed average of certain similar variables. Sensitivity scores are created for the last chapter, and a custom methodology is employed to encapsulate the variability of long-term bond rates and foreign exchange rates in emerging markets in a given year. Several dummy variables are used for the panel analysis: they are partly derived from observed data, and a different part is manually collected and compiled.

AE-EM factor

Regarding the leading composite variables, such as the EM_FC4, which is broadly translatable as a comoving component of long-term government bond yields, and AE_MC, which is a composite for advanced short rates, are generated from several direct variables. For encapsulating the trends and creating a suitable composite variable, a similar methodology to Kocsis & Nagy (2011)'s work was followed, where they created a decomposition methodology for sovereign CDS spreads. They argued that an adequately designed factor analysis is suitable for creating international, regional, and local factors. Their methodology has been simplified to using only one factor (the so-called international/emerging factor) and was applied to long-term bond rates and short-term financial market rates instead of CDS prices. (Kocsis & Nagy, 2011)

1. Table Constituents of aggregated variables

USD_MC	EUR_MC	JPY_MC	AE_MC	EM10_FC
• O/N, 1W and 1M USD deposit rate • 1M LIBOR • 3M T-bill (YTM) • 1M, 12M USD swap • 1M, 12M Fed fund future rate • Fed effective rate • Fed target rate (upper bound) *weight: factor analysis*	• 1M, 12M EUR swap • EURONIA • 1W, 1M EURIBOR • 1M EUR interbank rate • 1W, 1M EUR LIBOR • 3M German T-bill (YTM) *weight: factor analysis*	• 1W, 1M, 1Y JPY deposit rate • 1W, 1M, 1Y JPY futures • 1M, 1Y JPY OIS • 1M, 1Y JPY swap • 3M T-bill (YTM) *weight: factor analysis*	• USD_MC • EUR_MC • JPY_MC *weight: relative SDR weight*	Long_term_rate of every country in the sample. *weight: factor analysis*

Technically approaching the process, all relevant rates from the full sample between 2008 and 2022, were considered and subject to factor analysis as it was required to prepare the suitable index. The constituents of certain indices are listed in Table 1. This factor analysis showed that the first factor explains 53 percent of the total variance. The loads, which are weights, were used to calculate a hypothetical emerging bond rate in the case of EM10_FC and an average funding cost in the case of USD_MC, EUR_MC, and JPY_MC. AE_MC is a weighted average of these three composites based on the relative value in IMF's SDR basket at the time of observation. The advantage of these composite rates is that they grab the significant common changes throughout the whole sample and represent the overall common dynamics of the respective time series. Numerically, this hypothetical EM factor is close to a simple average, but the dynamic changes are believed to be encapsulated better.

Sensitivity scores

Sensitivity scores are created for the last chapter, and a custom methodology is employed to encapsulate the variability of long-term bond yields and foreign exchange rates in emerging markets in a given year. The creation of these series was also motivated by Kocsis & Nagy (2012), but a different step of their calculation: they established a relationship between the calculated global factor and observed CDS prices. The idea was applied in the following way. In a slightly different and simplified way, a pure linear regression is run on defined sub-samples: in each sub-sample, one year of data from one country is selected. The dependent variables are observed in emerging markets, and the sole independent variable is specific advanced market data in accordance with the aim of the respective variable. Several different sensitivity scores were created by this approach. In all cases, one score was calculated for all countries and years in the sample. For ease of use, several additional neutral transformations were done to keep the comparability between each country and year intact. A more detailed description of these variables may be found in Chapter 7.

Dummies

There are two types of dummy variables used in the panel models. On the one hand, several variables were generated based on observed variables or assigned to the country based on its known characteristics. A dummy variable denotes the given country's geographic location, and dummy variables are used to flag certain country characteristics, such as higher inflation or investor risk. As an alternative measure, several shock variables are generated after flagging weeks when extremely large changes occurred in advanced markets. On the other hand, manually collected and compiled datasets denote those event days when certain types of policy announcements took place in advanced economies. These series are used for an event-study analysis. A more detailed description of these variables is to be found in Chapter 5.

Used data – datasets assignment for certain tasks

The collected, transformed, and generated data from the two manually compiled databases is used in the following way throughout the thesis. Chapter 4 uses several aggregated datasets, focusing on the stylized relationship between emerging and advanced markets. The initial steps are done on daily

datasets, but weekly, monthly, and quarterly aggregated datasets are also used in the chapter. Chapters 5 and 6 use panel structured data, but as argued later, the daily frequency is altered with weekly observations, and instead of levels, differences are used. Chapter 7 uses the smaller database with the created sensitivity scores: though it is a panel structure, the regressions do not use panel features as it is explained later.

3.3 Empirical strategy and estimation methods

The data collected, generated, and compiled are examined through different types of quantitative methods according to the characteristics of the dataset and the goals of the analysis. The general idea behind all these methods is to establish a systematical relationship between the dependent and independent variables, with the help of a model estimated based on factual data points. In certain cases, there are prerequisites for certain types of models or the performance of models are examined and compared rigorously. The aim of this chapter is not to serve as a quick summary of graduate textbooks with equations and proofs but to recall the most important pieces of information and considerations in the case of certain empirical methods. For further details, please see the referenced books and articles.

Time-series models

Chapter 4 compares aggregated time series to seek systematical relationships between emerging countries' long-term government bond yields and advanced short-term rates. The difficulty of tackling this task lies in choosing suitable variables for analysis, thus, several different variables (constructed indices and market-observed variables) with different frequencies are tested. The application of time series techniques is quite standard in the literature and broadly follows the algorithm of Shresta & Bhatta (2018). Initially, our information base is the pure datasets with the same frequency and relatively similar scales. As they describe, statistical tests are used to determine some characteristics that are prerequisites to certain time series models, and the result of such tests helps to decide the suitable modeling approach. First, stationarity is tested, and differences are derived from the original data series if necessary. After determining the integration order of all data series, AE – EM pairs are assigned based on certain considerations. The two variables are jointly tested for cointegration. If a cointegrating relationship is suspected, the autoregressive-distributed lag model (ARDL) or its asymmetric version of the nonlinear autoregressive-distributed lag model (NARDL) is developed. The model's specification is heuristic, but it was later tested with a bound t-test to determine if it is actually a valid model. If there is no sign of cointegration, a vector-autoregressive model (VAR) is designed similarly, which does not require the variables to be cointegrated; it just has a stationary nature. In case of unsuccessful VAR modeling, and for experimental reasons, a simple linear regression is proposed: these are usually univariate models, and the coefficient obtained from the model provides an average of the variables' relationship without regarding any lags or leads, therefore, the result is a constant. This approach is also applied for illustrative purposes. (Shrestha & Bhatta, 2018)

ARDL models and their non-linear version, NARDL models, became popular recently because of their relatively few input data requirements, providing relatively robust estimates for short-term and long-term relationships.

Hansen (p.498) provides a great overview of the question of what type of time series model the ARDL model is. If we consider a simple static model that seeks to establish a relationship between dependent and independent variables at T time, we may do it with simple linear regression, but it will surely be misspecified in dynamic terms as the relationship between variables at T on both sides hardly say anything about the dynamic relationship. Let us add that in certain cases, we decide to do so, bearing in mind that stationarity is required and serial correlation (autocorrelation), thus the error term is time-dependent, is an issue that calls for robust standard errors. A distributed lag model solves the first problem, as it allows the past values of the independent variable to determine the value of the dependent variable at T, thus, a dynamic relationship is established, but it fails to handle serial correlation. The ARDL model is described as follows:

$$Y_t = \alpha_0 \quad + \alpha_1 Y_{t-1} + \cdots + \alpha_p Y_{t-p} + Z'_{t-1}\beta_1 + \cdots + Z'_{t-q}\beta_q + e_t$$

1. Equation

Where α and β are regressed coefficients, Y_{t-n} is the autoregressive part of the dependent variable, and Z is the independent variable with appropriate lag structure. For the parameters p and q, there are two handful possibilities. One is to suppose a reasonable lag structure based on the data structure and test if it performs well, or this could be done automatically with the software package, however, it may be resource-intensive as it literally runs and contrasts all possible lag structures within a boundary. The model performance is primarily assessed via a bound t-test, which basically tests for cointegration. The usual R square performance mostly correlates with the result of the bound test, and the latter is conventionally more accepted in the case of ARDL models.

The obtained coefficients are used to calculate multipliers, thus, for one certain observation, it encapsulates all relevant lags (variables) to provide a time-dependent downplay of the estimates, and therefore, it may be interpreted as a nonlinear function of coefficients.

Hansen recommends calculating multipliers this way, though the statistical software is also able to provide these results automatically.

$$\frac{\beta_1 + \ldots + \beta_q}{1 - \alpha_1 - \ldots - \alpha_p}$$

2. Equation

(Hansen, 2022; Turner, 2021)

Many papers have followed this methodology recently. Mészáros & Kiss (2020) used this approach to estimate the impact of sovereign risk spread, Sharaf examined the impact of external debt on Egyptian growth, while Shresta & Bhatta tested a set of variables concerning money supply and inflation. (Kiss et al., 2022; Sharaf, 2022; Shrestha & Bhatta, 2018)

Vector autoregression (VAR) models are more traditional time series methods that do not require variables to be cointegrated, therefore, the results cannot capture long-term relationships. VAR models are usually used with a set of variables to highlight the relationship between certain variables; thus, they are more flexible in terms of expanding with different variables.

The idea behind VAR model is to fully exploit the previous values of the dependent and independent variables and create a regression system encapsulating the changes of the time series, highlighting the short to medium-term interactions between variables generally.

The lag selection also works similarly to the ARDL, heuristic or automated processes may also lead to optimal lag structure. VAR models are usually tested with the Portmanteau test, which will also be considered decisive in our examples: if the specifications fail to be acceptable based on this test, it is reconfigured or disregarded, while if it is positive, the proposed model is considered final. Those models deemed acceptable are used by extracting impulse response functions (IRF), which is a traditional method of visualizing and analyzing the output of VAR models. IRFs show the relationship between two dependent or independent variables in a time dimension. In the paper, the application of IRFs works in the following way. The impact of the advanced rate on emerging yield (as a function) is divided by the impact of the advanced rate on itself, which could be roughly defined as a traditional monetary transmission. This way, the international impact is not analyzed as an absolute term, but as a ratio, nonetheless, its meaning falls very close to the multipliers that are extracted for ARDL models.

Cross-sectional and panel models

In econometrics, the most basic yet one of the most powerful tools is linear regression, which is generally explained with a set of disclaimers and restrictions. In ordinary cases, cross-sectional data are examined to find a systematic, linear relationship between one dependent and one or more independent variables, mostly by fitting the most efficient function that describes the nature of the data with the help of a so-called ordinary least square (OLS) method. This basic concept may be expanded largely for more advanced analysis, considering the need for certain data types and datasets. A special extension is when the dataset is cross-sectional and has a time dimension, a so-called 'panel dataset.' This could be explained as stacked cross-sectional observations for many identities (N) throughout several time periods (T). The thesis incorporates both cross-sectional and panel datasets, thus it is pertinent to revisit the key observations regarding linear regressions and panel data methods. However, it is not the intention to extensively recapitulate the logical progression found in econometrics textbooks.For this purpose, several textbooks explain the general functioning of linear regression and OLS estimation and the advantage of using panel data and estimating panel models. This overview, starting from cross-sectional analysis to panel models, broadly follows their explanation. (Biørn, 2016; Croissant & Millo, 2019; Wooldridge, 2016)

The general idea of any kind of data analysis done by regression techniques is the following:

$$y \sim bx$$

where y is an observed dependent variable, x is an observed independent (target) variable, and b is an estimated coefficient calculated with a chosen method to fit on a straight line (in case of linear regression) therefore, to enable further analysis by revealing the systematic (linear) relationship between the dependent and (target) independent variables.

Standard textbooks translate this idea into the following form:

$$y = \alpha + \beta_1 * x + \ldots \beta_n * z \ldots + \varepsilon$$

3. Equation

where y is still an observed dependent variable, x is a target variable, and b is now β to empathize that it is an estimated coefficient. Note that variables from x to z are independent from each other. The framework is extended with three additional elements:

1. the regressed line may have a non-zero intercept, which is marked with α.
2. additional independent variables are added: these are called 'control variables. These variables reasonably influence y beyond x but are linearly independent of x in a required degree. These variables provide validity and robustness for the estimate of β_1 by aiming to limit the unobserved variable bias and enhance the explanatory power of the whole equation.
3. ε denotes the error term: no regression method is able to provide a 100 percent fit (except in exceptional circumstances); therefore, the remaining error is legitimately part of the equation, and several assumptions are connected to it in order to accept the estimated equation as plausible.

This is the base of linear regression, however, other types of regressions (log, exponential, quadratic) are possible. In the literature, linear regressions are mostly used in similar research papers, so throughout the dissertation, a type of linear regression is employed, however, necessary changes are made due to the panel structure of data, leading to 'panel regression models'.

Several methods are known to estimate β parameters. The most popular method, the ordinary least square, is applicable in a wide range of estimating tasks, given that some assumptions are met. Briefly, the idea is to draw a linear line on the set of observations to minimize the square sum of errors, in other words, the best-fitting model is the one that gives the smallest errors when predicted values are compared to actual observations. Regarding the details of assumptions, diagnostic tests, and possible threats of misspecification, see Brooks (2014). The five, sometimes challenging assumptions are mostly connected to the error term, partly to the input variables. In general terms, too many variables raise the risk of multicollinearity (as independent variables may correlate) or developing an inefficient model with irrelevant variables. Using too few variables may lead to omitted variable bias and may lead to a non-satisfactory modeling of the underlying economic processes.

However, the dataset may be in panel structure by disregarding the time dimension, one may receive a normal linear regression. This approach is often called the 'pooled OLS model' and contrasted with

panel models. It is mostly used when statistical tests confirm that panel models are not significantly better than the pooled model, which disregards panel features.

The reason for turning to panel methods is to control for unobserved heterogeneity that may be related to the earlier-mentioned dimensions (country, time). During the model planning phase, it is critical to answer whether this unobserved heterogeneity influences which part of the regression and which dimension may grab it.

Panel data models examine group effects, time effects, or both to deal with heterogeneity that may not be observed anyway. It is either a fixed or random effect, depending on which part of the regression equation the effect influences. A fixed effect model estimates different intercepts (α) vary across groups or time periods, whereas a random effect model handles differences in error variance components across individuals or time periods. A practical extension of these model families is using two (or more) sets of variables, thus creating two-way models. However, starting with simpler models is generally recommended as a one-way model may be more efficient. (Park, 2011; Wooldridge, 2016)

The choice between the different types of models is based on standard econometric tests. The pooled model, which disregards panel features, may be accepted if all assumptions of linear regressions hold. For example, the Breusch-Pagan test for determining homoscedasticity and the Durbin-Watson test for the lack of autocorrelation help to decide if panel models are needed. In panel datasets, panel estimating methods are usually recommended. Based on the Hausmann test result, the decision may be made between random and fixed effect models.

Similar to others in the literature, a country-fixed effect panel model is tested primarily, which means that different intercepts are estimated for each country. As the number of observations is relatively large, a time-fixed effect (in a textbook version) may not be efficient. In order to support this choice, a set of tests should be carried out, with a handful of economic reasoning, as these tests are less binding than the ones for time series: in the majority of the cases the efficiency is the question and overriding some tests for the sake of any cold-headed argument carries much less risk of invalidating the results and the overall findings.

The general equation of the panel dataset, thus, may be described in the following form:

$$y_{i,t} = \alpha_i + \beta_1 * x_{i,t} + \dots \beta_n * z_{i,t} \dots + \varepsilon$$

4. Equation

where i denotes countries, and t denotes time. As shown, the intercept is let to be different for different countries, while the coefficients are common for all observations. Target independent and control variables are separated for illustrative purposes only: while x carries the information the research aims for, control variables provide validity and robustness. Note that variables x to z are still independent from each other.

In brief, linear regressions are used in most cases, while when using panel-structured data, this method is applied accordingly with fixed effects. Diagnostic tests are done when constructing each model but

are introduced only for the first time. These tests showed – without exception – that the country-fixed effect model is more effective than pooled or random-effect models.

Driscoll-Kraay

Regarding technical details, one important feature is worth mentioning. As explained after the regressions, they are biased in several ways and violate *some* of the assumptions the estimation would require. In order to overcome bias, one widely accepted approach is to apply robust standard errors that account for certain issues in the original model and help uncover falsely claimed significance in certain cases. Throughout the text, the Driscoll-Kraay covariance matrix is used to provide standard errors to the estimated coefficients, and these standard errors are used when calculating p values, thus ultimately deciding whether a variable is significant or not. Two important remarks may be made next to Driscoll-Kraay robust standard errors. On the one hand, Vogelsang (2012) showed that using fixed effect with DK is not an issue, and Millo (2014) argues that it is useful for cases when T is larger than N, despite that the original paper by DK describes near square panels (similar N and T). (Millo, 2014; Vogelsang, 2012)

GMM

A typical and relatively advanced panel modeling technique is the General Methods of Moments (GMM). It has a fairly large advantage in handling endogeneity issues and provides robust standard error as a base. It uses instruments thus, it is part of the instrumental variable regression family. Instruments are variables with hypothetically similar statistical moment, and the regression minimizes the difference from this hypothetical distribution. Technically, the estimation is similar to OLS and two steps least square (2SLS). The lag of the dependent variable may be used on the right side to eliminate the autocorrelation in the error term; therefore, no differencing is needed. To find the optimal number of instruments, a J test is standardized to avoid having the model over-identified. The limitation of GMM is the required number of instruments: from a capacity point of view, neither too long nor too wide panels are unsuitable. Also, the iterative nature of the estimation may be resource intensive, thus, careful preliminary, theoretical planning is required. (Biørn, 2016; Croissant & Millo, 2019)

Others

Some minor tricks and best practices are applied throughout the paper. One method is designed to compare two estimated coefficients using point estimates and standard deviations. As it is shown in Chapters 5 and 6, the following formula provides a Z score:

$$Z = \frac{\beta_1 - \beta_2}{\sqrt{st.dev(\beta_1)^2 + st.dev(\beta_2)^2}}$$

5. Equation

which tested with standard hypothesis testing. When employing the commonly used confidence level, it is customary to compare the obtained value with 1.96. If the magnitude of the observed value

exceeds this threshold, we can reject the null hypothesis of equality. Conversely, if the magnitude is smaller, we cannot reject the null hypothesis and consider the values to be equal. P values are provided for illustrative purposes.

An emerging and handful tool is a bootstrap process, which briefly means automated trial and error with the computing capacity of the device. It is not presented exhaustively, but a bootstrap process was used in the initial stage of variable selection when the panel benchmark was created. However, the results were largely overridden, and the final model specification is more committed to the economics argument than to the outcome of this method.

A bootstrap-type regression analysis was performed as a form of robustness in case of the Fed's impact: randomly selected, 200 observations were chosen 1000 times, and the same regression was run over and over. The obtained coefficients are noted and visualized.

Overall, the thesis paper uses a wide variety of econometrical methods, starting with time-series analysis to basic and more advanced cross-sectional and panel models, to analyze the collected data in the most reliable manner.

3.4 Validity, concerns, and limitations

All quantitative methods, thus all research that relies on empirical research design, come with a decent set of disclaimers and limitations. The wisest way to handle this constraint is to count on these potential issues and objectively report those assumptions and potential weaknesses that may limit the results.

For collecting and capturing data, it is important to note that errors in such large databases can be made and the ones used in this research do not fall to exception either. These errors may come from several sources. While the data collection process itself is quite reliable, the data that Bloomberg provides may have gaps, extreme values, or unreasonable market quotes. From my experience, this is rare, but in the case of the most important variables, a visual check was done, and missing values were recorded fairly and consistently. The most important advantage of the large dataset is that one omission or input data does not really make any difference, particularly when different changes are used instead of levels. Based on visual and randomly conducted numerical cross-checks, errors and data issues are rare, but notably, they could be existing problems. However, any uncovered data problems are believed to be non-systematic and random.

Concerns regarding the choice of empirical methodologies may arise from the adequacy of the chosen method and the design of certain econometrical approaches. The thesis provides enough space to explain and argue for certain choices, which is frequently done in the relevant chapters. Similarly, certain methods' known weaknesses and drawbacks are explained when applied. In some cases, it was necessary to override or disregard some solutions that are suggested by textbooks, but when it happens, it is explained in detail.

Beyond these regular concerns, the methodology has several issues that are not directly technical, such as data problems, or theoretical, such as potential violations of certain assumptions, but factors that are known weaknesses of the empirical strategy. The three most important shall be explained here.

One is handling time and, generally, the assumptions of certain processes being unchanged over time. The importance of time and the frequency of the dataset is a regularly mentioned point in the paper; the choice between the available data frequency often comes from intuition. One of the numerous choices is to use weekly frequency for panel analysis: while weekly frequency is suitable for monetary policy-related issues, and panel analysis is reasoned exhaustively, the number of observations is still high as the time period covered is large fortunately. Therefore, higher frequency data was chosen instead of recommendations for the number of observations in panel models. Furthermore, the same issue leads to the concern that a period of more than 13 years is a rather unconventional choice in the literature. Empirical macro models use datasets spanning several decades, but they usually do it with monthly or quarterly data. The majority of claims are based on the estimation of the full sample, though it is possible that certain periods would yield different results. This is routinely checked via robustness tests, but these attempts are rather illustrative than rigorous. The final reported numbers are valid for the whole sample period, thus, it is an average estimate that may fall very far from certain subperiods. Two good examples are the early 2010s, when the initial working papers were published on monetary policy spillovers, versus those recent estimates that only cover either the Covid crisis or the recent high-inflation period.

Second is the exclusion of all other factors. All models are designed to point out those processes that are intended to be analyzed, but the proposed models are a result of several considerations, and they may not efficiently control for all unrelated factors. This is called unobserved variable bias. The models aim to ensure that this bias is not systematic, and the outcome is not distorted, but certainly, this bias may impact the estimations.

Third is the efficiency of the models. After several iterations and attempts, one or more models were described and reported in this paper, but there is always a possibility that a more efficient, better performing model may exist, even with the same dataset and/or with the same estimation method. In the case of those models that require a formal test for the validity or fitness of the models, the tests are done, and in such cases, the reported models are deemed to be final.

These disclaimers are necessary to make and should be kept in mind when discussing the limitations of the thesis and certain parts of the calculations. However, in general, the outcomes and conclusions are deemed valid and robust in a scientific way.

■

4 Relationship between advanced and emerging rates – an introductory time series approach

This chapter seeks to establish connections between long-term government bond yields in emerging countries and short-term rates in advanced countries to prove that they are statistically related and to reveal the nature of their interconnectedness with standard time series methods. Firstly, a naïve correlation approach will be laid out. Following that, the EM and AE variables will be tested separately and jointly using standard statistical tests. The results of these tests will be used as inputs for the next step, where the appropriate time series models will be chosen. A comprehensive analysis of various models has been conducted, resulting in a total of 40 distinct models that produced reliable outcomes. The validity of these models will be regularly assessed through rigorous testing procedures. The presence of the said relationship is established by verifying the time series model's validity and executing a standard hypothesis test, which demonstrates that the estimated coefficients deviate significantly from zero. Furthermore, the evolution of the process over time is determined by the multipliers and impulse response functions of the corresponding equations.

4.1 Correlation between aggregate variables

The correlation matrix below in Table 1 presents the bivariate correlations between each variable on a daily dataset, which is the highest frequency collected in the database. The variables are coming from different origins. Some of them have been created for the task as described in the Methodology chapter (USD_MC, EUR_MC, JPY_MC, AE_MC, EM10_FC, EM10_CEE_FC, EM10_LatAm_FC, EM10_Asia2_FC, EM10_FC4), while there are variables that are directly observed (USDSWAP_1M, EURSWAP_1M, JPOIS_1M, JPM_JY_EM_rate1).

2. Table Correlation matrix for main aggregated variables

	USD_MC	EUR_MC	JPY_MC	AE_MC	EM10_FC	EM10_CEE_FC	EM10_LatAm_FC	EM10_Asia2_FC	EM10_FC4	USDSWAP_1M	EURSWAP_1M	JPYOIS_1M	JPM_HY_EM_rate1
USD_MC	1,00												
EUR_MC	-0,01	1,00											
JPY_MC	-0,28	0,88	1,00										
AE_MC	0,82	0,56	0,27	1,00									
EM10_FC	-0,01	0,82	0,81	0,47	1,00								
EM10_CEE_FC	-0,13	0,82	0,86	0,37	0,95	1,00							
EM10_LatAm_FC	0,22	0,58	0,45	0,51	0,80	0,61	1,00						
EM10_Asia2_FC	0,00	0,65	0,68	0,38	0,86	0,77	0,62	1,00					
EM10_FC4	0,05	0,81	0,79	0,51	0,99	0,92	0,83	0,84	1,00				
USDSWAP_1M	0,99	0,09	-0,20	0,86	0,05	-0,07	0,26	0,04	0,11	1,00			
EURSWAP_1M	-0,01	0,99	0,87	0,56	0,79	0,79	0,55	0,62	0,78	0,09	1,00		
JPYOIS_1M	-0,45	0,77	0,90	0,07	0,69	0,71	0,37	0,64	0,64	-0,36	0,76	1,00	
JPM_HY_EM_rate1	0,35	0,31	0,11	0,46	0,42	0,22	0,66	0,48	0,41	0,36	0,30	0,16	1,00

Some of the results are worth mentioning but with caution. The two custom-designed composite variables, EM10_FC reflecting long-term emerging yields and AE_MC reflecting advanced monetary conditions, have a bivariate correlation of 0.47, implying a relatively solid and positive relationship between the variables. Similarly, the two market-observed variables, USDSWAP_1M and JPM_HY_EM_rate1, have a similar 0.36 correlation. Caution is needed to interpret the results of certain variable pairs, as they look more independent than previously believed. In many cases, this may result from either the daily observations (and time issues) or the fact that, arguably, rate changes

occur sequentially and not simultaneously, particularly in the case of composite variables. The same observation also applies to the correlation between various advanced rates and a comparable disparity between market-observed and calculated values. It is noteworthy, however, that Japanese rates exhibit a considerable number of negative correlations. However, it can be observed that the levels of the most significant time series tend to exhibit a concurrent movement, and their relationship appears to be stochastic. Therefore, it is necessary to conduct additional analysis to make further claims.

4.2 Time series methods – an overview

Before conducting the analysis, the most essential features of the data series under investigation are worth reiterating. There are two types of variables regarding the country/instrument coverage. Thus, some are related to emerging long and others to advanced short rates. Also, there are two types of variables: custom indices created by the Author and described in the Methodology chapter and market-observed variables, resulting in four different types of variables. All of them are observed on a daily basis. However, lower frequencies are also subject of interest for several reasons: daily observations may be more sensitive to time-related issues, discretional interventions on any sides, or different behaviors of repricing of financial assets. Therefore, weekly, monthly, and quarterly datasets are created beyond daily datasets by simply averaging the daily observations or providing the last observation of the respective time period. Although this causes a loss of information, the previous arguments motivate us to take them into consideration. The time dimension of the data evolution is also drawn near this line. The usual results of time series models are the following: first, the relationship is checked, and if it exists, a hypothetical shock is measured, which is most likely the highest right after the shock period and decreases later in time. However, the shock period is not necessarily one day or one week. Thus, several setups are tested for this sake.

AE and EM pairs are formed by considering the aforementioned features to ensure a systematic approach. Specifically, matching the frequency is a prerequisite for applying any method, and it is advisable to compare the aggregation method, either through averaging or using the last value. Simultaneously, the data source should remain consistent to facilitate the comparison of market values with other market values or custom indices with similar indices. However, as mentioned earlier, the preference is constricted during the final stage, and cross-type pairing is also employed following suitable statistical tests.

The empirical design broadly follows Shrestra & Bhata (2018) and Kiss et al. (2021). After the appropriate samples are created, variables are tested in various ways. Most importantly, series are tested for stationarity. The concept of stationarity pertains to the continuity of statistical characteristics over time, particularly variance, within a time series. In the literature, the Augmented-Dickey Fuller test is used with the null hypothesis that there is a unit root in the series, meaning it may not be stationary. The null hypothesis is rejected based on standard tests on conventional significance levels. In some cases, the levels were stationary at 10 percent, but since most of the time series are non-stationary, additional analysis was conducted. As it is common in the literature, stationarity was aimed

to be reached by differencing the data series, and these differences were also tested with ADF. In the majority of the cases, they were stationary. In some puzzling cases, not even differences were stationary, but after a brief consideration of an alternative method, the Phillips-Perron test was also applied for levels and differences. The reason for doing so is that ADF is more sensitive to structural breaks and may falsely reject H0 in some instances due to this.[11] Based on this task, the results are not surprising: nearly without exception, all data are stationary when differenced. Thus, the integration level is deemed in every case based on these tests: variables stationary on level are I(0), stationary at first difference are I(1), and stationary on second differences are I(2).

The pairs are contrasted to find out if their relationship is cointegrating, and based on these results, a primer estimation method is proposed, which is confirmed on a case-by-case basis. Cointegration is tested with the Johansen test, where the number of cointegration relationships was confidently zero; it was concluded that they are not cointegrated. When this hypothesis could have been rejected, cointegration was assumed.

As a next step, appropriate models are developed bearing in mind the following considerations. In cases when pairs are cointegrated, an ARDL or NARDL model was proposed. The parameters were chosen after brief considerations and thoroughly tested with a bound t-test. Even if the Johansen test showed cointegration, the bound test may conclude that there is no cointegration with the specific parameters, then the model was dropped in that form and reconfigured. Only models with acceptable bound tests were used further. In case of lack of cointegration, a VAR model was used with differences, finding the appropriate lag similarly. In case of unsuccessful VAR model building, simple OLS regressions were tested with differences: these give a non-time-differenced result but an average of time series' comovement, a static but robust relationship between the variables.

Once again, these models are validated with appropriate tests; however, in most cases, they are not well-performing, just valid models. In cases of ARDL and NARDL models, bound tests were considered decisive: if it shows invalid results, the model is discarded. In the same way with VAR models, a Portmanteau test was used to deem the validity of the model, and if it was not met, the VAR model was dismissed and reconfigured. These tests do not imply the efficiency or fitness of models but rather just the validity and consistency. From these models, the impact on certain periods is extracted by applying multipliers or with the help of impulse response functions. In ARDL/NARDL cases, these multipliers are created automatically, not considering the hypothesis test associated with the given lag; however, the test should define if the lag is different from zero, even if it is statistically not different, the point estimate is further used by the software package. In the case of impulse response functions, the shock of AE on EM and the shock of AE on AE functions were considered and divided to determine the approximate rate of shock transmission between the regions.

[11] Thank you for this hint to an anonymous user on Stackoverflow.

4.3 Time series data – basic statistics and creating pairs for modeling

The time series analysis is conducted with several variables and equations to find robust and nuanced results. As earlier described, each variable and designated variable pairs were tested with appropriate statistical tests before deciding the model type. The decision was mostly based on these results, with very few exceptions. One reason was overriding this automatic process when it was impossible to reach any reasonable parameters for ARDL models despite the Johansen test showing a cointegrating relationship between the variables.

Concerning the tested variables, certain simplifications were implemented compared to the previous correlation analysis. From market observed data, only one month USD swap rates were used as a proxy for short-term rates. The argument is that based on the literature review, the influence excerted by the USD is unquestionable, with most prior scholarly works focusing on the impact of the Fed and the USD markets. Choosing 1-month USD swap rates as a good proxy for USD liquidity was necessary based on several considerations: one month is objectively short-term but longer than noisy overnight and weekly rates, while the swap rate shows the price of liquidity on a respective maturity. In terms of emerging markets, a composite index from Bloomberg was used, as explained in the Methodology. Regarding the composite variables, only AE_MC and EM10_FC were used, but with different frequencies.

3. Table Statistics of variable pairs

Frequency (sample)	Variable	ADF	ADF(diff)	PP	PP(diff)	I-level	Pairs	Johansen R=0	First choice
Daily	AE_MC	2.96	-11.2***	9.52	-4416.8***	1	I.	32.73***	N/ARDL
	EM10_FC	-0.53	-12.99***	0.02	-2689.8***	1			
	USDDEPO1W	0.74	-16.33***	-0.28	-4156.2***	1	II.	20.35**	N/ARDL
	HY_RATE1	-0.88	-13.21***	-1.99	-3658.2***	1			
Weekly	AE_MC	-0.69	-3.91**	8.34	-691.3***	1	III.	17.49	VAR/OLS
	EM10_FC	-0.46	-8.48***	-0.41	-688.53***	1			
	USDDEPO1W	-0.9	-5.73***	-2.47	-918.08***	1	IV.	33.38***	N/ARDL
	HY_RATE1	-1.29	-6.94***	2.95	-856.06***	1			
Monthly	MA_AE_MC	-2.85	-2.21	3.75	-48.16***	1	V.	16.64	VAR/OLS
	MA_EM10_FC	-1.28	-3.73**	-0.22	-118.96***	1			
	MA_USDSWAP_1M	-3.21*	-2.96	0.06	-81.74***	1	VI.	18.58*	N/ARDL
	MA_HY_RATE1	-1.86	-3.12	-3.87	-102.34***	1			
	AE_MC	-2.71	-2.21	4.06	-60.41***	1	VII.	16.56	VAR/OLS
	EM10_FC	-1.46	-3.69**	-1.23	-154.61***	1			
	USDSWAP_1M	-3.17*	-2.99	-0.27	-90.69***	1	VIII.	16.64	VAR/OLS
	HY_RATE1	-2.06	-3.58**	-4.35	-161.82***	1			
Quarterly	QA_AE_MC	-3.27*	-3.06**	0.11	-29.41***	1	IX.	12.66	VAR/OLS
	QA_EM10_FC	-1.16	-3.91**	1.01	-49.20***	1			
	QA_USDSWAP_1M	-3.27*	-3.63**	-0.44	-27.05**	1	X.	17.45	VAR/OLS
	QA_HY_RATE1	-2.32	-3.06	-4.27	-29.59***	1			
	AE_MC	-1.91	-1.09	-4.53	-4.22	2	XI.	16.16	VAR/OLS
	EM10_FC	-0.48	-3.58**	-1.80	-36.95***	1			
	USDSWAP_1M	-2.98	-1.09	-7.61	-5.43	2	XII.	18.81*	N/ARDL
	HY_RATE1	-3.11	-2.06	-6.32	-34.97***	1			

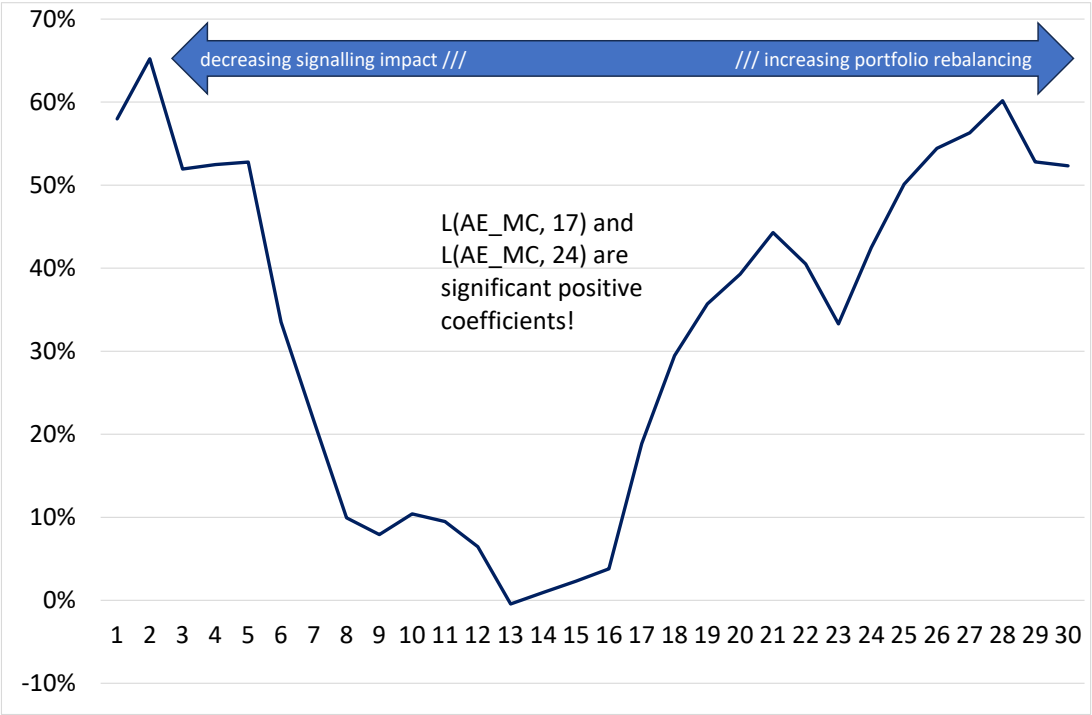
Also, it was briefly mentioned that almost all variables are stationary as first differences, and around half of the pairs show some proof of cointegration. Based on the results, variables with higher frequency tend to be cointegrated. In all cases, the dependent variable was chosen from emerging market variables, reflecting long-term rates in emerging countries, and the independent variable was chosen from advanced market variables. The lag for the dependent variable was usually one, while the lag for independent variables varied reasonably. The predicting period was based on the frequency of the original dataset.

4.4 Baseline model with ARDL estimate

The first pair is a daily dataset using two composite variables: the dependent variable is the EM10_FC composite, while the independent variable is the AE_MC describing advanced short rates. Both ADF and PP tests confirmed that both variables are stationary on first differences; thus, they are I(1). One feature of ARDL and NARDL models, which is why they are popular, is that integration order does not matter, and no transformation is needed before using the variables as inputs in the model. On the other hand, it does not restrict the use of variables, both being I(1), thus taking into account the result of the Johansen test, which stated that there is cointegration between the variables, ARDL-NARDL models were selected.

The parameters of the model were the following. The lag of the dependent variable was 1, and the lag of the independent variable was 30. Remember, in the case of stationary processes, even the large number of lags does not necessarily cause extreme multicollinearity. The lags were selected after several iterations and by considering that it is daily data. The chosen model type consisted of an equation with constant but without trend. (Type 3) The estimated model was tested with a bound t-test, and the test statistics of 11.78 strongly reject the null hypothesis of no cointegration. Consequently, the minimum requirement of the model validity has been met.

5. Figure Impact of advanced market shock on EM aggregate (ARDL model)



The result of the model suggests that in the initial few days, the transmission of advanced shock is extremely heavy and decreases steadily until the 8th (working) day after the shock. This is a reasonable time of adjustment, and overall, it brings back the usual idea of such a time series model that if a shock exists, it vaines after a few periods. Also, it is something that everyday experience would suggest that

even the largest shock remains only for a few days because market participants are acting accordingly, and a new equilibrium is reached. As noted, the partial impact on a given day is calculated with a multipliers function in the R package that does not count insignificant lags as zero but uses the point estimate, enabling smooth downplaying of any processes. Interestingly, lags 17 and 24 are significant and positive, creating two additional secondary waves of the original shock. The economic reasoning is that portfolio rebalancing takes time and appears later, though one should be cautious: Why 17 and 24 days, and how is it tied to the original shock if it waned around day 13? The model specification is probably the origin of this phenomenon and may not be connected to any actual economic processes. Nonetheless, the reporting of coefficients and multipliers is not cut at day 13 because the final aim of the chapter is to provide a comprehensive overview of the evolution of the process, and no decisive methodological concern prevents reporting the values beyond that day.

Clearly, one single model may not describe the processes well enough, despite the statistical appropriateness. The previously examined pairs are further used with different time frequencies and some of these models are worth elaborating better. All models that were designed and tested may be found in the Appendix.

It is a noteworthy addition to the previous ARDL model to test whether coefficients are significantly different when independent variable increases (financial conditions tighten in advanced economies) or decreases. This idea leads to the NARDL model, which is estimated in a similar way. The statistical package uses automatic lag selection process, thus the parameter that we use is assumed as a maximum number of lags, which is 5 in this case. It provides less reflection in time than the original setup, but two reasons support this choice. The automatic lag selection is resource intensive, as all attempt is compared with all others, and as a rule of thumb, a model may be appropriate regardless, that better models may exist. Both short and long-time asymmetry is proven based on the standard tests, and diagnostic tests show an acceptable result, thus the NARDL model of the respective variable is also a valid model with 5 lags. Regarding the coefficients, the positive immediate response has a coefficient of 0.37, the first lag is -0.29, while the second lag is insignificant. On the contrary, the negative immediate response has a coefficient of 0.13, the first lag is insignificant, while the second is -0.49. It seems, that increases of advanced rate are transmitted to emerging rates quicker and more robustly than decreases.

A good example for non-cointegrated variable pairs is pair V: in this case the advanced rate proxy is the monthly average of AE_MC, while the emerging market rate proxy is the is the monthly average of EM10_FC. This is a monthly dataset, the variables were deemed to be not cointegrated, but stationary on differences, thus a vector autoregression model was chosen. The optimal lag selection process recommended to use 2 lags (p=2) and no constraints or specific features were applied on the equation system (type='none'). After extracting the two impulse response functions: on one hand, the impact of AE on EM, and the impact of AE on itself, their quotients provide the transmission rate that may be used in a similar way as the multipliers in case of ARDL models. The result of this calculation

shows that the transmission in the first period is weak, but 76 percent in the second period. The average of obtained transmission rate for up to one year is 31.4 percent.

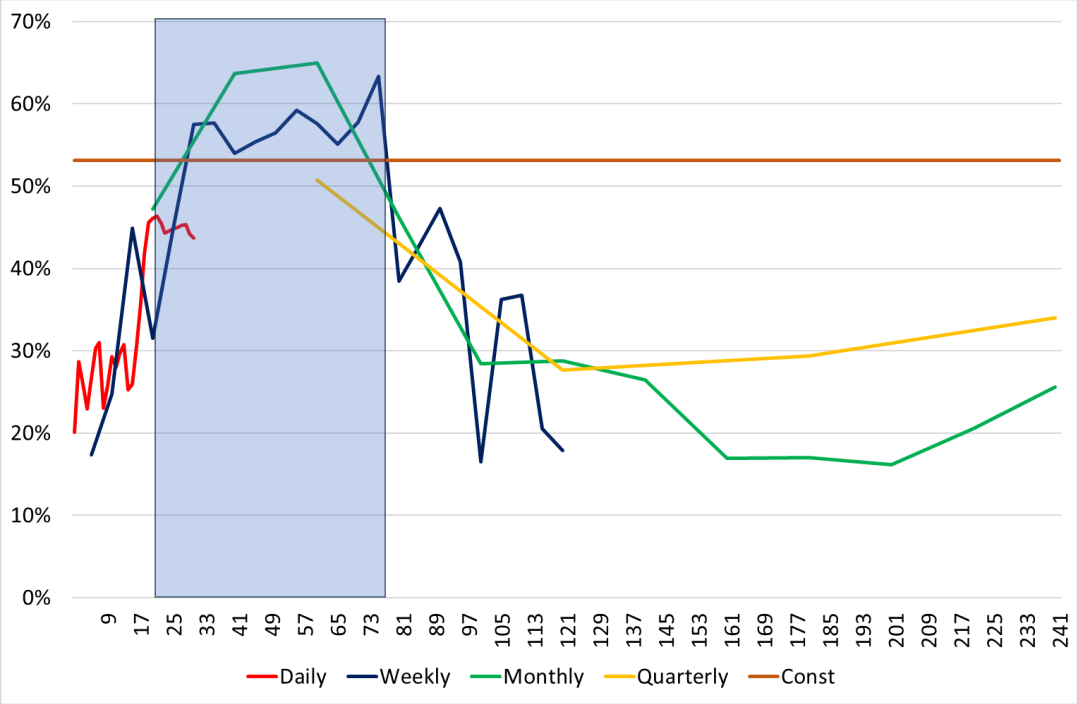
4.5 Further models and robustness

As explained, beyond the baseline models, all twelve pairs resulted in at least one model, and these models were valid without exception based on the respective tests. Several modifications were made to enhance the robustness of the models, primarily involving the estimation process. These modifications included variations in the inclusion or exclusion of a constant term and adjustments to the lag structures of the independent variables. Coefficients are summarized similarly: with multipliers or IRF-s, in the case of simple OLS models, the estimated coefficient is a constant. However, they did not materially change the overall picture of the model, except in some instances, all models were valid and consistent within the framework outlined above. In some cases, models were created where the frequency matched, but one variable was observed, while the other was a composite. Altogether, the twelve pairs, the robust modifications, and the cross-variable attempts yielded 40 different models that were estimated with either ARDL, NARDL, VAR, or OLS methods. A brief description of the models may be found in the Appendix. Based on the predefined criteria, all of them are valid models, providing a valid rundown of the time impact of advanced short-term rate shocks. The distinction between the two entities lies in the fact that the impact, as demonstrated across various specified time periods, inherently arises from the frequency of the variables and how the model is designed. Obviously, data with higher frequency is suitable for estimating impact for a shorter period, while, on the other hand, models using quarterly variables only use four lags, and the estimation period lasts for four periods, effectively being 240 (working) days. All models show an initially significant impact in the first period, but the length of this first period differs based on the time-frequency: the impact is portrayed for the last day of the period where the estimate belongs. Unfortunately, some results are counterintuitive, and – beyond the previously explained baseline models – the fitness and efficiency of the models vary. One attempt was made to summarize the results nonetheless: the calculated time rundowns are averaged based on the original frequency of the data; thus, a daily, weekly, monthly, quarterly, and constant average was developed for the days where impacts were calculated.

Based on these aggregated results, some cautious remarks could be made. First and foremost, given that created time series models are valid and coefficients significantly differ from zero, it is possible to claim that advanced short-term rates indeed have an impact on long-term government bond yields in emerging markets. The forty different models and their summarising imply that daily data are noisy, and the oscillating impact of approximately 20-30 percent transmission seems reasonable. Weekly, monthly, and partly quarterly data overlap and, fortunately, do not contradict each other. The estimated average shock transmission appears to be the strongest between 20 and 80 days, thus between 1 to 4 months. It suggests that shocks coming from advanced economies and targeting emerging long rates do not dissipate within a day or two. However, while the initial impact on daily data may appear to diminish due to the presence of noise in higher frequency data, lower frequency data still indicates

that market participants continue to react for a longer duration than what can be inferred from daily data. Even more, based on these findings, it was found that advanced shocks transmitted to emerging markets reach their peak passthrough 1 to 4 months after the initial shock, despite the quick rundown that could be observed in daily data.

6. Figure Change in size of advanced market shock transmission



Admittedly, these models are designed to model shock transmission and spread between two regions, and financial markets are hardly working this way. Technically, every day could be a smaller or larger shock, and even if a shock is larger, it cumulatively contributes to the final decision of the market participants; thus, modeling one shock may hardly describe the relationship's essence. Beyond these models, it is hard to find ones that are not working this way, and based on the previous arguments on the consistent nature of the solution designed for this research task, these caveats shall be regarded as valid research findings on their own.

4.6 Conclusion on time series

The first empirical chapter aims to establish a connection between long-term government bond yields in emerging countries and short-term rates in advanced economies. After carefully considering the variable choice, it was found that both market observed and composite variables are valid for time series analysis, and these variables were additionally tested on several frequencies with different aggregation methods. These data mostly behave like financial data usually do: stationary on first differences, and half of the variable pairs are cointegrated, making them eligible to use ARDL – NARDL models. VAR models or linear regressions with OLS were estimated with the first differences in the rest of the cases. The time dimension of the response was captured with multipliers derived from

ARDL-NARDL estimates, with impulse response functions, or with the interpretation of estimated coefficients associated with the independent variables. In all cases, they mean the share of transmitted advanced market shock to emerging markets.

Two important research conclusions must be drawn. As all-time series models are valid and at least some of the lags of the independent variable are significant, it is safe to claim that short-term rate shocks in advanced economies significantly influence the financial costs in emerging countries. This relationship is systematical and relatively robust, as much as the chosen models could encapsulate these. The second conclusion is that comparing models from different frequencies, it seems that shock transmission peaks around 20 to 80 days after the initial shocks; however, models from daily data, by their design, show a quicker downplay of these shocks.

4.7 Formal Hypothesis 1

Hypothesis 1:
Short-term rates in advanced markets influence long-term government bond yields in emerging markets.

Decision:
Accepted. Empirical evidence confirms that there is a relationship between short-term rate changes and long-term government bond yields in the sample. This relationship was measured using an aggregated advanced market index and one-month USD swap rates as proxies for short-term rate changes. Multiple alternative specifications and robustness tests have been conducted to validate this finding, which has demonstrated robustness.

■

5 Measuring monetary policy spillovers: A panel approach

As noted at the end of the previous chapter, the conventional time series analysis applied lacks two important features. On the one hand, emerging markets are not homogenous, and the original, panel-structured dataset has further possibilities to explore by taking into account the differences between the various levels of development, structural differences, and financial policy choices made by emerging countries. On the other hand, based on the previous discussion, the more accurate definition of 'monetary policy spillover' requires further polishing the methodology by employing control variables. Thus, this chapter turns to a panel-data analysis in order to accurately measure the monetary policy spillover, taking into account several aspects and focusing on the three chosen central banks: the Federal Reserve (Fed) in the US, the European Central Bank (ECB) in the Eurozone, and the Bank of Japan (BoJ).

As discussed in the earlier methodology section, variable choice is crucial in several respects. First, the nature of the data determines how it is possible to use it to reach the final goals; therefore, the frequency and the availability of several data limit our options. Second, the final regressions must rely on economic reasoning at the end. Third, the models should meet the standard requirements of panel regressions. While the most important factors and barriers are discussed regarding the estimation of cross-border monetary policy connections, the existence of such spillovers is also presented.

This chapter is organized as follows. Following a concise introduction, the initial step involves the preparation of a benchmark model. The benchmark model has been subjected to multiple tests and extensions in order to gain insights into various dimensions of the transmission of cross-border monetary policy and to demonstrate the resilience of the estimates. The question surrounding the comparability of the coefficients obtained is extensively examined. The findings derived from these modeling exercises establish a robust foundation for the second hypothesis.

5.1 Advantages of a panel dataset

As addressed in the previous chapters, the research aims to identify and quantify the cross-border impacts on emerging countries' long-term government bond yields. As noted earlier, several factors may influence government bond yields in general. Government bond markets are characterized by the demand and supply of the given financial instruments; thus, the price is determined by the current supply and demand on the market. On the other hand, the value of the bond may be approached by other factors, mostly macroeconomics and financial variables, that may influence the future price and value of the security. Panel data structure tackles the question of increasing the number of observations (though it is not an issue in our case) and handling the heterogeneity among emerging countries – better than the index, which works only slightly better than a simple average. Therefore, collecting data from several countries through the sample period enables us to create a more nuanced picture of the international transmission of monetary policy developments.

In accordance with conventional practices, a panel dataset is used for panel modeling. The choice between several options is discussed later, but one should recall that the most important advantage of panel models and panel datasets is that certain parts of the model may reflect heterogeneity, limit the potential impact of data and observational errors, and further subsampling helps to understand processes better. In the most general case, a country-fixed model is employed, which means that the intercept differs for every identity (country) in the sample. One shall recall the subchapter (3.4) explaining the difference between time series and panels and the most popular methods to create panel models. The following chapter explains how the benchmark model is created, analyzed, and expanded with several target variables.

5.2 Creating the benchmark model

The size of monetary policy spillover will be estimated in a panel model framework; thus, empirical observations are deducted by using panel econometrics methodology to robustly estimate the financial market impact that advanced markets have on emerging bond yields. To facilitate this process, a benchmark model that is both robust and efficient is developed and utilized in the subsequent stages. This benchmark model does not have any of those variables that encapsulate the hypothetical monetary policy spillover impact; its purpose is only to robustly estimate the relationship between long-term yields in emerging countries (dependent variable) and the chosen explanatory variables.

The following steps are executed in order to identify the benchmark model. First, the variables were chosen. As shown in the table, the dependent variable is the 'Long_term_yield' of emerging countries, while several options were considered for independent variables. One mindful decision was to use differences instead of levels. The reason is that the dependent variable is I(1), so stationary on differences, and therefore, differenced variables make the final model less exposed to autocorrelation, removing the majority of potential trends and seasonality, which arguably may appear at least in some parts of the chosen variable. Another option would be to include lags in the final model, but the possibility of using dynamic models is not granted; thus, a more general approach was taken first, resulting in static panel models. Differencing took place with a slight reduction of frequency: instead of daily changes, weekly changes were used, and only one data point (the one associated with Fridays) was considered from each week while creating a new dataset, *weeklypanel*. Using potential variables, several regressions were built. The model selection was attempted in several ways. An automated bootstrap method was employed, and it recommended keeping all variables or only removing VIX_index. The manual version: examining potential models with Variance Inflator Factor, a common method to detect multicollinearity, suggested similar results. In the most saturated version (equation 1), the largest VIF was associated with the VIX_index and the Stock_index. The VIX index indeed shows a significant correlation with a bunch of variables, but instead of using all of them – bearing in mind the potential expansion of the model – it is kept in the final version, and the majority of variables considered are removed to keep the benchmark regression tidy. The final version (equation 4),

regarding the variable choice, is not dramatically worse than the more saturated versions, allowing some flexibility and potential for further model expansion.

4. Table Development of benchmark panel regression

	Dependent variable:			
	DW_Long_term_yield			
	(1)	(2)	(3)	(4)
DW_DEPO3M	0.018***	0.018***	0.018***	0.019***
	(0.002)	(0.002)	(0.002)	(0.002)
DW_CDS	0.0002***	0.0002***	0.0002***	
	(0.00004)	(0.00004)	(0.00004)	
DW_VIX_index	-0.009		-0.026***	0.018*
	(0.010)		(0.010)	(0.009)
DW_FX_USD	-3.308***	-3.298***	-3.239***	-3.704***
	(0.114)	(0.114)	(0.114)	(0.109)
DW_Stockindex	-0.979***	-0.967***	-0.920***	
	(0.061)	(0.059)	(0.060)	
DW_Citi_Global_Uncerta	-0.00002**	-0.00002**		
	(0.00001)	(0.00001)		
DM_CPI	0.004**	0.004**	0.004**	
	(0.002)	(0.002)	(0.002)	
DW_Citi_Global_Surprise	0.001***	0.001***		
	(0.0003)	(0.0003)		
DW_Brent_oil	0.202***	0.209***		
	(0.035)	(0.034)		
Constant	4.092***	4.055***	4.185***	3.684***
	(0.120)	(0.111)	(0.119)	(0.112)
Observations	12,801	12,801	12,801	13,677
R^2	0.116	0.116	0.112	0.091
Adjusted R^2	0.115	0.115	0.112	0.091
F Statistic	186.020*** (df = 9; 12791)	209.187*** (df = 8; 12792)	270.051*** (df = 6; 12794)	456.026*** (df = 3; 13673)
Note:				*p<0.1; **p<0.05; ***p<0.01

Regarding the panel features, the following considerations were made. In this case, the choice between a simple linear regression, which is the same as a pooled panel model, and panel models is supported by an F-test for individual heterogeneity. This test confirmed that heterogeneity indeed exists and applying a panel method is reasonable. The result of the Hausmann test, which is designed to choose between random effect and fixed effect models, is ambiguous. The high p-value of the test statistic shows that both models are applicable, and based on the dataset's structure, a country-fixed effect was chosen. Based on the variable selection, however, two country-specific variables may be correlated with the individual-specific effect, it is still more convincing to use further to count for unobserved heterogeneity among countries.

Additional tests further revealed significant bias in the panel sample and the sample regression used. Panel-serial correlation in the sample is a potential cause of autocorrelation in the error term of the estimated regression; cross-sectional dependence among identities (countries) may threaten the validity of parameters, while heteroskedasticity in the error term (non-constant variance) of the regression may cause biased hypothesis tests and invalid standard errors. Thus, a correctional

mechanism is needed and deemed to be applied to all relevant long-panel models. Following the literature, Driscoll-Kraay covariance matrix was used when calculating standard errors; therefore, p values of estimates are calculated with these robust standard errors. Generally, robust standard errors result that p values associated with estimated coefficients being more robust, and often, seemingly significant variables become insignificant. It is important to note that the estimated coefficient will not be changed; only the standard errors and the p values will be calculated based on them. So, the same estimate will be more strictly evaluated during the standard hypothesis testing, which is implied in all regression analyses.

The final model that has been chosen as a benchmark consists of the weekly changes in long-term yields of emerging countries as the dependent variable and the following variables as independent variables:

- the change in the local deposit rate to account for the impact of domestic monetary policy and the expectations about near-term policy changes;
- the change in the VIX index to account for the general risk sentiment of the investors, as it is often included in other papers;
- the change of FX rate to offset the impact of changes on the foreign exchange market, as the paper focuses on interest rate spillovers mainly;
- the country-fixed effect, as argued above.

The chosen model is a country-fixed effect panel model, with both country-specific and common variables, on a long panel dataset with weekly observations. This model specification will be further used to track the impact of monetary policy spillovers. The strategy of doing this is adding additional variables described earlier associated with developments in the external monetary policy environment.

5.3 Extension of model to measure monetary spillovers: The Fed's impact

The analysis of target variables, e.g., the impact of certain central banks, is based on a relatively simple strategy in the case of the long panel that has been introduced earlier. The benchmark model discussed in the preceding subchapter is now being extended to incorporate one or more target variables. The coefficients assigned to these variables indicate the influence exerted by the respective factors they aim to assess. By doing so, the most important conclusions are derived from this exercise based on the hypothesis tests – therefore, the decision to be made on the significance of the given target variable. Notwithstanding, the estimated coefficient is also subject to further analysis, particularly intending to provide a sound comparison between the advanced central banks in the research focus.

Following this strategy, the estimated regression differs only slightly from the benchmark model that was earlier explained. The dependent variable is still the weekly changes in long-term government bond yields in emerging countries, and all independent variables remain as control variables in the new regressions. Additionally, the shock variable is added, resulting from a deeper consideration. The main regressions used composite variables derived through factor analysis of various financial

variables of the relevant advanced markets. (For a more detailed explanation, visit the methodology chapter.)

The reason for doing this is that the composite variable is more robust and expresses better the changing financial conditions compared to one or two directly observed variables. This decision relaxes the original restriction on using observed and composite variables in the same regression, as it was intended in Chapter 4. It is also important to reiterate the paper of Wu-Xia on the shadow rate concept, which is not very far from this approach: though they only focused on the time of effective zero lower bound and the period of quantitative easing programs, this exercise consequently using this idea in all baseline regressions. (Wu & Xia, 2018)

The non-stationarity of advanced rate levels requires using them in a similar first difference form as the dependent variable. The comparability and the economic reasoning also support this choice, so the target variables are used in weekly differences. Overall, the long panel is estimated on a weekly frequency, where observations are selected based on the calendar day: values on Friday were used and compared to those on the previous Friday, except for the balance sheet data where monthly log changes were used. This yields more than 13,000 observations, which is an atypical sample for panel regression.

5. Table Advanced market and Fed spillovers to emerging markets

	Dependent variable:			
	DW_Long_term_yield			
	(1)	(2)	(3)	(4)
DW_AE_MC	0.371***			
	(0.143)			
DW_USD_MC		0.228**	0.211*	
		(0.108)	(0.115)	
D30LFED_BS_2			-0.314	-0.455**
			(0.237)	(0.207)
DW_DEPO3M	0.019***	0.019***	0.019***	0.019***
	(0.002)	(0.002)	(0.002)	(0.002)
DW_FX_USD	-3.703***	-3.694***	-3.690***	-3.704***
	(0.407)	(0.412)	(0.413)	(0.410)
DW_VIX_index	0.020	0.019	0.018	0.016
	(0.015)	(0.015)	(0.015)	(0.015)
Observations	13,677	13,677	13,677	13,677
R^2	0.095	0.094	0.095	0.092
Adjusted R^2	0.094	0.093	0.093	0.091
F Statistic	358.308*** (df = 4; 13654)	355.319*** (df = 4; 13654)	285.776*** (df = 5; 13653)	346.277*** (df = 4; 13654)
Note:				*p<0.1; **p<0.05; ***p<0.01

The expanded regressions provide intuitive results in terms of significant coefficients, as shown in the table above. The composite variable, which depicts the financial market changes in advanced markets, is substantial, with the coefficient estimated to be 0.37. Regarding the impact of the Federal Reserve, several specifications were tested. In regression 2, only the variable associated with USD market

changes is used and estimated to be significant with a coefficient of 0.23. Regression 3 uses both the price-type variable about USD rate changes and the one derived from the Fed's balance sheet. In case 4, only the monthly changes of the Fed's balance sheet were used. Based on models 2—4, it was found that the balance sheet is indeed significant, even on its own, but parallel use with the price-type rate variable is not justifiable. The most convincing explanation for these results is that the composite variables pretty well encapsulate the changes in financial conditions similarly to shadow rates used in the literature, unlike one or two directly observed variables. Therefore, the impact of balance sheet policies is reported in the paper, but the baseline models only use the composite variables that encapsulate interest rate-type variables. Note that the coefficients of control variables did not change significantly in the different specifications, while the overall explanatory power increased slightly. These facts suggest that the additional variables are indeed relevant, and the estimations are pretty robust.

The result of the panel regression exercise leads to an important conclusion in connection with the hypothesis of this chapter. The overall changes in the monetary conditions that are influenced by the three large central banks in focus affect the long-term rates of emerging markets significantly. Out of 100 basis point changes, about 37 are directly transmitted toward the emerging markets via the financial market channels, even if we account for several coinciding factors. The changes in the Fed's monetary conditions significantly influence long-term government bond yields in emerging markets. In general, 22.8 percent of a given change is transmitted to emerging markets. Therefore, a 100 basis point increase (decrease) results in a 22.8 percent increase (decrease) in emerging long yields. This result appears to be significant, even after applying Driscoll-Kraay covariance matrix on the standard error.

The impact of the Fed's balance sheet policy – or, to be more accurate, the impact of changes in the Fed's balance sheet – also appears to be significant, and the sign of the coefficient is also intuitive: the increase of the Fed's balance sheet is associated with the decrease of the long-term yields in emerging markets. This is in line with other authors' findings and the previous theoretical discussion on the *'hunt for yield'* effect: as the Fed creates scarcity in safe assets, demand for riskier assets increases; thus, yields fall. Contrary to the regression that uses only the price-type variable, in the one that uses both price and balance sheet size, the size of the coefficient associated with the USD rate is smaller, and the p-value is higher, while the balance sheet variable is insignificant. Therefore, the two variables weaken each other as they are highly correlated, thus, models 1 and 2 shall be considered as final models.

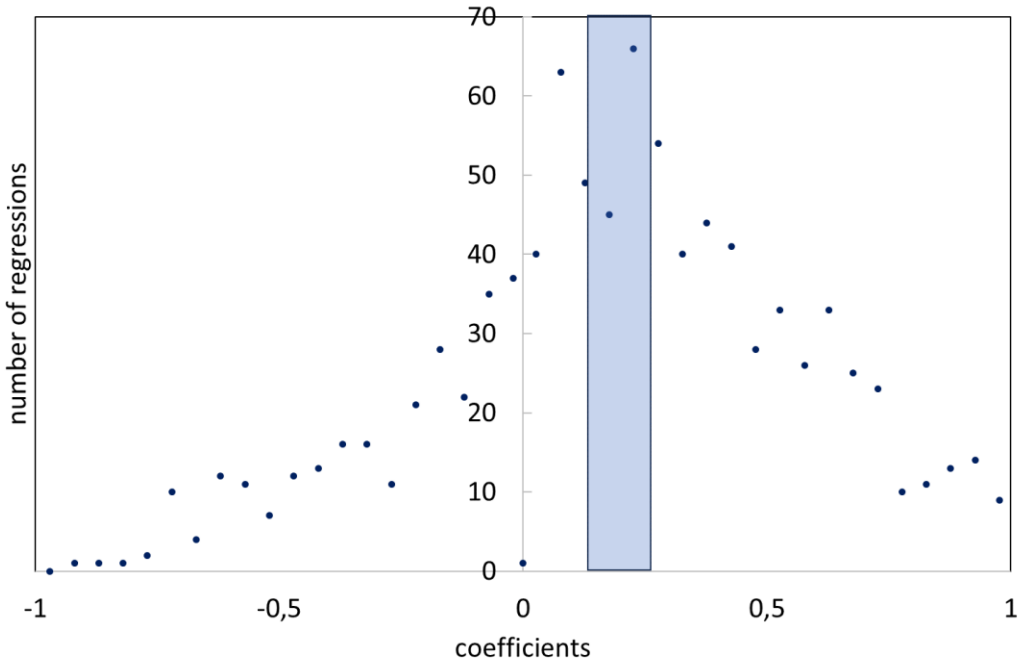
In general, the changes in advanced markets transmit to emerging markets at 37 percent, while the changes in USD rates at 22.8 percent. In order to enhance the validity of the findings, it is imperative to undertake additional measures. Specifically, a comprehensive and rigorous robustness analysis should be carried out before expanding the original benchmark model with EUR and JPY rates consistent with the established methodology. After determining the mean transmission rate for all

three central banks, subsequent procedures involve verifying these findings by considering market and event shocks. This process also serves as a mean to assess the robustness of the results.

5.4 Robustness of Fed transmission rate

Additional analysis is necessary to examine the robustness and validity of the point estimates discussed in the previous subchapter. The regression findings have been corroborated by multiple sources. Firstly, it is crucial to emphasize the statistical precision of the model by correctly interpreting it. The obtained coefficient describes a statistically significant and positive relationship between the short-term USD rates and long-term government bond yields in emerging countries, which may largely differ in certain circumstances, thus, it shall be regarded as a robust long-time average of rate transmission between the markets.

7. Figure Result of bootstrap regressions



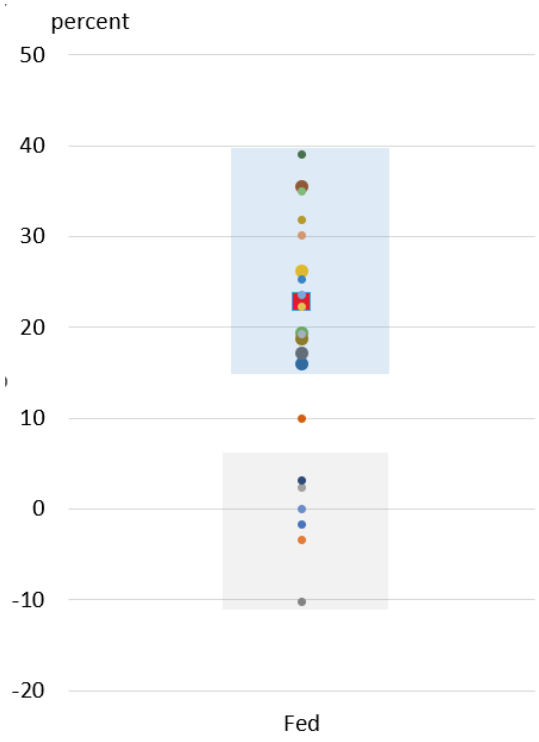
A compelling way of visualizing the statistical validity of the regression coefficient is to generate a bootstrap cycle with the regression of interest to show that the estimated coefficient is stable and that the estimate falls within the boundaries of anticipated errors. Building upon this concept, a bootstrap regression analysis was conducted by randomly subsampling 200 observations, running the underlying regression 1000 times, and visualizing the obtained coefficients for USD_MC. The brackets in the x-axis mean 0.05 wide ranges of the estimated USD_MC coefficient, while the numbers on the y-axis show how many times the estimated coefficient fell into the given range. The coefficient size was between 0.12 and 0.33, nearly 250 times of the observations, and it was higher than 0.12 (which was deemed a positive relationship based on the robust standard error on the baseline estimate) 580 times out of 1000. This result should be compared with the fact that 224 times, the estimated coefficient was practically zero (between -0.12 and 0.12) and was negative 196 times. This task has shown that the

point estimate is valid; even after using robust standard errors, the estimated coefficient clearly differs from zero and ensures the relationship is most likely positive.

Secondly, the adequacy of using a composite variable is an essential consideration in relation to the shock variable. By utilizing certain components of the composite variables, it is possible to demonstrate that the majority of outcomes retains their significance with consistent directionality. However, it should be noted that certain alternative specifications lose their significance at this juncture. All in all, using constituents of USD_MC variable instead of USD_MC brings back broadly similar results, therefore, the composite variable indeed encapsulates the US market processes well. The results are represented in the figure below.

The third argument pertains to the examination of the sample. By dividing the sample into smaller subsamples and conducting the regression analysis again, the newly derived coefficients are expected to closely resemble the estimates obtained from the entire sample. The results of this analysis, though, reveal some weaknesses of the method and lead to an important constraint that needs to be explicitly claimed.

8. Figure Alternative models for the Fed transmission rate



Many subsamples, subsequent periods and not, yield a similar coefficient than for the whole sample period, but for example, in case of the consecutive period between 2015 and 2019, the USD_MC coefficient becomes statistically insignificant. The regression coefficients on heuristically chosen subsamples are demonstrated on the graph, which overall confirms the validity of the main estimate as the majority of 22 alternative estimates (with constituents on the whole period and certain subperiod) are indeed close to the main regression result and only fewer cases resulted in coefficients

that are practically zero. However, the suspect of time-dependence of the variable is investigated with yearly subsamples, and it was revealed that the coefficient of USD_MC was largely different in certain years. This finding is indeed alarming, but the main finding still holds. However, the coefficient seems to be higher when quantitative easing programs in the US are conducted at a large scale, but the sample period is long enough, with different monetary policy regimes, to provide a robust long-term average. Also, this finding does not change the choice of using interest rate (price-type) variables in the regressions, instead of balance sheet sizes as price changes are still deemed to be a better proxy for monetary policy environment due to the composite nature of the variable used.

Finally, two subchapters below (5.7 and 5.8) may also be considered as a robustness test. In these alternative models, the shock variable is not a weekly change of a composite on the right-hand side but a dummy variable that denotes shock (extreme) events in the sample. However, one should keep in mind that those regressions target a slightly different angle of monetary policy spillovers compared to this baseline model; nonetheless, they are interesting approaches to expanding the scope of the analysis.

All in all, it is possible to claim that the estimates in the previous subchapter are adequately robust: they do not change substantially, or at least remain significant and keep the sign in case of the different alternative specifications, with different USD variables and in many different alternative subsamples, however, the size of the impact may be time-dependent.

5.5 Extending the model to the European Central Bank and the Bank of Japan

This methodology may be extended to other shock originators as well. Based on the paper's research strategy, the potential impact of the ECB's and BOJ's monetary policy is tested on emerging government bond markets. The exercise required to estimate the transmission level of the two new originator countries does not differ significantly from the earlier approach. Even more, the primary emphasis is placed on ensuring the comparability and unbiasedness of the extended task, with only minimal modifications being made to achieve appropriate regression analyses.

On the left-hand side, the long-term government bond yields of emerging countries remain. The dataset is still the same in a panel structure, and all the considerations that lead to the benchmark model choice still apply. On the right-hand side, the shock variable is an alternative with analogous variables that reflect the Eurozone's or Japan's monetary conditions. These composite variables grab the main changes in the Eurozone and Japanese short-term financial rates, similarly that was for the Fed earlier. The variable related to the respective central banks' balance sheet has been changed accordingly. All variables are used in weekly (or monthly) changes as earlier.

The advantages and limitations of these extended regressions are exactly the same as in the Federal Reserve case. Thus, the coefficients of target variables are understood analogously and reported in the same context with the same disclaimers. It is important to point out two issues from the earlier discussion. This is still a so-called long panel with many more observations than identities (countries).

However, it is still reasonable that the trade-off between correctly identifying the changes in the monetary environment and the limitations coming from a large number of observations supports the choice of weekly observations. On the other hand, standard errors are calculated with Driscoll-Kraay's robust covariance matrix; therefore, we account for a set of biases explained earlier.

6. Table Euro and yen shock transmission to emerging markets

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
DW_EUR_MC	0.231***	0.211***	
	(0.068)	(0.069)	
D30LECB_BS_2		-0.414*	-0.519**
		(0.245)	(0.221)
DW_DEPO3M	0.019***	0.019***	0.019***
	(0.002)	(0.002)	(0.002)
DW_FX_USD	-3.721***	-3.726***	-3.718***
	(0.403)	(0.404)	(0.409)
DW_VIX_index	0.018	0.017	0.016
	(0.015)	(0.015)	(0.015)
Observations	13,677	13,677	13,677
R^2	0.093	0.094	0.092
Adjusted R^2	0.092	0.093	0.091
F Statistic	351.532*** (df = 4; 13654)	283.496*** (df = 5; 13653)	346.721*** (df = 4; 1365

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
DW_JPY_MC	-0.175	-0.176	
	(0.234)	(0.237)	
D30LBOJ_BS_2		-0.438*	-0.437*
		(0.249)	(0.248)
DW_DEPO3M	0.019***	0.019***	0.019***
	(0.002)	(0.002)	(0.002)
DW_FX_USD	-3.711***	-3.689***	-3.689***
	(0.406)	(0.406)	(0.408)
DW_VIX_index	0.016	0.018	0.020
	(0.015)	(0.015)	(0.015)
Observations	13,677	13,677	13,677
R^2	0.091	0.093	0.092
Adjusted R^2	0.090	0.091	0.091
F Statistic	343.558*** (df = 4; 13654)	278.847*** (df = 5; 13653)	347.111*** (df = 4; 136

Based on the regressions that were run as explained, the results seem intuitive. In the case of the ECB, the regression with only the price-type composite variable yielded a coefficient of 0.23, which may be translated into a 23.1 percent average international transmission of the ECB's monetary policy. In terms of balance sheet policy and QE effect, we have very similar results to in the case of the Fed, though in this case, the variable for the financial condition in the second regression does not show any sign of an increase in p-value and thus remains significant regardless. However, the coefficient for the financial condition is somewhat lower. The balance sheet exhibits a consistently negative value across all specifications, indicating a significant and intuitive trend. The expansion of the ECB's balance sheet coincided with a decrease in yields in emerging countries, potentially due to international portfolio rebalancing. In the case of the ECB, the regression with rates and balance sheet variables performs better than the one with only the rate composite. On the other hand, the previous argument that the composite index accounts for some changes caused by balance sheet policies is still valid, and the comparability across shock originators also supports the first regression as a baseline regression for ECB transmission. Thus, the conclusion is that out of 100 basis point changes in EUR, short-term rate changes of around 23.1 basis points are transmitted directly to the long rates of emerging countries via financial markets.

The right panel shows the results of the impact of changes in Japanese financial conditions on emerging markets. Regarding the rates, it is important to note that the coefficients are the highest (in absolute values) in this case, which is the direct result of the marginal variability of yen rates in the sample period. Using normal standard errors, these large coefficients would be more than enough to be largely significant, though after applying Driscoll-Kraay robust standard errors, it turns out that these coefficients are not statistically different from zero. Balance sheet changes appear to be significant and negative, similar to the Fed and ECB.

From the point of thesis and keeping in mind the considerations explained earlier, the first regression in the right panel should be considered as the baseline regression that measures the impact of Japanese impact on emerging financial markets. Thus, it may be concluded that the Bank of Japan does not systematically impact long-term changes in emerging markets.

Regarding the robustness of these estimates, similar tasks may be carried out as in the case of the Fed. The results are broadly similar: changing the composite to the constituent of EUR_MC or JPY_MC does not change the overall picture, while subsampling suggests that the transmission may be time-dependent. The statistical features of the benchmark estimate in the case of ECB and BOJ seem to confirm that the reported coefficients are valid, statistically different from zero in the case of the ECB, while the point estimate is quasi zero in case of Bank of Japan, considering robust standard errors.

A unique element, extending beyond the paper's scope, shall also be considered. Although the coefficients pertaining to the rate changes are intuitive (and will be elaborated upon in the subsequent subchapter), our findings indicate that the significance of all balance sheet policies is also statistically significant at a 10 percent level. One may argue that it is rather a coincidence as, in the majority of cases, the balance sheet expanded, and emerging long rates indeed decreased. The inflated balance sheet was the most interesting puzzle of the 2010s' economic talks, while emerging rates tend to increase much quicker than decrease, so we may observe more days when they actually decreased. However, the regression analysis shows a systematic relationship between them, and knowing these trends does not invalidate the results. A more theoretical discussion could be the impact of global liquidity. H. Rév's argument centers around this part of international financial relations and may be a possible source of existing international financial dependence. Based on the previous experience in the case of the Federal Reserve, it appears that the extent of monetary policy spillover increases when shock originator countries apply balance sheet policies, but the impact may be better measured on interest rate changes instead of balance sheet sizes. The divergence between the estimated coefficients, in the case of certain years, is supposed to be closely related to the monetary policy tools employed by the shock originator countries.

5.6 Comparison of large central banks

Prior to presenting the findings and drawing conclusions in this chapter, it is necessary to engage in a discussion regarding the significance of the three baseline regressions. This discussion addresses the extent to which these regressions can be compared and reveals which central bank has the greatest impact on emerging countries. The final aim of this discussion is to define and underline precisely the monetary policy spillover generated by the three large central banks, namely the Federal Reserve, the European Central Bank, and the Bank of Japan.

One concern that may arise is that we estimated the impact of given central banks in a regression where other central banks' monetary policy spillovers were not sufficiently covered. Though the control variable VIX index may have a similar role, we argued earlier that its application is more

attached to risk sentiment than to monetary policy decisions. In reality, the international impact of large central banks coincides if they exist. Therefore, one thing to be discussed is whether a joint, "all-central-bank-included" version will be used or whether the earlier one-by-one approach sufficiently describes the international transmission of these monetary policy developments. The drawback of a joint regression is that it may be the uncontrolled covariance between these variables, thus may be unnecessarily redundant, and the coefficients may be biased.

The second concern may arise from the different scales of shock variables, therefore the understanding of the spillover coefficient. In the case of the Japanese estimate, it was noted that a minimal variability of the Japanese short-term rates caused an inflated regression coefficient. This may be a valid concern when comparing the Fed and the ECB. Remember that coefficients are reasonably close to each other, soliciting a thorough discussion of the subject matter. However, from an econometrics perspective, Fed and ECB rate changes are perfectly comparable: the weekly changes have the same standard deviation, and the mean is zero. However, the levels have different standard deviations: it is nearly double for the Fed compared to the ECB, which comes from the wider range of USD rate changes throughout the sample period. It is not very surprising: policy shifts caused a more colorful rate environment in the US, meaning that after some of the rare and impactful policy decisions, larger shifts occurred, but the weekly changes, on a long-time average, appeared to be very similar in both cases.

To address these concerns, some further specifications are tested and contrasted. Regarding the first issue, the coexistence of monetary policy spillover is a simple solution: a joint regression is estimated with a very similar setup, and the associated coefficients to the respective shock sender central bank are reported as a common effect. Regarding the second issue, the answer is more complicated. Variables shall be normalized to enhance their comparability.

Consequently, the shock variables were generated by normalizing the original dataset. This involved subtracting the mean from each observation and dividing the result by the standard deviation of the dataset. This process ensures that all data series possess a mean of zero and a standard deviation of one. The same goes for control variables on the right-hand side to counteract any possible collision between the normalized and un-normalized series among the independent variables. These new variables are used for alternative regression with the intention of obtaining individual and shared impacts of certain central banks. In light of the persistent issue of autocorrelation, irrespective of normalization, first differences are used to estimate coefficients.

Based on the results, around 37.1 percent of the changes in advanced monetary conditions are directly transmitted to emerging countries. Therefore, when the advanced economic environment experiences a 100 basis point increase in the risk-free rate, approximately 37.1 basis points are allocated to emerging countries, assuming all other factors remain constant. It is not meaningful to normalize and transform further as this number is reported and underlined as one of the key results of the panel regression exercise. However, if we did it, we obtained results similar to those of the Federal Reserve,

given that the standard deviation of the advanced rate composite was smaller than in the case of the Fed's.

7. Table Summary of transmission rates

	Based on changes ~ estimated transmission of individual changes		**Based on normalized variables ~ retrospective relative impact**	
	Individual effect	Joint effect	Individual effect	Joint effect
USD	22.8%**	19.4%*	16.2%*	15.1%**
EUR	23.1%***	16.8%**	15.4%*	9.4%
JPY	-17.5%	-25.4%	-5%	-6.7%
AE	37.1%***	-	2.9%***	-

As we noted earlier, the individual effect that was estimated in a regression where only the respective central bank shock appeared and none of the other two were 22.8 percent in the case of the Fed and 23.1 percent in the case of the ECB, while the coefficient associated with the impact of the Bank of Japan turned to be insignificant after applying robust standard errors in the hypothesis testing. Regarding the comparison of the coefficients for the Fed and ECB, a simple hypothesis testing method is applied as it is explained in Chapter 3. After contrasting the coefficients and robust standard errors, the Z score is 0.02, which means that the hypothesis that the two coefficients are equal may not be rejected.

In a joint regression, the three coefficients change slightly. Using Driscoll-Kraay, robust standard errors, similar to earlier Japanese short-rate, remain insignificant in the regression. The more debatable issue is the Fed and ECB: the coefficient associated with the latter decreased but may be the result of the overall smoother nature of the data series, and when it did, many times, USD rates may change similarly. This connection is a subject of further discussion and analysis, but currently, we may note that the ECB's coefficient has decreased in a simultaneous case.

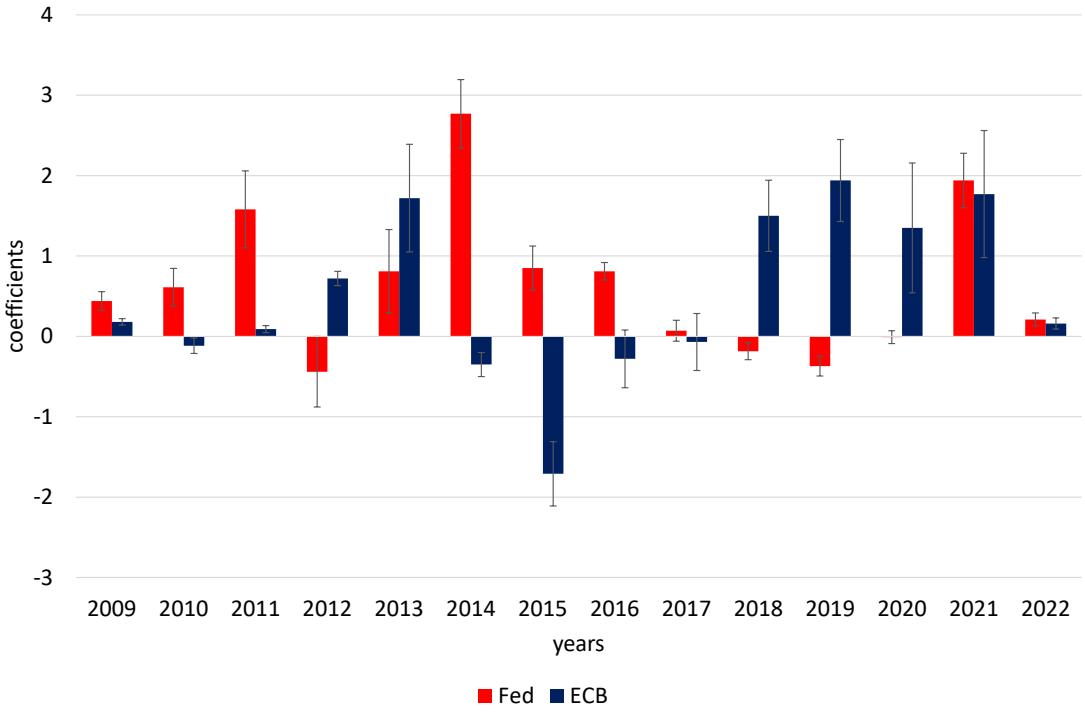
Though the transmission rate is similar in both cases, a unit of Fed and ECB shock is transmitted to a different extent to emerging long rates. Based on the scale-independent regressions, the overall market impact was higher in the case of the Federal Reserve. In other words, a near-sighted answer would be that the point estimate is slightly higher, while statistical answer would be that the coefficients are not different, though more than zero in both cases. Even the descriptive statistics are very similar for the differenced variables. On the other hand, one should not forget that differenced variables, thus weekly changes, do not give a full picture of the processes: the range of the level variable was significantly larger in case of the Fed, therefore, the same coefficient signs higher overall market impact. This is mirrored in the scaled, level-independent calculations: the transmission of Fed rates is indeed larger, in this case though remains close to ECB's impact. Once again, applying the hypothesis test for equality, the result is the same as in case of the levels: it may not be rejected that the two coefficients

differ, but both of them differ from zero. Also, it is interesting to note that only the Fed remains significant in a joint regression on average, but this may be a result of better co-movement with global liquidity conditions.

After a formal comparison of the coefficient, one more supplementary task is worth to be mentioned. It is once again important to reiterate that these coefficients represent average transmission estimated on the full sample, but as the observation period consisted of several different periods of advanced and emerging monetary policies, it gives a robust long-time average for monetary policy spillover. Following the earlier idea of rerunning the regressions on yearly samples, comparing two shock originators shows an interesting pattern.

Based on the alternative regressions on yearly subsamples, the cross-border impact of the Fed was particularly strong in the early 2010s when quantitative easing programs were implemented. On the contrary, in the late 2010s, when the Fed terminated the asset purchase programs and the ECB launched them, the monetary policy spillover of the ECB's financial condition notably increased. In 2021, both large central banks had a strong influence on emerging markets and contributed to the decrease of funding costs in emerging markets.

9. Figure Fed and ECB shocks by year in the sample



In conclusion, the transmission rate of the Fed's and ECB's policy shocks are nearly similar, averaging around one-fifth of the total change. However, after we normalized the variables, we found that the USD shocks were slightly more prominent than the ECB's. Yearly subsamples revealed that monetary policy spillover is time-dependent, in general, and strengthens when the shock originator country implements balance sheet policies. On the other hand, the Bank of Japan policy has no impact in rate terms, but its balance sheet policies impact similarly to the other two central banks.

5.7 Alternative approach – Using binary variables to identify market shocks

The concept of monetary policy spillover, particularly the measurement of the phenomenon, may be approached in several ways, and surely, the approach described in the previous subchapter is not the only one. Two other approaches will be considered beyond the explained baseline models that have a slightly different aim but provide a valuable cross-check and insight into the current understanding of spillovers.

The empirical methodology employed in this alternative approach goes as follows. In this subchapter, the shock variable is altered by the introduction of a set of binary variables that capture those instances when significant fluctuations in the original shock variable occurred. Similarly, the subsequent subchapter utilizes event sets to substitute monetary policy shocks, specifically by describing policy events and announcements. Both of these methodologies employ a shared conceptual approach in which specific days are selected for analysis, meaning that the average rate discrepancies are assessed and compared to the typical fluctuations observed on other days.

A shock-based modification of the original baseline model thus uses a constructed variable as the independent variable while the rest of the model remains unchanged. The weekly changes of emerging long-term government bond yields are regressed by the new target variable and the control variables that also express changes in time to mitigate the risk of autocorrelation. The regression is run with panel-fixed effects, and the coefficients are explained accordingly. The new target variable is technically a dummy, which has a value of 1 when the weekly change of the respective Fed, ECB, and BoJ composite variable was substantial in absolute value. The 1 and 2 percent of the largest increases and decreases are flagged in these custom series for each shock originator. In an alternative version, dummy values are changed to 0 from 1 when the other two shock originators also showed a heavy financial market reaction, noting that the shock is most likely not solely reflected in the changes of the given central banks' monetary policy, but a more general shock has been absorbed on the market.

8. Table Percentiles used for identifying extreme events

(weekly changes)	**1%**	**2%**	**98%**	**99%**
USD	-0.119	**-0.050**	**0.102**	0.144
EUR	-0.116	**-0.082**	**0.102**	0.130
JPY	-0.067	**-0.049**	**0.037**	0.049

Based on the calculated percentiles (shown in the table above), one percent of the observations of USD_MC decreased by more than 0.119 percentage points. Thus, weekly changes smaller than this value are flagged as an extreme (1%) decrease in USD monetary conditions. Potentially, these are the weeks of large monetary policy easings per se, or admittedly, it could result from extremely worsening macroconditions that imply future US monetary policy easing. Likewise, a proportion of 2 percent of

the observations exhibited a decrease exceeding 0.05 percentage points. Remarkably, the observed extreme events did not indicate a noticeable degree of extremity that would suggest data errors. However, upon conducting calculations, it becomes evident that weekly fluctuations of substantial magnitude are infrequent within the examined dataset. Analogously, weeks, when the USD_MC index increased by more than 0.144 percentage points when the USD_MC index increased by more than 0.144 percentage points are regarded and flagged as extreme increases in USD rates, and the top 2 percent of increases (which are larger than 0.102 percent) is marked with a dummy in a different shock series. The same, easy but handful shock identification exercises have also been done for euro and yen composites.

9. Table Impact of extreme events

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
TOP1E_DW_USD_MC	0.125***		
	(0.019)		
TOP1E_DW_EUR_MC		0.024	
		(0.021)	
TOP1E_DW_JPY_MC			-0.069***
			(0.015)
DW_FX_USD	-3.691***	-3.719***	-3.718***
	(0.109)	(0.109)	(0.109)
DW_VIX_index	0.015	0.017*	0.014
	(0.009)	(0.009)	(0.009)
Observations	13,908	13,908	13,908
R^2	0.086	0.083	0.084
Adjusted R^2	0.085	0.082	0.083
F Statistic (df = 3; 13886)	434.908***	419.267***	426.674***
Note:		*p<0.1; **p<0.05; ***p<0.01	

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
BOTTOM1E_DW_USD_MC	0.100***		
	(0.019)		
BOTTOM1E_DW_EUR_MC		0.001	
		(0.019)	
BOTTOM1E_DW_JPY_MC			-0.054***
			(0.021)
DW_FX_USD	-3.692***	-3.715***	-3.704***
	(0.109)	(0.109)	(0.109)
DW_VIX_index	0.008	0.017*	0.017*
	(0.010)	(0.009)	(0.009)
Observations	13,908	13,908	13,908
R^2	0.085	0.083	0.083
Adjusted R^2	0.083	0.082	0.082
F Statistic (df = 3; 13886)	428.794***	418.778***	421.236***
Note:		*p<0.1; **p<0.05; ***p<0.01	

The understanding of the coefficients associated with the new, shock-based target variable is that in case of such an extreme event, to what extent emerging long rates tend to move. The most important aim of this exercise is to contrast the results with the general transmission that was calculated earlier, and it may shed light on the origin of advanced market 'waves'. Reiterating the empirical strategy of the thesis paper, we may say that this is the closest when we approach exclusive monetary policy-driven advanced market changes on a relatively high-frequency panel dataset. However, generalizing from extreme events may not be sensible, meaning that this exercise does not change the way we regard the previous baseline regressions.

The table above shows the regressions where the shock variable is defined as an extreme weekly change (of one percent extent) of USD_MC, EUR_MC, and JPY_MC when it exclusively occurs. Drastic increases in USD rates appear to be transmitted to emerging markets quite heavily. As per the results, long-term government bond yields tend to increase by 12.5 basis points each time when an extreme and exclusive weekly increase in USD short-term. Given that the top 1 percentile of USD_MC

is 0.144 percentage points and the maximum weekly changes are around 0.32 percentage points, it is safe to say that in case of extreme changes in USD financial conditions, the monetary policy spillover is larger. Interestingly, the extreme and exclusive increases in EUR rates do not significantly impact emerging bond markets, while extreme rate increases in JPY rates tend to lower emerging long yields.

Regarding the opposite directions, when short-term rates fall in advanced markets, a similar pattern can be observed in terms of significance, though the sign of change is surprising. The largest drops in EUR rates are insignificant from the point of EM long rates, and emerging rates fall as much as JPY rates on those days when JPY has a large and exclusive drop. When USD rates decrease in extreme amounts, long-term government bond rates tend to increase in emerging markets by about 10 basis points each time. It is also important to note that both USD specifications (large increases and drops) make the changes in the VIX index insignificant in the model, which might be one of the reasons why USD and EM rates move in the opposite direction. In the previous subchapter, the robustness test showed no sign that Fed easing is associated with an increase in long rates, even the opposite, and the literature review concluded similarly. Therefore, large drops in USD market conditions may be associated with a risk-off mode: when financial market investors experience risk avoidance, temporarily pushing EM risk premia higher.

The primary caveat of this exercise lies in the significant transmission of extreme USD events to emerging markets. While it is worth noting that this transmission is especially apparent in instances where USD rates experience a decline or an increase, it is surprising that both increase and decrease in USD rates are associated with a temporary increase in emerging bond yields. Also, the coefficients' size implies that temporary transmission these days is higher than on average. There is also a suspicion that this response is linked to market participants' risk perception and is only temporary. Interestingly, EUR rate drops and increases are insignificant in all specifications, while JPY rate changes are equally associated with the decrease of emerging long yields.

5.8 Alternative approach II. – Using binary variables to estimate the impact of policy events

Beyond standard methodologies that build regressions on one or more proxy variables, as was done earlier, another widely used approach in the literature examining the impact of individual monetary policy decisions is the event-study approach. The advantage of this method is that the perceived reactions are more certainly connected to the monetary policy decisions, but the method is weak in estimating the persistence of the cross-border impact. This subchapter uses a similar event study with the most recent data.

The primary aim of the methodology is to make a quantitative difference between those observations (days) when a certain type of monetary policy announcement took place compared to any other trading days. More specifically, a variable that describes (in a binary way) the events during the sample period is used, and the earlier panel regression framework is employed.

The most critical part of the methodology is pointing out the appropriate monetary-policy-related events. In all cases, the event set consists of important announcements and speeches by the respective central banks: the Federal Reserve, the European Central Bank, and the Bank of Japan. Most of the events in the database are explained on the central banks' website, but some other relevant events were also added. For example, some of the speeches by central bankers that were explained and considered by Falagiarda et al. (2015) in their work were added, similarly to recent events, that are related to the 2020 pandemic crisis: announcements and launch of new programs (Falagiarda, McQuade, & Tirpak, 2015).

Technically, event series are created based on the nature of the announcements. By definition, they are dummy variables, where specified event dates have the value of 1, while the value on any other day is 0. We selected events that announced decisions or intentions of easing monetary conditions and tightening conditions, respectively. Also, announcements concerning asset purchase programs were considered separately. These series are common for all countries in the panel sample, and the value of the variable never exceeds 1, even if multiple decisions were announced.

On the other hand, the days preceding and following the days of actual events were also considered to grab anticipated and lagged effects; thus, we extended the event window from the typical one day to a week by flagging the respective week as a policy event for weekly analysis. This also helps to control the problems related to different time zones: in CEEMEA regions, markets are mostly closed at the time of usual Fed announcements on rate-setting days; therefore, market participants may react only on the following working day. In an alternative version, which is deemed to be the final, the weekly time frequency was shifted back to daily, yielding nearly 76,000 observations, but the weekly time frame for the event window remained unchanged to differentiate event periods from non-event periods comfortably. As the rest of the variables are still weekly changes of the level observations, this decision, admittedly, amplifies the impact of monetary policy announcements. This may be an acceptable choice given that different but closely occurred events are impossible to differentiate anyway, and the building of market expectations about policy change lasts for an uncertain amount of time. It is important to emphasize that this method is extremely sensitive to the choice of relevant monetary policy events. In the compiled event database, the best way to handle this issue was to collect large periods of events for the same central bank from the same source, but in some cases, the perceived importance of individual announcements largely differs.

For the variable 'Event,' we had the following sets of dummy variables:

$$Event_t = \{Easing\_ASP; Easing\_Other;\ Easing\_All; Tightening\_ASP;\ Tightening\_other; Tightening\_all\}$$

These categories collected events when the given central bank announced a policy step in the same direction with the same type of policy tool. Easing by asset purchase program is the quasi benchmark: many papers investigated only this setup at the time of quantitative easing programs. Other measures may mean conventional steps like rate cuts or other unconventional tools like liquidity provision or targeted loan programs. Changes in forward guidance are also considered in other events: when the

communication implied that rates would be lower or less high than previously anticipated, the event fell into Easing_other, while the opposite direction fell into Tightening_other. Event sets ending with _all are the union of events related to asset purchase programs and others.

Both easing and tightening announcements of the Federal Reserve significantly impact emerging markets, but based on the comparison of the two different regressions (simple weekly and weekly changes but daily observations), the impact of easing news perishes within a week while the transmission of tightening news is stronger. Based on these results, easing announcements contribute to a decrease in emerging long yields by nine basis points each time, and interestingly, the non-QE announcement appeared to be stronger. The opposite could be observed regarding the tightening news: announcements about quantitative tightening increase long-term government bond yields in emerging countries by 7 basis points each time, while other tightening announcements are not significant. Note that rate hikes and other tightening announcements are usually hinted at earlier, thus, the novelty may fall out from the – anyway wide – event window.

10. Table Results of event study regressions

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
WES_EV_Fed_Easing_ASP	-0.063***		
	(0.009)		
WES_EV_Fed_Easing_Other		-0.113***	
		(0.011)	
WES_EV_Fed_Easing_All			-0.090***
			(0.007)
DW_DEPO3M	0.046***	0.046***	0.046***
	(0.001)	(0.001)	(0.001)
DW_FX_USD	0.049***	0.049***	0.049***
	(0.002)	(0.002)	(0.002)
DW_VIX_index	0.103***	0.103***	0.102***
	(0.005)	(0.005)	(0.005)
Observations	76,866	76,866	76,866
R^2	0.037	0.037	0.038
Adjusted R^2	0.036	0.037	0.038
F Statistic (df = 4; 76841)	732.567***	744.775***	760.241***
Note:		*p<0.1; **p<0.05; ***p<0.01	

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
WES_EV_Fed_Tightening_ASP	0.072***		
	(0.009)		
WES_EV_Fed_Tightening_Other		-0.002	
		(0.011)	
WES_EV_Fed_Tightening_All			0.052***
			(0.008)
DW_DEPO3M	0.046***	0.046***	0.046***
	(0.001)	(0.001)	(0.001)
DW_FX_USD	0.049***	0.049***	0.049***
	(0.002)	(0.002)	(0.002)
DW_VIX_index	0.104***	0.104***	0.104***
	(0.005)	(0.005)	(0.005)
Observations	76,866	76,866	76,866
R^2	0.037	0.036	0.037
Adjusted R^2	0.037	0.036	0.036
F Statistic (df = 4; 76841)	734.638***	718.727***	730.160***
Note:		*p<0.1; **p<0.05; ***p<0.01	

Similarly, announcements about the ECB's monetary easing have a much smaller to statistically insignificant and short-living effect on emerging long yields. In the case of BoJ, only ASP announcements have a similar short impact. The main finding is that policy events are most importantly influential in the case of the Federal Reserve, but not in the case of the ECB or the Bank of Japan.

5.9 Dynamic panel models: a GMM approach

Dynamic panel models possess the inherent advantage of incorporating lagged variables and feedback effects into the regression equation, thereby establishing a system of equations for estimation purposes.

This model helps to mitigate bias arising from the non-stationarity of the level data, thereby reducing the likelihood of autocorrelation between the error term and any of the variables. This approach also enables the presentation of the aspect of time of the regressed variables. This feature finally leads to one of the greatest advantages of this method: to be relatively good at predicting values and showcasing certain dynamic changes in the variables. The generalized method of moments (GMM) is a commonly employed approach for estimation, particularly when dealing with panel data structures. Though dynamic models clearly allow further analysis of panel data, compared to static models, GMM models have some particular drawbacks that must be considered. As it was explained in the Methodology chapter, the model uses so-called instruments that limit the optimal panel size, where it is feasible to estimate. Therefore, the two most important limitations are the time dimension and the possibility of customization of the regression. First, the so far employed weekly dataset may not be suitable for panel-GMM regression, and second, the selection of variables must be tidied.

Acknowledging these restrictions, a single set of regression is proposed, focusing heavily on the feasibility, mostly in terms of variable choices and computing capacity. The dataset was downgraded to monthly frequency, and the sample was restricted to the pre-COVID period (before 2020). In the regression, the dependent variable remained the long-term government bond yield in emerging countries, while the independent variables were the first lag of the dependent variable and the short-term rates, with the first lags.

11. Table GMM model results

	Dependent variable:			
	Long_term_yield			
	(1)	(2)	(3)	(4)
lag(Long_term_yield, 1)	0.990***	0.993***	0.993***	0.986***
	(0.001)	(0.001)	(0.001)	(0.002)
USD_MC	1.029***			0.956***
	(0.222)			(0.182)
lag(USD_MC, 1)	-1.030***			-0.943***
	(0.223)			(0.182)
EUR_MC		0.434***		0.282***
		(0.085)		(0.063)
lag(EUR_MC, 1)		-0.441***		-0.281***
		(0.088)		(0.071)
JPY_MC			1.690***	0.033
			(0.517)	(0.331)
lag(JPY_MC, 1)			-1.734***	0.148
			(0.516)	(0.312)
Observations	21	21	21	21
Note:				*p<0.1; **p<0.05; ***p<0.01

The three models use only one variable of short-term rates: the USD_MC, the EUR_MC, or the JPY_MC. The last is a joint regression with all of these short-term rates and their first lags. Regarding the regression, one-step level-difference system GMM models were estimated, with CPI and VIX index being instrumental variables. The one-step method was chosen for computational efficiency, while level-difference type system models are usually preferred over simple differenced equations. The conducted diagnostic tests yielded results deemed acceptable, thus, the Sargan test, the autocorrelation tests, and the Wald test for coefficients all confirmed the validity of the model.

A general observation is that the difference between this month's and last month's impact of advanced rate conditions are similar but with different signs, and all of them are significant, except in the joint regression where variables for Japanese financial conditions appeared to be insignificant. The dependent variable exhibits a large degree of autocorrelation, which is handled with the incorporation of the first lag.

A short calculation demonstrates the power of this estimation method.

12. Table Example for Fed and ECB shocks in GMM model

dependent: EM long rate, estimation for current period	Model 1 – only Fed	Model 4 - Fed and ECB
Let's suppose that EM rate was 5 percent last month, thus	5*0.99=4.95	5*0.986=4.93
also let's suppose that USD rate was 2.1 percent last month	2.1*(-1.03)= -2.16	2.1*(-0.943)= -1.98
also let's suppose that the USD rate increased to 2.2 percent in this month	2.2*1.029=2.26	2.2*0.956=2.10
Prediction for this month's EM long term rate is:	5.05	-
Model prediction for the impact of 10 basis point USD rate increase	5 basis point	-
Let's suppose that the ECB rate was 1.7 percent last month	-	1.7*(-0.281)=-0.48
and increased to 1.8 percent this month	-	1.8*0.282=0.51
Prediction for this month's EM long term rate is:	-	5.08
Model prediction for the impact of simultaneous 10-10 basis point USD and EUR rate increase	-	8 basis point

The related table in the Appendix helps to analyze these impacts further. For the sake of ease, let us suppose that the emerging yield last month was 5 percent and that the initial short-term rates were 1 percent for the Fed and the ECB. Each column represents a ten basis point change in EUR short rates, and each row illustrates a ten basis point change in USD short rates, while the values in the table show the impact on the emerging long-term yields.

Some of the cells are worthy of being regarded separately. For example, in case of no changes in USD and EUR rates, the model predicts a slight decrease in long rates, broadly in line with the long-term trend of emerging rates throughout the sample period. This decreasing trend is estimated to be able to offset a small, ten basis point magnitude of EUR rate increase (given that the USD rate is unchanged), but predicted emerging long-rates increase by 3.6 basis points if the USD rate increases by a similar extent (while EUR rate is unchanged). A coordinated 100-100 basis point increase in both USD and EUR rates leads to a combined increase of 118 basis points in emerging long yields, to 6.18 percent. In these three cases, the relative change, which was translated as a transmission rate or the extent of

monetary policy spillover, happened to be -31 percent when the EUR rate increases slightly, 37 percent when the USD rate increases marginally, and 59 percent when both short rates increase by 100 basis points each.

All in all, the greatest advantage of the panel GMM method is that it successfully exploits the autocorrelation of the dependent and independent variables therefore, point estimates tend to be reasonable and consistent. This way, this model, with the estimated coefficient introduced above, is able to illustrate certain shocks numerically, and it is able to quantify a simultaneous impact of the two large central banks' monetary policy changes easily. One should note that these coefficients are even more sensitive to the estimated period chosen, which should be counted toward the drawbacks of this model. Moreover, the frequency reduction increased the risk of falsely measuring coinciding factors, other than monetary policy spillovers, with the coefficients. These restrictions and drawbacks limit the general usability of the model, so the benchmark models are still the static panel-fixed models that were estimated on the long panel in the previous subchapters.

5.10 Conclusion on monetary policy spillovers

The panel-structured dataset provided a chance for further analysis of the international monetary policy transmission by exploiting the country-specific differences in shock recipient countries. The research design was straightforward. The main model was built carefully around a benchmark model without reflecting on advanced monetary conditions. Then, several shock variables were tested. The main model uses weekly changes; thus, the baseline shock variables are also weekly changes of the respective advanced rates, though alternative approaches with the help of dummy variables were also tested. Extreme value changes on a weekly basis were flagged, and several dummy variables have been created as an alternative. Also, policy announcements have been studied similarly by applying dummy variables. Dynamic panel models were also built and introduced, but the baseline model remained the initial static model with country-fixed effects, estimated on a long, weekly panel dataset.

Turning to the results, the most important caveat of the chapter is that monetary policy spillovers exist, at least in the case of the Federal Reserve and the European Central Bank. The extent of the spillovers and the relationship between the importance of the two large shock originators were discussed thoroughly. The baseline model suggests that the Fed and the ECB have similar impacts on emerging markets, but additional calculations point toward a stronger Fed spillover. The impact that was measured on so-called extreme days and the dynamic panel model also suggests that the impact of the Federal Reserve is larger on emerging financial markets.

5.11 Formal Hypothesis 2

Hypothesis 2:
Changes in advanced markets' short-term rates have a direct financial market impact on long-term government bond yields in emerging countries, thus, the so-called 'monetary policy spillover' exists in the case of certain central banks and emerging markets.

Decision:
Accepted empirical findings confirmed that the monetary policy decisions of the Federal Reserve and the European Central Bank do have an impact on the long-term government bond yields in the sample.
Several alternative specifications and robustness tests confirmed this result, which turned out to be robust. On the other hand, the Bank of Japan has no systematic impact on emerging financing costs.

Sub-hypotheses:
a) The changes in the monetary policy of the Federal Reserve have a systematic impact on the long-term government bond yields in emerging countries.
Decision: **Accepted.**

b) The changes in the monetary policy of the European Central Bank have a systematic impact on the long-term government bond yields in emerging countries.

Decision: **Accepted.**

c) The changes in the monetary policy of the Bank of Japan have a systematic impact on the long-term government bond yields in emerging countries.

Decision: **Rejected.**

■

6 Regional impact of large central banks

Though the global economy is interconnected, the ties between each economy vary by distance: some economies have much more interactions, while others have only a few areas to cooperate. Discussions pertaining to these economic relations may extend beyond the intended scope of this analysis and potentially delve into the broader discourse surrounding the global economic order. The common understanding is that international trade is where these connections could be tracked, and financial flows are discussed less often. We argued that large sums of capital flew from advanced to emerging economies during the extraordinary easing measures and asset-purchase programs of advanced central banks. The literature review showed that these financial flows are particularly important when becoming abnormal, namely during aggressive capital flight episodes and sudden stops. Without tracking any of these financial flows, we are about to estimate the impact that certain central banks have in each geographical region. Similar to international trade, it would be arguable that the large central bank, which is closer, thus the one mostly influencing the investors in respective emerging markets, has more impact, though the effect which goes beyond regional borders may also be regarded as a perspective of the relative importance of each advanced central bank.

In this chapter, we analyze whether the spillover estimated earlier breaks down between certain regions, thus in which emerging regions react the most to certain advanced central banks' monetary policy changes.

6.1 How do we measure regional impact?

The empirical analysis will slightly modify earlier exercises by exploiting the fact that shock recipient emerging countries are located in three large geographic regions: in Central-Eastern Europe (and around), thus the neighboring relevant economies around the Eurozone, in Latin America, and in Asia.

Two major directions of measuring such phenomenon, an influence of a factor that is relevant only for a few identities in the panel, may be possible. One handful idea is to modify the regression by calculating dummy interacted terms, where the dummies represent the geographical regions, as they are assigned to all countries. In this way, we create additional variables: a dummy series for Latin America (all observations that are from a country in Latin America, see Methodology) interacted with the target variable, which is mostly a series representing the shock coming from advanced markets to Latin America, likewise the dummy series for CEE regions while we omit Asia to avoid the dummy trap[12]. The regional impact for Asia will be estimated on the uncrossed shock term. The advantage of this approach is that we have the same amount of equations and it is possible to decompose the combined spillover effect into respective regions relatively easily. The rest of the equation, the method

[12] Dummy trap is a commonly known multicollinearity issue with categorical variables. It occurs when all possible categories are covered by the variable, thus they are perfectly predictable from each other and causes the instability of parameter estimation. In order to avoid this issue, one category should be left out.

for estimating the coefficient, and how the hypothesis test is concluded shall not differ from the regressions we described earlier.

Another approach could be that we create subsets of the original sample, and the same regressions are run as earlier, the same way, but obviously with fewer observations (though the time-frequency and length will not differ; thus, there are enough observations, and it is still a long panel with its advantages and disadvantages). The major difference between the empirical strategies is that in the first case, the estimated coefficients for the control variables remain unchanged, and the use of Driscoll-Kraay covariance matrix will lead to an evaluation of the hypothesis test where the new variables are examined as strictly as in the original, un-interacted terms. From the econometrician viewpoint, the latter is hardly problematic because the reason for applying robust standard errors remains valid but may be counterintuitive when both global (which were not crossed with any dummy) and interacted terms yield insignificant results despite the earlier robust estimation of existing monetary policy spillovers. This may happen when the new variable decreases the explanatory power of the regression, and the chance for this occurrence is higher when robust standard errors are applied. The second approach has the advantage of letting the control variables be more accurate, not only the target variable, and the number of observations is still not a concern in our case. The drawback is that coefficients associated with the target variables in the two unrelated regressions are hard to formally and properly compare. For a comprehensive view of the research question and to underscore the robustness and validity of the results, decisions will be made based on the results of both estimates.

6.2 Regional extension of the baseline model

As explained, the baseline regression model was extended with regional dummies and run again in the same way as in the previous chapter. Remember, the dependent variable is still weekly changes of emerging long-term yields in a panel structure, the target variable is now interacted with a dummy that reflects the geographical region of the respective shock recipient emerging countries, and the control variables are used similarly as before. The model's overall performance hardly changed due to the introduction of dummy variables.

Based on the regression result, only the shocks originating from the US had a general impact on all regions, including Asia. In the case of the USD_MC variable, the CEE dummy interaction yielded an insignificant coefficient, regardless of relative understandable size. Thus, the combined effect for CEE shall be equal to that of Asia. Latin American countries react more: a combined 27.6 percent to the changes in USD on average. So, all in all, we found a general impact of the Fed: a smaller impact for CEE and Asia and a larger monetary policy spillover for Latin America. Notably, the estimation of spillover for the Federal Reserve (22.8 percent) did not necessitate the use of averaged regional-crossed variables. Each of these variables represents a point estimate accompanied by a confidence interval. Therefore, the absence of numerical equivalence between these estimates does not invalidate either of the results.

The changes in the Eurozone's monetary conditions do not impact Asian economies but a wide range of emerging economies in the other two regions. This may be because fixed FX regimes are mostly in Asia in the sample, and these countries have a very distant relationship with the changes in euro conditions on a weekly basis. On the other hand, long-term yields in Latin America respond almost as heavily to eurozone changes and the long-term yields of CEE regions. The changes in Eurozone monetary conditions are transmitted to the emerging markets of the CEE region at 26.1 percent, while to the Latin American markets at a 22.7 percent extent. The responsiveness of the Latin American region is supported by the fact that the changes in Japanese financial conditions also have a significant impact on them, despite the fact that they do not have an impact on emerging Asian markets. The reason may be the same as mentioned at the ECB: long rates in countries operating with fixed rates may generally be less responsive. It is important to note that the VIX index, a general measure of investors' risk-taking, is now insignificant in all three regressions.

Based on the dummy interactions, it was concluded that the Fed has a general impact on all emerging markets, with a special emphasis on Latin American long yields. ECB has a similar impact on CEE and Latin American rates, and in a puzzling way, Japanese rate changes are associated with the changes in Latin American long yields.

With this specification, two remarks shall be added. Once, variables that are associated with the balance sheet of advanced central banks were also tested, but further interpretation was rejected due to the same argument as before: as the composite variable encapsulates some of the impact of balance sheet policies not necessarily needed to use them along the price-type composite variable. Numerically, they are weakening each others' estimated impact due to increased multicollinearity. Second, the VIX index may be a critical point in this setup: as a variable observed in the US, it may be significantly multicollinear with USD_MC, but the previous argument still holds that it measures risk appetite unrelated to other variables. In a test specification, the anyway insignificant VIX index was removed from the regressions, but the coefficients and the results of the hypotheses tests did not change considerably.

Turning to the subsetting approach, the appropriate subsets of the original sample were created, and the analogous regressions were run on each of them.

13. Table Panel regression with region-specific dummies

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
DW_USD_MC	0.111*		
	(0.063)		
DW_EUR_MC		0.085	
		(0.067)	
DW_JPY_MC			-0.075
			(0.194)
DW_DEPO3M	0.019***	0.019***	0.019***
	(0.002)	(0.002)	(0.002)
DW_FX_USD	-3.694***	-3.730***	-3.708***
	(0.414)	(0.403)	(0.405)
DW_VIX_index	0.019	0.018	0.016
	(0.015)	(0.015)	(0.015)
DW_USD_MC:IsCEE	0.232		
	(0.216)		
DW_USD_MC:IsLatAm	0.165*		
	(0.085)		
DW_EUR_MC:IsCEE		0.261*	
		(0.140)	
DW_EUR_MC:IsLatAm		0.227***	
		(0.085)	
DW_JPY_MC:IsCEE			0.110
			(0.239)
DW_JPY_MC:IsLatAm			-0.515**
			(0.201)
Observations	13,677	13,677	13,677
R^2	0.095	0.094	0.092
Adjusted R^2	0.093	0.092	0.091
F Statistic (df = 6; 13652)	238.641***	236.060***	231.020***
Note:			*p<0.1; **p<0.05; ***p<0.01

14. Table Shock variables in different region subsamples

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
DW_USD_MC	0.113*	0.351	0.281***
	(0.065)	(0.232)	(0.098)
DW_DEPO3M	0.005	0.025***	0.003
	(0.004)	(0.003)	(0.006)
DW_FX_USD	-3.480***	-3.303***	-4.308***
	(0.414)	(0.571)	(0.469)
DW_VIX_index	-0.028**	0.091***	0.002
	(0.014)	(0.025)	(0.024)
Observations	5,708	4,392	3,577
R^2	0.050	0.139	0.088
Adjusted R^2	0.048	0.137	0.086
F Statistic	74.748*** (df = 4; 5696)	176.693*** (df = 4; 4382)	86.251*** (df = 4; 3568)
Note:			*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:		
	DW_Long_term_yield		
	(1)	(2)	(3)
DW_EUR_MC	0.089	0.341**	0.315***
	(0.068)	(0.137)	(0.074)
DW_DEPO3M	0.005	0.025***	0.003
	(0.004)	(0.003)	(0.006)
DW_FX_USD	-3.511***	-3.376***	-4.288***
	(0.400)	(0.570)	(0.453)
DW_VIX_index	-0.029**	0.088***	0.002
	(0.014)	(0.025)	(0.025)
Observations	5,708	4,392	3,577
R^2	0.049	0.137	0.088
Adjusted R^2	0.047	0.135	0.086
F Statistic	73.143*** (df = 4; 5696)	173.678*** (df = 4; 4382)	85.822*** (df = 4; 3568)
Note:			*p<0.1; **p<0.05; ***p<0.01

Note: Left panel: Fed shocks to certain regions, right panel: ECB shocks to certain EM regions. EM regions are (1): Asia, (2) CEE, (3) Latin America subsamples.

Results are similar to the dummy interactions, but some changes are worth pointing out. Regarding the Fed, the most important change was the relationship between the VIX index and the target variable. Similar results were received in Asia with dummy interactions as in the previous version. Although the coefficient is relatively large in CEE, it is insignificant after applying Driscoll-Kray robust standard errors. Note that the VIX index in CEE has some similar impact as USD_MC and VIX_index combined in Asia. Thus, despite of the fact that USD_MC is insignificant in CEE, it is reasonable to claim that CEE and Asia have similar responses to US shocks. The coefficient supports our previous result in Latin America, though the VIX index appears insignificant. A version of regressions was tested without the VIX index. Interestingly, not much has changed: USD_MC is still insignificant in CEE, and the rest of the table is basically the same. Interestingly, the model for Asian EM markets is significant based on the F statistics, but the R square is significantly lower than in the other two cases.

Regarding the ECB, Asia is resilient, while CEE and Latin America receive broadly similar shocks. In the case of CEE, the VIX index became significant, while in Latin America, it is not, which appears to be a technical issue. Though both regions face similar risk appetites of international investors, the variable of euro rates probably crowds out the impact of the VIX index in this model specification. Similarly to USD shocks, leaving out the VIX index did not change significantly, and using balance sheet data is still a rejected option.

The overall view that the policy of the Bank of Japan caused no monetary policy spillover remained unchanged after the calculations. Analogously, the exercise was done for the Japanese rates as well, and the overall picture did not change: the responsiveness of the Latin American region remained puzzling, but nowhere else was significant. However, the VIX index turned out to be significant in Asia and CEE but insignificant in Latin America. This observation reassures the earlier suspect that there may be some tradeoff (multicollinearity) between the VIX index and the target variable, but leaving out of the final model was declined for several reasons. Most importantly, the risk perception should be controlled somehow, and based on the literature, the VIX index is the most common measure for it. Also, the performance of the models did not improve significantly after leaving the VIX index out, thus, the economics argument and the effort to keep the comparability among long panel models motivated to keep the VIX index in the model.

Beyond these two, equally acceptable solutions, there may be at least one more regression design, which appears to be reasonable at first, but was discarded later due to some of the issues it involves. Similarly to the previous chapter one might argue for designing a regression, which incorporates all of the shock originators at the same time, with the regional focus enforced by the subsampling of the observation of respective regions. Therefore, three alternative regressions are run, similarly to the subsetting approach above, but this time, not only one but all of the three shock originators appear. The general problem with the regression is that the estimated coefficients appear to be reasonable, but applying Driscol-Kraay covariance matrix for computing robust standard errors, they become insignificant. Based on these regressions, none of the originators (even the Fed) would have an impact

on Asia. In the CEE subsample, the EUR_MC, which is associated with the ECB, is significant and positive, 0.24, suggesting a robust 24 percent of transmission rate from the ECB. On the other hand, the coefficient for the USD is 0.28, but the robust standard error is so high that it is not significant at any conventional level. The Latin-American region is the most ambiguous: while the coefficient for USD is 0.24 is not significant, the EUR's 0.251 is, indeed, significant. Also, JPY has a strongly negative impact on Latin American rate, which is still puzzling and was disregarded in the previous analysis. Therefore, the Latin American region appears to be sensitive to everything except the Fed, and this reveals the problem of this method: no real theoretical reasons or any pieces of literature confirm this result, which seems to be a methodology issue, thus, this approach shall be disregarded.[13]

15. Table Common impact of advanced central banks in different regions

	Dependent variable:			
	DW_Long_term_yield			
	(1)	(2)	(3)	(4)
DW_USD_MC	0.194*	0.108	0.283	0.246
	(0.103)	(0.066)	(0.232)	(0.232)
DW_EUR_MC	0.168**	0.054	0.240*	0.251**
	(0.073)	(0.074)	(0.128)	(0.128)
DW_JPY_MC	-0.264	-0.121	-0.102	-0.691**
	(0.235)	(0.199)	(0.309)	(0.309)
DW_DEPO3M	0.019***	0.005	0.025***	0.003
	(0.002)	(0.004)	(0.003)	(0.003)
DW_FX_USD	-3.744***	-3.330***	-3.467***	-4.292***
	(0.404)	(0.397)	(0.578)	(0.578)
Observations	13,677	5,708	4,392	3,577
R^2	0.096	0.049	0.135	0.093
Adjusted R^2	0.094	0.047	0.133	0.090
F Statistic	289.164*** (df = 5; 13653)	58.908*** (df = 5; 5695)	137.302*** (df = 5; 4381)	72.753*** (df = 5; 3567)
Note:				*p<0.1; **p<0.05; ***p<0.01

All in all, the change of the baseline long panel model of spillover impact resulted in the fact that the regional impacts could have been decomposed. It was found that only the Fed policy has a general impact on emerging markets, including Asian markets, while the ECB has a significant impact only in CEE and Latin American regions. The magnitude of this impact is the largest for Latin America, in the case of the Fed; and for CEE, in the case of ECB. The evaluation of BoJ results leads to the conclusion that no matter the puzzling impact on Latin America, BoJ policy is still deemed to have no monetary policy spillover on emerging markets. Regarding the question from the position of emerging markets, it seems that Latin America is sensitive to various types of shocks, including the monetary policy of the ECB. Central European countries are more responsive to the shocks from the ECB, but the impact of the Fed (even if it is via the risk-taking channel, proxied by the VIX index) appears to

[13] The problem is most likely caused by an interference between the variables, however VIF did not show serious level of multicollinearity.

be significant. Asian emerging countries are relatively resilient, except for the impact of the Federal Reserve. [14]

6.3 Transmission of market shocks in different regions

In the previous chapter, the weekly change of advanced rate changes was used as a variable of interest, which is now changed to a dummy variable that denotes extreme rate changes or policy events. Also, the dummy interactions and subsetting are used parallelly as previously.

Table 16 below summarizes the results of market shock transmission into certain regions. In the case of dummy variables, the coefficients associated with the shock transmission in Asia are equal to the global variables (without any interactions). In the case of CEE and Latin America, the dummy-interacted variables are shown with estimated coefficients and significance. In order to find the estimate for CEE and Latin America, one should add up the variable at the Asian dummy column with CEE or LatAm dummy column, accordingly, but except TOP1_JPY, none of the global variables are significant, so this time, it is not critical. The values in the subset columns are the estimated coefficients associated with the target variables in the first column, in the subset respective to the region split—no need to add up or consider anything else in this case. The table reflects the weeks when the largest 1 percent of increases and decreases took place in the respective monetary conditions, excluding those weeks when the same happened in any other monetary conditions. Driscoll-Kraay covariance matrix was used when determining the hypothesis test results, so the estimates are corrected to heteroskedasticity and autocorrelation as earlier.

16. Table Regional impact of extremely large AE changes

	Asia		CEE (over Asia/level)		LatAm (over Asia/level)	
variable of interest	dummy	subset	dummy	subset	dummy	subset
TOP1E_USD	0.022	0.027	0.207**	0.223**	0.123	0.139*
TOP1E_EUR	-0.011	-0.013	0.077	0.064	0.025	0.018
TOP1E_JPY	-0.041**	-0.046**	-0.023	-0.056*	-0.082***	-0.124***
BOTTOM1E_USD	0.015	0.030	0.186***	0.181**	0.090	0.101
BOTTOM1E_EUR	-0.007	-0.008	0.050	0.043	-0.023	-0.030***
BOTTOM1E_JPY	-0.019	-0.025	-0.071	-0.092***	-0.039	-0.052

Based on the results, the largest increases in USD rates are associated with a significant soar in government bond yields in CEE regions, partly in Latin America, while Asia does not respond to such shocks. Similarly, the largest drops in USD rates are associated with a significant increase in CEE long yields. Consequently, when monetary conditions ease, the spillover is rather negative: yields increase despite the drop in advanced funding rates. Euro rates are insignificant in all specifications, except a marginal decrease in Latin American long rates is observable when euro rates decrease

[14] Although it is not reported, a statistical note must be made. Comparing the non-zero coefficients similar way as earlier, it is not possible to reject the nullhypothesis that they are equal. This disclaimer must be added to these comparisons.

extremely. It looks like Japanese rates are working differently than USD rates regarding emerging spillovers. In the case of a Japanese rate increase, emerging long-rate tends to decrease somewhat, and it looks quite uniform. Compared with earlier regressions, it is still not convincing that BoJ has any systematic and lasting impact on emerging rates, but it looks like there is indeed some portfolio rebalancing when Japanese rate changes occur.

6.4 Extension of the dynamic panel model

Similar to the baseline regression model, the dynamic panel model, which uses GMM method, may be extended to regional aspects. One should recall the most important features of GMM models from Chapter 3 and the results of applying them to the full sample in Chapter 5. The method of estimation and the advantages and drawbacks of these models remain the same, and it is worth emphasizing that the better generalizability of static models led to the preference for static models as baseline models.

The regression is modified in the following way. Three different regressions are developed and run on the same, *monthly*, sample as in the previous chapter. Beyond the previous and current interest rate proxies, one for the USD and another for EUR rates, a regional-crossed version of these variables is incorporated into the model, while JPY was dropped from the regression.

The enormous output table, for editing reasons, is placed in the Appendix. A stylized version of the result is shown here.

17. Table Stylized summary table of region-specific GMM models

	Asia		CEE		LatAm	
EM previous period	0.987		0.988		0.986	
Regional fixed	0.045		-		0.074	
USD current period	1.071	1.071	1.260	0.406	0.751	0.751
Regional crossed USD current	-		-0.854		-	
USD previous period	-1.048	-1.048	-1.243	-0.395	-0.731	-0.731
Regional crossed USD previous	-		0.848		-	
EUR current period	0.544	-0.071	0.412	0.412	-	0.7
Regional crossed EUR current	-0.615		-		0.7	
EUR previous period	-0.456	0.04	-0.356	-0.356	-	-0.656
Regional crossed EUR previous	0.496		-		-0.656	

Some important considerations and decisions were made during the interpretation of the results. Those parts of the equation, the impact of those variables that produced insignificant coefficients is considered as zero, nonexistent. If the current or the previous period produced significant coefficients, both are considered for modeling reasons. This is a small relaxation of the former strict handling of statistical significance, but it is hardly intuitive that only the lag or the current value has an impact on its own. This was the case, for the impact of the EUR in Latin America: the lagged variable was

significant, but the current level of EUR rate was not, thus, for this consideration, both of them were deemed influential and appear in the table above.

On the contrary, none of the variables without regional dummy, in the same regression was significant thus they were left out. The coefficients were estimated on the full EM sample. The influence of the regional-crossed variables is added for visual representation, but current and previous periods were not merged.

The analysis of the results may be done twofold. First, only the coefficients and their significance are analyzed, then, some illustrative examples are presented. The long-term government bond yields in emerging markets, not very surprisingly, are still autocorrelated. A region-fixed impact may be read as a fixed effect that is not time-related. The general impact of USD, and therefore the Federal Reserve, still holds. Interestingly, the EUR has a marginal but negative impact on Asian emerging markets, contrary to the static model. The impact of Fed and ECB is more balanced in CEE, which is also a difference from the baseline model. The importance of the Fed in Asia is similar to the previous calculations, while it seems that Latin American region is indeed sensitive to changes in global financial conditions.

18. Table Illustrative examples for USD and EUR shock transmissions in different regions

Considering initial EM rate to be 5 percent, initial EUR and USD rate to be 1 percent, and simultaneous change of USD and EUR rates..											
Case	USD change (assummption)	EUR change (assummption)	Combined change	EM long rate		EM long rate - Asia		EM long rate - CEE		EM long rate - Latin America	
				Predicted level	Transmission rate	Predicted level	Transmission rate	Predicted level	Transmission rate	Predicted level	Transmission rate
1	0	0	0	4.94	-	4.97	-	5	-	5.07	-
2	100	0	100	5.89	89%	6.04	104%	5.41	41%	5.81	81%
3	0	100	100	5.22	22%	4.9	-10%	5.42	42%	5.77	77%
4	50	50	100	5.56	56%	5.47	47%	5.42	42%	5.79	79%
5	100	100	200	6.18	59%	5.97	49%	5.83	42%	6.52	76%

A more appealing approach to understanding this result is presenting hypothetical calculations and comparing the models' outputs. The four models: the EM model introduced in Chapter 5, without regional features, and three region-specific models using regional dummies for Asia, CEE, and Latin America, respectively. Five scenarios are calculated with the model, with hypothetical rate changes in USD and EUR short rates. All of them suppose an increase in advanced rates, but the vast majority of the coefficients imply a movement in the same direction, thus, a decrease in advanced rate would initiate a similar decline in long-term yields of emerging countries. The predicted level is the output of the model, while the transmission rate is defined as the ratio of the deviation from the initial value of 5 percent and the combined changes of advanced rates.

The first scenario is shown for illustrative purposes only to show the impact of the lagged dependent variable. The second scenario assumes that USD rates change by 1 percentage point. The results suggest a relatively large reaction in case of Asia, while the response of the CEE rates is the smallest. It is slightly different from the results of the static model. A similar change is assumed from the ECB in the third scenario, and it is clearly visible that the overall impact is much smaller. In the case of

Asia the impact is negative, the response is similar to the Fed's changes in CEE, while Latin America's reaction is exaggerated. In the fourth case, the supposed increase is 50 – 50 basis points in both USD and ECB rates, and the results are intuitive, as the regression is linear: the transmission rate is the average of the two previous cases. A simultaneous 100 – 100 basis point increase on both advanced markets would mean more than 1.5 percentage point increase in Latin American long yields. The Asian and CEE rates would increase by 97 and 53 basis points, respectively.

The dynamic models suggest similar patterns to the static baseline models and broadly confirm previous findings. A notable difference is that the predicted transmission rate is generally higher, but it largely depends on the initial values in the dynamic case. Also, the reaction of Asian long rates is a bit surprising, in this model, they react to USD rate changes more aggressively, while the impact of EUR rate changes is negative. The sensitivity of Latin American countries is similar in the dynamic model to the static model's results. In the GMM version, the impact of USD and EUR rate changes is more balanced.

Taking into account all the drawbacks of the panel data modeling explained earlier, the static models are better choice for understanding the cross-border impact of large central banks. Therefore, these models are considered as a secondary attempt to model the relationship between advanced short-term rates and emerging long-term government bond yields. However, they provided a different angle that allowed us to regard monetary policy spillovers differently, they did not materially change our view on the findings that came from the static models. Contemplating the previous arguments on the challenges of dynamic models, the static models are considered as a baseline model.

6.5 What is better than regions?

After carefully reviewing the potential impact of geographical proximity and trying to identify region-specific patterns, there is room for further discussion on what factors actually make a difference between these countries. Emerging countries are wildly heterogeneous, exhibiting different development patterns, resources, governance, and policies. The primary inquiries in financial policy pertain to the degree of openness of the capital account, the depth of financial markets, and the domestic monetary authority's interest rate and exchange rate policies.

There are relatively few countries in the sample examined despite the enormous daily database. We would have identified common factors and differences without any calculations just by looking at the country list in the methodology chapter. For example, in the dataset's CEE countries, the sovereign risks are relatively moderate, but the policies are quite uniform: inflation targeting with floating exchange rate. In Asia, where the significance of balance sheet and/or exchange rate policies is more pronounced, many countries have adopted fixed or quasi-fixed exchange rate systems. Though careful considerations preceding all steps in the estimation process and all countries in the sample are relevant, these factors and their potential influence a subject for deeper analysis.

From the point of view of the thesis paper, this discussion leads to further restrictions on the findings and enables us to summarize the findings more nuancedly. Also, it briefly introduces the motivation of the following chapter, which focuses on country-level factors. Though the financial linkage thesis that roughly motivated the chapter is theoretically sound, one may not forget that generalization came from a relatively small number of countries. Other factors than belonging to certain economic regions may probably be more important. This subchapter focuses on this question.

Six factors are proposed to be tested this time: the empirical methodology will modify earlier models that account for certain characteristics of the countries described beforehand. Therefore, country groups are created, unrelated to certain countries' geographical location, mostly measurable by statistical data. Small adjustments could have been made to put similar countries into the same box. After that, dummy variables and subsets of the original weekly panel data were created. We have shown that both approaches could work, and the difference between them makes the analysis more nuanced. However, this time, subsetting would make more sense, as it is more than reasonable that the difference in a key feature may not only have an impact on the coefficient of the target variable but also on other variables, thus letting the control variables be flexible makes more sense this time.

19. Table Country groups

FX-rate		Interest rate		CPI rate		GDP per cap		CDS		Political	
FLOAT	FIX	HIGH	LOW	HIGH	LOW	Large	Small	HIGH	LOW	HIGH	LOW
Brazil	Bulgaria	Brazil	Bulgaria	Brazil	Bulgaria	Chile	Brazil	Brazil	Bulgaria	Brazil	Bulgaria
Chile	China	Colombia	Chile	Chile	China	Czechia	Bulgaria	Colombia	Chile	China	Chile
Colombia	Czechia	Hungary	China	Colombia	Czechia	Hong Kong	China	Hong Kong	China	Colombia	Czechia
Hungary	Hong Kong	Indonesia	Czechia	Hungary	Hong Kong	Hungary	Colombia	Hungary	Czechia	Indonesia	Hong Kong
Indonesia	Malaysia	Mexico	Hong Kong	Indonesia	Malaysia	Poland	Indonesia	Malaysia	Indonesia	Mexico	Hungary
Mexico	Romania	Peru	Malaysia	Mexico	Poland	Romania	Malaysia	Mexico	Poland	Peru	Malaysia
Peru	Singapore	Philippines	Singapore	Peru	Singapore	Singapore	Mexico	Peru	Singapore	Philippines	Poland
Philippines	Taiwan	Poland	South Korea	Philippines	South Korea	South Korea	Peru	Philippines	South Korea	Romania	Singapore
Poland	Thailand	Romania	Taiwan	Romania	Taiwan	Taiwan	Philippines	Romania	Taiwan	Thailand	South Korea
South Korea		Turkey	Thailand	Turkey	Thailand	Turkey	Thailand	Turkey	Thailand	Turkey	Taiwan
Turkey											

In the case of the FX-rate, the categorization broadly follows the AREAER report of the IMF. The data for the latest year was used, but the countries involved had relatively similar FX-rate policies over the sample period.[15] In the case of interest rates, the average of the yearly averages was the base of the categorization: the ten countries with the largest interest rates got a flag for high interest rates, and the rest went to the category of low interest rates. The same happened with CPI rates and GDP per capita. The former should be closely connected with the interest rates; therefore, the categorization is nearly the same, though high interest rate countries did not necessarily end in a high inflation rate bucket as the categorization method was more rigorous about the strict order of the averages. GDP per capita grabs the idea of the country's development: if the GDP per capita is high, the country is more advanced and closer to advanced countries, while otherwise, the country is considered less developed. CDS price describes the market sentiment on the sovereign risk in a given country. Unfortunately, not all countries had data for the whole sample period, but the available data on CDS or, in the worst case, the interest rate level helped to categorize those countries reasonably. Remember, CDS prices *per se*

[15] Some modifications were necessary in order to keep the balance between the subgroups in terms of observation numbers. For example Czechia is considered as a country with fixed exchange rate, based on the CNB's long-term commitment of applying exchange rate cap, though at the end of period Czech Koruna is categorized as de facto floating currency by IMF's AREAER report.

are not used in any of the regressions, only the belonging of a certain group is used in this subchapter. Political risk is measured with a Bloomberg index, as described in the methodology chapter, and roughly understood as policy uncertainty, e.g., how likely it is that a political shift will dramatically change the economic policy in a given country.

Regarding the countries, there seems to be some pattern in the categorization, though it is currently disregarded. Briefly, there is a group of countries with floating exchange rates, thus with higher inflation and interest rates, and another group with fixed exchange rates that comes with smaller inflation and interest rates. That is quite reasonable and reflects the discussion in the literature review chapter. On the other hand, there is a tendency for more developed countries to appear to be less risky in the eyes of investors. Therefore, the last three categories are also significantly related to each other.

These six variables are potentially better in making a difference between emerging countries. To ensure simplicity, each variable is classified into two distinct categories, and the regressions are adjusted accordingly by incorporating the same set of control variables as per the requirements of this exercise. The aim of this approach is less about validating the research question on regional heterogeneity but rather to elaborate further on how different emerging countries are in the sample and to guide the research toward country-specific features.

The dummy variables are placed in the regressions in a way that uses only one in each equation. The AE_MC composite index was used in the first setup, which yielded an aggregate of 37.1 percent for all EM countries as a transmission rate. By incorporating regional dummies, the analysis revealed that the transmission effect specific to the Asia and CEE region was estimated at 16.28 percent. Additionally, the combined spillover effect for Latin America was estimated at 44.6 percent, while considering conventional levels of statistical significance. Thus, Latin America impact existed in this sample as the dummy variable for Latin America was significantly different from zero in the regression, and the uninteracted AE_MC variable was also significant; thus, their sum yields the partial impact of belonging to the Latin American region.

Analogously, dummy variables for the floating exchange rate, high interest rates, high CPI rates, low GDP per capita, high CDS level, and high political risks were used in separate regressions, and none of them, except high CDS level, turned to be significant after using Driscoll-Kraay covariance matrix in the hypothesis testing. It is surprising. Note that there is no difference in which category's dummy was used in the regression.

In an alternative specification, the same exercise was done for USD_MC. As it was shown, the EM-wise transmission was estimated to be 22.8 percent, the regional transmission was 11 percent in Asian and CEE regions, and 27 percent in Latin America. None of the six other category flags turned out to be significant. Similarly, region interactions and uninteracted variable were both significant in the baseline regression, while the six new category variable was not significant on conventional levels.

These results are surprising but statistically robust. Earlier, it was argued that one of the drawbacks of this method is that the coefficient for the same variable should be somehow split between the interacted

and the normal terms, but the robust standard error is strict on deciding significance. Though the estimated coefficients often look reasonable, the uninteracted changes visibly, and the interacted term has a large coefficient, but the hypothesis testing rejects them to differ from zero significantly.

The suspicion is definitely worrying in the case of the second regression with high interest rates. Most importantly, it is clear that insignificant coefficients shall not be reported and shall be considered as practically zero. So, only out of curiosity, the uninteracted term fell by almost a third, and the interacted term is 0.346 (p-value: 0.103). Though none are significant, the initial uninteracted term was substantial even with robust standard errors.

20. Table Monetary policy transmission in different country groups

	Dependent variable:			
	DW_Long_term_yield			
	(1)	(2)	(3)	(4)
DW_AE_MC	0.315**	0.190	0.312**	0.265**
	(0.132)	(0.132)	(0.132)	(0.132)
DW_DEPO3M	0.019***	0.019***	0.019***	0.019***
	(0.002)	(0.002)	(0.002)	(0.002)
DW_FX_USD	-3.704***	-3.711***	-3.705***	-3.701***
	(0.408)	(0.408)	(0.408)	(0.408)
DW_VIX_index	0.020	0.020	0.020	0.020
	(0.015)	(0.015)	(0.015)	(0.015)
DW_AE_MC:CO_FLOAT	0.098			
	(0.100)			
DW_AE_MC:CO_HINT		0.346		
DW_AE_MC:CO_HCPI			0.112	
DW_AE_MC:CO_LGDP				0.222
Observations	13,677	13,677	13,677	13,677
R^2	0.095	0.096	0.095	0.095
Adjusted R^2	0.094	0.094	0.094	0.094
F Statistic (df = 5; 13653)	286.847***	289.453***	286.920***	287.790***
Note:				*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:	
	DW_Long_term_yield	
	(1)	(2)
DW_AE_MC	0.242**	0.380***
	(0.103)	(0.134)
DW_DEPO3M	0.019***	0.019***
	(0.002)	(0.002)
DW_FX_USD	-3.708***	-3.703***
	(0.407)	(0.406)
DW_VIX_index	0.020	0.020
	(0.015)	(0.015)
DW_AE_MC:CO_HCDS	0.246*	
	(0.146)	
DW_AE_MC:CO_HPOL		-0.017
		(0.137)
Observations	13,677	13,677
R^2	0.095	0.095
Adjusted R^2	0.094	0.093
F Statistic (df = 5; 13653)	288.055***	286.633***
Note:	*p<0.1; **p<0.05; ***p<0.01	

Moreover, it is worth noting that there may be considerable variations in the estimates of control variables. For instance, when considering the foreign exchange rate, employing subsetting techniques could produce a more effective analysis. The drawback is that the two variables of interest from the two regressions are difficult to contrast, but a solution can be given with simple hypothesis testing.

Thus, subsamples were created based on the features of the recipient countries that were explained earlier, and regression was re-run with the same conditions. Although the number of observations decreased due to the smaller numbers in each sample, it did not materially alter the regressions and validity because the long panel contained more than enough variables for a reasonable estimate. The obtained coefficient of interest is collected and contrasted with a simple Z test. First, the difference between the two coefficients is calculated and divided by the square root of the square sum of the standard errors of the two corresponding variables. The obtained Z score is analyzed as usual: we reject the null hypothesis of the two estimates equal if the Z score is higher than 1.96 in absolute terms.

Based on these results, it is hardly possible to claim that the origin of monetary policy spillover has been found. Even the opposite that it is possible to conclude after these exercises. The phenomenon of monetary policy spillover is more uniform than thought earlier. However, the transmission effect of the three major central banks on emerging markets exhibits notable variations, which are likely to change over time and differ across specific regions. However, it is not one or two feature that matters: country groups, assigned nearly any way to highlight the importance of certain factors, produce no significantly different coefficients in the standard regression, regardless that in some cases, the point estimate looks rather different.

21. Table Comparison of country groups

Target	A coeff name	A coeff	rob. St.e	B coeff name	B coeff	rob.st.e	difference	sq(sum(st.e^2))	Z	p
AE	Float	0.416	0.155	Fixed	0.318	0.134	0.098	0.205	0.478	0.636
AE	HINT	0.548	0.212	LINT	0.224	0.099	0.324	0.234	1.385	0.166
AE	HCPI	0.433	0.178	LCPI	0.331	0.118	0.102	0.214	0.478	0.636
AE	LGDP	0.490	0.209	SGDP	0.269	0.104	0.221	0.233	0.947	0.344
AE	HCDS	0.497	0.187	LCDS	0.266	0.114	0.231	0.219	1.053	0.292
AE	HPOL	0.369	0.163	LPOL	0.387	0.142	-0.018	0.216	-0.083	0.935
AE	Latam	0.455	0.133	Asia	0.167	0.097	0.288	0.165	1.750	0.080*
AE	2021	3.37	1.054	2018	0.375	0.356	2.995	1.112	2.692	0.071*
USD	Latam	0.281	0.098	Asia	0.113	0.065	0.168	0.118	1.429	0.153
USD	HINT	0.348	0.165	LINT	0.137	0.069	0.211	0.179	1.180	0.238
USD	Float	0.267	0.121	Fixed	0.193	0.097	0.074	0.155	0.477	0.633
USD	CPI	0.26	0.137	CPI	0.224	0.085	0.036	0.161	0.223	0.823
USD	LGDP	0.293	0.159	LGDP	0.178	0.076	0.115	0.176	0.653	0.517
USD	HCDS	0.322	0.146	HCDS	0.156	0.083	0.166	0.168	0.988	0.323
USD	2021	1.9467	0.677	2018	-0.185	0.209	2.1317	0.709	3.009	0.003**

Therefore, after overviewing emerging markets as a whole, with a time series approach, seeking to find an EM-wise and region-wise impact of large central banks, it is still meaningful to further understand the difference between the reaction of certain countries to international monetary shocks.

6.6 Formal Hypothesis 3

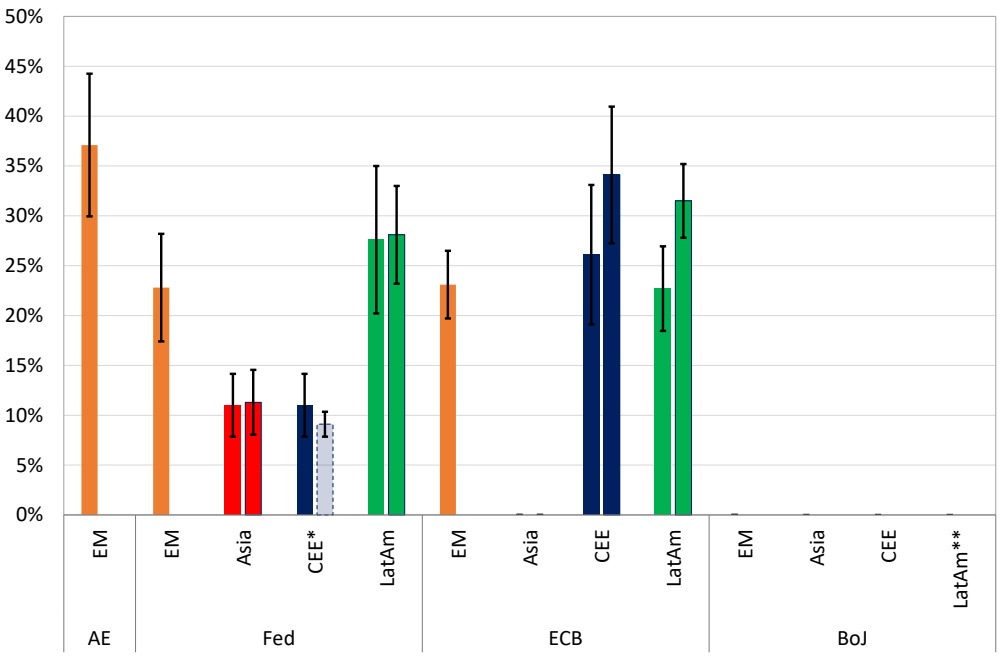
Chapter 6 aimed to quantify the monetary policy spillovers in certain geographic regions, thereby extending the framework described in the previous chapter. It is worth revisiting the findings on monetary policy spillovers.

Panel regressions confirmed that the impact of large central banks' monetary policy indeed has an impact on the long-term government bond yields of emerging countries. The overall rate transmission was calculated with a composite variable that was designed to encapsulate the interest rates of the

three large central banks. This calculation provided that the average transmission rate to emerging markets is 36 percent. Regarding the large central banks' impact separately, it was found that the transmission rate is surprisingly similar in the case of the Fed and ECB, while further calculations revealed that the actual market impact of this transmission may be higher in case of the Fed. The Bank of Japan has no systematic impact on emerging markets.

The regional impact of monetary policy changes was approached in several ways. It was found that the Federal Reserve has a more general impact on emerging financial markets, which is similar to other papers' findings. Central European markets tend to react more heavily to euro rate changes, while USD changes appear to be significant only via the risk-taking channel. In the dynamic model, the reactions were more balanced, CEE yields reacted similarly to USD and EUR shocks. The response of Latin American markets to EUR shocks is also relatively large. Generally, Latin American markets are sensitive to both USD and EUR shocks. Asian rates appeared to be relatively resilient to interest rate shocks in the static models, only responding to USD changes mildly, but the dynamic model showed a more intense response.

10. Figure Summary of spillover impact



Note: The bottom row of the x-axis contains the shock sender regions and central banks, while the x-axis names above are associated with the shock recipient emerging region for which the former shock sender's impact is presented. Percentages are identical to the coefficient in the respective panel model. Lines represent standard errors of the coefficient, denoting an approximate 68 percent confidence interval. The two separate estimates come from two different sampling methods. Between the Fed and CEE, the second bar represents the version with the VIX index instead of the Fed's coefficient. The impact of the Bank of Japan on Latin America was disregarded based on the previous argument.

A concluding subchapter raised the question that geographical regions are probably not the most important differentiating factor between emerging countries. Several attempts were made to create

similar groups of countries to measure their responsiveness to advanced market rate shocks, but the results suggest that even these groups may not be able to show the differences efficiently enough. A simple statistical method and hypothesis testing led to the conclusion that monetary policy spillover is more uniform than it was believed. A country-level approach is needed to further understand the difference between each country's reaction to external financial shocks.

Hypothesis 3:

Advanced central banks have a larger impact on emerging markets, which are tied to them more directly proxied by regional groups. An advanced central bank influences more emerging government bond yields in countries in the same region. A larger influence is suspected from the Fed to Latin America, the ECB to CEE region, and the Bank of Japan to Asia.

Decision:

Partly accepted. In relation to the Federal Reserve and Latin America, it holds, but none of the ECB and BoJ have explicitly higher impact in the region where they are located: ECB has a similar impact on Latin America, and the Bank of Japan has no impact on Asian rates.

Sub-hypotheses:

a) The changes in Fed short rates have a larger impact on emerging markets in Latin America than on any other region.

Decision: **Accepted,** based on the baseline regression, the coefficient of interest crossed with the region dummy for Latin America is the largest.

b) The changes in ECB short rates have a larger impact on emerging markets in the Central-Eastern European region than on any other.

Decision: **Rejected,** based on the baseline regression, the coefficient of interest crossed with the region dummy is similar for Central Eastern Europe and Latin America.

c) The changes in Japanese short rates have a larger impact on Asian emerging markets than others.

Decision: **Rejected,** Bank of Japan has no systematic impact on emerging markets in Asia and Central Eastern Europe. Interestingly, the variable associated with Latin America turned out to be significant.

■

7 Country-level factors that determine the sensitivity to international shocks

Several times, the idea of emerging markets being heterogeneous has been emphasized in this paper. However, there are several factors to discover when this heterogeneity is considered. Though some country-specific features have been considered in the previous chapter to create adequate groupings for emerging markets, it is worth discussing how these factors are translated into financial market transmission. This chapter aims to develop a conceptual framework and provide empirical insight into the financial market aspects of different emerging market paths.

7.1 Considerations behind moving from fixed effects to sensitivity scores

The more granulate analysis of the thesis is the attempt to understand the international monetary policy transmission on a country level and estimate the impact advanced central banks may have on certain emerging countries. In order to follow the previous analytical framework and theoretical discussions, the original benchmark panel model, with advanced economy shocks, needs to be considered further.

On a theoretical basis, in Chapter 4, a robust correlation was found between advanced short-rates and emerging long-term government bond yields. In Chapter 5 & 6 several panel regressions were described to estimate the impact of monetary policy spillover from advanced to emerging markets, with particular emphasis on certain economic regions. At the end of Chapter 6 it was found that the monetary policy spillover, as it is described in the paper, based on the estimations conducted, is not really driven by the most handful country features as country groups with different economic properties did not seem to produce statistically significantly different results.

Although our analysis discussed the potential underlying factors contributing to these findings, it is imperative to reemphasize the most significant among them. From a statistical perspective, a primary factor of significance lies in the utilization of Driscol-Kraay covariance matrices for all point estimates of coefficients. Consequently, the robust standard errors exhibit a significantly wider range than those derived from the usual estimation methods. Though the reported findings revealed that coefficients do robustly differ from zero, using the same robust standard error did not support the alternative hypothesis of having different estimates in different country groups. An analytical interpretation of this result is that the definition of monetary policy spillover is rather uniform, and visibly differing coefficients do not differ enough to claim that difference exists among country groups.

Earlier, it was explained that country-fixed effects are reasonable when estimating. However, this argument was an economic consideration rather than empirical: as variables became stationary with differencing, it was less likely to find out that certain countries may systematically have higher or lower intercepts throughout 12 years while the differences still being mean reverting. Ex ante, it could not be ruled out, but some of the fixed effects are non-significant. The utilization of fixed effects in the analysis took into consideration the underlying similarity within groups, irrespective of the fact that two country-specific variables were used in the regression model, thus, the fixed effect estimate

reached this goal. However, in the main regressions, the target variables hardly changed in alternative estimations. The first natural idea would have been extracting the fixed effects in the main regressions, but it does not lead anywhere meaningfully. Beyond the main regressions with differences, some specifications used the dependent, target, and control variables in different forms. In the case of level equations, the fixed effect represents only the average long-term yield level in the respective emerging market, and nothing else, and also, earlier explanations would not support the use of that regression. Regarding the normalized variable, it could be reasonable, however, normalized variables are not necessarily stationary, thus, reporting the regression with them may be flawed, and the obtained regressions may be misleading.

Remember, these extractions aim to extract the alfa coefficients of the regressions that are supposed to be country-specific. On the other hand, it would not really represent the country-specific impact of advanced monetary policy shocks. Instead, similarly to the region-specific dummies, the vector of country-specific dummies (or factors as it is called in R) should be added as an interaction term to the target variable. Theoretically, these coefficients yield the country-specific impact of the target variable, even more, this idea could be expanded to the time dimension by adding a set of variables regarding the year of observation. One should not forget that the table above suggests that monetary policy spillover may be time-varying.

Certainly, it is possible to create a regression with both time and country terms on the target variables, but it would yield over 300 regressors and may be inefficient and flawed for several reasons. However, this insight motivates us to move on, creating a time- and country-specific sensitivity score that establishes the relationship between the changes in advanced markets' monetary conditions and changes in long-term yields in emerging markets. Also, a slight modification is proposed from this point forward. Some rest is reasonable to add to the framework that has been applied before. As we shift the focus from a group of countries to individual countries, the most important aim of the exercise is to estimate the sensitivity to international factors and compare each country fairly. Admittedly, the estimated impact will now represent the sensitivity of certain countries to international shocks rather than a country-specific impact of monetary policy spillovers. From the point of the thesis, this more comprehensive view is regarded to understand the general differences between each emerging country's reactions to international shocks.

7.2 Creating sensitivity scores

This subchapter presents a set of variables describing the sensitivity of certain emerging countries' long rates to foreign shocks. This part of the analysis is divided into two parts: first, the relationship shall be formalized, and then it needs to be adjusted to be ready for further use in the rest of the chapter.

The first part is motivated by and similar to the work of Kocsis-Nagy (2011). Similarly, they established a relationship between a set of variables accumulated with a principal component method and CDS price changes. A simple linear regression leads to the numerical aspect of the relationship.

The dependent variable is always the weekly changes in long-term government bond yields in emerging countries, but it is sometimes used in a modified form. The only independent variable is the shock variable that reflects the foreign shock about to be measured. (Kocsis & Nagy, 2011)

In technical terms, country and year subsamples are created. As a result, every subsample has about 50 observations as weekly changes are used. Regressions are run without constant, with a simple OLS method, and used in a relatively unorthodox way. Without evaluating the goodness of the regressions or providing a formal hypothesis test for the coefficient associated with the target variable, the estimated point estimates are further used after adjusting them accordingly. Though bias from levels and autocorrelations shall be handled by differencing the variables in the regressions, the fair comparison among countries will not be hurt if usual hypothesis testing and the application of control variables are omitted. The rationale behind this approach is that the fair and consequent comparison among countries and years, thus among the samples, is not hurt by the fact whether the obtained regression differs from zero in a relatively badly performing univariate model, in other words, even it is seriously biased and definitely not appropriate from modeling perspective it is assumed that subsamples biased in a similar way, and for the purpose of this exercise it serves well.

The following variables are created following the respective regressions:

- SENS_INT: a score that comes from a regression where the dependent variable is the weekly changes of emerging long yields, and the independent variable is the changes of advanced short-rate composite on each year/country subsample. It shows how responsive the given country was in the given year to the changes in advanced markets' short rates. The more and more intensely it moved together weekly, the higher the score.
- SENS_INT_NORM: a score that comes from a regression where the dependent variable is the weekly normalized changes of emerging long yields and the independent variable is the changes of normalized advanced short-rate composite on each year/country subsample.[16] It shows the responsiveness of the given country in the given year to the changes of advanced markets' short rates without the effect of original levels. Though weekly changes do not necessarily need to be larger for countries with larger bond yields, it appears so. This also helps to evaluate the change in short rate changes: relatively larger changes on their own scale are considered.
- SENS_Int_FX_corr: a score that comes from a regression where the dependent variable is the weekly changes of emerging long yields corrected with the weekly change of FX rate (grabbing an external value approach: depreciation added negative value, appreciation gave positive value to yield changes) and the independent variable is the changes of advanced short-rate composite on each year/country subsample. It shows how responsive the given

[16] Normalized changes involve demeaning and dividing all observations by the respective standard deviation within the time period of the subsample. In the case of panel data, normalization was performed on each panel's observations, utilizing the means and standard deviations associated with the emerging countries or advanced rates.

country was in the given year to the changes in advanced markets' short rates, considering the FX-rate changes in each period. The more and more intensely it moved together weekly, the higher the score was.

- SENS_FX: a score that comes from a regression where the dependent variable is the weekly changes of FX rate versus the USD and the independent variable is the same as in SENS_INS: the changes of advanced short-rate composite on each year/country subsample. It shows that the country's FX rate is responsive to rate (monetary policy) changes of advanced countries.
- SENS_FX_NORM: a score that comes from a regression where the dependent variable is the weekly changes of FX rate versus the USD, normalized, and the independent variable same as in SENS_INS_NORM: the changes of normalized advanced short-rate composite on each year/country subsample. It shows that the country's FX rate is responsive to rate (monetary policy) changes of advanced countries in a scale-independent system.

The obtained coefficients are further adjusted. The coefficients are multiplied by a hundred and rounded to the closest round number. This could be regarded as a raw sensitivity score for each country and year subsample, and after further consideration, all data were normalized by the average of the data series and multiplied back by hundreds. Thus, all scores have a mean of hundreds and differ by country and year. All these transformations keep comparability between countries intact.

7.3 Validity of sensitivity scores

This subchapter aims to prove that the previously explained sensitivity scores measure the sensitivity of emerging markets as intended, and most importantly, they are indeed related to rates and FX markets, not being random numbers.

The rate sensitivity is cross-checked indirectly with CDS prices. As noted, creating these rate sensitivity scores moves away from monetary policy spillovers and aims to represent the general changes, the sensitivity, regardless its origin. Therefore, a directly observed market variable associated with riskiness of investing in the respective country proves that these numbers are valid or at least associated with risk. The rest of the possible variables may not be used for testing as they will have different roles in a later subchapter. A very simple linear model estimated with intercept and OLS method reveals that sensitivity scores are associated with riskiness proxied by CDS; thus, these numbers validly describe a part of investors' perception of the respective market. Note that only rate sensitivity scores (SENS_INT, SENS_INT_NORM, SENS_INT_FX_CORR) are associated with CDS, while FX-rate sensitivity is not. This aligns with the idea that rate should be associated with perceived riskiness and CDS prices, thus the same for the rate sensitivity score.

The good news is that volatility is a directly observable variable on FX-rate sensitivity by definition, but the bad news is that it will be analyzed further, so this is not an independent cross-check but a preview. Also, rate scores are associated with volatility, which is unsurprising if we consider the

problem of an international investor seeking to maximize profit in foreign currency. FX rate scores are associated with volatility, so these variables are more or less doing what they are intended to do.

22. Table Test of sensitivity scores

	Dependent variable:				
	SENS_INT	SENS_INT_NORM	SENS_INT_FXC	SENS_FX	SENS_FX_NORM
	(1)	(2)	(3)	(4)	(5)
CDSY	0.356***	0.221***	0.254***	-0.032	-0.038
	(0.077)	(0.063)	(0.086)	(0.092)	(0.064)
Volat_10DY	2.710*	-3.553***	3.442**	9.366***	3.475***
	(1.405)	(1.148)	(1.562)	(1.662)	(1.156)
Constant	17.232	85.335***	24.817	24.490	68.865***
	(14.414)	(11.777)	(16.016)	(17.040)	(11.854)
Observations	198	198	198	198	198
R^2	0.156	0.076	0.098	0.152	0.046
Adjusted R^2	0.147	0.066	0.088	0.144	0.036
Residual Std. Error (df = 195)	87.296	71.326	96.996	103.200	71.791
F Statistic (df = 2; 195)	17.981***	8.014***	10.536***	17.543***	4.658**
Note:					*p<0.1; **p<0.05; ***p<0.01

7.4 Analysis of scores

When visually analyzing the obtained scores, it is important to note a few simple facts that are observable at first sight. In the INT_SENS table, it is found that countries with larger inflation and interest rates, notwithstanding floating exchange rates, are on the partly surprising top. On one hand, nations experiencing economic difficulties may exhibit greater receptivity to fluctuations in developed markets. It is widely agreed that inflation risks, in particular, are carefully evaluated when the monetary authority functions as an inflation-targeting central bank. On the other hand, the floating exchange rate implies less imported interest rates and inflation conditions from abroad, because of independent monetary policy, meaning that interest rates are generally higher because inflation is generally higher in countries with floating FX rates. Briefly, this is a level issue: though these countries react more heavily nominally, the case is actually the opposite in a scale-independent environment. Therefore, a country where interest rates are relatively low may react more heavily and actually should react more heavily due to imported monetary conditions on its own scale, which is reflected in the SENS_INT_NORM score. We can observe the opposite as earlier, but from a theoretical viewpoint, it is more meaningful to discuss scale-independent changes. FX-rate adjustment, which may be debatable to handle this way, hardly changes the view compared to the SENS_INT score, so the results are expected to be very similar in this case, either.

Regarding FX sensitivity and the normalized version, however no game-changing difference is identified; arguably, scale-independent measures may be more meaningful in these cases as well. FX sensitivity is relatively intuitive: countries with floating rates and sometimes with occasional exchange rate overreaction tend to score higher on this list. Regardless of the observations on scale dependence,

all created scores are tested and reported in the following subchapters. All scores obtained based on the method earlier described are available in the Appendix.

7.5 The relationship between sensitivity to shocks and basic macroeconomic variables

The following regressions are created without fixed effects but with constants to ensure multicollinearity is as little binding as possible. First, the GDP, CPI, and unemployment data are tested in different specifications. Once in the way, we usually understand these variables, so in the case of GDP, it is a year-on-year change of output (real GDP) in the respective country, and in the case of CPI, it is the yearly CPI in year-on-year terms. The alternative specification uses the differences from last year, except unemployment, which is on levels in both cases. The latter specification aims to grab dynamic trends that investors might observe during pricing.

23. Table Relationship between the responsiveness to international shocks and certain macro variables

	Dependent variable:			
	SENS_INT	SENS_INT_NORM	SENS_INT	SENS_INT_NORM
	(1)	(2)	(3)	(4)
GDP_YOY	-1.993	-0.301		
	(1.808)	(2.135)		
CPI_YOY_Y	7.510**	2.006*		
	(3.225)	(1.142)		
DY_CPI_YOY_Y			5.876**	3.602*
			(2.593)	(1.967)
DY_GDP_YOY			1.290	1.702
			(1.572)	(1.566)
UNEMPY	0.849	-2.304	3.647	-1.694
	(2.435)	(1.639)	(2.318)	(1.445)
Constant	74.019***	106.671***	77.199***	108.159***
	(17.234)	(13.941)	(13.886)	(9.790)
Observations	252	252	252	252
R^2	0.118	0.015	0.054	0.032
Adjusted R^2	0.107	0.004	0.043	0.020
Residual Std. Error (df = 248)	99.771	83.493	103.278	82.797
F Statistic (df = 3; 248)	11.010***	1.298	4.755***	2.716**
Note:				*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	SENS_FX	SENS_FX_NORM	SENS_FX	SENS_FX_NORM
	(1)	(2)	(3)	(4)
GDP_YOY	-8.585***	-6.535***		
	(1.803)	(2.532)		
CPI_YOY_Y	-0.542	1.873*		
	(0.830)	(0.970)		
DY_CPI_YOY_Y			-0.159	2.105
			(0.982)	(1.344)
DY_GDP_YOY			-3.662***	-3.993**
			(1.421)	(1.559)
UNEMPY	3.773**	-0.107	4.706***	1.526
	(1.497)	(1.865)	(1.500)	(1.915)
Constant	109.001***	115.331***	74.057***	91.483***
	(12.126)	(17.855)	(9.458)	(12.603)
Observations	252	252	252	252
R^2	0.095	0.087	0.042	0.059
Adjusted R^2	0.084	0.076	0.030	0.047
Residual Std. Error (df = 248)	101.384	77.308	104.304	78.504
F Statistic (df = 3; 248)	8.669***	7.882***	3.626**	5.144***
Note:				*p<0.1; **p<0.05; ***p<0.01

Based on the results, a higher CPI level seems to contribute to higher rate sensitivity regardless of the scale of original changes. When the original changes are considered, the variable is only significant for the FX rate. Regarding the GDP, a worse macroeconomic outlook may contribute to higher FX sensitivity but not to interest rate sensitivity (a negative coefficient with negative observation would yield a higher score). The yearly changes show a very similar pattern: increasing inflation is associated with higher rate sensitivity, and worsening GDP (negative) is associated with higher FX sensitivity. Higher unemployment may contribute to higher FX sensitivity as investor perception worsens. An important caveat is that worsening macroeconomic conditions increase the sensitivity to international shocks; a higher inflation rate is associated with increased risk sensitivity, and worse GDP and unemployment figures may drive FX rate sensitivity.

Another set of macroeconomic variables is shown in the regression table below. These regressions were conducted exactly the same way as the earlier ones, and the interpretation of the coefficients also follows a similar logical path. However, these variables are relatively interrelated; thus, bivariate

regressions are reported with intercept. Based on the results, the pure changes in interest rates are associated with worsening financing conditions. The worsening government budget, current account balance, and higher external debt make interest rate sensitivity less surprising. Regarding the FX rate changes, similar worsening of these variables negatively influences the resistance to FX rate shocks, and the FX rate becomes more sensitive, regardless of whether these variables mostly describe debt, which generally pays interest rate.

24. Table Relationship between the responsiveness to international shocks and certain macro variables II.

	Dependent variable:			
	SENS_INT			
	(1)	(2)	(3)	(4)
BUDGET_Y	-4.687*			
	(2.530)			
CA_GDP_Y		-3.823***		
		(0.995)		
LXTR_DEBT_Y			31.306***	
			(7.592)	
LGDP_PCAP_USD				-32.187*
				(19.272)
Constant	90.027***	103.261***	51.860***	231.111***
	(7.900)	(6.886)	(11.599)	(80.103)
Observations	252	252	252	252
R^2	0.014	0.046	0.015	0.009
Adjusted R^2	0.011	0.042	0.011	0.005
Residual Std. Error (df = 250)	105.012	103.327	104.974	105.323
F Statistic (df = 1; 250)	3.676*	12.020***	3.863*	2.183
Note:				*p<0.1; **p<0.05; ***p<0.01

	Dependent variable:			
	SENS_FX			
	(1)	(2)	(3)	(4)
BUDGET_Y	-6.282***			
	(2.208)			
CA_GDP_Y		-2.908***		
		(0.854)		
LXTR_DEBT_Y			38.561***	
			(8.482)	
LGDP_PCAP_USD				-31.056
				(18.920)
Constant	86.634***	102.480***	40.704***	226.507***
	(7.819)	(6.782)	(11.208)	(79.259)
Observations	252	252	252	252
R^2	0.026	0.026	0.023	0.008
Adjusted R^2	0.022	0.022	0.019	0.004
Residual Std. Error (df = 250)	104.759	104.732	104.916	105.714
F Statistic (df = 1; 250)	6.635**	6.768***	5.867**	2.017
Note:				*p<0.1; **p<0.05; ***p<0.01

The findings of this subchapter underscore the importance of macroeconomic and financing conditions in terms of sensitivity to international interest rates and FX shocks. Based on the regression, it was confirmed that higher inflation drives rate sensitivity, worse GDP, and higher unemployment drive FX sensitivity up, while worsening budget deficit, current account balance, and increasing external debt increase both interest rate and FX-rate sensitivity up.

7.6 Institutional variables: openness and financial development

An interesting additional exercise is to test whether some institutional variables are associated with either interest rate or FX-rate sensitivity. The following regressions include a variable describing financial openness following Aizenman et al., an index for political or rather policy risk from Bloomberg, and a financial development index calculated by the World Bank. As these scores are relatively independent from each other, a joint regression is possible; thus, all three variables are used in the same regression, while the dependent variable has changed. Interestingly, neither the openness index nor the policy risk measure were significant in any specifications. Regarding the financial developments, the results are ambiguous. Though higher financial development is associated with lower scores in interest rate vulnerability when the normalized regressions are the base of the dependent variables, an increase is associated with higher financial development. Regarding the FX sensitivity, these issues may have emerged from the fact that higher financial development scores are

rather associated with countries using fixed exchange rates, which does not imply any causal relationship between the two facts. This observation leads to the decision to disregard this finding and not interpret false relationships, which may be purely a result of the country's choice.

25. Table Relationship between sensitivity scores and institutional variables

	Dependent variable:			
	SENS_INT	SENS_INT_NORM	SENS_FX	SENS_FX_NORM
	(1)	(2)	(3)	(4)
Financial_Openness_Index	-0.322	31.179	-37.384	11.399
	(26.011)	(21.779)	(22.743)	(27.564)
POL_RISK	0.590	0.049	-1.004*	-0.375
	(0.597)	(0.604)	(0.576)	(0.658)
FD	-78.347**	100.887***	-127.094***	14.609
	(39.016)	(34.969)	(41.035)	(40.653)
Constant	118.762**	24.717	229.183***	98.952*
	(46.624)	(45.778)	(48.849)	(52.976)
Observations	252	252	252	252
R^2	0.023	0.043	0.030	0.009
Adjusted R^2	0.011	0.032	0.019	-0.003
Residual Std. Error (df = 248)	104.977	82.311	104.938	80.535
F Statistic (df = 3; 248)	1.949	3.728**	2.588*	0.771
Note:				*p<0.1; **p<0.05; ***p<0.01

7.7 Institutional variables: monetary policy framework

Finally, it is a noteworthy aspect of our analysis that our sensitivity scores relate to certain features of the financial policy mix, thus, to certain choices of the monetary policy framework. One of the key questions this chapter seeks to answer is whether the exchange rate and monetary policy regime choice lead to any difference in the transmission of international shocks.

In the last chapter, one simplified approach was presented: a group of countries with fixed exchange rate regimes and another group with floating exchange rates was created, and the monetary policy spillover regression was run on these subsamples. However, the equality of the two coefficients could not be rejected with robust standard errors. One shall recall, that the last chapter concluded that monetary policy spillovers are similar in fixed and floating exchange rate regimes.

As emphasized earlier, sensitivity scores aim to document a larger part of international financial transmission: the avoiding of control variables and the design of scores allows us to identify the nature of usual comovement between long-term yields in certain countries in certain years with advanced short rates in the same sample. The question is, again, whether fixed and floating exchange rates indeed have any impact on the sensitivity of certain financial markets.

Based on the literature review, this question has some preliminary concepts. Regarding rate transmission, it would be meaningful that countries with fixed exchange rate regimes – or at least those where the exchange rate is more rigid – experience a larger impact as the FX rate cannot absorb the external shock. (See Kearns et al., 2018.) On the other hand, the introduction of scores revealed that

scores without normalization tend to show that countries with floating exchange rates, thus with higher inflation and rates, appear more sensitive to international shocks. The FX rate behaves similarly: when exchange rates are rigid, they do not really absorb the shocks coming from abroad; thus, the FX rate sensitivity shall be smaller in these cases.

The empirical strategy is to use simple OLS regressions, where dependent variables are the sensitivity scores calculated earlier, while independent variables reflect the rate and FX variability in the respective countries. Univariate regressions with intercepts are used to avoid any conflict from multicollinearity, and estimated coefficients are evaluated with robust standard errors on the conventional significant levels. The coefficients themselves do not really contain any meaningful information and may not be directly compared, thus, most importantly, the sign and the associated significance level are evaluated, as shown in the table below.

The measurement of interest rate transmission in emerging countries involves the assessment of both short-term and long-term rates. Beyond the variables that have been created from observations of market data, Trilemma indices by Aizenman et al. were also tested: in terms of rates, the monetary policy independence index was contrasted. However, the score of Aizenman measure is very similar as we deem it important to highlight the difference. The Monetary Policy Independence Index was developed based on the monthly comovement of rates in certain jurisdictions, using a set of advanced economies as base countries. They are also market-observed variables but were processed differently than our sensitivity scores. Therefore, there is no exact collinearity with our dependent variable, but it measures a similar concept, thus, having it in the list of dependent variables is rather for an illustrative purpose. Results showed that where monetary policy independence is large, thus, where the short-term rates are dissimilar, the rate sensitivity, e.g., the systematic comovement of long-term rates vs. short-term rates in advanced economies, is small. Not surprisingly.

The FX-rate transmission is examined similarly. Variables have been created from market observations on the FX markets and contrasted with the FX sensitivity score, which briefly denotes the comovement between the change in respective emerging FX rates versus USD and the monetary policy shock that is originated from advanced countries. Aizenman et al.'s exchange rate stability index is created similarly: it is an aggregated index on the comovement of FX rates versus a designated home country's currency. Thus, the higher the exchange rate stability is, the more rigid the FX rate is. However, Aizenman's index consider only the monthly movements of the currency, while the variable used here reflects to the responsiveness of monetary changes (measured in rate changes).

It is essential to reiterate earlier observations on the sensitivity indices. SENS_INT is, though the final scores are normalized, were created from weekly changes. Consequently, not surprisingly, countries with floating exchange rates and supposedly higher inflation and interest rates tend to have higher sensitivity scores. Contrasting with the yearly average of 3M rates, it is clear that this is a level issue: even if we processed weekly changes, they tend to be higher for countries where 3M rates are genuinely larger. However, the understanding of SENS_INT underscores the numerical logic that was

followed in the earlier subchapters. On the contrary, SENS_INT_NORM was created from pre-normalized variables, and it shows that countries with fixed or quasi-fixed rates tend to be more sensitive to international shocks on their own scale, disregarding the original levels of rates. SENS_INT_FXcorr series of sensitivity is very similar to SENS_INT, though an effort was made to account for changes of FX rate changes that are associated with long-term bond investments in emerging countries, the outcome is not different from the results, including the drawbacks explained earlier, as we have seen in SENS_INT. Regarding the FX-rate scores, the same issue has arisen: weekly FX rate changes were used for finding SENS_FX rates, but without prior normalizing them, the average level of FX rate vs USD is conflicting with the estimate, thus SENS_FX_NORM makes more sense, in my view.

Interest rate shock transmission is mainly possible to evaluate based on the regression involved sensitivity score 'SENS_INT_NORM.' The standard deviation of the 3M depo rate appears to be significant and positively associated with sensitivity, which is intuitive: the countries that have high sensitivity on their scale are mostly using fixed rates that are unable to absorb shocks without adjusting in FX policy thus interest rate tends to move more often causing a higher standard deviation. Although these rates do not vary as much within a year, compared to countries with floating rates, the range of short-term rates is not necessarily larger, as the quasi-imported monetary conditions are usually less volatile in advanced countries than in emerging ones with floating rates, thus the normalized yearly difference between the maximum and minimum 3M depo rates appears to be insignificant. Coefficients with long-term yields tell a different story: the previous argument seemingly applies to short rates. Based on all specifications, it turned out that countries where long-term rates are more volatile, having a larger intrayear range, are more exposed to the sensitivity of international rate changes at their own level; thus, in general, more volatile long rates are associated with more international rate transmission regardless to the FX rate or the initial level of interest rate as several reflections were made on the FX rate regime and the behavior of FX rate it worth to consider the dependent variables associated with rates as well. The majority of them are unrelated to rate transmission, but earlier findings appeared to be supported by some of these variables. In countries where the daily FX rate changes, the yearly standard deviation of the FX rate change is larger, and the rate sensitivity is smaller, which is also the finding if we consider the relevant trilemma index: if the exchange rate stability is higher, the rate sensitivity also tends to be higher, in general. Regarding the volatility-type variables, it is to be found that daily, weekly, and medium-term changes in FX rate do not really matter from rate sensitivity but rather the broad picture of FX-rate policy.

The transmission of international financial shocks on the foreign exchange market exhibits an analogy to previous assumptions.

Remember, FX rate sensitivity is explained as the relationship between the changes in local currency expressed in USD versus the change in advanced rates. The interest rate-related variables have no significant impact on the FX rate sensitivity based on the results. The exceptions are related to standard

deviation and the standardized yearly range of long-term rates, which both may be translated as a result of sovereign risk: the more volatile the long-rates are and the more they vary over a year, which may be a result of sudden changes in investors' confidence.

26. Table Sensitivity scores and certain interest rate and FX rate characteristics

No	TYPE	VARIABLE (ROWS) /SAMPLE (COLUMNS)	SENS_INT	SENS_INT_NORM	SENS_INT_FXCorr	SENS_FX	SENS_FX_NORM
1	INT	Standard deviation of 3M deposit rate	***+	*+	**+	0	**+
2	INT	Normalized yearly change of 3M deposit rate	*+	**+	**+	0	**+
3	INT	Normalized yearly change of long-term yields	***+	***+	***+	0	0
4	INT	Standard deviation of long term yields	***+	***+	***+	***+	0
5	INT	Normalized range of long-term yields	***+	***+	***+	***+	0
6	INT	Monetary_Independence_Index	**-	***-	***-	0	***-
7	INT	Yearly average of 3M deposit rate	***+	0	***+	0	0
8	INT	Normalized yearly average of 3M deposit rate	***+	0	****+	0	0
9	INT	Normalized range of 3M deposit rate	***+	0	**+	0	**+
10	FX	Standard deviation of REER rate (by JP Morgan)	***+	0	***+	*+	***+
11	FX	Normalized yearly change of FX-rate vs. USD	***+	0	***+	*+	***+
12	FX	Yearly average of daily FX-rate changes vs. USD	***+	**-	***+	***+	**+
13	FX	Yearly average of 10 day realized volatility of FX rate	***+	0	***+	***+	**+
14	FX	Yearly average of 1M implied volatility of FX rate	***+	0	***+	***+	0
15	FX	Normalized yearly average of 10 day realized volatility of FX rate	***+	0	***+	***+	**+
16	FX	Normalized yearly average of 1M implied volatility of FX rate	***+	0	***+	***+	0
17	FX	Exchange_Rate_Stability_Index	***-	*+	***-	***-	0
18	FX	Normalized yearly FX-rate change (with direction)	0	0	0	*-	***-
19	FX	Normalized standard deviation of FX rate	0	**-	0	0	**+
20	FX	Normalized yearly change of REER rate (by JP Morgan)	**+	0	**+	0	***+

All variables designed to capture the impact of foreign exchange market changes show that foreign exchange markets with more vivid pricing changes appear to be more sensitive, in FX-rate terms to the changes of advanced interest rate changes. This result hints that fixed exchange rates are adjusted more slowly, thus countries that generally have more flexible exchange rate exhibit higher FX shock transmission. However, those countries that react, relatively, more vividly in FX rates to interest rate changes, are not necessarily those that generally observe higher volatility.

All in all, this exercise and the conclusion of this subchapter holds important caveat for the empirical testing of literature review. The original trilemma appears to hold: in a fixed rate regime, the relative transmission of international interest rate shock is higher, however, the financial cost, the nominal interest rate, is influenced by the fact that countries with floating exchange rates tend to have higher inflation, thus higher interest rates. Therefore, seemingly higher interest rate sensitivity is connected to the higher level of rates, in general. Supposedly the same countries, unsurprisingly, observe higher FX-shock transmission as their floating currencies can adapt to international environment more quicly. Also, it is an important finding that FX-rate dimensions do not primarily influence rate sensitivity, and domestic rate changes have a marginal influence on FX rate transmission.

As a discussion of this finding, it is important to note that in the majority of cases, absorption of international shocks occurs in the interest rates and the FX rates at the same time, or, based on the policy, the shock absorption may be significantly deteriorated by discretional policy shifts. As the sensitivity scores are based on systematic weekly comovement between markets, these findings are mostly robust in the short-to-mid term: in one week, market participants digest the majority of new information, and the pricing moves accordingly. On the other hand, local monetary policy authorities may intervene within their mandates during this time, and policy shifts are less likely to occur only in emergencies. In general, policy shifts facilitate external adjustment over longer time periods, typically

on a monthly or yearly basis, by formally or informally modifying the policy response in relation to the new external stance. In a base case, an inflation-targeting central bank with reasonable external and near-infinite internal power on monetary conditions regards the sum of FX rate and interest rate adjustment within its policy framework before intervening. This exercise intentionally left out the cross-effect of FX and interest rate adjustments as it would go way beyond the scope of this paper.

7.8 Discussion

Though the previous chapter ended by explaining the surprisingly uniform nature of monetary policy spillovers, the different reactions of emerging countries to international shocks remained unresolved, and a relatively different framework was needed to analyze. Based on empirical observations, sensitivity scores that reflect the interest rate and FX market sensitivity of emerging countries in certain years were created, and these indices became the base of the analytical framework. After briefly explaining that variables are more or less valid and a general introduction of scores took place, three groups of variables were proposed to contrast. The study examined three distinct groups of variables. The first group focused on fundamental macroeconomic indicators, while the second group compared institutional variables that were relatively stable over time. The third group of variables analyzed the monetary frameworks employed by the countries included in the sample.

The results are partly intuitive, but interesting insights and findings were revealed in some parts. Regarding the macroeconomic conditions, it was found that higher inflation drives rate sensitivity, worse GDP, and higher unemployment drive FX sensitivity up, while worsening budget deficit, current account balance, and increasing external debt increase both interest rate and FX-rate sensitivity up. Most of these results are intuitive: though inflation and GDP are not equally influential on rate and FX sensitivity, while variables on financial position influence both. Institutional variables appeared to be insignificant and, in the case of financial development, spuriously significant, thus, it is impossible to establish a relationship between these institutional variables and shock sensitivity based on the analysis conducted.

Based on the variables that reflect interest rate and FX policy regimes, it was found that the original trilemma appears to hold: in a fixed rate regime, the relative transmission of international interest rate shock is higher, however, the financial cost, the nominal interest rate is influenced by the fact that countries with floating exchange rate tend to have higher inflation, thus higher interest rates. In case of FX rates, the currency of those countries that have more flexible exchange rate regimes react to international rate shock more vividly.

7.9 Formal Hypothesis 4

This chapter investigated the country-specific factors of financial market comovements emerging from the heterogeneity of the responsive countries. Moving away from the strictly analyzed monetary policy spillovers, the sensitivity of certain countries showed a larger variation in the sample, shedding light on factors one needs to consider when discussing the financial market developments in emerging

markets. The initial step was to create sensitivity scores that describe how a certain emerging market responds to certain advanced market shocks in a given year. For this reason, a simple, univariate OLS regression was used. After creating the scores, necessary adjustments took place.

Regarding the regression analysis, first, the most important and well-used macroeconomic variables are tested: whether they do influence the interest rate and FX-market sensitivity of a given country. Second, some institutional variables were tested. Finally, the scores are discussed in light of the trilemma framework, and the exercise provided an empirical attempt to create a connection between advanced interest rate and FX market shock sensitivity and basic market features on the respective financial markets.

Hypothesis IV.: Country-specific factors, including monetary policy framework, influence certain countries' sensitivity to global shocks.

Decision:
Partly accepted. Some macroeconomic variables and the monetary policy framework influence the interest rate and FX market sensitivity of emerging countries, though institutional variables are mostly insignificant.

Sub-hypotheses:
a) Countries with weaker fundamentals are more exposed to international financial shocks.
Decision: **Partly accepted.**

b) Institutional variables, such as policy risks and financial developments, influence the sensitivity to international financial shocks.

Decision: **Rejected.**

c) The sensitivity to international shock is broadly similar to what the trilemma theory explains: countries with fixed exchange rates are more sensitive to interest rate shocks, while floaters are more sensitive to FX-rate changes.

Decision: **Accepted.**

■

8 Summary of the thesis and concluding remarks

Globalization has profoundly shaped international relations, particularly impacting economic and political landscapes over the past decades. Various scholars highlight the interconnection of interest rates on domestic financial markets, emphasizing the necessity of understanding the international context to analyze asset price dynamics. However, the mechanism, through which these influence cross borders has remained largely unexplored. This thesis seeks to uncover the nuanced ways, in which major advanced central banks impact financial markets in emerging economies.

Several authors in the literature argued that interest rates on domestic financial markets are significantly correlated, and asset price dynamics are impossible to analyze without understanding the international economic environment. (Rey, 2015; Takats & Vela, 2014) The interconnection of sovereign financial systems gained prominence, especially after the Global Financial Crisis in 2008-2009. Central banks in advanced countries implemented aggressive monetary stimulus and a wide array of unconventional measures to navigate through the period of financial instability. The most impactful initiatives were the quantitative easing programs, during which these central banks purchased securities with the intention of reducing risk premia—the excess rate that market participants demanded to risk their capital on the financial markets. Numerous studies have found that these interventions had significant international effects, commonly referred to as 'monetary policy spillovers.' Arguably, these international effects are linked to substantial cross-border capital flows, particularly towards investments in international bond markets. An increased volume of portfolio investment flowed into emerging markets as advanced bond markets offered relatively low returns due to the interventions of large central banks.

This research is a contribution to the international finance literature. Several research focused on understanding of the new order of global financial markets. Two of the main contributors are Aizenman and Rey: their debate on the nature of the interconnection of the financial market helped to draw a framework to understand current issues in international finance. The debate between Rey and Aizenman is around two major issues. First is, the approach which is different in the two theories. While Rey followes an approach that inducted the theory based on empirical evidence, particularly wide-scale modeling results, Aizenman argues for extending the theory-based Mundell-Fleming model which is based on current stylized facts and observations. Secondly, Aizenman notes that the difference between the two theories is rooted in the hypothetical importance of FX rates and general financial policies. The global financial cycle hypothesis disregards any financial policies and quantitative results estimated on a global market level, except for some regional breakdowns. Therefore, the shock absorbent capacity of the foreign exchange market is neglected, which was found to be an oversimplification by Aizenman. In the literature review, several empirical papers have been examined that provided insight to the relationship between advanced short rates and emerging long-term government bond yields. The literature review revealed that the cross-border impact of the advanced central bank's monetary policy was quantifiable, especially due to unconventional monetary

policy tools adopted to respond to the Global Financial Crisis. Most of the last 15 years were characterized by low inflation and low interest rates in advanced and emerging economies, but tightening steps from the Federal Reserve took place in the second half of the 2010s. The COVID-19 crisis reshaped the monetary policy environment: to help mitigate the risk of freezing economies, central banks turned to aggressive easing policies, but not more than a year later, inflation increased significantly, which made central banks tighten financial conditions.

The aim of the thesis paper is to reveal some parts of cross-border financial linkages, particularly the impact of advanced central banks on emerging government bond markets. The main goal of the thesis was to quantify so-called 'monetary policy spillovers', examine them exhaustively with regards to regional differences, and support discussions on the factors that relate to the sensitivity of emerging countries to changes in the external financial environment.

Regarding the methodology of this thesis, diverse quantitative methods were utilized to unveil the relationship between emerging and advanced rates. The empirical part of the thesis was inspired by various papers introduced in the previous literature review chapter. In essence, a range of time series models and different panel models were predominantly applied. Given the flexibility of the collected dataset to accommodate various panel modeling techniques, models were estimated with fixed effects, and in different specifications, with the generalized method of moments. These models were applied to a relatively extensive dataset consisting of daily observations for up to 19 countries over nearly 14 years. Sample adjustments were made as needed by reducing frequency. The dataset encompassed a variety of financial data, including government bond yields, swaps, and deposit rates, which were then contrasted with several macroeconomic variables, event sets, and newly defined variables.

The findings of the thesis, along with the hypotheses, are as follows.

In the fourth chapter, by applying several time series methods, it was found that advanced short-term interest rates do influence emerging long-term government bond yields. Several specifications were tested, and based on the aggregate results, it turned out that the transmission of advanced market shocks is the strongest between 1 and 4 months after the initial shock.

Hypothesis 1 was formulated as follows. **Short-term rates in advanced markets influence long-term government bond yields in emerging markets.**

Based on empirical evidence, the hypothesis was accepted. Several time series models confirmed that there is a relationship between short-term rate changes and long-term government bond yields in the sample. This relationship was measured using an aggregated advanced market index and one-month USD swap rates as proxies for short-term rate changes. Multiple alternative specifications and robustness tests have been conducted to validate this finding, which has demonstrated robustness.

The fifth chapter empirically tested the narrow understanding of monetary policy spillover on a long panel dataset. A main model, a static panel-model with fixed effects, was designed to highlight

several different angles of monetary policy spillovers by employing different shock variables that reflect the monetary conditions in advanced countries. Several alternative specifications, an attempt to test robustness-test, and an alternative modeling approach (with dynamic panel model) were introduced. Based on several panel regressions, the monetary policy of certain advanced central banks directly affects emerging markets through money and capital markets. The baseline model suggests that the monetary policy of the Fed and the ECB have similar transmission rates to emerging markets, but additional calculations revealed that the market impact of the Federal Reserve may be larger, particularly when the impact of larger changes and new policy announcements were measured, thus it appears to be confirmed that the 'Fed creates the waves' on the financial markets. The Bank of Japan demonstrated no sign of monetary policy spillovers, thus, the cross-border impact of Japanese monetary policy was rejected.

Hypothesis 2 was formulated as follows. **Changes in advanced markets' short-term rates have a direct financial market impact on long-term government bond yields in emerging countries, thus, the so-called 'monetary policy spillover' exists in the case of certain central banks and emerging markets.**

Based on several panel regressions, the hypothesis was accepted. Empirical findings confirmed that the monetary policy decisions of the Federal Reserve and the European Central Bank do have an impact on the long-term government bond yields in the sample. Several alternative specifications and robustness tests confirmed this result, which turned out to be robust. On the other hand, the Bank of Japan has no systematic impact on emerging financing costs.

The sixth chapter examined monetary policy spillovers in the context of regional disparities. The regional impact of monetary policy changes was approached in several ways. It was found that the Federal Reserve has a more general impact on emerging financial markets, which is similar to the findings of other papers. Central European markets tend to react more heavily to euro rate changes, while USD changes appear to be significant only via the risk-taking channel. In the dynamic model, the reactions were more balanced, CEE yields reacted similarly to USD and EUR shocks. The response of Latin American markets to EUR shocks is also relatively large. Generally, Latin American markets are sensitive to both USD and EUR shocks. Asian rates appeared to be relatively resilient to interest rate shocks in the static models, only responding to USD changes mildly, but the dynamic model showed a more intense response. However, point estimates appeared to be vary in certain regions, in statistical terms, the effect is surprisingly uniform. Even more, several attempts were made to create similar groups of countries, based on their features, to measure their responsiveness to advanced market rate shocks, but the results suggest that even these groups may not be able to show the differences efficiently enough in statistical terms. This called for a country-level approach that helped to further understand the difference between each country's reaction to external financial shocks.

Hypothesis 3 was formulated as follows. **Advanced central banks have a larger impact on emerging markets, which are tied to them more directly proxied by regional groups.** An advanced

central bank influences more emerging government bond yields in countries in the same region. A larger influence is suspected from the Fed to Latin America, the ECB to CEE region, and the Bank of Japan to Asia.

Based on the modifications of the previous panel models, **the hypothesis was partly accepted.** It holds in relation to the Federal Reserve and Latin America, but none of the ECB and BoJ have explicitly higher impact in the region where they are located: ECB has a similar impact on Latin America, and the Bank of Japan has no impact on Asian rates. On the other hand, in statistical terms, these differences are not significant, which called for an additional step to examine the responsiveness of emerging countries to external financial shocks on an individual level.

In the seventh chapter, the broadly understood interest rate and FX rate sensitivity were examined with the help of custom sensitivity indices. The general interest rate and FX rate sensitivity are understood as a result of all sorts of systematic, joint movement, but not only of those that arise as a result of changes in monetary policy in advanced economies. Thus, this is a wider understanding of monetary policy spillover. Custom indices reflecting interest rate and FX sensitivity were contrasted with a set of variables, thus the impact of macroeconomic, institutional, and policy variables were tested systematically. Regarding the macroeconomic variables, the regressions showed that a higher inflation rate increases interest rate sensitivity while worsening growth and higher unemployment drive FX rate sensitivity up. Plus, an important caveat is that worsening financial position increases both interest rate and FX sensitivity.

Several approaches were tested to provide a robust result regarding the choice of financial policy regime. It turned out that emerging markets' general yield and exchange rate sensitivity to the evolution of global interest and exchange rate conditions roughly correspond to what is described in the trilemma theory. However, simultaneously, the sensitivity of countries with freely floating exchange rates and, therefore, higher inflation and interest rates to advanced interest rates is nominally higher. In the case of currencies with a floating exchange rate, they react more decisively to external interest rate shocks, while countries with a managed exchange rate are better prevented from affecting the exchange rate.

Hypothesis 4 was formulated as follows. **Country-specific factors, such as the macroeconomic environment, institutional variables, and monetary policy framework, influence certain countries' sensitivity to global shocks.**

The hypothesis was partly accepted based on a series of regressions on the custom sensitivity indices. Some macroeconomic variables and the monetary policy framework influence the interest rate and FX market sensitivity of emerging countries, though institutional variables are mostly insignificant.

The result of the thesis is a synthesis of two different views of Réy and Aizenman: although monetary policy shocks do create "waves" in the capital markets, which spread roughly uniformly, the sensitivity of individual countries to external shocks differs for many reasons, including their monetary framework.

The thesis unveils certain aspects of international finance and revealed the relationship between the monetary policy decisions (proxied by short-term rates) of advanced countries and the long-term government bond yields of emerging countries.

Several improvements are possible to this research. Regarding the content and research hypotheses level, there is a room for further development by considering stock and flow indicators in cross-border transactions, choosing a better country grouping than geographical regions, and considering the changes in the reaction of local monetary policy. In the aftermath of the COVID-19 crisis, the elevated level of inflation and rising global rates may also deliver different results, which can be subject for future research.

Assessing the strengths and weaknesses of the thesis, it significantly contribute to the field of international finance by providing further insights into the dynamics of cross-border impacts of advanced central banks, with a special emphasis on emerging countries that may gain increased attention in the foreseeable future. Concurrently, the perpetual evolution of old and emerging challenges in monetary policy continually refines our comprehension of international financial links/connections, keeping the topic in the center of spotlight and interest. The findings of the paper do not only provide a foundations for future research, but it also offers valuable insights for financial markets'‟ policymakers and investors in both advanced and emerging countries.

■

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■

Appendix - List of Appendices

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A) Authors's publication list

Bihari, P., & Sztanó, G. (2015). Sikertörténet vagy sok hűhó semmiért? *Köz-Gazdaság*, *X.*(2.), 23–39. Retrieved from http://www.retp.eu/index.php/retp/article/view/677/632

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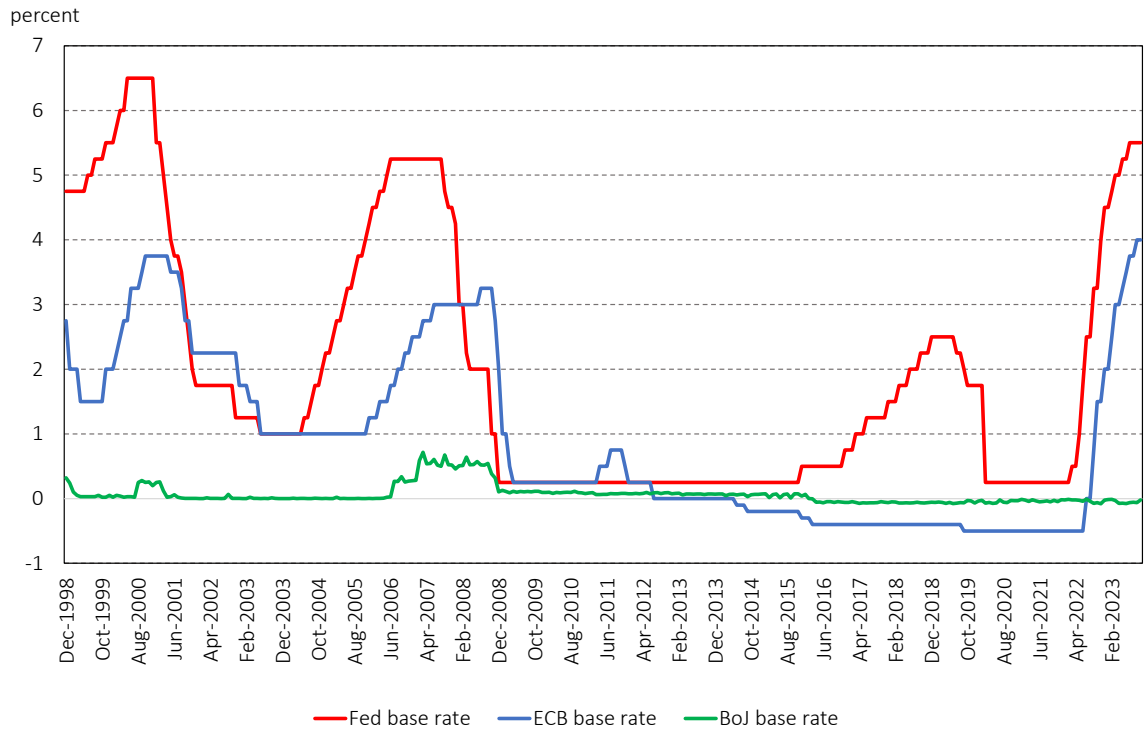
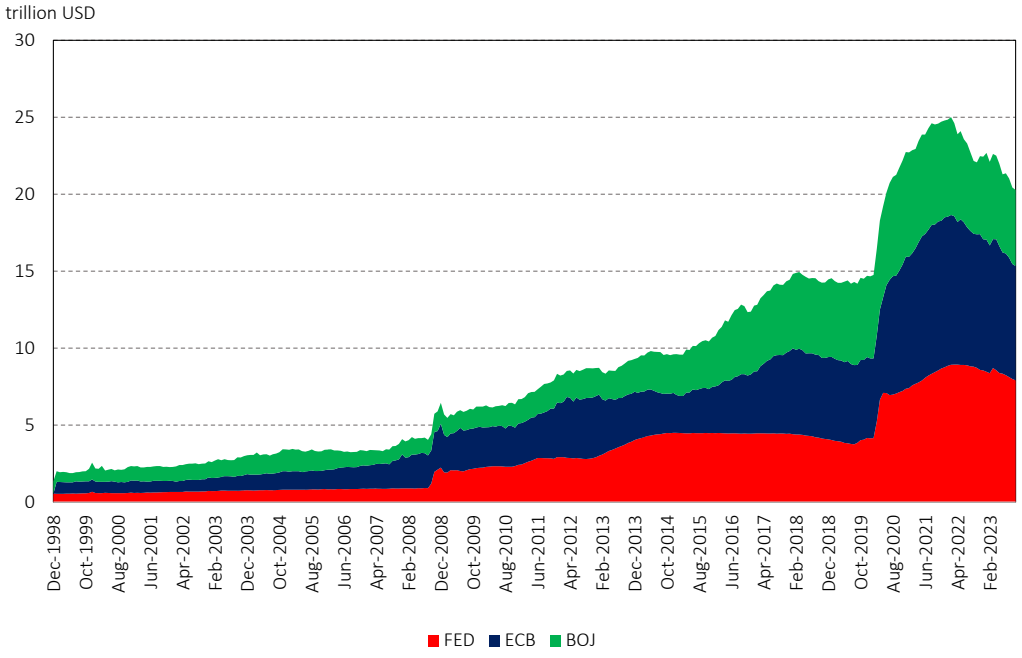
B) Supplementary graphs to Chapter 1

1. Figure Central bank base rates in the USA, Eurozone and Japan



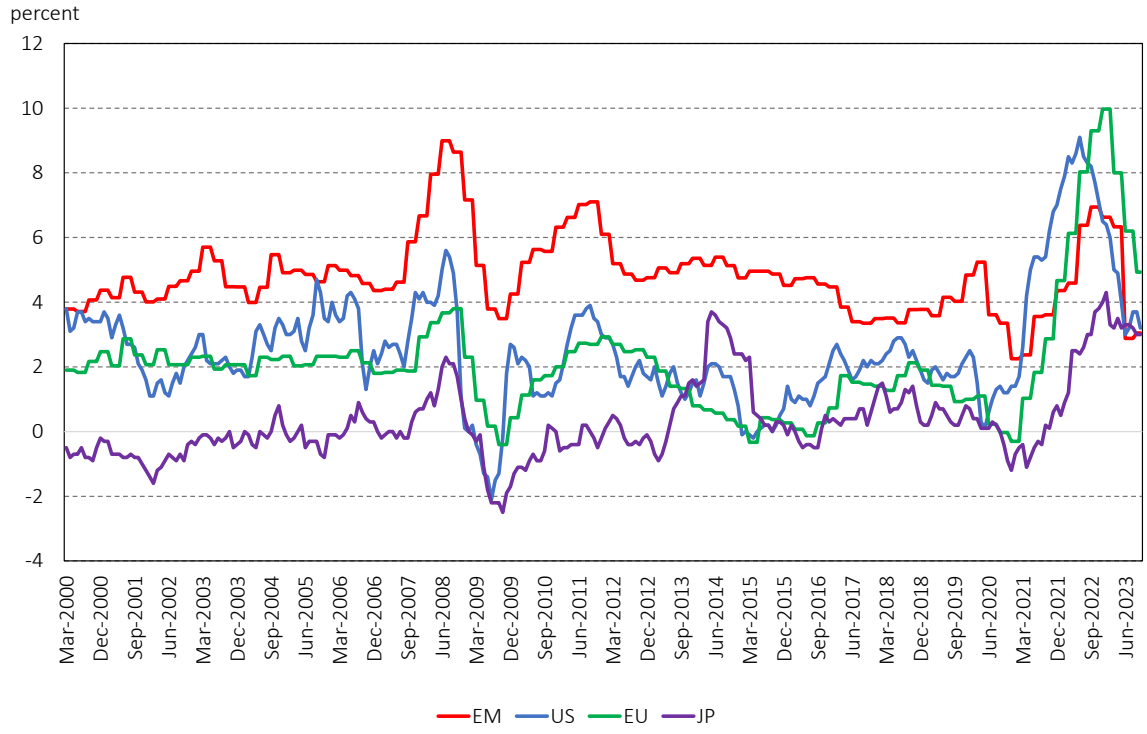
Source: Bloomberg.

2. Figure Evolutions of balance sheets of the Fed, ECB, and BoJ



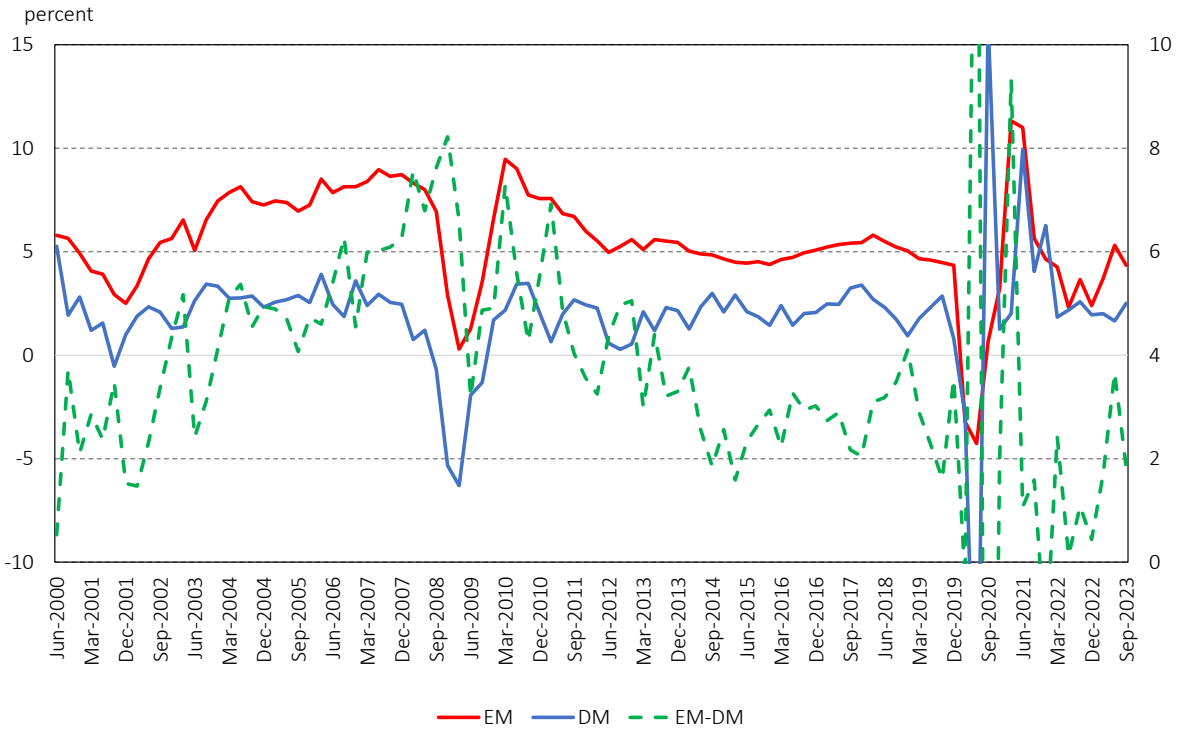
Source: Bloomberg, own calculations.
Comments: Published monthly central bank balance sheet statistics. In case of ECB and BoJ end-of-month exchange rate is used to calculate USD values. Trillion means 1000 billion.

3. Figure Inflation in selected countries and emerging countries



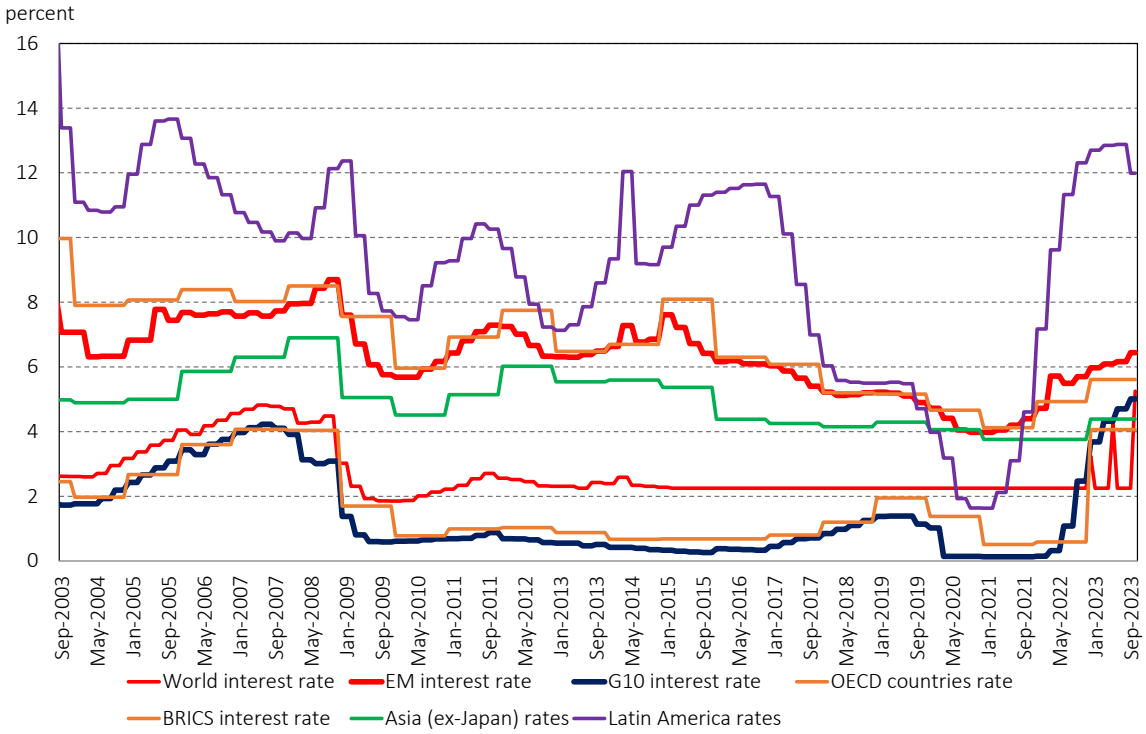
Source: Bloomberg, IMF.
Note: Group of emerging countries is defined by IMF.

4. Figure Average GDP growth (year-on-year) in selected country groups



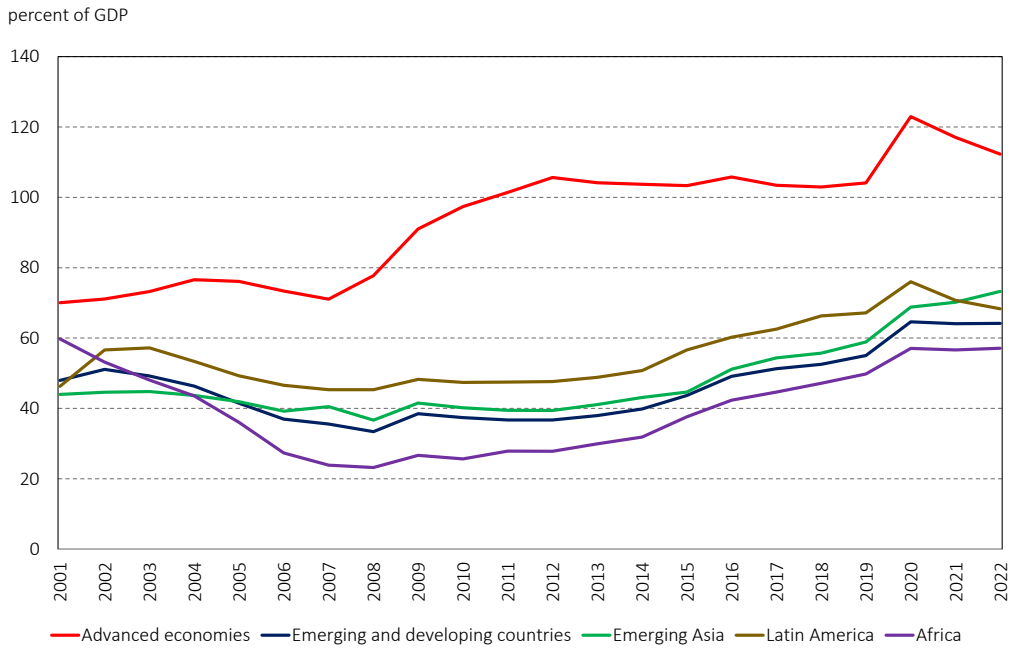
Source: Bloomberg, IMF

5. Figure Avarage central bank interest rates in selected regions



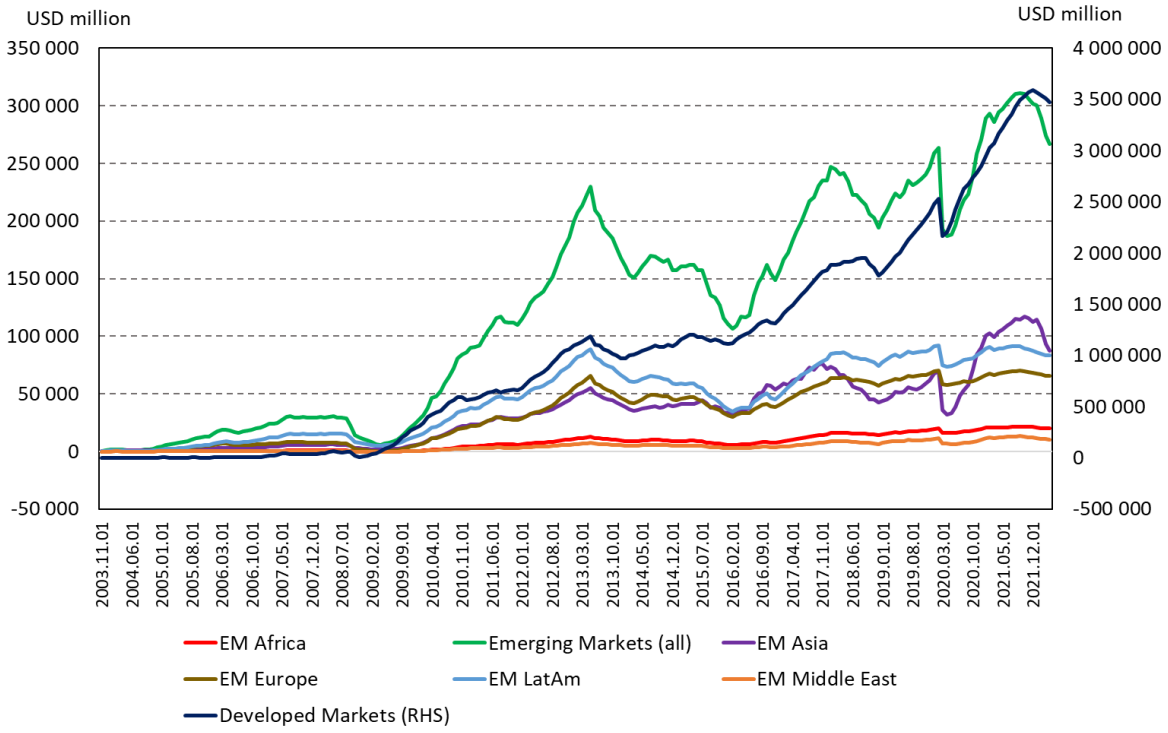
Source: Bloomberg, IMF.

6. Figure Government debt in different regions



Source: Bloomberg, IMF. Note: Weighted average of outstanding government debt divided by GDP.

7. Figure Cross-border bond flows



Source: EPFR Global (author's calculations). Note: Cumulative flows since the beginning of the time series.

C) List of countries

	Local currency	Exchange rate policy (Currency)	Monetary policy framework	Region
Brazil	Brazilian real	Floating	Inflation target	LatAm
Bulgaria	Bulgarian lev	Currency board	Exchange rate anchor (euro)	CEE
Chile	Chiliean peso	Free floating	Inflation target	LatAm
China	Chinese renminbi	Crawl-like arrangement	Monetary aggregate target	Asia
Colombia	Colombian peso	Floating	Inflation target	LatAm
Czechia	Czech koruna	Free floating	Inflation target	CEE
Hong Kong	Hong Kong dollar	Currency board	Exchange rate anchor (USD)	Asia
Hungary	Hungarian forint	Floating	Inflation target	CEE
Indonesia	Indonesian rupiah	Floating	Inflation target	Asia
Korea	Korean won	Floating	Inflation target	Asia
Malaysia	Malaysian ringgit	Floating	Other framework	Asia
Mexico	Mexican peso	Floating	Inflation target	LatAm
Peru	Peruvian sol	Floating	Inflation target	LatAm
Philippines	Philippine peso	Crawl-like arrangement	Inflation target	Asia
Poland	Polish zloty	Free floating	Inflation target	CEE
Romania	Romanian leu	Crawl-like arrangement	Inflation target	CEE
Singapore	Singapore dollar	Stabilized arrangement	Exchange rate anchor (composite)	Asia
Thailand	Thai baht	Floating	Inflation target	Asia
Turkey	Turkish lira	Floating	Inflation target.	CEE

Source: IMF, 2021, Annual Report on Exchange Arrangements and Exchange Restrictions (AREAER)

D) Descriptive data for the variables

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
1	USD_MC	dailyone	Own calculation	N	3659	0,12174	4,47216	0,729515	0,24736	0,87811
2	EUR_MC	dailyone	Own calculation	N	3659	-0,5929	2,39648	0,0416191	-0,1003	0,57572
3	JPY_MC	dailyone	Own calculation	N	3659	-0,4568	0,58299	0,0757838	0,0461	0,14501
4	EM10_FC	dailyone	Own calculation	N	3659	2,41261	6,87472	4,251436	4,0106	1,02642
5	EM10_CEE_FC	dailyone	Own calculation	N	3659	1,46051	8,20884	3,695758	2,94209	1,6922
6	EM10_LatAm_FC	dailyone	Own calculation	N	3659	3,90988	10,8273	6,66816	6,50813	1,25084
7	EM10_Asia2_FC	dailyone	Own calculation	N	3659	1,18258	3,64603	2,440962	2,46442	0,55574
8	EM10_FC4	dailyone	Own calculation	N	3659	2,80921	6,78659	4,368388	4,14065	0,89541
9	USDSWAP_1M	dailyone	Bloomberg	N	3659	0,0726	4,9504	0,7697524	0,2573	0,95459
10	EURSWAP_1M	dailyone	Bloomberg	N	3659	-1,14	2,6898	0,0544397	-0,0754	0,60062
11	JPYOIS_1M	dailyone	Bloomberg	N	3659	-0,108	0,11393	0,0132852	0,05625	0,06258
12	AE_MC	dailyone	Own calculation	N	3659	-0,1561	2,93808	0,3932205	0,29695	0,46981
13	USDDEPO1W	dailyone	Bloomberg	N	3659	0	4,985	0,6870483	0,25	0,85642
14	AE_MC	weeklyone	Own calculation	N	732	-0,1514	2,92825	0,3925503	0,29433	0,46917
15	EM10_FC	weeklyone	Own calculation	N	732	2,4216	6,84683	4,248815	4,01203	1,02814
16	USDDEPO1W	weeklyone	Bloomberg	N	732	0	4,985	0,6834011	0,25	0,85923
17	MA_AE_MC	monthlyone	Own calculation	N	170	-0,151	2,88024	0,4001837	0,29741	0,49604
18	MA_EM10_FC	monthlyone	Own calculation	N	170	2,45837	6,64375	4,257374	4,02508	1,03009
19	MA_USDSWAP_1M	monthlyone	Bloomberg	N	170	0,08666	4,89074	0,7822872	0,25821	0,98787
20	AE_MC	monthlyone	Own calculation	N	170	-0,1528	2,91813	0,4044765	0,29327	0,51125
21	EM10_FC	monthlyone	Own calculation	N	170	2,41261	6,71254	4,240542	4,00465	1,03766
22	USDSWAP_1M	monthlyone	Bloomberg	N	170	0,0859	4,918	0,7966559	0,25685	1,01485
23	QA_AE_MC	quarterlyone	Own calculation	N	57	-0,1488	2,56428	0,3803113	0,28656	0,46061
24	QA_EM10_FC	quarterlyone	Own calculation	N	57	2,51081	6,45692	4,248193	3,96517	1,02639
25	QA_USDSWAP_1M	quarterlyone	Own calculation	N	57	0,09833	4,6369	0,7527076	0,26778	0,94041
26	AE_MC	quarterlyone	Bloomberg	N	57	-0,1526	2,91161	0,3997826	0,28992	0,52468
27	EM10_FC	quarterlyone	Own calculation	N	57	2,41261	6,56159	4,229389	4,01508	1,05731
28	USDSWAP_1M	quarterlyone	Bloomberg	N	57	0,1039	4,8978	0,8128421	0,2539	1,02976
29	CDS	weeklypanel	Bloomberg, Refinitiv	Y	13908	0	3875	135,8658	101,837	213,088
30	DEPO3M	weeklypanel	Bloomberg	Y	13908	-3,32	52	3,718477	2,7785	3,96258
31	CPI_YOY	weeklypanel	Bloomberg	Y	13908	-2,76	1981,09,01	3,700751	3	4,85408
32	POL_RISK	weeklypanel	Bloomberg	Y	13908	10	71	38,71621	39	12,4753
33	VIX_index	weeklypanel	Bloomberg	N	13908	2023,09,14	1966,04,01	19,44178	17,285	8,02643
34	Brent_oil	weeklypanel	Bloomberg	N	13908	21,44	126,65	76,87231	72,82	25,2934
35	S_EV_Fed_Easing_ASP	weeklypanel	Own collection	N	13908	0	0	0	0	0
36	S_EV_Fed_Easing_Other	weeklypanel	Own collection	N	13908	0	0	0	0	0
37	S_EV_Fed_Easing_All	weeklypanel	Own collection	N	13908	0	0	0	0	0
38	S_EV_Fed_Tightening_ASP	weeklypanel	Own collection	N	13908	0	0	0	0	0
39	S_EV_Fed_Tightening_Other	weeklypanel	Own collection	N	13908	0	0	0	0	0

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
40	S_EV_Fed_Tightening_All	weeklypanel	Own collection	N	13908	0	0	0	0	0
41	S_EV_ECB_Easing_ASP	weeklypanel	Own collection	N	13908	0	0	0	0	0
42	S_EV_ECB_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0013661	0	0,03694
43	S_EV_ECB_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0013661	0	0,03694
44	S_EV_ECB_Tightening_ASP	weeklypanel	Own collection	N	13908	0	1	0,0013661	0	0,03694
45	S_EV_ECB_Tightening_Other	weeklypanel	Own collection	N	13908	0	0	0	0	0
46	S_EV_ECB_Tightening_All	weeklypanel	Own collection	N	13908	0	1	0,0013661	0	0,03694
47	S_EV_BOJ_Easing_ASP	weeklypanel	Own collection	N	13908	0	0	0	0	0
48	S_EV_BOJ_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0040984	0	0,06389
49	S_EV_BOJ_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0040984	0	0,06389
50	Stockindex	weeklypanel	Bloomberg	N	13908	0,12738	130076	10163,94	2372,05,01	19410,9
51	FED_up	weeklypanel	Own_calculation	N	13908	0	1	0,2909836	0	0,45423
52	FED_keep	weeklypanel	Own_calculation	N	13908	0	1	0,307377	0	0,46142
53	FED_down	weeklypanel	Own_calculation	N	13908	0	1	0,4016393	0	0,49025
54	ECB_up	weeklypanel	Own_calculation	N	13908	0	1	0,2691257	0	0,44352
55	ECB_keep	weeklypanel	Own_calculation	N	13908	0	1	0,1693989	0	0,37512
56	ECB_down	weeklypanel	Own_calculation	N	13908	0	1	0,5614754	1	0,49622
57	EM10_FC4	weeklypanel	Own_calculation	N	13908	2,84607	6,76795	4,366079	4,13854	0,89604
58	DW_Long_term_yield	weeklypanel	Own_calculation	Y	13908	-2,7261	2,73354	-0,0002052	0	0,18966
59	DW_DEPO3M	weeklypanel	Bloomberg	Y	13908	-33,05	21	-0,0007921	0	0,82745
60	DW_CDS	weeklypanel	Bloomberg, Refinitiv	Y	13908	-3832	875	-0,3289964	0	41,164
61	DW_VIX_index	weeklypanel	Bloomberg	N	13908	0,57337	2,34836	1,011272	0,98644	0,16785
62	DM_CPI	weeklypanel	Bloomberg	Y	13908	-5,1	29	0,0322728	0	0,88637
63	DW_FX_USD	weeklypanel	Bloomberg	Y	13908	0,79096	1,37543	0,9995521	0,99995	0,01454
64	DW_Stockindex	weeklypanel	Bloomberg	Y	13908	0,774	1,18012	1,001677	1,00068	0,02874
65	DW_Citi_Global_Surprise	weeklypanel	Bloomberg	N	13908	-93	59	0,7467547	0,97231	6,1845
66	DW_Citi_Global_Uncerta	weeklypanel	Bloomberg	N	13908	-640,3	3125,01,01	17,45259	2,91502	204,779
67	DW_Brent_oil	weeklypanel	Bloomberg	N	13908	0,74774	1,36823	1,00221	1,00352	0,04963
68	DW_USD_MC	weeklypanel	Own_calculation	N	13908	-0,5537	0,45177	0,0054977	0,00119	0,04696
69	DW_EUR_MC	weeklypanel	Own_calculation	N	13908	-0,3614	0,35969	-0,0009177	-0,0012	0,04
70	DW_JPY_MC	weeklypanel	Own_calculation	N	13908	-0,1261	0,1932	-0,0008175	-0,0006	0,02039
71	DW_AE_MC	weeklypanel	Own_calculation	N	13908	-0,2955	0,3461	0,0022738	0,00048	0,03211
72	DW_USDDEPOON	weeklypanel	Bloomberg	N	13908	-0,805	0,78	0,0054493	0	0,09982
73	DW_USDDEPO1W	weeklypanel	Bloomberg	N	13908	-0,78	0,745	0,0050273	0	0,1134
74	DW_USDLIBOR1M	weeklypanel	Bloomberg	N	13908	-0,6526	0,34043	0,0053605	0,00018	0,04383
75	DW_USFFM1M	weeklypanel	Bloomberg	N	13908	-0,7075	0,7025	0,0056933	0	0,06754
76	DW_GOV3M_USA	weeklypanel	Bloomberg	N	13908	-0,5668	0,361	0,0033411	0	0,06531
77	DW_GOV10Y_USA	weeklypanel	Bloomberg	N	13908	-1,6891	0,522	-5,57E-05	-0,004	0,1272
78	DW_USDSWAP_1M	weeklypanel	Bloomberg	N	13908	-0,5991	0,354	0,0060671	7,00E-04	0,05356
79	DW_Nshadow_US	weeklypanel	Bloomberg	N	13908	-1,37	2023,01,02	0,0065027	0	0,14864

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
80	DW_USDFW_1M 1M	weeklypanel	Bloomberg	N	13908	-0,5907	0,3537	0,0054284	8,00E-04	0,05473
81	DW_USDFW_6M 1M	weeklypanel	Bloomberg	N	13908	-0,7347	0,8389	0,0069807	0,00455	0,10144
82	D30LFED_BS_2	weeklypanel	Bloomberg	N	13908	-0,0652	0,14946	0,0032005	0,00068	0,0134
83	D30LECB_BS_2	weeklypanel	Bloomberg	N	13908	-0,0405	0,05523	0,0033202	0,00236	0,01236
84	D30LBOJ_BS_2	weeklypanel	Bloomberg	N	13908	-0,0593	0,06652	0,003135	0,00346	0,01532
85	WES1_EV_Fed_Easing_ASP	weeklypanel	Own collection	N	13908	0	1	0,0095628	0	0,09732
86	WES1_EV_Fed_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0040984	0	0,06389
87	WES1_EV_Fed_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0122951	0	0,1102
88	WES1_EV_Fed_Tightening_ASP	weeklypanel	Own collection	N	13908	0	1	0,0095628	0	0,09732
89	WES1_EV_Fed_Tightening_Other	weeklypanel	Own collection	N	13908	0	1	0,0068306	0	0,08237
90	WES1_EV_Fed_Tightening_All	weeklypanel	Own collection	N	13908	0	1	0,0136612	0	0,11608
91	WES1_EV_ECB_Easing_ASP	weeklypanel	Own collection	N	13908	0	1	0,0163934	0	0,12699
92	WES1_EV_ECB_Easing_Other	weeklypanel	Own collection	N	13908	0	2	0,0204918	0	0,15102
93	WES1_EV_ECB_Easing_All	weeklypanel	Own collection	N	13908	0	2	0,0368853	0	0,1956
94	WES1_EV_ECB_Tightening_ASP	weeklypanel	Own collection	N	13908	0	1	0,0040984	0	0,06389
95	WES1_EV_ECB_Tightening_Other	weeklypanel	Own collection	N	13908	0	1	0,0027322	0	0,0522
96	WES1_EV_ECB_Tightening_All	weeklypanel	Own collection	N	13908	0	1	0,0068306	0	0,08237
97	WES1_EV_BOJ_Easing_ASP	weeklypanel	Own collection	N	13908	0	1	0,0095628	0	0,09732
98	WES1_EV_BOJ_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0191257	0	0,13697
99	WES1_EV_BOJ_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0286885	0	0,16694
100	WES_EV_Fed_Easing_ASP	weeklypanel	Own collection	N	13908	0	1	0,0095628	0	0,09732
101	WES_EV_Fed_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0040984	0	0,06389
102	WES_EV_Fed_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0122951	0	0,1102
103	WES_EV_Fed_Tightening_ASP	weeklypanel	Own collection	N	13908	0	1	0,0095628	0	0,09732
104	WES_EV_Fed_Tightening_Other	weeklypanel	Own collection	N	13908	0	1	0,0068306	0	0,08237
105	WES_EV_Fed_Tightening_All	weeklypanel	Own collection	N	13908	0	1	0,0136612	0	0,11608
106	WES_EV_ECB_Easing_ASP	weeklypanel	Own collection	N	13908	0	1	0,0163934	0	0,12699
107	WES_EV_ECB_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0191257	0	0,13697
108	WES_EV_ECB_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0355191	0	0,18509
109	WES_EV_ECB_Tightening_ASP	weeklypanel	Own collection	N	13908	0	1	0,0040984	0	0,06389
110	WES_EV_ECB_Tightening_Other	weeklypanel	Own collection	N	13908	0	1	0,0027322	0	0,0522
111	WES_EV_ECB_Tightening_All	weeklypanel	Own collection	N	13908	0	1	0,0068306	0	0,08237
112	WES_EV_BOJ_Easing_ASP	weeklypanel	Own collection	N	13908	0	1	0,0095628	0	0,09732
113	WES_EV_BOJ_Easing_Other	weeklypanel	Own collection	N	13908	0	1	0,0191257	0	0,13697
114	WES_EV_BOJ_Easing_All	weeklypanel	Own collection	N	13908	0	1	0,0286885	0	0,16694
115	TOP2_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,0204918	0	0,14168
116	BOTTOM2_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,0204918	0	0,14168
117	TOP2_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,0204918	0	0,14168
118	BOTTOM2_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,0204918	0	0,14168

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
119	TOP2_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,0122951	0	0,1102
120	BOTTOM2_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,0204918	0	0,14168
121	TOP2E_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,0136612	0	0,11608
122	TOP2E_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,0122951	0	0,1102
123	TOP2E_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
124	TOP2E_DW_ALL_MC	weeklypanel	Own calculation	N	13908	0	1	0,0081967	0	0,09017
125	BOTTOM2E_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,0150273	0	0,12167
126	BOTTOM2E_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,0163934	0	0,12699
127	BOTTOM2E_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,0136612	0	0,11608
128	BOTTOM2E_DW_ALL_MC	weeklypanel	Own calculation	N	13908	0	1	0,0081967	0	0,09017
129	TOP1_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
130	BOTTOM1_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
131	TOP1_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
132	BOTTOM1_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
133	TOP1_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,0122951	0	0,1102
134	BOTTOM1_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
135	TOP1E_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,0068306	0	0,08237
136	TOP1E_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,0054645	0	0,07372
137	TOP1E_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,010929	0	0,10397
138	TOP1E_DW_ALL_MC	weeklypanel	Own calculation	N	13908	0	1	0,0054645	0	0,07372
139	BOTTOM1E_DW_USD_MC	weeklypanel	Own calculation	N	13908	0	1	0,0068306	0	0,08237
140	BOTTOM1E_DW_EUR_MC	weeklypanel	Own calculation	N	13908	0	1	0,0068306	0	0,08237
141	BOTTOM1E_DW_JPY_MC	weeklypanel	Own calculation	N	13908	0	1	0,0054645	0	0,07372
142	BOTTOM1E_DW_ALL_MC	weeklypanel	Own calculation	N	13908	0	1	0,0068306	0	0,08237
143	NORMDCDS	weeklypanel	Bloomberg, Refinitiv	Y	13908	-1,5789	1	0,1824627	0,18387	0,28308
144	NORMDDEPO3M	weeklypanel	Bloomberg	Y	13908	-0,3538	1	0,2968618	0,24959	0,22255
145	NORMDVIX_index	weeklypanel	Bloomberg	N	13908	0	0,77362	0,1400649	0,11074	0,10913
146	NORMDBrent_oil	weeklypanel	Bloomberg	N	13908	0,01942	0,98776	0,5296117	0,49231	0,2328
147	NORMDCiti_Global_Surprise	weeklypanel	Bloomberg	N	13908	0,00557	1	0,4899723	0,47539	0,1445
148	NORMDCiti_Global_Economic_Policy_Uncerta	weeklypanel	Bloomberg	N	13908	0	1	0,2716468	0,20424	0,21173
149	NORMDLong_term_yield	weeklypanel	Bloomberg	Y	13908	0	1	0,3787989	0,35353	0,22422
150	NORMDAE_MC	weeklypanel	Own_calculation	N	13908	-1,0969	4,78084	-0,058673	-0,2461	0,89485
151	NORMDStockindex	weeklypanel	Bloomberg	Y	13908	0	1	0,5166554	0,51703	0,2477
152	NORMDFX_USD	weeklypanel	Bloomberg	Y	13908	0	1	0,4991518	0,48367	0,2604
153	NORMDUSD_MC	weeklypanel	Own_calculation	N	13908	0	0,99916	0,1395116	0,02925	0,20188
154	NORMDEUR_MC	weeklypanel	Own_calculation	N	13908	0,00044	0,55292	0,1186003	0,0927	0,10762
155	NORMDJPY_MC	weeklypanel	Own_calculation	N	13908	0,05847	0,68397	0,3500633	0,33004	0,09568
156	CPI_YOY	monthly_GMM	Bloomberg	N	2835	-2,76	22,39	3,073605	2,83	2,71332
157	VIX_index	monthly_GMM	Bloomberg	N	2835	9,51	59,89	19,16304	16,52	8,70713

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
158	Long_term_yield	monthly_GMM	Bloomberg	N	2835	0	17,914	4,483708	3,902	2,77947
159	USD_MC	monthly_GMM	Own_calculation	N	2835	0,13681	2,45866	0,6701671	0,25081	0,72997
160	EUR_MC	monthly_GMM	Own_calculation	N	2835	-0,4929	3,98972	0,1919818	0,11099	0,69968
161	JPY_MC	monthly_GMM	Own_calculation	N	2835	-0,1423	0,84455	0,1152355	0,11976	0,17666
162	AE_MC	monthly_GMM	Own_calculation	N	2835	0,05541	2,30741	0,4255922	0,33994	0,36205
163	DW_Long_term_yield	weeklypanel_Asia	Bloomberg	Y	5856	-1,525	1,35	-0,0004491	0	0,12901
164	DW_USD_MC	weeklypanel_Asia	Own_calculation	N	5856	-0,5537	0,45177	0,0054977	0,00119	0,04696
165	DW_EUR_MC	weeklypanel_Asia	Own_calculation	N	5856	-0,3614	0,35969	-0,0009177	-0,0012	0,04
166	DW_JPY_MC	weeklypanel_Asia	Own_calculation	N	5856	-0,1261	0,1932	-0,0008175	-0,0006	0,02039
167	DW_DEPO3M	weeklypanel_Asia	Bloomberg	Y	5856	-9,9344	9,5951	-0,0004886	0	0,48865
168	DW_FX_USD	weeklypanel_Asia	Bloomberg	Y	5856	0,91467	1,0879	0,9999304	1	0,0084
169	DW_VIX_index	weeklypanel_Asia	Bloomberg	N	5856	0,57337	2,34836	1,011272	0,98644	0,16785
170	DW_Long_term_yield	weeklypanel_CEE	Bloomberg	Y	4392	-1,666	2023,02,02	-0,0012694	-0,004	0,2037
171	DW_USD_MC	weeklypanel_CEE	Own_calculation	N	4392	-0,5537	0,45177	0,0054977	0,00119	0,04696
172	DW_EUR_MC	weeklypanel_CEE	Own_calculation	N	4392	-0,3614	0,35969	-0,0009177	-0,0012	0,04
173	DW_JPY_MC	weeklypanel_CEE	Own_calculation	N	4392	-0,1261	0,1932	-0,0008175	-0,0006	0,02039
174	DW_DEPO3M	weeklypanel_CEE	Bloomberg	Y	4392	-33,05	21	0,0006993	0	1,2425
175	DW_FX_USD	weeklypanel_CEE	Bloomberg	Y	4392	0,79096	1,37543	0,9991209	0,99962	0,01837
176	DW_VIX_index	weeklypanel_CEE	Bloomberg	N	4392	0,57337	2,34836	1,011272	0,98644	0,16786
177	DW_Long_term_yield	weeklypanel_LatAm	Bloomberg	Y	3660	-2,7261	2,73354	0,0014623	0	0,24552
178	DW_USD_MC	weeklypanel_LatAm	Own_calculation	N	3660	-0,5537	0,45177	0,0054977	0,00119	0,04696
179	DW_EUR_MC	weeklypanel_LatAm	Own_calculation	N	3660	-0,3614	0,35969	-0,0009177	-0,0012	0,04
180	DW_JPY_MC	weeklypanel_LatAm	Own_calculation	N	3660	-0,1261	0,1932	-0,0008175	-0,0006	0,02039
181	DW_DEPO3M	weeklypanel_LatAm	Bloomberg	Y	3660	-11,21	7,765	-0,0031075	0	0,58457
182	DW_FX_USD	weeklypanel_LatAm	Bloomberg	Y	3660	0,89239	1,13316	0,9994642	0,99963	0,01689
183	DW_VIX_index	weeklypanel_LatAm	Bloomberg	Y	3660	0,57337	2,34836	1,011272	0,98644	0,16786
184	Long_term_yield_YAVG	vulnerabilitypanel1	Bloomberg	Y	252	0,26361	13,7322	4,537558	3,88284	2,74898
185	POL_RISK	vulnerabilitypanel1	Bloomberg	Y	252	10	68	37,8254	39	11,9258
186	Exchange_Rate_Stability_Index	vulnerabilitypanel1	Other	Y	252	0,09621	1	0,3882199	0,32841	0,212
187	Monetary_Independence_Index	vulnerabilitypanel1	Other	Y	252	0,01712	0,93837	0,4109329	0,44956	0,20042
188	Financial_Openness_Index	vulnerabilitypanel1	Other	Y	252	0,16435	1	0,6663856	0,70016	0,31643
189	GDP_YOY	vulnerabilitypanel1	Bloomberg	Y	252	-7	2023,05,15	3,311889	2023,03,04	3,35922
190	GDP_PCAP_USD	vulnerabilitypanel1	Bloomberg	Y	252	2464,96	72794,9	15630,51	10644,7	13982,8
191	CDSY	vulnerabilitypanel1	Bloomberg, Refinitiv	Y	252	16,3442	477,289	137,289	116,174	89,3174
192	FD	vulnerabilitypanel1	Other	Y	252	0,25853	0,84944	0,5217525	0,47832	0,16186
193	CPI_YOY_Y	vulnerabilitypanel1	Bloomberg	Y	252	-1,7059	59,0276	3,69617	3,02695	4,57974
194	BUDGET_Y	vulnerabilitypanel1	Bloomberg	Y	252	-9,7387	5,82447	-2,127632	-2,2177	2,71119
195	XTR_DEBT_Y	vulnerabilitypanel1	Bloomberg	Y	252	0,1	118,152	43,07935	1939,08,01	23,374
196	CA_GDP_Y	vulnerabilitypanel1	Bloomberg	Y	252	-18,42	23,5241	0,8529768	-0,5106	5,91389
197	FX_regY	vulnerabilitypanel1	Bloomberg	Y	252	0,02367	95,2493	8,322133	0,36332	18,4749
198	FX_USDY	vulnerabilitypanel1	Bloomberg	Y	252	0,00271	0,80049	0,2249808	0,14974	0,21052

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
199	FX_DayhighY	vulnerabilitypanel1	Bloomberg	Y	252	0,00325	0,8337	0,2398458	0,15815	0,22291
200	FX_DaylowY	vulnerabilitypanel1	Bloomberg	Y	252	0,00222	0,7776	0,2079046	0,14262	0,19702
201	Volat_10DY	vulnerabilitypanel1	Bloomberg	Y	252	0,12252	22,4638	8,50073	7,98267	4,83007
202	Volat_imp1MY	vulnerabilitypanel1	Bloomberg	Y	252	0	25,3662	9,166337	8,75008	5,50698
203	FX_JpmReefY	vulnerabilitypanel1	Bloomberg	Y	252	45,1604	127,9	95,91158	98,4551	13,3322
204	REERY	vulnerabilitypanel1	Bloomberg	Y	252	45,38	129,081	96,76381	99,1726	13,2063
205	FX_DayhighperFX_Daylow	vulnerabilitypanel1	Bloomberg	Y	252	0	0,0449	0,0067277	0,00597	0,00538
206	FX_IntradayChangeYAVG	vulnerabilitypanel1	Bloomberg	Y	252	0	0,0233	0,0083787	0,00802	0,00466
207	Stockindex_dailychg	vulnerabilitypanel1	Bloomberg	Y	252	-0,0019	0,00465	0,00024	7,18E-05	0,00083
208	Stockindex_dailychg_YAVG	vulnerabilitypanel1	Bloomberg	Y	252	-0,0016	0,0026	0,0002562	0,00013	0,00065
209	YAVG_DEPO3M	vulnerabilitypanel1	Bloomberg	Y	252	-0,3894	27,5642	3,815408	2,86487	3,81947
210	STDEV_DEPO3M	vulnerabilitypanel1	Bloomberg	Y	252	0	11,2766	0,6675883	0,31928	1,06982
211	NYCHG_DEPO3M	vulnerabilitypanel1	Bloomberg	Y	252	0	108,27	1,697205	0,6036	7,27501
212	YAVG_LYLD...54	vulnerabilitypanel1	Bloomberg	Y	252	0,26361	13,7322	4,537558	3,88284	2,74898
213	STDEV_LYLD	vulnerabilitypanel1	Bloomberg	Y	252	0,07191	1,8276	0,4473934	0,33637	0,32718
214	NORMY_LYLD	vulnerabilitypanel1	Bloomberg	Y	252	-1,4775	3,03611	-0,0452181	-0,2646	0,92124
215	NYCHG_LYLD	vulnerabilitypanel1	Bloomberg	Y	252	0,09321	2,5407	0,4531661	0,359	0,32474
216	MIN_LYLD	vulnerabilitypanel1	Bloomberg	Y	252	0,00429	11,855	3,749184	3,2065	2,4729
217	MAX_LYLD	vulnerabilitypanel1	Bloomberg	Y	252	0,561	16,839	5,461	4,4805	3,25242
218	YAVG_LYLD...60	vulnerabilitypanel1	Bloomberg	Y	252	0,26361	13,7322	4,537558	3,88284	2,74898
219	MAX_DEPO3M	vulnerabilitypanel1	Bloomberg	Y	252	-0,12	59	5,464953	3,95	6,16724
220	MIN_DEPO3M	vulnerabilitypanel1	Bloomberg	Y	252	-4,77	15,85	2,53108	1,975	2,80504
221	AVG_DEPO3M	vulnerabilitypanel1	Bloomberg	Y	252	-0,3894	27,5642	3,815408	2,86487	3,81947
222	YAVG_FX_USD	vulnerabilitypanel1	Bloomberg	Y	252	0,00271	0,80061	0,2249731	0,14971	0,21052
223	MIN_FX_USD	vulnerabilitypanel1	Bloomberg	Y	252	0,00225	0,779	0,2088228	0,14339	0,19763
224	MAX_FX_USD	vulnerabilitypanel1	Bloomberg	Y	252	0,00324	0,8329	0,2390126	0,15806	0,22227
225	STDEV_FX_USD	vulnerabilitypanel1	Bloomberg	Y	252	3,99E-05	0,05637	0,0077993	0,00423	0,00915
226	YEAR_MAXMINCHG_FX	vulnerabilitypanel1	Bloomberg	Y	252	0,00124	1,35642	0,1613841	0,13695	0,1356
227	YEAR_MAXMINCHG_FX_SAMPNORM	vulnerabilitypanel1	Bloomberg	Y	252	-1,1321	9,5073	0,1251922	-0,0666	1,0646
228	YAVG_DMAXpDMIN_FX	vulnerabilitypanel1	Bloomberg	Y	252	1	1,02332	1,008382	1,00801	0,00467
229	MIN_FX_JpmReef	vulnerabilitypanel1	Bloomberg	Y	252	28,5439	124,304	90,9645	94,035	14,8166
230	MAX_FX_JpmReef	vulnerabilitypanel1	Bloomberg	Y	252	48,3671	133,283	100,255	102	12,8929
231	STDEV_FX_JpmReef	vulnerabilitypanel1	Bloomberg	Y	252	0,3338	7,93668	2,248365	1,91237	1,37139
232	AVG_FX_JpmReef	vulnerabilitypanel1	Bloomberg	Y	252	45,2003	127,912	95,91351	98,4655	13,3328
233	NYCHG_FX_JpmReef	vulnerabilitypanel1	Bloomberg	Y	252	0,01577	0,58987	0,1028176	0,08417	0,07276
234	SAMPNORM_YCHG_3MDEPO	vulnerabilitypanel1	Bloomberg	Y	252	-72,406	16,0466	0,4451452	0,38693	4,97641
235	SAMPNORM_YCHG_LYD	vulnerabilitypanel1	Bloomberg	Y	252	0,22515	6,137	1,094611	0,86715	0,78441
236	YAVG_VOLATFX10D	vulnerabilitypanel1	Bloomberg	Y	252	0,12257	22,4826	8,505548	7,99596	4,83687
237	YAVG_VOLATFXIMP1M	vulnerabilitypanel1	Bloomberg	Y	252	0	25,3033	9,161492	8,75609	5,49995
238	DYAVG_3M	vulnerabilitypanel1	Bloomberg	Y	252	-3,7551	4,52674	-0,0941085	-0,1718	1,14981

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
239	DYAVG_LYD	vulnerabilitypanel1	Bloomberg	Y	252	-8,7334	8,61959	-0,1116225	-0,0667	1,98154
240	DYFXpc	vulnerabilitypanel1	Bloomberg	Y	252	-0,1212	0,06729	-0,0056132	-0,0005	0,0229
241	LGDP_PCAP_USD	vulnerabilitypanel1	Bloomberg	Y	252	3,39181	4,8621	4,073483	4,02711	0,30514
242	LXTR_DEBT_Y	vulnerabilitypanel1	Bloomberg	Y	252	-1	2,07244	1,537726	1,59988	0,41597
243	DY_CPI_YOY_Y	vulnerabilitypanel1	Bloomberg	Y	252	-6,9514	42,6045	0,3105236	-0,041	3,51745
244	DY_FX	vulnerabilitypanel1	Bloomberg	Y	252	0,00163	1,65982	0,172933	0,14442	0,15138
245	DY_GDP_YOY	vulnerabilitypanel1	Bloomberg	Y	252	-15,3	2023,07,17	0,2014603	-0,2	4,21054
246	SENS_INT	vulnerabilitypanel1	Own_calculation	Y	252	3,59589	632,877	100	61,1301	105,571
247	SENS_INT_NORM	vulnerabilitypanel1	Own_calculation	Y	252	0	396,71	100	75,0532	83,6421
248	SENS_INT_FXC	vulnerabilitypanel1	Own_calculation	Y	252	0	720,416	100	65,4924	109,348
249	SENS_FX	vulnerabilitypanel1	Own_calculation	Y	252	0	822,419	100	71,5147	105,929
250	SENS_FX_NORM	vulnerabilitypanel1	Own_calculation	Y	252	1,52894	532,071	100	81,0339	80,4248
251	CDS	dailypanel0	Bloomberg	Y	78225	0	3875	140,9756	103,587	209,869
252	DEPO3M	dailypanel0	Bloomberg	Y	78225	-4,77	59	3,529715	2,58	3,93322
253	CPI_YOY	dailypanel0	Bloomberg	Y	78225	-2,76	1981,09,01	3,545373	2,87	4,70592
254	POL_RISK	dailypanel0	Bloomberg	Y	78225	10	71	38,15322	39	12,2496
255	VIX_index	dailypanel0	Bloomberg	N	78225	2023,09,14	82,69	20,28842	17,55	9,62061
256	FED_BS_1	dailypanel0	Bloomberg	N	78225	1,506	8,9655	4,442856	4,258	1,98754
257	FED_BS_2	dailypanel0	Bloomberg	N	78225	1504499	8965487	4442085	4258030	1988306
258	Long_term_yield	dailypanel0	Bloomberg	Y	78225	0	20,955	4,415504	3,8196	2,86963
259	DWFX_USD	dailypanel0	Bloomberg	Y	78225	0,7603	1,44043	0,9996312	1	0,01328
260	USD_MC	dailypanel0	Own_calculation	N	78225	0,12174	4,47216	0,740031	0,25521	0,87945
261	EUR_MC	dailypanel0	Own_calculation	N	78225	-0,5929	4,75251	0,1029017	-0,0923	0,7372
262	JPY_MC	dailypanel0	Own_calculation	N	78225	-0,4568	1,06344	0,0886558	0,05466	0,17329
263	AE_MC	dailypanel0	Own_calculation	N	78225	-0,1561	3,30613	0,4232924	0,31365	0,52396
264	EM10_FC	dailypanel0	Own_calculation	N	78225	2,41261	8,16049	4,301097	4,03023	1,0843
265	EM10_CEE_FC	dailypanel0	Own_calculation	N	78225	1,46051	8,30951	3,760466	3,01514	1,74553
266	EM10_LatAm_FC	dailypanel0	Own_calculation	N	78225	3,90988	11,636	6,729087	6,52621	1,32379
267	EM10_Asia2_FC	dailypanel0	Own_calculation	N	78225	1,18258	3,8766	2,454497	2,47519	0,56266
268	GOV3M_USA	dailypanel0	Bloomberg	N	78225	0,20488	4,81875	1,019734	0,55613	0,96796
269	GOV5Y_USA	dailypanel0	Bloomberg	N	78225	0,1902	4,2424	1,692661	1,6311	0,7409
270	GOV10Y_USA	dailypanel0	Bloomberg	N	78225	-0,978	4,0772	1,980566	2,2101	1,18085
271	USDDEPOON	dailypanel0	Bloomberg	N	78225	0,065	4,35	0,6661087	0,205	0,84083
272	USDDEPO1W	dailypanel0	Bloomberg	N	78225	0	5	0,7049046	0,255	0,87865
273	USDLIBOR1M	dailypanel0	Bloomberg	N	78225	0,07263	4,5875	0,7475182	0,25625	0,9046
274	USFFM1M	dailypanel0	Bloomberg	N	78225	0,0475	4,3325	0,612274	0,1625	0,84249
275	FED_up	dailypanel0	Own_collection	N	78225	0	1	0,286443	0	0,4521
276	FED_keep	dailypanel0	Own_collection	N	78225	0	1	0,3009396	0	0,45867
277	FED_down	dailypanel0	Own_collection	N	78225	0	1	0,4126174	0	0,49231
278	ECB_up	dailypanel0	Own_collection	N	78225	0	1	0,264698	0	0,44118
279	ECB_keep	dailypanel0	Own_collection	N	78225	0	1	0,166443	0	0,37248
280	ECB_down	dailypanel0	Own_collection	N	78225	0	1	0,5688591	1	0,49524

ID	variable	dataset	Source	Panel	obs	min	max	mean	median	std
281	EM10_FC4	dailypanel0	Own_calculation	N	78225	2,80921	8,25565	4,415418	4,15812	0,95647
282	USDFW_1M1M	dailypanel0	Bloomberg	N	78225	0,0696	4,9374	0,7940813	0,2635	0,97818
283	USDFW_6M1M	dailypanel0	Bloomberg	N	78225	-0,4352	5,5542	0,9284724	0,4693	1,06295
284	USDFW_1Y1M	dailypanel0	Bloomberg	N	78225	-0,2026	5,2807	1,107961	0,7594	1,02792
285	EURFW_1M1M	dailypanel0	Bloomberg	N	78225	-1,1877	6,3435	0,1764174	-0,0272	0,87034
286	EURFW_6M1M	dailypanel0	Bloomberg	N	78225	-0,7542	4,1805	0,2270449	0,0093	0,83131
287	EURFW_1Y1M	dailypanel0	Bloomberg	N	78225	-0,6876	3,863	0,343484	0,0601	0,91408
288	JPYFW_1M1M	dailypanel0	Bloomberg	N	78225	-0,18	0,4981	0,0181792	0,0558	0,08097
289	JPYFW_6M1M	dailypanel0	Bloomberg	N	78225	-0,2985	0,682	0,0112221	0,0463	0,10241
290	JPYFW_1Y1M	dailypanel0	Bloomberg	N	78225	-0,3602	0,552	0,0157565	0,0513	0,11671
291	USDSWAP_1M	dailypanel0	Bloomberg	N	78225	0,0726	4,9504	0,7937297	0,2635	0,98121
292	EURSWAP_1M	dailypanel0	Bloomberg	N	78225	-1,14	5,3702	0,1237752	-0,062	0,79604
293	JPYOIS_1M	dailypanel0	Bloomberg	N	78225	-0,108	0,45642	0,0180944	0,05773	0,07316
294	JPM_HY_EM_rate1...134 (JFORHYRF Index)	dailypanel0	Bloomberg	N	78225	0	10,055	7,067725	7,122	1,78192

E) Summary of time series models

No. Of model	Pair	Frequency	X	Y	Cointegration test	Model Type	Specification	Test for validity	Value	IRF/multipliers
1	I.	Daily	AE_MC	EM10_FC	32.73***	ARDL	p=1, q=10, type=1	F-test	3.51*	30
2	I.	Daily	AE_MC	EM10_FC	32.73***	ARDL	p=1, q=20 type=1	F-test	6.02***	30
19	II.	Daily	USDDEPO1W	HY_RATE1	20.35**	ARDL	=1, q=30, type=non	F-test	3.39*	30
22	Blend	Daily	AE_MC	HY_RATE1	-	ARDL	p=1, q=20, type=1	F-test	6.75***	30
23	Blend	Daily	AE_MC	HY_RATE1	-	ARDL	p=1, q=10, type=1	F-test	5.05**	30
24	Blend	Daily	USDDEPO1W	EM10_FC	-	ARDL	p=1, q=25 type=1	F-test	3.33*	30
25	Blend	Daily	AE_MC	EM10_FC	-	ARDL	p=1, q=20 type=3	F-test	6.53**	30
26	Blend	Daily	AE_MC	EM10_FC	-	ARDL	p=1, q=30 type=3	F-test	11.78***	30
27	Blend	Daily	USDDEPO1W	HY_RATE1	-	ARDL	p=1, q=30 type=3	F-test	7.10**	30
28	Blend	Daily	USDDEPO1W	HY_RATE1	-	ARDL	p=1, q=20, type=1	F-test	5.25**	30
7	V.	Monthly	MA_AE_MC	MA_EM10_FC	16.64	VAR	p=2, type=none	Portmanteau	42.61	12
8	VI.	Monthly	MA_USDSWAP_1M	MA_HY_RATE1	18.58*	ARDL	p=1, q=8, type=1	F-test	3.91*	8
9	VI.	Monthly	MA_USDSWAP_1M	MA_HY_RATE1	18.58*	ARDL	p=1, q=4, type=1	F-test	4.11**	12
10	VII.	Monthly	AE_MC	EM10_FC	16.56	VAR	p=5, type=none	Portmanteau	30.17	12
11	VII.	Monthly	AE_MC	EM10_FC	16.56	diff OLS	without constant	F-statistic	6.34**	const
12	VIII.	Monthly	USDSWAP_1M	HY_RATE1	16.64	VAR	p=9, type=none	Portmanteau	19.95	12
13	VIII.	Monthly	USDSWAP_1M	HY_RATE1	16.64	diff OLS	without constant	F-statistic	23.06***	const
3	XI.	Quarterly	AE_MC	EM10_FC	16.16	VAR	p=4, type=none	Portmanteau	27.21	10
14	IX.	Quarterly	QA_AE_MC	QA_EM10_FC	12.66	VAR	p=4, type=none	Portmanteau	40.08	4
15	IX.	Quarterly	QA_AE_MC	QA_EM10_FC	12.66	diff OLS	without constant	F-statistic	24.04***	const
16	X.	Quarterly	QA_USDSWAP_1M	QA_HY_RATE1	17.45	VAR	p=1, type=none	Portmanteau	38.35	4
17	X.	Quarterly	QA_USDSWAP_1M	QA_HY_RATE1	17.45	diff OLS	without constant	F-statistic	15.24***	const
18	XII.	Quarterly	USDSWAP_1M	HY_RATE1	18.81*	ARDL	p=1, q=4, type=3	F-test	9.97***	4
4	III.	Weekly	AE_MC	EM10_FC	17.49	ARDL	p=1, q=12, type=1	F-test	6.13***	15
5	IV.	Weekly	USDDEPO1W	HY_RATE1	33.38***	ARDL	p=1, q=12, type=1	F-test	4.87***	15
6	IV.	Weekly	USDDEPO1W	HY_RATE1	33.38***	ARDL	p=1, q=8, type=1	F-test	4.61**	15
20	III.	Weekly	AE_MC	EM10_FC	17.49	ARDL	p=1, q=24, type=3	F-test	7.87***	24
21	Blend	Weekly	AE_MC	HY_RATE1	-	ARDL	p=1, q=24, type=3	F-test	8.29***	15
29	Blend	Weekly	USDDEPO1W	HY_RATE1	-	ARDL	p=1, q=8, type=1	F-test	4.99**	15
30	Blend	Weekly	USDDEPO1W	HY_RATE1	-	ARDL	p=1, q=16, type=1	F-test	6.40***	15
31	Blend	Weekly	USDDEPO1W	HY_RATE1	-	ARDL	p=1, q=16, type=3	F-test	12.52***	15
32	Blend	Weekly	USDDEPO1W	HY_RATE1	-	ARDL	p=1, q=8, type=3	F-test	8.06***	15
33	Blend	Monthly	MA_AE_MC	MA_HY_RATE1		ARDL	p=1, q=12, type=1	F-test	5.46**	12
34	Blend	Monthly	MA_AE_MC	MA_HY_RATE1		ARDL	p=1, q=6, type=1	F-test	3.62*	12
35	Blend	Monthly	MA_USDSWAP_1M	MA_EM10_FC		ARDL	p=1, q=6, type=3	F-test	5.31*	12
36	Blend	Monthly	MA_USDSWAP_1M	MA_EM10_FC		ARDL	p=1, q=4, type=3	F-test	7.15**	12
37	Blend	Quarterly	QA_AE_MC	JPM_HY_EM_rate1		VAR	p=4, type=const	Portmanteau	44.76	4
38	Blend	Quarterly	QA_AE_MC	JPM_HY_EM_rate1		VAR	p=2, type=const	Portmanteau	37.82	4
39	Blend	Quarterly	QA_USDSWAP_1M	QA_EM10_FC		VAR	p=1, type=const	Portmanteau	38.48	4
40	Blend	Quarterly	QA_USDSWAP_1M	QA_EM10_FC		VAR	p=1, type=none	Portmanteau	35.43	4

F) Event set for the event study analysis

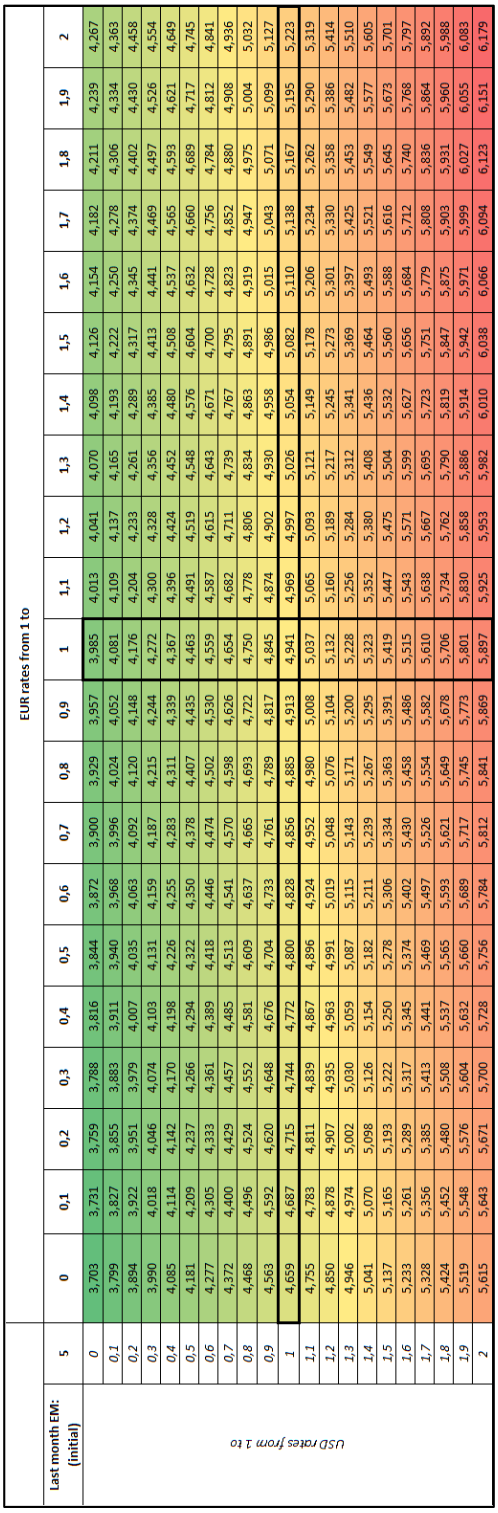
1	2008.10.15	ECB	Easing	Other	S_EV_ECB_Easing_Other
75	2008.10.29	Fed	Easing	Other	S_EV_Fed_Easing_Other
23	2008.11.06	ECB	Easing	Other	S_EV_ECB_Easing_Other
76	2008.11.25	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
77	2008.12.01	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
36	2008.12.02	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
24	2008.12.04	ECB	Easing	Other	S_EV_ECB_Easing_Other
78	2008.12.16	Fed	Easing	Other	S_EV_Fed_Easing_Other
37	2008.12.19	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
25	2009.01.15	ECB	Easing	Other	S_EV_ECB_Easing_Other
38	2009.01.22	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
79	2009.01.28	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
43	2009.02.01	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
39	2009.02.19	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
26	2009.03.05	ECB	Easing	Other	S_EV_ECB_Easing_Other
40	2009.03.18	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
80	2009.03.18	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
27	2009.04.02	ECB	Easing	Other	S_EV_ECB_Easing_Other
2	2009.05.07	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
41	2009.07.15	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
42	2009.10.30	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
44	2010.03.17	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
3	2010.05.10	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
45	2010.05.21	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
4	2010.06.30	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
81	2010.08.10	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
46	2010.08.30	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
47	2010.10.05	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
82	2010.11.03	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
83	2010.12.15	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
48	2011.03.14	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP

28	2011.04.07	ECB	Tightening	Other	S_EV_ECB_Tightening_Other
49	2011.06.14	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
29	2011.07.07	ECB	Tightening	Other	S_EV_ECB_Tightening_Other
84	2011.08.09	Fed	Easing	Other	S_EV_Fed_Easing_Other
50	2011.08.14	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
5	2011.10.06	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
51	2011.10.27	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
30	2011.11.03	ECB	Easing	Other	S_EV_ECB_Easing_Other
31	2011.11.04	ECB	Easing	Other	S_EV_ECB_Easing_Other
6	2011.12.08	ECB	Easing	Other	S_EV_ECB_Easing_Other
52	2012.02.14	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
53	2012.03.13	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
54	2012.04.27	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
85	2012.06.20	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
32	2012.07.05	ECB	Easing	Other	S_EV_ECB_Easing_Other
7	2012.07.11	ECB	Easing	Other	S_EV_ECB_Easing_Other
55	2012.07.12	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
8	2012.07.26	ECB	Easing	Other	S_EV_ECB_Easing_Other
9	2012.09.06	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
86	2012.09.13	Fed	Easing	Other	S_EV_Fed_Easing_Other
87	2012.09.13	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
56	2012.09.19	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
57	2012.10.30	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
88	2012.12.12	Fed	Easing	Other	S_EV_Fed_Easing_Other
58	2012.12.20	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
59	2013.01.22	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
60	2013.03.20	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
61	2013.04.04	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
33	2013.05.02	ECB	Easing	Other	S_EV_ECB_Easing_Other
89	2013.05.22	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
90	2013.06.19	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
10	2013.07.04	ECB	Easing	Other	S_EV_ECB_Easing_Other
62	2013.10.31	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
34	2013.11.07	ECB	Easing	Other	S_EV_ECB_Easing_Other

91	2013.12.18	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
92	2014.01.29	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
11	2014.06.05	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
12	2014.09.04	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
93	2014.10.29	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
74	2014.10.31	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
63	2015.04.30	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
13	2015.12.03	ECB	Easing	Other	S_EV_ECB_Easing_Other
94	2015.12.16	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
95	2015.12.16	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
64	2016.01.29	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
14	2016.03.10	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
35	2016.03.16	ECB	Easing	Other	S_EV_ECB_Easing_Other
65	2016.07.29	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
66	2016.09.21	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
15	2016.12.08	ECB	Tightening	ASP	S_EV_ECB_Tightening_ASP
96	2016.12.14	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
97	2017.03.15	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
98	2017.06.14	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
99	2017.06.14	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
67	2017.07.20	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
16	2017.10.06	ECB	Tightening	ASP	S_EV_ECB_Tightening_ASP
100	2017.12.13	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
101	2018.03.21	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
68	2018.04.09	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
69	2018.04.27	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
102	2018.06.13	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
17	2018.06.14	ECB	Tightening	ASP	S_EV_ECB_Tightening_ASP
70	2018.07.31	BOJ	Easing	Other	S_EV_BOJ_Easing_Other
103	2018.09.26	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
104	2018.12.19	Fed	Tightening	Other	S_EV_Fed_Tightening_Other
105	2019.01.30	Fed	Easing	Other	S_EV_Fed_Easing_Other
106	2019.01.30	Fed	Tightening	ASP	S_EV_Fed_Tightening_ASP
107	2019.07.31	Fed	Easing	Other	S_EV_Fed_Easing_Other

18	2019.09.12	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
108	2019.09.18	Fed	Easing	Other	S_EV_Fed_Easing_Other
109	2019.10.30	Fed	Easing	Other	S_EV_Fed_Easing_Other
110	2020.03.03	Fed	Easing	Other	S_EV_Fed_Easing_Other
111	2020.03.15	Fed	Easing	Other	S_EV_Fed_Easing_Other
71	2020.03.16	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
19	2020.03.18	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
112	2020.03.18	Fed	Easing	Other	S_EV_Fed_Easing_Other
113	2020.03.23	Fed	Easing	ASP	S_EV_Fed_Easing_ASP
114	2020.04.19	Fed	Easing	Other	S_EV_Fed_Easing_Other
72	2020.04.27	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP
20	2020.04.30	ECB	Easing	Other	S_EV_ECB_Easing_Other
21	2020.06.04	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
115	2020.11.30	Fed	Easing	Other	S_EV_Fed_Easing_Other
22	2020.12.10	ECB	Easing	ASP	S_EV_ECB_Easing_ASP
73	2020.12.18	BOJ	Easing	ASP	S_EV_BOJ_Easing_ASP

G) GMM table



Last month EM: (initial)	5	0	0,1	0,2	0,3	0,4	0,5	0,6	0,7	0,8	0,9	1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	2
USD rates from 1 to	0	3,703	3,731	3,759	3,788	3,816	3,844	3,872	3,900	3,929	3,957	3,985	4,013	4,041	4,070	4,098	4,126	4,154	4,182	4,211	4,239	4,267
	0,1	3,799	3,827	3,855	3,883	3,911	3,940	3,968	3,996	4,024	4,052	4,081	4,109	4,137	4,165	4,193	4,222	4,250	4,278	4,306	4,334	4,363
	0,2	3,894	3,922	3,951	3,979	4,007	4,035	4,063	4,092	4,120	4,148	4,176	4,204	4,233	4,261	4,289	4,317	4,345	4,374	4,402	4,430	4,458
	0,3	3,990	4,018	4,046	4,074	4,103	4,131	4,159	4,187	4,215	4,244	4,272	4,300	4,328	4,356	4,385	4,413	4,441	4,469	4,497	4,526	4,554
	0,4	4,085	4,114	4,142	4,170	4,198	4,226	4,255	4,283	4,311	4,339	4,367	4,396	4,424	4,452	4,480	4,508	4,537	4,565	4,593	4,621	4,649
	0,5	4,181	4,209	4,237	4,266	4,294	4,322	4,350	4,378	4,407	4,435	4,463	4,491	4,519	4,548	4,576	4,604	4,632	4,660	4,689	4,717	4,745
	0,6	4,277	4,305	4,333	4,361	4,389	4,418	4,446	4,474	4,502	4,530	4,559	4,587	4,615	4,643	4,671	4,700	4,728	4,756	4,784	4,812	4,841
	0,7	4,372	4,400	4,429	4,457	4,485	4,513	4,541	4,570	4,598	4,626	4,654	4,682	4,711	4,739	4,767	4,795	4,823	4,852	4,880	4,908	4,936
	0,8	4,468	4,496	4,524	4,552	4,581	4,609	4,637	4,665	4,693	4,722	4,750	4,778	4,806	4,834	4,863	4,891	4,919	4,947	4,975	5,004	5,032
	0,9	4,563	4,592	4,620	4,648	4,676	4,704	4,733	4,761	4,789	4,817	4,845	4,874	4,902	4,930	4,958	4,986	5,015	5,043	5,071	5,099	5,127
	1	4,659	4,687	4,715	4,744	4,772	4,800	4,828	4,856	4,885	4,913	4,941	4,969	4,997	5,026	5,054	5,082	5,110	5,138	5,167	5,195	5,223
	1,1	4,755	4,783	4,811	4,839	4,867	4,896	4,924	4,952	4,980	5,008	5,037	5,065	5,093	5,121	5,149	5,178	5,206	5,234	5,262	5,290	5,319
	1,2	4,850	4,878	4,907	4,935	4,963	4,991	5,019	5,048	5,076	5,104	5,132	5,160	5,189	5,217	5,245	5,273	5,301	5,330	5,358	5,386	5,414
	1,3	4,946	4,974	5,002	5,030	5,059	5,087	5,115	5,143	5,171	5,200	5,228	5,256	5,284	5,312	5,341	5,369	5,397	5,425	5,453	5,482	5,510
	1,4	5,041	5,070	5,098	5,126	5,154	5,182	5,211	5,239	5,267	5,295	5,323	5,352	5,380	5,408	5,436	5,464	5,493	5,521	5,549	5,577	5,605
	1,5	5,137	5,165	5,193	5,222	5,250	5,278	5,306	5,334	5,363	5,391	5,419	5,447	5,475	5,504	5,532	5,560	5,588	5,616	5,645	5,673	5,701
	1,6	5,233	5,261	5,289	5,317	5,345	5,374	5,402	5,430	5,458	5,486	5,515	5,543	5,571	5,599	5,627	5,656	5,684	5,712	5,740	5,768	5,797
	1,7	5,328	5,356	5,385	5,413	5,441	5,469	5,497	5,526	5,554	5,582	5,610	5,638	5,667	5,695	5,723	5,751	5,779	5,808	5,836	5,864	5,892
	1,8	5,424	5,452	5,480	5,508	5,537	5,565	5,593	5,621	5,649	5,678	5,706	5,734	5,762	5,790	5,819	5,847	5,875	5,903	5,931	5,960	5,988
	1,9	5,519	5,548	5,576	5,604	5,632	5,660	5,689	5,717	5,745	5,773	5,801	5,830	5,858	5,886	5,914	5,942	5,971	5,999	6,027	6,055	6,083
	2	5,615	5,643	5,671	5,700	5,728	5,756	5,784	5,812	5,841	5,869	5,897	5,925	5,953	5,982	6,010	6,038	6,066	6,094	6,123	6,151	6,179

EUR rates from 1 to

H) Output table (Chapter 6.4)

	Dependent variable:		
	Long_term_yield		
	(1)	(2)	(3)
lag(Long_term_yield, 1)	0.988***	0.986***	0.987***
	(0.002)	(0.002)	(0.003)
IsCEE	-0.006		
	(0.017)		
IsLatAm		0.074**	
		(0.035)	
IsAsia			0.045**
			(0.022)
USD_MC	1.260***	0.751***	1.071***
	(0.313)	(0.217)	(0.322)
lag(USD_MC, 1)	-1.243***	-0.731***	-1.048***
	(0.312)	(0.215)	(0.326)
EUR_MC	0.412***	0.122	0.544***
	(0.129)	(0.120)	(0.208)
lag(EUR_MC, 1)	-0.356***	-0.089	-0.456**
	(0.111)	(0.101)	(0.178)
IsCEE:USD_MC	-0.854**		
	(0.423)		
IsCEE:lag(USD_MC, 1)	0.848**		
	(0.424)		
IsCEE:EUR_MC	-0.357		
	(0.447)		
IsCEE:lag(EUR_MC, 1)	0.324		
	(0.386)		
IsLatAm:USD_MC		0.878	
		(0.796)	
IsLatAm:lag(USD_MC, 1)		-0.920	
		(0.807)	
IsLatAm:EUR_MC		0.700	
		(0.451)	
IsLatAm:lag(EUR_MC, 1)		-0.656*	
		(0.375)	
IsAsia:USD_MC			-0.300
			(0.477)
IsAsia:lag(USD_MC, 1)			0.258
			(0.476)
IsAsia:EUR_MC			-0.615*
			(0.358)
IsAsia:lag(EUR_MC, 1)			0.496*
			(0.288)
Observations	21	21	21
Note:	*p<0.1; **p<0.05; ***p<0.01		

I) Sensitivity scores

Country	Year	SENS_INT	SENS_INT_NORM	SENS_INT_FC_CORR	SENS_FX	SENS_FX_NORM
Brazil	2008	179,8	10,7	58,2	125,2	136,1
Brazil	2009	179,8	10,7	58,2	125,2	136,1
Brazil	2010	179,8	57,2	109,2	187,7	62,7
Brazil	2011	136,6	10,7	116,4	26,8	32,1
Brazil	2012	43,2	114,4	7,3	71,5	79,5
Brazil	2013	136,6	35,7	43,7	44,7	131,5
Brazil	2014	93,5	60,8	94,6	44,7	169,7
Brazil	2015	323,6	35,7	356,6	196,7	152,9
Brazil	2016	194,2	92,9	167,4	384,4	9,2
Brazil	2017	57,5	32,2	116,4	107,3	27,5
Brazil	2018	28,8	50,0	87,3	62,6	59,6
Brazil	2019	222,9	164,4	174,6	107,3	61,2
Brazil	2020	64,7	32,2	494,8	420,1	273,7
Brazil	2021	165,4	185,8	50,9	152,0	10,7
Brazil	2022	330,8	60,8	225,6	321,8	152,9
Bulgaria	2008	122,3	21,4	160,1	125,2	256,9
Bulgaria	2009	122,3	21,4	160,1	125,2	256,9
Bulgaria	2010	7,2	50,0	43,7	205,6	289,0
Bulgaria	2011	79,1	14,3	50,9	89,4	6,1
Bulgaria	2012	93,5	271,6	87,3	214,5	133,0
Bulgaria	2013	28,8	42,9	36,4	107,3	22,9
Bulgaria	2014	7,2	35,7	14,6	0,0	172,8
Bulgaria	2015	21,6	42,9	0,0	35,8	111,6
Bulgaria	2016	28,8	14,3	7,3	295,0	21,4
Bulgaria	2017	21,6	71,5	0,0	17,9	58,1
Bulgaria	2018	21,6	42,9	36,4	80,5	64,2
Bulgaria	2019	28,8	78,6	14,6	80,5	94,8
Bulgaria	2020	21,6	21,4	29,1	134,1	162,1
Bulgaria	2021	79,1	42,9	0,0	44,7	4,6
Bulgaria	2022	36,0	185,8	36,4	169,8	252,3
Chile	2008	79,1	46,5	21,8	26,8	162,1
Chile	2009	79,1	46,5	21,8	26,8	162,1
Chile	2010	43,2	17,9	72,8	26,8	226,3
Chile	2011	28,8	35,7	36,4	143,0	174,3
Chile	2012	21,6	3,6	0,0	152,0	128,4
Chile	2013	3,6	25,0	7,3	44,7	122,3
Chile	2014	14,4	67,9	21,8	80,5	41,3
Chile	2015	14,4	14,3	21,8	17,9	100,9
Chile	2016	57,5	14,3	36,4	330,8	84,1
Chile	2017	14,4	75,1	21,8	80,5	58,1
Chile	2018	43,2	32,2	36,4	89,4	38,2
Chile	2019	151,0	96,5	720,4	53,6	4,6
Chile	2020	222,9	278,8	262,0	259,2	305,8
Chile	2021	107,9	353,8	138,3	187,7	22,9
Chile	2022	79,1	14,3	72,8	259,2	240,0
China	2008	43,2	271,6	58,2	26,8	24,5
China	2009	43,2	271,6	58,2	26,8	24,5
China	2010	14,4	100,1	14,6	17,9	151,4
China	2011	86,3	60,8	80,0	35,8	26,0
China	2012	21,6	3,6	7,3	8,9	128,4
China	2013	14,4	21,4	50,9	17,9	22,9
China	2014	7,2	253,8	21,8	35,8	142,2
China	2015	28,8	21,4	14,6	62,6	32,1
China	2016	136,6	92,9	87,3	134,1	307,3
China	2017	7,2	207,3	36,4	8,9	169,7

Country	Year	SENS_INT	SENS_INT_NORM	SENS_INT_FC_CORR	SENS_FX	SENS_FX_NORM
China	2018	57,5	185,8	50,9	17,9	241,6
China	2019	36,0	14,3	43,7	35,8	105,5
China	2020	7,2	50,0	65,5	44,7	134,5
China	2021	43,2	96,5	36,4	35,8	19,9
China	2022	14,4	3,6	7,3	89,4	85,6
Colombia	2008	381,2	107,2	334,7	268,2	146,8
Colombia	2009	381,2	107,2	334,7	268,2	146,8
Colombia	2010	14,4	132,2	152,8	125,2	52,0
Colombia	2011	21,6	17,9	58,2	116,2	27,5
Colombia	2012	14,4	135,8	14,6	143,0	125,4
Colombia	2013	201,4	82,2	283,8	80,5	3,1
Colombia	2014	100,7	7,1	109,2	80,5	229,3
Colombia	2015	179,8	17,9	160,1	250,3	177,4
Colombia	2016	258,9	28,6	232,9	205,6	64,2
Colombia	2017	57,5	21,4	58,2	44,7	44,3
Colombia	2018	28,8	39,3	14,6	35,8	114,7
Colombia	2019	100,7	57,2	72,8	89,4	84,1
Colombia	2020	36,0	10,7	218,3	438,0	272,2
Colombia	2021	165,4	178,7	211,0	187,7	74,9
Colombia	2022	553,8	368,1	574,9	241,4	157,5
Czech Republic	2008	115,1	3,6	109,2	62,6	88,7
Czech Republic	2009	115,1	3,6	109,2	62,6	88,7
Czech Republic	2010	14,4	85,8	29,1	250,3	172,8
Czech Republic	2011	57,5	42,9	43,7	125,2	84,1
Czech Republic	2012	21,6	232,3	7,3	250,3	82,6
Czech Republic	2013	36,0	7,1	50,9	98,3	78,0
Czech Republic	2014	21,6	193,0	7,3	17,9	140,7
Czech Republic	2015	50,3	35,7	43,7	26,8	91,7
Czech Republic	2016	36,0	17,9	29,1	339,7	44,3
Czech Republic	2017	43,2	153,7	21,8	17,9	41,3
Czech Republic	2018	7,2	35,7	21,8	143,0	52,0
Czech Republic	2019	14,4	78,6	123,7	98,3	102,4
Czech Republic	2020	7,2	82,2	50,9	187,7	181,9
Czech Republic	2021	79,1	168,0	65,5	178,8	1,5
Czech Republic	2022	395,5	243,0	356,6	125,2	168,2
Hong Kong	2008	172,6	278,8	181,9	26,8	12,2
Hong Kong	2009	172,6	278,8	181,9	26,8	12,2
Hong Kong	2010	107,9	164,4	58,2	8,9	88,7
Hong Kong	2011	129,5	107,2	87,3	8,9	1,5
Hong Kong	2012	43,2	289,5	36,4	8,9	94,8
Hong Kong	2013	201,4	114,4	232,9	0,0	99,4
Hong Kong	2014	43,2	128,7	7,3	0,0	45,9
Hong Kong	2015	79,1	32,2	80,0	0,0	9,2
Hong Kong	2016	316,4	253,8	276,5	8,9	108,6
Hong Kong	2017	28,8	28,6	21,8	0,0	6,1
Hong Kong	2018	28,8	107,2	36,4	17,9	64,2
Hong Kong	2019	50,3	50,0	29,1	8,9	218,6
Hong Kong	2020	21,6	271,6	240,1	17,9	68,8
Hong Kong	2021	7,2	210,9	29,1	0,0	76,4
Hong Kong	2022	21,6	235,9	29,1	8,9	532,1
Hungary	2008	201,4	239,5	87,3	80,5	145,2
Hungary	2009	201,4	239,5	87,3	80,5	145,2
Hungary	2010	165,4	25,0	123,7	89,4	241,6
Hungary	2011	165,4	71,5	232,9	134,1	50,5
Hungary	2012	197,8	200,1	50,9	178,8	41,3
Hungary	2013	230,1	21,4	247,4	89,4	50,5
Hungary	2014	79,1	103,6	94,6	17,9	145,2
Hungary	2015	28,8	3,6	14,6	44,7	16,8

Country	Year	SENS_INT	SENS_INT_NORM	SENS_INT_FC_CORR	SENS_FX	SENS_FX_NORM
Hungary	2016	7,2	3,6	65,5	393,3	16,8
Hungary	2017	79,1	67,9	80,0	35,8	44,3
Hungary	2018	107,9	125,1	80,0	116,2	21,4
Hungary	2019	201,4	46,5	225,6	143,0	64,2
Hungary	2020	64,7	7,1	58,2	143,0	160,5
Hungary	2021	179,8	121,5	145,5	232,4	62,7
Hungary	2022	122,3	282,3	465,7	44,7	85,6
Indonesia	2008	50,3	139,4	101,9	8,9	44,3
Indonesia	2009	50,3	139,4	101,9	8,9	44,3
Indonesia	2010	64,7	125,1	109,2	98,3	4,6
Indonesia	2011	230,1	39,3	247,4	0,0	35,2
Indonesia	2012	64,7	10,7	58,2	53,6	50,5
Indonesia	2013	86,3	57,2	101,9	98,3	142,2
Indonesia	2014	179,8	10,7	101,9	125,2	29,0
Indonesia	2015	50,3	46,5	138,3	53,6	58,1
Indonesia	2016	330,8	57,2	334,7	160,9	30,6
Indonesia	2017	115,1	57,2	131,0	17,9	29,0
Indonesia	2018	93,5	110,8	72,8	26,8	100,9
Indonesia	2019	93,5	50,0	58,2	0,0	59,6
Indonesia	2020	294,9	3,6	240,1	429,1	204,9
Indonesia	2021	50,3	7,1	80,0	26,8	1,5
Indonesia	2022	57,5	28,6	29,1	62,6	108,6
Malaysia	2008	21,6	336,0	87,3	160,9	81,0
Malaysia	2009	21,6	336,0	87,3	160,9	81,0
Malaysia	2010	7,2	171,6	14,6	71,5	15,3
Malaysia	2011	14,4	46,5	0,0	53,6	19,9
Malaysia	2012	57,5	42,9	50,9	71,5	47,4
Malaysia	2013	57,5	28,6	58,2	160,9	107,0
Malaysia	2014	21,6	96,5	0,0	98,3	197,2
Malaysia	2015	36,0	28,6	36,4	8,9	58,1
Malaysia	2016	21,6	214,4	211,0	402,3	22,9
Malaysia	2017	28,8	89,3	14,6	8,9	33,6
Malaysia	2018	21,6	67,9	21,8	26,8	104,0
Malaysia	2019	a43,2	243,0	21,8	8,9	81,0
Malaysia	2020	136,6	185,8	138,3	62,6	149,8
Malaysia	2021	7,2	260,9	94,6	17,9	30,6
Malaysia	2022	28,8	171,6	72,8	89,4	186,5
Mexico	2008	280,5	17,9	283,8	26,8	70,3
Mexico	2009	280,5	17,9	283,8	26,8	70,3
Mexico	2010	7,2	178,7	21,8	116,2	42,8
Mexico	2011	151,0	50,0	94,6	35,8	47,4
Mexico	2012	129,5	125,1	101,9	152,0	74,9
Mexico	2013	14,4	32,2	14,6	35,8	107,0
Mexico	2014	86,3	57,2	116,4	98,3	120,8
Mexico	2015	28,8	17,9	36,4	169,8	81,0
Mexico	2016	251,7	128,7	269,2	455,9	111,6
Mexico	2017	36,0	32,2	7,3	125,2	267,6
Mexico	2018	115,1	146,5	101,9	26,8	52,0
Mexico	2019	237,3	200,1	232,9	26,8	113,1
Mexico	2020	100,7	117,9	65,5	822,4	276,7
Mexico	2021	330,8	175,1	283,8	98,3	21,4
Mexico	2022	266,1	157,3	262,0	17,9	88,7
Peru	2008	115,1	160,8	58,2	8,9	44,3
Peru	2009	115,1	160,8	58,2	8,9	44,3
Peru	2010	43,2	39,3	0,0	35,8	41,3
Peru	2011	21,6	60,8	7,3	17,9	42,8
Peru	2012	539,4	128,7	21,8	17,9	38,2
Peru	2013	187,0	92,9	196,5	17,9	65,7

Country	Year	SENS_INT	SENS_INT_NORM	SENS_INT_FC_CORR	SENS_FX	SENS_FX_NORM
Peru	2014	14,4	64,3	14,6	8,9	94,8
Peru	2015	57,5	60,8	65,5	35,8	13,8
Peru	2016	100,7	71,5	29,1	8,9	243,1
Peru	2017	7,2	110,8	14,6	89,4	218,6
Peru	2018	36,0	92,9	21,8	62,6	73,4
Peru	2019	115,1	157,3	116,4	98,3	36,7
Peru	2020	158,2	160,8	174,6	89,4	142,2
Peru	2021	107,9	135,8	7,3	89,4	278,3
Peru	2022	43,2	164,4	58,2	8,9	79,5
Poland	2008	129,5	57,2	50,9	8,9	198,8
Poland	2009	129,5	57,2	50,9	8,9	198,8
Poland	2010	64,7	17,9	36,4	71,5	185,0
Poland	2011	43,2	42,9	21,8	53,6	19,9
Poland	2012	21,6	168,0	21,8	143,0	16,8
Poland	2013	28,8	0,0	21,8	53,6	29,0
Poland	2014	43,2	203,7	65,5	8,9	226,3
Poland	2015	21,6	32,2	80,0	44,7	81,0
Poland	2016	86,3	53,6	43,7	366,5	16,8
Poland	2017	50,3	53,6	43,7	44,7	12,2
Poland	2018	50,3	32,2	65,5	107,3	29,0
Poland	2019	136,6	114,4	131,0	116,2	102,4
Poland	2020	7,2	107,2	29,1	196,7	105,5
Poland	2021	151,0	218,0	152,8	152,0	35,2
Poland	2022	632,9	289,5	538,5	169,8	137,6
Romania	2008	194,2	396,7	65,5	125,2	146,8
Romania	2009	194,2	396,7	65,5	125,2	146,8
Romania	2010	43,2	3,6	80,0	178,8	238,5
Romania	2011	474,7	64,3	487,6	53,6	117,7
Romania	2012	64,7	28,6	50,9	339,7	181,9
Romania	2013	43,2	39,3	7,3	44,7	48,9
Romania	2014	64,7	135,8	80,0	26,8	217,1
Romania	2015	7,2	32,2	50,9	107,3	73,4
Romania	2016	237,3	32,2	189,2	366,5	79,5
Romania	2017	50,3	60,8	43,7	17,9	42,8
Romania	2018	28,8	50,0	29,1	71,5	99,4
Romania	2019	28,8	57,2	7,3	98,3	76,4
Romania	2020	338,0	46,5	152,8	134,1	142,2
Romania	2021	187,0	203,7	203,8	53,6	7,6
Romania	2022	294,9	225,2	298,4	152,0	188,1
Singapore	2008	230,1	160,8	211,0	44,7	186,5
Singapore	2009	230,1	160,8	211,0	44,7	186,5
Singapore	2010	14,4	157,3	101,9	0,0	126,9
Singapore	2011	36,0	92,9	0,0	44,7	119,3
Singapore	2012	7,2	75,1	72,8	62,6	68,8
Singapore	2013	115,1	92,9	152,8	80,5	96,3
Singapore	2014	14,4	35,7	14,6	80,5	206,4
Singapore	2015	107,9	92,9	58,2	89,4	108,6
Singapore	2016	165,4	182,3	94,6	295,0	188,1
Singapore	2017	7,2	82,2	94,6	26,8	38,2
Singapore	2018	7,2	35,7	29,1	35,8	1,5
Singapore	2019	86,3	153,7	65,5	17,9	113,1
Singapore	2020	57,5	260,9	7,3	71,5	287,4
Singapore	2021	165,4	150,1	167,4	8,9	91,7
Singapore	2022	107,9	386,0	160,1	98,3	157,5
South Korea	2008	129,5	125,1	72,8	214,5	226,3
South Korea	2009	129,5	125,1	72,8	214,5	226,3
South Korea	2010	86,3	153,7	65,5	44,7	71,9
South Korea	2011	86,3	57,2	58,2	71,5	53,5

Country	Year	SENS_INT	SENS_INT_NORM	SENS_INT_FC_CORR	SENS_FX	SENS_FX_NORM
South Korea	2012	64,7	182,3	43,7	35,8	26,0
South Korea	2013	172,6	25,0	167,4	107,3	73,4
South Korea	2014	7,2	164,4	7,3	125,2	209,5
South Korea	2015	7,2	3,6	29,1	134,1	9,2
South Korea	2016	122,3	103,6	80,0	348,6	258,4
South Korea	2017	79,1	50,0	80,0	35,8	9,2
South Korea	2018	21,6	103,6	21,8	107,3	3,1
South Korea	2019	14,4	64,3	58,2	17,9	145,2
South Korea	2020	50,3	21,4	72,8	125,2	154,4
South Korea	2021	93,5	78,6	145,5	8,9	94,8
South Korea	2022	172,6	221,6	254,7	89,4	175,8
Thailand	2008	36,0	196,6	14,6	35,8	29,0
Thailand	2009	36,0	196,6	14,6	35,8	29,0
Thailand	2010	79,1	117,9	36,4	89,4	3,1
Thailand	2011	79,1	42,9	72,8	17,9	93,3
Thailand	2012	36,0	0,0	7,3	26,8	1,5
Thailand	2013	86,3	17,9	58,2	89,4	42,8
Thailand	2014	21,6	107,2	14,6	53,6	55,0
Thailand	2015	7,2	28,6	58,2	71,5	18,3
Thailand	2016	273,3	157,3	196,5	178,8	68,8
Thailand	2017	7,2	103,6	29,1	35,8	44,3
Thailand	2018	57,5	96,5	29,1	35,8	188,1
Thailand	2019	107,9	264,5	87,3	44,7	1,5
Thailand	2020	79,1	182,3	123,7	26,8	44,3
Thailand	2021	165,4	100,1	160,1	8,9	87,1
Thailand	2022	165,4	150,1	167,4	196,7	281,3
Turkey	2008	273,3	189,4	174,6	89,4	90,2
Turkey	2009	273,3	189,4	174,6	89,4	90,2
Turkey	2010	36,0	117,9	72,8	62,6	35,2
Turkey	2011	64,7	25,0	72,8	8,9	15,3
Turkey	2012	14,4	196,6	36,4	71,5	53,5
Turkey	2013	251,7	28,6	269,2	152,0	125,4
Turkey	2014	36,0	78,6	36,4	35,8	47,4
Turkey	2015	43,2	21,4	101,9	17,9	139,1
Turkey	2016	280,5	103,6	291,1	259,2	39,8
Turkey	2017	14,4	32,2	29,1	17,9	35,2
Turkey	2018	122,3	171,6	21,8	53,6	131,5
Turkey	2019	107,9	96,5	36,4	125,2	88,7
Turkey	2020	496,2	75,1	436,6	107,3	79,5
Turkey	2021	151,0	110,8	174,6	35,8	316,5
Turkey	2022	258,9	128,7	211,0	53,6	178,9

J) R codes

```
# Appendix - R codes used for the calculations
# © Gabor Sztano, 2023
# This code accompanies the Doctoral dissertation submitted to Corvinus University of Budapest
# in partial fulfilment of the PhD degree.

# Note: this is a shortened version of the code. The coding is not the nicest so many repetitive parts were
# left out. The full version of thousands of rows is available upon request with the original dataset
# or at the personal website of the Author. Variable names may be different from the one that is in the main
# text, and some of the commands are resource heavy and/or inefficient. Caution is recommended.
#
# Contact the Author in case of any questions or concerns.

library(readxl)
library(plm)
library(stargazer)
library(lmtest)
library(ARDL)
library(nardl)
library(car)
library(dplyr)
library(psych)
library(forecast)
library(stats)
library(tseries)
library(urca)

#Overview:
#Data management: transformations
#Data management: new variables
#Chapter 4: Time series
#Chapter 5: Panel
#Chapter 6: Regions with panel
#Chapter 7: Country-level: sensitivity scores (former: vulnerability scores)
#Chapter 7: Country-level: analysis

#Data management
#read data
dailyone0 <- read_excel("C:/*/spillover_panel_final_A_dailyone.xlsx")
dailypanel0 <- read_excel("C:/*/spillover_panel_final_B_dailypanel.xlsx")
yearlypanel0 <- read_excel("C:/*/spillover_panel_final_E_yearly.xlsx")
monthlypanel0 <- read_excel("C:/*/spillover_panel_final_C_monthlypanel.xlsx")
vulnerability0 <- read_excel("C:/*/spillover_panel_final_D_vulnerabilitypanel.xlsx")

#flag excluded countries
dailypanel0$dropped <- ifelse(dailypanel0$Country_long %in% c('Nigeria','India','Croatia','South Africa','Vietnam'), 1, 0)
monthlypanel0$dropped <- ifelse(monthlypanel0$Country_long %in% c('Nigeria','India','Israel','South Africa', 'Vietnam'), 1, 0)
yearlypanel0$dropped <- ifelse(yearlypanel0$Country_long %in% c('Nigeria','India','Israel','South Africa', 'Vietnam'), 1, 0)
vulnerability0$dropped <- ifelse(vulnerability0$Country_long %in% c('Nigeria','India','Israel','South Africa', 'Vietnam'), 1, 0)

#variables (variables and subsets may need refresh)

#in: daily
dailypanel0$DW_Long_term_yield<-dailypanel0$Long_term_yield-lag(dailypanel0$Long_term_yield,5)
dailypanel0$DW_DEPO3M<-dailypanel0$DEPO3M-lag(dailypanel0$DEPO3M,5)
dailypanel0$DW_CDS<-dailypanel0$CDS-lag(dailypanel0$CDS,5)
dailypanel0$DW_VIX_index<-dailypanel0$VIX_index/lag(dailypanel0$VIX_index,5)
dailypanel0$DW_Long_term_yield<-dailypanel0$Long_term_yield-lag(dailypanel0$Long_term_yield,5)
dailypanel0$DM_CPI<-dailypanel0$CPI_YOY-lag(dailypanel0$CPI_YOY,20)
dailypanel0$DW_FX_USD<-dailypanel0$FX_USD/lag(dailypanel0$FX_USD,5)
dailypanel0$DW_Stockindex<-dailypanel0$Stockindex/lag(dailypanel0$Stockindex,5)
#25 rows missing

#events
dailypanel0$WES1_EV_Fed_Easing_ASP<-
dailypanel0$S_EV_Fed_Easing_ASP+lag(dailypanel0$S_EV_Fed_Easing_ASP,1)+lag(dailypanel0$S_EV_Fed_Easing_ASP,2)+lag(dailypanel0$S_EV_Fec
dailypanel0$WES1_EV_Fed_Easing_Other<-
dailypanel0$S_EV_Fed_Easing_Other+lag(dailypanel0$S_EV_Fed_Easing_Other,1)+lag(dailypanel0$S_EV_Fed_Easing_Other,2)+lag(dailypanel0$S_
dailypanel0$WES1_EV_Fed_Easing_All<-
dailypanel0$S_EV_Fed_Easing_All+lag(dailypanel0$S_EV_Fed_Easing_All,1)+lag(dailypanel0$S_EV_Fed_Easing_All,2)+lag(dailypanel0$S_EV_Fec
dailypanel0$WES1_EV_Fed_Tightening_ASP<-
dailypanel0$S_EV_Fed_Tightening_ASP+lag(dailypanel0$S_EV_Fed_Tightening_ASP,1)+lag(dailypanel0$S_EV_Fed_Tightening_ASP,2)+lag(dailypar
#25 rows missing

#create weeklypanel
#of: dailypanel
dailypanel1 <- subset(dailypanel0,Date >= "2009-01-01")
dailypanel2 <- subset(dailypanel1,dailypanel1$dropped==0)
weeklypanel <-subset(dailypanel2,dailypanel2$Weekofday==5)
quantile(weeklypanel$BS_AE_pc, probs=c(.01,.25, .75, .99), na.rm=TRUE)

# create variables in weeklypanel
quantile(weeklypanel$DW_JPY_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
quantile(weeklypanel$DW_USD_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
quantile(weeklypanel$DW_EUR_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
quantile(weeklypanel$DW_JPY_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
weeklypanel$TOP2_DW_USD_MC <- ifelse(weeklypanel$DW_USD_MC>0.1020,1,0)
weeklypanel$BOTTOM2_DW_USD_MC <- ifelse(weeklypanel$DW_USD_MC>-0.0502,0,1)
weeklypanel$TOP2_DW_EUR_MC <- ifelse(weeklypanel$DW_EUR_MC>0.10243,1,0)
weeklypanel$BOTTOM2_DW_EUR_MC <- ifelse(weeklypanel$DW_EUR_MC>-0.0829,0,1)
weeklypanel$TOP2_DW_JPY_MC <- ifelse(weeklypanel$DW_JPY_MC>0.0494,1,0)
weeklypanel$BOTTOM2_DW_JPY_MC <- ifelse(weeklypanel$DW_JPY_MC>-0.0496,0,1)
weeklypanel$TOP2E_DW_USD_MC <- ifelse(weeklypanel$TOP2_DW_USD_MC-weeklypanel$TOP2_DW_EUR_MC-weeklypanel$TOP2_DW_JPY_MC==1,1,0)
#26 rows missing
#slice weeklypanel accordingly
weeklypanel_2020 <-subset(weeklypanel,Date <= "2021-01-01")
weeklypanel_postcovid<-subset(weeklypanel,Date >= "2020-01-01")
weeklypanel_precovid<-subset(weeklypanel,Date <= "2020-01-01")
weeklypanel_post2015<-subset(weeklypanel,Date >= "2015-01-01")
weeklypanel_bt20152019<-subset(weeklypanel_post2015,Date <= "2020-01-01")
weeklypanel_postcovidtightening<-subset(weeklypanel,Date >= "2022-01-01")
weeklypanel_pretaper<-subset(weeklypanel,Date <= "2013-04-01")
weeklypanel_top25qe<-subset(weeklypanel,BS_AE_pc >= 101.56925)
weeklypanel_top25qt<-subset(weeklypanel,BS_AE_pc <= 99.85768)
weeklypanel_lowvol<-subset(weeklypanel,VIX_index <= 12.05)
```

```
weeklypanel_highvol<-subset(weeklypanel,VIX_index >= 29.62)
weeklypanel_Fedup<-subset(weeklypanel,FED_up == 1)
weeklypanel_Feddown<-subset(weeklypanel,FED_down == 1)
weeklypanel_Fedkeep<-subset(weeklypanel,FED_keep == 1)
weeklypanel_CEE <-subset(weeklypanel,IsCEE== "1")
weeklypanel_LatAm <-subset(weeklypanel,IsLatAm== "1")
weeklypanel_Asia <-subset(weeklypanel,IsAsia== "1")

#variables to create in: vulnerabilitypanel
vulnerability0$LGDP_PCAP_USD<-log(vulnerability0$GDP_PCAP_USD,10)
vulnerability0$LXTR_DEBT_Y<-log(vulnerability0$XTR_DEBT_Y,10)
vulnerability0$DY_CPI_YOY_Y<-vulnerability0$CPI_YOY_Y-lag(vulnerability0$CPI_YOY_Y,1)
vulnerability0$DY_FX<-(vulnerability0$FX_DayhighY/vulnerability0$FX_DaylowY)-1
vulnerabilitypanel1 <- subset(vulnerability0,Date >= "2009-12-01")
vulnerabilitypanel2 <- subset(vulnerabilitypanel1,Date <= "2021-01-01")
#42 rows missing

#factors
faktor_usd <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/usd.xlsx")
faktor_eur <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/eur.xlsx")
faktor_jpy <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/jpy.xlsx")
faktor_ae <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/allAE.xlsx")
faktor10_em <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/em.xlsx")
faktor10_em_cee <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/em_cee.xlsx")
faktor10_em_latam <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/em_latam.xlsx")
faktor10_em_asia <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/em_asia.xlsx")
faktor10_em_asia2 <- read_excel("C:/Users/Probook/OneDrive - Corvinus University of
Budapest/Szakmai/PhD/Research_on_thesis/Datafiles/Principal/em_asia2.xlsx")

Faktor_usd<- fa(faktor_usd, nfactors=4, rotate="none")
Faktor_eur<- fa(faktor_eur, nfactors=4, rotate="none", fm="minres")
Faktor_jpy<- fa(faktor_jpy, nfactors=4, rotate="none")
Faktor_ae<- fa(faktor_ae, nfactors=4, rotate="none", fm="minres")
Faktor_em<- fa(faktor10_em, nfactors=4, rotate="none", fm="minres")
Faktor_em_cee<- fa(faktor10_em_cee, nfactors=4, rotate="none", fm="minres")
Faktor_em_latam<- fa(faktor10_em_latam, nfactors=4, rotate="none", fm="minres")
Faktor_em_asia<- fa(faktor10_em_asia, nfactors=4, rotate="none", fm="minres")
Faktor_em_asia2<- fa(faktor10_em_asia2, nfactors=4, rotate="none", fm="minres")
#end_data_process
#
#Chapter 4: Time series

# Tests
perform_adf_test <- function(series, diff = FALSE) {
  if (diff) {    series <- diff(series)
    adf_test_result <- adf.test(series)
    cat("ADF Test for Diff Series:\n")
  } else {    adf_test_result <- adf.test(series)
    cat("ADF Test for Series:\n")  }
  print(adf_test_result)}

# Pair I: dailyone$AE_MC, dailyone$EM10_FC
ae_mc <- dailyone$AE_MC
em10_fc <- na.omit(dailyone$EM10_FC)
perform_adf_test(ae_mc)
perform_adf_test(em10_fc)
perform_adf_test(ae_mc, diff = TRUE)
perform_adf_test(em10_fc, diff = TRUE)
pp_result11 <- pp.test(ae_mc, alternative = "stationary")
print(pp_result11)
pp_result12 <- pp.test(em10_fc, alternative = "stationary")
print(pp_result12)
pp_result13 <- pp.test(diff(ae_mc,1), alternative = "stationary")
print(pp_result13)
pp_result14 <- pp.test(diff(em10_fc,1), alternative = "stationary")
print(pp_result14)
cointegration_test1 <- ca.jo(cbind(ae_mc, em10_fc), type = "trace", ecdet = "const", K = 5)
summary(cointegration_test1)
#appropriate model
model1_1 <- ardl(formula = EM10_FC ~ AE_MC-1 , data = dailyone, order = c(1, 10))
summary(model1_1)
bounds_test1 <- bounds_f_test(model1_1, case = 1)
bounds_test1
multipliers(model1_1, type="30")
model1_2 <- ardl(formula = EM10_FC ~ AE_MC-1 , data = dailyone, order = c(1, 20))
summary(model1_1)
bounds_test1_2 <- bounds_f_test(model1_2, case = 1)
bounds_test1_2
multipliers(model1_2, type="30")
#766 rows missing

# -- Chapter 5. -- panel - measuring spillovers

#bmk -1-
eq_2_bmk1_t2 <-plm(DW_Long_term_yield~ DW_DEPO3M+DW_CDS+DW_VIX_index+DW_FX_USD+DW_Stockindex+DW_Citi_Global_Uncerta+DM_CPI+
DW_Citi_Global_Surprise+DW_Brent_oil ,  data=weeklypanel, effect="individual",model='pooling', index = c("Country_long","Date"))
eq_2_bmk1_t4 <-plm(DW_Long_term_yield~ DW_DEPO3M+DW_CDS+DW_FX_USD+DW_Stockindex+DW_Citi_Global_Uncerta+DM_CPI+
DW_Citi_Global_Surprise+DW_Brent_oil ,  data=weeklypanel, effect="individual",model='pooling',  index = c("Country_long","Date"))
eq_2_bmk1_t6 <-plm(DW_Long_term_yield~ DW_DEPO3M+DW_CDS+DW_FX_USD+DW_Stockindex+DW_VIX_index+DM_CPI ,  data=weeklypanel,
effect="individual",model='pooling',  index = c("Country_long","Date"))
eq_2_bmk1_t8 <-plm(DW_Long_term_yield~DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel, effect="individual",model='pooling',
index = c("Country_long","Date"))
eq_2_bmk1_t8b <-plm(DW_Long_term_yield~DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel, effect="individual",model='between',
index = c("Country_long","Date"))
eq_2_bmk1_t8c<-lm(DW_Long_term_yield~DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel)
stargazer(eq_2_bmk1_t2,eq_2_bmk1_t4,eq_2_bmk1_t6,eq_2_bmk1_t8, style="default",type="text",out="spilltable.htm")
```

```
#fixed bmk modell shall be
#  eq_2_bmk2_t3 <-plm(DW_Long_term_yield~ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel, effect="individual",model='within',
index = c("Country_long","Date"))
vif_results1 <- car::vif(eq_2_bmk1_t8)
print(vif_results1)
vif_results2 <- car::vif(eq_2_bmk1_t2)
print(vif_results2)
phtest(eq_2_bmk1_t8,eq_2_bmk1_t8b )
pFtest(eq_2_bmk1_t8b,eq_2_bmk1_t8c)

#AE rates + usd -2-
eq_2_rd1_0t1<-plm(DW_Long_term_yield~ DW_AE_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_0t2<-plm(DW_Long_term_yield~ DW_USD_MC+D30LFED_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_0t3<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_0t4<-plm(DW_Long_term_yield~ D30LFED_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_0t5<-plm(DW_Long_term_yield~ D30LFED_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_1_eq_2_rd1_0t1 <- sqrt(diag(vcovSCC(eq_2_rd1_0t1)))
robust_se_2_eq_2_rd1_0t2 <- sqrt(diag(vcovSCC(eq_2_rd1_0t2)))
robust_se_3_eq_2_rd1_0t3 <- sqrt(diag(vcovSCC(eq_2_rd1_0t3)))
robust_se_4_eq_2_rd1_0t4 <- sqrt(diag(vcovSCC(eq_2_rd1_0t4)))
robust_se_5_eq_2_rd1_0t5 <- sqrt(diag(vcovSCC(eq_2_rd1_0t5)))
stargazer(eq_2_rd1_0t1,eq_2_rd1_0t3,eq_2_rd1_0t2,eq_2_rd1_0t4,se = list(robust_se_1_eq_2_rd1_0t1,robust_se_3_eq_2_rd1_0t3,
robust_se_2_eq_2_rd1_0t2,robust_se_4_eq_2_rd1_0t4), style="default",type="text",out="spilltable.htm")

#robustness of usd

#measuring usd shocks and robustusness -4-
eq_2_rd1_t1<-plm(DW_Long_term_yield~ DW_USDDEPOON+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t2<-plm(DW_Long_term_yield~ DW_USDDEPO1W+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t3<-plm(DW_Long_term_yield~ DW_USDLIBOR1M+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t4<-plm(DW_Long_term_yield~ DW_USFFM1M+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t5<-plm(DW_Long_term_yield~ DW_USDFW_1M1M+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t6<-plm(DW_Long_term_yield~ DW_USDFW_6M1M+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t7<-plm(DW_Long_term_yield~ DW_GOV3M_USA+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t8<-plm(DW_Long_term_yield~ DW_GOV10Y_USA+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t9<-plm(DW_Long_term_yield~ DW_USDSWAP_1M+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd1_t10<-plm(DW_Long_term_yield~ DW_Nshadow_US+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_eq_2_rd1_t1 <- sqrt(diag(vcovSCC(eq_2_rd1_t1)))
robust_se_eq_2_rd1_t2 <- sqrt(diag(vcovSCC(eq_2_rd1_t2)))
robust_se_eq_2_rd1_t3 <- sqrt(diag(vcovSCC(eq_2_rd1_t3)))
robust_se_eq_2_rd1_t4<- sqrt(diag(vcovSCC(eq_2_rd1_t4)))
robust_se_eq_2_rd1_t5 <- sqrt(diag(vcovSCC(eq_2_rd1_t5)))
robust_se_eq_2_rd1_t6 <- sqrt(diag(vcovSCC(eq_2_rd1_t6)))
robust_se_eq_2_rd1_t7 <- sqrt(diag(vcovSCC(eq_2_rd1_t7)))
robust_se_eq_2_rd1_t8 <- sqrt(diag(vcovSCC(eq_2_rd1_t8)))
robust_se_eq_2_rd1_t9 <- sqrt(diag(vcovSCC(eq_2_rd1_t9)))
robust_se_eq_2_rd1_t10 <- sqrt(diag(vcovSCC(eq_2_rd1_t10)))
stargazer(eq_2_rd1_t2,eq_2_rd1_t3,eq_2_rd1_t5,eq_2_rd1_t6,se = list(robust_se_eq_2_rd1_t2,robust_se_eq_2_rd1_t3,
robust_se_eq_2_rd1_t5,robust_se_eq_2_rd1_t6), style="default",type="text",out="spilltable.htm")
stargazer(eq_2_rd1_t7,eq_2_rd1_t8,eq_2_rd1_t9,eq_2_rd1_t10,se = list(robust_se_eq_2_rd1_t7,robust_se_eq_2_rd1_t8,
robust_se_eq_2_rd1_t9,robust_se_eq_2_rd1_t10), style="default",type="text",out="spilltable.htm")
stargazer(eq_2_rd1_t1,eq_2_rd1_t4,eq_2_rd1_t9,eq_2_rd1_t10,se = list(robust_se_eq_2_rd1_t1,robust_se_eq_2_rd1_t4,
robust_se_eq_2_rd1_t9,robust_se_eq_2_rd1_t10), style="default",type="text",out="spilltable.htm")

#slicing
eq_2_rd11_t1<-plm(DW_Long_term_yield~ DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t2<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_pretaper,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t3<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_bt20152019,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t4<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_precovid,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t5<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_postcovid,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t6<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_postcovidtightening,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t7<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_top25qe,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t8<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_top25qt,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t9<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_highvol,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t10<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_lowvol,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t11<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_Feddown,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd11_t12<-plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_Fedup,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_eq_2_rd11_t1 <- sqrt(diag(vcovSCC(eq_2_rd11_t1)))
robust_se_eq_2_rd11_t2 <- sqrt(diag(vcovSCC(eq_2_rd11_t2)))
robust_se_eq_2_rd11_t3 <- sqrt(diag(vcovSCC(eq_2_rd11_t3)))
robust_se_eq_2_rd11_t4<- sqrt(diag(vcovSCC(eq_2_rd11_t4)))
robust_se_eq_2_rd11_t5 <- sqrt(diag(vcovSCC(eq_2_rd11_t5)))
robust_se_eq_2_rd11_t6 <- sqrt(diag(vcovSCC(eq_2_rd11_t6)))
robust_se_eq_2_rd11_t7 <- sqrt(diag(vcovSCC(eq_2_rd11_t7)))
robust_se_eq_2_rd11_t8 <- sqrt(diag(vcovSCC(eq_2_rd11_t8)))
robust_se_eq_2_rd11_t9 <- sqrt(diag(vcovSCC(eq_2_rd11_t9)))
robust_se_eq_2_rd11_t10 <- sqrt(diag(vcovSCC(eq_2_rd11_t10)))
```

```
robust_se_eq_2_rd11_t11 <- sqrt(diag(vcovSCC(eq_2_rd11_t11)))
robust_se_eq_2_rd11_t12 <- sqrt(diag(vcovSCC(eq_2_rd11_t12)))
stargazer(eq_2_rd11_t1,eq_2_rd11_t2,eq_2_rd11_t3,eq_2_rd11_t4,se = list(robust_se_eq_2_rd11_t1,robust_se_eq_2_rd11_t2,
robust_se_eq_2_rd11_t3,robust_se_eq_2_rd11_t4), style="default",type="text",out="spilltable.htm")
stargazer(eq_2_rd11_t5,eq_2_rd11_t6,eq_2_rd11_t7,eq_2_rd11_t8,se = list(robust_se_eq_2_rd11_t5,robust_se_eq_2_rd11_t6,
robust_se_eq_2_rd11_t7,robust_se_eq_2_rd11_t8), style="default",type="text",out="spilltable.htm")
stargazer(eq_2_rd11_t9,eq_2_rd11_t10,eq_2_rd11_t11,eq_2_rd11_t12,se = list(robust_se_eq_2_rd11_t9,robust_se_eq_2_rd11_t10,
robust_se_eq_2_rd11_t11,robust_se_eq_2_rd11_t12), style="default",type="text",out="spilltable.htm")

#robustness via bootstrap
model <- plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index, data = weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
# Define the number of bootstrap iterations
n_bootstraps <- 1000
set.seed(123)

# Create an empty matrix to store coefficients
coeff_matrix<-matrix(data=NA, nrow=n_bootstraps, 4)
coeff_matrix
# Bootstrap loop
for (i in 1:n_bootstraps) {
  # Resample your data with replacement
  # resampled_data <- weeklypanel[sample(nrow(weeklypanel), replace = TRUE), ]
  resampled_data <- weeklypanel[sample(nrow(weeklypanel), size = 200, replace = TRUE), ]

  resampled_data
  # Fit the model on resampled data
  boot_model <- plm(DW_Long_term_yield~ DW_USD_MC+ DW_DEPO3M+DW_FX_USD+DW_VIX_index, data = resampled_data,
effect="individual",model='within',  index = c("Country_long","Date"))

  # Save coefficients for this iteration
  coeff_matrix[i, ] <- coef(boot_model)
}

# Create a boxplot or density plot of coefficients
usd_mc_coefficients <- coeff_matrix[, 1]
boxplot(usd_mc_coefficients, main = "Coefficient Distribution for USD_MC", xlab = "USD_MC Coefficients")
coeff_counts <- table(basket_counts)
coeff_counts
basket_width <- 0.05
baskets <- cut(usd_mc_coefficients, breaks = seq(min(usd_mc_coefficients), max(usd_mc_coefficients) + basket_width, by =
basket_width), right = FALSE)
# Count the number of observations in each basket
basket_counts <- table(baskets)
basket_counts
# Display the basket counts
print(basket_counts)
boxplot(usd_mc_coefficients, main = "Coefficient Distribution for USD_MC",
        xlab = "USD_MC Coefficients", ylab = "Frequency",
        names = names(baskets))

# Convert basket_counts to a data frame for plotting
basket_df <- data.frame(Basket = names(basket_counts), Frequency = as.numeric(basket_counts))
basket_df

ggplot(basket_df, aes(x=Basket, y=Frequency),geom_bar(stat = "identity"))

#extension to ecb and boj -5-
#ecb
eq_2_rd2_t1<-plm(DW_Long_term_yield~ DW_EUR_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd2_t2<-plm(DW_Long_term_yield~ DW_EUR_MC+D30LECB_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd2_t3<-plm(DW_Long_term_yield~ D30LECB_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_eq_2_rd2_t1 <- sqrt(diag(vcovSCC(eq_2_rd2_t1)))
robust_se_eq_2_rd2_t2 <- sqrt(diag(vcovSCC(eq_2_rd2_t2)))
robust_se_eq_2_rd2_t3 <- sqrt(diag(vcovSCC(eq_2_rd2_t3)))

stargazer(eq_2_rd2_t1,eq_2_rd2_t2,eq_2_rd2_t3,se =
list(robust_se_eq_2_rd2_t1,robust_se_eq_2_rd2_t2,robust_se_eq_2_rd2_t3),style="default",type="text",out="spilltable.htm")
stargazer(eq_2_rd2_t1,eq_2_rd2_t2,eq_2_rd2_t3, style="default",type="text",out="spilltable.htm")

#boj
eq_2_rd3_t1<-plm(DW_Long_term_yield~ DW_JPY_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd3_t2<-plm(DW_Long_term_yield~ DW_JPY_MC+D30LBOJ_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd3_t3<-plm(DW_Long_term_yield~ D30LBOJ_BS_2+ DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))

robust_se_eq_2_rd3_t1 <- sqrt(diag(vcovSCC(eq_2_rd3_t1)))
robust_se_eq_2_rd3_t2 <- sqrt(diag(vcovSCC(eq_2_rd3_t2)))
robust_se_eq_2_rd3_t3 <-sqrt(diag(vcovSCC(eq_2_rd3_t3)))

stargazer(eq_2_rd3_t1,eq_2_rd3_t2,eq_2_rd3_t3, style="default",type="text",out="spilltable.htm")
stargazer(eq_2_rd3_t1,eq_2_rd3_t2,eq_2_rd3_t3, se =
list(robust_se_eq_2_rd3_t1,robust_se_eq_2_rd3_t2,robust_se_eq_2_rd3_t3),style="default",type="text",out="spilltable.htm")


#comparison  -6- -table w coeff-
#without norm
stargazer(eq_2_rd1_0t2,eq_2_rd2_t2,eq_2_rd3_t2, style="default",se = list(robust_se_2_eq_2_rd1_0t2,robust_se_eq_2_rd2_t2,
robust_se_eq_2_rd3_t2),type="text",out="spilltable.htm")
stargazer(eq_2_rd1_0t3,eq_2_rd2_t1,eq_2_rd3_t1, style="default",se = list(robust_se_3_eq_2_rd1_0t3,robust_se_eq_2_rd2_t1,
robust_se_eq_2_rd3_t1),type="text",out="spilltable.htm")
stargazer(eq_2_rd1_0t1,eq_2_rd1_0t3,eq_2_rd2_t1,eq_2_rd3_t1,se = list(robust_se_1_eq_2_rd1_0t1,robust_se_2_eq_2_rd1_0t2,
robust_se_eq_2_rd2_t1,robust_se_eq_2_rd3_t1), style="default",type="text",out="spilltable.htm")

eq_2_rd4_t1<-plm(DW_Long_term_yield~ DW_USD_MC+DW_EUR_MC+DW_JPY_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd4_t2<-plm(DW_Long_term_yield~ D30LFED_BS_2+D30LECB_BS_2+D30LBOJ_BS_2+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd4_t3<-plm(DW_Long_term_yield~
```

```
DW_USD_MC+DW_EUR_MC+DW_JPY_MC+D30LFED_BS_2+D30LECB_BS_2+D30LBOJ_BS_2+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_eq_2_rd4_t1 <-         sqrt(diag(vcovSCC(eq_2_rd4_t1)))
robust_se_eq_2_rd4_t2 <-         sqrt(diag(vcovSCC(eq_2_rd4_t2)))
robust_se_eq_2_rd4_t3 <-        sqrt(diag(vcovSCC(eq_2_rd4_t3)))

stargazer(eq_2_rd4_t1,eq_2_rd4_t2,eq_2_rd4_t3,se =
list(robust_se_eq_2_rd4_t1,robust_se_eq_2_rd4_t2,robust_se_eq_2_rd4_t3),style="default",type="text",out="spilltable.htm")

#normalize
eq_2_rd51_t6_B1 <-plm(NORMDLong_term_yield~ NORMDUSD_MC+NORMDDEPO3M+NORMDVIX_index+NORMDFX_USD ,data=weeklypanel,
effect="individual",model='fd',  index = c("Country_long","Date"))
eq_2_rd51_t6_B2 <-plm(NORMDLong_term_yield~ NORMDEUR_MC+NORMDDEPO3M+NORMDVIX_index+NORMDFX_USD ,data=weeklypanel,
effect="individual",model='fd',  index = c("Country_long","Date"))
eq_2_rd51_t6_B3 <-plm(NORMDLong_term_yield~ NORMDJPY_MC+NORMDDEPO3M+NORMDVIX_index+NORMDFX_USD ,data=weeklypanel,
effect="individual",model='fd',  index = c("Country_long","Date"))
eq_2_rd51_t6_B4 <-plm(NORMDLong_term_yield~ NORMDAE_MC+NORMDDEPO3M+NORMDVIX_index+NORMDFX_USD ,data=weeklypanel,
effect="individual",model='fd',  index = c("Country_long","Date"))
eq_2_rd51_t6_B5 <-plm(NORMDLong_term_yield~ NORMDUSD_MC+NORMDEUR_MC+NORMDJPY_MC+NORMDDEPO3M+NORMDVIX_index+NORMDFX_USD
,data=weeklypanel, effect="individual",model='fd',  index = c("Country_long","Date"))
robust_se_eq_2_t6_B1 <- sqrt(diag(vcovSCC(eq_2_rd51_t6_B1)))
robust_se_eq_2_t6_B2 <- sqrt(diag(vcovSCC(eq_2_rd51_t6_B2)))
robust_se_eq_2_t6_B3 <-sqrt(diag(vcovSCC(eq_2_rd51_t6_B3)))
robust_se_eq_2_t6_B4 <-sqrt(diag(vcovSCC(eq_2_rd51_t6_B4)))
robust_se_eq_2_t6_B5 <-sqrt(diag(vcovSCC(eq_2_rd51_t6_B5)))
stargazer(eq_2_rd51_t6_B4,eq_2_rd51_t6_B1,eq_2_rd51_t6_B2,eq_2_rd51_t6_B3,se =
list(robust_se_eq_2_t6_B4,robust_se_eq_2_t6_B1,robust_se_eq_2_t6_B2,robust_se_eq_2_t6_B3),style="default",type="text",out="spilltable.
summary(eq_2_rd51_t6_B5,vcov = vcovSCC)

#shocks with 1_2pct of vars -7-
quantile(weeklypanel$DW_JPY_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
quantile(weeklypanel$DW_USD_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
quantile(weeklypanel$DW_EUR_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)
quantile(weeklypanel$DW_JPY_MC, probs=c(.01,.02, .98, .99), na.rm=TRUE)

# -8- -top1pct is shown only-
eq_2_rd7b_t1<-plm(DW_Long_term_yield~ TOP1E_DW_ALL_MC+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
#22 rows missing
#event study analysis -9-
eq_2_rd6_t1<-plm(DW_Long_term_yield~ WES_EV_Fed_Easing_ASP +DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd6_t2<-plm(DW_Long_term_yield~ WES_EV_Fed_Easing_Other +DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_2_rd6_t3<-plm(DW_Long_term_yield~ WES_EV_Fed_Easing_All +DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))

stargazer(eq_2_rd6_t1,eq_2_rd6_t2,eq_2_rd6_t3, style="default",type="text",out="spilltable.htm")
#58 rows missing

#pgmm -10-

monthly<-pdata.frame(monthlypanel0,index = c("Country_long","Date"))
monthly_GMM_t1<- subset(monthly,as.Date(Date) >= as.Date("2008-01-01"))
monthly_GMM<- subset(monthly_GMM_t1,as.Date(Date) <= as.Date("2020-01-01"))

eq_G3B_t7_1<-pgmm(Long_term_yield~lag(Long_term_yield,1)+USD_MC+lag(USD_MC,1)
                  | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")

eq_G3B_t7_2<-pgmm(Long_term_yield~lag(Long_term_yield,1)+EUR_MC+lag(EUR_MC,1)
                  | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")

eq_G3B_t7_3<-pgmm(Long_term_yield~lag(Long_term_yield,1)+JPY_MC+lag(JPY_MC,1)
                  | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")

eq_G3B_t7_4<-pgmm(Long_term_yield~lag(Long_term_yield,1)+USD_MC+lag(USD_MC,1)+EUR_MC+lag(EUR_MC,1)+JPY_MC+lag(JPY_MC,1)
                  | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")

stargazer( eq_G3B_t7_1,eq_G3B_t7_2,eq_G3B_t7_3,eq_G3B_t7_4, style="default",type="text",out="spilltable.htm")

#--Chapter 6 --- regions

#-11- table w region dummies
eq_5_rd21_t12<-plm(DW_Long_term_yield~ DW_USD_MC*IsCEE+DW_USD_MC*IsLatAm+DW_DEPO3M+DW_FX_USD,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_5_rd21_t22<-plm(DW_Long_term_yield~ DW_EUR_MC*IsCEE+DW_EUR_MC*IsLatAm+DW_DEPO3M+DW_FX_USD,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_5_rd21_t32<-plm(DW_Long_term_yield~ DW_JPY_MC*IsCEE+DW_JPY_MC*IsLatAm+DW_DEPO3M+DW_FX_USD ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_eq_5_rd21_t12 <- sqrt(diag(vcovSCC(eq_5_rd21_t12)))
robust_se_eq_5_rd21_t22 <- sqrt(diag(vcovSCC(eq_5_rd21_t22)))
robust_se_eq_5_rd21_t32 <- sqrt(diag(vcovSCC(eq_5_rd21_t32)))
stargazer(eq_5_rd21_t12,eq_5_rd21_t22,eq_5_rd21_t32, se =
list(robust_se_eq_5_rd21_t12,robust_se_eq_5_rd21_t22,robust_se_eq_5_rd21_t32),style="default",type="text",out="spilltable.htm")

#-12- subsetting
#subsetting fed

eq_5_rd21_s12<-plm(DW_Long_term_yield~ DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index,  data=weeklypanel_Asia,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_5_rd21_s22<-plm(DW_Long_term_yield~ DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index,  data=weeklypanel_CEE,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_5_rd21_s32<-plm(DW_Long_term_yield~ DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index,  data=weeklypanel_LatAm,
effect="individual",model='within',  index = c("Country_long","Date"))
robust_se_eq_5_rd21_s12 <- sqrt(diag(vcovSCC(eq_5_rd21_s12)))
robust_se_eq_5_rd21_s22 <- sqrt(diag(vcovSCC(eq_5_rd21_s22)))
robust_se_eq_5_rd21_s32 <- sqrt(diag(vcovSCC(eq_5_rd21_s32)))
stargazer(eq_5_rd21_s12,eq_5_rd21_s22,eq_5_rd21_s32, se =
list(robust_se_eq_5_rd21_s12,robust_se_eq_5_rd21_s22,robust_se_eq_5_rd21_s32),style="default",type="text",out="spilltable.htm")
#48 rows missing

#-14- market shocks vs region table
#top1E - rest is done similarly
#sliced
```

```
eq_5c_rd4_t1<-plm(DW_Long_term_yield~ TOP1E_DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_Asia,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_5c_rd4_t2<-plm(DW_Long_term_yield~ TOP1E_DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_CEE,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_5c_rd4_t3<-plm(DW_Long_term_yield~ TOP1E_DW_USD_MC+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel_LatAm,
effect="individual",model='within',  index = c("Country_long","Date"))
#23 rows
#pgmm w regions

eq_G3B_t7_12<-pgmm(Long_term_yield~lag(Long_term_yield,1)+IsCEE*USD_MC+IsCEE*lag(USD_MC,1)+IsCEE*EUR_MC+IsCEE*lag(EUR_MC,1)
                   | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")
eq_G3B_t7_13<-pgmm(Long_term_yield~lag(Long_term_yield,1)+IsLatAm*USD_MC+IsLatAm*lag(USD_MC,1)+IsLatAm*EUR_MC+IsLatAm*lag(EUR_MC,1)
                   | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")
eq_G3B_t7_14<-pgmm(Long_term_yield~lag(Long_term_yield,1)+IsAsia*USD_MC+IsAsia*lag(USD_MC,1)+IsAsia*EUR_MC+IsAsia*lag(EUR_MC,1)
                   | VIX_index+CPI_YOY, data=monthly_GMM, effect="individual",model="onestep",transformation="ld")
stargazer( eq_G3B_t7_12,eq_G3B_t7_13,eq_G3B_t7_14, style="default",type="text",out="spilltable.htm")

#better than region
#dummies -15-
#variables_to_be_replaced
weeklypanel$CO_FLOAT <- ifelse(weeklypanel$Country_long %in% c('Brazil','Chile','Colombia','Hungary','Indonesia', 'Mexico','Peru',
'Philippines', 'Poland','South Korea','Turkey'), 1, 0)
weeklypanel$CO_HINT <- ifelse(weeklypanel$Country_long %in% c('Brazil','Colombia','Hungary','Indonesia', 'Mexico','Peru',
'Philippines', 'Poland','Romania','Turkey'), 1, 0)
weeklypanel$CO_HCPI <- ifelse(weeklypanel$Country_long %in% c('Brazil','Colombia','Hungary','Indonesia', 'Mexico','Peru',
'Philippines', 'Chile','Romania','Turkey'), 1, 0)
weeklypanel$CO_LGDP <- ifelse(weeklypanel$Country_long %in% c('Chile','Czech Republic','Hong Kong', 'Hungary','Poland','Romania',
'Singapore', 'South Korea', 'Taiwan', 'Turkey'), 1, 0)
weeklypanel$CO_HCDS<-ifelse(weeklypanel$Country_long%in%c('Brazil',
'Colombia','HongKong','Hungary','Malaysia','Mexico','Peru','Philippines',
'Romania','Turkey'),1,0)
weeklypanel$CO_HPOL<-ifelse(weeklypanel$Country_long%in%c('Brazil','China',
'Colombia', 'Indonesia', 'Mexico', 'Peru', 'Philippines', 'Romania',
'Thailand', 'Turkey' ), 1, 0)


#regression
eq_9_rd1_1<-plm(DW_Long_term_yield~ DW_USD_MC+DW_USD_MC*CO_FLOAT+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_9_rd1_2<-plm(DW_Long_term_yield~ DW_USD_MC+DW_USD_MC*CO_HINT+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_9_rd1_3<-plm(DW_Long_term_yield~ DW_USD_MC+DW_USD_MC*CO_HCPI+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_9_rd1_4<-plm(DW_Long_term_yield~ DW_USD_MC+DW_USD_MC*CO_LGDP+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_9_rd1_5<-plm(DW_Long_term_yield~ DW_USD_MC+DW_USD_MC*CO_HCDS+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))
eq_9_rd1_6<-plm(DW_Long_term_yield~ DW_USD_MC+DW_USD_MC*CO_HPOL+DW_DEPO3M+DW_FX_USD+DW_VIX_index ,  data=weeklypanel,
effect="individual",model='within',  index = c("Country_long","Date"))

robust_se_eq_9_rd1_1 <- sqrt(diag(vcovSCC(eq_9_rd1_1)))
robust_se_eq_9_rd1_2 <- sqrt(diag(vcovSCC(eq_9_rd1_2)))
robust_se_eq_9_rd1_3 <- sqrt(diag(vcovSCC(eq_9_rd1_3)))
robust_se_eq_9_rd1_4 <- sqrt(diag(vcovSCC(eq_9_rd1_4)))
robust_se_eq_9_rd1_5 <- sqrt(diag(vcovSCC(eq_9_rd1_5)))
robust_se_eq_9_rd1_6 <- sqrt(diag(vcovSCC(eq_9_rd1_6)))
summary(eq_9_rd1_2, vcov = vcovSCC)
sgive me a shout if_u (ever read)
stargazer(eq_9_rd1_1,eq_9_rd1_2,eq_9_rd1_3,eq_9_rd1_4,se = list(robust_se_eq_9_rd1_1,robust_se_eq_9_rd1_1,
robust_se_eq_9_rd1_1,robust_se_eq_9_rd1_1), style="default",type="text",out="spilltable.htm")
stargazer(eq_9_rd1_5,eq_9_rd1_6,se = list(robust_se_eq_9_rd1_5,robust_se_eq_9_rd1_6),
style="default",type="text",out="spilltable.htm")
#61 rows missing

#Chapter 7 - Country level analysis
#Sens scores
mypanelc2__BRA_2009<-subset(weeklypanel,weeklypanel$Country_sh=="BRA"&weeklypanel$Year=="2009")
mypanelc2__BUL_2009<-subset(weeklypanel,weeklypanel$Country_sh=="BUL"&weeklypanel$Year=="2009")
#293 rows missing
eq_SENS_v5_1<-lm(DW_Long_term_yield~DW_AE_MC,  data=mypanelc2__BRA_2009)
eq_SENS_v5_2<-lm(DW_Long_term_yield~DW_AE_MC,  data=mypanelc2__BUL_2009)
#
eq_SENS_v5_1[["effects"]][["DW_AE_MC"]]
eq_SENS_v5_2[["effects"]][["DW_AE_MC"]]
#
#standardized

eq_SENS_v6_1<-lm(NORMDLong_term_yield~NORMDAE_MC,  data=mypanelc2__BRA_2009)
eq_SENS_v6_2<-lm(NORMDLong_term_yield~NORMDAE_MC,  data=mypanelc2__BUL_2009)
#
eq_SENS_v6_1[["effects"]][["NORMDAE_MC"]]
eq_SENS_v6_2[["effects"]][["NORMDAE_MC"]]
#
eq_SENS_v7_1<-lm(DW_FXC_Long_term_yield~DW_AE_MC,  data=mypanelc2__BRA_2009)
eq_SENS_v7_2<-lm(DW_FXC_Long_term_yield~DW_AE_MC,  data=mypanelc2__BUL_2009)
#
eq_SENS_v8_1<-lm(NORMDWFX_USD~NORMDAE_MC,  data=mypanelc2__BRA_2009)
eq_SENS_v8_2<-lm(NORMDWFX_USD~NORMDAE_MC,  data=mypanelc2__BUL_2009)
#
eq_SENS_v9_1<-lm(DWFX_USD~NORMDAE_MC,  data=mypanelc2__BRA_2009)
eq_SENS_v9_2<-lm(DWFX_USD~NORMDAE_MC,  data=mypanelc2__BUL_2009)
#
#not random
vulnt4_1<- lm(VUL5H ~ CDSY+Volat_10DY, data=vulnerabilitypanel2)
vulnt4_2<- lm(VUL6H ~ CDSY+Volat_10DY, data=vulnerabilitypanel2)
vulnt4_3<- lm(VUL7H ~ CDSY+Volat_10DY, data=vulnerabilitypanel2)
vulnt4_4<- lm(VUL8H ~ CDSY+Volat_10DY, data=vulnerabilitypanel2)
vulnt4_5<- lm(VUL9H ~ CDSY+Volat_10DY, data=vulnerabilitypanel2)

stargazer(vulnt4_1,vulnt4_2,vulnt4_3,vulnt4_4,vulnt4_5, style="default",type="text",out="spilltable.htm")

#macro
#-18- unconsequent numbering
vuln_mac_11<-lm(VUL5H~GDP_YOY+CPI_YOY_Y+UNEMPY,data=vulnerabilitypanel2)
```

```
summary(vuln_mac_1)
cov_mac_11<-vcovHC(vuln_mac_11, type = "HC1")
robust_se_vuln_mac_11<-sqrt(diag(cov_mac_11))
vuln_mac_2<-lm(VUL6H~GDP_YOY+CPI_YOY_Y+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_2<-vcovHC(vuln_mac_2, type = "HC1")
robust_se_vuln_mac_2<-sqrt(diag(cov_mac_2))
vuln_mac_3<-lm(VUL5H~DY_CPI_YOY+DY_GDP_YOY+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_vuln_mac_3<-vcovHC(vuln_mac_3, type = "HC1")
robust_se_vuln_mac_3<-sqrt(diag(cov_mac_vuln_mac_3))
vuln_mac_4<-lm(VUL6H~DY_CPI_YOY+DY_GDP_YOY+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_vuln_mac_4<-vcovHC(vuln_mac_4, type = "HC1")
robust_se_mac_vuln_mac_4<-sqrt(diag(cov_mac_vuln_mac_4))
stargazer( vuln_mac_11,vuln_mac_2,vuln_mac_3,vuln_mac_4, se = list(robust_se_vuln_mac_11,robust_se_vuln_mac_2,
robust_se_vuln_mac_3,robust_se_mac_vuln_mac_4),style="default",type="text",out="spilltable.htm")
vulnerabilitypanel2$DY_CPI_YOY_Y

vuln_mac_11<-lm(VUL8H~GDP_YOY+CPI_YOY_Y+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_11<-vcovHC(vuln_mac_11, type = "HC1")
robust_se_vuln_mac_11<-sqrt(diag(cov_mac_11))
vuln_mac_2<-lm(VUL9H~GDP_YOY+CPI_YOY_Y+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_2<-vcovHC(vuln_mac_2, type = "HC1")
robust_se_vuln_mac_2<-sqrt(diag(cov_mac_2))
vuln_mac_3<-lm(VUL8H~DY_CPI_YOY+DY_GDP_YOY+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_vuln_mac_3<-vcovHC(vuln_mac_3, type = "HC1")
robust_se_vuln_mac_3<-sqrt(diag(cov_mac_vuln_mac_3))
vuln_mac_4<-lm(VUL9H~DY_CPI_YOY+DY_GDP_YOY+UNEMPY,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_vuln_mac_4<-vcovHC(vuln_mac_4, type = "HC1")
robust_se_mac_vuln_mac_4<-sqrt(diag(cov_mac_vuln_mac_4))
stargazer( vuln_mac_11,vuln_mac_2,vuln_mac_3,vuln_mac_4, se = list(robust_se_vuln_mac_11,robust_se_vuln_mac_2,
robust_se_vuln_mac_3,robust_se_mac_vuln_mac_4),style="default",type="text",out="spilltable.htm")
vulnerabilitypanel2$DY_CPI_YOY_Y

#-17-
vuln_mac_1<-lm(VUL5H~Financial_Openness_Index+POL_RISK+FD,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_1<-vcovHC(vuln_mac_1, type = "HC1")
robust_se_vuln_mac_1<-sqrt(diag(cov_mac_1))
vuln_mac_2<-lm(VUL6H~Financial_Openness_Index+POL_RISK+FD,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_2<-vcovHC(vuln_mac_2, type = "HC1")
robust_se_vuln_mac_2<-sqrt(diag(cov_mac_2))
vuln_mac_3<-lm(VUL8H~Financial_Openness_Index+POL_RISK+FD,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_vuln_mac_3<-vcovHC(vuln_mac_3, type = "HC1")
robust_se_vuln_mac_3<-sqrt(diag(cov_mac_vuln_mac_3))
vuln_mac_4<-lm(VUL9H~Financial_Openness_Index+POL_RISK+FD,data=vulnerabilitypanel2)
summary(vuln_mac_1)
cov_mac_vuln_mac_4<-vcovHC(vuln_mac_4, type = "HC1")
robust_se_mac_vuln_mac_4<-sqrt(diag(cov_mac_vuln_mac_4))
stargazer( vuln_mac_1,vuln_mac_2,vuln_mac_3,vuln_mac_4, se = list(robust_se_vuln_mac_1,robust_se_vuln_mac_2,
robust_se_vuln_mac_3,robust_se_mac_vuln_mac_4),style="default",type="text",out="spilltable.htm")

#on financial policy
vuln_51<-lm_robust(VUL5~YAVG_DEPO3M,data=vulnerabilitypanel2)
vuln_52<-lm_robust(VUL5~NYCHG_DEPO3M,data=vulnerabilitypanel2)
vuln_53<-lm_robust(VUL5~STDEV_DEPO3M,data=vulnerabilitypanel2)
vuln_54<-lm_robust(VUL5~YAVG_LYLD...54,data=vulnerabilitypanel2)
vuln_55<-lm_robust(VUL5~NYCHG_LYLD,data=vulnerabilitypanel2)
vuln_56<-lm_robust(VUL5~STDEV_LYLD,data=vulnerabilitypanel2)
vuln_57<-lm_robust(VUL5~STDEV_FX_USD,data=vulnerabilitypanel2)
vuln_58<-lm_robust(VUL5~YEAR_MAXMINCHG_FX,data=vulnerabilitypanel2)
vuln_59<-lm_robust(VUL5~YEAR_MAXMINCHG_FX_SAMPNORM,data=vulnerabilitypanel2)
vuln_510<-lm_robust(VUL5~YAVG_DMAXpDMIN_FX,data=vulnerabilitypanel2)
vuln_511<-lm_robust(VUL5~STDEV_FX_JpmReef,data=vulnerabilitypanel2)
vuln_512<-lm_robust(VUL5~NYCHG_FX_JpmReef,data=vulnerabilitypanel2)
vuln_513<-lm_robust(VUL5~SAMPNORM_YCHG_3MDEPO,data=vulnerabilitypanel2)
vuln_514<-lm_robust(VUL5~SAMPNORM_YCHG_LYD,data=vulnerabilitypanel2)
vuln_515<-lm_robust(VUL5~YAVG_VOLATFX10D,data=vulnerabilitypanel2)
vuln_516<-lm_robust(VUL5~YAVG_VOLATFXIMP1M,data=vulnerabilitypanel2)
vuln_517<-lm_robust(VUL5~DYAVG_3M,data=vulnerabilitypanel2)
vuln_518<-lm_robust(VUL5~DYAVG_LYD,data=vulnerabilitypanel2)
vuln_519<-lm_robust(VUL5~DYFXpc,data=vulnerabilitypanel2)

vuln_61<-lm_robust(VUL6~YAVG_DEPO3M,data=vulnerabilitypanel2)
vuln_62<-lm_robust(VUL6~NYCHG_DEPO3M,data=vulnerabilitypanel2)
vuln_63<-lm_robust(VUL6~STDEV_DEPO3M,data=vulnerabilitypanel2)
vuln_64<-lm_robust(VUL6~YAVG_LYLD...54,data=vulnerabilitypanel2)
vuln_65<-lm_robust(VUL6~NYCHG_LYLD,data=vulnerabilitypanel2)
vuln_66<-lm_robust(VUL6~STDEV_LYLD,data=vulnerabilitypanel2)
vuln_67<-lm_robust(VUL6~STDEV_FX_USD,data=vulnerabilitypanel2)
vuln_68<-lm_robust(VUL6~YEAR_MAXMINCHG_FX,data=vulnerabilitypanel2)
vuln_69<-lm_robust(VUL6~YEAR_MAXMINCHG_FX_SAMPNORM,data=vulnerabilitypanel2)
vuln_610<-lm_robust(VUL6~YAVG_DMAXpDMIN_FX,data=vulnerabilitypanel2)
vuln_611<-lm_robust(VUL6~STDEV_FX_JpmReef,data=vulnerabilitypanel2)
vuln_612<-lm_robust(VUL6~NYCHG_FX_JpmReef,data=vulnerabilitypanel2)
vuln_613<-lm_robust(VUL6~SAMPNORM_YCHG_3MDEPO,data=vulnerabilitypanel2)
vuln_614<-lm_robust(VUL6~SAMPNORM_YCHG_LYD,data=vulnerabilitypanel2)
vuln_615<-lm_robust(VUL6~YAVG_VOLATFX10D,data=vulnerabilitypanel2)
vuln_616<-lm_robust(VUL6~YAVG_VOLATFXIMP1M,data=vulnerabilitypanel2)
vuln_617<-lm_robust(VUL6~DYAVG_3M,data=vulnerabilitypanel2)
vuln_618<-lm_robust(VUL6~DYAVG_LYD,data=vulnerabilitypanel2)
vuln_619<-lm_robust(VUL6~DYFXpc,data=vulnerabilitypanel2)

#This is the end of the R code extract.
#This is the end of the thesis. Thank you for reading, I appreciate it.
```