Monetary spillover effect from the US to the Selected Emerging Market Economies: Europe and others

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This paper refelcts the past and recent experience of the Federal Reserve Bank (Fed) related to its policy of Quantitative Tightening (QT) and its effect on BRICS and other selected emerging market (EM) countries in the Europe. We intend to show that the long-end yields were unanchored till the starting of QT. We selected a sample of coutries to examine the impact of the Fed's QT on 10-year government bond yields, between the period of 2012-2022. The result proves that the highest correlation between the long-end yields of the United States and the selected EM has materialized exactly during the first QT operation by the Fed, between 2017 and 2019 and we expected the same behaviour of long-end yields during the second QT policy for the selected EM countries.

JEL codes: E52: Monetary Policy, G15: International Financial Markets, O23: Fiscal and Monetary Policy in Development

Keywords: Emerging market, Monetary transmission mechanism, Taper tantrum

Preliminaries

The background motivation was to investigate in the relation of long-end yields affected from a hegemon country (USA) towards the selected group of countries (BRICS). QT became relevant as it supports tightening of conventional monetary policy, with the similar contribution of avoiding further inflationary pressures, which we could observe in recent business cycle. Lim, Mohapatra, and Stocker (2014) from the World Bank evidented that the unconventional monetary policy in form of Quantitative Easing affects gross financial inflow from the United States to the other advanced and developing countries, where the government bond flow channel tends to be even more sensitive than other foreign direct investments. a comparison analysis related to the existing Blanchard and Quah (1989) literature - incorporates inflationary timeframe of 1970s – where the economic assumption is that, the demand shocks have no lasting effect on income levels. This paper also discovers the behaviour of growth and unemployment rate, when there is demand and supply shock.The effects of QT are immediately visible in interest rates and asset prices, and in the spillover effect to EM countries. This paper demonstrates addition to the existing World Bank literature, it discovers the behaviour of long-

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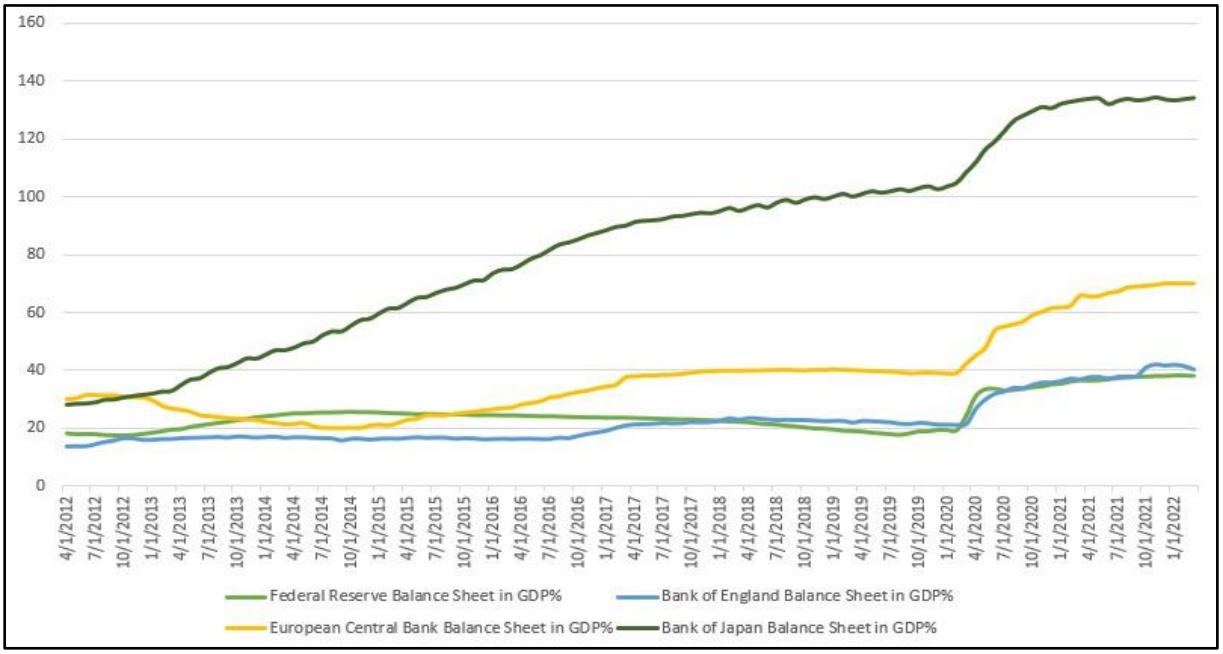
term government bond yields effect from the policy of QT. In this environment, it was important to examine the behaviour of the impact countries. We considered that statistical tools can in decent way interprete the spillover effect form the US to other emerging markets.

Figure 1. Balance Sheet Comparison of the Major Central Banks (in *Percentage*)



Note: *Figure 1*. shows the balance sheet comparison of the four major central banks for nearly a decade period. Actually, if we see, it starts from a moderate level and than increases gradually. It is visible that the liquidity excess is much higher in 2022 than in 2012. The balance sheet level of the Fed and the Bank of England in the GDP percentage is slowly following each other. While, the Bank of Japan's acceleration was outstanding compared to its peers. The European Central Bank follows the same tendency such as the Fed and the Bank of England, only with a greater volume.

Data source: Bloomberg

Over the last few years, several emerging economies have raised their sovereign debt level to tackle the impact of the Covid-19 pandemic. In order to cover their accelerated budget deficit, the governments issued more securities, where in the role of investors were not only the traditional public or the private sector appeared, but also the financial institutions, such as the central bank, for instance the Fed. These institutions, without any obligation or government forces have the autonomy to purchase securities with free will and unimpeded decision-making about the financial transactions. In the response to Covid-19, the monetary authority of the United States, the Fed, initiated an unconventional monetary policy in the form of Quantitative Easing (QE) through its asset purchase program, which led to a significant expansion of its balance sheet (*Figure 1*.). It was the fourth Quantitative Easing (QE4) operation since the global financial crisis. According to this latest operation, the Fed announced a $700 billion purchase of assets on March 15, 2020[1]: respectively $500 billion of treasury securities and $200 billion of Mortgage-Backed Securities (MBS) to support the liquidity needs of the financial market in response to the pandemic[2].

Under these circumstances, the accumulation of securities more than doubled on the Fed's balance sheet compared to the period before the pandemic. It increased from $4 trillion to $9 trillion in the form of Treasuries and MBS. Due to the uncertainty surrounding the Covid-19

pandemic, it was not possible to predict how much the balance sheet of Central Banks would increase. By the end of 2020, the Fed's balance sheet was standing at 34% of GDP in the U.S., contemporaneously, the ECB's at 59% in Europe, the Bank of England's 40%, and the Bank of Japan's 127%. Consequently, the Fed's policymakers signaled that the balance sheet is higher than the average level, and further shrinkage is necessary to happen in 2022. The Fed's asset purchase program ended in March 2022[3]. The list of same open market purchase transaction according to the International Monetary Fund was utilized by the large number of other countries from the advanced and EM economies[4].

It raises a question that, why is Quantitative Tightening an appropriate monetary policy tool for the current macroeconomic environment? Besides, the Fed's intention to normalize its primary policy rate,[5] the first motivation we see in building-up further the already existing principles from the past experience of first QT, which was between the period of 2017-2019. Second motivation, relies on the need to reduce its huge accumulated balance sheet, which can be done only by QT. The third motivation, inflation was increasing[6] and complementary tightening tool was required, which is QT again.

In comparison, the QE decreases interest rates and creates an easing monetary environment, while contrary QT increases long-end yields. The latter is also designed to maintain the system without collapsing the financial market. Lim, Mohapatra, and Stocker (2014) from World Bank found that 62% of the increase in financial inflows was during 2009–2013 from the US to other advanced and developing countries, where at least 13% of this was attributed to QE in high- income countries and 5% for the average developing countries. We estimated that the monetary policy shock from the U.S. raises long-term yields by 42.70 basis points related to the top five- major emerging market with high population (called BRICS) and 85.32 basis points for other selected emerging markets with low population.

The paper is organized as follows. Section 1. defines quantitative tightening from the perspective of active and passive approach, which was differentiated. The Section 2. provides an overview of the literature. The Section 3. describes a comparative analysis of the prior and current cycle of the balance sheet tightening policy. The Section 4. demonstrates the monetary transmission channels. Section 5. documents the economic outlook. Finally, Section 6. summarizes the main results.

1. The program: Quantitative Tightening

Quantitative Tightening or Quantitative Tapering is a process of decreasing the fixed-income *assets* held by a central bank. This paper differentiate the active and passive approch. Namely, the active approach means shrinkage of the balance sheet by actively selling securities. The passive approach means that the securities on the balance sheet expire automatically without any financial transaction. In the very last phase of the process, when treasury securities reach their maturity date, they are paid off by the government. While, the Mortgage-backed securities are paid off by government-sponsored enterprises, such as the Federal National Mortgage Association or the Federal Home Loan Mortgage Corporation.

The Fed's balance sheet assumes equality on both the *assets* and liabilities side (*Table 1.*). The assets side consists primarily of U.S. Treasury Securities and Mortgage-Backed Securities. The liabilities include Federal Reserve notes and the reserve deposits, which banks and other depository institutions hold with the Fed. The tightening process of selling securities causes an increase in supply, which pushes the prices lower, and accordingly, the yields are adjusted upward. In the history, the First Quantitative Tightening (QT1) lasted for less than two years, between 2017 and 2019. Essentially, this tightening policy had never been done before on a massive scale in the United States. Engemann (2019) defines it as redeeming or reducing the Fed's balance sheet size. However, Hopper (2018) reflects on it as the normalization of monetary policy through "unwinding", where the term "unwinding" means the slow and gradual nature of the reduction of the Fed's balance sheet, which expanded in size after the global financial crisis. Alternatively, Wheelock (2018), interpreted "unwinding" as simply stopping the replacement of securities that mature. Additionally, Waller (2018) pointed out that it is a process of increasing the supply of Treasuries in the financial market, where the Fed explicitly lets the supply of Treasuries in the hands of the private sector grow.

Table 1. Federal Reserve Balance Sheet (billion$)

Assets		**Liabilities**	
U.S. Treasury securities	5,700	Reserves (*depository institutions*)	3,271
MBS	2,726	Repurchase agreements	2,494
Other	425	Currency	2,276
		Treasury general account	530
		Other	280
Total	**8,851**	**Total**	**8,851**

Note: Balance sheet composition of total assets and liabilities.

Data source: Federal Reserve statistical release (H.4.1.), August 25, 2022

The Federal Open Market Committee (FOMC) members implemented the second quantitative tightening program (QT2) in addition to hiking rates starting on June 1, 2022. Two main reasons can be found behind the voting for quantitative tightening program:

1.) the inflation is much higher than the average level and this complementary tightening operation could help to fight against inflation. The price increasing in the supply chain and also in the energy, fuel, and non-durable goods prices, inflation remained elevated throughout 2022.

2.) over-accumulation of assets on the Fed's balance sheet urge quantitative tightening operation.

According to the Fed's past experience, starting the QT2 was subject to condition of being over the zero lower bound. Therefore, the Federal Funds Target Rate increased from 0.08% (range 0.00-0.25) to 0.33% (range 0.25-0.50) in mid-March, 2022; then from 0.33% (range 0.25-0.50) to 0.83% (range 0.75-1.00) at the beginning of May, 2022. After that, the base rate further increased from 0.83% (range 0.75-1.00) to 1.58% (range 1.50-1.75) in mid-June, 2022. The treasury securities are initially set at $30 billion per month from June, 2022. Then, after three months, from September 2022, the selling was set at $60 billion per month. In comparison, MBS was initially set at $17.5 billion per month. After three months, from September 2022 to be increased to $35 billion per month.

2. Literature review

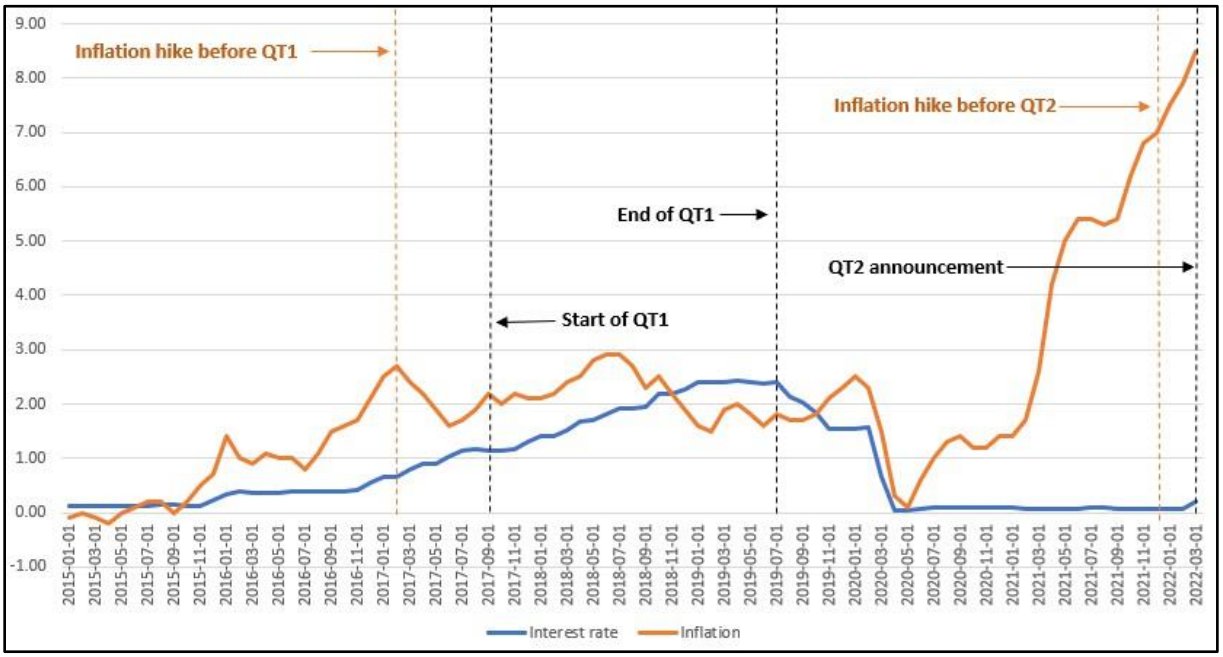
Monetary policy has gone through various changes over the last decades, which witnessed the end of the "*reserve position doctrine*" and the turn to a clear focus on short-term and long-term interest rates. The reserve position doctrine was supported by Keynes and later by the monetarist school, developed mainly by the U.S. central bankers during the early 1920s. It became the unchallenged principle for over sixty years. Bindseil (2003) reflects in his book on monetary policy history and explains the three supporting instruments of monetary policy: open market operations, standing facilities, and reserve requirements, where open market operations are the subject of QE and QT. Five years ago, the incumbents thought that the balance sheet was a poorly understood tool according to Hollenhorst et al. (2022) and any further effect on the markets should be slowly and quietly unwound. D'Amico and Seida (2020) performed a quantitative analysis, and they found that the yield sensitivities of QT are more prominent on average, than yield sensitivities of QE. While, Goodhart (2010) emphasizes the role of the central bank through its balance sheet operations. These financial instruments serve to reach targets, where the Fed has a dual mandate: price stability and reaching maximum employment. Over the past three decades, central banks of advanced economies have established a credible track record of achieving inflation targets (Bordo et al., 2007; Eichengreen, 2022).
Cecchetti and Tucker (2021) pointed out that official declarations of aiming for price stability and financial stability are unsatisfactory if there is a jump to end goals without attending to the specific operations and facilities. The authors alternatively provide a categorization of operations: (1.) stimulating or dampening aggregate demand by monetary policy to achieve price stability with full use of the economy's productive resources; (2.) lending funds to firms whose financial needs cannot be met via private markets – central bank as a lender of last resort; (3.) addressing liquidity problems in specific markets – central bank as a market maker of last resort; (4.) ensure the flow of credit to specific sectors, regions, or firms – central bank as a selective credit supporter; (5.) providing needed funds directly to the government – central bank as in an emergency government finance role. We added here, the (6.) operation of balance sheet policy and its specific transmission mechanism channels, more details are in Section 4.

The QT has complementary effect, according to Wei (2022) estimation, a $2.2 trillion passive roll-off of nominal treasury securities from the Federal Reserve's balance is equivalent to an increase of 29 basis points in the current federal effective funds rate at ordinary times, over the three years of observations, and 74 basis points increase during the crisis periods. Similarly, Crawley et al. (2022) predict reducing the size of the balance sheet by about $2 trillion over the next few years, which would be roughly equivalent to raising the policy rate by a little more than 50 basis points.

3. Macroeconomic Outcomes: Prior vs. Current Cycle of QT

The prior cycle could serve as a reference point for the current one, where the policy rate remains the primary and active tool of the monetary policy, and the quantitative tightening program secondary and complementary tool in the background. In comparison with QT1 program, the QT2 is expected to gear up faster, related to a more rapid runoff of short-maturity Treasuries. *Figure 2*. provides an overview of the inflation behaviour through quantitative tightening programs by the Fed:

Figure 2. Quantitative Tightening and Inflation Hikes (in Percentage)



Note: Quantitative tightening program serves as a response to the inflation hike.

Data source: St. Louis Fed, U.S. Bureau of Labor Statistics

There was a plan to cut the balance sheet level by about $95 billion a month in 2022, splitting between $60 billion of Treasuries and $35 billion of MBS. It is almost double of $50 billion/month targeted during the 2017-2019 cycle. When the Fed initiated its first QT1, its total balance sheet was around $4.5 trillion in size, and the Fed managed to bring it down to $3.8 trillion before the program ended. This time, the annualized monthly level of reduction works out to more than $1.1 trillion a year. The balance sheet reduction targeting is about $3 trillion in total balance sheet shrinkage over three years. The maturity structure of the treasury portfolio is longer in maturity than in the previous QT1 (Bernanke, 2022).[7] During the prior cycle span of 2017-2019, the Fed was more conservative with its balance sheet reduction, as it had initiated a decrease of only $10 billion/month, followed by a reduction of $50 billion/month. The $50 billion was split in the following way: $30 billion in Treasuries and $20 billion in MBS. It took

a full year for the Fed to reach its maximum reduction level of $50 billion/month. In the current cycle of 2022-2025, the tapering has started with a $47.5 billion/month decrease, followed by a $95 billion/month reduction from September 2022. The balance sheet decrease is $60 billion for Treasuries and $35 billion for MBS. The initiation of the tapering is followed by the increase of the interest rate target range. (Anstey 2022).

Some of the features of balance sheet tightening program, which can be observed:

1.) Money supply in the system decreases by balance sheet tightening as it induces less money in the market circulation.
2.) Small and recursive active sales – active sales of securities occur when passive runoff of Treasuries and MBS reach below the monthly target. Consequently, a small amount of sales is less likely to involve market concerns. Alternatively, there is a possibility that the Fed sells long-term Treasuries and buys short-end papers in the market. The selling of treasury security on the asset side of the balance sheet is decreasing, while the liability side of the balance sheet exactly matches the decrease in assets (Hollenhorst et al., 2022).
3.) The fact of the passive runoff of Fed's balance sheet is also relevant. Approximately, $1.3 trillion in treasury and $400 billion in MBS are projected to mature in 2023, allowing the Fed to reduce the balance sheet passively.
4.) Inflation, debt, and income inequality could endanger recovery in emerging economies, according to the World Bank's Global Economic Prospects report.[8] Growth in advanced economies is expected to decline by 3.8% in 2022 and 2.3% in 2023, while in emerging economies, growth is expected to drop by 4.6% in 2022 and 4.4% in 2023.
5.) The Fed officials can opt to reinvest toward shorter maturities, for instance, by purchasing several 3-months T-bills in form of shorther maturity resinvestments.
6.) The tightening balance sheet conditions affect yields as they start to increase, as it is seen in *Figure 3*. There is a spillover effect initiated with QT towards EM countries.
7.) The expectation of inflation shrinkage – by effective policy rate hike and balance sheet tightening policy.
8.) The trade-off between balance sheet reduction and effective funds rate hike – some market participants use the „3 to 1" rule of thumb, such that the 3-basis point (bp) move in policy rates is worth one bp on 10-year treasury yield change. The $50 billion per month of balance sheet reduction implies $600 billion per year, which is a substitution for 2% additional rate hikes per year. The Kansas City Fed President, Ester George, mentioned that policy rate hikes might slow once the balance sheet reduction starts (Hollenhorst et al., 2022).

Table 2. The remaining maturity distribution of selected assets (billion $)

Maturity	Within 15d	16d-90d	91d-1y	1y-5y	5y-10y	Over 10y	All
U.S. Treasury security holdings	78,233	324,425	819,487	2,017,728	1,009,321	1,451,434	5,700,628
Weekly changes	-44	+615	-505	+565	+22,583	-21,761	+1,453
MBS holdings	0	2	57	2,412	57,525	2,665,909	2,725,906
Weekly changes	0	0	0	-1	-2	-1,565	-1,567

Note: "d" stands for "days", "y" stands for "years".

Data source: Federal Reserve statistical release (H.4.1.), August 25, 2022

In addition to treasury and MBS securities, there are other assets on the Fed's balance sheet in a much smaller amount, such as FX swap lines and the Fed's discount window. FX swap lines provide U.S. dollars to the five major central banks. However, given the stability in U.S. dollar funding markets (Cabana, Craig 2022), its usage is minimal. T*able 3.* indicates a comparison overview of the Fed's prior versus current QT cycle, where the projections usually refer to three year period (Sengupta and Smith, 2022; Wei, 2022).

Ben Bernanke: Taper Tantrum

In 2013 Ben Bernanke, then-chairman of the Fed, recommended *tapering asset purchases*, which sent a negative shock to the market, causing bond investors to sell their bonds. The outcome was that the yield on 10-year U.S. Treasuries rose from around 2% in May 2013 to around 3% in December 2013. This sharp climb in yields is often referred to as the "*taper tantrum*".

In July 2021, Fed officials signaled that the Federal Reserve would need to reduce the volume of its bond purchases. This signal made some investors worry (Bernanke, 2022) about another "*taper tantrum*", due to its negative connotation and shock to the market. Despite these fears, most investors remained placid when the Fed hinted at tapering in July 2021. The treasury yield remained around 1.3%, declining from its recent peak in early April 2021. Comparing bond market reactions in 2013 with 2021, one explanation for this difference in market responses stands out. Essentially, the announcement in 2021 was in line with market expectations, and the announcement in 2013 came much earlier than expected. Ben Bernanke indicated that a balance sheet reduction should follow the effective policy funds rate increase as a first phase of tightning process. However, Bernanke was taking no position on the appropriate pace of overall monetary tightening. The policy communication can be easier, and the risk of market disruption is minimized if the shrinkage of the balance sheet is predictable. Since the effect of balance sheet reduction on broader financial conditions is uncertain, it is prudent not to begin that process until short-term interest rates are comfortably away from their effective lower bound. The first quantitative tightening program did not begin until rates had reached 1.00-1.25%.

Table 3. Comparison of the prior and the current cycle

Period	Quantitative Tightening (QT)
	Prior cycle (QT1)
June 2017	Plan for balance sheet reduction announced
September 2017	The balance sheet reduction started at $10 billion/month in October
October 2018	Speed of $50 billion/month ($30 billion/month treasury bills and 20$ billion/month Mortgage-Backed Securities – MBS) reached.
January 2019	The committee announced that it would implement a policy in an "ample reserves" regime.
March 2019	Announced that balance sheet reduction will be fully phased out in September 2019
July 2019	Balance sheet reduction ended two months earlier than planned, along with a 25bp cut in the policy rate.
	Current cycle (QT2)
June 2022	Balance sheet reduction from June 1. Declining split between $30 billion/month Treasuries and $17.5 billion/month Agency debt and Agency MBS.
September 2022	Rise at monthly intervals to $95 billion/month (split of $60 billion/month Treasuries and 35$ billion/month MBS).
Mid-2024	Sufficient liquidity has been drained, so the reserve repo facility (RRF) is no longer used. As a result, bank deposits may move sideways as the depletion of the RRF means reserves shrink faster.
Mid-2025	The balance sheet approaches $6 trillion in assets ($4 trillion in treasury holdings, $2 trillion in MBS holdings) and $2.5 trillion in reserves. At this point, balance sheet reduction might be slowed or stopped as Fed officials seek to maintain a comfortable level of aggregate reserves. According to estimation, the $2.2 trillion passive roll-off of nominal treasury securities from the Federal Reserve's balance sheet over three years is equivalent to an increase of 29 basis points in the current federal funds rate.

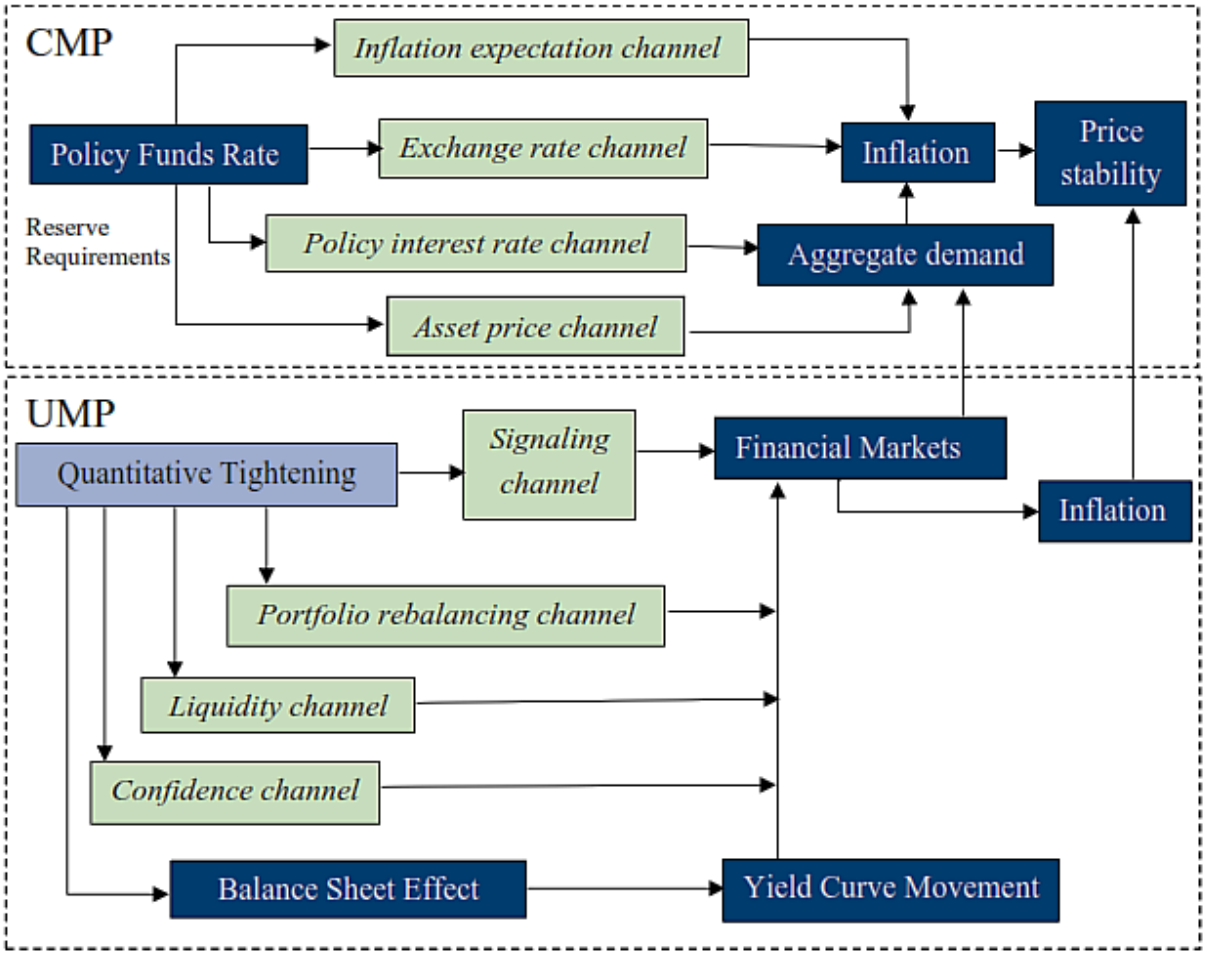
Note: Projections shown are based on Rajdeep Sengupta and A. Lee Smith: Assessing Market Conditions ahead of Quantitative Tightening, Economic Bulletin, Federal Reserve of Kansas City, 2022. and Wei, B. 2022. "*How Many Rate Hikes Does Quantitative Tightening Equal?*", Federal Reserve of Atlanta's Policy Hub, Center for Quantitative Economic Research, No. 11–2022 July 2022

Source: Fed of Kansas City, Fed of Atlanta, Fed of New York

4. The general transmission mechanism of QT

Through the transmission mechanism channel of quantitative tightening program, the asset sales affect even cross-border capital flows and market yields (Gagnon et al., 2011; Hamilton and Wu, 2012; Jacob de Haan, Schoenmaker, Wierts, 2020). Market participants adjust their investment portfolios according to the operations of the Fed through portfolio rebalancing channel. These market transactions, in turn, increase the available stock of privately held assets by buying securities. The second channel is the *signaling channel* (Jacob de Haan, Schoenmaker, Wierts 2020), where the central bank communicate its expectations according to the base rate and the quantitative tightening program. It improves the perception of financial institutions, businesses, and households by diminishing their concerns. The third is the *liquidity channel* (Gagnon et al., 2011; Joyce et al., 2011; Krishnamurthy and Vissing-Jørgensen, 2013), where its effects are moderate with less money in the financial circulation but the expansion of yields on securities.

Figure 3. Transmission mechanism of CMP and UMP



Note: The Conventional Monetary Policy (CMP) and Unconventional Monetary Policy (UMP). QT should not have any material effect through signalling channels and the portfolio balance channel has small and temporary effects on yields.

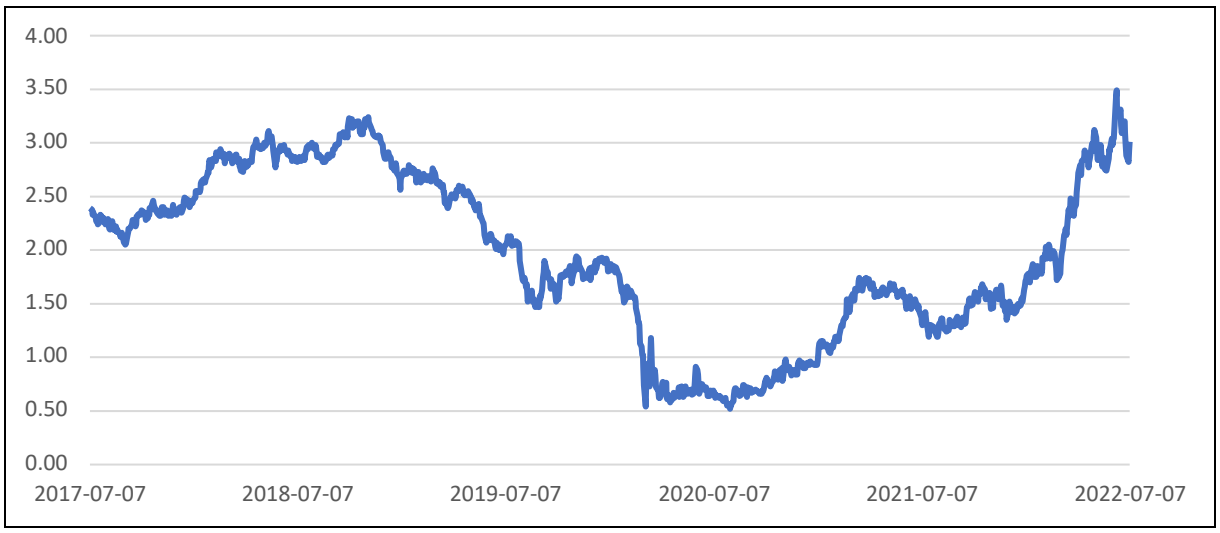
Source: Authors' analysis

Consequenly, the amount of money in circulation decreases in order to slow down inflation. Through *confidence channel* affect other countries by increasing yields of securities. The unconventional monetary policy transmission channels directly affect the yield curve and the price stability (*Figure 5.*).

5. Economic outlook

This paper reflects on the hypothesis of 10-year U.S. treasury yield and the yields of long-dated government bonds of selected EM countries. The first group is the BRICS countries with high population, and stands for the acronym associated with the five major emerging economies: *Brazil, Russia, India, China, and South Africa*. The BRICS members are known for their significant influence on their respective regional affairs, to the extent that there is even a further spillover effect to other neighboring countries in their region. The second group refers to an arbitrary sampling of the following countries: Mexico, Peru, Hungary, Greece, and Turkey. The U.S. and EM yields have moved upward during the QT1 operation between 2017 and 2019, which proves the theory of quantitative tightening program, that there is increase in yields and a strong correlation between the rates moving across the world.

Figure 4. The yield on U.S. treasury securities at 10-year constant maturity (in *Percentage*)



Note: Daily yields on 10-year U.S. Treasuries between July 2017 and July 2022.

Data source: FRED (St. Louis Fed)

The following statistical overview serves as a comparative analysis between the U.S. and the selected EM economies:

Table 4. Key Statistics of the USA and BRICS (in *Percentage*)

	April 2022			2021-2022	
	Inflation	**10-year Yields**	**Policy interest rate**	**GDP 2021Q4**	**Unemployment rate 2022Q1**
Brazil	12.1	12.29	11.75	1.60	11.1
India	7.8	7.14	4.25	5.40	7.6
China	2.1	2.84	1.50	4.0	5.80
Russia	17.8	10.17	17.00	5.0	4.20
South Africa	11.9	10.36	4.25	1.7	35.3
USA	**8.3**	**2.93**	**0.50**	**5.5**	**3.80**
Mean	**10.34**	**8.56**	**7.75**	**3.54**	**12.80**

Note: Mean only refers to the BRICS.
Data source: World Bank, Bloomberg (World Economic Statistics)

The USA fulfills the (a.) GDP, (b.) Unemployment, (c.) Policy interest rate conditions for the QT program, while in Brazil, India and South Africa the unemplyment rate is too high for the policy implementation.

The time frame of the analysis was split into five periods:
(1.) May 2012 – May 2022: *a full decade overview*;
(2.) May 2012 – June 2017: *a period from 2012 till the announcement of QT1*;
(3.) June 2017 – October 2017: *a period from QT1 announcement till the QT1 program starts*;
(4.) October 2017 – July 2019: *a full period of the QT1*;
(5.) July 2019 – May 2022: *a period from the end of QT1 until the current period of QT2 announcement.*

The data frequency is monthly data, and the examined yields are the 10-year government bond yields in the local currency of the respective countries.

Table 5. Correlation of the USA and BRICS

Time frame/ Selected Countries	(1)	(2)	(3)	(4)	(5)
Brazil	0.46	0.23	0.09	0.72	0.60
India	0.61	0.29	0.57	0.90	0.85
China	0.59	0.70	0.34	0.27	0.04
Russia	0.39	0.07	0.58	0.29	0.62
South Africa	0.16	0.23	0.59	0.24	0.30
Mean	**0.44**	**0.30**	**0.43**	**0.48**	**0.48**

Note: The correlation of 10-year Yields between the USA and India was the highest during QT1 (Column 4).

Data source: Bloomberg (GGR - Generic Government Rates)

Column (4) indicates the first quantitative tightening program (QT1), where the highest correlation of 10-year yields was between the USA and India (0.90), followed by the USA and Brazil (0.72).

Table 6. Key Statistics of the Other Emerging Markets (*in Percentage*)

	April 2022			2021-2022	
	Inflation	**10-year Yields**	**Policy interest rate**	**GDP 2021Q4**	**Unemployment rate 2022Q1**
Hungary	**9.5**	6.9	5.40	7.1	3.57
Mexico	**7.7**	8.32	6.50	1.1	3.47
Greece	**10.13**	3.33	0.00	7.4	12.9
Turkey	**69.97**	8.65	14.00	9.1	11.40
Peru	**7.96**	7.85	4.50	3.2	8.97
Mean	**21.05**	**7.01**	**6.08**	**5.58**	**8.06**

*Note:*Selected Other Emerging Markets, where the population is lower than in BRICS.

Data source: Bloomberg (World Economic Statistics)

Hungary fulfills the (a.) GDP, (b.) Unemployment rate, (c.) Policy interest rate hike (over the zero lower bound) conditions, while Greece, Turkey and Peru due to high unemployment rate doesn't, also in Mexico the GDP level was low for policy implementation. However, in Mexico the unemployment rate is satisfied.

Table 7. Correlation of the USA and Other Selected Emerging Markets

Time frame/ Selected Countries	(1)	(2)	(3)	(4)	(5)
Hungary	0.26	0.01	0.46	0.57	0.72
Mexico	0.44	0.52	0.52	0.37	0.86
Greece	0.11	0.53	0.06	0.50	0.67
Turkey	0.01	0.64	0.90	0.01	0.40
Peru	0.43	0.15	0.13	0.63	0.66
Mean	**0.26**	**0.39**	**0.41**	**0.41**	**0.65**

Note: The correlation becomes stronger during QT1 in Hungary and Peru. The mean is the highest in the fifth time frame (Column 5).

Data source: Bloomberg (GGR - Generic Government Rates)

Hungary (0.57) and Peru (0.63) are correlated with the US 10-year government yields during the first quantitative tightening (QT1).

Economic overview of the BRICS with high population:

Brazil. The inflation was high 12,1% in April, 2022; similarly, the unemployment rate was high with 11.1% in the first quarter of 2022. The GDP growth was 1.6% in the fourth quarter of 2021. The policy interest rate was 11.75% in April 2022. The correlation between the U.S. 10-

year treasury yields and the Brazilian 10-year treasury yields was strong (0.72) during QT1; we expect a similar correlation of treasury yields during QT2. According to the regression analysis, a 1% increase in the U.S. 10-year treasury yields affects a 2.21% increase in the Brazilian 10- year treasury yields, ceteris paribus. The annual variation of the 10-year Brazilian treasury yields between 2017 and 2018 increased by 0.22%.

India. According to the data, inflation was 7.8% in April 2022, and the policy rate was 4.25%. The unemployment rate was 7.6% in the first quarter of 2022, and the GDP growth rate was 5.40%. The correlation between the U.S. 10-year treasury yields and the Indian 10-year treasury yields was a strong 0.90 during QT1; we expect a similar correlation of treasury yields during QT2. Related to the regression analysis 1% increase in the U.S. 10-year treasury yields affects a 0.50% increase in the Indian 10-year treasury yields ceteris paribus. The annual variation of 10-year Brazilian treasury yields between 2017 and 2018 increased by 0.99%.

China had the lowest inflation among the selected EM countries at 2.1% in April 2022, and its policy rate was also down at 1.50%. The unemployment rate was 5.80% in the first quarter of 2022, and the GDP growth was 4%, according to the fourth quarter of 2021. The correlation between the U.S. 10-year treasury yields and the Chinese 10-year treasury yields was weak at 0.27 during QT1; we expect a similar correlation of treasury yields during QT2. According to the regression analysis, a 1% increase in the U.S. 10-year treasury yields affects a 0.37% increase in the Chinese 10-year treasury yields ceteris paribus. The annual variation of 10-year Brazilian treasury yields between 2017 and 2018 decreased by 0.36%. China commits to its quantitative easing program to support markets and capital yields through government bond buying. In China, inflation seems to be under control. While the Fed has a more aggressive tone, which reflects a realization of the more significant threat of inflation, it has further led to a bond market sell-off and rapid widening of the gap between short-and long-term interest rates (García-Herrero, 2022). The dollar's dominant role as the reserve currency is key to understanding how the Fed's quantitative tightening may affect China. China is a net creditor overall, with more assets than liabilities in dollars; a stronger U.S. currency and higher interest rates should create a positive wealth effect for the country despite a lower value for its holdings of U.S. treasuries. The situation is different for corporations. Companies with access to the offshore market are heavily indebted in dollars, which means that their cost of funding will rise after the Fed tightens and all the more so if the dollar appreciates with it. In addition, Chinese banks have increased their lending in many emerging economies, most of which are in dollars.

Russia had 17.8% inflation in April 2022, and the policy rate was 17% for the same period. Therefore, the Bank of Russia insists on declines in policy rates. The unemployment rate was 4.20% in the first quarter of 2022. GDP growth was 5%, according to the fourth quarter of 2021. The correlation between the U.S. 10-year treasury yields and the Russian 10-year treasury yields was weak at 0.29 during QT1; we expect a similar correlation of treasury yields during QT2. Related to the regression analysis 1% increase in the U.S. 10-year treasury yields affects a 0.97% increase in the Brazilian 10-year treasury yields ceteris paribus.

South Africa the correlation between the U.S. 10- year treasury yields and the South African 10-year treasury yields was strong at 0.24 during QT1; we expect a similar correlation of treasury yields during QT2. According to the analysis related the South Africa, a 1% increase in the U.S. 10-year treasury yields affects a 0.19% increase in the South African 10-year treasury yields ceteris paribus. As a result, the annual variation of 10-year South African treasury yields between 2017 and 2018 increased by 0.29%.

The economic outlook on the other selected EM countries:

Hungary had a low unemployment rate of 3.57%, according to the data for the first quarter of 2022; inflation was 11.7% based on June 2022. The policy interest rate was increased from 5.40% to 7.75% in June 2022. GDP was printed at 8.2% in Q4, 2021. The correlation between the U.S. 10-year treasury yields and the Hungarian 10-year treasury yields was strong at 0.57 during QT1; we expect a similar correlation of treasury yields during QT2. Related to the regression analysis 1% increase in the U.S. 10-year treasury yields affects a 0.67% increase in the Hungarian 10-year treasury yields ceteris paribus. The annual variation of 10-year Hungarian treasury yields between 2017 and 2018 increased by 1.17%.

Mexico had the lowest unemployment rate, with 3.47% among the selected EM countries in the first quarter of 2022. Inflation was 7.7%, and the policy rate was 6.50%, according to the data in April 2022. The correlation between the U.S. 10-year treasury yields and the Mexican 10-year treasury yields was weak at 0.37 during QT1; we expect a similar correlation of treasury yields during QT2. According to the regression analysis, a 1% increase in the U.S. 10-year treasury yields affects a 0.54% increase in the Mexican 10-year treasury yields ceteris paribus. As a result, the annual variation of 10-year Mexican treasury yields between 2017 and 2018 increased by 1.61%.

Greece had a double-digit unemployment rate of 12.9% in Q1 of 2022. Inflation was 10.13% in April 2022. The correlation between the U.S. 10-year treasury yields and the Greek 10-year treasury yields was 0.50 during QT1; we expect a similar correlation of treasury yields during QT2. Related to the regression analysis 1% increase in the U.S. 10-year treasury yields affects a 2.39% increase in the Greek 10-year treasury yields ceteris paribus. The annual variation of 10-year Greek treasury yields between 2017 and 2018 decreased by 1.22%. The Bank of Greece, as a European Monetary Union member state, has a euro currency.

Turkey. The policy interest rate was the second highest among the selected EM countries, 14%, according to April 2022 data. The unemployment rate was 11.40% in the first quarter of 2022. GDP was relatively high at 9.1% in the last quarter of 2021. The inflation was 69.97% in April 2022. The correlation between the U.S. 10-year treasury yields and the Turkish 10-year treasury yields was very weak at 0.01 during QT1; we expect a similar correlation of treasury yields during QT2. According to the regression analysis, a 1% increase in the U.S. 10-year treasury yields affects a 1.08% increase in the Turkish 10-year treasury yields ceteris paribus. The annual variation of 10-year Turkish treasury yields between 2017 and 2018 increased by 2.19%.

Peru. According to the data, inflation was 7.96% in April 2022, and the policy rate was 4.50%. The unemployment rate was 8.97% in the first quarter of 2022, and the GDP growth rate was 3.2%. Peru had the highest correlation in 10-year government bond yields with the United States. The correlation between the U.S. 10-year treasury yields and the Greek 10-year treasury yields was 0.63 during QT1; we expect a similar correlation of treasury yields during QT2. Related to the regression analysis 1% increase in the U.S. 10-year treasury yields affects a 0.67% increase in the Greek 10-year treasury yields ceteris paribus. The annual variation of 10-

year Greek treasury yields between 2017 and 2018 increased by 0.51%. In the Peruvian economy additionally, *financial dollarization* occurred, and loans were also denominated in foreign currency. Therefore, with the rationality of reserve requirement, the Central Bank of Peru has allowed induced QT required to face the domestic spillover effects of the unprecedented QE policy engaged in other developed countries (Armas et al., 2014). In the Peruvian economy, QT dampened the expansionary effects of capital inflows on domestic credit conditions. The reserve requirements in foreign currency credits for commercial banks were higher than those for domestic currency obligations. Therefore, the Central Bank of Peru intended to limit dollarization risk by setting up reserve requirements, given that it cannot act as a lender of last resort (LOLR) in foreign currency. The experience of the QT of Peru between 2002 and 2009 reflects that this rule not only satisfies the Taylor principle but also indicates that the central bank gives greater weight to inflation volatility than to output gap volatility. Based on the estimations, the interest response to inflation was close to 1.9, and the response to output is close to 0.5 in the Peruvian economy (Armas et al., 2014).

Table 8. Data panel regression

Dependent variable: 10-year government yields (EM country)					
	Independent variable (10-year U.S. government yield)	**t-statistics**	**R^2**	**F-statistic**	**Intercept**
Brazil	2.21*** (0.19)	11.61***	0.77 (1.10)	128.61***	30.31*** (5.88)
India	0.50*** (0.08)	6.68***	0.77 (0.42)	127.67***	12.03*** (1.71)
China	0.37*** (0.05)	7.39***	0.55 (0.31)	47.45***	-0.54 (0.15)
Russia	0.97*** (0.21)	4.53***	0.15 (1.46)	20.52***	6.14*** (0.46)
South Africa	0.19* (0.10)	1.95*	0.66 (0.48)	78.37***	7.98*** (2.70)
Hungary	0.67*** (0.23)	2.94***	0.07 (1.55)	8.64***	2.45*** (0.48)
Mexico	0.54*** (0.15)	3.68***	0.35 (0.76)	20.39***	6.80 (4.63)
Greece	2.39** (0.96)	2.48**	0.18 (4.94)	8.21***	2.71 (43.0)
Turkey	1.08*** (0.11)	9.47***	0.78 (0.61)	137.08***	45.09 (5.33)
Peru	0.67*** (0.13)	5.15***	0.19 (0.87)	26.56***	4.07 (0.27)

Note: Robust standard errors are reported in parentheses. *p<0.1; **p<0.05; ***p<0.01

Data source: Bloomberg (Generic Government Rates)

The QT adjusted the expansionary effects of capital inflows on domestic credit conditions and, through this channel, also reduced the output gap and inflationary pressures. Inflation was 9.5% in April 2022, the unemployment rate was 3.57% according to the 2022Q1 data, while GDP was 7.1% in 2021Q4.

Table 6. indicates the comparable panel regressions applying to the simulated data – on the 10-year government bond yields with the intention to validate the hypothesis, which is that the 10-year U.S. government bond yield has an impact on EM countries' 10-year government bond yields. *Table 7.* shows a variation of the 10-year government yields for over a year between 2017 and 2018 related to BRICS. According to the results, the change in yields in the U.S. was an increase of 0.85%, then the change in yields in India increased by 0.99%, and a similar occurred in Russia with a 1% annual increase in 10-year government yields. Related to the results, the variation in yields in Brazil increased by 0.22% and in South Africa by 0.29%. Only in China was a decrease in the 10-year government yields for the selected period with 0.36%.

Table 9. Change of 10-year Government Yields for over a year for BRICS and the U.S. during QT1

	October 2017	October 2018	Change in bps	Change in %
USA	2.29	3.14	84.93	0.85
Brazil	9.99	10.21	21.98	0.22
India	6.86	7.85	99.00	0.99
China	3.88	3.52	-35.50	-0.36
Russia	7.60	8.60	99.50	1.00
South Africa	9.09	9.38	28.50	0.29
Mean	**7.48**	**7.91**	**42.70**	**0.43**

Data source: Bloomberg (Generic Government Rates)

Table 8. describes changes in the 10-year government yields for other selected countries between 2017 and 2018. Related to the results, the change in yields in Turkey was an increase of 2.19%, then the change in yields in Mexico increased by 1.61%, and a similar occurred in Hungary with a 1.17% annual increase in 10-year government yields.

Table 10. Change of 10-year Government Yields for over a year for the Selected EM

	October 2017	October 2018	Change in bps	Change in %
Hungary	2.47	3.64	116.90	1.17
Mexico	7.27	8.88	161.00	1.61
Greece	5.43	4.21	-121.50	-1.22
Turkey	5.28	7.47	219.20	2.19
Peru	5.38	5.89	51.00	0.51
Mean	**5.17**	**6.02**	**85.32**	**0.85**

Data source: Bloomberg (Generic Government Rates

Conclusion

According to the historical analysis, the strongest correlation was among the BRICS countries during QT1 for India (0.90) and Brazil (0.72). While among the other selected countries, the strongest correlation was during QT1 for Hungary and Peru. We assume a similar correlation between the yields for the QT2 and increasing long-end yields for these countries. The USA fulfilled the (a.) GDP, (b.) Unemployment, (c.) preliminary policy interest rate increase condition for the QT program, while in Brazil, India and South Africa the unemplyment rate is high for the policy implementation. Hungary fulfills the (a.) GDP, (b.) Unemployment rate, (c.) Policy interest rate hike (over the zero lower bound) conditions, while Greece, Turkey and Peru due to high unemployment rate doesn't. In Mexico the GDP level was low, however, the unemployment rate is satisfied. The result shows that there is a monetary spillover effect from a hegemon country towards the selected goup of countries in the Europe and other countries in the sample!

Future work

The future work adds Structural Vector Autoregression (SVAR) estimation in oder to examine *the causual relationship* in the financial market, incorporating data of Eurodollar futures (from ED1 to ED4), the Fed fund futures (FF4), Bond indices corporate (BAA) and Volatility index (Bauer, Swanson, 2023; Gertler, Karadi, 2015; Miranda-Agrippino and Ricco, 2015) in the upcoming month and relying on the latter mentioned literature.

Notes

1. Federal Reserve issued FOMC (Federal Open Market Committee) statement on March 15, 2020, related to the asset purchase program. *Source*: Board of Governors of the Federal Reserve System
2. The FOMC purchased Treasury securities and agency Mortgage-Backed Securities in the optimal amounts needed to support smooth market functioning and effective monetary policy transmission. *Source*: Federal Reserve announces extensive new measures to support the economy Board of Governors of the Federal Reserve System
3. The same situation occurred in Europe; the European Central Bank (ECB) announced the discontinuation of its Pandemic Emergency Purchase Program (PEPP) at the end of March 2022.
4. List of Asset Purchase Programs for Advanced economies: Australia, Canada, Iceland, Israel, South Korea, New Zealand, Norway, Sweden, United Kingdom. Developed and Emerging Market Economies: Angola, Bolivia, Cabo Verde, Chile, China, Colombia, Costa Rica, Croatia, Egypt, Hungary, India, Indonesia, Jamaica, Mauritius, Mexico, Philippines, Poland, Romania, South Africa, Thailand, Turkey, Ethiopia, Ghana, Papua New Guinea, Rwanda, Uganda. List of Asset Purchase Programs, p.27-31. In IMF Working Paper written by Chiara Fratto, Brendan Harnoys Vannier, Borislava Mircheva, David de Padua, and Hélène Poirson, January 2021.
5. FOMC Communications Related to Policy Normalization related to plans and principles for reducing the size of the Federal Reserve's Balance Sheet. Source: Board of Governors of the Federal Reserve System.
6. Ha, Kose, and Ohnsorge (2022) from World Bank compared similarities and differences between the Great Inflation in the 1970s and the Inflation of 2022. Similarities appeared in supply disruptions driven by the pandemic, supply shocks of energy prices resemble the oil shocks in 1973 and 1979–1980 and heightened geopolitical tensions.
7. U.S. Department of the Treasury, Quarterly Refunding Statement of Deputy Assistant Secretary for Federal Finance Brian Smith, 4th of May 2022.

8. Global Economic Prospects Report, Stagflation Risk Rises Amid Sharp Slowdown in Growth World Bank, 2022.

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