# EVALUATING THE EFFECTIVENESS OF QUANTITATIVE EASING MEASURES OF THE FEDERAL RESERVE AND THE EUROPEAN CENTRAL BANK

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## ABSTRACT

This scientific paper examined the relation between conventional and unconventional monetary policy, with an anticipation to provide a comprehensive assessment of how they behave with the goal of mitigating financial distress, at the state level, influencing global economy. The sampling frame involved five variables related to the US Federal Reserve and five variables related to the European Central Bank, observed during the period 2015-2020 (data for January, April, July and October of each year, regarding every research variable were collected). These variables included: Euro Area Inflation Rate, ECB Bonds Yields, Euro Area Broad Money Supply (M2), Euro Area Unemployment Rate, Debt to GDP; and US Inflation Rate, US Treasury Yields, US Broad Money Supply (M2), US Unemployment Rate, Debt to GDP. Accordingly, two adequate research models were created. Research methodology focused on examining the accuracy of the hypotheses using SmartPLS 3 as a tool for conducting mediation analysis. Research implications suggest that Quantitative Easing caused a significant increase in the Federal Reserve's and European Central Bank's balance sheet, especially during the global financial crisis (2007-2008) and during the post-crisis, recovery period. In terms of policy recommendations, monetary authorities need to have policy sets ready in place, in order to know how to behave during and post an economic crisis. This scientific paper will serve as an accurate source of information to future researchers in the field of conventional and unconventional monetary measures, because the work is well systematically organized, clear for interpretation and provides an extensive insight into the Fed's and ECB's transmission mechanisms of monetary policy.

**Contribution/ Originality:** The study offers theoretical explanations and an innovative analytical and methodological approach connected to the specific case of asset purchase programs/quantitative easing measures, executed by the Federal Reserve and the European Central Bank, to examine the efficacy and reflection of their balance sheets as well as the effectiveness of unconventional monetary measures.

## 1. INTRODUCTION

### 1.1. Conventional and Unconventional Monetary Policy Explained

The significance of monetary policy for this study is rooted in its capacity to maintain stable prices, thus supporting conditions for long-term economic growth and maximum employment in the US and Euro Area, through its conventional or unconventional mechanisms. During and after the global financial crisis of 2007-2009, central banks worldwide have been adopting different measures to prevent the collapse of financial systems.

Another goal of adopting new measures was to sustain aggregate demand through the processes of reduction in policy rates and quantitative easing. According to data of the World Bank, the global annual gross domestic product (GDP) growth after the crisis of 2007-2009 recorded one of its lowest historical outcomes since 1961, which was at -1.3%, at the end of 2009. Other lower outcome was recorded at the end of 2020, because of COVID-19 global health and financial crisis, amounting -3.4%, is shown in Figure 1:
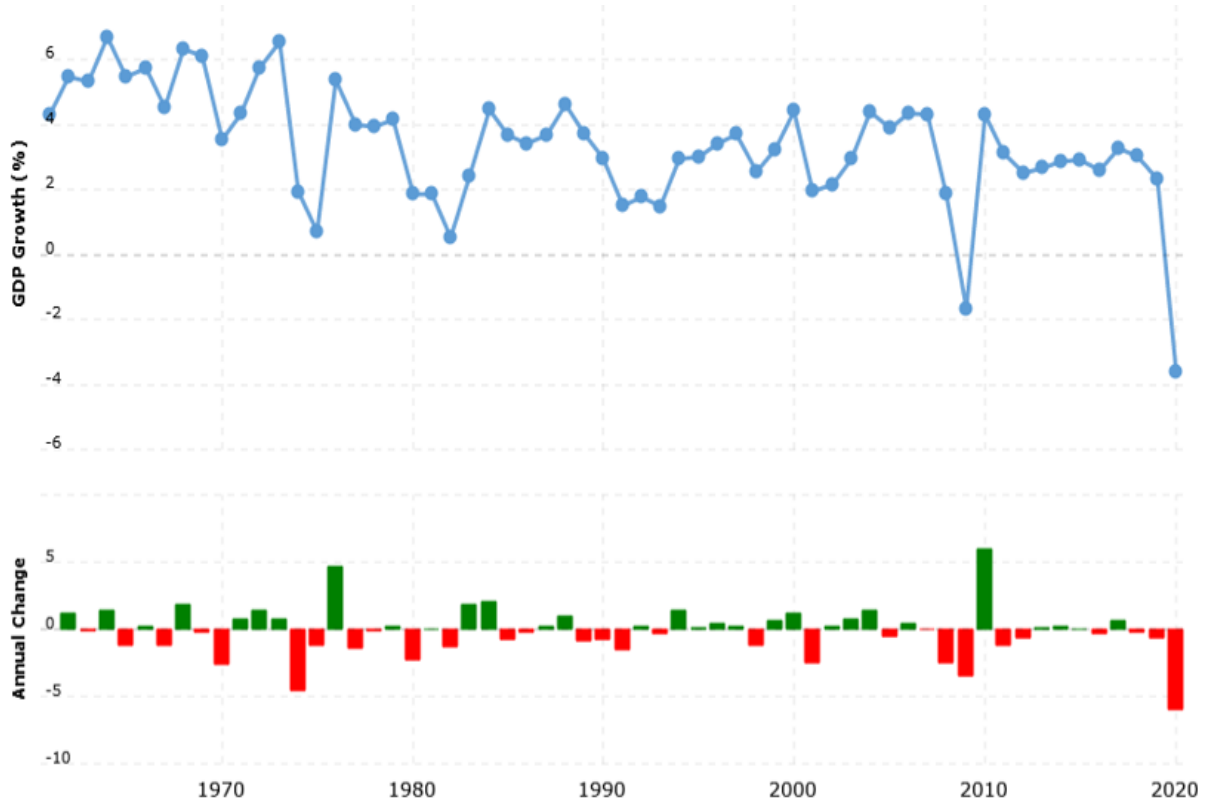


**Figure 1.** World's GDP growth (annual %).

**Source:** The World Bank.

The global financial crisis and weakening economies led many countries, especially countries such as the U.S., Japan, and the Euro Area, which played extremely significant roles at the world's financial scene, to seek after dynamic approaches to forestall the development of the emergency and to defeat the fallout. Decreasing financing costs-interest rates was a characteristic money related response to the emergency. Monetary policy played a key role in offsetting the negative impact of uncertainty shocks (Bundick, 2014).

Monetary policy is divided into two categories:

1.   Conventional monetary policy.
2.   Unconventional monetary policy.

*Conventional monetary policy* represents the operation of monetary policy under normal circumstances. Normal circumstances mean that short-term interest rate still has a significant impact on between-banks borrowing and lending transactions. *Unconventional monetary policy* is put into an action when the short-term interest rate operations get worse than usual (extremely low, close to zero), in order to stimulate banking activity.

### 1.2. Transmission Mechanisms of Conventional and Unconventional Monetary Policy

In implementing its monetary policy, with the goal of maintaining stable prices, thereby supporting conditions for long-term economic growth and maximum employment, central banks apply both conventional and unconventional monetary policy tools. For example, using open market operation, as a conventional measure, the central bank buys and sells government bonds in order to achieve the expansionary or contractionary monetary

policy, and to accomplish its intermediate results, which are, usually, regulations of interest rate levels or monetary aggregates. Despite these possibilities central bank has, intermediate results are additionally influenced by private sector and their economic settlements. Then, another measure by the central bank-policy instrument, comes into an action, in order to connect policy tools and intermediate goals. Figure 2 illustrates Mechanism of conventional monetary policy:
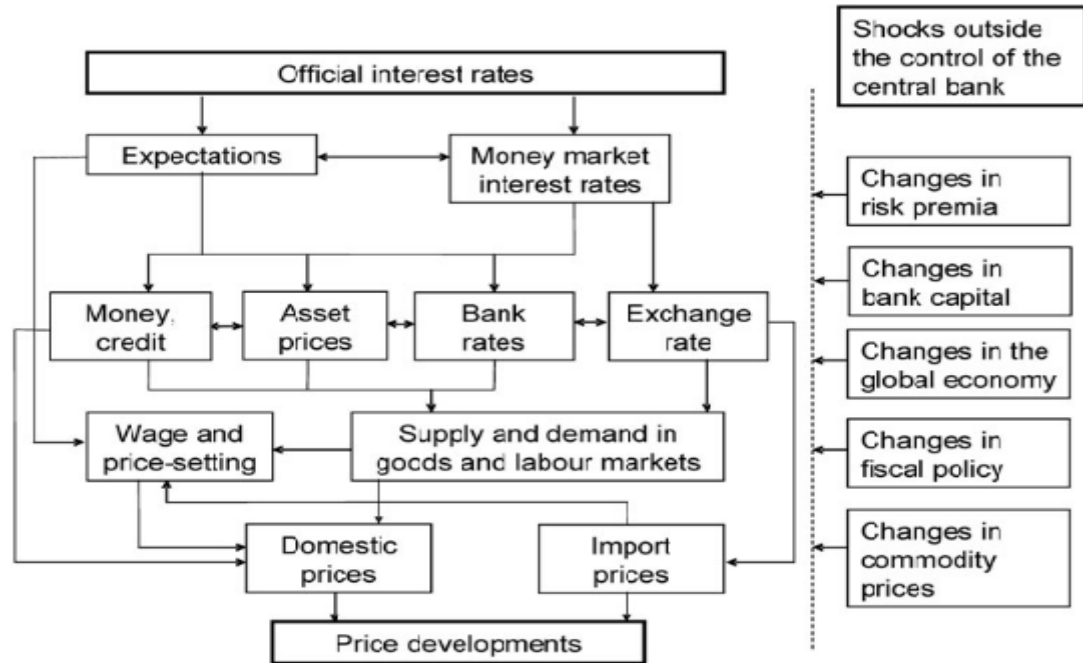


**Figure 2.** Mechanism of conventional monetary policy.
**Source:** European Central Bank (2012).

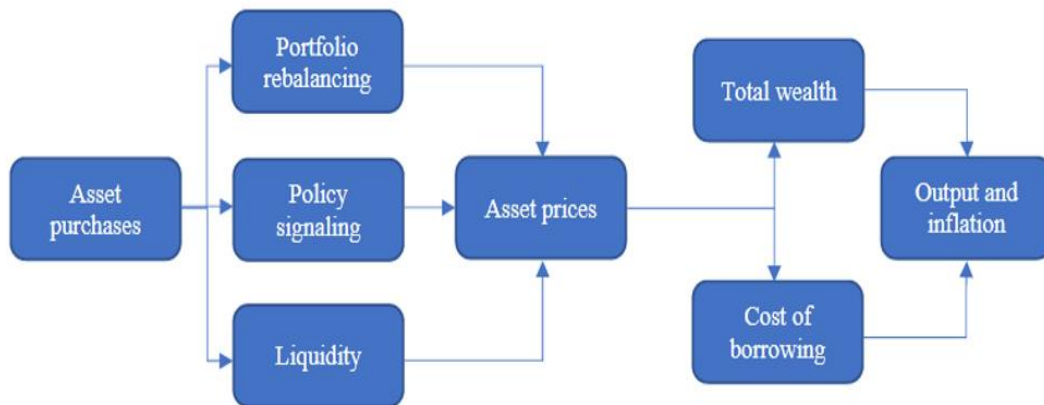The general mechanism of unconventional monetary policy is explained in Figure 4:



**Figure 3.** Mechanism of unconventional monetary policy.
**Source:** Bowdler and Radia (2012).

Figure 2 and Figure 3 illustrate that both mechanisms use some of the same operations; however, the difference is in the period of application. When making comparison of graphs of mechanisms of conventional and unconventional monetary policies, it is noticeable that, when using unconventional monetary policy, it could impact the economic processes via multiple channels. These channels are:

*Portfolio Rebalancing Channel*: This means an increase in demand for bonds leads to larger prices of them, and decreasing yields. By purchasing assets from the private sector, the central bank intrudes the portfolios of the sellers of bonds (Bowdler & Radia, 2012). In the case that private sector is apathetic of holding money or bonds,

which are perceived as perfect replacements, the process comes to an end, with portfolios remaining in balance, although the central bank intervened.

*Policy Signaling (macro-policy news channel)*: This represents a forward guidance policy; wherein economic agents get extra information regarding the underlying state of the economy, by central bank. By trying to make the effects of monetary policy lighter, the central bank can be signaling its expectation towards policy rates to stay lower for longer period of time.

*Liquidity (market functioning effect)*: The market presence of the central bank, as an important purchaser of assets, has an ability of reducing liquidity premium (Brózda, 2016). This effect could function at periods of financial market stress.

*Asset Prices:* The intervention of QE measures, which includes injection of money into the economy by purchasing government bonds from banks, pension funds or insurance companies, sets off a shift in asset prices, what can be perceived as the first step of the transmission mechanism of QE measures. Higher asset prices should stimulate increases in spending through both reducing the cost of capital and increasing wealth (Bowdler & Radia, 2012).

*Total Wealth:* An upward progress in asset prices also means increases in net wealth for their owners. Consequently, spending should be stimulated by households and firms. This happens because QE activities raise the value of the assets and liabilities in similar amounts, meaning a widening deficit.

*Cost of Borrowing:* The rates at which companies and households finance are ordinarily identified with the risk-free rates at the maturity they try to acquire. In this scientific work, cost of borrowing refers to the cost of borrowing corporate bonds. Subsequently, falls in the yield curve are probably going to mean a decrease in interest rates, in an analogous way to conventional monetary policy. In a case in which banks get an advantage from higher asset prices, similar to what non-monetary organizations do, then, at that point, their expense of debt issuance will be lower.

### 1.3. Output and Inflation

QE measures influence the money supply in a positive way by augmenting the deposit reserves of the non-bank private sector. For this sector to be capable of holding such supply of money, one of the elements of the demand for money should shift. The demand for money is supposely to depend on three following variables: the value of transactions in the economy or nominal spending; the overall value of asset portfolios; and the relative rate of return on money as compared to other assets. The main task in executing this type of policy is for the central bank to persuade the private sector to have confidence in its promise to retain interest rates lower and inflation higher, in the future. This is complicated because once the economy starts recovering due to the reduction in real rates that the central bank's promise has delivered, there is no willing for the central bank to go through on its promise. The policy is time-inconsistent. The central bank will consider it optimal to return inflation to target. Therefore, this monetary policy solution will only have an effect if the central bank is capable of finding a way to convince market participants it will go past its inflation target by keeping interest rates low for an extended period of time (Bridges & Thomas, 2012).

### 1.4. Research Questions

The relationship between quantitative easing measures, balance sheets and other variables were analyzed through the following research questions.

The Federal Reserve related questions:

1. Do Quantitative easing (QE) activities play a statistically significant mediating role between Fed's Balance Sheet and US Inflation Rate?

2.      Do Quantitative easing (QE) activities play a statistically significant mediating role between Fed's Balance Sheet and US Treasury Yields?

3.      Do Quantitative easing (QE) activities play a statistically significant mediating role between Fed's Balance Sheet and US Unemployment?

4.      Do Quantitative easing (QE) activities play a statistically significant mediating role between Fed's Balance Sheet and US Broad Money Supply (M2)?

5.      Do Quantitative easing (QE) activities play a statistically significant mediating role between Fed's Balance Sheet and Debt to GDP?

The European Central Bank related questions:

1.      Does Asset Purchase Programme (APP) play a statistically significant mediating role between ECB's Balance Sheet and Euro Area Inflation Rate?

2.      Does Asset Purchase Programme (APP) play a statistically significant mediating role between ECB's Balance Sheet and ECB Bond Yields?

3.      Does Asset Purchase Programme (APP) play a statistically significant mediating role between ECB's Balance Sheet and Euro Area Broad Money Supply (M2)?

4.      Does Asset Purchase Programme (APP) play a statistically significant mediating role between ECB's Balance Sheet and Euro Area Unemployment Rate?

5.      Does Asset Purchase Programme (APP) play a statistically significant mediating role between ECB's Balance Sheet and Debt to GDP?

## 2. THEORETICAL BACKGROUND

### 2.1. General Information

Besides the division of monetary policies into conventional and unconventional, they can also be divided into expansionary and contractionary types. Following the principles of expansionary monetary policy, in order to expand the monetary base, central bank usually reduces the short-term interest rate, or buys government bonds in order to bring more liquidity into the banking sector (Olivier, Jonathan, Atish, & Marcos, 2016). At the point of time when traditional monetary policy may not have much choice left, when competitive devaluations are accomplishing more negative than positive effects, larger fiscal stimulus and wide range of structural reforms should be introduced. Psychology to understand decisions and measures created during crisis period is recognized by behavioural economics (Diamond & Vartiainen, 2007). As Reinhart (2016) states, the anaemic recovery in many advanced economies, half ignoring the need for greater policy coordination, happens because of the dominant "extend and pretend" admission to debt. In such circumstances, large corporations preferably do not invest, but pay down their debts, and buy their shares back. Further, during times of high vulnerability, liquidity inclination of investors strongly ascends because of dread of capital misfortunes, poor assumptions regarding future financial flows and vulnerability about planned yields. Thus, central banks should be aware of the chance of a liquidity trap.

### 2.2. The Federal Reserve: Unconventional Monetary Policy Operations

The Federal Reserve purchases securities to make their way onto its balance sheet. On its webpage, Fed provides the evidence of how its balance sheet has grown cumulatively, caused by the changes in quantitative easing:

*   QE1: $2.3 Trillion in Assets: The Federal Reserve's first quantitative easing program ran from January 2009 to August 2010, with the fundamental purchase of $1.25 trillion in mortgage-backed securities (MBS).

*   QE2: $2.9 Trillion in Assets: The Federal Reserve's second quantitative easing program ran from November 2010 to June 2011, involving purchases of $600B in longer-term Treasury securities.

- Purchases named Operation Twist (Maturity Extension Program), finished in December 2012, did not expand the Fed's balance sheet. In order to decrease long-term rates further, the Fed utilized the proceeds from its maturing short-term Treasury bills, to buy longer-term assets.
- QE3: $4.5 Trillion in Assets: In September 2012, the Fed started buying MBS at a rate of $40B/month, was supported with the buy of long-term Treasury securities at a rate of $45B/month, in January next year, with the conclusion of both programs in October 2014.
- In order to normalize its balance sheet in October 2017, Fed introduced $3.7 Trillion in Assets worth Normalization Program, with an initial rate of $10B/month, followed by $10B/month increase every quarter, with a final reduction rate of $50B/month.
- QE4: $6 Trillion and Counting: in order to ease liquidity issues in overnight lending markets, Fed started buying Treasury bills at a rate of $60B/month, in October 2019 (Lu, 2021).

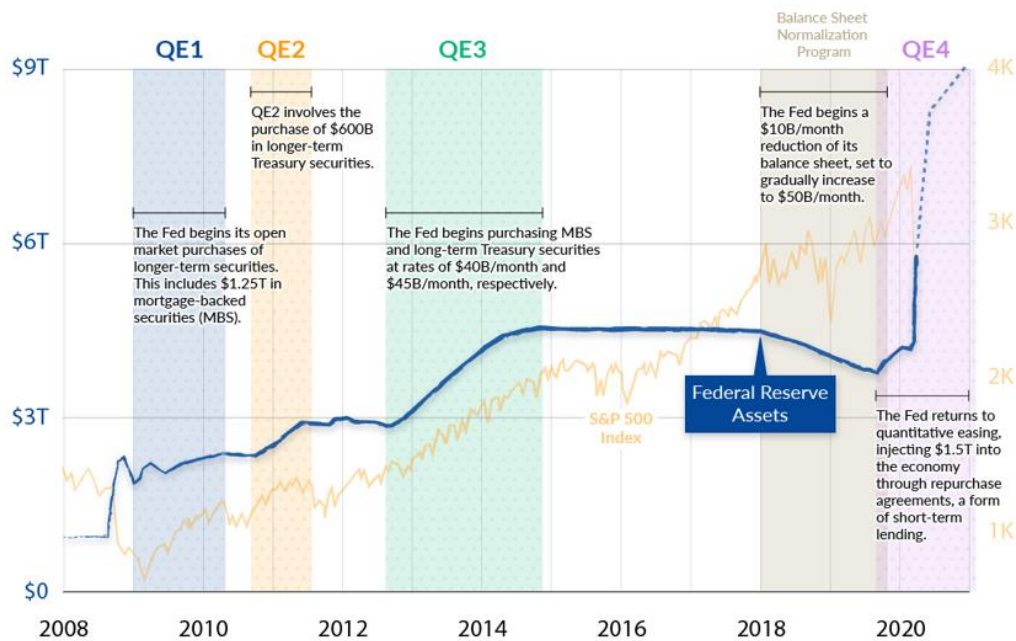Figure 4 illustrates historical overview Cumulative net purchases of securities by Fed:



**Figure 4**. Cumulative net purchases of securities by fed.

Source: Fed, CNBC.

### 2.3. The European Central Bank: The Federal Reserve: Unconventional Monetary Policy Operations

The European Central Bank's Asset Purchase Programme (APP) represents fragment of a package of unconventional monetary policy measures, involving targeted longer-term refinancing operations. This program began in mid-2014, with the goal of supporting the monetary policy transmission mechanism and providing the amount of policy accommodation, necessary to obtain stability of prices. The European Central Bank's Asset Purchase Programme (APP) contains:

- Corporate sector purchase programme (CSPP).
- Public sector purchase programme (PSPP).
- Asset-backed securities purchase programme (ABSPP).
- Third covered bond purchase programme (CBPP3) (European Central Bank, 2021).

During the period October 2014-December 2018, the ECB executed net purchases of securities under one or more of stated asset purchase programmes, with monthly purchases averaging:

- €60 billion from March 2015 to March 2016.
- €80 billion from April 2016 to March 2017.
- €60 billion from April 2017 to December 2017.

- €30 billion from January 2018 to September 2018.
- €15 billion from October 2018 to December 2018 (European Central Bank, 2021).

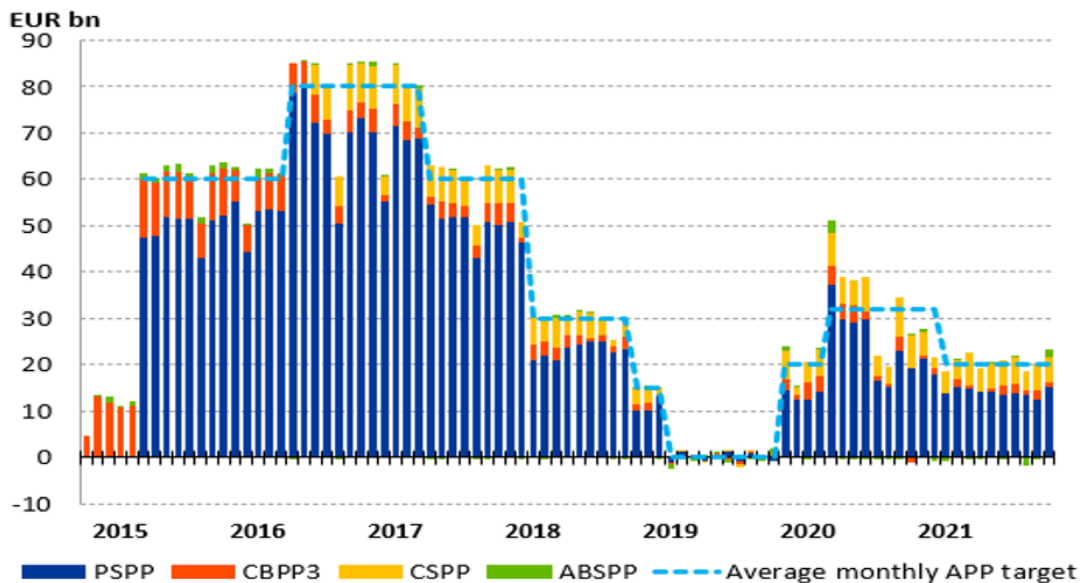Figure 5 exhibits the average monthly Asset Purchase Programme:



**Figure 5.** The average monthly APP.

**Source:** ECB.

### 2.4. The Federal Reserve and the European Central Bank Balance Sheets

In 2018, the Federal Reserve started unwinding its balance sheet by not replacing maturing securities. The trend finished in 2019, because of a crisis in repo markets. Fed's balance sheet, for the period January 2014-January 2021, is shown in the Figure 6:
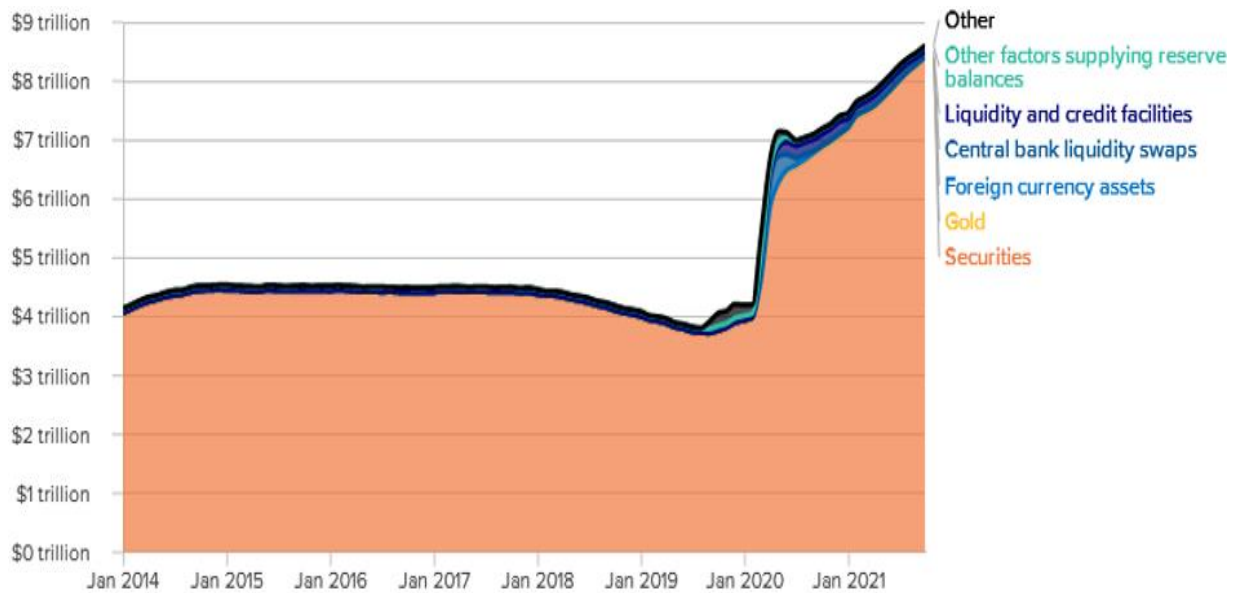


**Figure 6.** Fed's balance sheet.

**Source:** Fed (2021).

When it comes to the influence of QE practices on the European Central Bank's balance sheet, they have increased the size of the balance sheet by 83 percent, since the start of the COVID-19 pandemic. ECB's balance sheet, for the period January 2014-January 2021, is shown in the Figure 7:
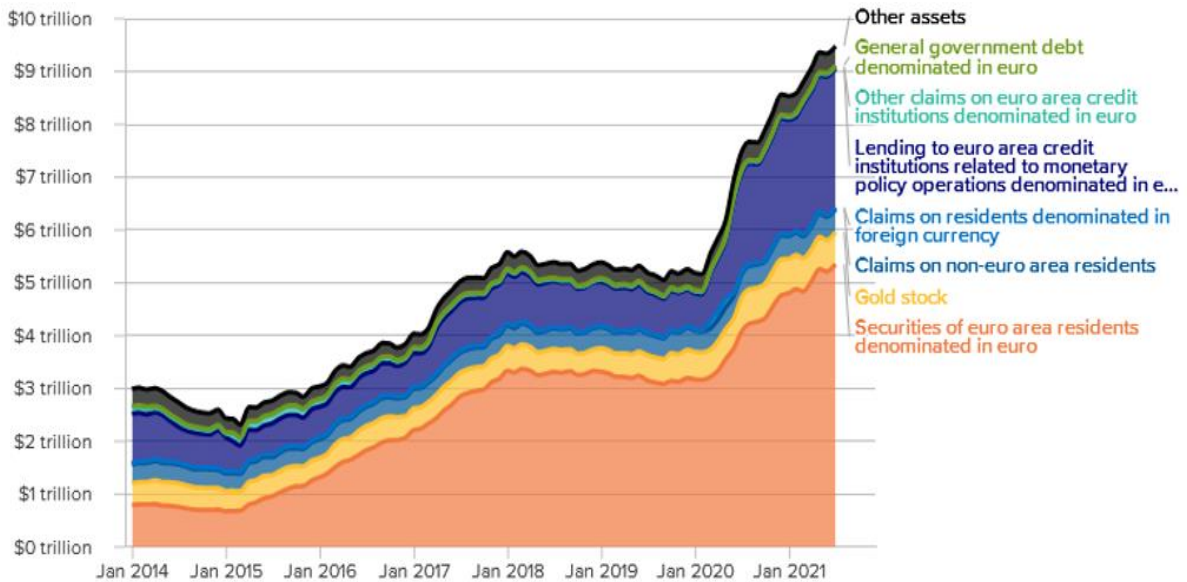
**Figure 7.** ECB's balance sheet.

*2.5. Statistical Indicators of the Impact of Quantitative Easing Measures Conducted by the Federal Reserve and the European Central Bank*

Insight into statistical indicators, including US Inflation Rate, US Treasury Yields, US Broad Money Supply (M2) and Rate of Change (12-month avg), US Unemployment and Labor Force Participation Rates, Debt to GDP; and Euro Area Inflation Rate, ECB Bonds Yields, Euro Area Broad Money Supply (M2) and Rate of Change (12-month average Euro Area Unemployment Rate, Debt to GDP, is necessary to create a research models, both for the Fed and the ECB. Therefore, graphs for stated Fed variables are given in the Figure 8, Figure 9, Figure 10 and Figure 11:
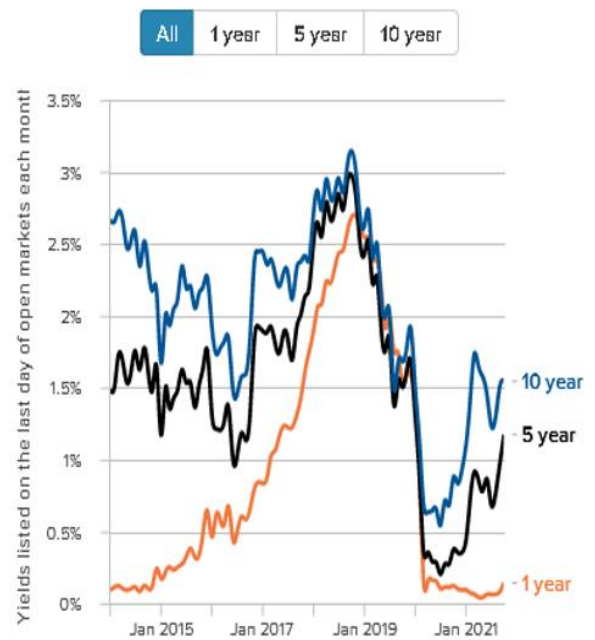
The Federal Reserve:
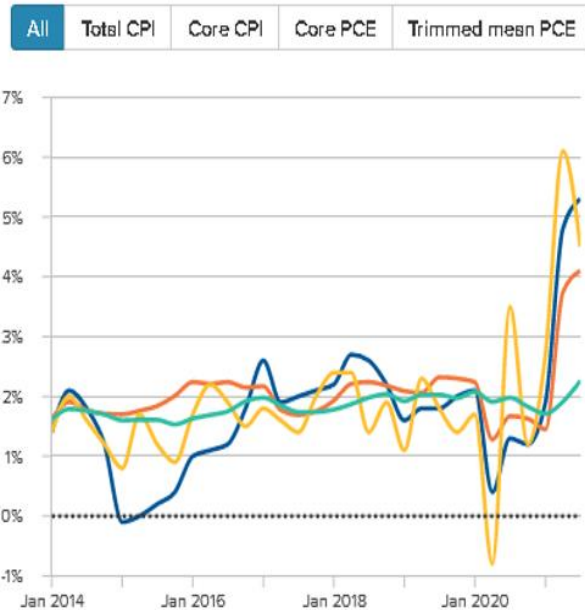


**Figure 8.** US inflation rate; US treasury yields.

**Figure 9.** US broad money Supply (M2) (orange color) and rate of change (12-month avg) (blue color).
**Source:** AtlanticCouncil (2021).
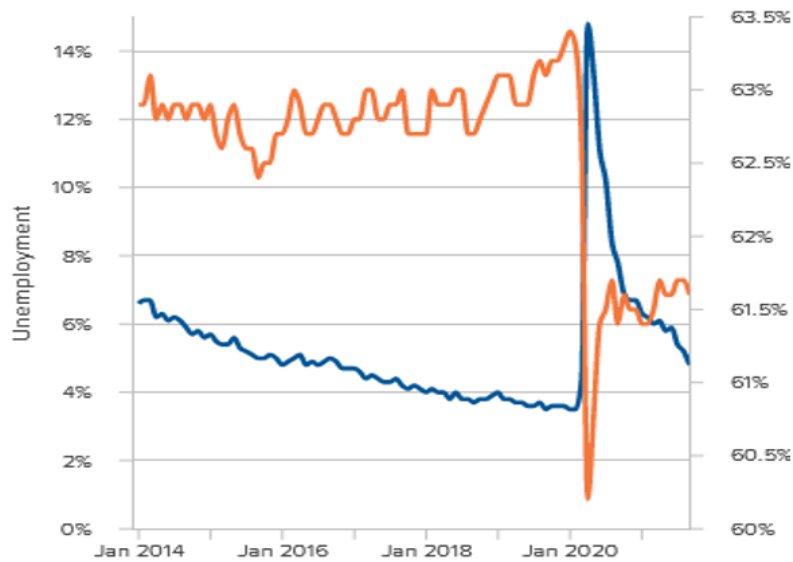


**Figure 10.** US Unemployment (blue color) and labor force participation rates (orange color).
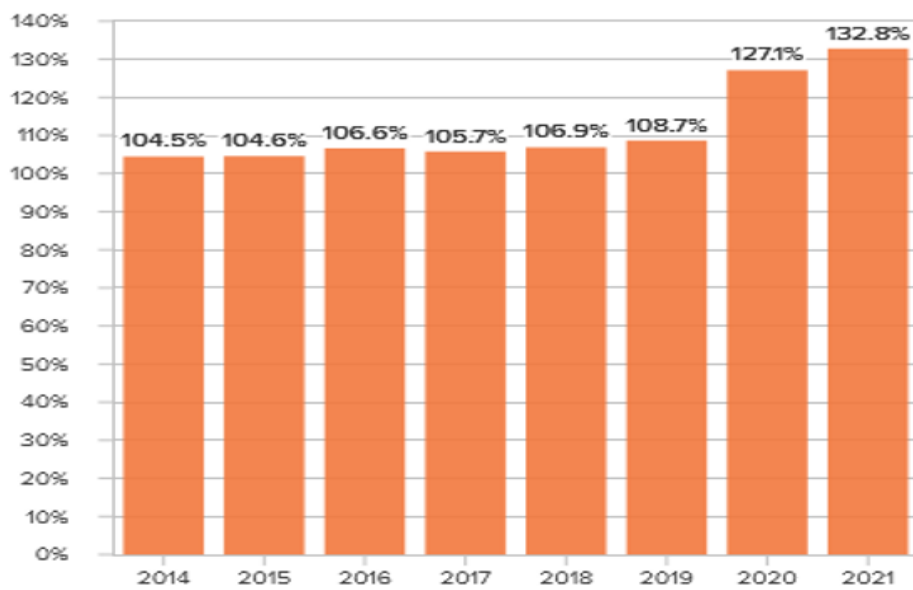


**Figure 11.** Debt to GDP.
**Source:** AtlanticCouncil (2021).

Graphs for stated ECB variables are given in the Figure 12, Figure 13, Figure 14 and Figure 15:
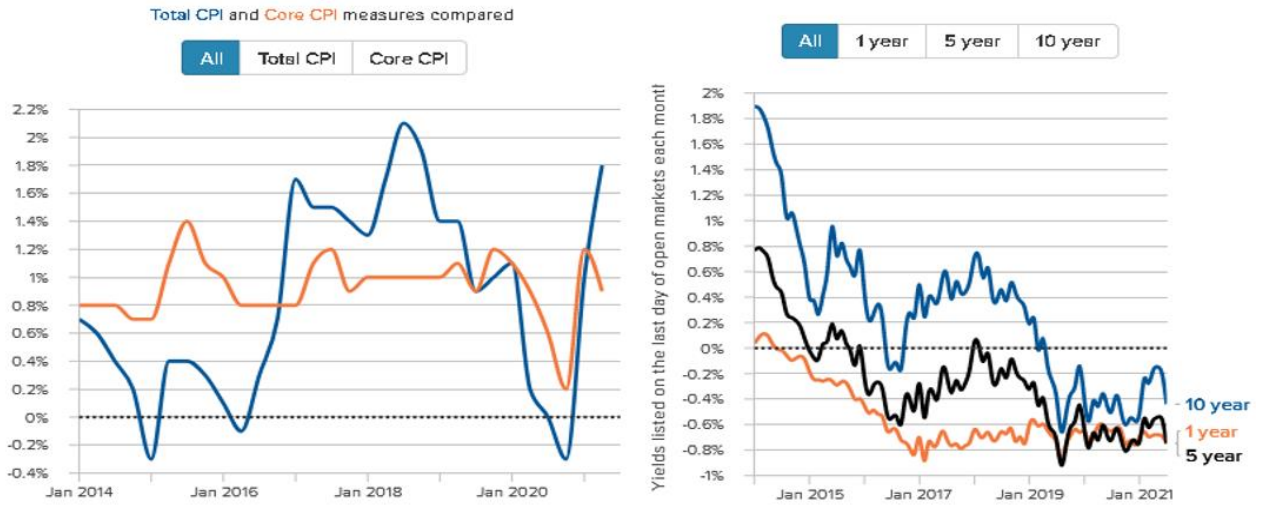


**Figure 12.** Euro area inflation rate; ECB bonds yields.
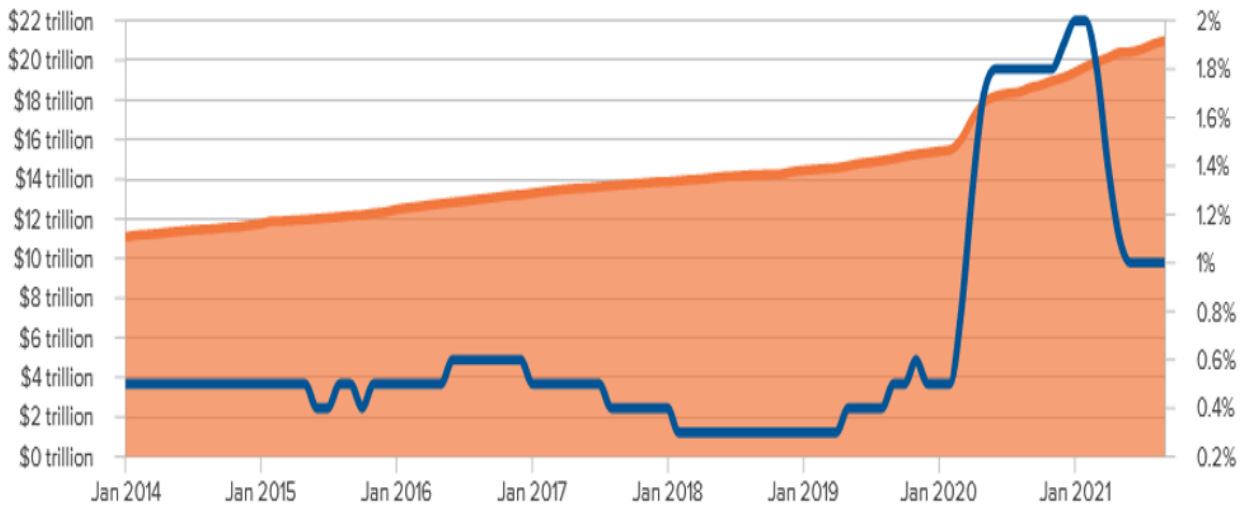**Source:** AtlanticCouncil (2021).
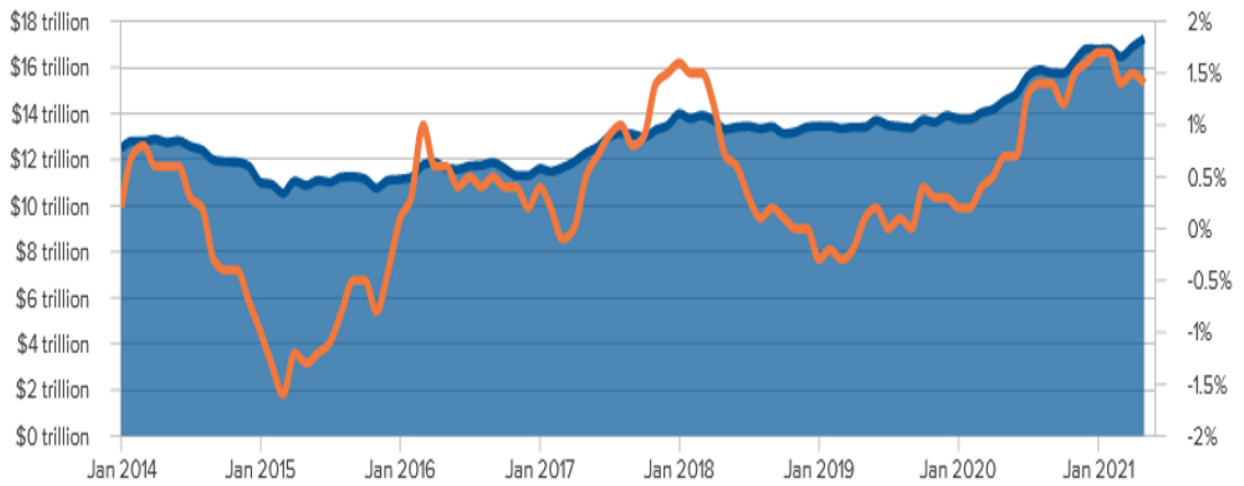


**Figure 13.** Euro Area Broad Money Supply (M2) (blue color) and Rate of Change (12-month avg) (orange color).
**Source:** AtlanticCouncil (2021).
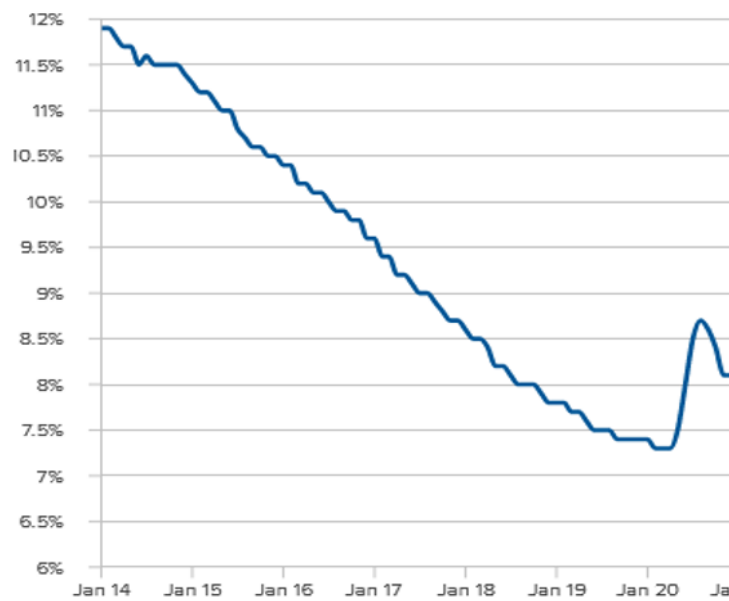


**Figure 14.** Euro area unemployment rate.
**Source:** AtlanticCouncil (2021).

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**Figure 15.** Debt to GDP.

## 3. LITERATURE REVIEW

In terms of the implementation of QE measures by the European Central Bank, the results of estimating the impact of quantitative easing on credit risk through an Arma-Garch model show that the the greatest expansion of credit risk was caused by the purchase of €60 billion in euro-denominated covered bonds followed by the announcements of 12-month longer-term refinancing operations (Albu, Lupu, Calin, & Popovici, 2014). As reported by Watkins (2014), quantitative easing policy has deteriorated the inequality of distribution of income and wealth, it did not have enough effect to reduce unemployment, thus violating principles of social 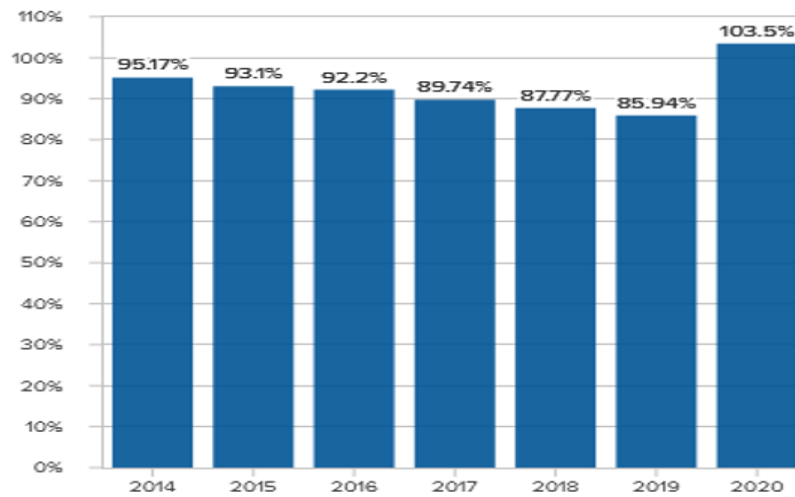justice. The Federal Reserve has been criticized for failure in their tasks: not achieving long-run price stability, allowing the purchasing power of the US dollar to fall rapidly (Selgin, Lastrapes, & White, 2012).

Although the Fed failed in preventing inflation, they succeeded in eliminating deflation (Selgin et al., 2012). A typical QE announcement of Fed or ECB results in the relative balance sheet increase of about 20 percent, while relative QE shock which expands the ECB's balance sheet, when compared to that of the Federal Reserve, depreciates the euro against the US dollar (Dedola, Georgiadis, Gräb, & Mehl, 2021). As stated by Houcine, Abdelkader, and Lachi (2020), although there is an increase in the money supply through unconventional monetary policy programs, individuals avoid larger consumption. As an alternative, they prefer monetary hoarding, because of the level of uncertainty, adversely affecting the development of aggregate demand. It is questionable whether government should continue as lender of last resort, because it leads an economy into hyperinflation (Friedman & Schwartz, 1986a).

As mentioned by Lundvall (2020), in a liquidity trap, central banks may be willing to reassure the public that there are no reasons for over-concern, and that fully adequate alternative solutions have already been created. According to Williamson (2017), QE (large-scale purchases of assets by central banks) caused a large increase in the Federal Reserve's balance sheet during the global financial crisis (2007-2008), as well as in the recovery process. The influence of cyclical shocks on real interest rates creates difficulties in precisely deciding which movements in the real interest rate ought to be attributed to standard patterns and which ones are repetitive variances (Lucke, 2004). Rogoff (2017) emphasizes the issue of developing a macroeconomic policy under near-zero or even negative interest rates. The problem of zero lower bound is designed by a specific intervention a government has to undertake: the provision of currency in its physical form-storing a value which is not able to provide any interest rate, in that form (Kocherlakota, 2019).

Few aspects of described problem have been recognized. Primarily, very low interest rates could be perceived as a short-term phenomenon, as central bank's response to the times of high financial difficulties (i.e. global financial crisis 2007-2009. In recent years, literature identifies interest rate reductions more common long-term pattern of

the last few decades (Del Negro, Giannone, Giannoni, & Tambalotti, 2019). Downward trend in interest rates could be perceived as an even larger complicacy for monetary policy.

Taking into consideration above stated facts, the question arises: should monetary policy act in opposition to the pattern towards declining and negative interest rates? Although there is no a definitive response to this question, economic theory is not capable of predicting the duration of low or negative natural interest rates (Guttmann, 2020). Measures with a potential higher effect of acting in opposite to low interest rates, as fiscal policies and structural reforms, do not represent an issue for implementing monetary policy. According to Coenen and Wieland (2003) and Peersman (2011) and their analysis of coordinated monetary policy, quantitative easing causes an upshift in inflation. Since the policy rate magnifies the effects of a spread shock on the macroeconomics, in several historical episodes of unconstrained responses of prices and real GDP, the central bank responds to the decline in the long-short spread by raising interest rates considerably, which contains inflation and output growth (Baumeister & Benati, 2013). The sign restrictions suggest that the spread should lead to higher levels of economic activity and exert upward pressure on inflation (Baumeister & Benati, 2013).

Following Ramsey optimal monetary policy, the joint stabilization of the output gap and inflation is not achieved in response to uncertainty shocks (Cho, Han, Oh, & Picco, 2021). At the point of time when a countercyclical use of money supply is not allowed the liquidity shock leads to a more sizeable decrease of output gap and inflation (Filiani, 2021). The counterfactual analysis by Liu, Theodoridis, Mumtaz, and Zanetti (2019) discovered that unemployment would have been 70 BP higher and inflation would have been 100 BP lower if the Federal Reserve had not conducted QE. According to Walker (2020), the cumulative effect of QE on the unemployment rate, over the 60-month horizon, shows a decrease of 79 BP, what is significantly smaller than the estimate provided by Chung, Laforte, Reifschneider, and Williams (2012).

As reported by Fawley and Neely (2013), a change in short-term real interest rates potentially influences the level of output and employment. According to Williamson (2017), QE (large-scale purchases of assets by central banks) caused a large increase in the Federal Reserve's balance sheet during the global financial crisis (2007-2008), as well as in the recovery process. Reverse Repo Facility, the repurchase program implemented by the Federal Reserve since 2013 opened an account on Fed's balance sheet for money-market funds, capable of depositing their excess liquidity against collateral, on specific conditions and inside of the restrictions set by the central bank. Following this principle, by replacing banks' reserves with money-market funds' "deposits", Fed has an ability of "freezing" liquidity created in QE activities. This results in creating free space in bank balance sheets, indirectly limiting the economy-financing role of money-market funds (Choulet, 2015).

As confirmed by Walker (2020), QE appears to have had a greater impact on 1-Year Treasuries than any other variable, although the Federal Reserve aimed more to decrease rates on long-term bonds. Yields on longer-term Treasuries and agencies fall 73 to 200 b p, much more than the 1-year yield (Krishnamurthy & Vissing-Jorgensen, 2011) . After conducting VAR analysis, concludes that U.S. Treasury Securities Maturing in 1 to 5 Years seem to have an intermittent impact (i.e., ranging between positive and negative) on CPI levels in US, as their corresponding impact is not clearly defined (Da Silva Ribeiro, 2020). onsistent with conclusions of research conducted by Fratzscher, Lo Duca, and Straub (2012), Fed Treasury purchases raised US equity prices by 15% (and EME and AE equity prices by more than 18%), and led to an effective depreciation of the US dollar by 4.8%. Also, in the research, Walker (2020) states that rates on 10-Year Treasuries fell by a peak value 5 BP 15 months after the initial shock and the impact remained negative for the duration of the 60-month horizon. On average, between 2008 Q4 and 2013 Q3, the increase in long-term asset holdings in the Fed balance sheet reduces the 10-year treasury spread by 82 bps, and increases GDP by 2.3 percent and the personal consumption expenditure price index by 0.5 percent, what arises as an endogenous response to an increase in the Fed's long-term asset holdings (Dahlhaus, Hess, & Reza, 2014). Observing the financial market reaction inside a short-time frame of the Fed announcements regarding QE, Gagnon (2016) claims that QE lowered long-term treasury yields by between 30 and 100 basis

points. As per research conducted by Reza, Santor, and Suchanek (2015), the cumulative effect of the QE programs have lowered the yield on 10-year Treasuries by 65-120 BP. Dahlhaus et al. (2014) found that QE lowered 10-year Treasuries by 82 BP. Employing a panel VAR framework, Bhattarai, Eggertsson, and Gafarov (2014) explains that expansionary QE shock caused an increased capital flow, exchange rate appreciation, reduction in long-term bond yields, and stock market booms in emerging economies. In their research, use Broad Money Supply (M2) variable to measure periods of stabilization and then reduction in the Fed's balance sheet. According to the findings presented in the scientific research "Inside the Money Creation in the United States", Choulet (2021) states that the Fed stabilized its balance sheet, by undertaking measures of reinvesting, in full, maturing debt in its securities portfolio, between October 2014 and October 2017. As per European Central Bank (2012), the important increase in excess central bank liquidity in the euro area was needed to offset the contractive impact of elevated liquidity stress on banks' balance sheet, what represents the relationship between base money, broad money and risks to price stability. As stated by the Fitch Ratings (2020), American credit rating agency, one of the "Big Three credit rating agencies", the connection among central bank balance sheets, base money, broad money supply and inflation across developed countries stays low, despite a decade of quantitative easing. According to Lenza and Slacalek (2019), quantitative easing did not increase inequality in the euro area. The Asset Purchase Programme implemented in the Euro Area relatively enhances household net wealth across the wealth distribution. Additionally, the effect on stock prices in Euro Area seems to be small and temporary, as a consequence of APP program.

Lenza and Slacalek (2019) claim that alterations in unemployment rates in Euro Area firmly influence household income: incomes rise significantly as households start earning wages (as an alternative to getting unemployment benefits). Reverse Repo Facility, the repurchase programme implemented by the Federal Reserve since 2013 opened an account on Fed's balance sheet for money-market funds, capable of depositing their excess liquidity against collateral, on specific conditions and inside of the restrictions set by the central bank. Following this principle, by replacing banks' reserves with money-market funds' "deposits", Fed has an ability of "freezing" liquidity created in QE activities. This results in creating free space in bank balance sheets, indirectly limiting the economy-financing role of money-market funds (Choulet, 2015). As the COVID-19 crisis started in March 2020, a way to stability in financial markets became an urgent 'dash for cash': even safe assets such as long-term government bonds were sold to obtain short-term highly liquid assets (Hauser, 2020). As stated by Brian, Martina, Elisabeth, and ĽUboš (2021) from ECB, there is substantial heterogeneity in the effectiveness of QE across different countries. Focusing on standardized effects, which are easier to compare across countries due to differences in QE program sizes, QE is most effective at raising output in the U.S., followed by the EA and UK. For inflation, QE is again the most effective in the U.S. (European Central Bank, 2021).

## 4. HYPOTHESES (RESEARCH QUESTIONS) AND RESEARCH MODEL

### 4.1. The Federal Reserve

Research questions of this scientific paper are converted into hypotheses, giving sequential answers to questions by analyzing hypotheses. Figure 16 illustrates the Federal Reserve's hypotheses testing model.

### 4.2. The European Central Bank

H1 Asset Purchase Programme (APP) plays a statistically significant mediating role between ECB's Balance Sheet and Euro Area Inflation Rate.

H2 Asset Purchase Programme (APP) plays a statistically significant mediating role between ECB's Balance Sheet and ECB Bond Yields.

H3 Asset Purchase Programme (APP) plays a statistically significant mediating role between ECB's Balance Sheet and Euro Area Broad Money Supply (M2).

H4 Asset Purchase Programme (APP) plays a statistically significant mediating role between ECB's Balance Sheet and Euro Area Unemployment Rate.

H5 Asset Purchase Programme (APP) plays a statistically significant mediating role between ECB's Balance Sheet and Debt to GDP.
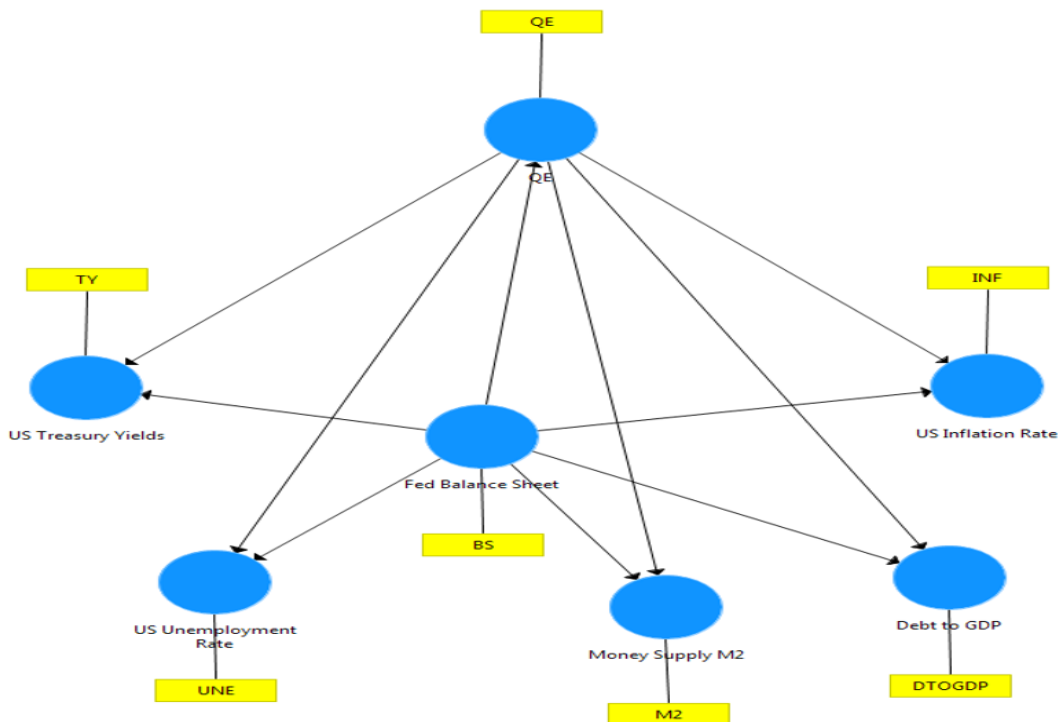


**Figure 16.** The federal reserve's hypotheses testing model.

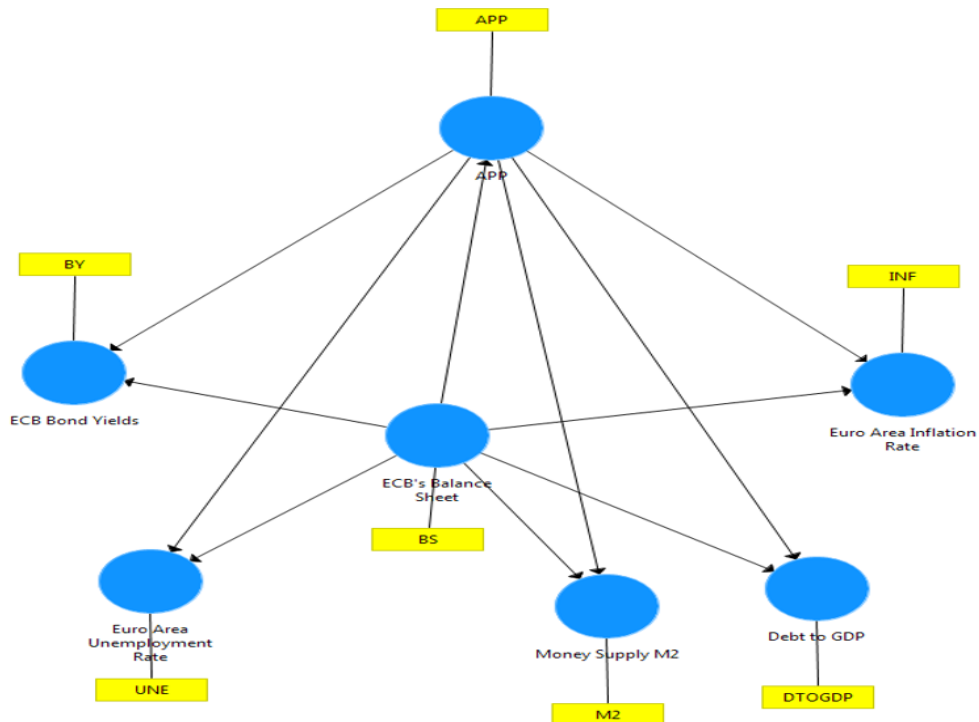Figure 17 illustrates the European Central Bank's hypotheses testing model:



**Figure 17.** The European Central Bank's hypotheses testing model.

## 5. METHODOLOGY

Literature-wise, certain sources refer to fundamental written works in the field of monetary policy, while the majority of literature consists primarily of the recent literature. However, when needed, certain references to fundamental works is the field are made. The US Federal Reserve's (Fed's) and the European Central Bank's (ECB's) monetary responses to economic shocks, i.e. unconventional monetary quantitative easing related policy responses are analysed by observing the influence on different variables, both for the Euro Area and the US. These variables include: Euro Area Inflation Rate, ECB Bonds Yields, Euro Area Broad Money Supply (M2), Euro Area Unemployment Rate, Debt to GDP; and US Inflation Rate, US Treasury Yields, US Broad Money Supply (M2), US Unemployment Rate, Debt to GDP.

The observed period for both the US Federal Reserve and the European Central Bank is 2015-2020 (data for January, April, July and October of each year, regarding every research variable were collected). Accordingly, two adequate research models have also been created. The accuracy of the hypotheses is examined using mediation in SmartPLS 3 software. Mediation is a process which happens when a third mediator variable has an intervention between two other related constructs. An alteration in the exogenous construct is the reason for a change in the mediator variable, which, in turn, results in a change in the endogenous construct in the PLS path model. Thus, a mediator variable governs the nature of the relationship between two constructs.

Analyzing the strength of the mediator variable's relationships with the other constructs concedes validating the mechanisms that underlie the cause-effect relationship among an exogenous construct and an endogenous construct. In the simplest pattern, the analysis takes into consideration only one mediator variable, but the path model can include a multitude of mediator variables simultaneously.

After conducting an analysis in SmartPLS, the results of the PLS-SEM algorithm and the bootstrapping procedures involve the direct, the total indirect effect, the specific indirect effects, and the total effect. These results, which can be found in the SmartPLS results reports, allow conducting a mediator analysis, what is executed for the purposes of the research, in this research paper. After creating an input data tables, both for the Fed and the ECB, which contain numerical data regarding Quantitative Easing (QE)-Assets and Lending, expressed in trillion USD, Fed and ECB balance sheets expressed in trillion USD, US and Euro Area Inflation Rate (percentage), US Treasury Yields and ECB Bond Yields (5 years, percentage), US and Euro Area Broad Money Supply (M2), expressed in trillion USD, US and Euro Area Unemployment Rate (percentage), US and Euro Area Debt to GDP (percentage), for the period 2015-2020 (January, April, July and October of each year-quarterly data), drawing the initial models in Smart PLS 3, PLS Algorithm process is executed, followed by Bootstrapping, and observing P values in Path Coefficients and Specific Indirect Effects Tables.

The strength of the relationships between given variables was obtained by applying the PLS algorithm. In this analysis, the path coefficients indicated the extent to which an independent variable affects a dependent variable (Mediation SmartPLS, 2020). The bootstrapping indicated whether these relationships were significant. Bootstrapping represents a nonparametric procedure that permits testing the statistical significance of different PLS-SEM results such as path coefficients. SmartPLS does not assume that the data are normally distributed, what strongly implicates that parametric significance tests cannot be applied to check if coefficients such as outer weights, outer loadings and path coefficients are significant. As an alternative, SmartPLS relies upon a nonparametric bootstrap procedure in order to test the relevance of estimated path coefficients in PLS-SEM. If Path Coefficient is larger than 0.05 (p>0.05), hypothesis is rejected, because an independent variable does not affect a dependent variable at the acceptable level. If Path Coefficient is smaller than 0.05 (p<0.05), hypothesis is confirmed, because an independent variable does affect a dependent variable at the wanted level.

In the Hypotheses Testing part of this scientific research, it was determined whether the mediating role between research variables was statistically significant. Statistical significance refers to the confident and forceful statement of fact that an outcome from data generated by testing or experimentation is not likely to happen

randomly or by chance, but is rather likely to be regarded as being caused by to a specific reason. Theoretical relevance of this scientific paper is based upon previous scientific research of extensive functioning of the transmission mechanism of unconventional monetary policy, including fundamental analysis of the same or similar variables, whose aim is to distinguish the various channels through which Quantitative Easing affects the real economy, covering relevant sample periods during which QE was undertaken. Some of these fundamental models can be found in scientific papers created by Boehl, Goy, and Strobel (2021), Walker (2020), Baumeister and Benati (2013); Gambacorta, Hofmann, and Peersman (2014); Peersman (2011).

## 6. RESULTS AND HYPOTHESES TESTING

### 6.1. The Federal Reserve: Results and Hypotheses Testing

After creating an input data table, containing numerical data regarding Quantitative Easing (QE)-Assets and Lending, expressed in trillion USD, US Balance Sheet expressed in trillion USD, US Inflation Rate (percentage), US Treasury Yields (5 years, percentage), US Broad Money Supply (M2), expressed in trillion USD, US Unemployment Rate (percentage), Debt to GDP (percentage), for the period 2015-2020 (January, April, July and October of each year), drawing the initial model in Smart PLS 3, PLS Algorithm process was executed, followed by Bootstrapping, and observing of P values in Path Coefficients and Specific Indirect Effects Tables.

Table 1 presents relations of variables among each other for Fed, whose significance is expressed by P values, and analyzed subsequently.

**Table 1.** Path coefficients (Fed).

|  | Original Sample | Sample Mean | Standard Deviation | T Statistics | P Values |
|---|---|---|---|---|---|
| Fed Balance Sheet->Debt to GDP | 0.493 | 0.523 | 0.783 | 0.629 | 0.529 |
| Fed Balance Sheet->Money Supply M2 | -0.502 | -0.916 | 1.789 | 0.281 | 0.779 |
| Fed Balance Sheet->QE | 0.685 | 0.688 | 0.166 | 4.117 | 0.000 |
| Fed Balance Sheet->US Inflation Rate | 0.249 | -0.542 | 3.270 | 0.076 | 0.939 |
| Fed Balance Sheet->US Treasury Yields | -0.524 | -1.609 | 4.349 | 0.121 | 0.904 |
| Fed Balance Sheet->US Unemployment Rate | 0.203 | 0.505 | 1.614 | 0.126 | 0.900 |
| QE->Debt to GDP | 0.224 | 0.170 | 0.763 | 0.294 | 0.769 |
| QE-> Money Supply M2 | 0.710 | 1.117 | 1.734 | 0.409 | 0.682 |
| QE-> US Inflation Rate | -0.305 | 0.476 | 3.304 | 0.092 | 0.927 |
| QE-> US Treasury Yields | 0.107 | 1.194 | 4.346 | 0.025 | 0.980 |
| QE-> US Unemployment Rate | 0.239 | -0.100 | 1.622 | 0.147 | 0.883 |

According to P values, which are higher than 0.05, in every case, except in the relation Fed Balance Sheet->QE, where P=0.000, it was concluded that none of the relations, except the relation Fed Balance Sheet->QE, was statistically significant. Table 2 presents Specific indirect effects of variables:

**Table 2.** Specific indirect effects (Fed).

|  | Original Sample | Sample Mean | Standard Deviation | T Statistics | P Values |
|---|---|---|---|---|---|
| Fed Balance Sheet->QE->US Treasury Yields | 0.073 | 1.152 | 4.346 | 0.017 | 0.987 |
| Fed Balance Sheet->QE-> Money Supply M2 | 0.486 | 0.904 | 1.771 | 0.275 | 0.784 |
| Fed Balance Sheet->QE-> US Inflation Rate | -0.209 | 0.564 | 3.278 | 0.064 | 0.949 |
| Fed Balance Sheet->QE-> US Unemployment Rate | 0.164 | -0.163 | 1.595 | 0.103 | 0.912 |
| Fed Balance Sheet->QE-> Debt to GDP | 0.154 | 0.106 | 0.757 | 0.203 | 0.839 |

*H1: Fed Balance Sheet>QE>US Inflation Rate: p=0.949>0.05; therefore, we REJECT H1.*

Actually, Quantitative easing (QE) activities DO NOT play a statistically significant mediating role between Fed's Balance Sheet and US Inflation Rate.

*H2: Fed Balance Sheet>QE>US Treasury Yields: p=0.987>0.05; therefore, we REJECT H2.*

Actually, Quantitative easing (QE) activities DO NOT play a statistically significant mediating role between Fed's Balance Sheet and US Treasury Yields.

*H3: Fed Balance Sheet>QE>US Unemployment Rate: p=0.918>0.05; therefore, we REJECT H3.*

Actually, Quantitative easing (QE) activities DO NOT play a statistically significant mediating role between Fed's Balance Sheet and US Unemployment Rate.

*H4: Fed Balance Sheet>QE>US Broad Money Supply (M2): p=0.784>0.05; therefore, we REJECT H4.*

Actually, Quantitative easing (QE) activities DO NOT play a statistically significant mediating role between Fed's Balance Sheet and US Broad Money Supply (M2).

*H5: Fed Balance Sheet>QE> Debt to GDP: p=0.839>0.05; therefore, we REJECT H5.*

Actually, Quantitative easing (QE) activities DO NOT play a statistically significant mediating role between Fed's Balance Sheet and Debt to GDP.

## *6.2. The European Central Bank: Results and Hypotheses Testing*

After creating an input data table, which contains numerical data regarding Asset Purchase Programme (APP)-Assets and Lending, expressed in trillion USD, Euro Area Balance Sheet expressed in trillion USD, Euro Area Inflation Rate (percentage), ECB Bonds Yields (5 years, percentage), Euro Area Broad Money Supply (M2), expressed in trillion USD, Euro Area Unemployment Rate (percentage), Debt to GDP (percentage), for the period 2015-2020 (January, April, July and October of each year), drawing the initial model in Smart PLS 3, PLS Algorithm process is executed, followed by Bootstrapping, and observe P values in Path Coefficients and Specific Indirect Effects Tables. Table 3 presents relations of variables among each other for ECB, whose significance is expressed by P values, and analyzed below the table.

**Table 3.** Path coefficients (ECB).

|  | Original Sample | Sample Mean | Standard Deviation | T Statistics | P Values |
|---|---|---|---|---|---|
| APP->Debt to GDP | 0.672 | 0.799 | 0.936 | 0.718 | 0.473 |
| APP ->ECB Bond Yields | -0.375 | -0.352 | 0.294 | 1.276 | 0.203 |
| APP->Euro Area Inflation Rate | 0.622 | 0.758 | 0.933 | 0.667 | 0.505 |
| APP-> Euro Area Unemployment Rate | -0.578 | -0.608 | 0.545 | 1.061 | 0.289 |
| APP-> Money Supply M2 | 0.259 | 0.170 | 0.382 | 0.679 | 0.497 |
| ECB's Balance Sheet->APP | 0.524 | 0.532 | 0.207 | 2.528 | 0.012 |
| ECB's Balance Sheet ->Debt to GDP | -0.400 | -0.507 | 0.935 | 0.428 | 0.669 |
| ECB's Balance Sheet ->ECB Bond Yields | -0.348 | -0.354 | 0.276 | 1.260 | 0.208 |
| ECB's Balance Sheet ->Euro Area Inflation Rate | -0.513 | -0.624 | 0.923 | 0.556 | 0.579 |
| ECB's Balance Sheet ->Euro Area Unemployment Rate | 0.371 | 0.368 | 0.523 | 0.708 | 0.479 |
| ECB's Balance Sheet -> Money Supply M2 | 0.079 | 0.173 | 0.365 | 0.217 | 0.828 |

**Table 4.** Specific indirect effects (ECB).

|  | Original Sample | Sample Mean | Standard Deviation | T Statistics | P Values |
|---|---|---|---|---|---|
| ECB's Balance Sheet ->APP->Euro Area Inflation Rate | 0.326 | 0.465 | 0.965 | 0.338 | 0.736 |
| ECB's Balance Sheet ->APP->Money Supply M2 | 0.136 | 0.053 | 0.297 | 0.457 | 0.648 |
| ECB's Balance Sheet ->APP->Debt to GDP | 0.352 | 0.481 | 0.972 | 0.362 | 0.717 |
| ECB's Balance Sheet ->APP->ECB Bond Yields | -0.197 | -0.183 | 0.266 | 0.740 | 0.460 |
| ECB's Balance Sheet ->APP-> Euro Area Unemployment Rate | -0.303 | -0.346 | 0.539 | 0.562 | 0.574 |

According to P values, which are higher than 0.05, in every case, except in the relation ECB's Balance Sheet->APP, where P=0.012, it is concluded that none of the relations, except the relation ECB's Balance Sheet->APP, is statistically significant. Table 4 presents Specific indirect effects of variables.

*H1: ECB's Balance Sheet>APP>Euro Area Inflation Rate: p=0.736>0.05; therefore, we REJECT H1.*

Actually, Asset Purchase Programme (APP) DOES NOT play a statistically significant mediating role between ECB's Balance Sheet and Euro Area Inflation Rate.

*H2: ECB's Balance Sheet>APP>ECB Bond Yields: p=0.460>0.05; therefore, we REJECT H2.*

Actually, Asset Purchase Programme (APP) DOES NOT play a statistically significant mediating role between ECB's Balance Sheet and ECB Bond Yields.

*H3: ECB's Balance Sheet>APP>Euro Area Broad Money Supply (M2): p=0.648>0.05; therefore, we REJECT H3.*

Actually, Asset Purchase Programme (APP) DOES NOT play a statistically significant mediating role between ECB's Balance Sheet and Euro Area Broad Money Supply (M2).

*H4: ECB's Balance Sheet>APP>Euro Area Unemployment Rate: p=0.574>0.05; therefore, we REJECT H4.*

Actually, Asset Purchase Programme (APP) DOES NOT play a statistically significant mediating role between ECB's Balance Sheet and Euro Area Unemployment Rate.

*H5: ECB's Balance Sheet>APP>Debt to GDP: p=0.717>0.05; therefore, we REJECT H5.*

Actually, Asset Purchase Programme (APP) DOES NOT play a statistically significant mediating role between ECB's Balance Sheet and Debt to GDP.

### 6.3. Results: Difference from Previous Studies

It is relevant to pay attention to the fact that there was a significant lag in observing the peak effect of QE on most of the macroeconomic variables listed in this research paper, and what has also been noticed in previous research in this field. Despite that, analysis showed that QE activities did have a long-lasting effect on most variables that totaled significant effects as a result of QE. Fact that a size of a balance sheet is relevant variable in measuring the impact of QE activities on overall economy, expressed as a percentage of GDP for the period 2006-2020, is also confirmed by Gregor Boehl (University of Bonn), Gavin Goy (De Nederlandsche Bank) and Felix Strobel (Deutsche Bundesbank), in Deutsche Bundesbank (2021), research entitled "A Structural Investigation of Quantitative Easing". Difference of scientific research "Evaluating the Effectiveness of Quantitative Easing Measures of the Federal Reserve and The European Central Bank", when compared to the research "A Structural Investigation of Quantitative Easing", is primarily in the methodological approaches.

In order to answer the question whether the Federal Reserve's Quantitative Easing (QE) in the aftermath of the financial crisis has macroeconomic effects, authors estimated a large-scale DSGE model over the sample from 1998 until 2020, including data of the Fed's balance sheet, and used nonlinear Bayesian likelihood approach which completely accounts for the zero lower bound on nominal interest rates. They found that hat QE increased output by about 1.2 percent, with a net increase in investment of nearly 9 percent, accompanied by a 0.7 percent drop in aggregate consumption. Authors claim that both government bond and capital asset purchases significantly improved financing conditions. However, a fall in consumption caused side disinflationary effect of 0.25 percent annually. When comparing results of both researches, we can notice that both confirm the fact that QE activities have significant influence on Fed's balance sheet (QE increased output by about 1.2 percent) and vice versa. However, as confirmed by listed authors, each shock reflects the exact contribution to Fed's balance sheet, independently of any ordering effects that might occur in nonlinear models. Higher wages and the return on capital equal the marginal product of capital in their model, pushing up marginal cost and thus inflation.

In contrast to the Fed benchmark model, presented in the paper "Evaluating the Effectiveness of Quantitative Easing Measures of the Federal Reserve and The European Central Bank", in the model "A Structural Investigation

of Quantitative Easing", it is stated that the demand effects of Large-Scale Asset Purchases outweigh their supply effects.

When comparing the results of scientific research "Evaluating the effectiveness of quantitative easing: An SVAR approach", by Seth Walker, again, the primary difference is in the methodological approaches. Author is investigating Impulse Response Functions regarding Federal Funds Rate, Unemployment Rate, Inflation, 1-Year Treasuries, 10-Year Treasuries and 30-Year Mortgages, as well as Industrial Production. The data used in this paper consists of 556 observations of 8 key macroeconomic variables, monthly and seasonally-adjusted, where applicable, from January 1973 to April 2019. In order to examine the effectiveness of QE, the author used VAR model:

$$Yt = c + A(L)Yt\text{-}1 + ut$$

where Yt represents a vector of endogenous variables, c is a vector of intercepts, A(L) is a matrix of autoregressive coefficients of lagged Yt values, and ut is a vector of residuals (Walker, 2020). The most significant effect on Federal Funds Rate is observed three to four months after the initial shock at -18 BP, while the cumulative effect is a decrease of the Federal Funds Rate by 280 BP. The influence that QE activities had on the unemployment rate changed signs during the 60-month horizon. Firstly, unemployment rate increased because of QE activities, with a peak effect of 2.5 BP 4 months after the shock. But, 14 months after the shock, the unemployment rate started decreasing and having the effect the Federal Reserve desired. The highest effect of QE on inflation is 12 BP 3-4 months after the shock to reserves. The author found that QE had a greater impact on 1-Year Treasuries than any other variable, while focusing on lowering the rates on 10-Year Treasuries and 30-Year mortgages. The behavior of industrial production showed that QE was not successful in increasing real economic activity. Since majority of variables used in the paper "Evaluating the effectiveness of quantitative easing: An SVAR approach" are the same/similar to the variables used in the research paper "Evaluating the Effectiveness of Quantitative Easing Measures of the Federal Reserve and The European Central Bank", it is somewhat surprising that the results are quite different. in the author's research, the effects of these variables on the balance sheet are not so strong, when observing P coefficients. Rather to say, they appeared to be insignificant and thus, it was shown that QE activities barely affect the mediating roles of variables and US or Euro Area Balance Sheets. Without QE activities, the variables would also be sustainable. Schenkelberg and Watzka (2013) claim that QE activities brought to a statistically significant decrease in long-term interest rates. That was a reason for a significant, but transitory, increase in output and prices. However, central banks might use other intervention measures. Macroeconomic dynamics in the US, as well as Euro Area, when analyzed using different methods, seem to result in slightly different effects in terms of the influence of QE measures on bonds, unemployment, inflation. Each model would require slight adjustments to facilitate the same empirical analysis of macroeconomic dynamics. However, different methodological approaches of different authors prove how broad and relative understandings of economic indicators can be. There is no universal formula for the success of the economy.

## 7. DISCUSSION AND CONCLUSION

Tenacious monetary rules and their incumbency mean provide the sign that it is harder to borrow and spend for households, prompting an expansion in total savings, either in light of consumer protection, or due to administrative measures on monetary intermediaries. In order to achieve consistency with their mandates, central banks are willing to raise, rather than bringing inflation lower, and guaranteeing their capacity. Monetary stability is as much in danger from low rates as high rates. The medium-term issue is the full ingestion of reserve funds rather than the swarming out of venture. Monetary transmission process is based upon anticipations, starting with basic decisions of amenable monetary bodies. The introduction of unconventional monetary policy instruments can have a success in anchoring long-term inflation expectations and reduction of the term premium and the risk premium. Monetary system has an economy-stimulating effect beyond the policy rate, by increasing its monetary

base. Interest rate spreads charged by banks decline persistently after a rise in the monetary base. Interest rate spreads increase significantly as a consequence of a fall in the policy rate. A significant short-run liquidity effect after an interest rate innovation does not exist.

If unconventional monetary measures are not adequately monitored, their functioning may result in unwanted consequence of bringing into existence financial circumstances that may be over-good-natured for private markets, commercial banks and sovereigns. In all highly developed economies, such situation may add to postponing the fundamental upgrades in rules and guidelines of the monetary area, improvements of balance sheets of financial institutions, primary changes of the economies, and financial change. Therefore, unconventional monetary policy measures should fulfill the accompanying conditions:

- Unconventional monetary measures should be led by purposes as strong as possible, in order for commercial banks to force them to take care about their medium-term recapitalization and balance sheets improvement problems.

- Unconventional monetary measures should be as unequivocally as conceivable comparable with the level of disengagement and interruption of market they should add to counter.

A review of the scholarly literature in this scientific paper suggests that financial rule makers from central banks at the knowledge to implement the appropriate policies; however, when they faced with the real world economic challenges which created difficulties to adequately operate the economy using conventional tools, the transition to unconventional measures was necessary. Therefore, in terms of policy recommendations, economic theory and rules of financial behavior of the monetary institution, followed by each central bank, with an emphasis to the ECB and the Fed, should be clear on what should they do during sudden economic changes such as shortages, supply shocks, financial bubbles, and liquidity traps. The rules should not be deviated from because the world economy is not a financial laboratory. Central banks should be completely consistent to fit into an adequate reinforcement of global governance, because conventional or unconventional monetary measures of a single country, especially if it is a larger, highly economically developed nation, are contributing to the overall financial environment of the global economy, thus changing monetary climate of the worldwide economy.

Proof of the limitations of this study is the impossibility of blaming one institution for the overall situation in a particular country or region. Considering to the fact that no single coherent theory which allows an explanation of extensive functioning of the transmission mechanism of unconventional monetary policy is existent, this scientific paper considers various approaches to explain the monetary outcomes of unconventional monetary tools. Referring to the status of monetary policy demands a comprehension of abilities and limitations of a central bank. "Accusing" only one institution (central bank) for failing to prevent or provoke something that is not completely under its control, but also depends on other financial institutions and general economic fluctuations, is not completely reasonable. However, the general name for the methods central banks impact economic flows is named "transmission mechanisms of monetary policy", representing what a central bank is capable of effectuating, and therefore, the methodology of this scientific paper focuses precisely on such mechanisms, with special reference to unconventional policy.

This scientific paper will serve as an excellent source of accurate information and research to future authors and researchers in the field of conventional and unconventional monetary measures, because the work is well systematically organized, clear for interpretation and provides an extensive, adequate insight into the situation regarding transmission mechanism of monetary policy. This research paper can be expanded in accordance with future directions: for example, an expansion on the number of variables considered. Except the size of ECB's and Fed's balance sheets, inflation rates, unemployment rates, debt-to-GDP ratios, EU Bond Yields and US Treasury Yields, money supply M2, other variables, such as industrial production, Federal Funds Rate, 30-Year Mortgage Rate, key ECB interest rates, can be considered in the future research. Having in mind the fact that the variables unquestionably influence each other, and without expert analysis, the obtained results of mediation call into

implementation the usage of other methodology, such as the vector auto-regression (VAR). Phenomenal volumes of empirical works have relied on the vector auto-regression (VAR) and its variants in the transmission exposition, with ordering of variables in the system informed by theory, for the purpose of financial research.

## REFERENCES

Albu, L. L., Lupu, R., Calin, A. C., & Popovici, O. C. (2014). Estimating the impact of quantitative easing on credit risk through an ARMA-GARCH model. *Romanian Journal of Economic Forecasting, 17*(3), 39-50.

AtlanticCouncil. (2021). Global QE tracker. Retrieved from: https://www.atlanticcouncil.org/global-qe-tracker/.

Baumeister, C., & Benati, L. (2013). Unconventional monetary policy and the great recession-Estimating the impact of a compression in the yield spread at the zero lower bound. *International Journal of Central Banking, 9*(2), 165-212.

Bhattarai, S., Eggertsson, G. B., & Gafarov, B. (2014). *Time consistency and the duration of government debt: A signalling theory of quantitative easing.* Paper presented at the Swiss National Bank (SNB) and the European Central Bank (ECB) in 2014.

Boehl, G., Goy, G., & Strobel, F. (2021). A structural investigation of quantitative easing. Discussion Paper; Deutsche Bundesbank; No 01/2021.

Bowdler, C., & Radia, A. (2012). Unconventional monetary policy: The assessment. *Oxford Review of Economic Policy, 28*(4), 603–621.Available at: https://doi.org/10.1093/oxrep/grs037.

Brian, F., Martina, J., Elisabeth, K., & Ľuboš, P. (2021). Fifty shades of QE: comparing findings of central bankers and academics. ECB. Retrieved from: https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2584~004629c8e7.en.pdf

Bridges, J., & Thomas, R. (2012). The impact of QE on the UK economy—some supportive monetarist arithmetic. Bank of England Working Paper No. 442.

Brózda, D. (2016). Transmission mechanism of the Federal Reserve System's monetary policy in the conditions of zero bound on nominal interest rates *Equilibrium, 11*(4), 751-767.Available at: https://doi.org/10.12775/equil.2016.034.

Bundick, B. (2014). Monetary policy and the great recession | eScholarship@BC. Dlib. Retrieved from: https://dlib.bc.edu/islandora/object/bc-ir:101609.

Cho, D., Han, Y., Oh, J., & Picco, A. R. (2021). Uncertainty shocks, precautionary pricing, and optimal monetary policy. *Journal of Macroeconomics, 69*, 103343.Available at: https://doi.org/10.1016/j.jmacro.2021.103343.

Choulet, C. (2015). QE and bank balance sheets: The American experience. Economic-Research.Bnpparibas.Com. Retrieved from: https://economic-research.bnpparibas.com/Views/DisplayPublication.aspx?type=document&IdPdf=25852

Choulet, C. (2021). Inside the money creation in the United States. Eco Conjoncture, BNP Paribas, 5. Retrieved from: https://economic-research.bnpparibas.com/Views/DisplayPublication.aspx?type=document&IdPdf=43264.

Chung, H., Laforte, J.-P., Reifschneider, D., & Williams, J. C. (2012). Have we underestimated the likelihood and severity of zero lower bound events? *Journal of Money, Credit and Banking, 44,* 47-82.

Coenen, G., & Wieland, V. (2003). The zero-interest rate bound and the role of the exchange rate for monetary policy in Japan. European Central Bank Working Paper Series, No. 218.

Da Silva Ribeiro, A. (2020). The effects of quantitative easing on U.S. Inflation and output. University Institute of Lisbon, Department of Economics / Department of Political Economy. Retrieved from: https://repositorio.iscte-iul.pt/bitstream/10071/21491/4/master_andre_silva_ribeiro.pdf.

Dahlhaus, T., Hess, K., & Reza, A. (2014). International transmission channels of US quantitative easing: Evidence from Canada (No. 2014-43). Bank of Canada Working Paper.

Dedola, L., Georgiadis, G., Gräb, J., & Mehl, A. (2021). Does a big bazooka matter? Quantitative easing policies and exchange rates. *Journal of Monetary Economics, 117,* 489–506.Available at: https://doi.org/10.1016/j.jmoneco.2020.03.002.

Del Negro, M., Giannone, D., Giannoni, M. P., & Tambalotti, A. (2019). Global trends in interest rates. *Journal of International Economics, 118*, 248–262.Available at: https://doi.org/10.1016/j.jinteco.2019.01.010.

Deutsche Bundesbank. (2021). Discussion paper. Bundesbank.De. Retrieved from: https://www.bundesbank.de/resource/blob/856942/7e54d0e3e2ca63ee39674805c366f6fe/mL/2021-01-26-dkp-01-data.pdf

Diamond, P., & Vartiainen, H. (2007). Behavioral economics and its applications (1st ed., pp. 1-336): Princeton University Press.

European Central Bank. (2012). The relationship between basee money, broad money and risks to price stability. ECB Monthly Bulletin, May 2012. Retrieved from: https://www.ecb.europa.eu/pub/pdf/other/mb201205_focus02.en.pdfropean Central Bank. (2016, August 8). Transmission Mechanism.

European Central Bank. (2021). Asset purchase programmes. Retrieved from: https://www.ecb.europa.eu/mopo/implement/app/html/index.en.html

Fawley, B. W., & Neely, C. J. (2013). Four stories of quantitative easing. *Federal Reserve Bank of St. Louis Review, 95*(1), 51-88.

Fed. (2021). Federal reserve board - recent balance sheet trends. Board of Governors of the Federal Reserve System. Retrieved from: https://www.federalreserve.gov/monetarypolicy/bst_recenttrends.htm.

Filiani, P. (2021). Optimal monetary–fiscal policy in the euro area liquidity crisis. *Journal of Macroeconomics, 70*, 103364.Available at: https://doi.org/10.1016/j.jmacro.2021.103364.

Fitch Ratings. (2020). Surging ECB balance sheet not inflationary. Fitch Ratings. Retrieved from: https://www.fitchratings.com/research/sovereigns/surging-ecb-balance-sheet-not-inflationary-21-08-2020.

Fratzscher, M., Lo Duca, M., & Straub, R. (2012). A global monetary tsunami? On the spillovers of US quantitative easing (October 19, 2012). Available at SSRN: https://ssrn.com/abstract=2164261 or http://dx.doi.org/10.2139/ssrn.2164261.

Friedman, M., & Schwartz, A. J. (1986a). Has government any role in money? *Journal of Monetary Economics, 17*(1), 37–62.Available at: https://doi.org/10.1016/0304-3932(86)90005-x.

Gagnon, J. E. G. (2016). Quantitative easing: An underappreciated success. *Policy Brief; Peterson Institute for International Economics; PB*, 16.

Gambacorta, L., Hofmann, B., & Peersman, G. (2014). The effectiveness of unconventional monetary policy at the zero lower bound: A cross-country analysis. *Journal of Money, Credit and Banking, 46*(4), 615-642.

Guttmann, R. (2020). The economic effects of low interest rates and unconventional monetary policy | Bulletin – September Quarter 2020. Reserve Bank of Australia. Retrieved from: https://www.rba.gov.au/publications/bulletin/2020/sep/the-economic-effects-of-low-interest-rates-and-unconventional-monetary-policy.html.

Hauser, A. (2020). Seven moment in spring: Covid-19, financial markets and the Bank of England'soperations", Retrieved from: https://www.bankofengland.co.uk/speech/2020/andrew-hauser-speech-hosted-by-bloomberg-via-webinar.

Houcine, B., Abdelkader, A., & Lachi, O. (2020). The impact of unconventional monetary policy tools on inflation rates in the USA. *Asian Economic and Financial Review, 10*(6), 628–643.Available at: https://doi.org/10.18488/journal.aefr.2020.106.628.643.

Kocherlakota, N. (2019). The future of the zero lower bound problem. IDEAS. Retrieved from: https://ideas.repec.org/a/eee/jimfin/v95y2019icp228-231.html

Krishnamurthy, A., & Vissing-Jorgensen, A. (2011). The effects of quantitative easing on interest rates: Channels and implications for policy (No. w17555). National Bureau of Economic Research.

Lenza, & Slacalek. (2019). Quantitative easing did not increase inequality in the Euro area. European Central Bank Research Bulletin, 54. Retrieved from: https://www.ecb.europa.eu/pub/economic-research/resbull/2019/html/ecb.rb190129.en.html.

Liu, P., Theodoridis, K., Mumtaz, H., & Zanetti, F. (2019). Changing macroeconomic dynamics at the zero lower bound. *Journal of Business & Economic Statistics, 37*(3), 391-404.

Lu, M. (2021). The fed's balance sheet: The other exponential curve. Visual Capitalist. Retrieved from: https://www.visualcapitalist.com/the-feds-balance-sheet-the-other-exponential-curve/.

Lucke, B. L. (2004). Real interest rates and productivity shocks: Why are business cycles negatively correlated between the European Union and Jordan? *Emerging Markets Finance & Trade, 40*(6), 82–94.Available at: https://www.jstor.org/stable/27750421.

Lundvall, H. L. (2020). What is driving the global trend towards lower real interest rates? Sverige's Riksbank Economic Review. Retrieved from: https://www.riksbank.se/globalassets/media/rapporter/pov/artiklar/engelska/2020/200513/2020_1-what-is-driving-the-global-trend-towards-lower-real-interest-rates.pdf

Mediation SmartPLS. (2020). SmartPLS. Retrieved from: https://www.smartpls.com/documentation/algorithms-and-techniques/mediation.

Olivier, B., Jonathan, D. O., Atish, R. G., & Marcos, C. (2016). Capital flows: Expansionary or contractionary? *The American Economic Review, 106*(5), 565–569.Available at: https://www.jstor.org/stable/43861083.

Peersman, G. (2011). EconStor: Macroeconomic effects of unconventional monetary policy in the euro area. EconStor. Retrieved from: https://www.econstor.eu/handle/10419/153831.

Reinhart, C. (2016). The anemic recovery in advanced economies: Are we ignoring a major cause? World Economic Forum. Retrieved from: https://www.weforum.org/agenda/2016/04/the-anemic-recovery-in-advanced-economies-are-we-ignoring-a-major-cause/.

Reza, A., Santor, E., & Suchanek, L. (2015). Quantitative easing as a policy tool under the effective lower bound: Bank of Canada Staff Discussion Paper.

Rogoff, K. (2017). Dealing with monetary paralysis at the zero bound. *Journal of Economic Perspective, 31*(3), 47–66.

Schenkelberg, H., & Watzka, S. (2013). Real effects of quantitative easing at the zero lower bound: Structural VAR-based evidence from Japan. *Journal of International Money and Finance, 33*, 327–357.Available at: https://doi.org/10.1016/j.jimonfin.2012.11.020.

Selgin, G., Lastrapes, W. D., & White, L. H. (2012). Has the Fed been a failure? *Journal of Macroeconomics, 34*(3), 569-596.Available at: https://doi:10.1016/j.jmacro.2012.02.003.

Walker, S. W. (2020). Evaluating the effectiveness of quantitative easing: An SVAR approach. Senior Honors Projects, 2020-current. 11. Retrieved from: https://commons.lib.jmu.edu/honors202029/11.

Watkins, J. P. (2014). Quantitative easing as a means of reducing unemployment: A new version of trickle-down economics. *Journal of Economic Issues, 48*(2), 431–440.Available at: https://doi.org/10.2753/jei0021-3624480217.

Williamson, S. (2017). Quantitative easing: How well does this tool work? St. Louis Fed. Retrieved from: https://www.stlouisfed.org/publications/regional-economist/third-quarter-2017/quantitative-easing-how-well-does-this-tool-work.