MASTER

MONETARY AND FINANCIAL ECONOMICS

MASTER'S FINAL WORK

DISSERTATION

THE EFFECTS OF QUANTITATIVE EASING IN THE US AND EUROZONE

MERISA OSMANOVIC

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AD – Aggregate Demand

BHS – Business, Households, and the State

CB – Central Bank

CD – Checkable Deposits

ECB – European Central Bank

Fed – The Federal Reserve

MBS – Mortgage-Backed Securities

MP – Monetary Policy

QE – Quantitative Easing

U.S. – United States

ABSTRACT, KEYWORDS, AND JEL CODES

This paper presents a comprehensive analysis of the impact of quantitative easing (QE) programs in the United States and the euro area during the QE1-QE3 period 2008-2013. The study's main objective is to critically examine both policies' positive and negative effects and assess their effectiveness. The paper analyzes whether QE 's goals of stabilizing financial markets, stimulating economic growth, and controlling inflation have been achieved and investigates which transmission channels proved the most effective. The paper also examines alternative explanations for the economic outcomes observed during the implementation of QE programs. Particular attention is paid to the effects of QE on consumption, investment, unemployment, and house prices, as well as to a critical analysis of the theoretical underpinnings and real-world consequences of increasing the monetary base in a modern economy. The study results show that QE has limited effectiveness in stimulating investment and consumption and, thus, has limited impact on the real economy; and the moreover risk involves of increasing social inequality.

KEYWORDS: Quantitative Easing; Unconventional Monetary Policy; Eurozone; US

JEL CODES: E52; E58; E44; E51

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MASTER'S FINAL WORK

By Merisa Osmanovic

THIS PAPER PROVIDES A DETAILED ANALYSIS OF THE IMPACT OF QUANTITATIVE
EASING (QE) IN THE U.S. AND EUROZONE DURING THE QE1-QE3 PERIOD (2008-
2013), FOCUSING ON ITS EFFECTIVENESS IN STABILIZING FINANCIAL MARKETS,
STIMULATING GROWTH, AND CONTROLLING INFLATION. THE STUDY
CRITICALLY ASSESSES QE'S POSITIVE AND NEGATIVE OUTCOMES,
PARTICULARLY ITS EFFECTS ON CONSUMPTION, INVESTMENT, UNEMPLOYMENT,
AND HOUSE PRICES. IT HIGHLIGHTS THAT WHILE QE HAD SOME SUCCESS, ITS
IMPACT ON THE REAL ECONOMY WAS LIMITED, WITH CONCERNS ABOUT
INCREASING SOCIAL INEQUALITY AND ITS EFFECTIVENESS IN BOOSTING
INVESTMENT AND CONSUMPTION. THE ANALYSIS ALSO EXPLORES
ALTERNATIVE EXPLANATIONS FOR THE OBSERVED ECONOMIC OUTCOMES.

1. INTRODUCTION

Quantitative easing (QE) in the United States and the Eurozone has been a significant monetary policy tool for addressing economic challenges, particularly during and after the financial crisis of 2008.

QE's initial goals and objectives in the United States were to provide economic stimulus once short-term interest rates had already been pushed near zero. QE was intended to stabilize the financial system by purchasing various securities, including mortgage-backed securities (MBS) and longer-term U.S. Treasuries, to reduce long-term interest rates and thereby support the housing market at a time when unemployment was high, and growth was slow or negative (Chen, 2024). Another critical objective was to sustain inflation rates close to the government's 2% target, bolstering business and consumer confidence (Bal et al., 2019). The European Central Bank (ECB) implemented QE to boost inflation and stimulate growth in the Eurozone.

The Federal Reserve in the United States and the ECB implemented several rounds of QE The Federal Reserve launched QE in three phases between 2008 and 2014. Similarly, the ECB introduced its QE program from 2015 to 2019. Both central banks (CB) adjusted their strategies to address evolving economic conditions (Chen, 2024; Christensen et al., 2024).

In the U.S., the crisis, precipitated by easily accessible credit and lenient borrowing criteria, led to a housing bubble, the deflation of which left financial institutions with large amounts of devalued subprime mortgage investments. Financial institutions began deleveraging as these securities lost value, causing a further price decline and a liquidity

shortage (Ito et al., 2014). In response, the Federal Reserve's QE1 involved purchasing MBS, consumer loans, and Treasury instruments to infuse liquidity and stabilize the financial system (Chen, 2024).

In the case of the Eurozone, disinflation inteifying in the latter half of 2014 pushed the ECB to act (Heam et al., 2015). Public declarations from ECB officials and the continued drop in inflation figures prepared the markets for this significant monetary intervention, which was officially unveiled in January 2015 (Heam et al., 2015).

The purpose of this paper is to provide a comprehensive analysis of the effects of QE in the United States and the Euro Area during the QE1-QE3 programs, and to make a critique of the effectiveness of these policies. The study aims to determine whether the objectives of QE have been achieved, which transmission channels have been most effective, and what alternative explanations could explain the observed economic outcomes.

Central research question:

What were the economic effects of quantitative easing in the United States and the euro area during the QE1-QE3 programs, and to what extent did these programs achieve their goals of stabilizing financial markets, stimulating economic growth, and controlling inflation?

The remainder of the thesis is divided into 4 sections. Section 2 presents the QE in the U.S. and Euro Zone. Section 3 explains the standard view of QE Section 4 examines how money is created by the Fed and by the ECB. Section 5 answers the question of what happened during these times.

2. THE QE IN THE U.S. AND EUROZONE

The German economist Richard Werner invented Quantitative easing's name. While working in Tokyo in 1994, he proposed a new type of monetary policy implemented by Japan (Werner, 1995). This new policy is not based on rate reductions but on credit creation for GDP transactions. The author contended that stimulating "credit creation" through the CB's purchase of treasury bills and direct loans to businesses and the government was required and sufficient to initiate an economic recovery. Additionally,

he recommended that the CB buy non-performing assets directly from commercial banks (Werner, 1995).

2.1. The U.S.

In the U.S., the crisis was triggered by easily accessible credit and lenient borrowing criteria, leading to a surge in housing prices that eventually resulted in bubble deflation, leaving financial institutions with vast amounts of devalued subprime mortgage investments. By December 2008, the Federal Reserve had reduced the federal funds rate to nearly zero, but conventional monetary policy measures were deemed insufficient to address the crisis, prompting the need for QE1 (Chen, 2024). The purchases were made through the trading desk at the New York Federal Reserve Bank (Fawley&Neely 2013).

In November 2008, the Federal Reserve announced QE1, which involved the purchase of long-term securities to support economic activity by putting downward pressure on long-term interest rates (Kamkoum, 2023). It involved the purchase of $200 billions of agency debt, $1.25 trillion in mortgage-backed securities (MBS), and $300 billion in extended-term Treasury bonds. This round directly responded to the dramatic loss of jobs and plummeting confidence in financial markets. Overall, QE1 effectively addressed the immediate financial crisis, although it did result in the Federal Reserve holding a large amount of risky assets on its balance sheet (Chen, 2024). The National Bureau of Economic Research reported that conforming mortgage originations surged by 170% during QE1.

The second round, QE2, extended from November 2010 to June 2011 and saw the Federal Reserve purchasing $600 billion in longer-term Treasury securities. The aim was to further stimulate the economy by lowering long-term interest rates and encouraging borrowing and investment. One of the significant outcomes of QE2 was its effect on inflation. Specifically, the total impact of Treasury purchases led to a reduction in bond yields by 4.83% in the U.S., 2.89% in emerging markets (EME), and 5.78% in advanced economies (A.E.) (Fratzscher et al., 2012). The model used by Fratzscher, Lo Duca, and Straub in their analysis of QE involved high-frequency, daily portfolio flows into bond and equity mutual funds. This model allowed them to study not only the impact of QE on asset prices but also on investor portfolio decisions. They differentiated between the

effects of QE announcements and actual market operations, revealing nuanced insights into how these different aspects of QE affected both U.S. and foreign financial markets. While QE2 concentrated solely on Treasury securities, mortgage rates still fell by approximately 35 basis points, leading to a roughly 65% rise in new loan originations, as per the National Bureau of Economic Research.

QE3 was more open-ended, starting in September 2012 and concluding in October 2014. Initially, the Federal Reserve committed to purchasing $40 billion in MBS per month, which was later increased to $85 billion monthly in combined MBS and Treasury securities purchases. The primary goals of QE3 were to support a more robust economic recovery and ensure that inflation moved back toward the Fed's 2% target (Chen, 2024). Firstly, it helped lower loan rates, which boosted loan originations by approximately 15% to 30%, according to the National Bureau of Economic Research through a difference-in-differences (DiD) model (Chen, 2024). This indicates that QE3 significantly impacted the U.S. financial markets by making borrowing cheaper and more accessible, stimulating economic activity. Additionally, the program contributed to reducing unemployment rates, which was one of its primary objectives (Kamkoum, 2023; Fawley&Neely 2013). The author likely employed an Interrupted Time-Series (ITS) analysis, which is commonly used in natural experimental settings.

In the U.S., QE measures have been associated with positive effects on the USDX and the DJIA but adverse effects on the VIX (Wang, 2023). The three rounds of QE in 2008-2013, significantly expanding the balance sheet of these federal reserves from $920 billion to $4.5 trillion. A few years later, in response to the COVID-19 pandemic, the Fed resumed QE in 2020, expanding its assets from $4.2 trillion to $7 trillion in three months, with a peak of about $9 trillion. This round of QE was characterized by a faster expansion compared to the previous cycle (2008-2013).

2.2. The Eurozone

In the Eurozone, the ECB initiated its QE program in January 2015, purchasing €60 billion per month of euro area bonds, which was later increased to €80 billion per month in March 2016. This program significantly increased the ECB's asset-GDP ratio from 86.57% in January 2015 to 151.74% in April 2017 (Bal et al., 2019). The ECB's QE

measures also aimed to lower interest rates and stimulate investment (Heam et al., 2015). In the Eurozone, QE contributed to a rapid rise in German and French stock price indices following the ECB's announcement, although these indices later converged, indicating no bubble formation (Heam et al., 2015). The authors compared the initial rapid rise in stock indices with their subsequent stabilization or convergence. So, this suggests that the stock price increases were not speculative but aligned with market fundamentals, as prices later normalized rather than continuing to rise uncontrollably.

The timeline of QE measures taken by the European Central Bank (ECB) in the Eurozone includes several critical events:

1. June 5, 2014: Announcement of the asset-backed security program (ABS) and targeted longer-term refinancing operations (TLTRO) (Heam et al., 2015).

2. August 2014: Renewal of the Covered Bonds purchasing program (Heam et al., 2015).

3. September 4, 2014: Mr. Draghi indicates that several ECB's monetary policy committee members favored a more substantial QE (Heam et al., 2015).

4. January 22, 2015: Announcement of the Expanded Asset Purchase Program (EAPP), with the ECB committing to buy €60 billion monthly until September 2016 (Christensen et al., 2024).

5. March 9, 2015: Start purchasing euro-denominated public sector securities in the secondary market (Beck et al., 2019).

6. September 3, 2015: Increase the issue share limit from 25% to 33% (Beck et al., 2019).

7. December 3, 2015: ECB lowers its deposit facility rate and extends the asset purchase program to March 2017 (Christensen et al., 2024).

8. March 10, 2016: ECB lowers policy rates and expands EAPP to €80 billion per month, expected to last until March 2017 (Christensen et al., 2024; Beck et al., 2019).

9. June 8, 2016: Start of purchases under the corporate sector purchase program (CSPP) (Beck et al., 2019).

10. October 20, 2016: ECB hints that the EAPP extension will be announced in December 2016 (Christensen et al., 2024).

11. December 8, 2016: EAPP extended to December 2017, with monthly purchases reduced to €60 billion (Christensen et al., 2024).

12. October 26, 2017: Purchases under EAPP extended to September 2018 but reduced to €30 billion per month from January 2018 (Christensen et al., 2024).

13. June 14, 2018: Purchases under EAPP are to end in December 2018 but reduced to €15 billion per month from October 2018 (Christensen et al., 2024).

14. December 13, 2018: ECB will keep key interest rates at least through the summer of 2019. Purchases under EAPP will end in December 2018 (Christensen et al., 2024).

15. September 12, 2019: ECB announces a -10 basis points rate cut and €20 billion per month in EAPP (Christensen et al., 2024).

Together: *"These asset purchase programs are aimed at further enhancing the transmission of monetary policy, facilitating credit provision to the euro area economy, easing borrowing conditions for households and businesses and contributing to returning inflation rates to levels below, but close to, 2 % over the medium term, consistent with the ECB's primary objective of maintaining price stability"* (ECB, 2016: 1).

2.3. Several definitions of QE by different economists

QE, also known as asset purchases, is one of the unconventional monetary policy tools that a CB uses to support economic growth and bring inflation to a 2% target (European Central Bank). It involves CB purchasing long-term financial assets such as government bonds and MBSs from commercial banks or other financial institutions. It lowers long-term interest rates. QE aims to stimulate borrowing, investment, and spending to promote economic growth during economic weakness or financial crisis periods. By purchasing low government bonds- risk investments, CB increase demand for these securities, lowering their yields and stimulating borrowing and lending. By buying MBS, CBs support the housing market and reduce mortgage interest rates, encouraging homebuying and refinancing activities (Fratzscher et al., 2012).

One can consult Bernanke's (2009) definition to differentiate between QE and credit easing. Bernanke claims that a credit easing program alters the structure and magnitude of a CB's balance sheet to assist particular markets and enhance credit conditions. The benefits of credit easing include the CB's ability to directly regulate monetary injections into important industries that support economic recovery and, consequently, prevent speculative bubbles. Furthermore, these strategies carry greater risk and are more challenging to implement (Bernanke, 2009).

However, quantitative easing refers to expanding a CB's balance sheet, which will raise the number of reserves that banks hold with CBs. The balance sheet's composition does not change because of this policy. QE is "a strategy that consists, in its pure form, of increasing the level of reserves of commercial banks and the level of bank liquidity," according to Bernanke (2009).

Drumetz et al. (2010) claim that these instruments can only be characterized negatively because they are actions that deviate from standard monetary policy procedures.

As a result, these regulations are only applicable when usual methods are ineffective. According to Krugman (2000), a credible commitment assuring public agents that the liquidity boost will continue as long as the requirements (targeted inflation rates, improved employment levels, sufficient credit flow) are unmet is necessary for the quantitative easing technique to be effective.

3. COMMON VIEW OF QE

According to the common view, QE provides banks with excess reserves, making them able to lend more money to consumers and investors (Diamond et al., 2023). The CB injects a monetary base into banks. By buying government bonds and MBS. This raises bond prices and lowering interest rates. Lower interest rates reduce the cost of borrowing. Consumers can get mortgages, car loans, and personal loans for a lower price.

Furthermore, businesses can finance expansions and capital projects more affordably. So, consumption and investment increased (Woodford, 2016). According to Meltzer (1995), a rise in liquidity results in an increased wealth effect. Private actors will raise aggregate demand (AD) because the increase in liquid assets makes them feel wealthier, leading to more consumption and investment. Rising asset prices (stocks, real estate) due to QE make households perceive themselves wealthier, and due to QE, businesses are more likely to invest in new technologies, factories, and hiring. Meltzer critiques Keynesian models, advocating for a monetarist view, where money supply plays a central role in economic fluctuations. He is using macroeconomic models such as the monetarist transmission mechanism to analyse how changes in the money supply impact asset prices, consumption, and investment through liquidity effects, interest rates, and the wealth effect. This increase in consumption and investment boosts AD, leading to higher output and reduced unemployment. When unemployment falls below 4%, inflation may rise as firms increase production and hire more workers to meet higher demand (Meltzer, 1995).

QE lowers mortgage rates by reducing yields on MBS. It takes time to build new homes, which leads to the conclusion that the housing supply is relatively inelastic. An

increased demand without a corresponding supply increase drives prices up. Which leads to a massive increase in housing prices. Suppose house prices rise sharply, from 100k to 180k. In that case, homeowners could potentially take out new loans up to 80k, using the increased value of their property as collateral. This additional borrowing capacity could fund higher consumption expenditure. The rise in consumption is further supported by a reduction in the interest rate spreads for consumption loans, which are typically 10 percentage points above mortgage loan rates (Di Maggio et al., 2019).

According to Baumeister's (2012) study, the U.S. and U.K.'s different unconventional policies (QE, credit easing, forward guidance) have sped up the process of exiting the crisis and decreased the probability of deflation. Furthermore, a study by Kapetanios (2012) emphasizes the beneficial effects of QE on the U.K.'s GDP and inflation. The Fed's policies between 2008 and 2010 reduced interest rates on Treasury bonds and bonds issued by non-financial companies, as Gagnon et al. (2016) demonstrated. The medium and long-term ability of these programs to lower interest rates was validated by the study of Altavilla, Giannone, and Lenze (2014). However, Hamilton and Wu (2012) qualified this claim by demonstrating the QE's minimal influence.

Daniel Thornton (2014) examines several drawbacks to CBs using QE. The first risk that could trigger QE is an increase in inflation above the 2% forecast. The second is that there is no universal theory that economists and policymakers can employ to explain how monetary growth leads to inflation. Risk was identified by Thornton, who noted that employment growth is incredibly sluggish throughout QE policy and economic recovery.

Only until the link between the money supply and the monetary base is established will the QE mechanism be functional. The consequences of an additional credit policy will not be required if there is no demand for credit in an economy (Choukairy et al., 2013). Eggertsson and Woodfort (2003) contend that limiting private agent expectations and preventing any money supply expansion are the only ways to escape the liquidity trap, mainly when interest rates are near zero.

The inflationary effects of QE vary. In the U.S., QE1 helped stabilize the financial system, while QE2 (2010-2011) and QE3 (2012) aimed to counter disinflation and spur growth. However, inflation remained below the Federal Reserve's 2% target during these periods (Bal et al., 2019). In the Eurozone, QE supported stock market prices and

economic activity but had a more moderate impact on inflation than the U.S. (Heam et al., 2015).

In the Eurozone, lower interest rates increased household consumption, while in the US, QE shifted investments toward riskier assets, improving businesses' financing capacity and stimulating consumption. QE also allowed firms with bond market access to issue long-term debt at lower yields, driving investment and job creation (Giambona et al., 2020).

QE reshaped liquidity for households, leading them to hold more deposits and less in mutual funds, improving their ability to spend even during unemployment. This liquidity transformation reduced precautionary savings and boosted AD for goods (Cui & Sterk, 2021).

4. THE CREATION OF MONEY: THE CASE OF THE FED AND ECB

4.1. The creation of money by a bank

Since 2014, economists have understood that money is created differently. In the old view, money creation starts with loaning reserves by CB to banks. In the new view of money, creation starts with the extension of loans by banks to economic agents, resulting in the creation of checkable deposits (CD).

CB decides to set a specific interest rate at which it is available to lend to banks any quantity of reserves they may want. The CB does not decide to lend any specific quantity of reserves to banks. The CB never refuses loans demanded by banks because history shows this can lead to bank runs followed by bank failures. Banks add a margin and set the interest rate at which they are willing to extend credits to businesses, households, and the state (BHS). The margin depends on the type of loans (mortgage loans around 1 p.p.; business loans around 2 p.p.). At that interest rate, BHS demands a certain amount of credit. Whether they own any reserves or not, banks grant the amount demanded they deem creditworthy. They do this not by handing notes and coins but by opening a checkable deposit. It is here that money first appears in the economy. The CB has not lent any reserves at all, yet banks have already created money.

Thus, money is created when BHS demands credit, a portion of which banks accept to grant, not when the CB decides to lend reserves to banks (Wray, 2007).

The economy decides the amount of money that is created: money is endogenous (Wray, 2007). Money held by economic agents is not net wealth because it is matched by a new liability. In the Eurozone, Banks need reserves to comply with the legal requirements. Roughly speaking, in the Eurozone, banks need 1% of all deposits in reserve requirements, and in the U.S., 10% of checkable deposits (CD). Banks own reserves and, at the same time, have a debt with the CB The CB has acquired a loan and owes reserves to banks.

Banks no longer need reserves when BHS repay the loan, with a deposit that banks thus eliminate. They tell the CB they no longer want the reserve loan. They use the reserves to repay the CB loan. Both money and reserves have now been extinguished.

4.2. Money creation by the banking system

A bank creates a CD of, say, 100 euros by extending a loan to an economic agent (BHS1) and then borrow 1 euro in reserves. However, what happens if the economic agent uses the CD to make a purchase? For the sake of this argument, assume, there are only two banks, 1 and 2. Bank 1 extends a loan by opening a CD of 100 euro. BHS 1 uses the money to make a payment in favor of another economic agent, who will only, by coincidence, be a client of the same bank. Most likely, he will be a client of another bank, bank 2. When BHS 2 receives the check, it deposits the cheque in its bank. Bank 2 presents the 100-euro cheque to Bank 1, which is obliged to give the total amount of reserves to Bank 2. Thus, bank 1 needs to support its 100-euro loan, not with reserves of 1 euro but with the total amount of the loan it granted and the CD it created. If the deposit was not used, the reserves would need to equal 1 euro.

However, bank 2 is no different from bank 1. It also extends credit, for the sake of the argument -100 euros- a loan of the same amount to say BHS2'. Bank 2 thus creates a new CD for BHS2' which this will use to make a payment in favor of another economic agent who will most likely not be a client of the same bank. BHS1' will be a client of Bank 1 and will receive the cheque. BHS1' will deposit the cheque at bank 1. Bank 1 receives the cheque and looks at the top right corner, where it finds the name of Bank 2 and presents

the cheque to Bank 2, which is obliged to transfer the full 100 euros in reserves. Initially, bank 1 was required to send reserves of 100 euros to bank 2. Now bank 2 is obliged to do the same to bank 1. So, they end up not having to transfer reserves to each other. Each bank will only need reserves depending on the amount of CD outstanding. Thus, in turn is determined by credit extended by other banks. In fact, a loan does not end up in a CD opened by the bank that extended it. It ends up as a CD of another bank that needs to back it with reserves of 1 euro. If the value of the two loans is the same, they both need the same amount of reserves.

It is as if there was a single bank in the economy. This extends a loan of 100 euros, paying 3% interest. The bank opens a CD to an economic agent: CD 1 to BHS 1. Up until now, this deposit only needs 1 euro to be backed. It is making 3% on 100 euro and just paying 1% on 1 euro. If BHS 1 makes a payment, it sends a cheque to BHS 2, who deposits it in the same bank. The bank crosses CD 1 and deposits the value on CD 2. It does not need to borrow more money. The reserves of 1 euro were first allocated to CD 1 and now are allocated to CD 2. This single bank is a money-making machine. Instead of extending loans of 100 euros, it can extend loans of 100 trillion euros, but it will have to borrow only 1 trillion euros to have them with reserves. It can create any amount of CD with barely any need for reserves.

It is the same for banks 1 and 2 if they extend credit simultaneously by the same amount. So, why don't banks expand loans without limits? Firstly, they do not decide how much loans they grant: they are restricted by the amount of credit demanded by economic agents. Secondly, if BHS starts demanding too much credit and, banks will start extending too much credit, too many CDs will be created. This leads to too much demand for goods and services. Finally, the CB can control the quantity of credit extended by banks. A law limits the loan amount to 10x a bank's equity capital. Suppose the demand for credit is 110 euros, and a bank's equity capital is 10 euros. The bank cannot extend all the credit being demanded. So actual credit is 10x10 (McLeay et al. 2014, McLeay et al., 2014a).

The Federal Reserve (Fed) differs from the ECB in two ways. First, the Fed has a dual mandate focused on two main goals: achieving full employment (F.E.) and maintaining inflation at 2%. Second, unlike the ECB, the Fed does not make explicit bank loans through refinancing operations. Instead, it lends reserves to banks in an implicit manner.

Specifically, the Fed sets a target interest rate for the Interbank Money Market (IBMM), 1.5% before the COVID-19 crisis. When the demand for credit by households and businesses rises, and banks meet this demand, the banks' need for reserves in the IBMM increases. This can push the interest rate above the Fed's target of 1.5%.

In response, the Fed intervenes by purchasing Treasury bonds from banks, which increases the supply of reserves in the interbank market. As a result, the increased reserve supply lowers the IBMM rate back to the target of 1.5%, helping to maintain the desired balance in the credit and money markets (Bernanke, B.S., 2020).

4.3. The Fed

So the question is how does the Fed lend reserves to banks or absorb reserves from banks? In order to control the amount of reserves in the American banking system, the Fed uses a variety of strategies. Its main instruments are the discount window lending, open market operations (OMOs), and interest on reserve balances (IORB). The Federal Reserve Bank of New York carries out Open Market Operations on behalf of the Federal Reserve, which constitutes the mainstay of the Fed's daily execution of monetary policy. The Fed purchases and sells U.S. government assets on the open market through OMOs. The Fed increases the amount of reserves in the banking system by purchasing assets and crediting the banks' reserve accounts with the corresponding funds. By boosting the quantity of reserves, this lowers the federal funds rate, making it easier and less expensive for banks to lend to one another overnight (Fed).

When the Fed sells securities, it debits the buying banks' reserve accounts, lowering the total amount of reserves in the system and potentially increasing the federal funds rate through tighter liquidity. Another essential instrument is the Discount Window, which enables banks to get short-term liquidity needs by directly borrowing reserves from the Fed. Three different credit categories are available from this facility: primary, secondary, and seasonal. In order to set a ceiling on the cost of short-term borrowing in the interbank market, primary credit is extended to banks that exhibit financial solid standing at a rate higher than the federal funds rate. Banks that do not meet the requirements for primary credit might apply for secondary credit, which is typically more expensive due to the higher risk involved. Seasonal credit is intended for smaller banks, such as those in the

agriculture sector, whose liquidity requirements fluctuate predictably. Using the Discount Window to borrow money offers instant liquidity, but it also raises red flags because it may indicate underlying financial difficulty. The Fed also employs Interest on Reserve Balances (IORB), a measure implemented following the 2008 financial crisis, to affect banks' reserve requirements. Since banks are unlikely to lend reserves at a rate less than what they could earn from the Fed by retaining them, the Fed can put a floor under the federal funds rate by altering the IORB rate. This weapon is crucial: even with a substantial amount of reserves in the system, the IORB rate allows the Fed to keep control over short-term interest rates.

While the Fed employs these tools to manage the supply of reserves in the U.S. banking system, the ECB follows a different set of practices tailored to the unique structure of the Eurozone. Understanding these distinctions highlights CB's varied approaches to achieve similar monetary policy objectives (Fed).

4.4. The ECB

The ECB manages the liquidity in the banking system through various instruments designed to either lend or absorb reserves from banks. This process is essential for maintaining financial stability and ensuring that short-term interest rates align with the ECB's policy objectives. When a bank issues a loan of 105 euros, it results in a 5-euro increase in currency, a 100-euro increase in checkable deposit (CD), and a corresponding 1-euro increase in reserves. Banks can obtain 6 euros in reserves through 5 distinct methods (European Central Bank, 2024b).

Main Refinancing Operations (MROs) are a vital tool through which the ECB provides liquidity to banks. Banks can borrow any quantity of reserves they require at a fixed rate, provided they offer eligible collateral, typically investment-grade bonds. These are one-week loans often rolled over with new one-week loans. Additionally, the ECB conducts Longer-Term Refinancing Operations (LTROs). These three-month loans provide banks with longer-term funding and are usually refinanced with subsequent three-month loans (European Central Bank, 2024).

Next, the ECB offers overnight lending and deposit facilities to manage short-term liquidity needs. Banks can borrow any quantity of reserves overnight, as long as they

provide the necessary collateral. The standing facilities include the Marginal Lending Facility. Banks can deposit excess reserves with the ECB or borrow short-term funds if they are short of reserves. This system allows banks to repay old loans and borrow new ones as needed. For example, on the first day of each month, a bank might repay 100 million euros in loans and borrow only 70 million euros, thereby reducing its reserves (European Central Bank, 2022).

In the Interbank Money Market (IBMM), banks with excess reserves lend to those short of reserves. the loans typically mature in one day, and the rates are influenced by the ESTER (Euro Short-Term Rate), which replaced the EONIA (Euro Overnight Index Average). The rates follow the EURIBOR (Euro Interbank Offered Rate) for maturities of one week, one month, three months, six months, and twelve months. The ECB's standing facilities create a corridor for the overnight interest rates. If the demand for reserves on the IBMM is zero, banks without high reserves will borrow from the ECB.

Conversely, if the supply of reserves is zero, banks would deposit their excess reserves with the ECB at a higher rate. On the first day of each month, the three-month EURIBOR rate cannot exceed the MRO/LTRO rate because banks would not borrow at higher rates from other banks. Instead, they would prefer the ECB's refinancing rate. Before 2010, IBMM loans were typically made without collateral, but since then collateral has become required (Giannone et al., 2012).

Between 2015 and 2022, the ECB engaged in QE by purchasing government bonds, typically with a 10-year maturity, and injecting reserves into banks. This process aimed to increase bond prices and lower yields. The ECB's monthly bond purchases ranged from 15 billion euros to 80 billion euros, with the Asset Purchase Programme (APP) stock reaching 3.4 trillion euros by February 2023 and 3.2 trillion euros by May 2023. When these bonds mature, the government must provide the necessary reserves to the bondholders, usually by issuing checkable deposits to the banks (Driffill, 2016).

From 2011 to 2022, the ECB conducted several rounds of Targeted Longer-Term Refinancing Operations (TLTROs). TLTROs I, II, and III offered 3 to 4-year loans at fixed interest rates. Unlike QE, the interest rates for TLTROs were fixed, and the operations did not follow a regular schedule, although they typically occurred quarterly. The allocation of funds was proportional to the amounts requested by the banks. For

instance, if banks requested 2 billion euros but the ECB had only 1 billion euros available, each bank would receive half its requested amount (Driffill, 2016).

The ECB's mechanisms for lending to banks and absorbing excess reserves are vital for managing liquidity and maintaining financial stability in the Eurozone. Using these tools, the ECB ensures that banks have the necessary reserves to support lending and economic activity while keeping short-term interest rates in line with policy targets.

5. WHAT HAPPENED DURING QE1-QE3?

The existing literature presents various perspectives on the effectiveness and consequences of QE in the U.S. and the euro area during the QE1-QE3 periods. These sources focus mainly on the general effects and methodology associated with QE, rather than criticizing specific phases of QE in these countries. The literature agrees that there is no firm evidence of side effects such as increased risks or adverse effects on stock market volatility, while accurate house prices and real credit either remain stable or show a downward trend (Beck et al., 2019). Moreover, the main transmission channel of QE's impact on inflation appears to be exchange rate depreciation rather than AD growth (Beck et al., 2019). However, these discussions do not directly address the criticisms of the QE1-QE3 periods in the United States and the Euro Area.

Critics argue that the effectiveness of QE has been overestimated, citing several points. First, there is no convincing evidence that QE has significantly increased accurate house prices or credit, suggesting that some risks to financial stability associated with QE policies may be exaggerated (Beck et al., 2019). Moreover, the marginal effects of QE on variables such as stock market volatility, accurate house prices, and actual credit appear to be minimal, suggesting that the broader economic benefits of QE may be limited (Beck et al., 2019; Acharya et al. 2019). Another critical point is that the main channel through which QE affects the economy is the exchange rate, which raises questions about its effectiveness in stimulating domestic economic activity instead of simply affecting the currency's value (Beck et al., 2019; Acharya et al. 2019). These arguments highlight the limitations and potential ineffectiveness of quantitative easing policies in the United States and the Eurozone.

In addition, the sources mainly discuss the positive economic effects of QE implemented by the ECB on interest rates, stock markets, housing markets, and the overall economic recovery in the euro area. For example, one source notes that the ECB's QE measures have contributed positively to the euro area recovery by lowering interest rates and affecting stock prices and the real estate market. Another source outlines the benefits of QE for various institutional sectors but does not delve into its adverse economic consequences. Another perspective emphasizes the positive impact of QE on the euro area export market with limited effects on asset pricing channels (Beck et al., 2019). Thus, while these sources provide a comprehensive understanding of the positive effects of QE, they lack information on the specific negative economic consequences of QE1-QE3 in the United States and the euro area.

Criticisms of the effectiveness of QE can be viewed through the prism of the modern understanding of money as debt. The impact of QE on financial markets can be significant, as excess liquidity can lead to higher asset prices, such as stocks and real estate, without corresponding growth in the real economy. This can create the illusion of economic growth, but not lead to significant improvements in employment or productivity. Since most benefits of rising asset prices go to those who already have assets (the wealthy), it can increase social inequality. The money injected into the economy does not always reach those most in need, as QE programs are often not directly targeted at households (Ivanova, 2018).

 QE can have a limited impact on the real economy because commercial banks may be reluctant to lend in response to increased reserves. Suppose banks are afraid to lend because of the risk of insolvency or insufficient demand from borrowers. In that case, even the money supply will not increase investment and consumer spending. This confirms the concept of money as debt: if debt cannot be converted into genuine transactions, the effect of QE remains limited. Another important aspect is that QE can make an economy dependent on monetary policy (Fratzscher, Duca & Straub, 2012; Ivanova, 2018). As markets become accustomed to CB support, this can lead to risks associated with reduced incentives for structural reforms. In this context, critics of QE point out that centralized money creation can distract attention from improving economic structures and policies that promote sustainable growth.

Evidence suggests that the effectiveness of QE during the QE1-QE3 periods was, in some respects, less significant. In the United States, despite the measures taken by the Federal Open Market Committee to support real GDP growth in 2013-2014, these measures failed to maintain the 2 percent inflation target, and CPI inflation under QE remained below the non-QE scenario (Bal et al., 2019). Similarly, in the euro area, the expanded asset purchase program launched in 2015 failed to show a sustained positive impact on real GDP growth, and inflation under QE was generally lower than without QE (Bal et al., 2019).

Counter-arguments to the proclaimed success of QE emphasize several points, such as the failure to achieve long-term inflation targets. While QE has achieved short- and medium-term inflation targets, its long-term results have been inadequate, meaning that the effects of QE on inflation may not be sustainable over long periods (Bal et al., 2019). In addition, there are concerns about the risk of asset price bubbles. Although German and French stock indices rose sharply after the ECB statement, the increase was not sustained, suggesting that a bubble had not formed. Nevertheless, the rapid growth of stock prices may still pose a risk in the future (Heam et al., 2015).

Furthermore, in the euro area, although QE stimulated demand in the housing market by lowering mortgage rates, housing prices did not experience a sharp increase in 2014 or 2015. This suggests that while QE may have supported real estate prices, it was not the dominant factor (Heam et al., 2015). These points provide a nuanced view of the effectiveness and potential risks of QE, and call into question the overall success of this policy in the U.S. and the euro area.

Yield Curve Control (YCC) is an alternative monetary policy tool CBs use to manage interest rates across different maturities of government bonds. Under YCC, the CB sets a specific long-term interest rate target and adjusts its bond purchases to maintain that rate. Unlike QE, which involves massive bond purchases without targeting a specific rate, YCC aims to achieve a predetermined yield. For example, if the desired long-term rate is 2%, the CB will buy or sell government bonds to maintain that rate. The Bank of Japan (BoJ) has successfully implemented YCC since 2016, targeting the 10-year government bond yield. By announcing that it would buy long-term bonds at a specific price, the BoJ immediately increased bond prices and decreased yields (Oda&Ueda 2007).

This policy provided more certainty and effectiveness in controlling long-term interest rates than QE. YCC offers more precise control over long-term interest rates. It eliminates the uncertainty associated with QE's impact on long-term rates, ensuring the targeted interest rate decrease is achieved. For example, under YCC, the BoJ announced it would buy long-term bonds at 200 Japanese yen (JPY), causing an immediate price increase from 100 JPY to 200 JPY and reducing the yield (i2) from 0.2% to 0.1%. Risk-averse banks sold their bonds to realize capital gains, while others held into bonds, accepting the reduced risk premium (R.P.). YCC is considered a better alternative to QE because it ensures that the intended decrease in long-term interest rates is achieved. The yield curve, representing the relationship between interest rates and time, is more effectively controlled under YCC (Hattori&Yoshida 2022).

In the United States, QE1, introduced in response to the financial crisis 2008, had notable impacts on various economic indicators. One of the primary effects was seen in the stock markets, with global stock prices rising significantly, particularly in the S&P 500 index, which started to show substantial gains in the middle of 2009 (Khan, 2016). Alongside this, QE1 led to a notable expansion of the monetary base, reflecting the Federal Reserve's objective to increase bank lending and thus stimulate economic activity (Khan, 2016). Additionally, QE1 caused the depreciation of the U.S. dollar against other major currencies, thereby enhancing the competitiveness of U.S. export prices in the global market (Khan, 2016).

With the implementation of QE2, the U.S. economy saw a mitigation of disinflationary trends that had emerged in 2010. This round of quantitative easing helped avert a situation akin to Japan's prolonged economic stagnation (Chen, 2024). Another notable impact was on Treasury yields, with the yield on 10-year Treasury notes beginning to decline from August 2010 in anticipation of QE2. This indicated that asset prices had already adjusted even before the official announcement of the program (Khan, 2016). During this period, long-term interest rates fell by 1.5 percentage points (p.p.), from 3.5% to just 2% (Haldane et al. 2016).

QE3, on the other hand, was targeted at further boosting economic growth and reducing unemployment. It involved monthly purchases of mortgage-backed securities and long-term Treasury securities, aiming to inject more liquidity into the financial

system (Chen, 2024). The overarching goal of these QE rounds was to stabilize financial markets, stimulate lending, encourage investment, and foster recovery in the wake of the financial crisis. The cumulative purchase of long-term bonds under these programs amounted to 2.6 trillion dollars, equivalent to one-sixth of the US GDP in 2013. As a result, the reserves held in U.S. bonds increased dramatically from 0.1 trillion dollars in September 2008 to 2.7 trillion dollars by 2014-2015. Public Debt and Interest Payments: Of the 2.6 trillion dollars, 2 trillion were treasury bonds, equating to one-seventh US GDP or public debt in 2013. The U.S. government effectively stopped paying interest on this portion of its debt, as it was owed to the Fed. Interest rates and investment: QE2 notably reduced long-term interest rates by 1.5 p.p., which spurred an increase in long-term loans to households and businesses, boosting investment demand. This increases AD and reduces unemployment. The lower interest rates on government bonds also decreased the interest payments on public debt. Risk premium and expectations: QE programs reduced the risk premium incorporated into long-term rates. However, they also raised expected short-term interest rates, leading to an increase in long-term rates. For instance, during QE1 and QE3, despite reducing the risk premium, the stronger-than-expected economic recovery raised expected short-term rates, leading to a 1 p.p. increase in long-term rates (Ivanova, 2018).

In the Eurozone, the ECB's quantitative easing measures also had significant impacts. Although the provided sources do not specifically mention QE1 and QE3 as they relate to the Eurozone, evidence shows that the ECB's QE programs substantially reduced interest rates across the region. Between July 2014 and January 2015, the ECB's QE program decreased around 80 basis points in 10-year sovereign bond yields (Heam et al., 2015). German yields, for example, decreased by approximately 60 basis points after 18 months and 80 basis points in the long term (Heam et al., 2015).

Moreover, anticipating the ECB's asset purchases by mid-2014 contributed to a decline in long-term interest rates and the flattening of the yield curve (Heam et al., 2015). This reduced the spread of government bonds from peripheral Eurozone countries such as Spain, Italy, Ireland, and Portugal, thus decreasing financial fragmentation within the Eurozone (Heam et al., 2015). Collectively, these steps supported the region's economic recovery.

However, the provided sources do not elaborate on the financial stability or side effects of QE in detail. Some general insights suggest that the anticipated financial stability risks of QE may have been overstated. According to sources, there was no substantial evidence of increases in risk, accurate house prices, or credit, nor a marked effect on stock market volatility (Beck et al., 2019). Although graphical data on various economic indicators were provided, they did not isolate specific side effects in the U.S. and Eurozone during the respective QE periods (Beck et al., 2019)).

QE also notably impacted local banking systems in the Euro area by enhancing the quantity or quality of available collateral. This, in turn, significantly affected the currency union, elevating output and inflation by 62 basis points and 60 basis points, respectively. Despite the fragmentation in local deposit markets, the pass-through of QE was uniform across countries, as all banks experienced reduced collateral costs from the union-wide asset market (Rogers, 2022).

Through which channels QE works?

QE affects financial stability through several transmission channels. These channels include:

1. Portfolio Rebalancing Channel: QE involves the purchase of long-term assets, which lowers their yields and encourages investors to shift towards riskier assets, such as equities and foreign assets. This rebalancing can lead to higher equity prices and a depreciation of the exchange rate, stimulating consumption and investment spending (Ito et al., 2014; Fratzscher et al., 2012).

2. Signaling Channel: Announcements of QE can influence market expectations about future monetary policy and economic conditions. This signaling effect can alter expectations about future interest rates and economic prospects, impacting financial stability (Fratzscher et al., 2012; Christensen et al., 2024).

3. Liquidity Channel: QE can improve the functioning of financial markets by increasing liquidity. The CB's purchases of assets can lower liquidity premia and enhance market demand and prices, which supports financial stability (Fratzscher et al., 2012; Christensen et al., 2024).

4. Exchange Rate Channel: By lowering domestic interest rates, QE can lead to domestic currency depreciation. This depreciation can boost exports and reduce imports, supporting economic growth and financial stability (Ito et al., 2014; Bal et al., 2019).

5. Confidence Effects: QE operations or announcements can boost confidence in the economy's prospects, positively affecting financial stability by encouraging investment and consumption (Fratzscher et al., 2012).

These channels collectively contribute to the overall impact of QE on financial stability by influencing asset prices, market liquidity, and economic expectations.

The provided sources do not contain specific information about the impact of QE on risk premia in the U.S. and Eurozone. The sources focus on the effects of QE programs conducted by Sveriges Riksbank and the ECB on the Swedish government bond market, including spillover effects from the ECB's QE program on Swedish bonds. Therefore, none of the sources help answer the query about the impact of QE on risk premia in the U.S. and Eurozone (Boel et al., 2015).

The effectiveness of QE on interbank market risk premia in the U.S. and EMU has been studied with a focus on credit risks and liquidity premia. The study investigates how these components in interbank rates developed during the crisis and the impact of QE on these relationships (Yao, 2015). Additionally, it is noted that QE significantly reduces the risk premia in interbank markets in the U.K. and the EMU (Yao, 2015). However, the provided sources do not detail the impact on the U.S. interbank market risk premia.

The refinancing channel plays a significant role in the effectiveness of QE. During QE1, the Federal Reserve's purchase of MBS led to a substantial increase in mortgage refinancing activity. This increase in refinancing had several downstream effects on the real economy.

Secondly, QE1 resulted in over $600 billion in additional refinancing originations, which led to a boom in equity extraction and significantly reduced interest payments for households that refinanced their mortgages (Di Maggio et al., 2016). This reduction in interest payments increased disposable income for these households, thereby boosting consumption. Precisely, the increase in consumption due to QE1 was estimated to be around $76 billion (Di Maggio et al., 2016)

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Moreover, the refinancing channel facilitated cash-out refinancing, where borrowers extracted home equity. This provided them with additional cash to spend, further stimulating consumption. On average, the amount of equity cashed out was about 11% of the total volume of refinances, translating into an increase in borrowers' consumption of about $67 billion (Di Maggio et al., 2016).

Overall, the refinancing channel was crucial in transmitting the effects of QE to the real economy by improving credit availability, lowering interest rates, and increasing household consumption (Di Maggio et al., 2016).

The primary channel QE can influence credit expansion is reducing long-term interest rates. QE involves the CB purchasing large quantities of government securities and other financial assets, which increases the demand for these assets, raises their prices, and subsequently lowers their yields. Lower yields on long-term securities translate into lower long-term interest rates across the economy, including mortgage rates, corporate bonds, and other forms of long-term debt. This reduction in borrowing costs can make it more attractive for businesses to invest in new projects and for consumers to finance large purchases, such as homes or cars. As borrowing becomes cheaper, the demand for loans may increase, leading to an expansion of credit (Fed).

However, the effectiveness of QE in promoting credit growth hinges on its ability to influence these long-term rates and the broader economic environment. Suppose the economy is experiencing weak demand or banks are cautious about lending due to perceived risks. In that case, the lower interest rates achieved through QE may not be sufficient to stimulate significant credit growth. Additionally, if businesses and consumers are deleveraging or saving more due to economic uncertainty, the impact of lower interest rates on borrowing and lending activity might be muted. Thus, while QE has the potential to expand credit by lowering long-term interest rates, its success is contingent upon broader economic conditions and the response of borrowers and lenders to the altered interest rate environment. In this way, QE's ability to expand credit is more about creating a conducive environment for borrowing than directly increasing banks' reserves.

6. CONCLUSION

This paper analyzes the impact of the QE programs in the United States and the euro area during the QE1-QE3 periods. It revealed both positive and negative effects of these measures. QE programs significantly impacted financial markets, helping to lower interest rates, increase asset values, and stimulate consumption and investment. In particular, in the United States, QE led to increased investment, especially by companies that had access to the bond market, ultimately leading to job creation. In the euro area, the QE programs helped lower mortgage rates, positively impacting the housing market, although the effect on house prices was limited.

Moreover, the main impact on inflation was achieved through exchange rate depreciation rather than through AD growth, which casts doubt on the effectiveness of these programs in stimulating domestic economic activity.

The limited impact of QE on the real economy may be due to the possible reluctance of banks to lend even with increased reserves. On the other hand, QE can contribute to increasing inequality, as the benefits of higher asset prices go primarily to the wealthy.

Thus, while QE has helped stabilize financial markets and somewhat supported economic growth, its effectiveness as a stimulus tool remains questionable. Further research should focus on alternative explanations for the economic effects of QE and possible policy adjustments to improve its effectiveness.

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