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***The transmission mechanism of monetary
policy: a preliminary analysis during Covid-
19 crisis***

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TABLE OF CONTENT

INTRODUCTION	3
LITERATURE REVIEW	4
1. ECB: THE EVOLUTION OF THE MONETARY POLICY TOOLS	6
ECB: ROLE AND HISTORY	6
ECB MONETARY TOOLS IN JANUARY 2020	8
ECB MONETARY POLICY TOOLS IN DECEMBER 2020.....	17
PEPP – PANDEMIC EMERGENCY PURCHASE PROGRAMME	21
2. THE GLOBAL EVOLUTION OF THE MONETARY POLICY TOOLS.....	26
THE FED RESPONSE TO THE 2020 ECONOMIC CRISIS	26
THE BoJ RESPONSE TO THE 2020 ECONOMIC CRISIS.....	38
THE PBC RESPONSE TO THE 2020 ECONOMIC CRISIS	44
3. TRASMISSION MECHANISM OF MONETARY POLICY: THE COVID-19 PANDEMIC IMPACT.....	52
INTRDUCTION AND BASELINE STUDY PAPER.....	52
CONSIDERED VARIABLES AND SOURCES	54
DESCRIPTIVE STATISTICS	62
DESCRIPTIVE STATISTICS: CROSS-CORRELATIONS.....	63
REGRESSIONS	69
CONCLUSIONS.....	79

INTRODUCTION

The COVID-19 pandemic has been a global disaster from a sanitary, social, and economic standpoint. The largest part of the countries around the world had to take tough decisions such as lockdown measures, social restrictions, and the shutdown of the non-essential economic activities. These measures had a huge impact on the global economy and led, in the worst case, to the disruption of the financial system. The central banks have been able to respond timely and avoid the worst scenario. The central banks' responses have focused on the increase in money supply through conventional and unconventional monetary policy measures. The tools adopted and their response to the COVID-19 pandemic differ from bank to bank, in particular, these aspects were linked to the economic targets of each organization. For example, the People's Bank of China has several different aims related to the price stability, economic growth, employment etc., the ECB, instead, has only one goal, which is ensuring the price stability. This work is focused on the economic impact of the pandemic, analyzing the different tools used to face the pandemic and their impact on financial markets through the transmission mechanism of monetary policy. The work is divided in three parts: the first chapter describes the conventional and unconventional measure used by the ECB to face the economic crisis, the second chapter focuses on the toolkit used by the Fed, BoJ and PBC. The third chapter performs an empirical analysis on the impact of the COVID-19 pandemic on the transmission mechanism of monetary policy, focusing on four main central banks: the Federal Reserve, the European Central Bank, the Bank of Japan and the People's Bank of China. In particular, the work replicates part of the work made by Xiaoyun Wei and Liyan Han (2020) through an OLS analysis. The chapter explores the effects of monetary policy decisions on financial markets, measuring their impacts. In order to make the most precise study we divided the considered period in two different parts: the pre-pandemic time (between January 2011 and January 2020) and the pandemic period (between February 2020 and November 2021). The work also distinguishes between conventional and unconventional monetary policy decisions showing that, the conventional monetary policy decisions have been slightly less efficient than the unconventional ones. The analysis shows that, the transmission mechanism of monetary policy became weaker during the pandemic, reducing the impact of the central banks' decisions on financial markets.

LITERATURE REVIEW

In order to build this study, we used a various “toolkit” made out of books, central banks’ relations and studies and scientific papers. The most used book is *Banche Centrali e politica monetaria*, written by Giorgio Di Giorgio, 2015. This last source has been fundamental to explain the conventional and unconventional monetary policy tools used by the ECB, shown in the first chapter. Another great help on building the ECB descriptive part came from the Banco de Espana relation n.2026, in 2020, called *the ECB monetary policy response to the Covid-19 crisis* (Aguillar, P., Arce, O., Hurtado, S., Martinez-Martin, J., Nuno, G., Thomas, C.), and the 2020, *relazione annuale* by Banca d’Italia. These sources have been incredibly helpful to understand the pandemics economic effects and the tools used to fight against them. The structure of the second chapter doesn’t comprehend many types of sources, in fact, we have used mainly, the central banks’ relations and studies as source of information. As far as the Fed policy is concerned, the most important studies have been: *The COVID-19 Crisis and the Federal Reserve’s Policy Response* (Clarida, R. H., Duygan-Bump, B., Scotti, C.) and the *Federal Reserve: Emergency Lending*. They show how the Federal Reserve fought against the economic recession through conventional and unconventional monetary policy. A surely larger material amount has been consulted for the BoJ description and analysis, due to the several different tools used during the pandemic. The best studies and relations have been: *Introduction of a New Fund-Provisioning Measure to Support Financing Mainly of Small and Medium-Sized Firms*, a statement made by the Bank of Japan in May 2020, in order to announce new unconventional measure to fight the pandemic, *Japan’s Economy and Monetary Policy* (Kuroda, H.), a speech from the BoJ governor to the business leaders in Osaka, *Response to COVID-19 and Medium- to Long-Term Challenges for Japan's Economy: With an Eye on the Post-COVID-19 Era* (Kuroda, H.), a speech from the BoJ governor at the Meeting of Councillors of Nippon Keidanren (Japan Business Federation) in Tokyo, *Monetary Policy during and after the COVID-19 Era* (Amamiya, M.), a speech from the BoJ deputy governor at the Yomiuri Economic Forum in Tokyo. Another important document, a lot more recent than the others, that we used is the *Statement on Monetary Policy*, a statement made by the Japanese Central Bank in December 2021, which announces the future monetary policy decisions and tools. The Chinese response to the pandemic changed several times the scope of the PBC’s response and monetary policy tools. These changes have been fully described in three main documents: *China / Monetary policy challenges in the post- pandemic era* (Dong, J., Xia, L.), which, in the first part, describes the most recent measures to fight the pandemic, *The People’s bank of China’s response to the coronavirus pandemic: A quantitative assessment* (Funke, M., Tsang, A.), a paper that shows how highly decisive the PBC has been, in response to the pandemic, *China Monetary Policy Report Q4*, a

report by the People's Bank of China, that shows how the Central Bank has reacted to the pandemic in 2020 and all the variation in scope of monetary policy decisions that it has made during the same year. The baseline referring paper for our third chapter is: *The impact of COVID-19 pandemic on transmission of monetary policy to financial markets* (Xiaoyun Wei, Liyan Han), which is going to be fully described on the first paragraph of the third paper. In order to build the regressions, we have also used the “gold price” variable, which gives us an index of uncertainty. In order to consider gold as a “safe heaven” for investors, we have consulted a study called *Measuring the response of gold prices to uncertainty: an analysis beyond the mean* (Jamal Bouoiyour, Refk Selmi, Mark E. Wohar).

1. ECB: THE EVOLUTION OF THE MONETARY POLICY TOOLS

ECB: ROLE AND HISTORY

The *European Central Bank* (ECB) is the central bank responsible for monetary policy of those *European Union* member countries which have adopted the euro currency. This region is known as *eurozone* and currently comprises 19 members¹.

The *Treaty on the Functioning of the European Union* (TFEU) and the *Statute of the European System of Central Banks and of the European Central Bank* represent the legal basis for the single monetary policy. The ECB and the *European System of Central Banks* (ESCB) were established by the Statute from 1 June 1998. Inside this system, the ECB is seen as the core of the *Eurosystem* and the ESCB². The ESCB and the Eurosystem are two institutions with a slight but very important difference: the ESCB comprises the ECB and the national central banks (NCBs) of all EU Member States whether they have adopted the euro or not, the Eurosystem comprises the ECB and the NCBs of those countries that have adopted the euro. There will be both, the Eurosystem and the ESCB as long as there will be EU Member States outside the euro area³.

The Central Banks have usually two different types of objectives: the final goals and the middle goals. The final goals regard the most common macroeconomic variables, such as income, inflation, occupation, etc. The middle goals, instead, regard mid-term variables relatively only to the monetary market such as interest rate and exchange rate.

The ECB is different from the other Central Banks from this point of view. It has precise final aim which is described in the TFEU:

¹ Hayes, Adam. Fact checked by Kirsten Rohrs Schmitt. “European Central Bank (ECB)”, updated December 12, 2020, <https://www.investopedia.com/terms/e/europeancentralbank.asp>

² “ECB, ESCB and the Eurosystem”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/ecb/orga/escb/html/index.en.html>

³ “ECB mission”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/ecb/orga/escb/ecb-mission/html/index.en.html>

“To maintain price stability is the primary objective of the Eurosystem and of the single monetary policy for which it is responsible”

Art.127 TFEU⁴.

In particular, the ECB is responsible for the prudential supervision of credit institutions located in the euro area and participating non-euro area Member States, within the Single Supervisory Mechanism, which also comprises the national competent authorities. It thereby contributes to the safety and soundness of the banking system and the stability of the financial system within the EU and each participating Member State³.

The ECB was created after the decision, taken in 1988, to build an Economic and Monetary Union which comprehended: free capital movements within Europe, a common monetary authority and a single monetary policy for all the countries in the euro area.

The European Council confirmed the goal to realize an Economic and Monetary Union (EMU) in June 1988.

⁴ “ECB mission”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/ecb/orga/escb/ecb-mission/html/index.en.html>

ECB MONETARY TOOLS IN JANUARY 2020

As we all know, the pandemic, the lockdown measures and the related economic crisis had a huge impact on the economic choices made during these last two years. Especially, it has changed the monetary policy tools used all over the world, taking the Central Banks to adopt new extraordinary measures. These next chapters are going to compare the tools used by the ECB right before the pandemic and everything it implied, with the measures used to face the economic crisis, focusing especially on the PEPP for the relevance it has in the current economic panorama. We are also going to analyze the measures adopted by the other main Central Banks, comparing them to the ones used by the ECB⁵.

With the word “tools” we are referring to all the possible ways for the Central Bank to intervene in the financial markets to reach its own goals.

In order to pursue the monetary policy objectives, the ECB uses a various wallet of tools. In particular, the main tools are three:

- Official interest rates changes
- Mandatory minimum reserve ratio changes
- Standard and non-standard open market operations

Official interest rates changes

The official interest rates changes are a tool used by the ECB to rule the conditions of loans and deposit from and to the Central Bank.

They are set and fixed by the ECB according to the financial market conditions, with the aim of injecting or absorbing liquidity from the monetary market through overnight operations. These operations are activated after the request of the counterparty, such as commercial banks seeking liquidity or having liquidity excess⁶.

This family of operations is called *Standing facilities*.

⁵ Giorgio Di Giorgio, “Gli obiettivi operativi e gli strumenti della politica monetaria”, in *Banche Centrali e Politica Monetaria*, ed. Minerva 2015, 57-66.

⁶ “Standing facilities”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/mopo/implement/sf/html/index.en.html>

The standing facilities offered by the Eurosystem are two:

- **Marginal lending facility** used to acquire overnight liquidity from the Central Bank, showing sufficient eligible assets.
- **Deposit facility** used to make overnight deposits with the central bank⁷.

The institutions who want to make this kind of operations have a time limit that is half hour after the closing of the *TARGET2*. The last working day of the reserve maintenance period is the only exception, during which, the time limit is an hour.

The TARGET2 is a real-time gross settlement system which processes and settles central banks and commercial banks payments⁸.

They also need to show guaranties called *eligible assets*, which can be divided into two groups:

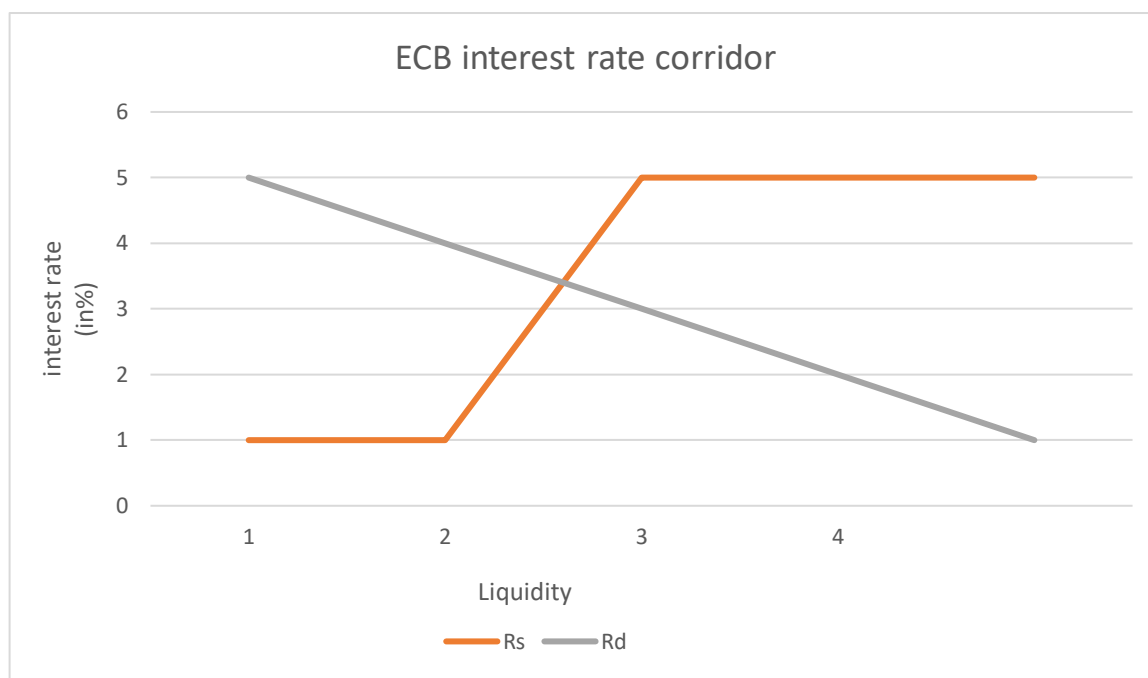
- *Tier one*, negotiable assets, in euro, which satisfy the general requirements specified by the ECB.
- *Tier two*, non-necessarily negotiable assets relevant in the banking and monetary national market.

After the introduction of the two standing facilities, we can summarize the rate control model, used by the ECB, in the following graph where, i_{mlf} and i_d are respectively the marginal lending facility rate and the deposit facility rate.

The two rates are respectively placed in the highest and lowest points touched by the R^s curve.

⁷ “Key ECB interest rates”, European Central Bank, accessed December 31, 2021, https://www.ecb.europa.eu/stats/policy_and_exchange_rates/key_ecb_interest_rates/html/index.en.html

⁸ “Operazioni su iniziativa delle controparti”, Dizionari Simone, accessed December 31, 2021, <https://dizionari.simone.it/6/operazioni-su-iniziativa-delle-controparti>



SOURCE: Giorgio Di Giorgio, “Gli obiettivi operativi e gli strumenti della politica monetaria”, R^s (liquidity supply curve), R^d (liquidity demand curve)

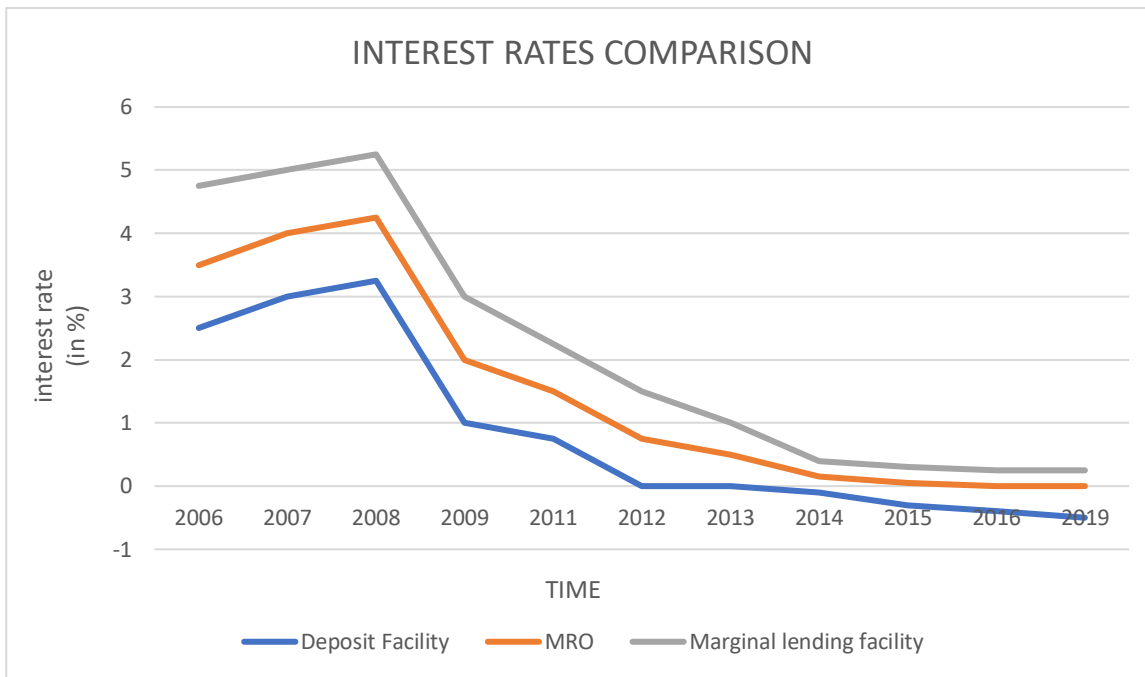
In the point where the liquidity supply curve (R^s) and the liquidity demand curve (R^d) meet, is set the overnight market interest rate (i_o).

The marginal lending interest rate and the deposit facility interest rate represent a ceiling and a floor for the overnight market interest rate, for that reason this interval is called *rates corridor*. In fact, no bank would find convenient to invest its liquidity at the overnight interest rate if it is lower than the deposit interest rate.

From this point of view, we can say that the rates corridor provides a representation of the liquidity supply in the long term, so if we can expect that the floor and ceiling rates do not change in the short term, what determines the overnight market interest rate in the short term? Looking at the graph, it's easily understandable that it is the liquidity demand curve.

The European Central Bank can push up and down the overnight market interest rate in three ways:

- acting on the quantity of liquidity offered through repurchase agreements
- acting on the level of the rate, in case of fixed rate operations
- changing the mandatory minimum reserve ratio



Source: “ECB key interest rates”, European Central Bank, accessed December 31, 2021.

Both the marginal lending facility rate and the deposit facility rate has been going down since the 2008 economic crisis.

Since 18 September 2019, the ECB has set them respectively at 0.25% and -0.5%, underlining the current situations of low (or negatives in this case) interest rates in the financial markets.

Mandatory minimum reserve ratio changes

Euro area banks and European subsidiaries of non-euro banks are required to hold a certain amount of funds as reserves in their current accounts at their national central bank. These are called *minimum reserves*.

The activity of the credit institutions in the market is divided in six-weeks periods, called *maintenance periods*. The mandatory minimum reserve is calculated before the beginning of the maintenance period, based on the bank’s balance sheet.

Banks must make sure that they meet the minimum reserve requirement on average over the maintenance period.

The minimum reserves are a tool used by the ECB with two main functions:

- Set the interest rates in the monetary market.
- Create or increase the structural liquidity deficit in the banking system.

Through the first function, the institutions controlled by the ECB can attenuate the daily fluctuations of liquidity. To do so, they can use part of the due reserve, counterbalancing it afterwards, but always inside the same maintenance period.

In particular, the credit institutions, are encouraged to use the reserve funds on the market if the short-term rates are higher than the expected ones for the remaining part of the maintenance period. If the expected rates are higher than the short-term ones, instead, the credit institutions would borrow funds from the market and keep a surplus of reserve position. This opportunity of arbitrage sets the overnight market interest rate during the maintenance period without frequent actions from the central bank to the monetary market.

Through the second function, the institutions controlled by the ECB can increase the liquidity needed to operate by the banking system. That allows the Eurosystem to work more efficiently from the liquidity supply point of view.

That happens because the mandatory minimum reserve increases the demand of liquidity from the Central Bank, making easier the monetary market rates control through liquidity injections.

The other minimum reserve functions are less important, but they can be still useful, for example it can be a good tool for the control credit fluxes or it can be used to boost the national incomes as the result of a *seigniorage* policy¹.

During the sovereign debt crisis, and, in particular, from January 2012, the mandatory minimum reserve ratio has been lowered, from the 2% of certain liabilities, to the 1% to lighten the costs on the banking system in the Euro area. The liabilities considered comprehended mainly customer deposits, they must be hold by the national Central Bank for the reference percentage.

The minimum reserve holdings are remunerated at the end of the maintenance period, with a rate equal to the weighted average of the *main refinancing operations* (MRO) rates made during carried out during the six-weeks period. Exceeding reserves are not remunerated, but they can be deposited at the Central Bank and, in that case, only the “floor” interest rate will be corresponded⁹.

⁹ “What are minimum reserve requirements?”, European Central Bank, accessed December 31, 2021, https://www.ecb.europa.eu/ecb/educational/explainers/tell-me/html/minimum_reserve_req.en.html#:~:text=A%20bank's%20minimum%20reserve%20requirement,week%20periods%20called%20maintenance%20periods.&text=This%20helps%20to%20stabilise%20the,at%20their%20national%20central%20bank.

Standard and non-standard open market operations

The Standard and non-standard *open market operations* are a tool used by the ECB to influence the money supply through the purchase or the sale, definitively or temporarily, of bonds from the authorized counterparts.

There are a few differences with the standing facilities, but the main one is that the open market operations are activated by the ECB (instead of the counterparts). The ways and conditions are also chosen by the Central Bank.

They are fundamental for the monetary policy to set the interest rates, determine the liquidity conditions on the market and point the stance of monetary policy out¹.

The open market operations can have a fixed or variable interest rate and based on this consideration; they can be divided in three groups:

- *Main refinancing operations* (MROs): weekly repurchase agreements with an extra-short maturity (7 days), regulated with auction mechanism.
- *Long-term refinancing operations* (LTROs): monthly repurchase agreements with three-months maturity, regulated with auction mechanism.
- *Fine tuning*: open market operations that can absorb or inject liquidity on the market. They are not regularly used, and they can be definitive or temporary. The fine tuning can also be regulated with auction mechanism or with bilateral procedures and can include currency swaps.

With the fixed rate operations, the ECB decides the amount of funding and its price, then, according to the demands submitted by the credit institutions, it shares the funds proportionally between them. So, if the sharing coefficient is the 10%, and a commercial bank want to ask for a million of euros, it will need to ask for ten times that amount.

With the variable rate operations, instead, the ECB decides only the amount of funding, then the competition between banks to get the funds will determine the interest rate. So, every bank will submit a demand for the funds that includes the interest rate they are willing to pay. At the end of the auction mechanism, the ECB lists the banks up based on how convenient the interest rate proposed is, then it satisfies the most convenient demands first, and then the others.

The marginal rate will be determined by the level of rate that makes the aggregate demand of funds equal to the amount of funds supplied.

Since January 2000, the ECB has often used the repurchase agreements with variable interest rate as main open market operation, however, after the 2007-2008 crisis and the sovereign debt crisis, it has introduced non-conventional monetary policy tools, to sustain the large demand of liquidity from the banking system¹.

Therefore, the open market operations can also be divided into standard operations, habitually used by the ECB, and non-standard operations, extraordinary measures mainly used in response to a particular phenomenon.

We have already analyzed the standard open market operation so now we can focus on the non-standard ones¹⁰.

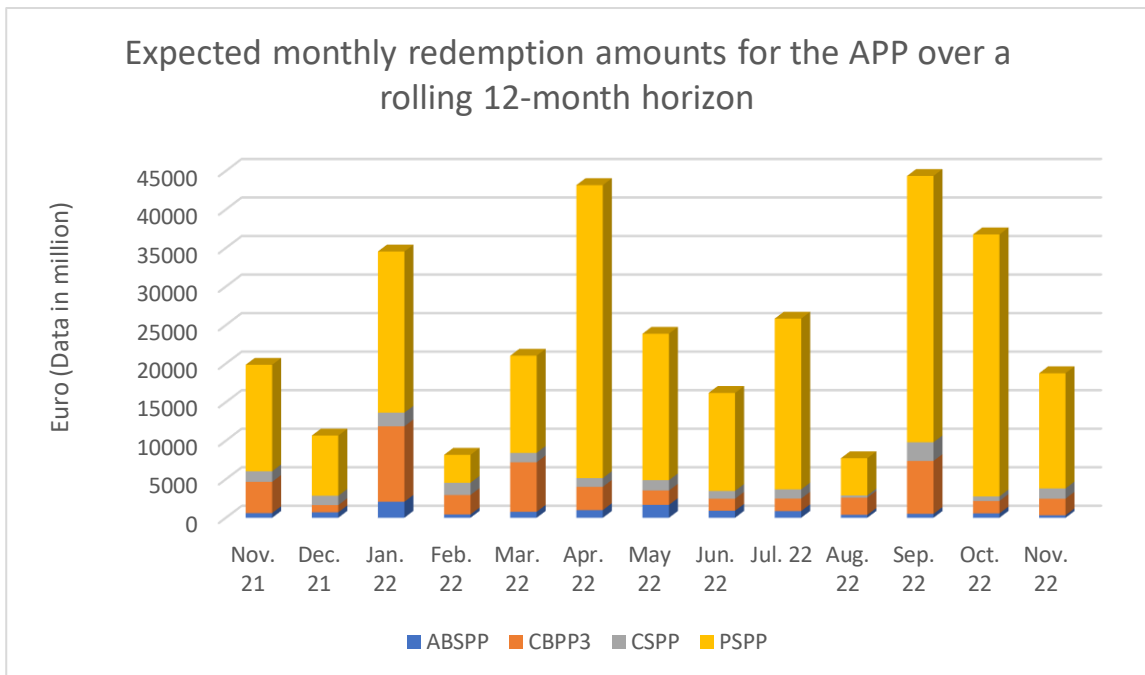
Besides the extraordinary operations used to face the 2020 economic crisis, which will be discussed in the next paragraph, the non-standard open market operations used until now are:

- Three-year LTROs: the operations of this kind have been two, maturing on 29 January 2015 and 26 February 2015. They have provided liquidity for over one trillion euros for the banking system in the Euro area, at the 1% interest rate.
- TLTROs: the targeted long term refinancing operations are a tool used by the Eurosystem to provide funds to credit institutions. The capital is conceded on favorable terms in order to make it easier for the commercial banks to lend money to the real economy. These operations can last up to four years.

Three series of TLTROs have been used by the ECB: the first one in 2014, then in 2016 and 2019.

- Six and twelve months LTROs: the aim of this tool is the *full allotment*, that allows the ECB to satisfy all the liquidity demand by commercial banks. At the same time the ECB accepted bonds as collateral.
- APP: the asset purchases programme is a tool, launched in October 2014 by the ECB, with two aims equally relevant. To encourage the growth in the euro area, and to reach the inflation goal.

¹⁰ “Open market operations”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/mopo/implement/omo/html/index.en.html>



Source: European Central Bank, accessed December 31, 2021, PSPP (public sector purchase programme), CBPP3 (covered bond purchase programme), CSPP (corporate sector purchase programme), ABSPP (asset-backed securities purchase programme)

As we can see from the graph, the asset purchase programme (APP) consists in four different purchase programs, public and private:

- The PSPP, public sector purchase programme, through which the ECB purchases bond emitted by governments, public organizations, and international institutions in the euro area
- The CBPP3, covered bond purchase programme, is used for the purchase covered bank bonds.
- The CSPP, corporate sector purchase programme, is used for the purchase bonds and, since March 2020, commercial paper issued by non-financial companies located in the Euro area.
- The ABSPP, asset-backed securities purchase programme, is used for the purchase of bonds issued after the securitization of bank loans.

The APP affects the market yields of public and private bonds, making them get lower in such a way to reach better conditions of credit supply and encourage the investments. Moreover, the liquidity surplus pushes the investors to buy private assets helping the private sector. Lastly, the reduction of the interest rates helps the depreciation of the exchange rate, ultimately encouraging the economic activity¹⁰.

The APP targets have always been respected with a slight exception for the 2020, where the unexpected economic crisis, made the ECB purchase more than foreseen from the targets, mainly regarding the corporate sector.

Other than the open market operations just described, it is possible for the ECB to use structural operations to permanently modify the position of the ESCB towards the financial system through the purchase or the sale of bonds or the emission of debt certificates. These operations have been used by the ECB to buy bonds of several countries in the Euro area during the sovereign debt crisis, focusing the purchases on those countries with hard public finance situations¹¹.

¹¹ “Asset purchase programme”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/mopo/implement/app/html/index.en.html>

ECB MONETARY POLICY TOOLS IN DECEMBER 2020

The tools seen until now are the ones generally used by the ECB to fulfil its duties, however, the 2020 pandemic and the economic crisis related have changed a lot the measures adopted by the ECB have changed. As said by the president of the ECB, Christine Lagarde: “Extraordinary times require extraordinary action. There are no limits to our commitment to the euro”, reminding the Mario Draghi’s “Whatever it takes”. Besides, the PEPP which will be analyzed in the next paragraph, the ECB response to the coronavirus pandemic focused on:

- Cancel or reduce the shock effect caused by the pandemic (through the PEPP measures)
- Keeping borrowing affordable
- Ensuring loans to firms and household
- Avoid lending problems from short-term concerns
- Increasing banks’ lending capacity
- Preserving financial stability through international cooperation

KEEPING BORROWING AFFORDABLE

The ECB has been keeping the main interest rates at historically low levels so there can be lower borrowing costs on the market. Since the interest rates set by the ECB have an influence on the cost of capital, lent from commercial banks, people can find easier borrow funds and support spending and investment.

ENSURING LOANS TO FIRMS AND HOUSEHOLD

To create easier condition for the commercial banks to borrow money, the ECB has increased the list of assets that can be used as a collateral. Also, they have been less strict with the *haircut*¹², the measures applied to determine the assets value. The haircuts are reductions applied to the value of

¹² “What are the haircuts?”, European Central Bank, accessed December 31, 2021

assets. They are extremely important to prevent decrease of value during the time it takes to sell the collateral¹³.

All these measures have one ambitious purpose: to increase the amount of money that banks can borrow, making easier for the banks to borrow money specifically to make loans to those hardest-hit by the spread of the virus, including small and medium firms¹⁴.

In particular, the emergency collateral package contains three main features:

- The National Central Banks can increase the scope of eligible credit claims for counterparties inside the country they represent, through the expansion of the additional credit claims (ACCs) framework
- Temporarily, the ECB has chosen to lower the minimum size for domestic credit claims to 0 euros and increased the percentage of unsecured debt from a single banking group, up to the 10%.
- Reduction of the haircuts by a fixed factor of 20%

ENSURING SHORT-TERM CONCERNS DO NOT PREVENT LENDING

The ECB has been offering immediate borrowing options at favorable rates to solving banks. This decision is meant to help them to continue granting loans to citizen and firms in need in a time of great uncertainty.

The European Central Bank has activated, to this aim, a series of additional longer term refinancing operations (LTROs) to safeguard liquidity and money market condition. Moreover, they have arranged operations allotted on weekly basis which matured on 24 June 2020⁵.

Focusing on the additional LTROs, on 30 April 2020 the ECB has decided to offer pandemic emergency longer-term refinancing operations which are called PELTROs.

To keep on with the distribution of liquidity to commercial banks, the European Central Bank has also decided, to add four additional PELTROs. This last measure was decided on December 10th 2020.

¹³ “ECB announces package of temporary collateral easing measures”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200407~2472a8ccda.en.html>

¹⁴ “Our response to the coronavirus pandemic”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/home/search/coronavirus/html/index.en.html>

These bonds have one year of maturity and are offered at accommodative terms, furthermore, the interest rate corresponded by the Central Bank is 25 basis points below the average rate applied for the MROs over the life of the respective PELTRO¹⁵¹⁶.

INCREASING BANKS' LENDING CAPACITY

The ECB has started a temporary policy of less strictness about the amount of funds (capital), that banks must hold as a buffer for difficult times. They are also being less strict about deadlines, procedures and giving more flexibility on supervisory timelines¹⁷.

All these measures are meant to help commercial banks to absorb the losses caused by the pandemic and support the economy. For that reason, according to the losses suffered during the last economic crisis, banks haven't been able to pay out dividends during 2020.

More specifically, credit institutions can entirely use their funds, including Pillar 2 Guidance¹⁸, but they will be also advantaged by an increase in flexibility in the supervisory measures and by less strict rules for the Pillar 2 capital composition⁷.

According to the financial stability institute (FSI), the *Pillar 2* is a tool used to make sure that credit institutions well-balance the risks taken to support their business¹⁹.

PRESERVING FINANCIAL STABILITY THROUGH INTERNATIONAL COOPERATION

Central Banks around the world usually hold currencies that are not their own. This happens because their domestic banks may need foreign currencies to do business, so they can ask for loans in these currencies during the daily negotiations.

¹⁵ "ECB announces measures to support bank liquidity conditions and money market activity", European Central Bank, accessed December 31, 2021, https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr200312_2~06c32dabd1.en.html

¹⁶ "Pandemic Emergency Longer-Term Refinancing Operations", Banca D'Italia, accessed December 31, 2021, <https://www.bancaditalia.it/compiti/polmon-garanzie/peltro/index.html?com.dotmarketing.htmlpage.language=1>

¹⁷ Bankingsupervision.europa.eu. "ECB Banking Supervision provides temporary capital and operational relief in reaction to coronavirus", European Central Bank, accessed December 31, 2021, <https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200312~43351ac3ac.en.html>

¹⁸ Bis.org, "Pillar 2 framework", BIS, accessed December 31, 2021, <https://www.bis.org/fsi/fsisummaries/pillar2.htm>

¹⁹ "ECB extends pandemic emergency longer-term refinancing operations", European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/press/pr/date/2020/html/ecb.pr201210~8acfa5026f.en.html>, December 10, 2020.

Furthermore, in times of uncertainty, the demand for foreign currency assets can increase, so banks should have enough currency reserves on hand to meet the increasing customers' demand or markets can become unstable. For that reason, Central Banks have developed the *currency swap lines*, in order to let themselves exchange their national currency reserves with the others around the world, ensuring that they can keep up with the increasing demand.

A currency swap line is defined by the ECB website as “an agreement between two central banks to exchange currencies”⁹. For example, this agreement allows all the national banks in the Euro area to exchange US dollars with the Federal Reserve for an equal amount of euros when in need.

The currency swap lines have been an important tool of monetary policy for all the Central Banks for decades but, their true importance was shown in 2007, when they played a crucial role in supplying foreign currencies to domestic banks.

This last tool has been extremely important during the financial crisis after the collapse of Lehman Brothers in 2008. In particular, when funding markets in one currency are troubled, it may be difficult for foreign commercial banks to finance their assets linked to this currency since they are not directly connected to the foreign Central Bank, so the swap lines help the Central Bank to provide the needed currencies for the domestic banks without decreasing its own foreign reserves.

That happens in 2008, when, due to an extreme aversion to risk, the funding markets dried up. To prevent an enormous assets sell with the consequent consistent price movement, the ECB and the Federal Reserve set up a currency swap line, allowing the Central Banks of Eurosystem countries to provide US dollars to their domestic banks.

Afterwards, when the financial crisis was over, the ECB set up temporary arrangements to provide euros to Denmark, Sweden, Latvia, Hungary and Poland.

In 2013 a new important swap line was opened with China, reflecting the country's growing importance in the global economic panorama.

In 2020 the ECB reactivated the swap arrangement with the Central bank of Denmark and established temporary swap lines with Croatia and Bulgaria²⁰.

²⁰ “What are currency swap lines?”, European Central Bank, accessed December 31, 2021, https://www.ecb.europa.eu/ecb/educational/explainers/tell-me-more/html/currency_swap_lines.en.html

PEPP – PANDEMIC EMERGENCY PURCHASE PROGRAMME

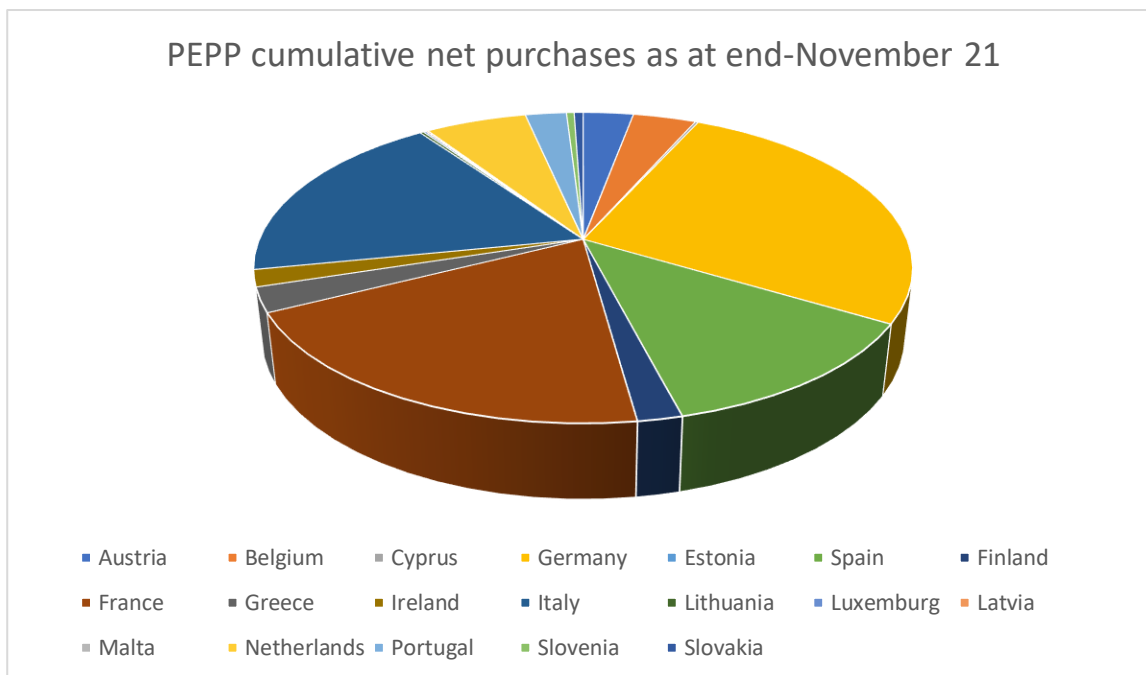
The ECB's pandemic emergency purchase programme (PEPP) can be defined as an extraordinary toolkit of monetary policy measures used to face the economic crisis started in March 2020.

The programme was shown to the world for the first time during an extraordinary reunion on 18 March 2020. At the beginning it announced investments for €750 billion, but it got “thicker” later, adding €600 billion on 4 June 2020 and €500 billion on 10 December 2020. In the end, the total programme worth is €1850 billion, and in terms of eligible assets categories, it is very similar to the APP, for example, it can be used to buy both public and private assets too²¹.

The PEPP will end when the COVID-19 crisis will be over but, was meant to not end in any case before March 2022. The maturing principal payments will be reinvested until at least the end of 2023. Compared to the other purchasing programmes, the PEPP is more flexible: first, because the minimum maturity of the bonds that the ECB can buy is 70 days (and not one year like previous purchasing programmes), in second place, there can be an exception to the *capital key* which makes the ECB buy bonds proportionally to the contribution to the Central Bank from the country. Italy benefits particularly from that exception, in fact, as analyzed by the CPI observatory, in May 2020 the country should have benefited from the programme for €29 billions, but the actual purchase has been of €37 billions thanks to the exception cited above²².

²¹ “Pandemic emergency purchase programme (PEPP)”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/mopo/implement/pepp/html/index.en.html>

²² Benny Mirko Procopio, “Cos'è il PEPP, il piano d'emergenza della Bce per contrastare la crisi scatenata dal Covid?”, TGCOM24, 20 settembre 2021, https://www.tgcom24.mediaset.it/tgcomlab/cos-il-pepp-il-piano-demergenza-della-bce-per-contrastare-la-crisi-scatenata-dal-covid-_28230896-202102k.shtml



SOURCE: European Central Bank, accessed December 31, 2021.

After more than one year, we can surely say that the PEPP has provided crucial support to euro area citizens in difficult times. It helped the ascent of the financial markets after the fall of March 2020 preventing devastating consequences for the firms, governments and consumptions²³.

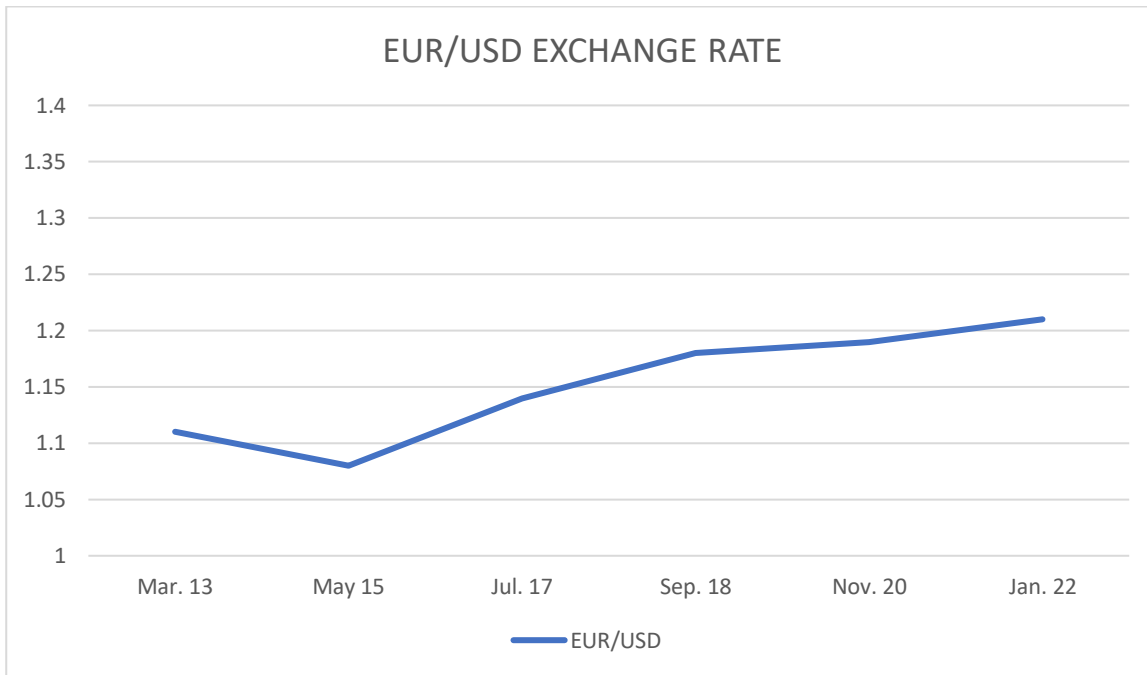
The Pandemic Emergency Purchase Programme has had two different kinds of impact.

IMPACT ON THE FINANCIAL MARKETS

The programme had a truly relevant impact on the financial markets. It is called “stock effect” in the economic literature, since it includes investors’ expectations of future developments in the stock of financial assets acquired by the central bank under the framework of these programmes. Several stock markets indicators can be used for the analysis such as the euro/dollar exchange rate, ten-year sovereign bond yields, spreads and inflations expectations. The results indicates that both the announcement of the Purchase Programme and the following increase of the allocated resources had a positive effect on these indicators. Considering the EUR/USD exchange rate, for example, it is easily understandable from the graph below what a powerful tool the PEPP has been²⁴.

²³ “One year of the PEPP: many achievements but no room for complacency”, European Central Bank, accessed December 31, 2021, <https://www.ecb.europa.eu/press/blog/date/2021/html/ecb.blog210322~7ae5eca0ee.en.html>, March 22, 2021

²⁴ Aguilar Pablo, Arce Oscar, Hurtado Samuel, Martinez-Martin Jaime, Nuno Galo and Thomas Carlos. “Documentos Ocasionales” n. 2026, Banco De Espana, Madrid, 2020, 20-23



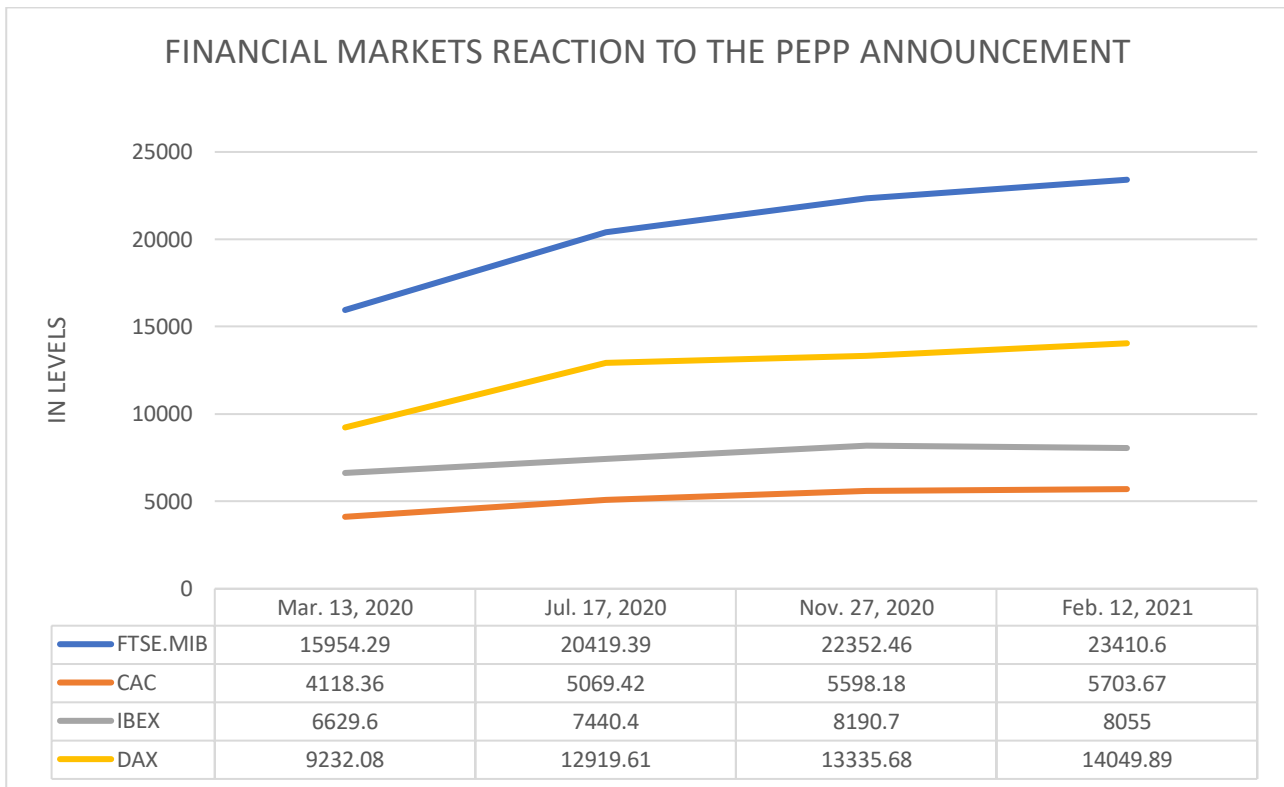
Source: Google, accessed January 3, 2022²⁵

After the PEPP announcement, on March 18th, 2020, the exchange rate has been going up, showing the huge impact of the Programme on the financial markets.

The graph shows also that the effect has not been immediate, in fact, even though the measures had been announced, in the first bimester the rate kept dropping, carrying on with the trend of the previous months. Historically, we have been able to see that the immediate impact of the measures is analyzable through the stock markets main index, so it would be interesting to study what happened in the FTSE.MIB after March 18th, for example.

Well, the graph below compares the “big four” (Italy, Spain, Germany and France) main stock index and the reaction to the PEPP announcement.

²⁵ “EUR/USD exchange”, Google, accessed January 3, 2022, https://www.google.com/search?q=eur+usd+exchange+rate&sxsrf=AOaemvK92VqAx9Q4qZAeJY118dt4o8QFmA%3A1641170145815&ei=4UTSYZydMc6wkwXEjIjwAQ&oq=eur+usd+e&gs_lcp=Cgdnd3Mtd2l6EAEYADIFCAAQgAQvBQgAEIAEMgUIABCABDIFCAAQgAQvBQgAEIAEMgUIABCABDIGCAAQFhAeMgYIABAWEB4yBggAEBYQHjIGCAAQFhAeOgcIABBHELADOGcIABCwAxBDogoiABCABBCHAhAUSgQIQRgASgQIRhgAUIkGWNcHYNgRaAFwAngAgAFviAHZAZIBAzAuMpgBAKABAcgBCsABAQ&scient=gws-wiz



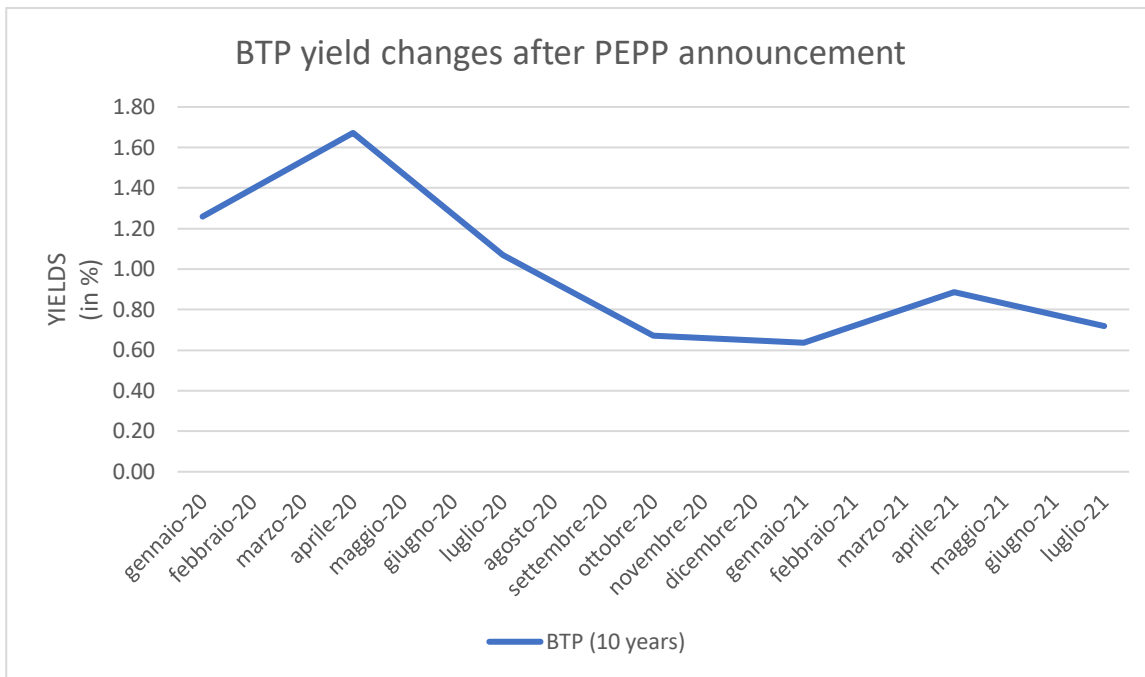
Source: “Riepilogo mercato > FTSE.MIB, CAC, DAX, IBEX”, Google, accessed January 3, 2022²⁶

The graph clearly shows that after the announcement of the PEPP, the main European stock indexes started going up after a disastrous month, where they touched lowest point of the last five years. It’s important to underline that the two following increases to the programme resources have had a leading role too in the stock value growth, allowing the main indexes to keep the positive trend for several months.

Last but not least, another quick and strong impact of the PEPP (suggested by the annual relation by Bank of Italy²⁷) has been the one on the bond yields. In the days after the announcement, the long-term bond yield and the prizes for the risk dropped significantly all around the Euro-Area, especially in the economies that have been economically “hit” the most by the pandemic⁹. For example, let’s think of the Italian BTP (10 years).

²⁶ “Riepilogo mercato > FTSE.MIB,CAC,DAX,IBEX”, Google, accessed January 3, 2022, <https://www.google.com/search?q=ftse+mib&oq=ftse+mib&aqs=chrome..69i57j0i512l3j0i433i512j0i512l3j0i433i512j0i512.2394j1j7&sourceid=chrome&ie=UTF-8>

²⁷ “Relazione annuale Banca D’Italia 2020”, Rome, May 31st, 2020, Banca D’Italia, accessed January 3, 2022, 38-40



Source: “Rendimento BTP Italia 10 anni”, Il sole 24 ore, accessed January 3, 2022²⁸

It is easily understandable from the graph that after the PEPP announcement, the BTP yield dropped to levels that hadn't been reached since decades. The lowest point registered was reached on the February 12th, 2021, where the yield was 0,495.

²⁸ “Rendimento BTP Italia 10 anni”, Il sole 24 ore, accessed January 3, 2022, https://mercati.ilsole24ore.com/obbligazioni/spread/GBITL10J.MTS?refresh_ce&nof

2. THE GLOBAL EVOLUTION OF THE MONETARY POLICY TOOLS

THE FED RESPONSE TO THE 2020 ECONOMIC CRISIS

The United States have been one of the hardest hit countries in the world by the pandemic, from both the points of view: sanitary and economic.

From an economic point of view the covid consequences have been disastrous, comparable only to the Great Depression. The Gross Domestic Product collapsed at an annual rate of over 30 percent in the second quarter of 2020. More than 22 million jobs were lost in just the first two months of the crisis, and the unemployment rate reached the 15 percent. Only a few months before it had reached the 50-year low of 3.5 percent. Another fact that created an even worse situation was the decline in aggregate demand, which had a significant impact on the consumer price level. The results have created a serious threat to financial conditions of the country, especially for the flow of credit to U.S. households and businesses.

The response, speaking of monetary policy, was unprecedented in terms of speed, scale and scope. The plan comprehended measures for 5.8 trillion dollars, about the 28% of the U.S. GDP.

The Federal Reserve responded to the COVID crisis through a considerable number of tools, which can be organized in four categories²⁹:

- *Conventional monetary policy measures*, which basically represent the tools generally used by the Central Bank to reach its own aims. An example can be lowering the interest rates or the repurchase agreement (repo) operations. Both played a key role facing the pandemic.
- *Liquidity providing measures* used to assist the money market functioning.
- *Facilities* with the aim of directly assisting the flow of credit to households and businesses.
- *Temporary recalibrations*, which are used by the Central Bank to support the monetary policy transmission mechanism.

²⁹ Clarida, Richard H., Burcu Duygan-Bump, and Chiara Scotti (2021). “The COVID- 19 Crisis and the Federal Reserve’s Policy Response,” Finance and Economics Discussion Series 2021-035. Washington: Board of Governors of the Federal Reserve System, <https://doi.org/10.17016/FEDS.2021.035>, 3-19.

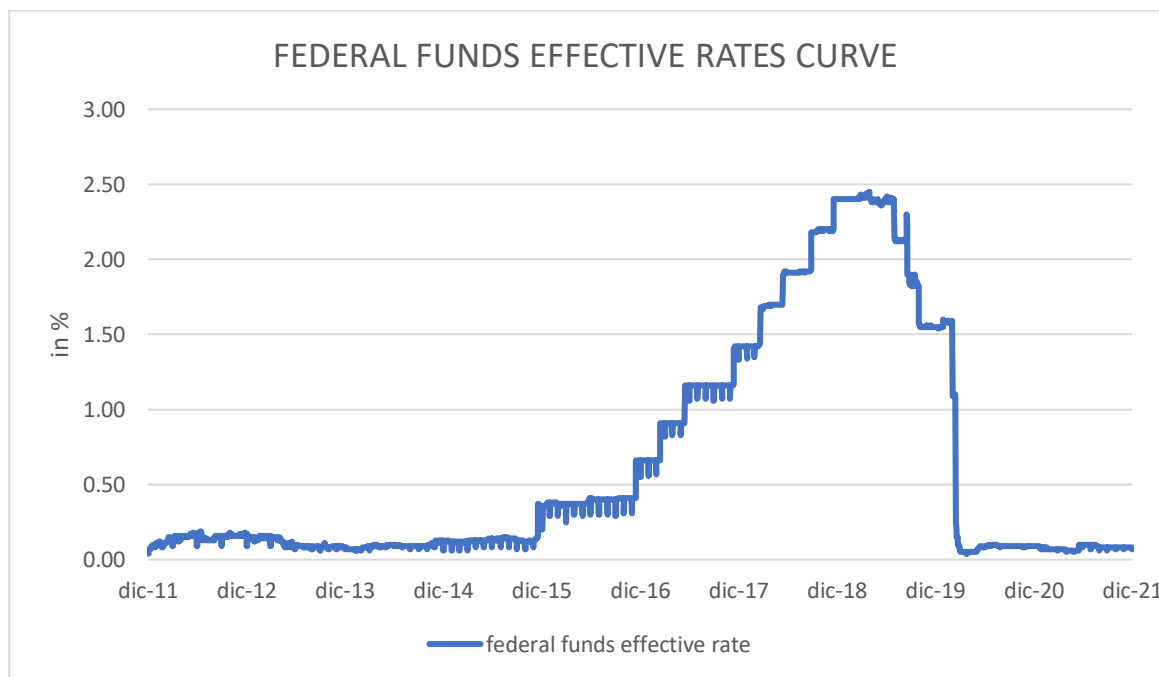
CONVENTIONAL MONETARY POLICY MEASURES

The conventional monetary policy toolkit comprehends three types of measures, regarding: interest rates, open market operations, guidance on the interest rates applied to loans and assets purchase.

Before describing the FED's behavior facing the pandemic, it is important to describe a fundamental tool: the *federal funds rate*, which is described as “the interest rate at which depository institutions (banks and credit unions) lend reserve balances to other depository institutions overnight on an uncollateralized basis” (source Wikipedia)⁵. The federal funds target rate is determined by the Federal Open Market Committee (FOMC).

On March 3 and March 15, 2020, the Federal Open Market Committee cut the target range for the federal funds rate by one and a half percentage points, bringing it to a range of 0 to 0.25 percent. The Committee also added a statement saying that this target range is expected to be maintained until they were confident that the economy was on track to achieve its maximum-employment and price-stability goals. At the same time, the Committee underlined that it would have kept monitoring the information related to the public health, the global development and the inflation level using its tool and acting appropriately to support the economy.

For a better comprehension of how brave the choice of lowering the target has been, the graph of the federal funds effective rates shows the drop that they had in the last years.



Source: “Federal Funds Effective Rate”, Fred, accessed January 4, 2022³⁰

³⁰ “Federal Funds Effective Rate”, Fred, accessed January 4, 2022, <https://fred.stlouisfed.org/series/DFE>

Focusing on the graph it's important to underline that the interest rate drop has not regarded only the ECB, but it's a policy adopted by several Central Banks. Right now, the Federal Reserve is still keeping the interest rate at the all-time-low, that is allowing firms to borrow money at a low price during the crisis.

In order to ensure that the supply of reserves remained ample and to support the smooth functioning of the critical funding markets, the FED also took action to expand the supply of short-term funding available. In particular, from March 9, 2020, the Central Bank increased the size of overnight and term repo operations: they introduced new weekly recurring one- and three-month term repo operations, a second daily overnight repo operation and increased the amount offered in each operation.

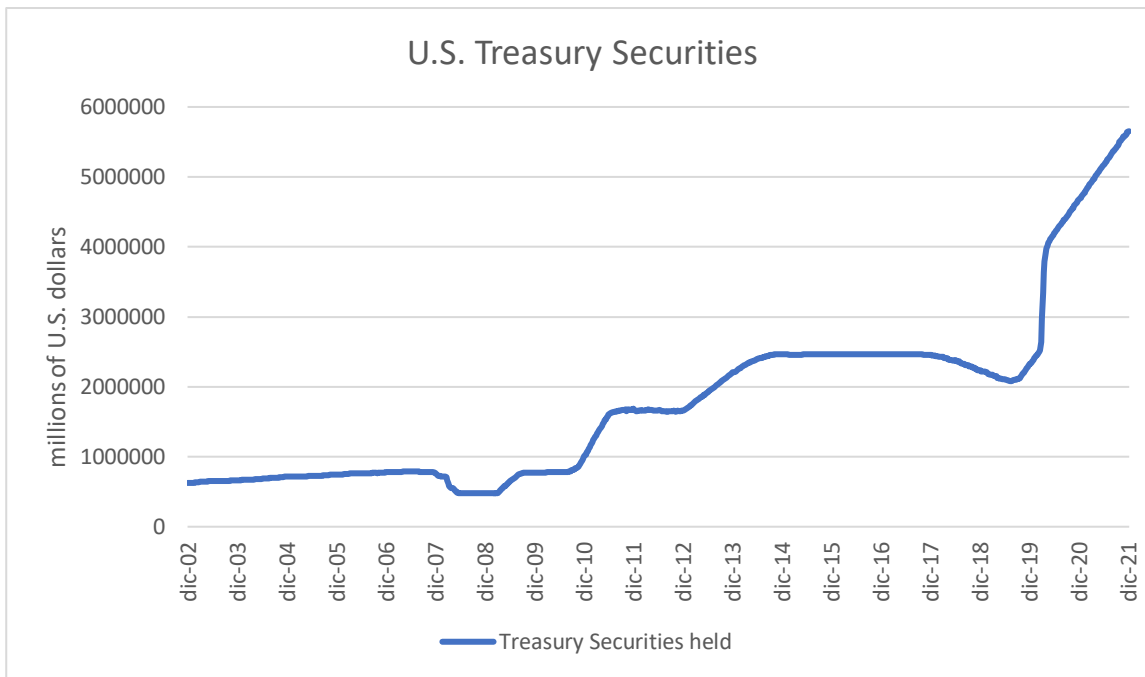
The assets detained by the Central Bank increased significantly during 2020, and especially the holdings of U.S. Treasury securities increased by 500 billion dollars on March 23. That measure allowed a more efficient functioning of the financial market and increased the effectiveness of the monetary policy transmission mechanism.

As a result of the increased repo operations and asset purchase, market functioning improved substantially, so the Fed decided to slow down the purchase.

The consequences of these measures increased the Federal Reserve's balance sheet significantly, almost tripling the Treasury Securities held by the Central Bank in a little over two years. As expected, this purchase program is giving a huge help to the economy providing a large amount of liquidity, but there is a big risk behind called inflation.

In fact, as the Fed was keeping on buying national bonds, the GDP has been recovering from the "lockdown losses" but at the same time the inflation has been going up, reaching levels that haven't been seen by the country since 1982, around 6.8% on annual basis (November 2021)³¹.

³¹ "L'inflazione USA vola al 6,8%, ai massimi dal 1982. Upb: rischi per l'economia", La Stampa, December 10, 2021, https://www.lastampa.it/economia/2021/12/10/news/1_inflazione_usa_vola_al_6_8_ai_massimi_dal_1982_upb_rischi_per_l_economia_-1324282/



Source: “Assets: Securities Held Outright: U.S. Treasury”, Fred, accessed January 4, 2022³²

To face the severe pandemic effects, the FOMC also provided forward guidance, indicating that, with inflation running persistently below 2 percent (March 15, 2020), its policy would aim to achieve inflation outcomes that keep inflation expectations well anchored at the 2 percent longer-run aim. The Committee stated that it will be appropriate to maintain the current 0 to 0.25 percent target range for the federal funds rate until the market returned to work properly and the parameters such as inflation or employment are back at pre-pandemic levels. In December 2020, the FOMC indicated that it would continue to increase its holdings of Treasury Securities by at least 80 billion per month and its holdings of agency MBS by at least 40 billion per month until “substantial further progress” was made toward its maximum-employment and price-stability goals.

STABILIZING SHORT-TERM FUNDING MARKETS

The operations used to stabilize the financial markets in the short term can be divided in two groups: the liquidity and funding operations and the easing strains in global dollar funding markets. For starting, the strains in financial markets have been caused by the increase in the demand for cash and

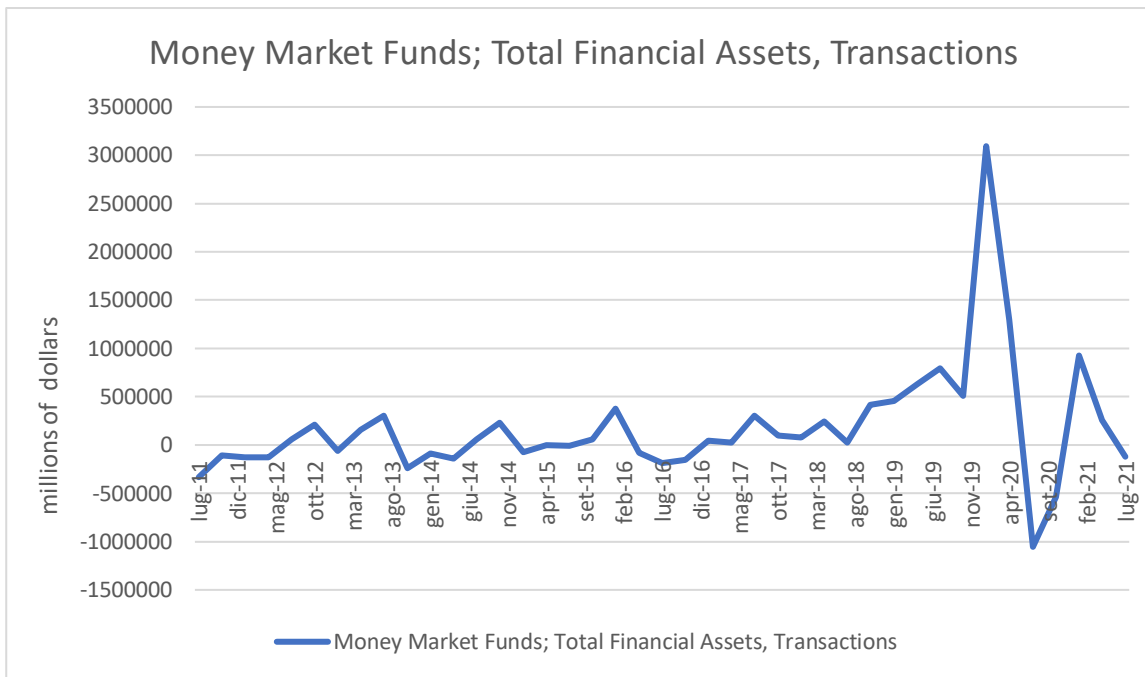
³² “Assets: Securities Held Outright: U.S. Treasury”, Fred, accessed January 4, 2022, <https://fred.stlouisfed.org/series/TREAST>

other liquid assets during March 2020. That led to a disruption in the flow of credit to businesses needed for critical operations, with tough consequences for the largest part of the firms. That happened because firms and local governments usually finance their activity with short-time debit or “commercial paper” (CP), which are emitted every few weeks. As the market was running out of liquidity due to a big increase in demand, many investors became unwilling to advance funds for longer than a few days, so firms were forced to issue CPs on daily basis, with no guarantee that investors would accept it. At the same time, investors started to pull away from money market mutual funds (MMF) which typically held the CP and other short term debit instruments. The large amount of investor redemptions the mutual funds had to give them back threatened to exhaust the liquidity in their hand, so the concern for restriction or suspensions in the daily redemptions grew, creating a situation even worse, with an even larger number of investors asking for their redemptions. The consequences of a failure in the CP market would have been disastrous: household and business would have missed payments, forcing technical default, with potential consequences for the entire economy.

To alleviate these strains, the Federal Reserve encouraged depository institutions to turn to the discount window to help meet demands for credit from households and businesses and reduced reserve requirement ratios to 0. To this aim, the Board took two decisions: lowered the primary credit rate by 150 basis points to 0.25 percent from March 16, 2020 and announced that depository institutions could borrow from the discount window for maximum 90 days. In addition, the FED reduced reserve requirement ratios to 0 percent.

The Central Bank’s response was not only limited to that. On March 17, it announced the Commercial Paper Funding Facility (CPFF) and on March 18, it announced the Monetary Market Mutual Fund Liquidity Facility (MMLF). Each facility had 10 billion dollars of equity to protect the Federal Reserve from losses.

Another tool announced on March 17, was the Primary Dealer Credit Facility (PDCF), used to provide liquidity to support the primary dealer that are critical intermediaries in short-term funding markets. From the following graph it is clear that the entity of the increase of the transaction regarding the assets of the MMF was truly relevant, and it is also understandable how well FED responded to that situation. In fact, the curve started going down only after the announcement of CPFF and MMLF.

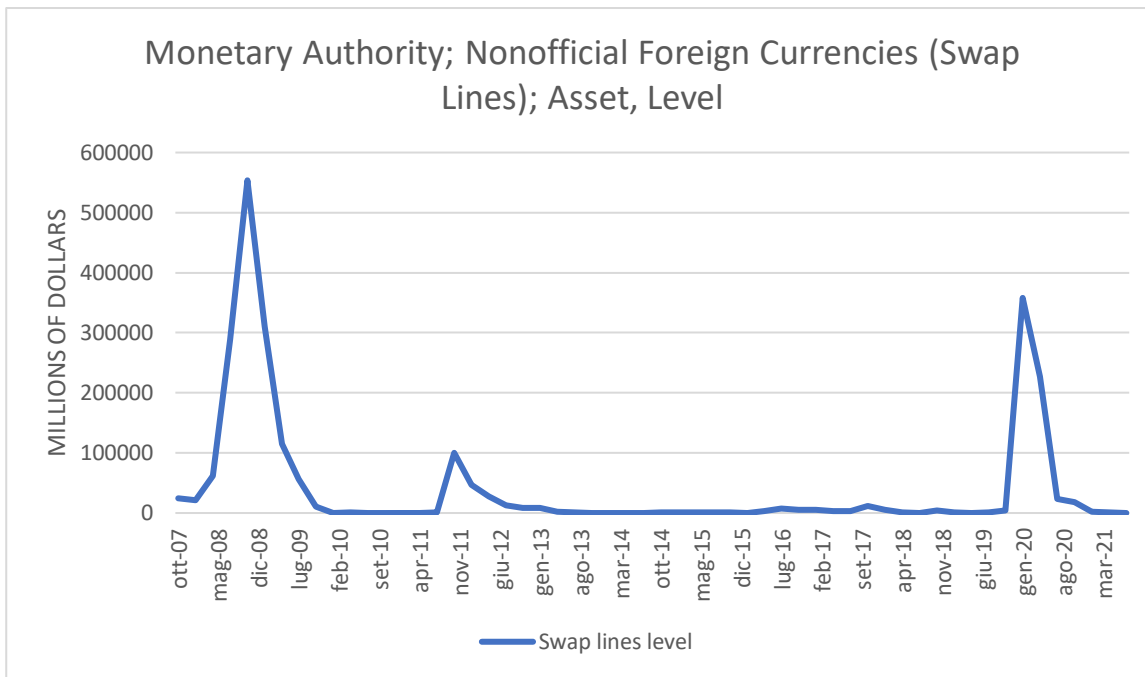


Source: “Money market funds; Total financial assets, transactions”, Fred, accessed January 4, 2022³³

As stated before, another tool used by the Federal Reserve to stabilize short-term funding markets was the easing strains in global dollar funding markets.

The Central Bank had to use this tool because the relationship with the foreign institutions was truly threatening the inner economy. The U.S. dollar has a leading role in the international trading and is also used as a funding and investments currency worldwide. However, the foreign institutions rely more on the wholesale funding markets than the U.S. institutions because their access to U.S. retail deposit or other institutions that provide the currency is limited. The problem comes up when the dollar funding markets seize up, with heavy effects on the foreign financial institutions. As a response they reduce lending to foreign borrowers, cutting also the lending to U.S. residents, and they start selling U.S. assets in order to obtain dollars. That threatens the households and firms in the United States. This effect is shown in the following graph, analyzing the increase in foreign exchange swap, which reached the global financial crisis level, 2007-2009.

³³ “Money market funds; Total financial assets, transactions”, Fred, accessed January 4, 2022, <https://fred.stlouisfed.org/series/MMMFTAQ027S>



Source: “Monetary Authority; Nonofficial Foreign Currencies (Swap Lines); Asset, Level”, Fred, accessed January 4, 2022³⁴

The response from the Federal Reserve was not long in coming, in fact, on March 15, 2020, it announced the expansion and enhancement of dollar liquidity swap lines with several Central Banks during the same week. It was not the only measure: longer-term swap operations were added for the four Central Banks that traditionally hold auctions, and temporary swap lines were reopened with the nine Central Banks that built up agreements during the global financial crisis with the Federal Reserve.

As shown by the graph, the swap levels fell, reaching again the pre-pandemic level.

On March 31, Fed also announced the FIMA (Foreign and International Monetary Authorities) Repo Facility, a program to support dollar funding markets. The main goal of this last measure was to provide dollar liquidity to several countries, many of which do not have swap agreements with the Federal Reserve. Through FIMA, they can have access to overnight repos with the U.S. Central Bank, temporarily exchanging U.S. Treasury securities they hold, for U.S. dollars. This system allows

³⁴ “Monetary Authority; Nonofficial Foreign Currencies (Swap Lines); Asset, Level”, Fred, accessed January 4, 2022, <https://fred.stlouisfed.org/series/ROWSLAQ027S>

central banks to obtain dollars for liquidity purposes without selling their Treasury securities outright³⁵.

SUPPORTING THE FLOW OF CREDIT TO HOUSEHOLDS, COMPANIES AND STATES

The most immediate consequence caused by the spread of the COVID-19 was that companies and households mainly, have seen a rapid increase of the interest rates for borrowing money. That situation led to a stop for operations and investments that had been programmed by small and medium firms.

The Federal Reserve responded through the section 13 (3) of the Federal Reserve Act, which is constitutive act of the Central Bank. The section 13 (3) is a unique power detained by the Fed which gives the possibility to the Central Banks of each country in the U.S. to provide liquidity directly to firms.

In particular, the Federal Reserve used six lending facilities to fight against the financial disruption of the market³⁶:

- **Commercial Paper Funding Facility (CPFF)** is a tool used support the commercial paper market, it is used to buy newly issued commercial paper that have not been bought by private investors. The purchases are limited to a maximum amount for each issuer, plus it must have a high rating³⁷.
- **Primary Dealer Credit Facility (PDCF)** is a tool used to support primary dealers through loans. They are investors that purchase bonds directly from the government, with the aim to resell them to others⁸. The interest rate applied is the Fed's primary interest rate and the maturity is maximum 90 days.
- **Money Market Fund Liquidity Facility (MMLF)** is a tool used to support financial institutions (such as banks) through liquidity loans that have used to buy assets sold by the money market funds.

Its aim is to reduce the chance of inefficiency bound to the liquidation of assets.

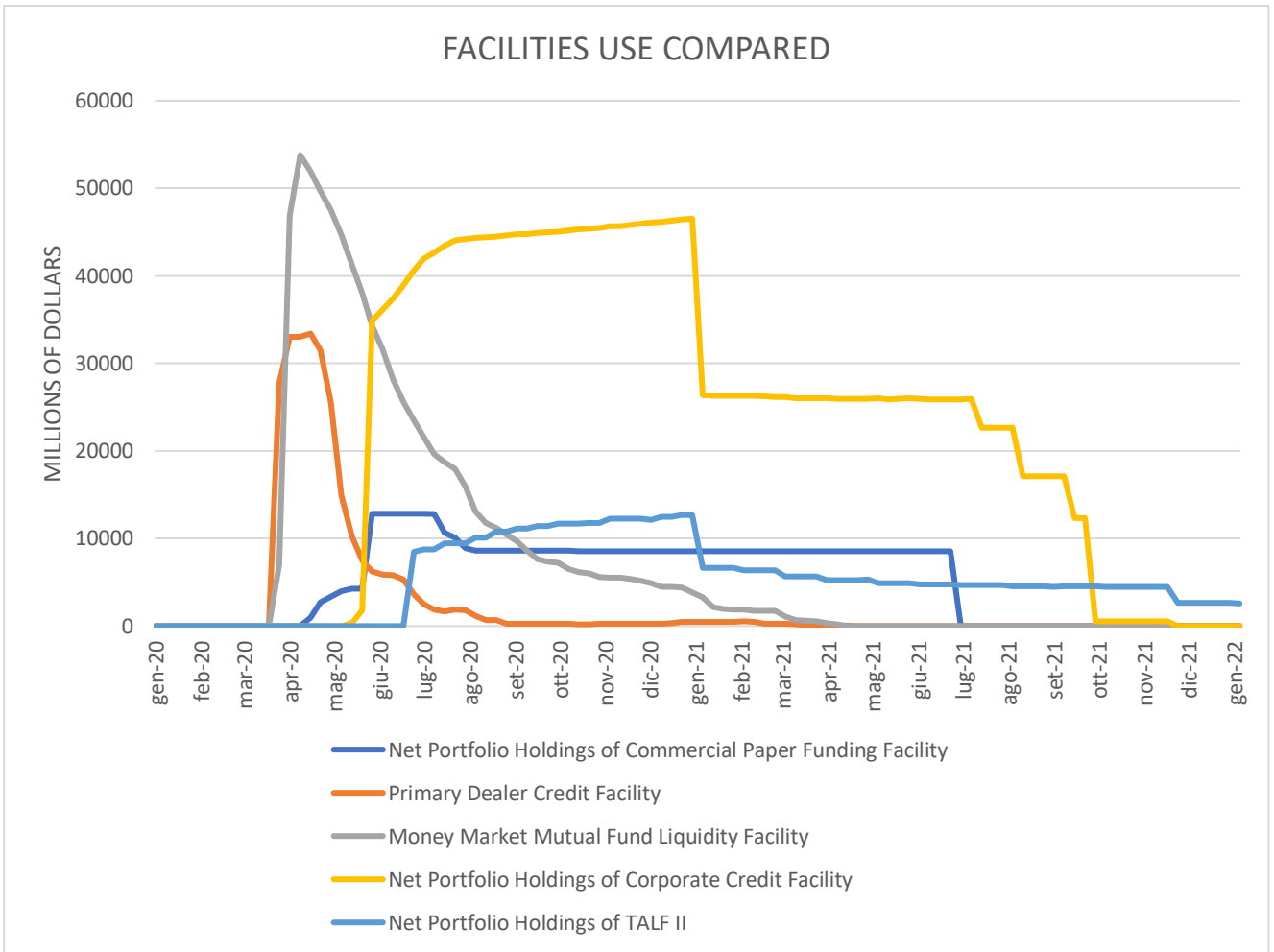
³⁵ ["Primary dealer", Wikipedia](https://en.wikipedia.org/wiki/Primary_dealer#:~:text=A%20primary%20dealer%20is%20a,and%20impose%20conditions%20of%20entry), accessed January 9, 2022, https://en.wikipedia.org/wiki/Primary_dealer#:~:text=A%20primary%20dealer%20is%20a,and%20impose%20conditions%20of%20entry

³⁶ "Federal reserve: Emergency Lending", Congressional Research Service, updated March 27, 2020, <https://sgp.fas.org/crs/misc/R44185.pdf>

³⁷ "Types of bonds", [investinginbonds.com](http://www2.investinginbonds.com/learnmore.asp?catid=5&subcatid=16), accessed January 9, 2022, <http://www2.investinginbonds.com/learnmore.asp?catid=5&subcatid=16>

- **Primary Market Corporate Credit Facility (PMCCF) and Secondary Market Corporate Credit Facility (SMCCF)** are two facilities needed to support the corporate bond market. The first one allows the Central Bank to support credit to employers through bond and loans to firms, the second one has the same goal, but it operates through liquidity injection to allow the issue of corporate bonds.
- **Term Asset-Backed Securities Loan Facility (TALF)** is a tool used to sustain the issue of Asset-Backed Securities (ABS). The ABS are bonds backed by financial assets. They derive from credits such as auto loans, home-credit loans and mortgage loans¹⁰. In particular, the TALF, are three-year loans to private investors to support the purchase of ABS.

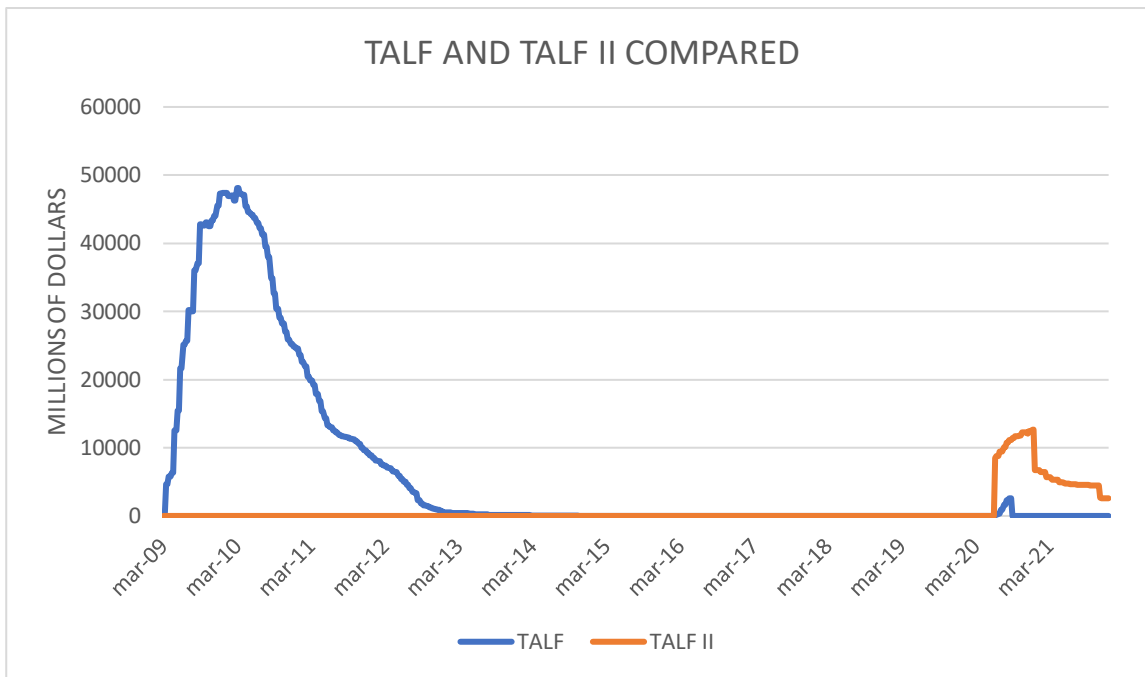
Comparing the facilities use by Fed, we can understand that their usage has been going down from the beginning of the pandemic, and since the second half of 2021 the Central Bank has stopped using these measures (only the TALF still goes on). That should curb the high increase of inflation, or at least that is what the Federal Reserve is hoping. The problem is that, according to the last data about inflation in the U.S. that is not happening, and as explained previously, it keeps running, reaching in November, the highest point in forty years (on annual basis).



SOURCE: “Net Portfolio Holdings of TALF II”, “Net Portfolio Holdings of Corporate Credit Facility”, “Money Market Mutual Fund Liquidity Facility”, “Primary Dealer Credit Facility”, “Net Portfolio Holdings of Commercial Paper Funding Facility”, Fred, accessed January 9, 2022³⁸

Should also be underlined that it was not the first time that many of these measures have been used. For example, the Term Asset-Backed Securities Loan Facility had been used also in 2009, to face the effects of the Global Financial Crisis. As we can see from the following graph, the use of the TALF has been reduced significantly compared to the 2009 investments.

³⁸ “Fred Graph”, Fred, accessed January 9, 2022, <https://fred.stlouisfed.org/series/TABSLFBORRW>



SOURCE: “Fred Graph”, Fred, accessed January 9, 2022³⁹, TALF-TALF II (Term Asset-Backed Securities Loan Facility)

SUPERVISORY AND REGULATORY INITIATIVES

According to the importance of a strong financial system, and the crucial role that credit institutions play in it, after the Global Financial Crisis (GFC), the Federal Reserve made stricter rules for banks so they will be able to sustain the flow of credit to the economy. This is the reason why banks have been able to face the COVID-19 pandemic with twice the capital and three times the liquid assets, compared to the GFC.

Even if the new rules saved the financial system, the cash demand by firms exceeded the available liquidity. As we have explained before, the Fed responded through liquidity injections, that led to an increase in loans for \$715 billions in less than three months and an increase in deposits equal to \$2.5 trillion through September 2020. From the point of view of the supervision, the Federal Reserve has played another important role, in fact, through a statement it encouraged banks to support the financial

³⁹ “Net Portfolio Holdings of TALF II”, “Net Portfolio Holdings of Corporate Credit Facility”, “Money Market Mutual Fund Liquidity Facility”, “Primary Dealer Credit Facility”, “Net Portfolio Holdings of Commercial Paper Funding Facility”, Fred, accessed January 9, 2022, <https://fred.stlouisfed.org/series/H41RESPPAATAL2HNWW> , <https://fred.stlouisfed.org/series/H41RESPPAAC2HNWW> , <https://fred.stlouisfed.org/series/H41RESPPAABNWW> , <https://fred.stlouisfed.org/series/H41RESPPALDHNWW> , <https://fred.stlouisfed.org/series/H41RESPPALDBXAWNWW> .

system lowering the interest rate for the conceded loans, that would help a lot the post pandemic recovery.

More concretely, it changed temporarily the rule about the supplementary leverage ratio. In particular, it would exclude deposits and U.S. Treasury securities from the calculation of the ratio. The measure increased the investments in Treasury securities and helped the flow of customer deposit.

The Federal Reserve has also allowed banks to mitigate the impact of expected credit losses, the reason is that doing so they could focus on lending money.

The Central Bank has also worked measures for the small banks such as easing the bank leverage ratio, regulatory reporting deadlines and appraisal requirements. These measures allowed the commercial banks to give a bigger help to small firms, in terms of money lending.

THE BoJ RESPONSE TO THE 2020 ECONOMIC CRISIS

Japan has been one of the countries hardest hit by the covid-19 economic crisis, according to the 2020 data, the GDP fell by the 4.6% that year. The country was also still recovering from the 2008 crisis, so the recent pandemic has only made worse an already complicated financial picture⁴⁰.

To face this difficult situation the Bank of Japan (BoJ) has responded through three different measures:

- Supporting Corporate Financing
- Stabilizing financial markets
- Active purchase of ETFs and J-REITs

SUPPORTING CORPORATE FINANCING

Supporting corporate financing is a powerful tool used by all the major central banks as shown in the previous paragraphs. The Bank of Japan has acted in the same way through one important measure: a program called “Special Program to Support Financing in Response to COVID-19”.

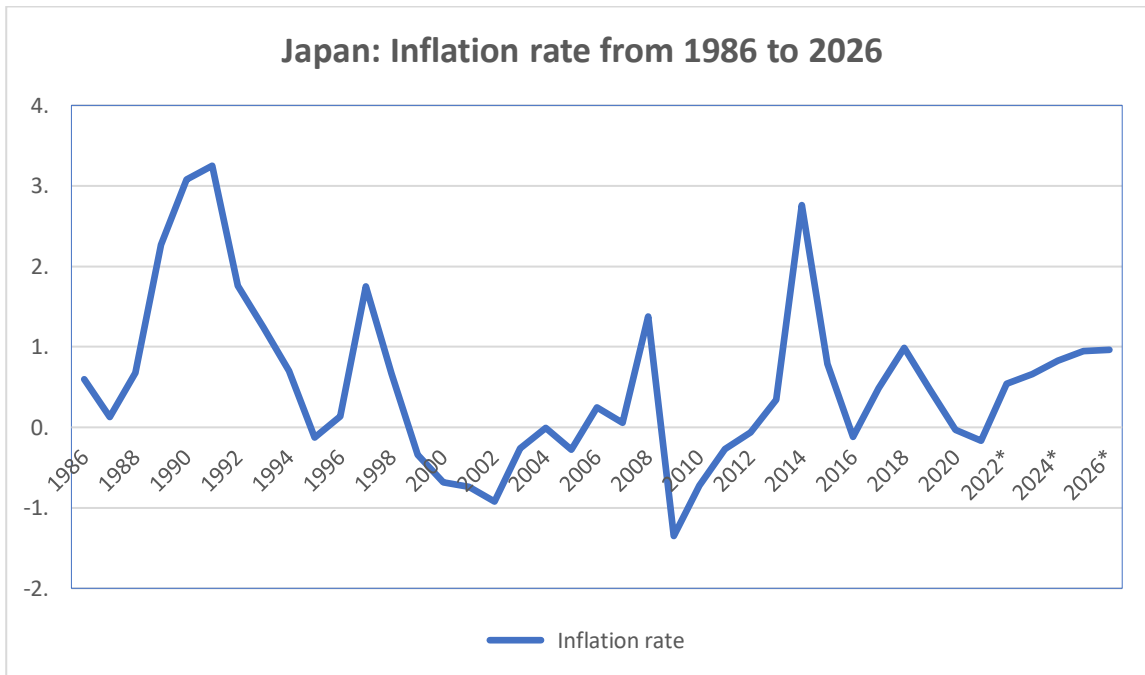
The Program was thought to support mainly small and medium firms and takes care of two important aspects: the purchase of commercial paper and corporate bonds for a maximum amount of 20 trillion yen and the creation of a 25 trillion-yen fund to support financing, called Special Funds-Supplying Operations

In the end, the program comprehended operations for 75 trillion yen, about 575 billion euros at the current rate of 130,39 yen per euro (January 15, 2022). A measure a lot smaller than the ones seen until now, which is unconventional according to the fact that the country struggles to increase the inflation rate and a bigger program would have been helpful from that point of view. The following graph explains the inflation problem, underlining that, even though the recent monetary policy measures have guaranteed liquidity injections, the prices didn’t change, or, in the worst scenario, they went down^{41,42}.

⁴⁰ “Japan’s economy and monetary policy”, Speech at a Meeting with Business Leaders in Osaka (via webcast), Kuroda Haruhiko, Governor of the Bank of Japan, Bank of Japan, September 23, 2020

⁴¹ “Introduction of a New Fund-Provisioning Measure to Support Financing Mainly of Small and Medium-Sized Firm”, Bank of Japan, May 22, 2020.

⁴² “Response to COVID-19 and Medium- to Long-Term Challenges for Japan’s Economy: With an Eye on the Post-COVID-19 Era”, Speech at the Meeting of Councilors of Nippon Keidanren (Japan Business Federation) in Tokyo, Kuroda Haruhiko, Governor of the Bank of Japan, Bank of Japan, December 24, 2020. “Monetary Policy during and after



SOURCE: Statista, Japan: inflation rate from 1986 to 2026, accessed January 15th, 2022⁴³, * stands for predictions.

As it's clear from the graph, the inflation rate has been under the 2% target since 2015. It has been varying between 0% and 1%, sometimes not even reaching a positive percentage which means that prices have been decreasing that year. This is what happened in 2020, when even though the monetary policy has flooded the financial markets with liquidity, the inflation rate went down by the 0,03%. The outlook for the future remains optimistic, but it still doesn't exceed the 1%. Should also be underlined that the data from 2021 to 2026 are just outlooks, so there are hopes for a larger future increase.

This is one of the reasons why the fund to support financing, which is the core of the program, have been increased to 110 trillion yen. In particular, each loan must be paid back within a year and the interest rate applied is 0%. The end of these measures has been delayed several times, right now they are supposed to be over in September 2022.

the COVID-19 Era”, Speech at the Yomiuri Economic Forum in Tokyo (via webcast), Amamiya Masayoshi, Deputy Governor of the Bank of Japan, March 8, 2021. “Statement on monetary policy”, Bank of Japan, December 17, 2021.

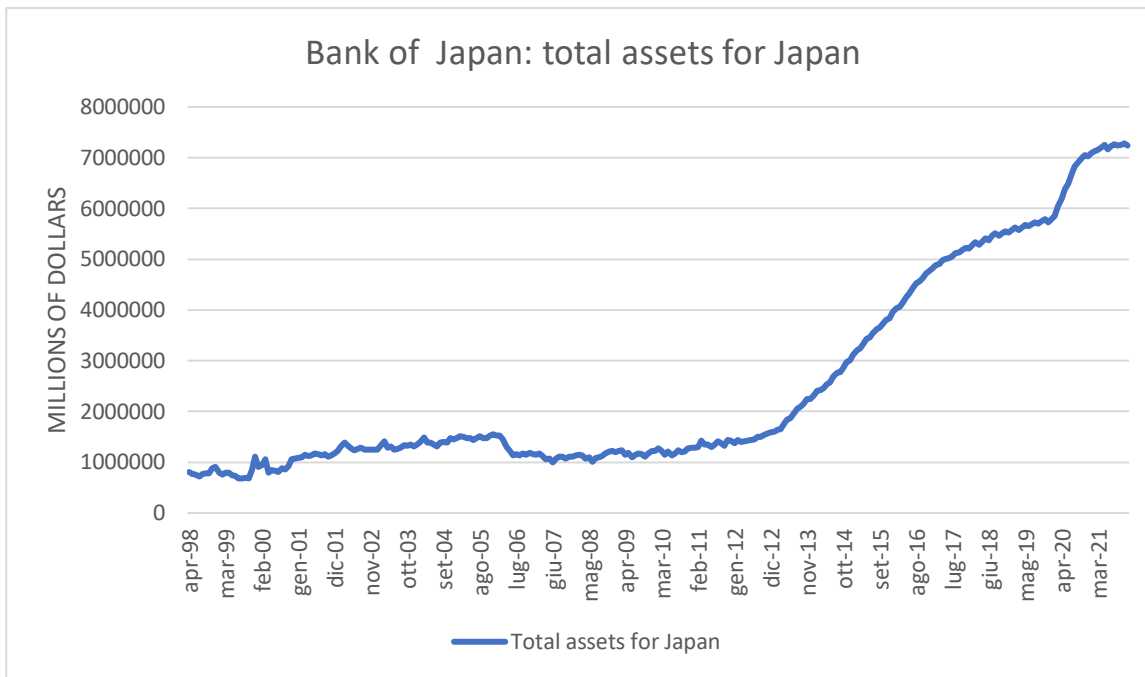
⁴³ Japan: inflation rate from 1986 to 2026, Statista, accessed January 15th, 2022, <https://www.statista.com/statistics/270095/inflation-rate-in-japan/>

STABILIZING FINANCIAL MARKETS

The Japanese financial market has been hardly affected by the covid-19 pandemic. In order to reach the stabilization of the financial markets, the Bank of Japan has used to different kinds of measures: the first measure was the purchase of Japanese Treasury securities (JGBs) and the purchase of T-bills, U.S. Treasury securities with one year maturity maximum. The second measure focused on collecting U.S. dollars and supplying the currency to the Japanese market to avoid lack of that currency.

The main goal of the monetary easing is to reach the price stability, taking the inflation rate to the 2% target. Actually, the BoJ has a long history linked to these kinds of measures. In 2013 the first monetary easing started and according to the data of the previous graph, it has been really helpful to fight against the low inflation rate, taking it from the 0.34% in 2013 to the 2.76% in 2014. The measure kept going on through the years and in 2016 the Central Bank decided to examine the effects. The results shown two things: the inflation target has only been reached in one case (2014), which led to a failure of the monetary policy for what regards its main aim, and the financial conditions improved for what regards corporate profits due to a depreciation of stocks and the adjustment in the excessive appreciation of yen. This last effect had a negative impact on banks' profits, insurance companies and pension funds.

The continues low inflation rate stuck an idea in people mindset: salaries and prices will not increase easily, that lowers the inflation expectations, and this is the reason why the country struggles so much from that point of view. The Central Bank's report admits, in the end, that it's going to take a long time before that mindset changes. To lower the negative effects of this policy, the BoJ introduced a new measure in September 2016: the "Quantitative and Qualitative monetary easing (QQE) with yield curve control", which allows the Bank of Japan to keep the interest rates at appropriate levels. That measure worked well, so was kept in order to fight against the 2020 pandemic. The following graph shows the scope of this program underlining the impact of the 2020 crisis on the assets purchase by the Central Bank.



Source: “Bank of Japan: total assets for Japan”, Fred, accessed January 16, 2022⁴⁴

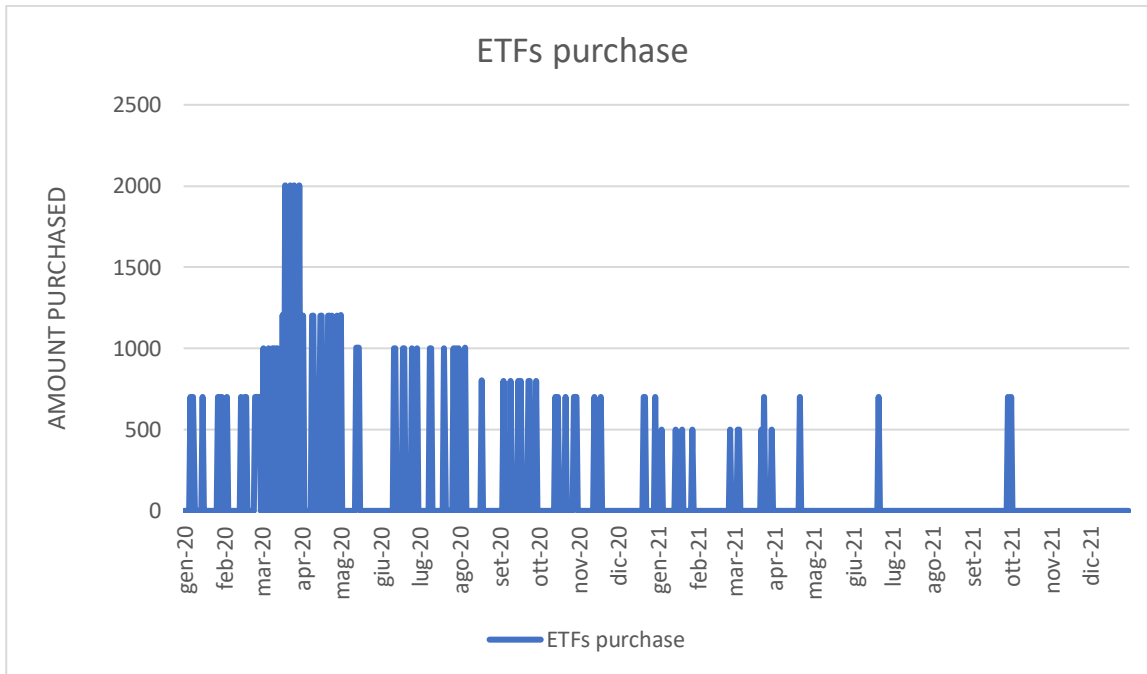
ACTIVE PURCHASE OF ETFs AND J-REITs

The recent monetary policy, as underlined before, can affect negatively credit institutions, and it did. This happens because of the low interest rates caused by the active purchase of Japanese Treasury bonds by the Central Bank. The uncertain situation for pension funds and banks increased the risk associated and so the risk premia of certain assets. In order to lower this last variable and to prevent the deterioration of households’ and firms’ sentiment caused by the volatility in asset markets, the BoJ decided to purchase Exchange Trade Fund (ETFs) and Japan Real Estate Investments Trusts (J-REITs).

The ETF purchase, in particular, has been affecting significantly the stock market, which touched the 30-years high in February 2021⁵. Compared to the 2020 data, it is understandable that the market has been going up by itself and so recovering from the pandemic drop, that’s why the Central Bank keeps lowering the ETF purchase. The following graphs explain how important the ETFs purchase has been

⁴⁴ “Bank of Japan: total assets for Japan”, Fred, accessed January 16th, 2022, <https://fred.stlouisfed.org/series/JPNASSETS>

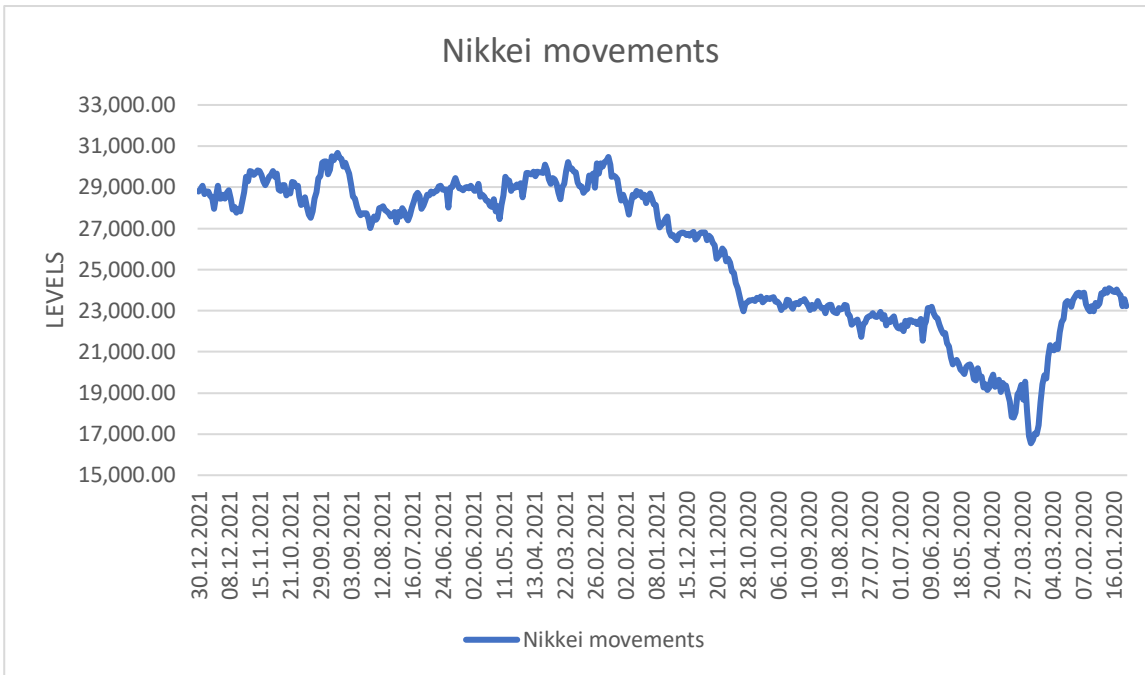
to sustain the market showing empirical evidence for the fact that now the market grows by itself without any help by the BoJ⁴⁵.



SOURCE: “Purchase on ETFs and J-REITs and Lending of ETFs”, Bank of Japan, accessed January 16, 2022⁴⁶

⁴⁵ “Bank of Japan seeks flexibility on \$55bn ETF target in bull market” Nikkei Asia, accessed January 16, 2022, <https://asia.nikkei.com/Business/Finance/Bank-of-Japan-seeks-flexibility-on-55bn-ETF-target-in-bull-market>

⁴⁶ “Purchase on ETFs and J-REITs and Lending of ETFs”, 2020 and 2021 data, Bank of Japan, accessed January 16, 2022, https://www3.boj.or.jp/market/en/menu_etf.htm



SOURCE: “Nikkei 225 dati storici”, Investing.com, accessed January 16, 2022⁴⁷

⁴⁷ “Nikkei 225 dati storici”, Investing.com, accessed January 16, 2022, <https://it.investing.com/indices/japan-ni225-historical-data>

THE PBC RESPONSE TO THE 2020 ECONOMIC CRISIS

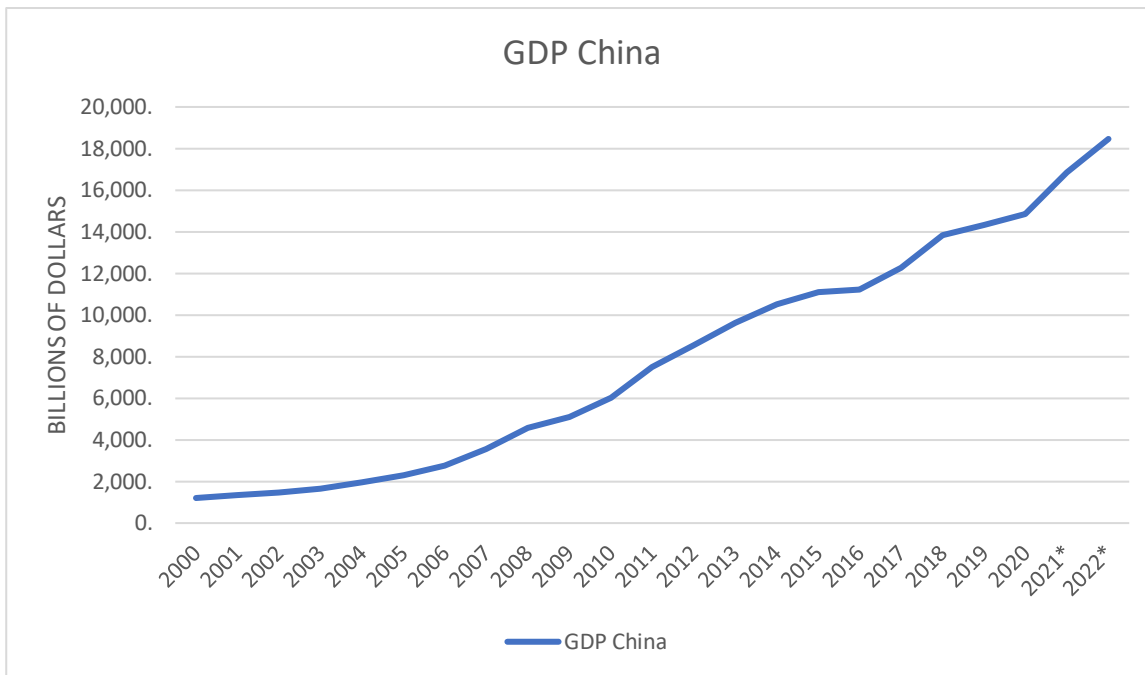
The Role of the People's Bank of China (PBC) is wider than the other central banks. It doesn't only focus on inflation but has several targets such as: the promotion of the economic growth, employment increase, and to guarantee financial stability. In order to reach those targets the PBC has a certain number of tools, increased in 2016 by the creation a corridor system similar to the European one. Since then, the Central Bank, added to its toolkit several options such as⁴⁸:

- Rate-DR007: which is the rate for 7-days repo operations. The rate is also used by commercial banks to lend money to each other.
- MLF rate: which is the rate for the medium-lending facilities. It provides funds for up to a year.
- SLF rate: which is the standing lending facilities rate and describes the ceiling for the corridor system. It allows credit institution to borrow liquidity from the Central Bank for a month.

The measures described until now are part of the Open Market Operations (OMO). Also, the PBC uses LPR (loan prime rate) which is the interest rate that usually the Central Banks charge on the customers with the higher interest rate, Excessive reserve rate which constitutes the bottom of the corridor system and the “liquidity management tools” such as PSL (pledged supplementary lending) and SLO (short term liquidity operations)₁. Last but not least, the PBC decides on the required reserve ratio (RRR).

China has been the first country to fight against the effects of the pandemic, as well as it was the first country affected by the economic recession. As understandable from the following graph, the Chinese response was effective and prompt, allowing the GDP to grow significantly even when the other countries were overwhelmed by the pandemic storm. The following 2021 and 2022 data are forecast.

⁴⁸ “China, monetary policy challenges in the post pandemic era”, Jinyue Dong / Le Xia, BBVA research, April 26th, 2021



SOURCE: “Gross domestic product (GDP) at current prices in China from 1985 to 2020 with forecasts until 2026”, Statista.com, accessed January 17, 2022⁴⁹, * stands for predictions.

The PBC’s response to the Covid-19 crisis was more complexed than the other central banks. The reason is that the Chinese Central Bank has many more targets compared to the other countries, so it is appropriate in this work to focus on the measures that affected mainly inflation and financial stability of the country, like it has been done for the economic systems described until now.

Mainly, the PBC has used four types of operations to fight against the effects of the pandemic:

- Required Reserve Ratio changes.
- Central Bank Bill Swap (CBS) operations.
- Facility operations: which comprehend MLF and SLF operations.
- TMLF operations.

⁴⁹ “Gross domestic product (GDP) at current prices in China from 1985 to 2020 with forecasts until 2026”, Statista.com, accessed January 17, 2022, <https://www.statista.com/statistics/263770/gross-domestic-product-gdp-of-china/>

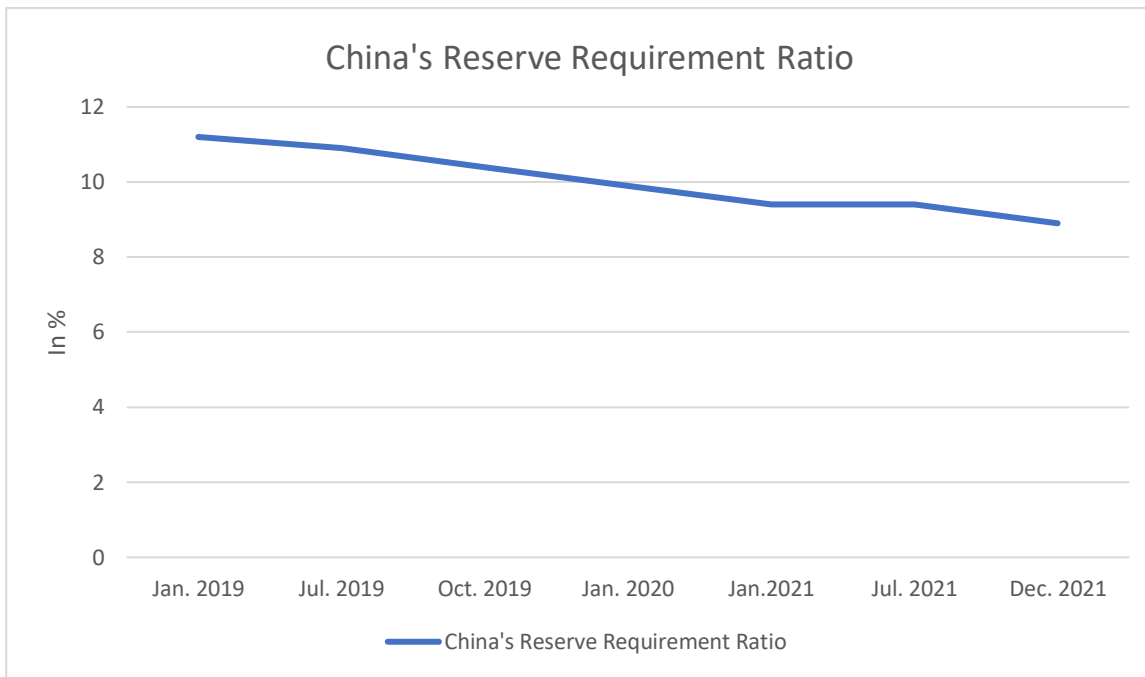
REQUIRED RESERVE RATIO CHANGES

The Required Reserve Ratio (RRR) changes have been one of the most powerful tools used by the PBC. They allowed the Chinese commercial banks to release great amounts of liquidity that would have remained unused otherwise. In order to support the economic recovery, the PBC has cut the interest rate on excess reserves and lowered the RRR three times. The aim of these measures was to increase the liquidity available by the commercial banks and, to make sure that they lend money to firms and households to support the economy, they also lowered the interest rate on excess reserves. The first round of RRR cuts was applied in January 2020, when it was reduced by 50 basis point. That operation released over 800 billion RMB (about 110 billion euros). In March 2020, banks with certain criteria, were allowed to cut the RRR for an amount equal to the 0.5% or 1.5%. The joint-stock commercial banks that received a 0.5% cut were not so unlucky according to the fact that they have been able to benefit of an additional 1% decrease. This time the measure release more than 550 billion RMB.

The third cut, which specifically happened between April 15 and May 15, advantaged the rural commercial banks. They have been able to benefit of an additional 1% cut, which released more than 400 billion RMB.

In 2020, these measures increased the liquidity available for commercial banks by 1.75 trillion of long-term funds.

As anticipated, in order to maximize the amount of money available for lending to people and households, in 2020, the interest rate on excess reserves, which represents the interest rate corresponded for depositing liquidity to the Central Bank, was lowered from 0.72% to 0.35%.



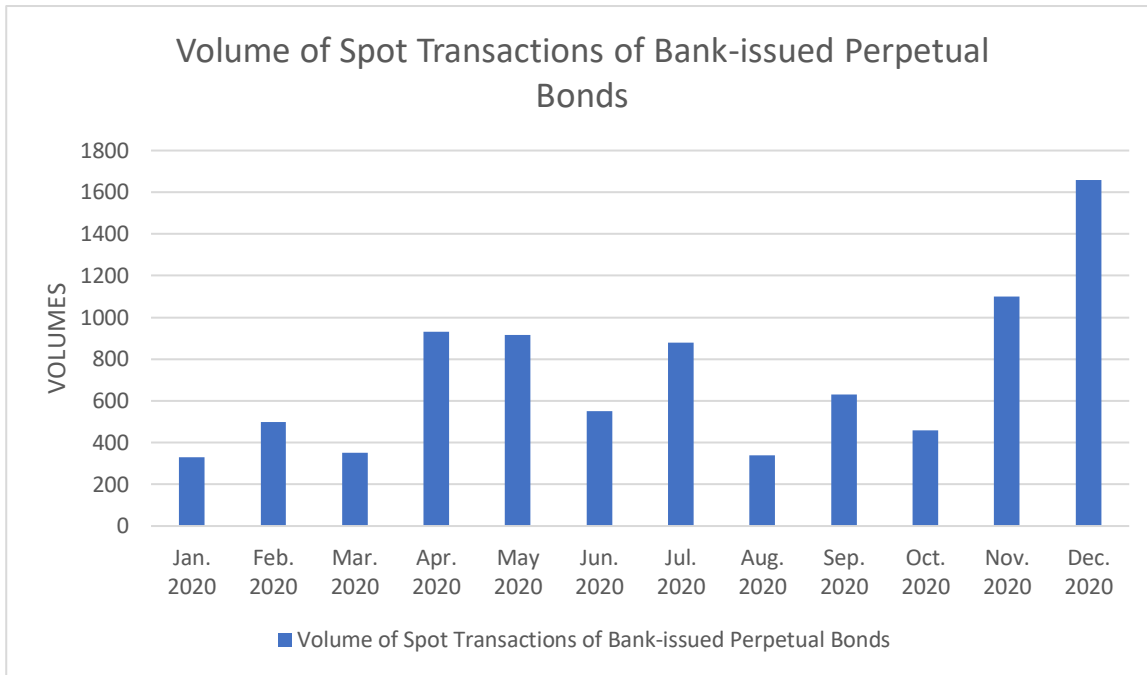
SOURCE: “China reserve requirement ratio”, Ceicdata.com, accessed January 18, 2022⁵⁰

CENTRAL BANK BILL SWAP OPERATIONS

The CBS operations are a tool used by the PBC to increase the money supply on the Chinese market. The main difference with the quantitative easing is the “bill swap”: the Central Bank bills are swapped with perpetual bonds. This process doesn’t allow the money supply to grow right away but it increases slowly instead. The Bill Swap operations have been fundamental for the liquidity injections on the market, especially for the small and medium firms as emerges from the “China monetary policy report” about the Q4, 2020. During 2020, the PBC has used this measure once per month, each month, for a total amount of 61 billion RMB. The same report underlines that in Q4, the Central Bank has conducted three operations for 15 billion RMB. To understand the importance of the measure, the following graph shows⁵¹

⁵⁰ “China reserve requirement ratio”, Ceicdata.com, accessed January 18, 2022, <https://www.ceicdata.com/en/indicator/china/reserve-requirement-ratio>

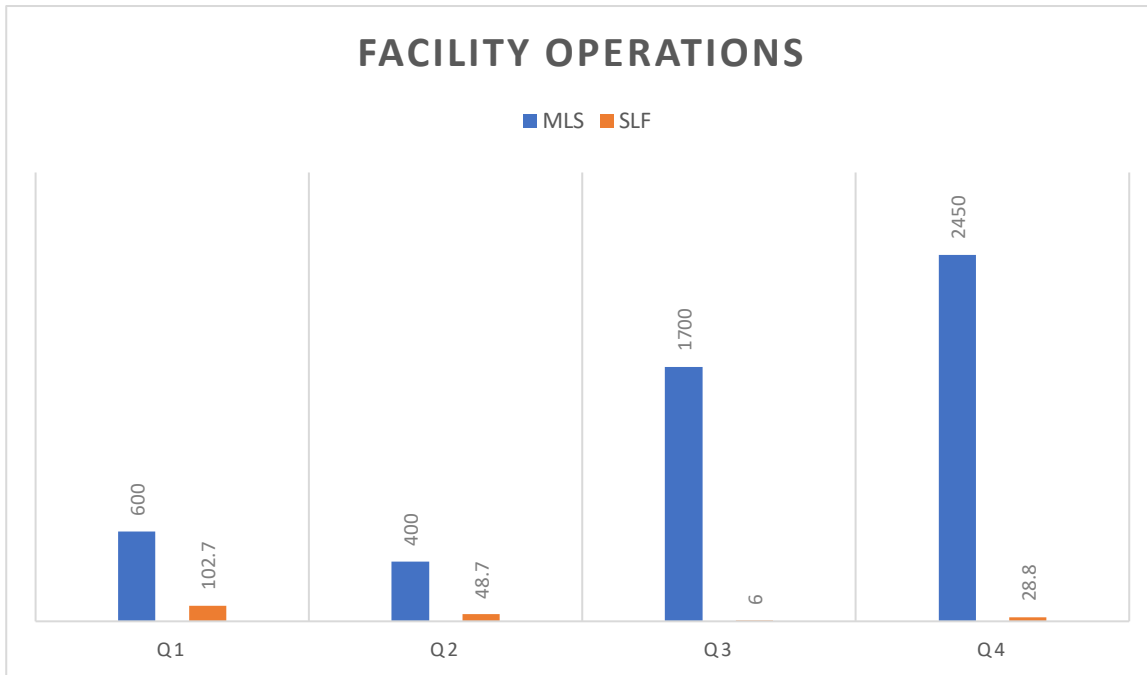
⁵¹ “China’s Central Bank bill swap different from QE”, Ceibs, accessed January 18, 2022, <https://www.ceibs.edu/new-papers-columns/china%E2%80%99s-central-bank-bill-swap-different-qe>



SOURCE: “China monetary policy report”, accessed January 18, 2022

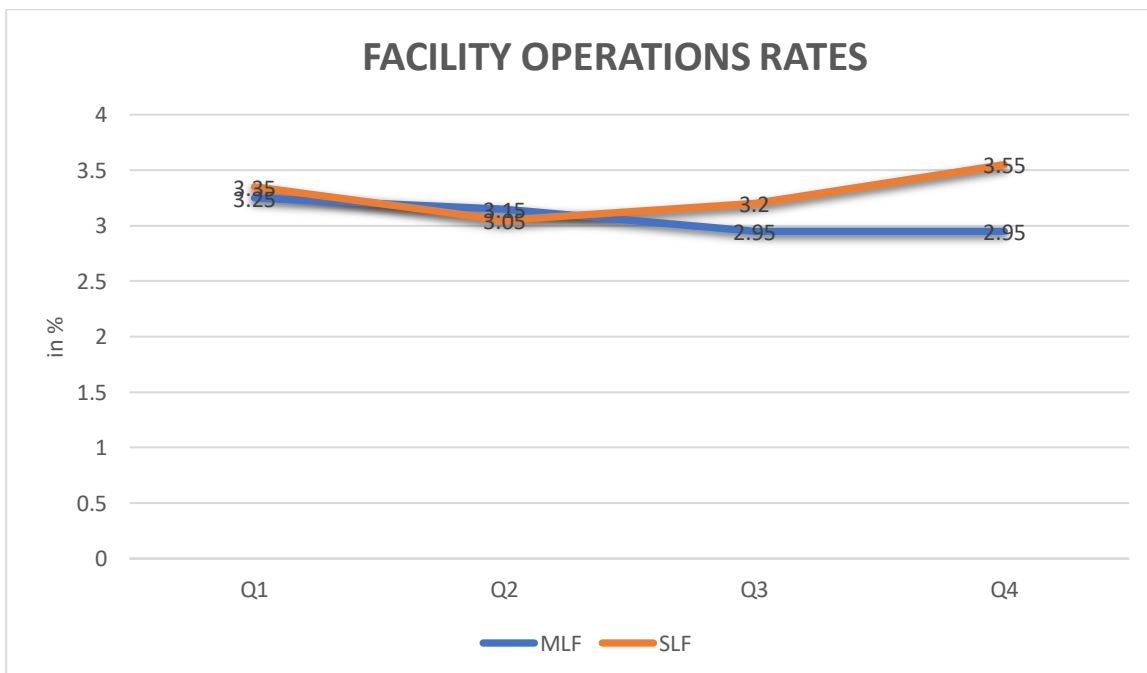
FACILITY OPERATIONS

The facility operations are the main part of the PBC response to the covid pandemic in terms of importance and scope. They are divided in two groups: medium-lending facilities (MLS) and standing lending facilities (SLF). Between the two, the bigger tool is the MLS which worth almost 28 times more than the other. In 2020, have been conducted MLS operations for 5.15 trillion RMB and SLF operations for 186.2 billion RMB. All the MLS operations had maturity one year. The following graph describes the measures in quantitative terms.



SOURCE: “China monetary policy report”, Monetary Policy Analysis Group of the People's Bank of China, February 8, 2021, accessed January 18, 2022, , MLF (medium-lending facilities), SLF (standing lending facilities)

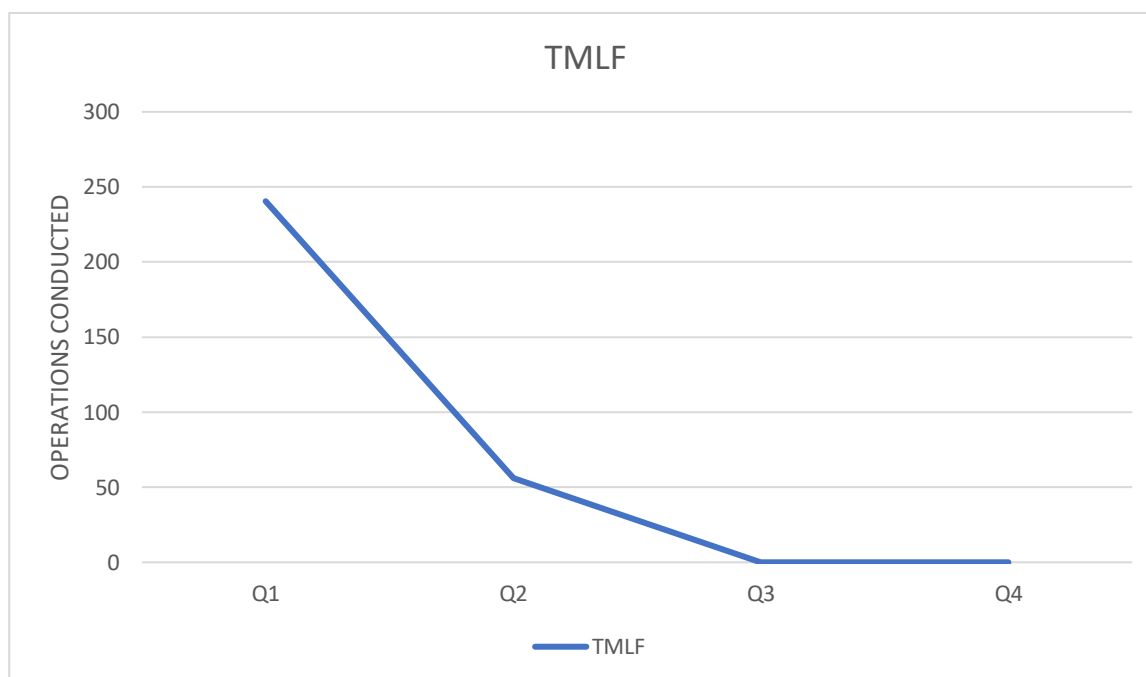
It should be underlined also that the MLS rate has been decreasing for the entire first half of 2020 and then it stabilized at 2.95%, while the SLF suffered a cut for 30 basis points in Q1 and then it went up reaching 3.55%. The following graph shows the rate variations.



SOURCE: “China monetary policy report”, Monetary Policy Analysis Group of the People's Bank of China, February 8, 2021, accessed January 18, 2022, MLF (medium-lending facilities), SLF (standing lending facilities)

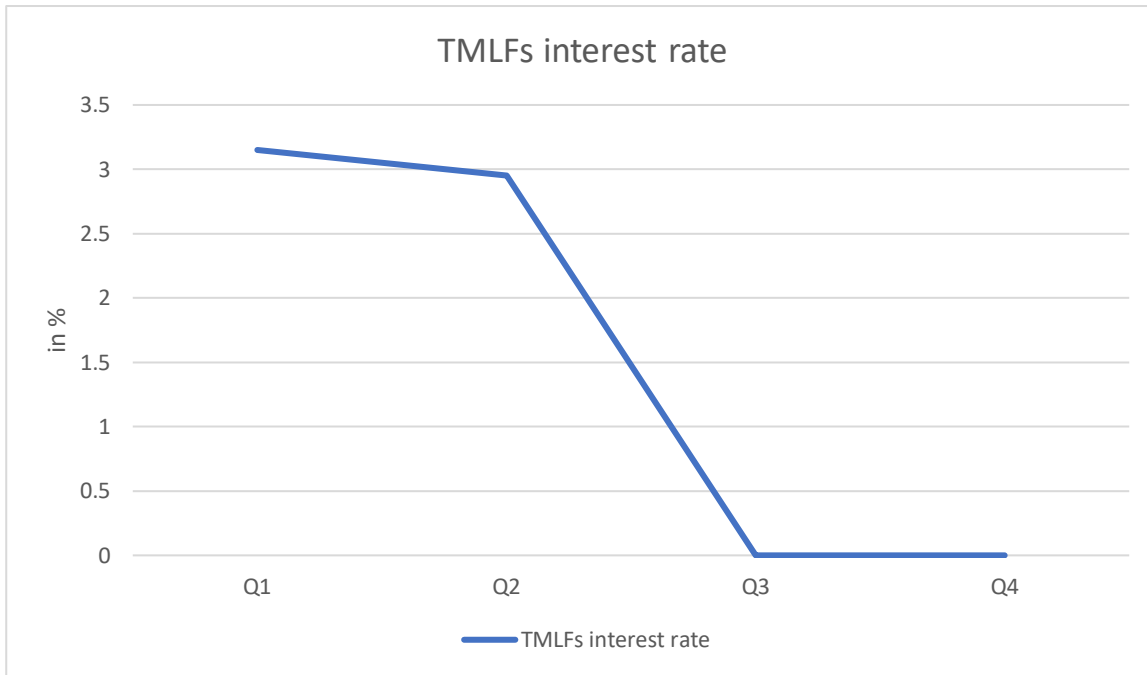
TMLF OPERATIONS

The Targeted Medium-term Lending Facility (TMLF) operations are a powerful tool developed by the PBC in the end of 2018 and introduced in January 2019. It is used to address liquidity to the industries that are having a temporary crisis. In 2020 it has been fundamental to ensure funding resources for financial institutions in order to provide liquidity for the small and medium firms. The following graphs describe the scope of the measure and the interest rate variations associated.



SOURCE: “China monetary policy report”, Monetary Policy Analysis Group of the People's Bank of China, February 8, 2021, accessed January 18, 2022, TMLF (Targeted Medium-term Lending Facility)

In Q3 the TMLFs operations that should have been conducted, have been converted to MLFs. In Q4, instead, the Central Bank decided to not conduct any TMLF operation.



SOURCE: “China monetary policy report”, Monetary Policy Analysis Group of the People's Bank of China, February 8, 2021, accessed January 18, 2022

In Q3 and Q4 the interest rate on TMLF operations is 0 for the same reason explained before. In 2020, the total amount used for this kind of operations was 296.6 billion RMB⁵².

⁵² “China monetary policy report”, Monetary Policy Analysis Group of the People's Bank of China, February 8, 2021, accessed January 18, 2022

3. TRANSMISSION MECHANISM OF MONETARY POLICY: THE COVID-19 PANDEMIC IMPACT

INTRDUCTION AND BASELINE STUDY PAPER

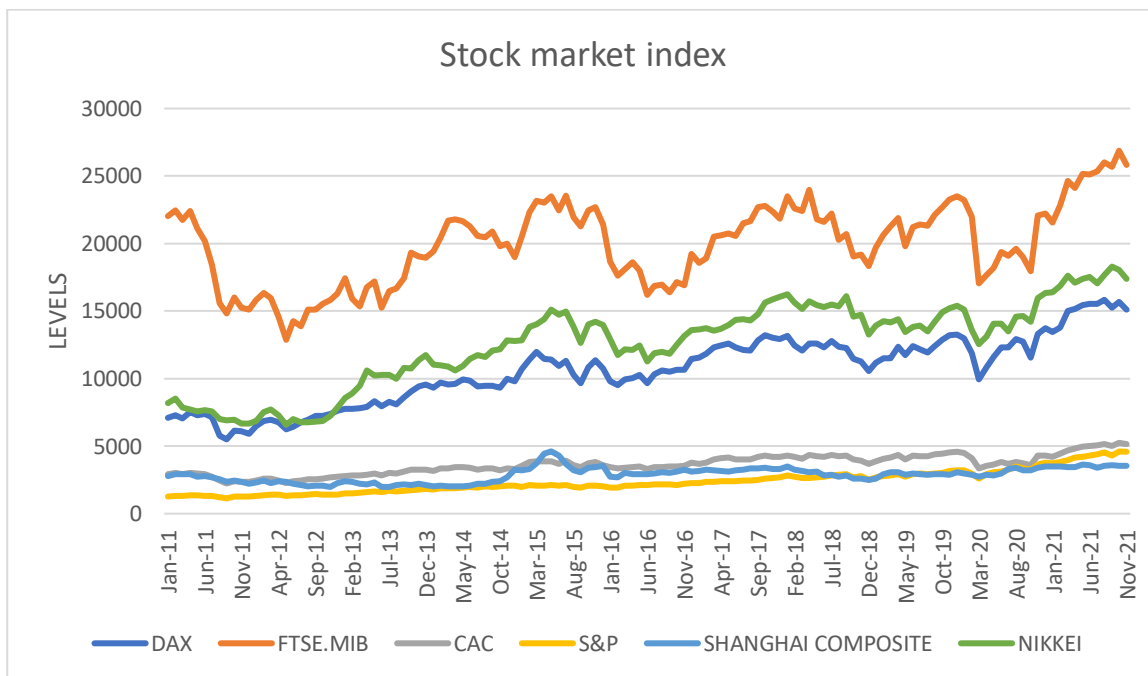
The transmission mechanism of monetary policy is defined as the process that leads a monetary policy decision to its final effects (Treccani). This definition can appear too generic, so, to be more specific, we can explain the mechanism with a practical example: let's pretend that the Central Bank of a certain country significantly increases the money supply, that choice is going to have effects on the people's everyday lives. In the considered case, we can assume that, according to the *quantity theory of money*, the prices are going to increase, affecting the purchase power of the consumers. This example explains (or better simplifies) the definition expressed by Treccani. The whole point of this work is focused on the described mechanism, in particular, we want to study the impact of Covid-19 on financial markets. Doing so we show evidence that the transmission mechanism of monetary policy became weaker with the pandemic, meaning that, the monetary policy decisions affect the people's lives less than the pre-pandemic period. Our idea has been previously object of study by Xiaoyun Wei and Liyan Han, respectively from the Department of Financial Mathematics, School of Statistics, Capital University of Economics and Business, Beijing, P.R.China and the Department of Finance, School of Economics and Management, Beihang University, Beijing, P.R.China. In a paper called "the impact of the COVID-19 pandemic on transmission of monetary policy to financial markets", they have demonstrated that, on a sample of 37 countries that have been heavily affected by the pandemic, the mechanism effects became weaker after the covid-19 spread. They considered a 10-year sample period, from January 1st, 2011, to April 30th, 2020, and distinguished the conventional and unconventional monetary policy measures, showing that the unconventional ones have been more effective, but still their effects are not the same as the pre-pandemic period. The difference with our study is that we consider six main economies (Italy, Germany, France, China, Japan, and the United States) for a longer period (from January 1st, 2011, to November 30th, 2021). Another main difference regards the frequency of the collected data: while the referring paper used the daily changes in the variables, we considered the monthly ones for the stock market and the monthly general data for all the other variables. These are surely important changes, but what really distinguishes our work from the baseline study paper are the collected data and the regression equations' structure. First because they consider the monetary policy rates and the unconventional

monetary policy announcements, which have been substituted in our work by unconventional monetary policy months and gold price (as an indicator of uncertain times), and second because they consider as dependent variable (y): the 10 years bond yields, the stock index returns, the changes in exchange rates and the 5 years CDS spreads. In order to build a more understandable and clear work we decided to focus on the 10 years bond yields as a dependent variable, studying its correlation with all the others shown in the next paragraph. In particular, it is important to underline the correlation between the monetary policy tools (conventional and unconventional) and the 10 years bond yields, which is the one that leads us to some very strong assumptions. Compared to the baseline study paper, we use a different approach, but we succeed to reach the same goal, showing that the transmission mechanism of monetary policy became weaker with the COVID-19 pandemic.

CONSIDERED VARIABLES AND SOURCES

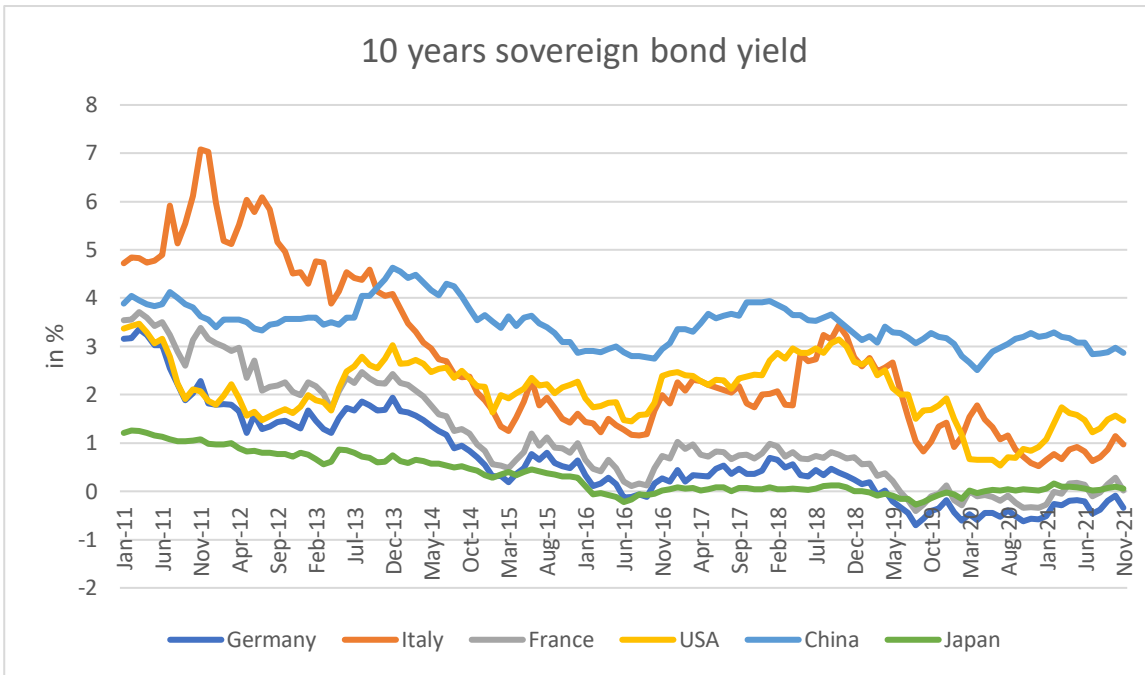
The main considered variables are five plus two dummy variables created in order to show empirical evidence of what we want to demonstrate. The five main variables are:

1. Stock market index (monthly changes): we have collected the monthly data of the main stock market index for the considered countries. Then we have calculated the percentual variation compared to the previous month. The considered indexes are: FTSE.MIB (Italy), DAX (Germany), CAC (France), S&P500 (USA), SSE COMPOSITE (China), NIKKEI (Japan).



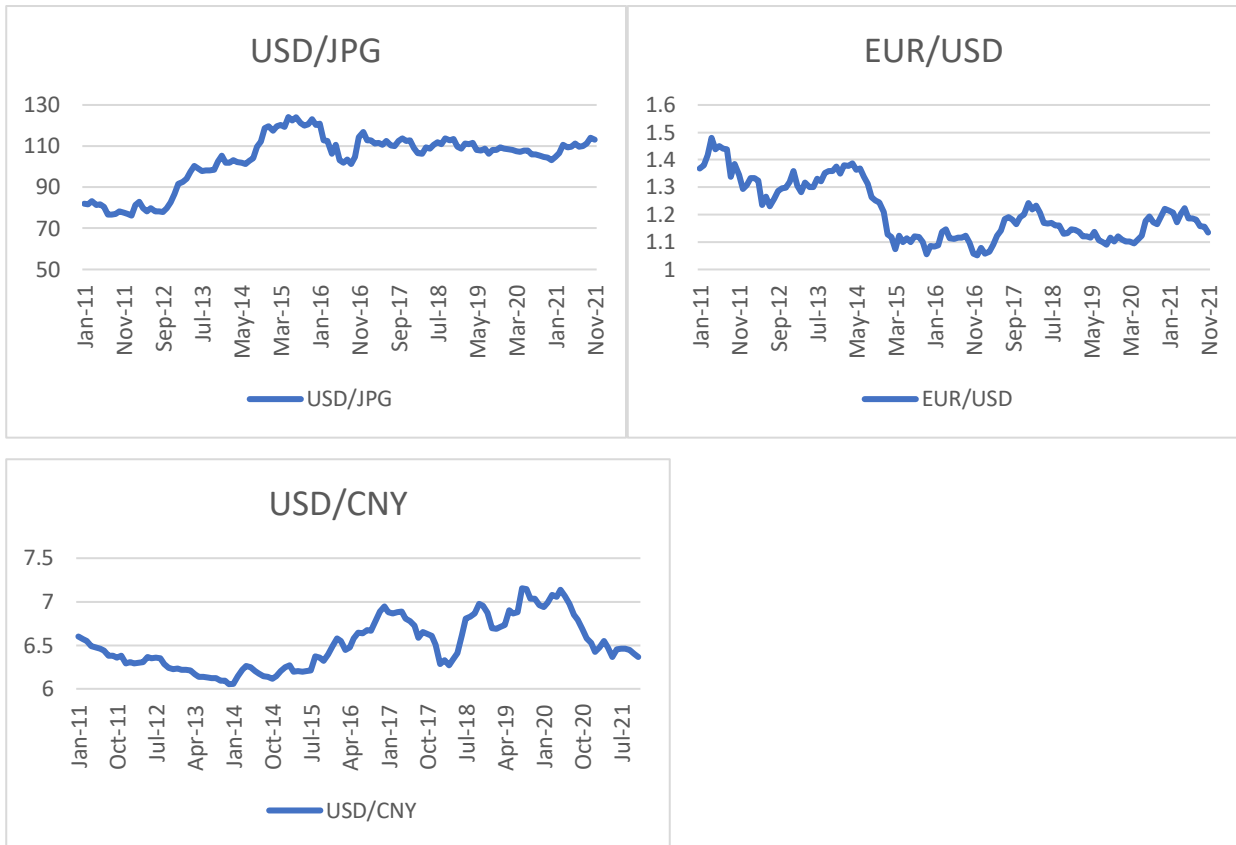
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2. 10 years sovereign bond yield: we have collected the monthly data of the main economies bond yield for the considered period. The most common sovereign bond is the 10 years one, that justifies the chosen maturity.



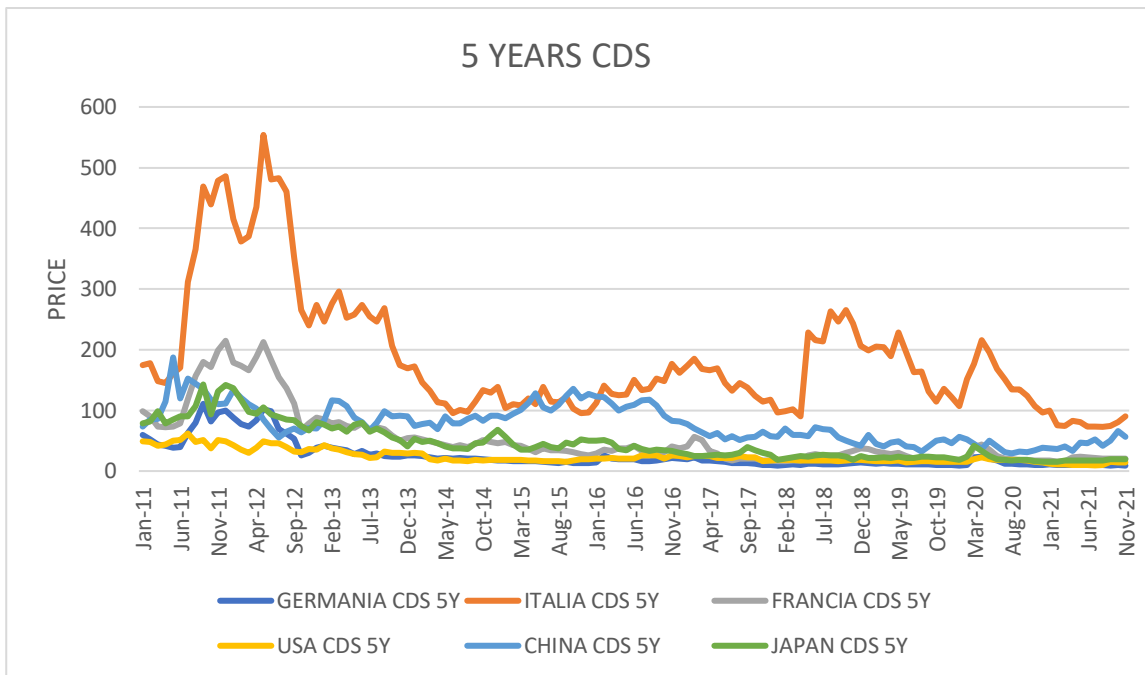
Processed by the author, data from Refinitiv Eikon Datastream

3. Exchange rates: we have collected the monthly data of the main currencies exchange rates for the considered period. The considered exchange rates are: USD/EUR, USD/CNY and USD/JPG.



Processed by the author, data from Refinitiv Eikon Datastream

4. 5 years CDS: we have collected the monthly data of the sovereign credit default swap prices for the considered countries. In particular, we considered the 5 years CDS due to the fact that the information about this last financial tool is not too easy to find, and the most accessible data regards the five years ones.



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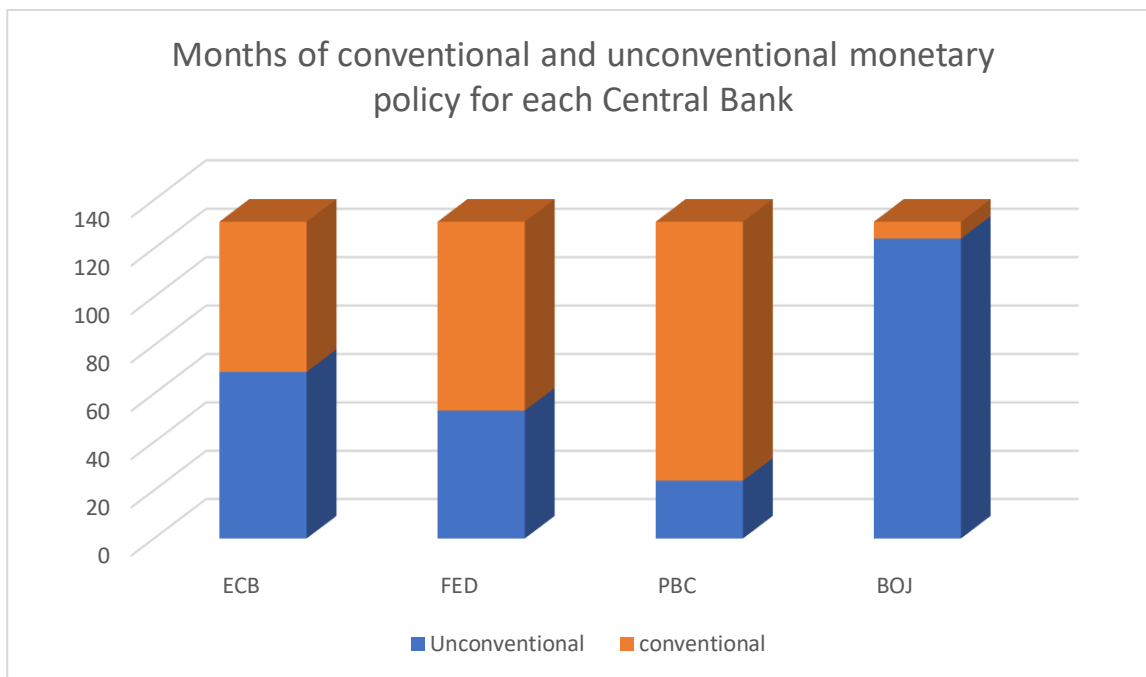
5. Gold price: we have collected the monthly data for the gold price in order to provide a more precise study compared to the baseline one. What we thought is that, it is commonly know that during uncertain times, the gold price goes up, because it is seen by investors as a safe heaven. Including it in our work would help shaping the uncertain times and better separating them from the safer ones. The correlation between gold price and uncertain times is shown by Jamal Bouoiyour, Refk Selemi and Mark E. Whoar in a paper called “Measuring the response of gold prices to uncertainty: an analysis beyond the mean”. The study shows that, diversifying the portfolio with a consistent amount of gold could help protecting by times when the financial markets get riskier.



Processed by the author, data from Refinitiv Eikon Datastream

What we have shown until now regards only the main variables, the data have been simply downloaded or elaborated in order to provide the strongest possible evidence. To reach this last aim we had to add two dummy variables created through the information obtained in chapters one and two. The variables made up are:

1. “ u_t ”: it is a dummy variable used to distinguish the periods when the unconventional monetary policy measures were or were not used. It assumes the value of 1 when the Central Bank has adopted unconventional monetary policy measures and 0 otherwise.



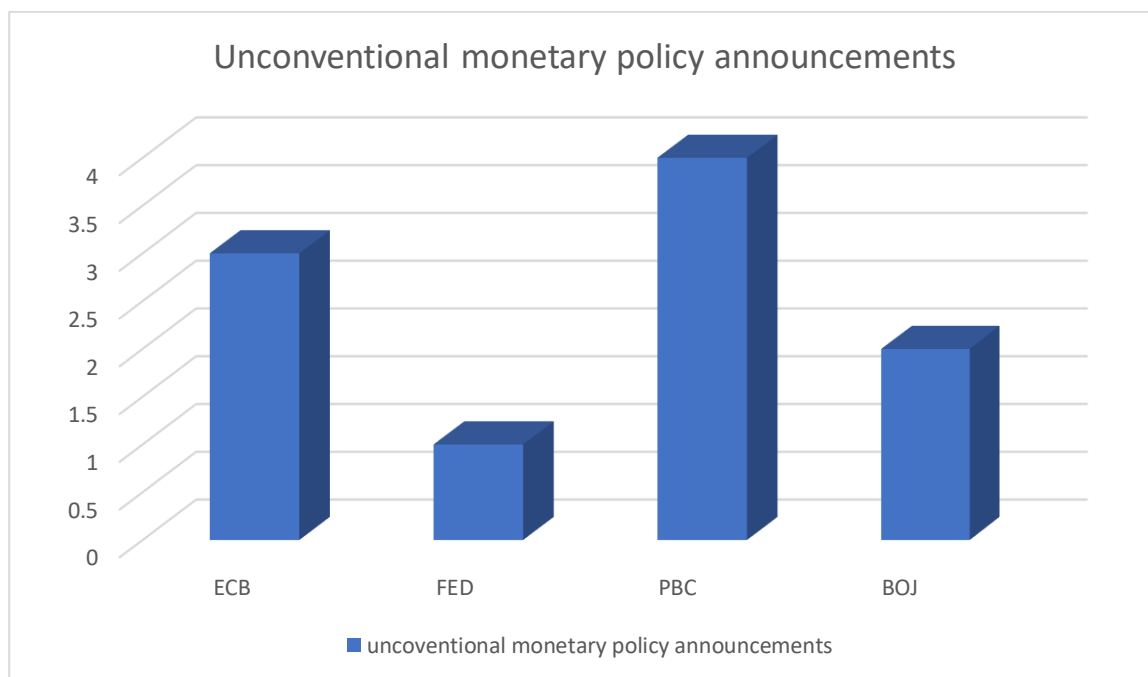
Processed by the author, data from Refinitiv Eikon Datastream

As we can see from the graph, the Central Banks have overused the unconventional monetary policy tools in the considered period, and we are going to show that, this choice has been less and less efficient. It should be also underlined that the Bank of Japan has chosen to keep increasing the money supply indefinitely. The reason behind a so brave decision is that no matter how much liquidity the Central Bank tried to inject in the system, the inflation rates kept remaining low, sometimes even decreasing, so since October 2010, the BoJ has started a more expansive monetary policy. This led to a constant increase in money supply through asset purchase programs which have been increased through the years until reaching the amount of 80 trillion Yen per year.

The Federal Reserve and the PBC have summarily kept an ordinary monetary policy until December 2020 and March 2020, respectively. The only exceptions have been made by the Fed from November 2010 to the second quarter of 2011 and from September 2012 to October 2014. These exceptions have been useful to face the effects of the of the Global Financial Crisis. The PBC, instead, did not need to use too many unconventional monetary policy measures, due to the economic boom that the country is living these years. The only time they needed that kind of choice was in December 2019. The decision was taken in order to sustain the growth even though the country was the first to suffer the lockdown measures and it had great effects on the economy, allowing the GDP to grow around the 2.2% in 2020 (a year that is certainly not known for the economic growth). The ECB has been using the quantitative easing to find against the Global financial Crisis and the Sovereign Debts Crisis until December 2018 through the Quantitative Easing (QE), which basically allowed the Central Bank

to buy bonds from the countries in the Euro area. The measure has been weakened through the years though.

2. “ w_t ”: it is a dummy variable that represents how many times, during the pandemic period, the central bank has announced monetary policy decisions to face the Covid-19 economic crisis. In particular, it assumes the value of 1 in the months when the Central Bank has announced unconventional monetary policy decision and 0 otherwise.



Processed by the author, data from Refinitiv Eikon Datastream

In this case we need to underline that, not all the announcements were the same, for example the Chinese announcements regarded measures relatively less “brave” than the European and the American ones, furthermore the FED has announced only one set of measures which is as brave as the European ones, or even more. All these information have been previously explained in chapter 1 and 2, but it is appropriate to quickly sum them up.

The ECB has announced measures three times: in March 2020, with the PEPP announcement, in June 2020, with the first increase in the PEPP budget and in December 2020, with the second budget increase. As explained in the second chapter, the Federal Reserve faced the pandemic mainly lowering the interest rates on loans to commercial banks. The measure was announced in March 2020. The same path was not followed by the Japanese central Bank, which responded through the “Special Funds-Supplying Operations to Facilitate Financing in Response to the Novel Coronavirus” in March 2020. The budget was increased in April 2020, that is the reason why the w value is 1 on that month

too. The PBC response, instead, has been focusing on the facility operations and the lowering of reserve ratios in commercial banks so that they could lend the largest amount of liquidity possible. Respectively the first measure has been announced in December 2019, and the second in March 2020. The Central Bank kept lowering the reserve ratio for two consecutive months: April and May. The simplicity of these data does not require statistical analysis.

Last but not least, we should spend some words for the sources of these information. The the information to build the dummy variables have the same sources of chapters 1 and 2, in fact, we based their structure on these chapters. All the other variables are downloaded from Refinitiv (Eikon DataStream).

DESCRIPTIVE STATISTICS

In order to process the best analysis, it would be appropriate to analyze the considered data through the main statistic indexes. They allow us to give a better explanation of the data and their variations in the pre-pandemic and pandemic period and allow the reader to gain a wider comprehension of the differences in the financial markets from country to country. The following table shows the analysis:

STATISTIC INDEXES ANALYSIS

	MIN	MAX	AVERAGE	DEV. STAND.	KURTOSIS	SYMMETRY
10y Bond Germany	-0,703	3,358	0,67365267	0,96206708	0,11856465	0,79884458
10y Bond Italy	0,521	7,079	2,70208397	1,65557324	-0,4927695	0,76773471
10y Bond France	-0,409	3,711	1,13016031	1,11312478	-0,6075248	0,69286715
10y Bond USA	0,533	3,47	2,07745802	0,64760863	-0,162162	-0,2724503
10y Bond China	2,51	4,63	3,46024427	0,44414255	-0,2380503	0,35659938
10y Bond Japan	-0,275	1,259	0,3278626	0,40681502	-0,772361	0,69336026
DAX %	-19,19%	0,15010453	0,00749643	0,05089762	1,9690569	-0,5301177
FTSE.MIB %	-22,44%	0,22949589	0,0034787	0,06036104	2,12743522	-0,2439375
CAC %	-18,33%	19,95%	0,00579448	0,04593895	3,36373329	-0,1965115
S&P 500 %	-12,51%	0,1268441	0,0107909	0,03863012	1,56863351	-0,3632471
SSE COMPOSITE %	-22,65%	0,20569385	0,00375148	0,05885801	2,83786629	0,09847472
NIKKEI %	-10,13%	0,12274924	0,00711055	0,04651227	0,27879643	-0,2344279
USD/EUR	1,0513	1,4799	1,21026031	0,10808426	-0,8111757	0,58003645
USD/CNY	6,0537	7,1543	6,50991145	0,29417203	-0,9012381	0,44944264
USD/JPY	76,19	124,11	103,753511	12,9798452	-0,2149163	-0,8814308
GERMANY CDS 5Y	8,99	110,83	25,7890534	23,1675747	3,63826082	2,09055056
ITALY CDS 5Y	72,84	553,89	186,373221	105,803128	2,071402	1,5984856
FRANCE CDS 5Y	15,56	214,71	53,0445802	47,2651668	3,13528903	1,96864517
USA CDS 5Y	9,34	61,926	23,9614046	11,1385583	0,91803585	1,29757952
CHINA 5Y CDS	29,11	187,24	77,2727557	31,2536629	-0,0196626	0,60404335
JAPAN CDS 5Y	15,5	142,7	46,0850458	29,9044528	1,17647817	1,29878542
Gold price	1.060,9100	1974,69	1433,43618	236,079384	-0,9599871	0,54707402

Processed by the author, data from Refinitiv Eikon Datastream

DESCRIPTIVE STATISTICS: CROSS-CORRELATIONS

At this point it would be useful to analyze the cross-correlations between the main variables considered. In order to do that, we thought it would be appropriate to create two different tables: the first one focuses on the pre-covid period and the second one focuses on the covid times. Without being too specific, we can provide two general tables for the main considered variables.

PRE-PANDEMIC PERIOD CROSS CORRELATIONS

	10y sovereign bond yield	Stock market index	Exchange rate	5y CDS
10y sovereign bond yield	1,00			
Stock market index	-0,04	1,00		
Exchange rate	-0,06	0,02	1,00	
5y CDS	0,63	0,00	-0,33	1,00

Processed by the author, data from Refinitiv Eikon Datastream

This first table describes the general correlation (between the considered countries) of the used variable in the pre-pandemic period. In this case, we can observe a negative correlation between the bond yields and the stock market which perfectly makes sense because, during an economic recovery, for example, the sovereign bonds become less risky, meaning a lower yield, and the stock prices increase. We can also see that the exchange rate has a summarily negative correlation with all the other variables, except for the stock market. In the end, the 5 years CDSs present a positive correlation with the 10 years sovereign bond yields and the stock market indexes. The first correlation is understandable for the own definition of CDS, so when their price goes up, it means that the sovereign bonds are riskier, and the yields increase too. The second correlation instead, does not make too much sense, because we can observe that when the stock markets went up, between 2011 and 2020, the countries, who should have become less risky in order to support the stocks growth, were actually getting riskier as the CDS price increase shows. Luckily, even if the correlation is positive, it is not strong enough to make these kinds of assumptions. Now it is important to analyze how these correlations changed with the pandemic, so between January 2020 and November 2021.

PANDEMIC PERIOD CROSS CORRELATIONS

	10y sovereign bond yield	Stock market index	Exchange rate	5y CDS
10y sovereign bond yield	1,00			
Stock market index	-0,03	1,00		
Exchange rate	-0,12	0,05	1,00	
5y CDS	0,29	-0,02	-0,35	1,00

Processed by the author, data from Refinitiv Eikon Datastream

During the pandemic, the correlation between the 10 years bond yields and the stock markets indexes remained negative. The same thing happened with the exchange rates correlations with all the other variables, except for the stock market which correlation with, not only remained positive but got even stronger. The only correlations that became weaker, overall, are the ones between the CDSs prices and the 10 years bond yields and between the stock market indexes and the CDSs prices, which turned upside-down becoming slightly negative. The first one, in particular, has lowered from 0.63 to 0.29.

Building a deeper analysis, we can extend the tables without compressing the data. In this case the work should look like that:

PRE-PANDEMIC PERIOD CROSS CORRELATIONS

Processed by the author, data from Refinitiv Eikon Datastream

	10y Bond Germany	10y Bond Italy	10y Bond France	10y Bond USA	10y Bond China	10y Bond Japan	DAX	FTSEMIB	CAC	S&P 500	SSE COMPOSITE	NIKEI	USD/EUR	USD/CNY	USD/JPY	GERMANY CDS 5Y	ITALIA CDS 5Y	FRANCE CDS 5Y	USA CDS 5Y	CHINA 5Y CDS	JAPAN CDS 5Y	Gold price		
10y Bond Germany	1.00																							
10y Bond Italy	0.82	1.00																						
10y Bond France	0.98	0.90	1.00																					
10y Bond USA	0.42	0.13	0.30	1.00																				
10y Bond China	0.62	0.42	0.56	0.57	1.00																			
10y Bond Japan	0.95	0.86	0.96	0.22	0.55	1.00																		
DAX	-0.80	-0.85	-0.86	0.10	-0.25	-0.87	1.00																	
FTSEMIB	-0.31	-0.64	-0.44	0.42	0.14	-0.40	0.74	1.00																
CAC	-0.75	-0.81	-0.82	0.18	-0.22	-0.83	0.98	0.79	1.00															
S&P 500	-0.83	-0.76	-0.86	0.06	-0.31	-0.89	0.94	0.63	0.96	1.00														
SSE COMPOSITE	-0.48	-0.64	-0.54	0.00	-0.37	-0.50	0.63	0.61	0.61	0.48	1.00													
NIKEI	-0.77	-0.85	-0.84	0.16	-0.23	-0.84	0.97	0.73	0.95	0.91	0.65	1.00												
USD/EUR	0.90	0.76	0.88	0.35	0.74	0.85	-0.73	-0.30	-0.68	-0.70	-0.55	-0.73	1.00											
USD/CNY	-0.55	-0.41	-0.55	-0.03	-0.54	-0.62	0.54	0.24	0.59	0.66	0.34	0.44	-0.60	1.00										
USD/JPY	-0.74	-0.87	-0.81	0.05	-0.27	-0.76	0.83	0.64	0.79	0.72	0.63	0.91	-0.75	0.26	1.00									
GERMANY CDS 5Y	0.65	0.84	0.76	-0.17	0.17	0.75	-0.84	-0.68	-0.83	-0.76	-0.45	-0.85	0.56	-0.31	-0.84	1.00								
ITALIA CDS 5Y	0.42	0.84	0.57	-0.22	0.04	0.54	-0.69	-0.78	-0.69	-0.54	-0.51	-0.70	0.37	-0.15	-0.75	0.86	1.00							
FRANCE CDS 5Y	0.63	0.87	0.76	-0.20	0.16	0.75	-0.85	-0.72	-0.85	-0.77	-0.49	-0.85	0.55	-0.35	-0.83	0.98	0.89	1.00						
USA CDS 5Y	0.79	0.84	0.84	0.02	0.26	0.79	-0.82	-0.57	-0.80	-0.80	-0.41	-0.86	0.67	-0.27	-0.87	0.84	0.68	0.81	1.00					
CHINA 5Y CDS	0.45	0.26	0.45	-0.10	0.00	0.48	-0.54	-0.28	-0.56	-0.65	0.01	-0.46	0.30	-0.46	-0.25	0.41	0.13	0.39	0.46	1.00				
JAPAN CDS 5Y	0.76	0.84	0.84	-0.14	0.22	0.86	-0.92	-0.65	-0.90	-0.88	-0.47	-0.89	0.66	-0.49	-0.81	0.91	0.74	0.91	0.84	0.91	1.00			
Gold price	0.44	0.69	0.54	-0.32	0.09	0.52	-0.63	-0.55	-0.59	-0.47	-0.49	-0.73	0.53	-0.10	-0.87	0.71	0.70	0.71	0.68	0.68	0.11	0.66	1	

As previously explained the table above refers to the pre-pandemic period, so the years between the January 1st 2011 to January 31st 2020. In this case we can see that there is a summarily positive relationship between the 10 years bond of the considered countries, which makes sense in a globalized world where all the financial systems are connected, so if a shock (such as covid) comes up, all the financial system would suffer (or benefit) for that. For the same principle, the stock indexes are positively, and strongly connected to each other, and also, they are negatively connected to the 10 years bond yields. That happens because, in times of uncertainty, the yields go up in order to balance the risk and the stock indexes go down for two reasons: the first one is that the stocks can appear riskier, and the investors are likely to prefer to build a safer portfolio, so they would prefer the bonds. In second place, we can simply think that the uncertain times can affect the future earnings, bringing down the companies' capability to generate income in the future (or just the expectations on them) and so, their total market value. Another thing that should be analyzed is that the correlations between the exchange rates and all the other variables, changes from rate to rate. For example, the correlation between the 10 years bond yields and the USD/EUR exchange rate is positive in all the considered cases, on the contrary for USD/CNY and USD/JPG, the same relationship is negative. The same concept turns upside down for the stock indexes, in particular, the USD/EUR exchange rate is negatively correlated, in all the considered cases, to the indexes, and in the other two cases, the relationship is positive, instead. The CDS market presents a curious fact that we can notice from the table. While all the CDS prices are positively related to the 10 years bond yield and show a negative correlation with the stock market as it should be, the foreign CDS have a negative relationship with the USA sovereign bonds considered. The only slightly positive one is between the USA 10 years Treasury bonds yields and its related CDS (even if it should be way stronger than 0,02). This last consideration shows that, in the considered period, when all the sovereign bonds get riskier, the 10 years USA bond yield, actually goes down. I think that the best explanation for this phenomenon is that, between 2011 and 2014-15, the USA lived an economic recovery, while the European countries for example were struggling to fight against the Sovereign Debt Crisis. This means that while the USA bond yield was dropping, the European bonds were getting riskier, at least, in the first part of the considered period. Finally, the gold price shows why it is considered a "safe heaven": in fact, it is positively correlated to the bond yields and CDS and negatively to the stock market indexes. In this case too, the black sheep is represented by the USA 10 years bond yields, which has a negative relationship with the gold price showing that, between 2011 and January 2020, when the USA bond yields were decreasing, the gold price was increasing.

PANDEMIC PERIOD CROSS CORRELATIONS

Processed by the author, data from Refinitiv Eikon Datastream

	10y Bond German	10y Bond Italia	10y Bond France	10y Bond USA	10y Bond China	10y Bond Japan	DAX	FTSEMIB	CAC	S&P 500	SSE COMPOSITE	NIKKEI	USD/EUR	USD/CNY	USD/JPY	GERMANIA CDS 5Y	ITALIA CDS 5Y	FRANCA CDS 5Y	USA CDS 5Y	CHINA 5Y CDS	JAPAN CDS 5Y	Gold price	
10y Bond German	1.00																						
10y Bond Italia	-0.10	1.00																					
10y Bond France	0.93	0.21	1.00																				
10y Bond USA	0.77	-0.46	0.63	1.00																			
10y Bond China	0.14	-0.79	-0.19	0.29	1.00																		
10y Bond Japan	0.68	-0.36	0.51	0.48	0.55	1.00																	
DAX	0.72	-0.61	0.55	0.83	0.36	0.51	1.00																
FTSEMIB	0.71	-0.54	0.57	0.89	0.23	0.39	0.95	1.00															
CAC	0.72	-0.52	0.60	0.88	0.20	0.41	0.96	0.99	1.00														
S&P 500	0.70	-0.59	0.55	0.80	0.31	0.54	0.97	0.94	0.96	1.00													
SSE COMPOSITE	0.59	-0.74	0.35	0.68	0.62	0.66	0.88	0.79	0.79	0.89	1.00												
NIKKEI	0.73	-0.65	0.53	0.87	0.42	0.62	0.96	0.93	0.94	0.95	0.89	1.00											
USD/EUR	0.27	-0.79	0.00	0.36	0.81	0.57	0.58	0.42	0.42	0.54	0.80	0.58	1.00										
USD/CNY	-0.57	0.76	-0.36	-0.80	-0.55	-0.60	-0.88	-0.85	-0.86	-0.91	-0.92	-0.93	-0.70	1.00									
USD/JPY	0.75	0.12	0.82	0.70	-0.33	0.23	0.61	0.70	0.72	0.63	0.31	0.56	-0.23	-0.38	1.00								
GERMANIA CDS 5Y	-0.34	0.84	-0.06	-0.63	-0.68	-0.33	-0.75	-0.72	-0.69	-0.72	-0.83	-0.72	-0.68	0.79	-0.20	1.00							
ITALIA CDS 5Y	-0.60	0.82	-0.36	-0.82	-0.60	-0.60	-0.90	-0.87	-0.86	-0.89	-0.91	-0.92	-0.72	0.95	-0.39	0.86	1.00						
FRANCA CDS 5Y	-0.13	0.84	0.20	-0.40	-0.79	-0.29	-0.53	-0.48	-0.42	-0.48	-0.68	-0.51	-0.66	0.59	0.07	0.92	0.71	1.00					
USA CDS 5Y	-0.54	0.74	-0.33	-0.82	-0.52	-0.44	-0.84	-0.81	-0.81	-0.77	-0.75	-0.82	-0.68	0.82	-0.35	0.73	0.89	0.58	1.00				
CHINA 5Y CDS	0.45	0.15	0.53	0.47	-0.41	-0.05	0.38	0.56	0.56	0.42	0.09	0.38	-0.33	-0.25	0.77	-0.10	-0.22	0.11	-0.20	1.00			
JAPAN CDS 5Y	-0.25	0.80	0.07	-0.41	-0.77	-0.42	-0.67	-0.53	-0.51	-0.61	-0.78	-0.63	-0.78	0.65	0.03	0.83	0.71	0.86	0.65	0.14	1.00		
Gold price	-0.02	-0.40	-0.17	-0.16	0.48	0.29	0.26	0.02	0.04	0.27	0.52	0.16	0.67	-0.27	-0.31	-0.41	-0.25	-0.46	-0.11	-0.41	-0.64	1.00	

This second table describes the changes in the relationships between the variables that were caused by the covid-19 pandemic. In particular, we have focused our studies on the period between February 2020 and November 2021. As it easy to understand from the table, the results clearly change. For starting the relationships between the 10 years bond yields are not entirely positive, but we can see more than one negative value. Furthermore, the correlation between bond yields and stock indexes is positive, meaning that, while the countries are getting financially more unstable, the linked stock indexes keep increasing their value. The only case where the correlation actually makes sense is Italy, in fact, it is the only country with a negative correlation of these last variables. Between the exchange rates and the CDS we can observe several changes, mainly because there are more negative correlations than the previous table. In this case, one important thing to underline is that the relationship between the Chinese CDS and the stock market indexes is summarily positive (for all the other countries considered, the same correlation is negative), showing that, while the other countries were fighting against the pandemic, China was already recovering. Without any doubt, we can say that the covid-19 pandemic created a lot of confusion in the CDS market, at least according to this last table. Last but not list, the “gold price” variable shows that, during the pandemic, gold lost its characteristic of strength during uncertain times. We can understand that from its mainly negative relationship with the 10 years sovereign bond yields and the positive correlation with the stock indexes.

The tables have been useful to make some strong assumptions and to understand the impact of the pandemic on the economic systems, but they are not enough to prove our main assumption and to demonstrate that the mechanism of monetary policy became weaker with the pandemic. That’s why the next paragraph is going to use regressions in order to confirm our hypothesis.

REGRESSIONS

Finally, we reached the core of our work: the regressions. Our aim is to understand the impact of the pandemic to financial markets. In order to do that we use an OLS (ordinary least squares) analysis to find a regression curve that links all the values considered. The curve should have this type of equation:

$$y_t = \beta_0 + \beta_1 a_t + \beta_2 b_t + \beta_3 c_t + \beta_4 d_t + \beta_5 u_t + \varepsilon_t \quad (1)$$

$$y_t = \beta_0 + \beta_1 a_t + \beta_2 b_t + \beta_3 c_t + \beta_4 d_t + \beta_5 u_t + \beta_6 w_t + \varepsilon_t \quad (2)$$

It's appropriate to underline that the first equation represents the pre-covid time, while the second one represents the covid period and it includes one more variable that we called "covid". In the equations:

- y_t represents the 10 years sovereign bond yields.
- a_t represents the stock index percentual variation.
- b_t represents the exchange rates.
- c_t represents the 5 years CDS prices.
- d_t represents the gold price variable. In this case we used the log values of the gold prices.
- u_t and w_t have been explained in the previous paragraph.

Now we are going to show two tables for each considered country: the first one regards the pre-pandemic times, so it includes 109 observations between January 2011 and January 2020. The second one regards the pandemic period and includes 22 observations between February 2020 and November 2021. After each one we are going to provide a brief explanation of the results. It is important to underline that the considered regressions show significantly high values of R^2 , showing the accuracy of our work.

GERMANY

Pre-pandemic

	Coefficienti	Errore standard	Stat t	Valore di significatività	Inferiore 95%	Superiore 95%	Inferiore 95,0%	Superiore 95,0%
Intercetta	3,99	2,72	1,47	0,15	-1,40	9,38	-1,40	9,38
USD/EUR	6,88	0,40	17,39	0,00	6,09	7,66	6,09	7,66
GERMANIA								
CDS 5Y	0,01	0,00	6,87	0,00	0,01	0,02	0,01	0,02
u ECB	0,15	0,09	1,67	0,10	-0,03	0,32	-0,03	0,32
Gold price (LN)	-1,65	0,37	-4,41	0,00	-2,40	-0,91	-2,40	-0,91
% Stock	-0,65	0,68	-0,95	0,34	-1,99	0,70	-1,99	0,70

Processed by the author, data from Refinitiv Eikon Datastream

The table shows that there is a positive and significant correlation between the exchange rate with the US dollar and the 10 years bond yields, which is maintained with the 5 years CDS prices and the monetary policy dummy variable (u). This last correlation (between u and the 10 years bond yields), shows that when the ECB has been using unconventional monetary policy tools, the yields kept getting higher. This paradox is mutual between the considered European countries. There is also a negative correlation between the stock index returns and the 10 years bond yields, which is something that all the considered countries have in common and that has been explained in the previous paragraph. Furthermore, the correlation between the gold prices and the bond yields is also negative.

Pandemic period

	Coefficienti	Errore standard	Stat t	Valore di significatività	Inferiore 95%	Superiore 95%	Inferiore 95,0%	Superiore 95,0%
Intercetta	11,92	5,17	2,31	0,04	0,91	22,94	0,91	22,94
USD/EUR	0,03	1,42	0,02	0,98	-2,99	3,05	-2,99	3,05
GERMANIA								
CDS 5Y	-0,02	0,01	-1,52	0,15	-0,05	0,01	-0,05	0,01

u ECB	0,63	0,23	2,73	0,02	0,14	1,13	0,14	1,13
Gold price (LN)	-1,70	0,75	-2,26	0,04	-3,30	-0,09	-3,30	-0,09
% Stock	-0,81	0,65	-1,25	0,23	-2,20	0,57	-2,20	0,57
w ECB	-0,09	0,10	-0,90	0,38	-0,30	0,12	-0,30	0,12

Processed by the author, data from Refinitiv Eikon Datastream

In this case we can observe that the correlation between the exchange rate with the US dollar and the 10 years bond yields is still positive, but its significance has been hardly reduced. We can also say that during the pandemic, the CDS prices correlation with the bond yields turned negative showing that while the bonds were getting riskier (yields increasing), the issuance prices against the country's default or downgrade risk were going down. The correlation between the 10 years bond yields and the unconventional monetary policy measures is still positive, instead, and became stronger than the pre-pandemic period. The gold price, and stock index returns, correlation with the bond yields is still negative. We can also observe that this time another variable is introduced, w, which indicates the unconventional monetary policy measures announcements to face the pandemic. This last relationship is negative, showing that, in Germany (and in all the other countries, except Japan), the unconventional monetary policy announcements during the pandemic have been effective to reduce the bond yields.

ITALY

Pre-pandemic

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	-1,31	3,26	-0,40	0,69	-7,78	5,17	-7,78	5,17
USD/EUR	7,74	0,45	17,20	0,00	6,85	8,64	6,85	8,64
ITALIA								
CDS 5Y	0,01	0,00	20,88	0,00	0,01	0,01	0,01	0,01
u ECB	0,08	0,10	0,75	0,46	-0,13	0,29	-0,13	0,29
Gold price (LN)	-0,99	0,47	-2,13	0,04	-1,92	-0,07	-1,92	-0,07

% Stock	-0,05	0,70	-0,07	0,94	-1,44	1,34	-1,44	1,34
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Processed by the author, data from Refinitiv Eikon Datastream

In Italy, the pre-pandemic situation in financial markets is similar to the German one. For starting, the exchange rate with the US dollar is strongly and positively correlated to the 10 years bond yields. The CDS prices are positively correlated with the bond yields, and the same thing is for u. The stock index and gold prices are negatively correlated with the 10 years bond yields instead. In this case, the only differences with Germany, regard the strength of the correlations, not the relationships.

Pandemic period

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	8,46	6,11	1,38	0,19	-4,57	21,49	-4,57	21,49
USD/EUR	-3,57	1,97	-1,82	0,09	-7,77	0,62	-7,77	0,62
ITALIA								
CDS 5Y	0,00	0,00	3,09	0,01	0,00	0,01	0,00	0,01
u ECB	0,57	0,27	2,08	0,06	-0,01	1,15	-0,01	1,15
Gold price (LN)	-0,58	1,01	-0,57	0,58	-2,74	1,58	-2,74	1,58
% Stock	-0,98	0,66	-1,49	0,16	-2,37	0,42	-2,37	0,42
w ECB	-0,11	0,12	-0,91	0,38	-0,36	0,14	-0,36	0,14

Processed by the author, data from Refinitiv Eikon Datastream

The pandemic period appears a lot different than the German one. For starting, the relationship between the 10 years bond yields and the exchange rate considered turned strongly negative. Another aspect to analyze is that, even though, all the other relationships did not change, they became significantly stronger. An example, from this point of view, is represented by the stock index returns or the “u” variable. This last one for example changed from 0.08 to 0.57. Another variable to focus on is “w”, in this case too it has a negative correlation with the bond yields, so the unconventional monetary policy announcements during the pandemic have been effective to reduce the risk linked to the country.

FRANCE

Pre-pandemic

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	2,20	2,75	0,80	0,42	-3,25	7,65	-3,25	7,65
USD/EUR	6,92	0,40	17,32	0,00	6,13	7,71	6,13	7,71
FRANCIA								
CDS 5Y	0,01	0,00	11,29	0,00	0,01	0,01	0,01	0,01
u ECB	0,21	0,09	2,42	0,02	0,04	0,39	0,04	0,39
Gold price (LN)	-1,39	0,38	-3,65	0,00	-2,14	-0,63	-2,14	-0,63
% Stock	-0,38	0,81	-0,47	0,64	-1,98	1,23	-1,98	1,23

Processed by the author, data from Refinitiv Eikon Datastream

As we have seen with Italy and Germany the pre-pandemic period has been equal between the European countries, which reported a positive (and in the first case strong) relationship between: the exchange rate with the US dollar, the CDS prices and “u”, and the 10 years bond yields. There is a negative relationship, instead, between the gold prices and the stock index return, and the bond yields, just like previously analyzed in the other countries.

Pandemic period

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	10,68	6,85	1,56	0,14	-3,92	25,27	-3,92	25,27
USD/EUR	0,60	1,69	0,36	0,73	-3,01	4,21	-3,01	4,21
FRANCIA								
CDS 5Y	0,00	0,01	0,23	0,82	-0,02	0,02	-0,02	0,02
u ECB	0,62	0,33	1,91	0,08	-0,07	1,32	-0,07	1,32
Gold price (LN)	-1,61	0,96	-1,68	0,11	-3,65	0,43	-3,65	0,43

% Stock	-1,07	0,80	-1,34	0,20	-2,79	0,64	-2,79	0,64
w ECB	-0,18	0,12	-1,58	0,13	-0,43	0,06	-0,43	0,06

Processed by the author, data from Refinitiv Eikon Datastream

Despite the other two European countries have seen variations in several relationships during the pandemic, in this case, the correlations remained the same, underlining a significant decrease in the exchange rate-10y bond yield relationship. As it happened to Italy and Germany, the pandemic has created a stronger relationship between the variable “u” and the 10 years bond yields. In this case too, “w” is in line with the other considered European countries showing a negative relationship with the bond yields.

USA

Pre-pandemic

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	17,86	2,53	7,07	0,00	12,85	22,87	12,85	22,87
USD/EUR	3,80	0,62	6,10	0,00	2,57	5,04	2,57	5,04
USA CDS 5Y	0,00	0,00	-0,16	0,87	-0,01	0,01	-0,01	0,01
u USA	-0,20	0,12	-1,69	0,09	-0,44	0,04	-0,44	0,04
Gold price (LN)	-2,79	0,37	-7,48	0,00	-3,53	-2,05	-3,53	-2,05
stock %	-1,24	1,02	-1,22	0,23	-3,27	0,78	-3,27	0,78

Processed by the author, data from Refinitiv Eikon Datastream

In the United States we can observe some similarities with the European countries. In particular, we can see that there is a positive correlation between the United States 10 years bond yields and the exchange rate with the EURO and between the bond yields and the CDS. This last one, especially is not in line with what emerged from the descriptive statistics. The only variable not in line with the European countries is “u”, in fact, in this case, the relationship with the 10 years bond yields is negative, showing that, when the Central Bank uses unconventional monetary policy measures, the bond yields go down, so the Central Bank succeeds to reduce the stress on the Treasury securities.

We can also observe that there is a negative correlation between the 10 years bond yields and the S&P index, the same thing happens with the gold price.

Pandemic period

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	17,04	10,14	1,68	0,11	-4,58	38,65	-4,58	38,65
USD/EUR	-2,63	2,96	-0,89	0,39	-8,94	3,68	-8,94	3,68
USA CDS 5Y	-0,10	0,02	-4,28	0,00	-0,15	-0,05	-0,15	-0,05
u USA	0,25	0,37	0,67	0,51	-0,53	1,03	-0,53	1,03
Gold price (LN)	-1,56	1,70	-0,92	0,37	-5,17	2,06	-5,17	2,06
stock %	0,28	1,36	0,21	0,84	-2,63	3,19	-2,63	3,19
w USA	-0,33	0,31	-1,06	0,31	-1,00	0,34	-1,00	0,34

Processed by the author, data from Refinitiv Eikon Datastream

The pandemic period brings several changes, such as the changes in the relationship between the 10 years bond yields and the exchange rates or the one between the bond yields and the CDS prices. All of them turned negative while the covid spread. Furthermore, the relationship between the bond yields and the stock, and the one between the “u” variable and the Treasury securities yields turned positive. This last one is showing that, the unconventional monetary policy measures during the pandemic, have compressively been inefficient, in fact, the 10 years bond yield rose anyway. We can also see that the gold price has maintained its negative relationship with the bond yields even if it became weaker. The attention should also be focused on the “w” variable which has a negative relationship with the Treasury securities yields, in line with the other countries analyzed until now.

CHINA

Pre-pandemic

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	8,60	2,11	4,08	0,00	4,42	12,78	4,42	12,78
CHINNA								
5Y CDS	0,00	0,00	-3,62	0,00	-0,01	0,00	-0,01	0,00
USD/CNY	-0,97	0,13	-7,48	0,00	-1,22	-0,71	-1,22	-0,71
stock %	-0,54	0,53	-1,03	0,30	-1,59	0,50	-1,59	0,50
u China	-0,19	0,25	-0,75	0,45	-0,69	0,31	-0,69	0,31
Gold price (LN)	0,22	0,26	0,87	0,39	-0,29	0,73	-0,29	0,73

Processed by the author, data from Refinitiv Eikon Datastream

Before the pandemic, China had a positive relationship between the bond yields and the CDS prices, and between the Treasury securities yields and the gold price. All the other relationships with the 10 years bond yields were negative, even the one with the “u” variable, meaning that, the unconventional monetary policy measures succeeded to lower the bond yields.

Pandemic period

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	7,71	5,18	1,49	0,16	-3,34	18,75	-3,34	18,75
CHINNA								
5Y CDS	-0,01	0,00	-3,18	0,01	-0,02	0,00	-0,02	0,00
USD/CNY	-0,34	0,15	-2,22	0,04	-0,67	-0,01	-0,67	-0,01
stock %	0,17	0,81	0,21	0,84	-1,56	1,90	-1,56	1,90
u China	0,00	0,00	-	-	0,00	0,00	0,00	0,00
Gold price (LN)	-0,25	0,65	-0,39	-	-1,64	1,13	-1,64	1,13

w CHINA	-0,26	0,12	-2,15	0,05	-0,52	0,00	-0,52	0,00
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Processed by the author, data from Refinitiv Eikon Datastream

The pandemic changed almost all the relationships in this last country. First of all, the relationship between the 10 years bond yields and the CDS prices turned negative, then, the same thing happened to the correlation between the bond yields and the gold price. The relationship between the Treasury securities yields and the stock index returns turned negative, while the one between the “u” variable and the bonds yields has 0 as coefficient, due to the fact that China has adopted unconventional monetary policy tools since December 2019 (in this work we consider the “pandemic period” since February 2020). The only correlation that did not change was the one between the bond yields and the exchange rates, which remain negative, even if it became less strong. The “w” variable shows a negative value in this case too.

JAPAN

Pre-pandemic

	Coefficienti	Errore standard	Stat t	Valore di significatività	Inferiore 95%	Superiore 95%	Inferiore 95,0%	Superiore 95,0%
Intercetta	8,70	2,54	3,43	0,00	3,67	13,72	3,67	13,72
USD/JPY	-0,01	0,00	-3,25	0,00	-0,02	0,00	-0,02	0,00
JAPAN CDS 5Y	0,01	0,00	8,99	0,00	0,01	0,01	0,01	0,01
u Japan	-0,30	0,09	-3,48	0,00	-0,47	-0,13	-0,47	-0,13
Gold price (LN)	-1,00	0,31	-3,26	0,00	-1,61	-0,39	-1,61	-0,39
stock%	-0,45	0,39	-1,17	0,25	-1,22	0,32	-1,22	0,32

Processed by the author, data from Refinitiv Eikon Datastream

This last country shows, in the pre-pandemic table, a negative relationship between the 10 years bond yields and all the considered variables, except the CDS prices which is the only variable that has a positive relationship with the country’s Treasury securities yields.

Pandemic period

	<i>Coefficienti</i>	<i>Errore standard</i>	<i>Stat t</i>	<i>Valore di significatività</i>	<i>Inferiore 95%</i>	<i>Superiore 95%</i>	<i>Inferiore 95,0%</i>	<i>Superiore 95,0%</i>
Intercetta	-0,84	2,44	-0,34	0,74	-6,03	4,36	-6,03	4,36
USD/JPY	0,01	0,00	1,88	0,08	0,00	0,02	0,00	0,02
JAPAN CDS 5Y	-0,01	0,01	-1,94	0,07	-0,02	0,00	-0,02	0,00
u Japan	0,00	0,00	-	-	0,00	0,00	0,00	0,00
Gold price (LN)	0,02	0,30	0,07	-	-0,62	0,66	-0,62	0,66
stock%	0,32	0,32	0,99	0,34	-0,37	1,00	-0,37	1,00
w JAPAN	0,13	0,10	1,26	0,23	-0,09	0,35	-0,09	0,35

Processed by the author, data from Refinitiv Eikon Datastream

The pandemic period has seen several changes in the relationships between the variables. The relationships between the bond yields and three variables (exchange rates, gold price and stock index return), turned positive. The relationship between the treasury securities yields and the “u” variable has 0 as a coefficient. That happens because the BoJ has been keeping an unconventional monetary policy since august 2011, constantly increasing the money supply in order to succeed to increase the inflation rate. Furthermore, the relationship between CDS prices and bond yields became negative. Last but not least, Japan is the only country with a positive correlation between the “w” variable and the bond yields, meaning that, the announcements of the unconventional measures adopted to face the pandemic did not succeed to stop the bond yields growth. The reasons will be explained in the next paragraph.

CONCLUSIONS

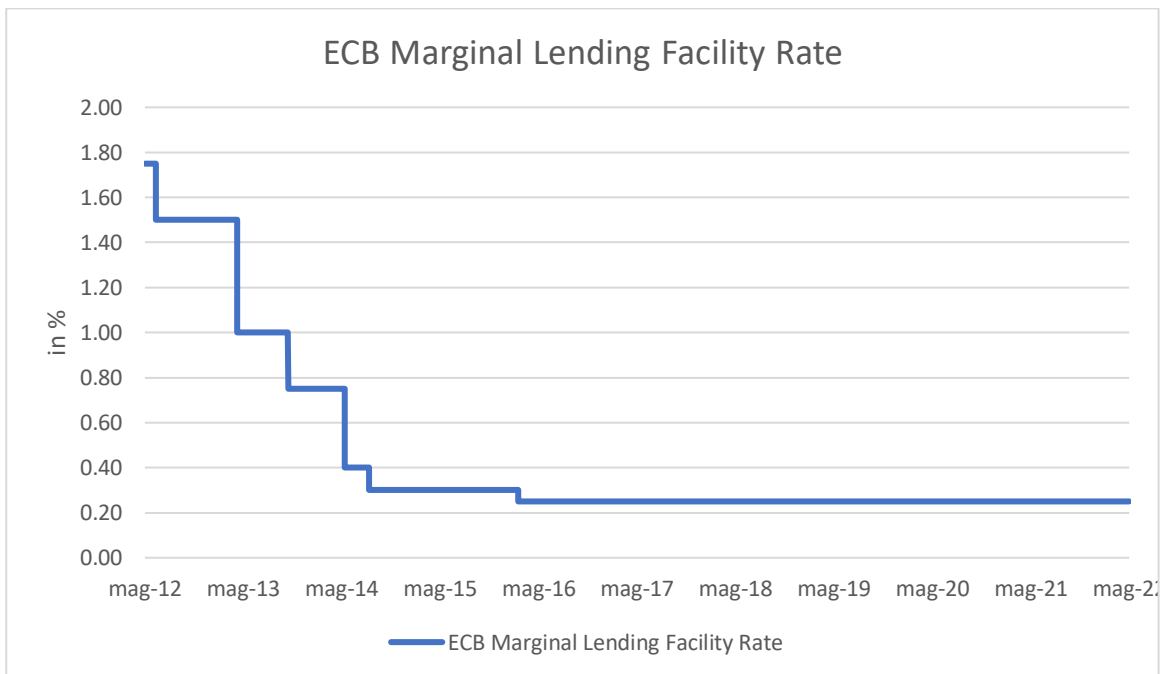
This work studies the impact of the pandemic on the transmission mechanism of monetary policy. Studying the regressions, we have been able to understand what a leading role the pandemic had in rebuilding the relationships between the considered variables and the 10 years bond yields. For example, we have seen that before the pandemic, all the countries had a positive correlation between the CDS and the bond yields, and that after the covid-19 spread, this relationship changed in the largest part of the cases. We also have seen that the correlation between the stock index return and the 10 years bond yields, which before the pandemic was negative in all the considered countries and during it became positive in the USA and in the Asian countries. In order to reach our aim, we need to focus on one main aspect: the “u” variable. As explained this last variable distinguishes the conventional and unconventional monetary policy measures. We have seen that this last variable, in the pre-pandemic period, has a positive relationship with the bond yields in Europe and a negative one in USA or Asia. After the pandemic, in all the considered countries there is a positive relationship between “u” and the bond yields. This means that, before the pandemic, the conventional monetary policy measures led to an increase of the 10 years bond yields in USA and Asia, while the unconventional one was reducing it. At the same time, the use of unconventional monetary policy tools, coincided with an increase of bond yields in Europe, and vice versa, considering a conventional monetary policy. After the pandemic, in all the considered countries, the unconventional monetary policy measures, which have been the only monetary policy used by the Central Banks during the covid period, failed to stop the bond yields growth, in fact, all the countries show a positive correlation between the 10 years bond yields and the “u” variable. Compressively, if, before the pandemic, the problem of a positive correlation, between “u” and the Treasury securities yields, regarded only European countries, after the covid spread, this phenomenon was extended to all the considered countries. The announcements of an unconventional monetary policy played a key role during the pandemic for one main reason: they have reduced the 10 years bonds yields in all the considered countries. It has been observed that whenever, during the pandemic, the Central Banks announced the use of unconventional monetary policy measures, the bond yields decreased. This last detail testifies that the unconventional measures announcements have been more effective than the conventional measures. The only country where it did not happen is Japan, where the excessive use of unconventional monetary policy measures through the last 10 years, has reduced the impact of their announcement, even for the ones used to face the covid pandemic. This last detail is understandable from the correlation studied between the bond yields and the “w” variable, which is positive only in Japan, and negative in all the other countries. In conclusion, our work succeeds to

show that the transmission mechanism of monetary policy became weaker with the pandemic. Even though both, conventional and unconventional, monetary policy measures became weaker in terms of transmission mechanism to financial markets, the unconventional monetary policy measures have been more effective than the conventional ones. It would be appropriate now to try to explain the reasons behind the pandemic effects on the transmission mechanism of monetary policy. Looking at the baseline study paper, we can observe that the authors indicated three different reasons:

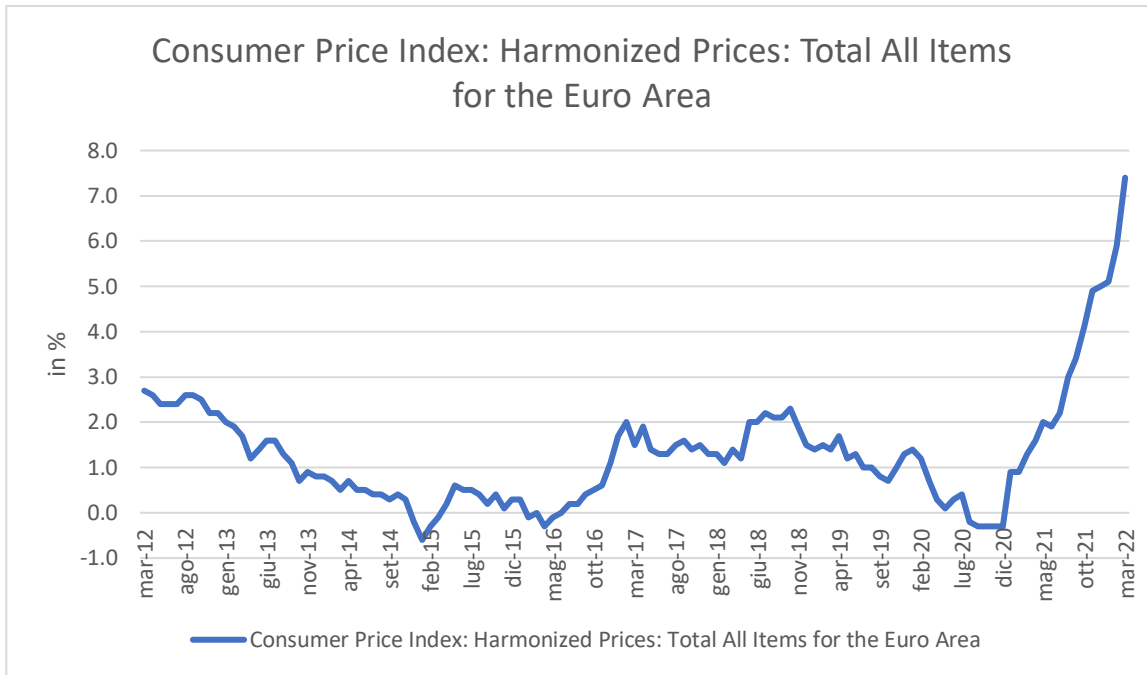
1. Investors were not expecting such an uncertain monetary policy in response to the pandemic, so the least risk tolerant between them avoided to buy assets. That reduced the impact of the central banks' decisions on the 10 years bond yields.
2. All the measures adopted by governments in order to fight against the virus spread (such as social distancing), have limited the financial and economic transaction.
3. Usually, investors are likely to move liquidity from asset to asset, driven by higher yields or safer investments. In the uncertainty caused by the pandemic, they have been reluctant to do so, compromising the impact of the central banks' decision on the 10 years bond yields.

All these conclusions are robust, and they surely have played a key role in determining the weakening of the transmission mechanism of monetary policy, but, they have not been the main reason. In fact, according to what has been described in chapters 1 and 2, we should also be thinking about the type of intervention by the central banks. We suggest looking for the main reason between the assets bought by the central banks in order to face the pandemic. The European Central Bank has used the PEPP liquidity to purchase the APP assets, so PSPP, CBPP3, CSPP, ABSPP. The Federal Reserve, instead, used tools that have a closer impact on the real economy (which have been shown in the table below and explained in chapter 2). From this point of view, we can say that they have been acting on both the public and private sector. What we should focus on, is the fact that, these types of assets had one specific aim: reducing the market interest rates, in order to sustain the economic system. In other words, increasing the liquidity in the financial system. The ECB problem with this kind of tools is called "Zero Lower Bound (ZLB)", it means that the market interest rates tended to zero before the pandemic, so the purchase of APP assets could not reduce them more. The situation was totally different than the 2008 and 2011 economic crisis, when the market interest rates were a lot higher than the ZLB level. In that case, the use of "quantitative easing" measures perfectly made sense, due to positive rates, so the tools made the rates drop and sustained the economic system. Before the Covid-19 crisis, instead, the ECB focused on keeping the rates low in order to incentive a European not-too-booming economy that was struggling to get back to the pre-Global Financial Crisis levels in

several countries. We should underline that no one was not expecting an economic and sanitary disaster such as a pandemic, so it was a totally understandable choice the one taken by ECB about not increasing the market interest rates during the recovery times post-GFC that we were living. Throughout the Covid-19 crisis, the measures have not been able to reduce the rates because they were already around “zero”, so it is perfectly logical to think that the reason why the transmission mechanism of monetary policy became weaker is that the used tools have been inappropriate for the European financial situation in March 2020. In return, the massive liquidity injections are partially responsible for the high inflation rates we are seeing during these months. To sustain my assumptions, the graph below shows the marginal lending facility rate and the inflation rate during both, the post-GFC period and the pandemic crisis.

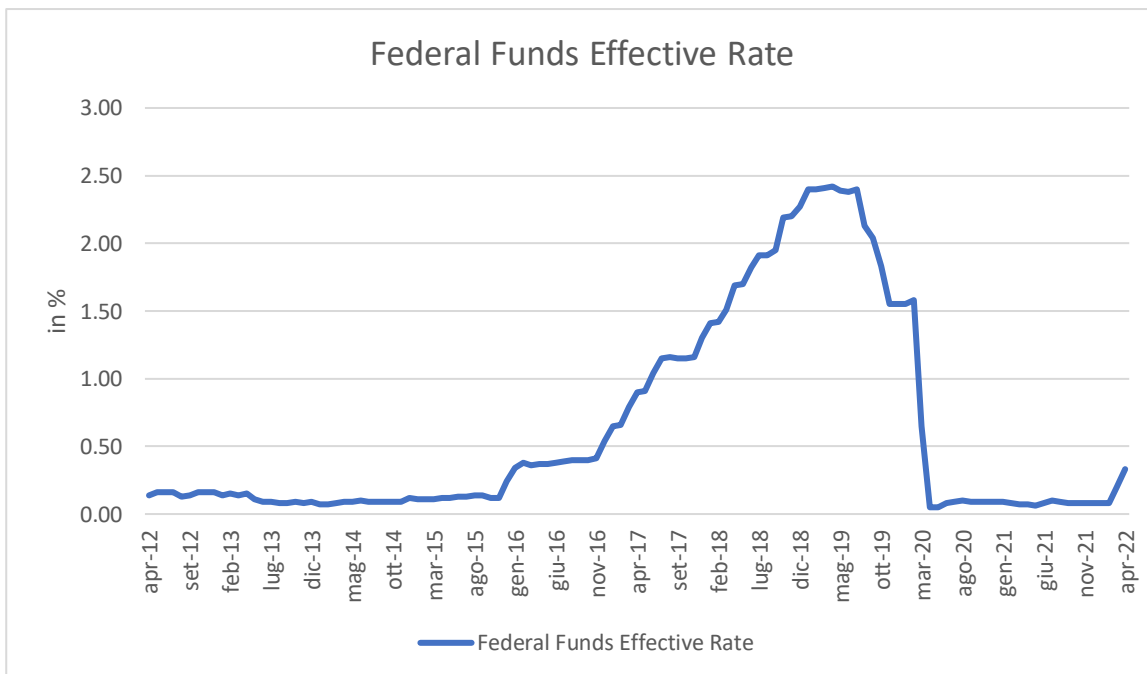


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The USA conclusive analysis is less simple than the ECB one, and I would like to start from the “federal funds effective rate”, shown in the following graph.

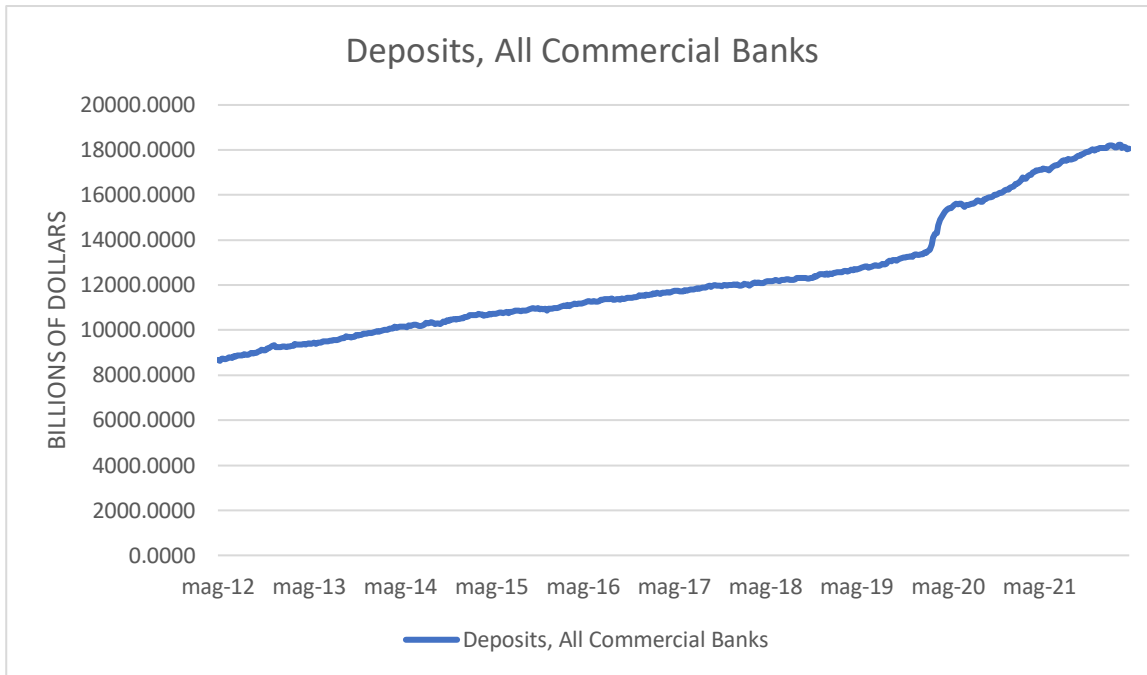


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As we can see from this graph, the Fed did not have the ZLB issue, so its action had more space to reduce the market interest rates through the covid-contrast measures and help the economy to recover.

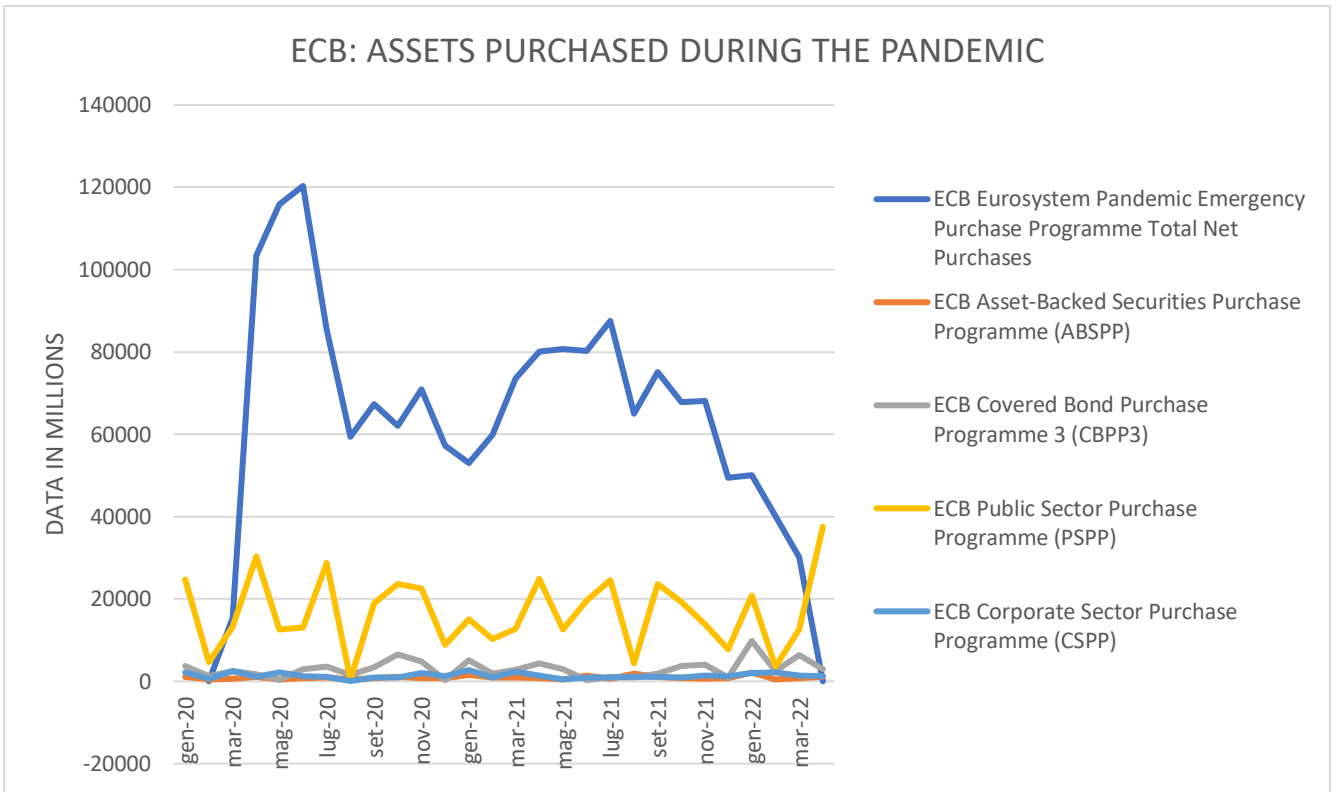
In this case we should be focusing on how this liquidity has been used by the financial institutions. From the 2007-2008 crisis, we have learned that the USA banks held back a large part of the liquidity that came from quantitative easing measures, without investing it in the real economy. In this crisis too we have all the elements to come up with such a conclusion, but the specificity of the tools and their impact on the Federal Funds Rate, allow us to make a deeper analysis. What has been likely to happen in this case, is that companies have been able to borrow liquidity at a low price after a long time, but not only the ones that needed the money to survive have borrowed it. There have been many companies who have borrowed the money and decided to hold liquidity instead of buying assets for two reasons: first, the uncertain times we have lived in 2020/2021 made the investors and companies more cautious in terms of investments and second, they wanted to hold liquidity against the risk of even tougher times. They have been able to do so because the interest rates were close to zero and that reduced a lot the “opportunity cost”. I would also like to add a third and more explaining reason: people were not spending, reducing a lot the expected revenue from the investment opportunities in the real economy. Due to the uncertain times and the restriction measures adopted to face the Covid-19 pandemic, the consumption dropped and slowly got better after several pandemic months. To sum this process up: companies kept liquidity, collecting debts without investing and the consumption dropped, their balance sheets debts became “heavier”, and the uncertainty in the real economy created by the lack of investments has influenced the Treasury Bond yield growth of the main country where these companies operate and pay taxes (so the United States).

This hypothesis would be confirmed by the fact that the deposits, in all the commercial banks, in the USA, have increased in 2020 and kept growing at a higher rate than usual in 2021. The following graph shows what previously explained.

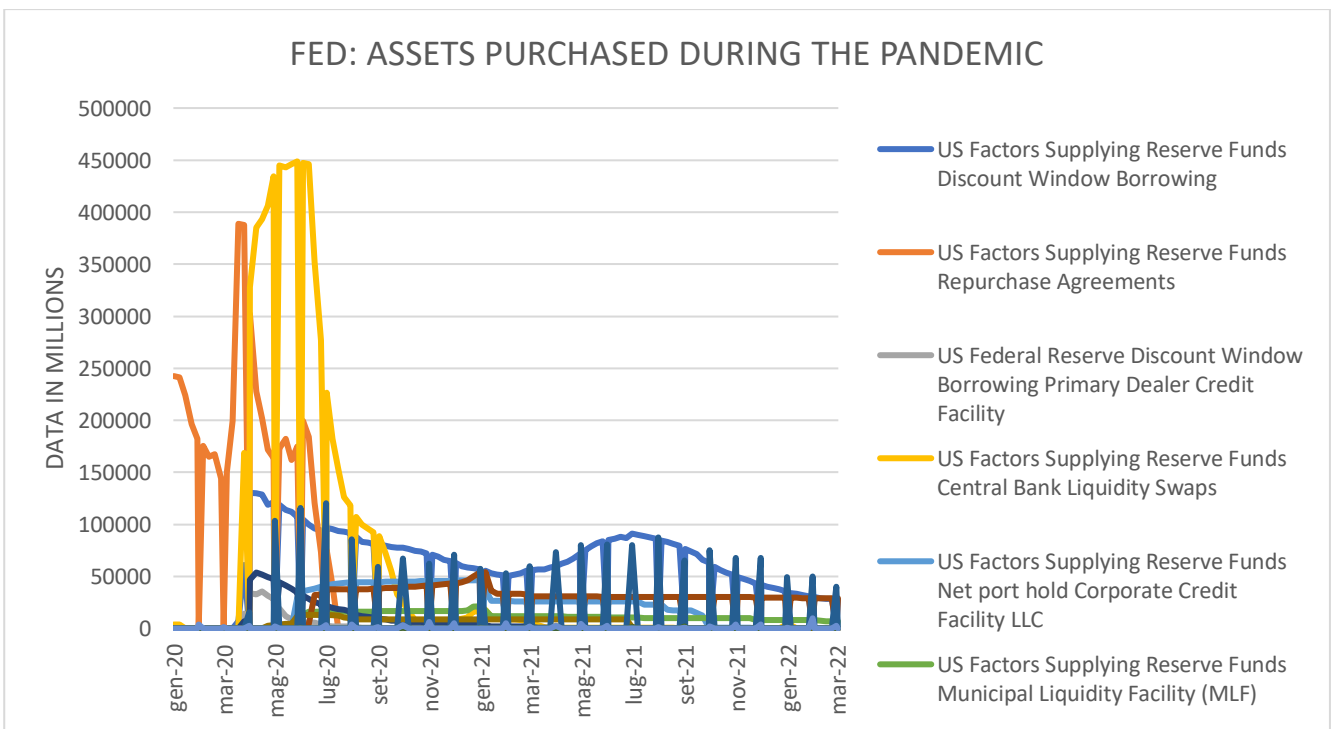


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Anyway, the Fed’s response will surely be “long term effective”, and even if it exposes the economy to a big inflation risk in the long run, the market and companies have collected so much liquidity that they could resist to an increase in interest rates, whiteout too many big deals. In this conclusive analysis we do not focus on China because the PBC did not actually buy assets in order to face the pandemic and we do not focus on Japan because their unconventional monetary policy measures have been used without any interruptions during the last 10 years, as explained before. I would like to conclude this work showing the assets bought by both, Fed and ECB for a better comprehension of the analysis developed previously.



Processed by the author, data from Bloomberg



Processed by the author, data from Bloomberg