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The role of Central Banking policies in the banking industry's response to the 2020 pandemic crisis:
The Euro Area

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Intro

Abstract

This thesis aims to investigate and analyze the actions taken by the European Banking system in response to the 2020 Economic Global Crisis brought on by the pandemic outbreak. The COVID-19 pandemic has had a significant impact on the global economy, and the banking industry has been a critical player in responding to this crisis. Therefore, this study employs analytical approach to study the effectiveness of the banking industry's response to the pandemic, with a specific focus on the European Union and the measures adopted by the international banking community.

The first chapter introduces the research and describes the approach used to analyze the banking industry's response to the pandemic while providing an overview of the study's scope and lays the foundation for the analysis that will be performed in the following chapters.

The second chapter provides an in-depth analysis of the banking industry's response to the pandemic crisis, examining the policies adopted by the banking industry to mitigate the impacts of the pandemic and investigates the impact of government policies on the industry's response.

In the third chapter, the focus is on the response of the Central Banking system, examining the measures adopted or introduced to cope with the crisis caused by the pandemic. This chapter also analyzes observable phenomena in the economy as a consequence of the pandemic and evaluates the effectiveness of the Central Banking system's response.

The fourth chapter includes a case study consisting of an analysis of the results of the pandemic crisis and the industry's response on a sample of major European Banks, investigating financial performance and evaluating the effectiveness of their response to the pandemic.

Finally, the conclusion summarizes the key findings of the thesis, highlighting the implications of the study, and offering recommendations for future research. Additionally, description of the dissertation process is provided, including the limitations of the research and the potential implications for policy and practice.

Preliminary considerations

This research aims to provide the reader with detailed and comprehensive information on various considerations related to the banking industry's response to the 2020 pandemic crisis. To achieve this, the study will utilize analytical documentation and graphical data visualization to expand on the argument and provide a more comprehensive perspective.

The analytical documentation will provide a detailed analysis of the various factors that influenced the banking industry's response to the pandemic, including the policies adopted, the impact of government policies, and the response of the Central Banking system. This analysis will be supported by the use of statistical software, with specific use of the R or Python programming languages in conjunction with the R Studio Integrated Development Environment.

The code utilized in the analysis will be made available to the reader, showcasing the portions that best represent the investigative intentions and presenting the obtained results. This will allow the reader to better understand the methodology used and to replicate the analysis if desired. Additionally, the graphical data visualization will be used to provide a visual representation of the data analyzed, allowing the reader to better understand the patterns and trends observed in the data.

Data Sets and Sources

In this section, a list of the main dataset sources used during the analytical and quantitative aspects of the thesis is provided. These datasets were selected based on their relevance to the research objectives and the availability and reliability of the data.

The datasets used in this study were obtained from a variety of sources, including official statistical agencies, financial institutions, and research databases. The data was collected using various methods, including surveys, interviews, and secondary data sources.

The analysis of the data was conducted using statistical software, including R or Python programming languages in conjunction with the R Studio Integrated Development Environment. The code utilized in the analysis will be made available to the reader, highlighting the investigative intentions and presenting the resulting outcomes.

For additional references, the reader is encouraged to refer to the Sitography chapter, which provides a list of relevant sources used in this study, including academic articles, official reports, and relevant websites.

1 A disruptive event in the system

The event: 2020 pandemic and consecutive crisis

The medical definition of COVID-19 provided by Merriam-Webster¹ is “a mild to severe respiratory illness that is caused by a coronavirus² (Severe acute respiratory syndrome coronavirus of the genus Beta coronavirus), is transmitted chiefly by contact with infectious material (such as respiratory droplets) or with objects or surfaces contaminated by the causative virus, and is characterized especially by fever, cough, and shortness of breath and may progress to pneumonia and respiratory failure.”

The first report of the unknown virus started in China, more precisely in the Wuhan region in December 2019. The virus would become known in the following months as Sars Covid-19, a Coronavirus from the SARS family of viruses. As the news of the presence of a new virus spread around the world, and multiple cases started to appear in different states across the globe the World Health Organization (WHO) declared a Public Health Emergency of International Concern on 30 January 2020 and lately officially characterize the outbreak officially as a Pandemic on March 2020.

Although the mortality rate for this virus is very low and has a relevant incidence only in already fragile people, its contagiousness is very high, indeed since the pandemic started, more than 2 million people in the European Region have died from the disease.

With restrictive measures imposed by local government, closure, and limitation of brick-and-mortar and productive activity, shortage of commodity and manufacturing goods from China and India, with an overall reduction in consumption, financial markets reacted heavily from the early stage of the Pandemic, until exogenous measures and financial aids have been introduced in the system from national and international institutions.

¹ Merriam-Webster, Inc. is an American company that publishes reference books and is especially known for its dictionaries. It is the oldest dictionary publisher in the United States. In 1831, George and Charles Merriam founded the company as G & C Merriam Co. in Springfield, Massachusetts.

² Any of a family (Coronaviridae) of large single-stranded RNA viruses that have a lipid envelope studded with club-shaped spike proteins, infect birds and many mammals including humans, and include the causative agents of MERS, SARS, and COVID-19.

1.1 Timeline and Events

To get the context in case the reader is not familiar with the matter, a timeline is now introduced with the most relevant events concerning the epidemic period.

Dates and occurrences are reported from the official ECB timeline.³

Relevant events

The following dates are considered relevant overall to better understand the consecutive developments, in particular for factual analysis of this thesis research, hence some minor events could be omitted.

The timeline starts with the report of the first case:

—

31 DECEMBER 2019

Wuhan reports the first cases. European Centre for Disease Prevention and Control starts surveillance.

—

24 JANUARY 2020

First reported European case of COVID-19.

—

FEBRUARY 2020

First aid worth €232 million was delivered to support global efforts.

—

28 FEBRUARY 2020

Joint procurement mechanism to secure masks and other equipment.

—

MARCH 2020

Strict public health measures in Italy, France, Spain, and other EU countries.

—

24 APRIL 2020

EU pledging effort for Coronavirus Global Response (€15.9 billion).

—

16 JUNE 2020

Adoption of EU COVID-19 Vaccines Strategy.

—

13 AUGUST 2020

Contract signed with Johnson & Johnson (authorized 11 March 2021).

—

27 AUGUST 2020

Contract signed with AstraZeneca (authorized 29 January 2021).

—

31 AUGUST 2020

EU joins COVID-19 Vaccine Global Access Facility (COVAX)

—

9 SEPTEMBER 2020

Contract signed with BioNTech Pfizer (authorized 21 December 2020).

—

19 OCTOBER 2020

Adoption of an EU-wide system of contact tracing and warning apps.

³ Link

—
11 NOVEMBER 2020

Adoption of the European Health Union for coordinated preparedness and response.

25 NOVEMBER 2020

Contract signed with Moderna (authorized 6 January 2021).

—
25 NOVEMBER 2020

Adoption of Pharmaceutical Strategy for Europe.

—
2 DECEMBER 2020

Adoption of Staying safe from COVID-19 during winter.

—
DECEMBER 2020

Identification of Alpha Variant.

—
27 DECEMBER 2020

Vaccination starts in all EU Member States.

—
8 JANUARY 2021

The second contract with BioNTech- Pfizer to ensure additional vaccine doses.

—
29 JANUARY 2021

Mechanism to tackle the lack of transparency of vaccine exports outside the EU.

—
17 FEBRUARY 2021

Launch of the “HERA Incubator” as a European bio-defense preparedness plan.

—
17 FEBRUARY 2021

The second contract with Moderna to ensure additional vaccine doses.

—
14 APRIL 2021

100M vaccine doses were administered in the EU.

—
MAY 2021

Identification of Delta Variant.

—
21 MAY 2021

€1 billion Team Europe initiative on Africa.

—
1 JULY 2021

EU Digital COVID Certificate enters application.

—
4 AUGUST 2021

Contract signed with Novavax (authorized 20 December 2021).

—
31 AUGUST 2021

70% of the EU adult population is fully vaccinated.

—
16 SEPTEMBER 2021

Creation of the Health Emergency Preparedness and Response Authority (HERA).

—
22 SEPTEMBER 2021

EU-US Global Vaccination Partnership.

—

18 OCTOBER 2021

1 billion vaccine doses were exported to more than 150 countries worldwide.

NOVEMBER 2021

Identification of Omicron Variant.

1 DECEMBER 2021

Adoption of Coordinated EU approach to address the resurgence of COVID-19.

10 FEBRUARY 2022

HERA launches €1.3 billion work plan for response and preparedness.

SEPTEMBER 2022

Goal for EU-US Partnership to achieve 70% global vaccination.

The Graph (Fig 1) shows the number of daily new cases in the Eurozone, from data retrieved by the European Centre for Disease Prevention and Control for a timespan of two years, until December 2022, when the data revelation has been discontinued. The graph shows the different waves of contagion alternated with periods of low new daily contagion, in accordance with the aforementioned events.

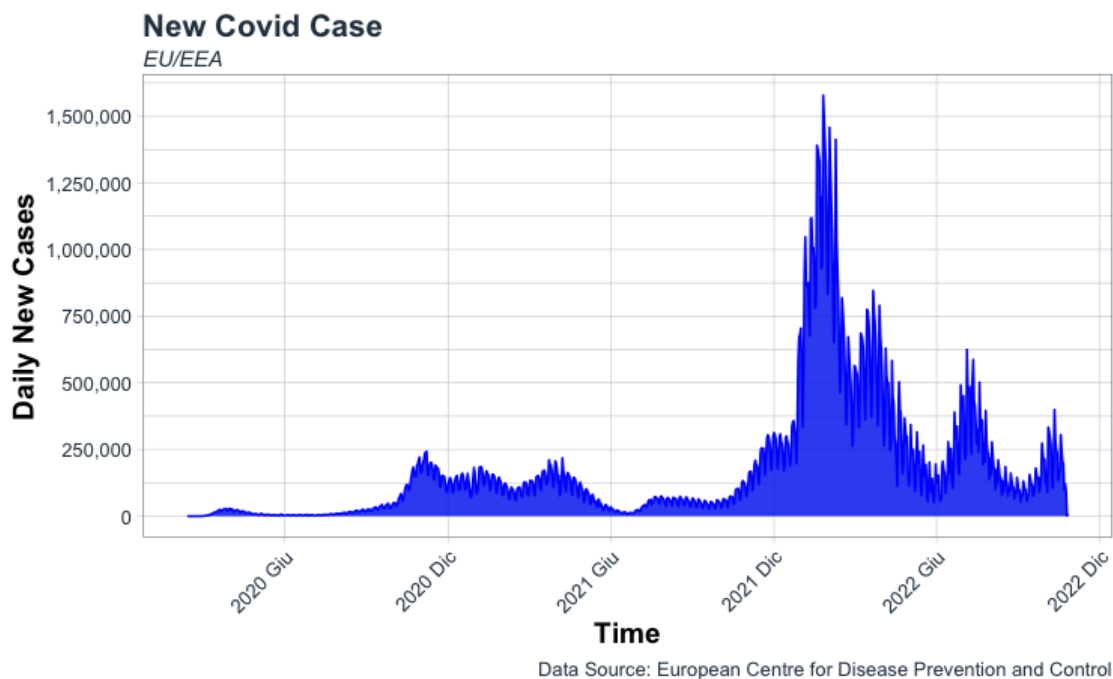


Figure 1: New cases observed daily. <https://www.ecdc.europa.eu/en/publicats-data/data-daily-new-cases-covid-19-eueea-country>

Retrieved from the same dataset, Figure 2 shows the number of covid related death in the European Union, clearly signaling the end of the waves during the summer and an overall decreasing trend.

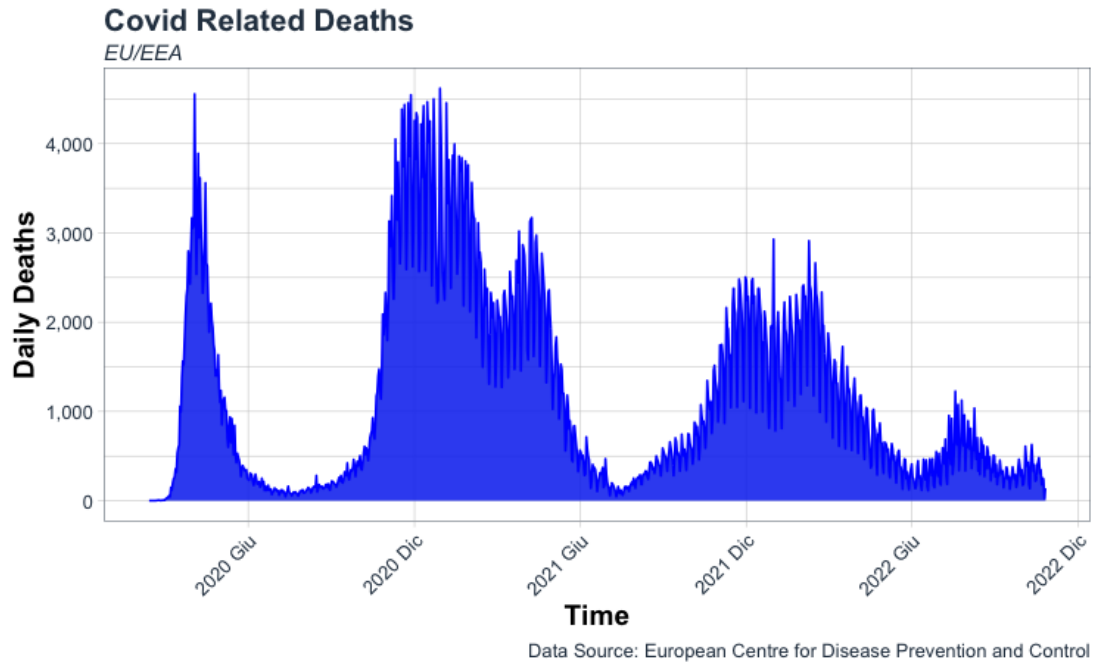


Figure 2 <https://www.ecdc.europa.eu/en/publications-data/data-daily-new-cases-covid-19-eueea-country>

1.2 Equilibrium in Economic and Financial Systems

Economic equilibrium theory is a fundamental concept in modern economic theory. It refers to the idea that markets tend to reach a state of balance in which the quantity of goods or services supplied is equal to the quantity of goods or services demanded. In this state, there is no excess supply or demand for the good or service in question.

The modern understanding of economic equilibrium theory builds upon the foundations laid by classical economists such as Adam Smith and David Ricardo. However, modern economists have developed more sophisticated mathematical models to analyze the behavior of markets and the factors that can influence equilibrium outcomes.

One of the most important developments in modern economic equilibrium theory is the concept of general equilibrium. This refers to a state in which all markets in an economy are simultaneously in equilibrium, considering the interdependence of markets and the feedback effects that occur when one market is disturbed (Arrow & Hahn, 1971).

Modern economic equilibrium theory has also expanded to incorporate the study of dynamic equilibria, which considers the time dimension of economic activity. This includes the study of how economies adjust to changes in supply and demand over time, and how the dynamics of economic activity can affect the long-run equilibrium outcomes of markets (Debreu, 1959).

Another important development in modern economic equilibrium theory is the study of market imperfections and the role of government in correcting these imperfections. This includes the analysis of externalities, public goods, and market power, and the study of how government interventions such as taxes, subsidies, and regulations that can improve economic outcomes (Stiglitz, 2017). Overall, modern economic equilibrium theory is a fundamental tool for understanding how markets work and how economic outcomes are determined. Its application to real-world problems and policy debates has helped to shape economic policy and improve the functioning of markets in modern times. The financial systems instead, encompass institutional units and markets that interact in an intricate manner, with the objective of raising funds for investments and offering services, such as payment systems, for the financing of business operations.⁴

The role of financial institutions within the system is primarily to intermediate between those that provide funds and those that need funds, a role that typically involves transforming and managing risk. Equilibrium in the financial system refers to the state in

⁴ IMF, 2004, *Compilation Guide on Financial Soundness Indicators*, IMF, Washington DC, para. 2.2.

which the quantity of financial assets supplied is equal to the quantity of assets demanded for a given price level, and there are no imbalances in the financial markets. This equilibrium is ensured through a complex interplay of market forces, intermediaries, and regulatory mechanisms that influence the supply and demand for financial assets. One of the primary factors that ensure equilibrium in the financial system is the price mechanism. According to Mishkin, Eakins, and Balakrishnan (2021), the price of a financial asset represents the balance between its supply and demand, and it adjusts to reflect changes in market conditions, such as changes in interest rates, inflation expectations, or geopolitical risks. When the price of a financial asset is too high, demand falls and supply increases, leading to a downward pressure on the price. Conversely, when the price is too low, demand increases and supply falls, leading to an upward pressure on the price.

Another important factor that ensures equilibrium in the financial system is the role of intermediaries. Intermediaries, such as banks, insurance companies, and investment funds, provide liquidity and diversification to investors and facilitate the allocation of capital to its most productive uses. According to Mankiw and Taylor (2014, p. 465), intermediaries act as market makers, absorbing imbalances in supply and demand by buying or selling financial assets and providing hedging and risk management services to investors.

Finally, effective regulation and supervision of the financial system are essential to ensure its stability and efficiency. Regulators and supervisors monitor the activities of financial institutions and markets, set prudential standards, and intervene when necessary to prevent or mitigate systemic risks, such as bank failures, market crashes, or liquidity crises. As noted by Mishkin, Eakins, and Balakrishnan (2021), regulation can promote market discipline, reduce information asymmetries, and enhance transparency and accountability in the financial system.

In conclusion, equilibrium in the financial system is ensured by the interplay of market forces, intermediaries, and regulation, which promote efficient allocation of resources, reduce information asymmetries, and maintain the confidence of investors and the public in the financial system. The equilibrium concept in economic theory is supposed to demonstrate not only the interdependence of economic phenomena in the marketplace, but also the ordering properties of the market. Under the equilibrium view, nature, through the market, generates both economic and social order. Equilibrium thus deals with the age-old social science concern of social order. The view that the market was an equilibrium system came not from the observation of markets but was a preconception that came to

economic theory through natural law philosophy, it is through this preconception that the natural law outlook still permeates modern economic theory.

In economics, namely the study of economies or the methods and organization of the production, distribution, and consumption of goods and services, the market-based economy is one in which the forces of supply and demand, determine where capital is allocated as well as general consumption behaviors. Economic equilibrium is a theoretical concept, the markets are always evolving and dynamic such that the market never truly reaches an equilibrium, but rather gravitates toward it through market cycles.

1.2.1 Equilibrium vs. Disequilibrium

When the economy is not in a state of equilibrium, the alternative state is known as imbalance or disequilibrium. Realistically, we are always in a state of disequilibrium that is trending toward a theoretical equilibrium. However, there may be certain situations where disequilibrium becomes more pronounced, for example in a specific case of a shock due to external causes, as in the case of the 2020 global pandemic.-Disequilibrium in the financial and economic system can arise due to various factors. Some of the most common causes of disequilibrium are as follows:

- Inflation: Inflation occurs when there is an increase in the general level of prices of goods and services in the economy. This can happen due to an increase in the money supply, a decrease in the supply of goods and services, or a combination of both. Inflation can lead to a decline in the purchasing power of money, which can create disequilibrium in the economy as a consequence (Mishkin, 2018).

- Unemployment: Unemployment occurs when there are not enough job opportunities available for the workforce in the economy. This can lead to a reduction in the overall level of economic activity, lower consumer spending, and reduced demand for goods and services. Unemployment can result in a decrease in economic growth and a shift towards disequilibrium in the economy (Blanchard, 2006).

- Government policies: Government policies such as taxation, regulation, and trade policies can impact the overall economic environment. Poorly designed policies can create market distortions, reduce economic growth, and cause disequilibrium in the economy (Mankiw, 2016).

- International trade: International trade can also lead to disequilibrium in the economy. For example, if a country exports more than it imports, it can result in a surplus of foreign currency, leading to inflation and trade imbalances. Similarly, if a country imports more than it exports, it can lead to a decrease in economic activity and lower growth rates (Mishkin, 2018).

- Natural disasters: Natural disasters such as earthquakes, hurricanes, and floods can lead to significant disruptions in economic activity, leading to disequilibrium in the economy (Mankiw, 2016).

- Market shocks: Sudden changes in market conditions, such as a sudden decrease in demand for a particular product or a significant increase in the price of a key commodity, can cause disequilibrium in the economy (Blanchard, 2006). In conclusion, there are many factors that can cause disequilibrium in the financial and economic system. Understanding these factors is essential for policymakers and economists to design effective policies to mitigate the effects of these factors and ensure stable economic growth.

1.3 Risks in a System

Risk in the financial system refers to the potential for financial loss or negative impact on a single asset or the overall system caused by various factors such as market fluctuations, credit defaults, operational failures, and external events (European Commission, 2019). Financial risk can arise from a wide range of sources, including complex economic conditions, geopolitical events, regulatory changes, and technological disruptions (Busch et al., 2019) or external shocks able to trigger repercussions on the overall system. Managing and mitigating risk is a crucial function of financial institutions and regulatory bodies, as it is the main method to ensure the stability and resilience of the financial system (Hopt, 2020). The main distinction in categorization is Systematic and Unsystematic risk, two types of risk that can impact the stability of a financial system. Systematic risk, (namely “the risk of the system”) also known as market risk, is the risk that affects the entire financial system or a significant portion. It arises from factors that are beyond the control of individual firms or investors, such as changes in macroeconomic conditions, political events, or global economic shocks. Systematic risk is hardly if not diversifiable, meaning that it cannot be reduced through the practice of portfolio diversification. It requires instead measures such as government interventions or regulatory policies to mitigate its impact. Systematic risk includes widespread economic recessions, war, natural disasters, and global scale phenomenon like the shock caused in 2020 by the pandemic crisis. On the other hand, unsystematic risk, also known as specific (or “asset” risk), is the risk that affects individual assets, firms, or financial asset within the financial system. It arises from factors tied to a particular company or sector, such as management changes, industry specific challenges, litigation, or regulatory changes. On the contrary, Unsystematic Risk is diversifiable by investing in a wider range of assets, reducing the overall risk of the portfolio. However, as most risks, it cannot be eliminated entirely, as it is inherent in the specific assets or companies being invested in. The fundamental takeaway is that while systematic risk affects the entire financial system, unsystematic risk impact individual companies or sectors. Therefore, it is crucial for investors and financial institutions to manage both types of risks to ensure the stability of the financial system.

1.3.1 Systemic Risk

Focusing on systemic risk, various studies have demonstrated that high levels of structural risk can significantly contribute to the intensity of economic contraction emphasizing crisis

and enhancing cyclical risk during financial cycle contractions, posing a significant threat to financial stability. Systemic risk is typically defined as the likelihood of a major failure of a key financial system component spreading within the entire financial ecosystem, resulting in unfavorable impacts on future development and economic outlook. The growth of systemic risk implies an increase in the vulnerability of the entire financial system and comprises two key components: the cyclical dimension, is linked to the accumulation of macro-financial imbalances throughout the financial cycle, and the structural dimension that is associated with the accumulation of systemic risk due to structural modifications in the financial system.

1.3.2 Cyclical Risk

In the academic literature, there is increasing consensus that cyclical risk tends to build up gradually, long before financial crises. Thus, it is linked to the financial cycle and the cyclical nature of the financial system in general. According to numerous studies, the average tenure of financial cycles for credit and asset prices is between 15 and 20 years. During the upward phase of the financial cycle, credit expansion and the prices of financial assets and real estate rise sharply with a background of extremely loose financial conditions. The elevated asset prices increase the value of securities and, consequently, the total amount of credit that the private sector is able to obtain until the process eventually reverses its own growth. According to historical data, financial cycles have frequently resulted in severe macroeconomic disruptions.

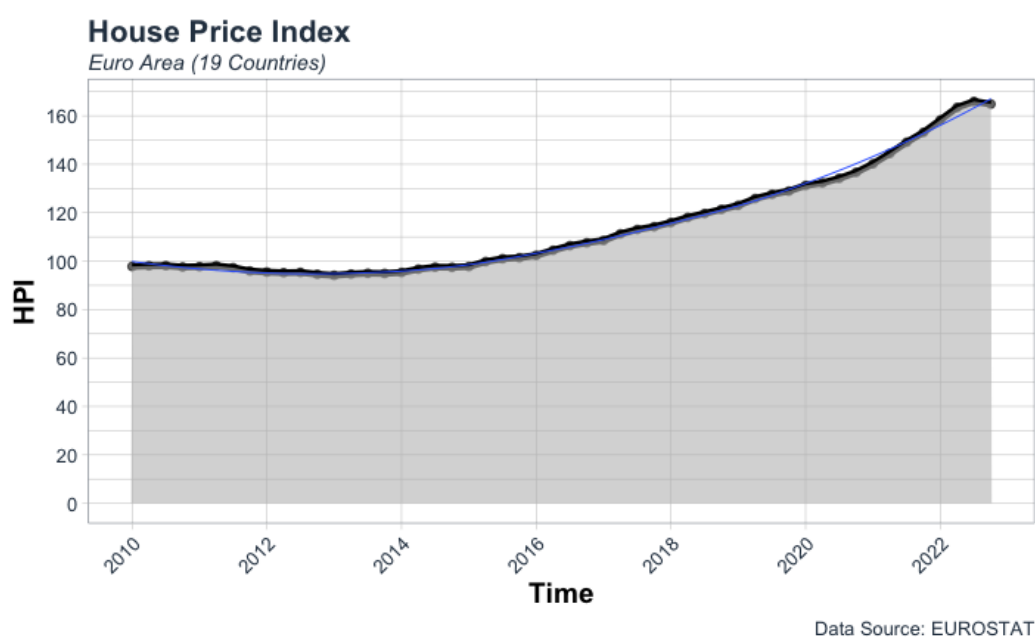


Figure 3: House Price Index in the Eurozone.

Credit and housing price indicators (*figure 3*) are two of the oldest and most extensively employed indicators to assess the cyclical phase of the financial cycle.

Analyzing the House Price Index for the Euro area we can notice an increasing slope in recent years, starting to accumulate increasingly in the last two years and showing early signs of retracement. This behavior is easier to observe when considering the yearly changes in the index observation, where last available data could signal a trend inversion for this indicator.

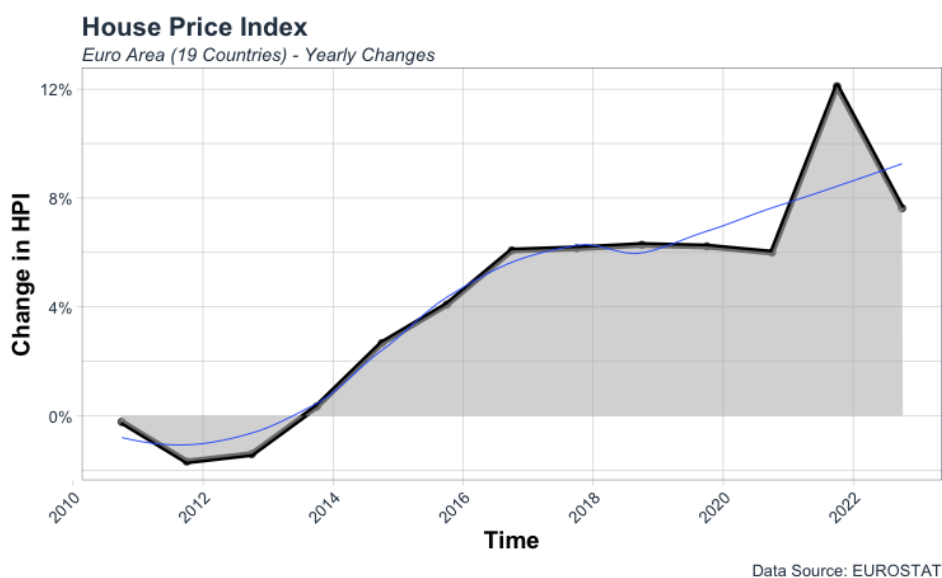


Figure 4: Yearly changes in House Price Index for the Eurozone.

When analyzing longer time frames, it is challenging to not overlook structural changes in the economy, such as changes in exchange rate, monetary, fiscal, and regulatory frameworks. For instance, prolonged periods of financial restrictions tend to influence the shape of the financial cycle. Comparing different financial cycles could be difficult or ineffective in spite of the existence of recurrent, protracted shifts in financial forces.

1.3.3 Structural Risks

A characteristic feature of structural risks is their potential to amplify the impact of adverse economic shocks (Liang, 2013). Financial crises have various origins and depths, but they mainly arise from interactions between cyclical imbalances and underlying structural risks. To categorize structural risks, we can divide them into two categories: Endogenous risks that arises from the structural characteristics of the banking sector and Exogenous risks to the banking sector that stem from the real economy, as in the case of

the 2020 pandemic. These risks can be amplified through direct linkages between financial institutions, common exposures, similar business models, low resilience, vulnerability of the private sector, and pro-cyclical financial regulation (Liang, 2013). Increased structural risks may contribute to deleveraging of the private sector, triggering a downward spiral of falling asset values and bank defaults during financial cycle contractions. The economic literature often highlights the risk of high private or public level of debt indebtedness showing that high overall debt can increase systemic risk and the probability of ruin during a financial crisis (Rose & Spiegel, 2012). High and rapidly increasing levels of household debt can be risky since they increase the sensitivity of households to a negative shock to their income or balance sheet.

The following series of data visualization show respectively the total consolidated Private Sector Debt in the Euro Area (*figure 5*) and the relative percentage Change (*figure 6*).

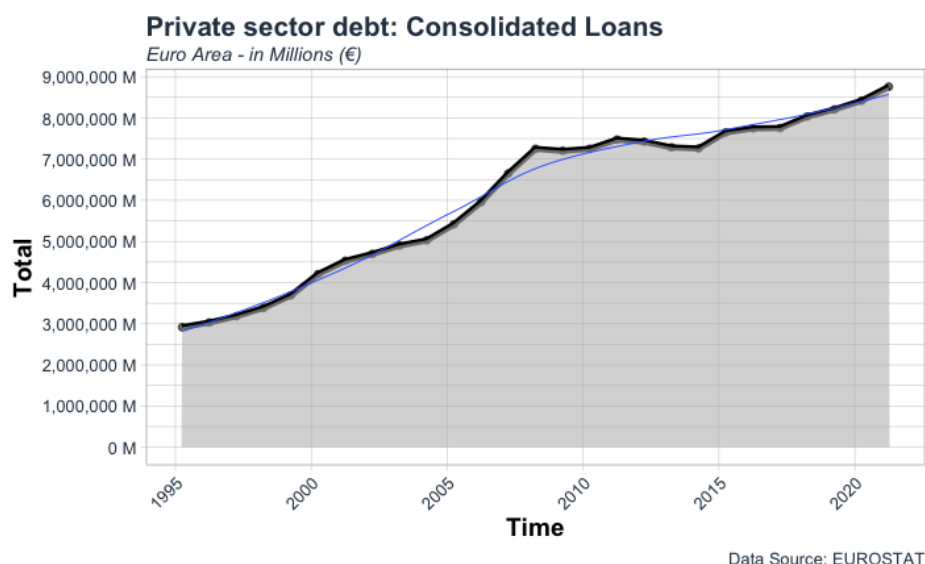


Figure 5: Level of Total consolidated Private sector Debt for the Euro Area.

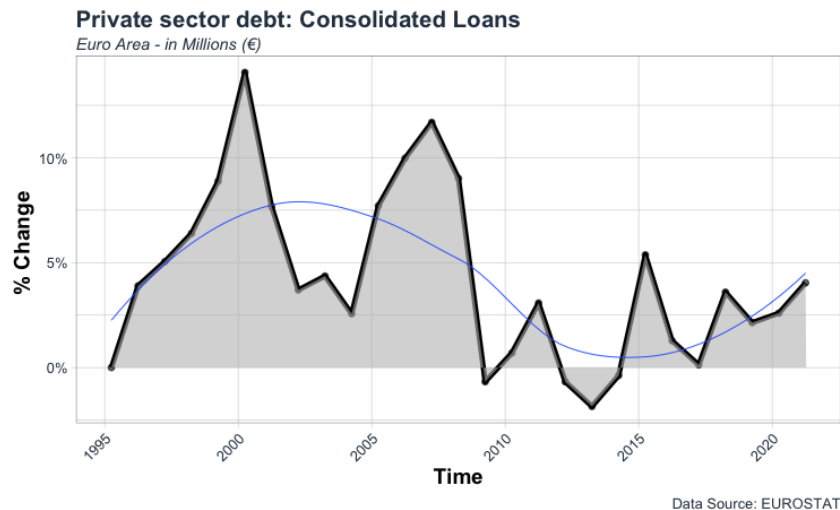


Figure 6: Change in the level of Total consolidated Private sector Debt for Euro Area.

During periods of financial stress, highly indebted households tend to cut their spending more than their less-indebted counterparts, thus amplifying the mechanism of cyclical risk materialization and explaining the deep fall in GDP seen during the 2007–2009 crisis and the subsequent slow recovery. It should be noted that higher indebtedness and a lower share of liquid assets change the sensitivity of the response of households to monetary policy (Gelos, 2019). Researchers widely recognize that certain structural characteristics of the financial sector or the economy in general directly affect the course of financial crises. Langfield and Pagano (2016) argued that countries with bank-based financial systems display higher systemic risk and lower economic growth than market-based ones, particularly during housing market crises.

Current research points to the existence of certain structural risk (of which indebtedness, both public and private is a key component) thresholds above which the economy is more vulnerable. Some studies suggested that there is a threshold effect whereby debt above 90% of GDP is associated with worse growth outcomes (Reinhart & Rogoff, 2010). Others have suggested the presence of negative long-run effects of debt on consumption and that these effects tend to intensify as the household debt-to-GDP ratio exceeds 60% (Lombardi et al., 2017). Despite different research on the topic, there is no simple debt ratio threshold above which medium-term growth prospects are severely undermined with statistical certainty, nonetheless, identifying a numeric threshold has the advantage of giving policymakers a single number as benchmark. Structural risks are not likely to develop in isolation but rather can create clusters of correlated structural risks that can exponentially amplify an adverse shock.

1.3.4 The Connection Between Structural and Cyclical Risks

The interaction between structural and cyclical risks correlated and varies across the financial cycle. Shin (2010) highlights that excessive asset growth leads to increased systemic risk arising from the banking system interconnection. On the other hand, Stremmel (2015) demonstrate that certain structural characteristics of the banking sector (referred to as structural risks) affect the magnitude of the financial cycle.

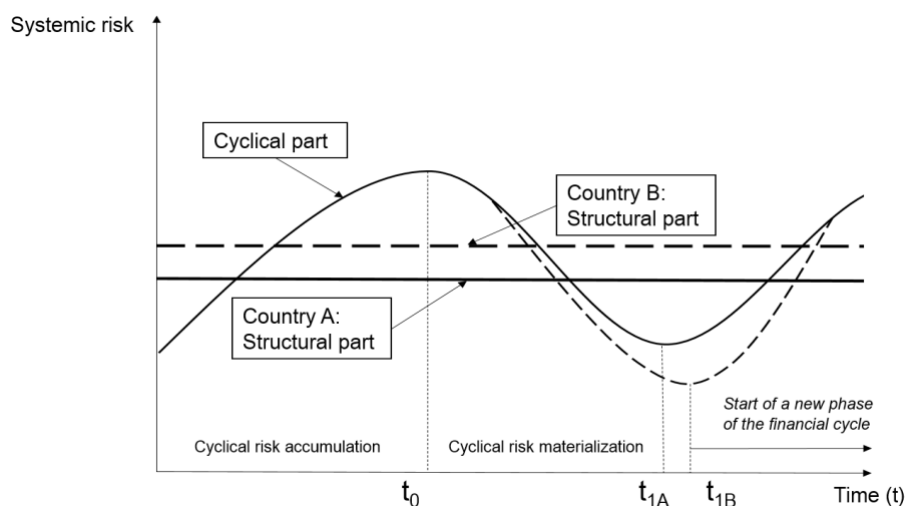


Figure 7: Stylized relation Between the Cyclical and the Structural Part of Systemic Risk.

Existing studies tend to investigate one structural element at time while leaving other aspects constant, in order to facilitate the quantitative analysis, this lead to the low number of empirical study on the relationship between cyclical and structural threats. Other works on the subject, such as Stremmel (2015), which investigated the relationship between cyclical aspects of the banking sector and a set of structural characteristics.

2 Analyzing Banking System Response

Examination and study of critical events, brings multiple benefits in terms of deep comprehension and evaluation, since financial crisis has increased in frequency over time, fully understanding the phenomenon will bring more clarity towards the procedure to adopt in similar scenarios in the future. As we will discuss later on, the diffusion of globalization had multiple benefits for the financial system but brought as downside possible increases in systemic risk. In this sense, studying how the complex system of financial infrastructure managed to develop resilience during and after different types of financial crises is important to gain a deeper understanding of mechanisms and correlations between causes and effects, enabling to assess strengths and weaknesses of the contemporary international risk management protocols.

The mechanisms in place could be divided in Precautionary and Rehabilitating measures, respectively with a *ex ante* and *ex post* approach to the occurrence. The following paragraph analyzes the adoption of some specific policies and mechanisms during the coronavirus crisis by the banking industry, in a collective effort with multiple European Institutions in order to ensure efficient functioning of the financial system.

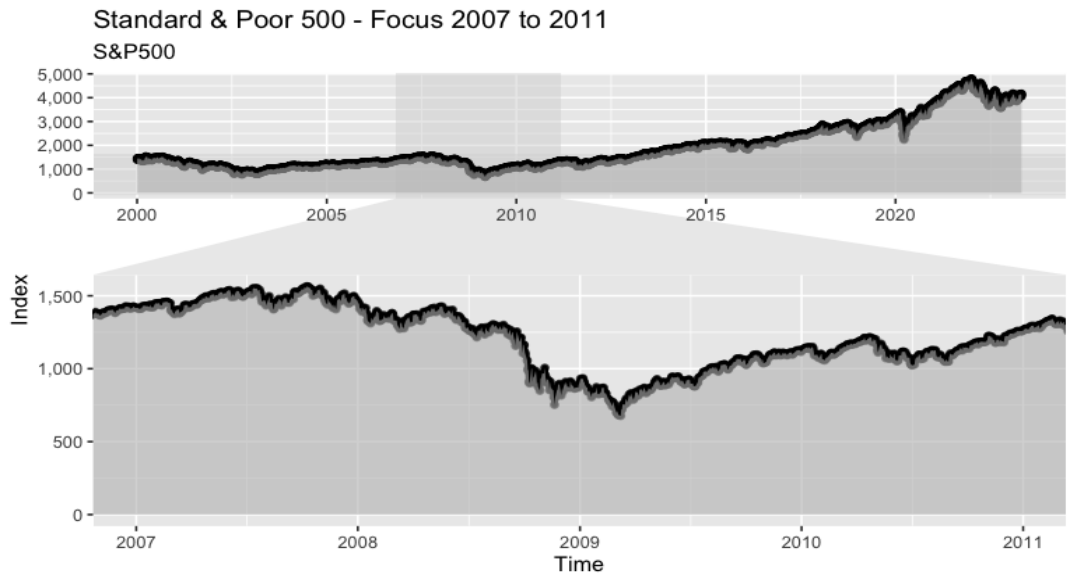
2.1 The immediate impairment to the financial system

The European financial system was severely affected by the COVID-19 pandemic during the initial phase of the crisis. The pandemic led to a sudden and sharp decline in economic activity, with many businesses being forced to shut down and millions of people losing their jobs. High unemployment, lower expectation for business revenues, and contracted consumer spending resulted in a significant increase in credit risk for banks and other financial institutions, leading to a liquidity crisis in the financial system. The European Central Bank (ECB) quickly responded to the crisis by implementing various monetary policy measures to provide liquidity to the financial system. These measures included the Pandemic Emergency Purchase Programme (PEPP), which allowed the ECB to purchase large quantities of government and corporate bonds to provide liquidity to the financial system. Additionally, the ECB also introduced a series of Targeted Longer-Term Refinancing Operations (TLTROs) to provide low-cost funding to banks, avoiding a sharp credit contraction. Despite the implementation of these measures, the European financial system experienced significant challenges during the initial phase of the pandemic. Many

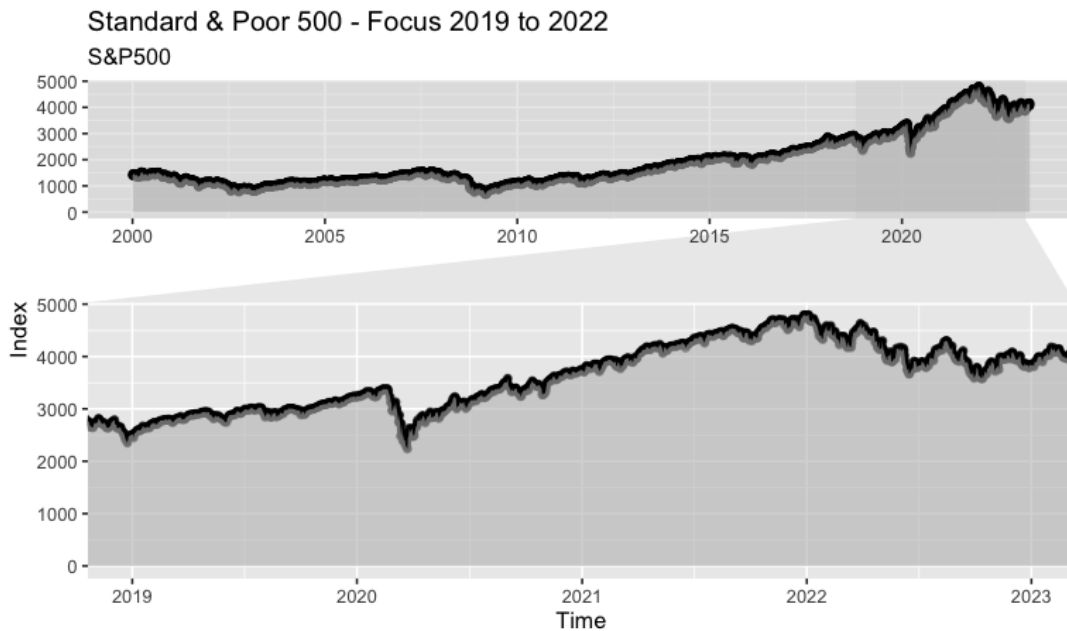
banks faced a surge in loan defaults, particularly in sectors such as hospitality, travel, and retail, which were hit harder by the pandemic. Additionally, many banks struggled to meet the regulatory requirements for capital and liquidity buffers, which led to increased pressure on their balance sheets. The EU enforced various measures to support the financial system during the crisis, among the emergency measures, the activation of the European Stability Mechanism (ESM) to provide financial assistance to member states in need. The European Union also introduced various fiscal stimulus packages to support the economy, including direct aid to businesses and households. Despite significant stress on the financial system, the response from the European Central Bank and the European Union helped to mitigate the extent of the crisis on the financial system through monetary and fiscal measures.

2.1.1 Lending sector during the Pandemic.

During the initial stages of the Pandemic crisis, various national legislators and European institutions implemented measures that had significant effects on banking activities, aimed at addressing the crisis. The regulatory actions taken by the Directorate-General for Competition, European Banking Authority (EBA), and ECB, as well as national legislators, had the objectives of sustaining business activities affected by the prolonged lockdowns and ensure financial stability. The initiatives undertaken by European authorities and national governments in the lending segment focused heavily on supporting firms and companies, which were the most negatively impacted by the circumstances. Due to the supply and demand shocks resulting from lockdowns, unemployment and overall uncertainty for the latter, and reduced product demand caused by customers being required to stay at home. During the initial phases some predicted that the economic fallout from the crisis may be the worst recession since the Great Depression of the 1930s. The following graphs show the Standard & Poor 500 Index with two different timeframes, on the 2009 Great Financial Crisis and on the recent Covid Crisis.



Data Source: EUROSTAT



Data Source: EUROSTAT

Figure 8: The graph shows a focus window of five years on the two most recent global economic crisis, in 2009 and 2020 during the Covid Pandemic.

The legal provisions and measures adopted by European and national legislators to support banks' financial assistance to industrial companies have shown both strengths and weaknesses. On one hand, such measures may help mitigate the negative effects of an economic downturn by ensuring enough credit lines to firms, small businesses, and corporations. On the other hand, banks faced challenges in providing credit due to doubts about the ability of debtors to repay their obligations, which amplified the negative effects of supply and demand shocks.

The lending activity has always been challenging, especially during times of recession, and banks were still repairing their balance sheets from the last global financial crisis. Therefore, the long-term effectiveness of the legal provisions and measures adopted will depend on how well banks will balance the need for supporting firms and ensuring financial stability with the potential risks and downsides. Among the others, moratoriums on payments and guarantees on new loans provided by national governments alleviated the financial burden on struggling firms during the initial phases. The decisions of the Directorate-General for Competition of the EU Commission and the guidelines provided by regulatory authorities such as the Basel Committee and EBA aim to provide clarity to banks and consumers on the application of prudential and supervisory measures to support lending to the real economy. The temporary relief measures adopted by the ECB Banking Supervision ensured that significant institutions were able to continue to support the real economy. Overall, these legal sources provided a framework for banks to offer financial support to struggling businesses and promote financial stability.

2.2 Legal framework of the Commission for government aid: policies adopted by national legislators

Three main measures have been adopted by the vast majority number of Member States to mitigate potential shocks on the financial system: moratoriums on existing loans, State guarantees on new loans granted by banks and subsidized interest rates for new loans funneled through banks, credit institutions or other public financial institutions. In Europe, a key objective has been to provide support to businesses that have been hit hard by the pandemic, while also ensuring financial stability. This has led to a range of regulatory initiatives from European authorities and national legislators aimed at achieving these dual objectives. At the heart of these initiatives is the need to support businesses that have been forced to close or have seen a decline in demand due to lockdown measures. Regulatory authorities such as the Basel Committee and EBA have provided guidance to banks on how to support lending to the real economy, while the ECB has implemented temporary capital, liquidity, and operational relief measures for significant institutions. While these measures have been designed to provide targeted support to businesses and ensure financial stability, there are limits to the amount of aid that can be provided and the duration of guarantees. These limits are necessary to ensure that the correct functioning of

the common market is not distorted, and to avoid the potential for long-term economic damage.

Overall, the legal provisions adopted by European and national legislators, as well as the measures approved by authorities, represent a significant effort to support businesses during this challenging time. While the full impact of these measures still remains to be seen, they represented an important step towards mitigating the short and medium-term effects of the pandemic on the European economy.

The exclusion of firms ‘in difficulty’ seems to be particularly appropriate, considering that notion referred to in the Temporary Framework.⁵ Those companies are indeed companies where more than half of their capital, has been depreciated as a result of accumulated losses or firm that has been subject to insolvency proceedings or who fulfill the criteria under their national law for being placed in collective insolvency proceedings at the request of their creditors.

According to the Commission's communication on the Temporary Framework, banks have a limited role in providing State aid to firms experiencing a sudden liquidity shortage. The aid takes the form of public guarantees and reduced interest rates, which are directly targeted at this issue. However, the Commission recognizes that such aid may also benefit the credit institutions indirectly. As a result, some safeguards has been implemented to limit any undue distortions to competition. It should be noted that this indirect aid does not aim to preserve or restore the viability, liquidity, or solvency of the credit institutions, and therefore, it cannot be considered as extraordinary financial support under the Bank Recovery and Resolution Directive (2014/59), which would trigger the resolution of banks (ECB, Guidance to Banks on Non-Performing Loans, 2017). On the one hand, banks replace the public administration in verifying whether firms meet the conditions established by law to obtain the State guaranteed loans, and, on the other hand, they carry out their core business, that is, granting credit to firms.

Banks should not relax the assessment of creditworthiness during the preliminary proceeding phase of their lending process, relying on public guarantees when lending to firms. Since public guarantees, despite being an additional layer of assurance are not a substitute for creditworthiness assessment.

⁵ In difficulty within the meaning of the General Block Exemption Regulation as defined in Article 2. (18) of the Commission Regulation (EU) No 651/2014 of 17 June 2014 declaring certain categories of aid compatible with the internal market in application of Articles 107 and 108 of the Treaty, OJ L 187 of 26.6.2014, p. 1.

Banks have a duty to ensure that the loans they provide are sustainable and that the borrowers have the ability to repay them. Relying solely on public guarantees without conducting a proper credit analysis may lead to banks granting loans to firms that are not creditworthy, leading to an increase in the risk of loan defaults. This specific case will be analyzed later in the document.

However, it is true that conducting a complex credit analysis may cause a time lag that is not compatible with the urgent need for liquidity of firms. To address this, some regulatory initiatives have been put in place to streamline the credit analysis process and provide guidance to banks. For example, the European Banking Authority (EBA) has issued guidelines on loan origination and monitoring that provide a framework for banks to assess the creditworthiness of borrowers in a timely and effective manner. The guidelines also emphasize the importance of risk management and the need for banks to adopt a risk-based approach to lending.

Even though the loans are guaranteed by the government, if a borrower is unable to repay the loan, the bank could still suffer losses. The public guarantee only covers a portion of the loan, and the bank would be responsible for the remaining portion. In addition, if many borrowers are unable to repay their loans, this could lead to a large number of defaults and losses for the banks, which could in turn lead to financial instability in the banking sector. Therefore, it is important for banks to carefully consider the creditworthiness of borrowers and to manage their loan portfolios in a responsible manner, even with the existence of public guarantees.

The extraordinary measures described above have a short-time horizon. But the effects of the pandemic on the economic system are likely to have long-term effects.

Indeed, in the short term the legislative provisions enacted by many Governments to support households and firms, like moratoriums and suspensions of mortgage payments for the purchase of houses as well as interventions to support household incomes and business continuity of companies, had and will have the effect of containing, even to a significant extent, the flow of impaired loans.

In the medium term, the credit quality of the loans provided by banks to companies will depend on how long the recession lasts and how quickly the economy recovers. Banks that have provided liquidity to firms with the assistance of the State guarantee will need to carefully consider the granted credit lines before making any abrupt decisions to cut them. Such decisions will need to be evaluated from both an accounting point of view and in accordance with the normal supervisory rules for capital provisions. This will ensure that

the banks are able to maintain their financial stability while continuing to support the real economy.

The following graph represent the Loan Loss Reserves for commercial banks in the US, from which we can observe an almost vertical increase, even steeper than the one occurred during the Great Financial Crisis of 2009. The last data available show what seems to be the initial phase of a plateau, arguably reached due to new satisfactory risk levels and the fulfillment of new regulatory requirements.

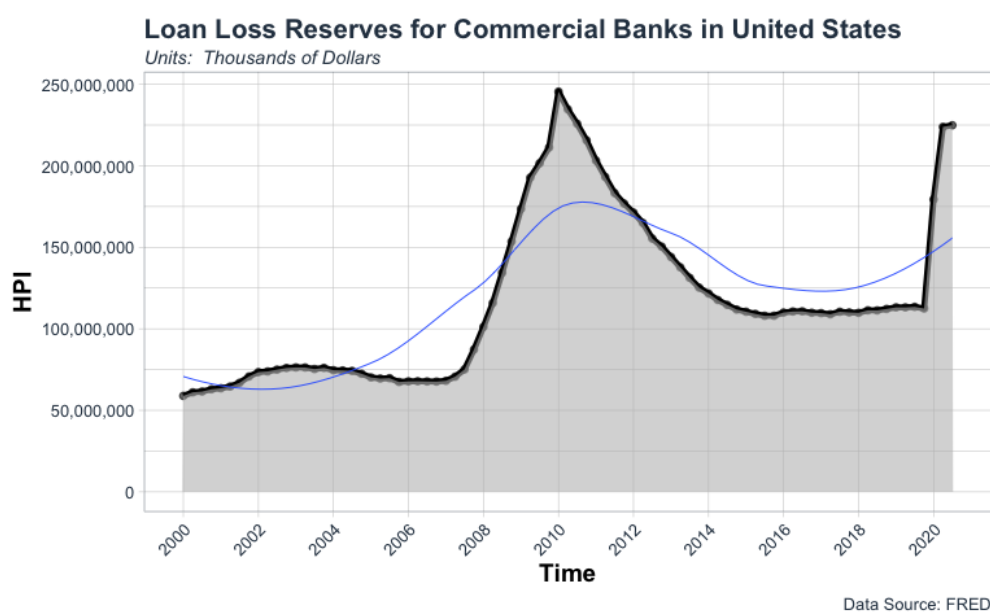


Figure 9: Loan Loss Reserves for Commercial Banks in United States (DISCONTINUED) [USLLR], retrieved from FRED,

2.2.1 Measures introduced by regulatory and supervisory authorities

To better comprehend the regulatory and supervisory authorities' actions, it is important to gain a deeper understanding of the possible short-term implication for the governments who implemented them and the outcome for banks in the long term.

The Basel Committee, the European Banking Authority, and the ECB established temporary capital, liquidity, and operating assistance programs for banks in an attempt to increase their capacity continue the funding of the economic system through the production of paperwork, the development of recommendations, and the implementation of regulations and guidelines. The intent of these regulations was to assess the consequences of government-implemented measures within the existing regulatory framework. Starting in 2020, the Basel Committee issued a document titled 'Measures to reflect the impact of COVID-19' with the intention of evaluating the impact of

extraordinary measures to mitigate the financial and economic impact of the COVID-19 consequences on the existing legal framework. The Basel Committee acknowledged that the risk-reducing effects of different exceptional assistance measures, such as government guarantees and various payment moratoriums, adopted in its member jurisdictions should be reflected in capital requirements based on risk-weighted measurements. To accomplish this, the Committee stated that, when determining a bank's credit risk requirement for loans subject to sovereign guarantees, the proper country's risk weight should be utilized. Afterwards, financial institutions calculating their capital requirements need to assess the risk-mitigating effect of the collateral in accordance with the Accord's general principles (CRE22 and CRE32 of the Basel Framework). Considering that the Basel Framework applies higher capital requirements to loans that are categorized as past due or in default, the Committee agreed that payment moratorium periods, publicly guaranteed or patronized by the bank, in relation to the Covid-19 outbreak could be excluded from the calculation of days past due loans when the if the payment schedule obtained the past due categorization in the last three months. In addition, the Basel Committee suggested that banks that have not yet done so take advantage of the transitional regime introduced with the implementation of IFRS 9, which was designed to mitigate the impact of unexpected events on regulatory capital. This framework, defined as transitional regulation has also been modified by the Basel Committee to enable jurisdictions that wish to utilize it to spread out the effects of the new value adjustments over a longer period of time and with more favorable mechanisms than are currently envisaged. In order to be implemented in Europe, this modification requires an amendment to the Framework regulating the prudential requirements for banks and investment firms (Regulation (EU) No. 575/2013) (P. Angelini, G.Gobbi).

In the months of March and April, 2021 EBA published several communications that called on the competent authorities to make use of the full flexibility provided for in the existing regulation and to establish guidelines containing a number of interpretative aspects on the functioning of the prudential framework in relation to the classification of loans in default, the identification of forbore exposures, and their accounting treatment. In these communications, the EBA also requested that the competent authorities use the full flexibility provided for in the existing regulation. The EBA stated that general payment delays caused by legislative initiatives which affected all borrowers do not automatically result in default, forbearance, or inability to pay. Prioritization should instead be based on an individual's likelihood of repayment. The EBA's approach to determining the extent to which the application of national laws mandating a payment moratorium could affect the classification of exposures appears to be rather conservative. Government measures are only one factor that banks must take into account when categorizing their exposure and determining their accounting treatment. Banks are not exempt from standard evaluations of the likelihood of loan repayment and the creditworthiness of financed companies. As the economic effects of the coronavirus became apparent by March 12, 2020, the ECB issued a series of specific measures aimed at guaranteeing that financial institutions could continue to finance the real-world economy. Many of these initiatives are supplemental to those implemented by governments in order to guarantee their full efficacy without interference from existing limitations imposed by the prudential regulation of banks. To achieve this goal, the ECB has introduced supervisory flexibility regarding the treatment of nonperforming loans (NPLs), allowing banks to gain full take advantage of guarantees and moratoriums implemented by government bodies in response to the faced distress.

ECB declared that, on a temporary basis, it will exercise flexibility regarding the classification of debtors as 'unlikely to pay' when banks call on public guarantees granted in the COVID-19 pandemic context. The ECB will also exercise a certain amount of flexibility regarding loans under COVID-19 related public moratoriums. Second, loans that become non-performing and are under public guarantees will benefit from preferential prudential treatment in terms of supervisory expectations about loss provisioning. Moreover, in the short term, supervisory authorities have adopted specific measures relaxing capital constraints, namely temporary capital, liquidity, and operational relief

measures to ensure that significant institutions are able to continue to support the real economy.

According to the ECB guidelines, banks will benefit from relief in terms of the composition of capital for Pillar 2 requirements. Furthermore, banks are allowed to operate temporarily below the level of capital defined by the Pillar 2 guidance and the capital conservation buffer. One last recommendation to banks from the ECB tries to balance the need to favor the capacity of banks to finance the real sector with the need to preserve the robustness of the bank's capital. Indeed, on 27 March 2020, the ECB updated its recommendation to banks on dividend distributions. To boost banks' capacity to absorb losses and support lending to households, small businesses and corporations, during the COVID-19 pandemic, has been recommended not to pay dividends until October 1, 2021. In any case, the ECB underlined that in the medium-long term, banks should continue to apply sound underwriting standards, pursue adequate policies regarding the recognition and coverage of non-performing exposures, and conduct solid capital and liquidity planning and robust risk management. To summarize, regulatory and supervisory authorities adopted a wide range of flexibility in applying regulatory standards and in interpreting the impact of government measures in terms of risk-reducing effects for accounting purposes and capital requirements. Despite this effort, an overview of the rules issued by governments, by the Commission for State aid and by supervisors does not suggest that banks' activity has changed radically as compared to the past. Banks could apply more flexible classification and accounting standards to assess the probability of default of firms; the measures relaxing capital constraints enlarge banks' possibilities to expand credit lines to firms. The bank's lending activities remains based on the assessment of the creditworthiness of the firm financed even if conditions for the borrower is favored by regulators.

In the time of COVID-19, the granting of credit must be based on verification of the firm's ability to repay the loan. The assessment of the impact, both in the short-term and in the medium-term, of the forced lockdown caused by COVID-19 and of what may happen going forward on the capacity of the firm's recovery remains with the bank.

This interpretation limits the capacity of the extraordinary aid measures taken by governments to face the firm's liquidity shortfall but reduces the risk that the industrial crisis will be transmitted to banks with dramatic consequences in terms of financial stability.

The predicted recession will have an impact on financial stability in the medium to long term, to cope with this problem, namely the large amount of non-performing loans as a result of the COVID-19 crisis, the European community will need to implement extraordinary tools Union level.

The following graph shows the total amount of member state government guarantees on debt, registering a sudden increase starting from 2020 in accordance with the policies implemented by the ECB.

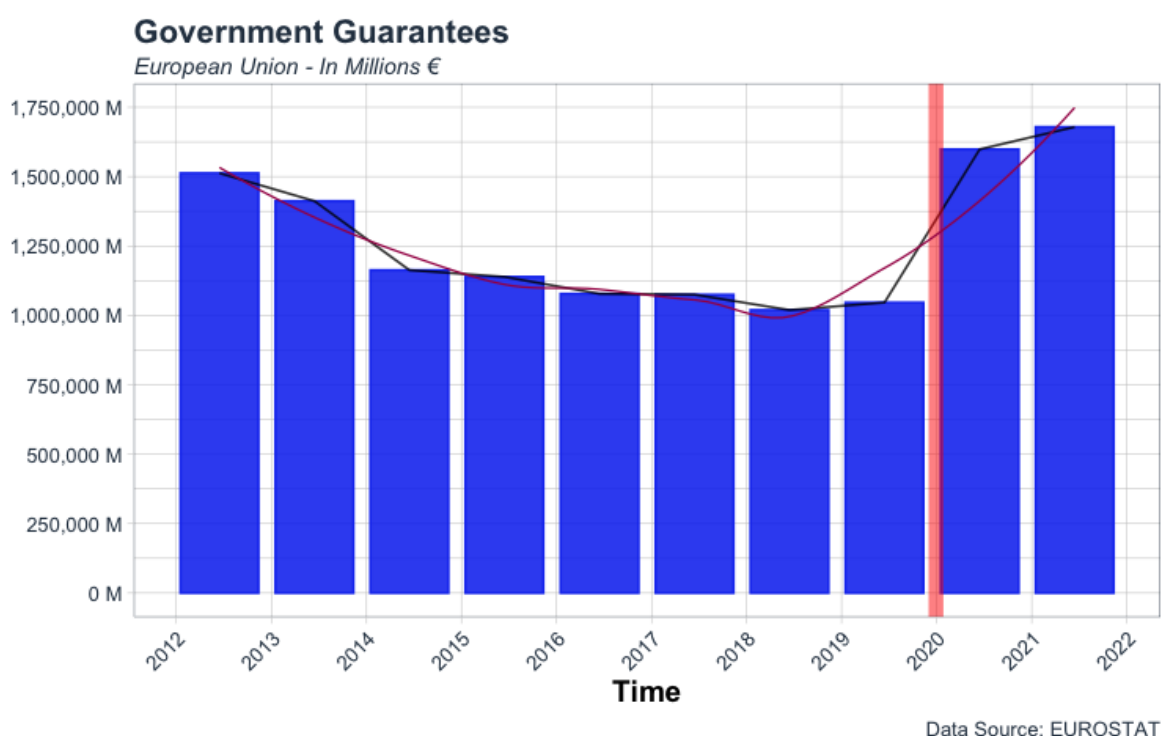


Figure 10: The Image shows the increase in volume of State backed guarantees on debt from European Union Member States.

https://ec.europa.eu/eurostat/cache/metadata/en/gov_cl_esms.htm

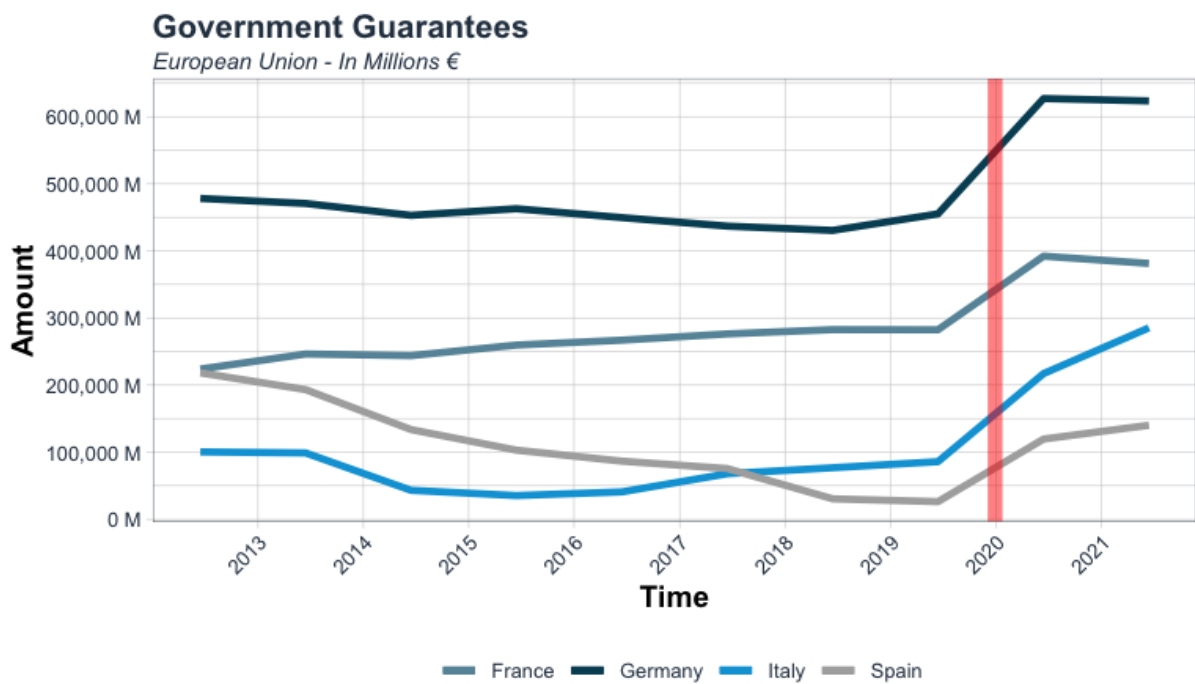
The answer to the firm’s request to get available financial resources in a short time, however, is not to make the banks the government’s *longa manus*. On the contrary, banks should have strong incentives to carry out their business in the most efficient way, reducing the bureaucratic burdens in granting credit and focusing on assessing the economic prospects of the company financed in the medium and long term. To boost economic growth in the European market, where bank-oriented systems prevail, it is crucial that banks establish long-term stable relationships with the companies financed.⁶

⁶ Ignazio Angeloni, ‘ECB should turn to the supervisory forbearance’ (March 2020) LUISS SEP Policy Briefs 7/2020

The euro area banking market has been integrated to some degree, although this process involved to a limited extent the retail banking sector.

It will be imperative to devise a European strategy to address the significant surge in non-performing loans (NPLs) that is anticipated to result from the recession following the pandemic crisis. While the aforementioned public interventions have helped to alleviate the adverse effects of the Covid-19 crisis on the economy, these measures were implemented at the national level, albeit with the Commission's authorization under the Temporary Framework for State Aid.

The following graph shows the amount of government guarantees for France, Germany, Italy and Spain, reelevating a similar behavior between the member states, with Germany and Italy having increased the guaranteed value the most.



Data Source: EUROSTAT

Figure 11: The image shows the amount of guaranteed volume by Germany, France, Italy and Spain.

2.2.1.1 Supervisory measures limiting distribution to shareholders

As mentioned, prudential supervisors, mostly in Europe, have adopted a number of measures recommending suspending both dividends distribution and share buyback⁷. After the global financial crisis, this aspect has acquired paramount importance and, in fact, in the context of the EU, the special provisions of CRR-CRD IV, on one side, request the supervisor's authorization to purchase own shares and, on the other, limit the possibility to distribute dividends when capital falls below a given threshold (so-called MDA). The importance of capital adequacy is further reiterated by the role of supervisory authorities that are meant not only to verify the compliance of institutions with regulatory requirements but may also set additional capital requirements under the stakeholder friendly corporate purposes, which highlights that now is the time to verify the role of corporate actors with respect to environmental issues and protection of employees, customers, and suppliers. Several recent statements in the banking field made by the Basel Committee of Banking Supervision, the European Banking Authority (EBA), and the European Central Bank, also highlighting that banks are invited to act responsibly, including by refraining from making dividend distributions to shareholders or adopting a conservative approach to the payment of variable remuneration namely final year bonuses. Supervisory review process (SREP), as a result of an assessment of the effective adequacy conducted on a case-by-case basis, against the actual exposure to risks not captured by the regulatory capital requirements⁸.

It is therefore not surprising that European regulators and supervisors have foremost highlighted the necessity that, in making their own decisions, banks and insurance companies pay careful attention to the need to strengthen their capital position. Accordingly, in view of the exceptional situation and the uncertainties concerning the seriousness of its impact on the economy, generally, these institutions were expected to refrain from remunerating shareholders through capital distributions.

The measures adopted in Europe by the authorities in the banking and insurance sectors to face Covid-19 do not just recall the need to ensure the institutions' stability to justify their

⁷ ³¹ The European Commission has also intervened in this regard with the Commission Interpretative Communication on the application of the accounting and prudential frameworks to facilitate EU bank lending (Supporting businesses and households amid COVID-19), 28 April 2020.

⁸ ³² For a recent overview of the CRD IV framework see Peter O. Mülbart and Alexander Wilhelm, 'CRD IV Framework for Banks Corporate Governance' in: Danny Busch and Guido Ferrarini (eds.), European Banking Union (2nd edn, OUP 2020).

recommendations to suspend dividends distribution and share buyback. They indeed refer such recommendations to a broader understanding of the role that banks and insurance companies should play in the economy and, more generally, inside society.⁹ In its initial recommendation, the ECB urged every bank to assess very prudently their appropriateness to pay out shareholders and, after grouping banks in different categories on the basis of the outcome of the capital adequacy assessment, intensified its recommendations by inviting the most exposed banks to fully retain earnings with a view to increasing their ability to absorb losses. In the last Recommendation, the request to refrain from capital distributions until October 2020, addressed to every bank, does not mention the need to enhance capital requirements further to face the significant losses resulting from the pandemic emergency. By contrast, it refers to the ability of banks to lend to the real economy and the need that banks will be in a position to finance both households and businesses in the period of the economic crisis that will inevitably follow the pandemic. In other words, the authorities' pressure to suspend any shareholders distribution is not primarily instrumental in enhancing banks' resilience, but rather in inducing banks to allocate as many resources as possible to their lending activities, in order to ensure they continue performing during the economic crisis their characteristic intermediation function. A reference to the peculiar function that, particularly during a crisis, banks are expected to play in order to support the economy and society is also made both in the measures adopted by the national competent authorities operating within the SSM and in the Statement addressed by the UK PRA to the largest UK banks. Analogous considerations concerning the need that also insurance companies have to keep on performing their characteristic intermediation function in transferring risks are made both in the last EIOPA's Recommendation and in the Statement addressed by the UK PRA to UK insurance institutions in order to explain the request to refrain from distributing net equity to shareholders.

Actually, the supervisory measures adopted by the European authorities are to be considered in the light of the results of the debate on the corporate purpose of financial institutions, particularly with regard to banks, that started after the global financial crisis and which have already led to progressively rethink, in this context, the shareholders' interest primacy¹⁰. Once the collective interest to the stability of the financial system has

¹⁰ The literature on this topic is extensive, among the most recent contributions, see Klaus J. Hopt, 'Corporate Governance of Banks and Financial Institutions: Economic Theory, Supervisory Practice, Evidence and Policy' (2020) ECGI Law Working Paper No 507/2020

emerged as crucial, the need to ensure that banks conduct their business with an adequate level of capital has become the primary objective of the regulation, and it has fostered a progressive shift in the corporate purpose of banks.

On the basis of these assumptions, the shareholders' interest was firstly placed at the same level as the other stakeholders' interests and then expressly subordinated to the depositors' interest, since the latter have been identified as the ones more interested to the bank's solidity.¹¹ The recent measures adopted by the supervisory authorities, from this viewpoint, seem to go even further, since they emphasize – the need that banks and insurance companies must perform their activity by pursuing, as their main objective, the goal that both banking intermediation and insurance intermediation can effectively continue. And this is even more so in light of the exceptional crisis that could occur, where the ability of banks to lend to the real economy as well as the ability of insurance companies to offer risk protection will be crucial for the survival of both the economic and social system.

Companies which have been hit by the health emergency and have accessed public support are made subject to a special regime characterized by a legislative restriction on shareholders' distributions that may imply, more or less temporarily, a substantial change in the company's purpose. Accordingly, shareholders' interests, which are no longer considered exclusive or prevailing, end up being subordinated to other interests, if not even temporarily cancelled.

2.2.2 NPL management

The European Commission and the Council recognized the need to set up an action plan for NPLs in Europe.¹² The Council agreed that measures to address existing stocks of NPLs and prevent a further accumulation of NPLs in the future would be beneficial for the EU as a whole. However, due to the large variation within the EU in the ratio of NPLs to total bank loans, the European institutions did not find a way to compromise on a European mechanism to tackle this issue.

¹¹ Such evolution can be appreciated thoroughly by comparing the objective of corporate governance of banks in the different versions of Basel Committee corporate governance principles for banks: 'Enhancing Corporate Governance for Banking Organisations' (16 September 1999)

¹² Council of the European Union, 'Report of the FSC Subgroup on Non- Performing Loans' 9854/17 EF 113 ECOFIN 481.

The case for action to develop an efficient secondary market in Europe for NPL transactions was very clearly highlighted, but no Pan-European solution was proposed.¹³

The need for a comprehensive response to clean up legacy assets of the 2007-2009 global crisis has already been supported in 2017 in a paper signed, by the Chair of the EBA and two other staff members of the EBA. The paper proposed a possible European scheme, which could have consisted of a single Asset Management Company (AMC), or of a coordinated blueprint for government-sponsored AMCs. Banks could have transferred some agreed segments of their NPLs to the AMC at their ‘real economic value,’ different from their ‘market value,’ under due diligence from the AMC and accompanied by full data sets available to potential investors. Aimed at addressing the inter-temporal pricing problem by overcoming market liquidity issues, the proposal provided a mechanism to ensure that if the ‘real economic value’ would have not been achieved within a limited timeframe or the assets would have remained unsold, the bank would have taken the full market price hit.

National responses, *i.e.* State aid to the national banking sector, will not be enough to limit the impact of the recession that will affect the European banking market as a whole, although not in a homogenous manner, preserving financial stability.

Because it is retained indispensable to safeguard the financial stability of the euro area as a whole and of its Member States’ (Article 3 of the ESM Treaty). The need for collective European action required by the coronavirus crisis makes a new approach on State aid controls urgent. This perspective will facilitate the setting up of a European vehicle to manage NPLs. The coronavirus pandemic exacerbated a problem already embedded in the EU legal sources regulating banking activity: the lack of flexibility of the rules due to the choice of the European legislature to fix, at the legislative level, a detailed framework for prudential supervisory purposes. This is a crucial point, which delays the prompt adaptation of prudential rules to crisis situations, aimed at mitigating their pro-cyclical nature.

Two examples are helpful to clarify the problem. The first significant case, already mentioned above, concerns the transitional regime introduced with the entry into force of IFRS 9, provided precisely for the purpose of mitigating the impact on the regulatory capital of unexpected events. The Basel Committee’s proposal to dilute the impacts of the new value adjustments over a longer period and with a more favorable mechanism than

¹³ See Emiliós Avoguelas ‘The EU Framework dealing with non-performing exposures. Legal and economic analysis, in Danny Bush and Guido Ferrarini (eds.) Banking Union (2nd ed., OUP 2020).

those currently envisaged, in Europe it requires amendments to Capital Requirement Regulation (Reg. 575/2013). The second relevant case is that of the new framework for the prudential treatment of NPLs.

The Council decided to establish minimum loss coverage for non-performing exposures, detailing the different coverage requirements depending on the classifications of the NPLs as ‘unsecured’ or ‘secured’ and whether the collateral is movable or immovable, amending Regulation (EU) 575/2013.

The same standards were established by the ECB within a Guidance to banks. Because the pandemic crisis required some degree of flexibility in the application of these standards, the ECB guidelines eventually changed, while Regulation 575 requires a long process of reform involving the Commission, Council and European Parliament. Precisely for the reasons outlined above, on 28 April 2020 the Commission proposed a few targeted ‘quick fix’ amendments to the EU’s banking prudential rules (the Capital Requirements Regulation) in order to maximize the banks’ ability to lend and absorb losses related to the coronavirus pandemic. The Commission proposed exceptional temporary measures to alleviate the immediate impact of coronavirus-related developments by adapting the timeline of the application of international accounting standards on banks’ capital, by treating public guarantees granted during this crisis more favorably, by postponing the date of application of the leverage ratio buffer and by modifying the way of excluding certain exposures from the calculation of the leverage ratio. The fast reaction from the Commission, in its role as legislator, is very welcome, but it highlights how difficult it is to adapt the current regulatory framework very rapidly to changes that can suddenly and unexpectedly occur in the real economy, as is the case with the pandemic crisis. Having inflexible rules codified by law, meaning within the European legal framework directives and Council Regulations, will help to achieve a level playing field among different legal and market systems. But they also create obstacles, which can be hard to overcome, when there is the need, as is the case of the crisis, to adapt the rules to new scenarios. The use of delegated legal acts to establish a detailed regulatory picture and an extensive use of the interpretative powers of European authorities, like the EBA, will favor a more flexible legal framework that will grant regulatory authorities the possibility to promptly react to crises such as the one we recently experienced.

2.3 Insight on Possible risk for the future

The result from massive liquidity injection in the financial markets and in the real economy allowed a rapid rebound of the economy after the initial crash due to the outbreak, but the consequence of this maneuver will continue to impact the world economy for years to come. Possible risks caused by this extremely expansive environment will be described in the following paragraph and then data analysis will be presented in order to identify economic evidence currently pointing towards those risk, in order to understand if those risks could materialize in the short to medium term.

2.3.1 Functioning of a Loan Loss Provision (LLP)

A loan loss provision is a reserve that banks and other financial institutions create to cover potential losses on loans and other credit products. This provision is an accounting entry that reduces the bank's profits and serves as a cushion against any losses that may arise due to credit defaults, bankruptcy, or other unforeseen events. When a bank creates a loan loss provision, it sets aside a portion of its earnings to cover potential future losses. This reserve is then reported on the bank's balance sheet as a liability, reducing the bank's net worth. The amount of the loan loss provision is based on a number of factors, including the type of loan, the borrower's creditworthiness, the economic climate, and other risk factors. The loan loss provision is an important tool for managing credit risk and ensuring the stability of the financial system. By creating a reserve for potential losses, banks can continue to lend to borrowers with confidence, knowing that they have a cushion against any unexpected losses. In addition, the LLP helps to ensure that banks remain financially sound and able to meet their obligations to depositors and other creditors. It is important to note that LLP can have a significant impact on a bank's financial performance, when a bank creates a provision for losses, it reduces its profits for the current period, which can have a negative effect on its stock price and other financial metrics. However, by taking a conservative approach to credit risk management, banks can help to ensure their long-term stability in adverse economic periods. Since the 2008 financial crisis, lending standards and reporting requirements have been subject to frequent changes and increasingly stringent constraints. The Dodd-Frank Act, which introduced enhanced regulations for banks, aimed to raise lending standards by imposing stricter requirements for borrower creditworthiness and higher capital liquidity standards for banks. Despite the improvements in lending standards, banks still face issues such as late payments and loan

defaults. These events have an impact on the bank's income statement, as the loan loss provision is recorded as an expense, leading to a decrease in operating profits. LLP are regularly updated to reflect changes in estimates and calculations based on statistics related to the bank's customer defaults. Historical default rates for different levels of borrowers are used to calculate these estimates. Credit losses resulting from late payments and collection expenses are also included in these calculations using a similar methodology that considers the previous payment statistics of a bank's credit clients. Through setting aside loan loss reserves and regularly updating estimates through loan loss provisions, banks can present an accurate assessment of their overall financial position. This financial position is typically released publicly through the bank's quarterly financial statements. Overall, loan loss provisions help ensure that banks are adequately prepared for potential losses resulting from loan defaults and late payments and can operate in a financially stable and responsible manner.

2.3.2 Non-Performing Loans (NPL)

Credit risk is an inherent aspect of banking, as granting loans always comes with the risk of them not being repaid. Therefore, credit risk is a significant focus of the ECB's supervisory work, which places special attention on non-performing loans (NPLs).

The level of non-performing loans is crucial for the economy, as these loans negatively impact banks' profitability and consume valuable resources, limiting their capacity to issue new loans. Banking issues can also spread rapidly to other sectors, posing a threat to employment and growth prospects. For this reason, the ECB supports banks in addressing this matter, thereby promoting the safety and stability of the European banking system.

As of mid-2020, banks under the ECB's direct supervision had non-performing loans worth over €550 billion on their balance sheets, equating to nearly 3% of their total loan portfolios. The amount of non-performing loans has been declining steadily since its peak in 2016 of approximately €1 trillion. However, the economic fallout of the COVID-19 pandemic is likely to result in a significant increase in non-performing loans.

The ECB's quarterly supervisory banking statistics offer additional information regarding the extent of non-performing loans.

2.3.3 Zombie lending

Zombie lending, also known as "zombie lending" or "zombie firms," refers to the practice of banks' lending money to firms that are technically insolvent and unable to repay their debts. These firms continue to operate due to the bank's loans, even though they are not profitable and have little chance of being so in the future.

This practice is called "zombie lending" because it allows these firms to survive in a state of financial limbo, much like a zombie that is neither fully alive nor dead. While zombie lending can provide some short-term benefits, such as maintaining employment and avoiding a sudden shock to the economy, it can also create long-term economic problems by preventing resources from flowing to more productive uses and sound companies.

Zombie lending has become a growing concern in many economies, particularly in the aftermath of the global financial crisis and then with the global pandemic crisis. According to a report by the Bank for International Settlements (BIS), the share of zombie firms in advanced economies has risen significantly in recent years, reaching around 12% in 2016. The report also found that zombie firms tend to have lower productivity and are less likely to invest in new technologies or expand their businesses.

2.3.4 Inflation

Inflation risk denotes the potential diminishment of monetary purchasing power resulting from a rise in the aggregate price level of goods and services within an economy. Factors contributing to inflation may include an expansion in the money supply, a contraction in the availability of goods and services, or an amalgamation of both phenomena.

The implications of inflation risk on an economy can be multifaceted and detrimental. A prominent consequence is the depreciation of the real value of currency. As monetary value declines, the purchasing capacity of individuals and enterprises correspondingly diminishes. This can precipitate a reduction in economic growth, as consumers and businesses may curtail expenditure due to elevated prices for goods and services, thereby initiating a downward economic spiral. In addition, inflation can exert influence on interest rates; specifically, central banks might elevate interest rates as a countermeasure against escalating prices. Elevated interest rates can result in decreased borrowing and expenditure, further impeding economic growth. Moreover, inflation can considerably affect investments, as it undermines the value of fixed-income securities, such as bonds, by diminishing the

purchasing power of interest payments and principal. In a similar vein, inflation can impact equity investments, as corporations may encounter difficulties in sustaining profits within a high-inflation milieu. Consequently, inflation risk constitutes a vital consideration for policymakers, investors, and individuals, given its substantial ramifications on the overall well-being of an economy and financial markets.

As a pressing concern for the European Central Bank (ECB), the present levels of inflation will be scrutinized in Chapter 4.

2.3.5 Credit risk

Increasing credit risk refers to the likelihood of default on a loan or credit product. When a borrower defaults on a loan, the lender loses money. Credit risk is one of the main concern for lenders, especially in times of economic uncertainty or when borrowers are struggling to meet their financial obligations.

There are several factors that can contribute to increasing credit risk. One of the primary factors is the borrower's creditworthiness. If a borrower has a low credit score, a history of missed payments, or a high level of debt, the risk of default is higher. Economic conditions can also contribute to credit risk, as a recession or other financial crisis can make it difficult for borrowers to meet their financial obligations.

In addition, the type of credit product can also affect credit risk. For example, unsecured loans or credit cards are typically riskier than secured loans, as there is no collateral to back up the debt. Loans to borrowers in certain industries, such as those in the energy or retail sectors, may also be riskier due to the potential for changes in market conditions.

Lenders use a variety of methods to assess and manage credit risk. This can include credit checks, borrower's financial history, and the request of a collateral or a guarantor for the loan. Lenders usually set interest rates based on the estimated level of credit risk, with higher rates charged for riskier borrowers. Overall, increasing credit risk can have significant implications for lenders and borrowers alike. It is important for lenders to carefully assess and manage credit risk to mitigate the potential for losses, while borrowers should take steps to maintain good creditworthiness and stay up to date on their financial obligations in order to avoid seeing future loan request being denied or the application of unfavorable condition or rates.

2.3.6 Euro currency devaluation

Currency devaluation refers to reduction in the value of a currency relative to another currency, commodity or a basket of currencies. The major causes of currency devaluation include:

- Trade imbalances: when a country has a large trade deficit, which means it imports more than it exports, its currency may depreciate as demand for its currency falls in the foreign exchange market.
- High inflation: as seen before if a country has a high rate of inflation, its currency may lose value as it becomes less attractive to hold. This is because higher inflation erodes the purchasing power of the currency, making it less valuable in the eyes of investors.
- Political instability: Political instability and uncertainty can cause investors to lose confidence in a country's economy and currency, leading to devaluation.
- Decrease in interest rates: A decrease in interest rates can lead to a decline in the value of a currency. This is because lower interest rates reduce the attractiveness of a currency for foreign investors, leading to a reduction in demand.
- Economic sanctions: Economic sanctions imposed by other countries can also lead to currency devaluation. This is because sanctions can reduce a country's ability to trade with other countries and limit its access to foreign currencies.

In conclusion, currency devaluation can have significant implications for a country's economy, including higher inflation, reduced purchasing power, and increased debt. Therefore, it is essential for policymakers to monitor the factors that can lead to currency devaluation and take appropriate measures to mitigate their impact.

3 The Response of Central Banks

The Covid-19 shock posed an unprecedented challenge to the banking system, as it caused an unexpected global halt in economic activity due to supply chain disruption brought by forced global lockdowns. This created a Knightian environment in which numerous possible scenarios were unable to be fully understood or projected, making inflation and economic growth predictions extremely difficult. Due to the extreme unpredictability, some central banks, including the Federal Reserve, the Bank of Canada (BoC), and the Bank of England (BoE), did not issue their typical forecasts during the initial phase of the pandemic. Additionally, the financial sector responded severely to the shock that caused heavy effect in most treasury and equity market. These market distortions caused concern in relation to the possible effectiveness of the typical channel through which central banks usually operates. The unprecedented nature of the Covid-19 crisis required Central bank to modify their monetary policy approaches employing a variety of new tools to gain control of the financial system. The emphasis of monetary policy shifted from the traditional mission of inflation targeting to promoting financial stability while ensuring the efficient operation of financial markets. This scenario necessitated more direct central bank intervention in financial markets and the provision of liquidity to guarantee the efficient functioning of these markets.

Overall, the Covid crisis demonstrated the necessity for central banks to be both flexible and versatile in their monetary policy approach, particularly during times of high uncertainty. The swift and decisive measures implemented by central banks contributed to restore equilibrium in financial markets and contributed to economic recovery, despite the unique challenges presented by the crisis.

3.1 Type of responses

During the Covid-19 crisis, central banks responded rapidly and aggressively by deploying a range of tools in a multidimensional strategy to address overlapping challenges. These tools can be broadly categorized into rate cuts and forward guidance, asset purchases, liquidity provision and credit support, and regulatory easing. First, rate cuts and forward guidance were utilized to ease strains in markets and support aggregate demand, helping economies to rebound. Second, asset purchases were used to address widespread dysfunction in key financial markets and provide additional support for aggregate demand. Third, liquidity provision and credit support were implemented in conjunction with governments to support the provision of credit to businesses, ensuring that viable firms could survive the crisis and support employment once the crisis ebbed. Finally, regulatory easing, such as reductions in the countercyclical capital buffer (CCyB) and other requirements for liquidity and capital buffers, were implemented to prevent banks from amplifying the contraction in credit and liquidity to meet regulatory standards. Overall, the response to the Covid-19 crisis demonstrated the need for central banks to have a wide range of tools available to address challenges and maintain economic stability. The use of rate cuts, forward guidance, asset purchases, liquidity provision and credit support, and regulatory easing were all crucial in addressing the challenges of the pandemic and supporting economic recovery. The Covid-19 crisis demonstrated that monetary policy, which used to be the primary focus of central banks, was only a small part of the response. This wide-ranging response to the crisis ended the arbitrary distinction between 'conventional' and 'unconventional' policies. Cutting rates to zero or negative, using forward guidance, buying assets, and implementing more generous lending programs are now all common tools of monetary policy. Even emerging markets, which had previously relied mostly on adjustments to policy rates and FX intervention, began to use asset purchases and other 'new tools' without generating a negative market reaction.

The response to the Covid-19 pandemic was aided by the prior research and work done in response to the Global Financial Crisis (GFC) (Claessens et al. 2020). The infrastructure already in place, such as the long-term lending facilities at the European Central Bank (ECB) and the Bank of Japan (BoJ) and the network of foreign exchange swaps, contributed to keeping banking systems stable and tensions in global funding markets manageable (Fratzscher 2020). Tools that had previously been used in the GFC, such as purchases of government bonds and the provision of liquidity to financial markets, were

quickly reactivated, benefiting from subsequent research and lessons learned about the risks of acting too timidly (Borio 2020).

The policy response to the pandemic was swift and decisive, with central banks using their balance sheets to purchase assets and inject liquidity into the financial system, while governments implemented fiscal stimulus measures (Haldane 2020). The coordinated response across countries and international organizations helped to prevent a global recession (Gopinath 2020). However, concerns have been raised about the low interest rate environment and the extensive use of unconventional monetary policy tools, which have the potential to create asset bubbles and undermine financial stability (Bernanke 2020). The pandemic has also exposed shortcomings in globalization and the need for a more resilient and sustainable global economic system (Stiglitz 2020). The disruption to supply chains and the challenges faced by vulnerable workers around the world underscore the need for a more equitable and sustainable economic model (Mazzucato 2020). Policymakers will need to take these issues into account when developing policies to respond to future crises. In conclusion, the prior research and work done in response to the GFC proved instrumental in the response to the Covid-19 pandemic (Rey 2020), enabling policymakers to act quickly and decisively. While the response was effective in preventing a global recession, it also highlighted the limitations of the existing policy framework and the need for a more sustainable global economic system (Roubini 2020). As the world continues to grapple with the pandemic and its aftermath, policymakers will need to draw on the lessons learned from prior crises and work to build a more resilient and equitable economic system. In contrast, the response was slower and initially more cautious with new tools, even if the category (i.e. asset purchases) was not new. For example, the Federal Reserve was initially somewhat cautious in its purchases of municipal and corporate bonds, subsequently loosening restrictions to include lower quality asset classes. The ECB was initially cautious with the expansion of its quantitative easing (QE) programme, and it was only after a spike in yields that it adopted the Pandemic Emergency Purchase Program (PEPP), which increased the flexibility of its purchases.

The Covid-19 crisis demonstrated the need for central banks to be flexible and have a wide range of tools available to address challenges and maintain economic stability. The willingness to use both conventional and unconventional policies, and the infrastructure already in place, allowed central banks to respond quickly and effectively to the economic challenges posed by the pandemic. Emerging markets were particularly cautious in

adopting asset purchase programmes, often restricting their purchases to a smaller scale and limited set of assets (which did not necessarily include government debt). Some countries (such as Brazil and Chile) gave their central banks new legal authority to purchase public debt, but then never started purchases. As central banks adopted this range of policy responses and regularly added to their toolkit, the motivation for action varied across central banks and time. Most central banks initially adopted a 'whatever it takes' approach focused on market stabilization. This approach helped justify large and rapid purchases of government bonds and intervention in private markets in ways that had previously never occurred. As markets recovered and economies began to rebound, however, most central banks adjusted their communication to refocus their actions on meeting their traditional mandates: inflation and employment and growth.

3.1.1 Rate cuts and forward guidance

Forward guidance is a tool used by central banks to communicate information regarding their expected future policy decisions. Typically, this tool involves public statements or communications from the central bank regarding the likely path of interest rates or other policy instruments over a certain period of time. The purpose of forward guidance is to influence market expectations and provide guidance to investors, businesses, and households on how the central bank is likely to act in the future. The application of forward guidance can take various forms, including explicit statements about future policy rates, projections of future inflation or economic growth, or indications of the timing and pace of asset purchases or sales. The content of forward guidance may vary depending on the central bank's policy framework, economic conditions, and communication strategy. One of the primary objectives of forward guidance is to increase policy transparency and decrease uncertainty about the central bank's future actions. This can help stabilize financial markets, reduce volatility, and create a more stable economic environment. Additionally, forward guidance can signal the central bank's commitment to achieving its policy objectives, such as price stability or maximum employment. In recent years, forward guidance has become an increasingly important tool for central banks, particularly following the global financial crisis. In advanced economies, rate cuts were implemented according to the "recession playbook" developed in response to the GFC. Policymakers quickly reduced rates to the effective lower bound (ELB), which represents a critical threshold beyond which additional reductions in the primary monetary policy interest rate would not enhance overall demand and GDP of the economy and may have negative

effects on the financial sector. ELB level rates were paired with state-contingent forward guidance. Within a few weeks, central banks with policy rates above the lower bound, including the Federal Reserve, the Bank of Canada, the Bank of England, the Reserve Bank of Australia, and the Reserve Bank of New Zealand, aggressively reduced rates to their respective ELBs. While the total amount of rate cuts was much less than during the GFC, given that the starting level was lower, emerging markets were able to cut policy rates more aggressively, with some reaching their ELBs, such as Chile and Poland. Many central banks augmented these reductions in policy rates with forward guidance, partially to compensate for the smaller amount of space available to reduce rates. Due to the Knightian uncertainty of the situation, this forward guidance was initially open-ended and imprecisely defined, though it remained state-contingent and linked to economic outcomes. The Federal Reserve, for instance, stated that it would maintain the level of interest rates until the economy "is on track to achieve its maximum employment and price stability goals." A few central banks went beyond state-contingent guidance and reinforced it with an implicit or explicit calendar guidance dimension. Overall, forward guidance has become a critical monetary policy tool for central banks to manage market expectations and provide guidance on future actions. The various forms of forward guidance, including state-contingent and calendar guidance, have proven effective in stabilizing financial markets and creating a more stable economic environment. As economic conditions continue to evolve, it is likely that forward guidance will remain an important tool for central banks.

3.1.2 Asset purchases

The acquisition of assets by central banks during the Covid-19 pandemic exhibited considerable diversity, contingent upon the unique requirements, past experiences, and institutional structures of each nation (Hale et al. 2020). The Federal Reserve, Bank of Canada, and Bank of England initially prioritized the acquisition of government securities as a means to mitigate risk limits of dealers' balance sheets and alleviate market disruptions. Conversely, the European Central Bank (ECB) adopted a more hawkish stance, resulting in a significant decrease in peripheral yields, before introducing the Pandemic Emergency Purchase Programme (PEPP) to ensure the effective transmission of monetary policy effects across all regions (De Groot and Schotman 2020). The Bank of Japan (BoJ) removed the upper limit on its purchase of Japanese Government Bonds (JGBs) and expanded the size of its existing private asset purchase programs, while also being the only central bank to acquire equities (Carvalho et al. 2020). Furthermore, some central banks

ventured into acquiring private assets or sub-national bonds. The Reserve Bank of Australia implemented yield curve control and subsequently a quantitative easing (QE) program (Barnes and Shields 2020). Notably, several of these asset procurement programs were executed at an accelerated pace and with larger volumes than during the Global Financial Crisis (GFC) (Cui et al. 2020). For instance, the Federal Reserve's holdings of government and agency mortgage-backed securities increased by over \$2 trillion between mid-March and mid-June 2020 (Carvalho et al. 2020). Conversely, some nations opted for smaller and/or slower asset purchase programs, such as Korea, Norway, and Israel, which executed some asset purchases but on a much smaller scale relative to GDP than during the GFC (De Groot and Schotman 2020). The Swiss National Bank (SNB) did not undertake any securities purchases and instead relied more heavily on foreign exchange intervention (Cui et al. 2020). The acquisition of assets by central banks during the Covid-19 pandemic was executed in a diverse manner, contingent upon the unique requirements, past experiences, and institutional structures of each nation. The size and pace of asset procurement programs varied significantly, with some nations deploying programs exponentially larger than during the GFC. Furthermore, variation exists in the approach to asset procurement across emerging markets, with some countries opting not to implement any asset purchase programs out of concern for potential damage to anti-inflation credibility.

3.1.3 Liquidity provision and credit support

Central banks responded to the emerging pressures in financial markets caused by the Covid-19 pandemic by providing liquidity to banks and other financial institutions. These liquidity programs typically extended term credit with different configurations of cost and collateral requirements. Central banks expanded the types of entities eligible for support, including nonbank lenders and broker-dealers. Additionally, many central banks introduced programs to support the availability of credit to a range of private sector companies, including nonfinancial companies. These programs aimed to ensure that viable companies could obtain the credit they needed to withstand the pandemic and restart growth once it ebbed. Central banks provided credit through asset purchases, including purchases of commercial paper and corporate bonds. Some central banks purchased shares of bank loans to businesses or extended loans in foreign currency. To achieve the same goal, many central banks also introduced programs under which low-cost central bank funding was provided to lenders that increased their credit to the private sector or to specific sectors

that have less access to corporate securities markets and are more reliant on banks. These programs included incentives for lending to small and medium-sized enterprises. Some of these lending schemes amounted to quasi-fiscal operations or had goals outside traditional central bank mandates. For example, the ECB's pandemic emergency targeted the longer-term refinancing operations program, which offered term loans to euro area banks at a rate below the ECB's deposit rate and offered an implicit subsidy of up to 50 basis points to banks. Similarly, the BoJ's decision to pay a positive rate on the excess reserves of regional banks that reduce overhead costs or engage in mergers or business integration was an example of industrial policy carried out by the central bank. These quasi-fiscal operations may be justified as a second-best option, but they raise questions about potential overreach of central banks beyond their mandates. In addition to providing liquidity and credit, most central banks explicitly supported expansionary fiscal policy to support their economies. This represented a break from past behavior, as many central banks generally either did not talk about fiscal policy or recommended fiscal consolidation. Central banks actively supported their governments' large fiscal packages and appeared to be explicitly coordinating monetary and fiscal policy. This blurring of the line between monetary and fiscal policy was not limited to advanced economies, as the government and the central bank in Indonesia issued joint decrees to coordinate the financing of the Covid-related deficit. Overall, central banks utilized a range of tools to support financial stability and ensure the proper functioning of financial markets while also supporting economic recovery during the Covid-19 pandemic.

3.1.4 Regulatory easing

In response to the initial market turbulence caused by the Covid-19 pandemic, regulatory and macroprudential easing measures were swiftly adopted in many countries, often with the involvement of central banks, with the aim of supporting the provision of credit and mitigating negative impacts on the broader economy. This represented the first real-world test of the macroprudential tools developed after the Global Financial Crisis (GFC), with the objective of reducing vulnerabilities to sudden shocks and minimizing negative amplification effects on the economy. The regulatory easing mainly centered on two areas: firstly, the relaxation of regulatory capital and liquidity requirements, including the reduction of countercyclical or systemic risk capital buffers, which allowed banks to temporarily operate below required capital and liquidity levels, and the suspension of some constraints on leverage.

These measures were often combined with restrictions on dividend distributions. Notably, the countercyclical capital buffer was lowered by 15 of the 16 countries that had previously set a buffer above zero, in some cases to zero. Secondly, regulatory forbearance on assets and loan valuations was allowed, including the easing of collateral eligibility rules and the permission for banks to apply more favorable valuations of assets and lower risk weights for certain loans, as well as the provision of greater flexibility in the treatment of non-performing loans. Prudential supervisors in many countries also encouraged banks to help borrowers affected by the pandemic to restructure loans and grant moratoria on loan repayments to small businesses and individuals.

The regulatory and macroprudential easing measures were implemented to support credit provision and prevent negative impacts on the broader economy. However, they also served as a test of the effectiveness of the macroprudential tools developed after the GFC. The use of these tools to reduce vulnerabilities to sudden shocks and their release after a shock to mitigate negative amplification effects were critical aspects of this testing. The regulatory easing focused on softening capital and liquidity requirements and allowing regulatory forbearance on assets and loan valuations. Prudential supervisors also encouraged banks to support borrowers affected by the pandemic.

3.2 Comparing responses between Emerging Markets and Advanced Economies

The Covid-19 pandemic has prompted central banks in various countries, including emerging markets, to implement regulatory and macroprudential measures to support credit provision, mitigate negative impacts on the broader economy, and reduce vulnerabilities to sudden shocks. The easing of regulatory standards has focused on softening capital and liquidity requirements, including the suspension of constraints on leverage and reducing systemic risk capital buffers. Additionally, regulatory forbearance has been granted on assets and loan valuations, including easing collateral eligibility rules and allowing banks to apply more favorable valuations of assets and lower risk weights for certain loans. Prudential supervisors in several countries have also encouraged banks to assist borrowers impacted by the pandemic through loan restructuring and offering moratoria on loan repayments to small businesses and individuals. Notably, the response of emerging market central banks to the pandemic shock mirrors that of advanced economies. Nearly all emerging markets have lowered their policy interest rates and launched new asset purchase programs, providing liquidity support and credit guarantees while easing regulatory requirements. However, differences exist across countries regarding the extent of these changes, with some EMs not following the same sequencing of interest rate cuts and asset purchases. The ability of EMs to pursue countercyclical monetary policy and employ the same tools as AEs should not be taken for granted, given substantial differences in the extent of these changes and their corresponding capacity to pursue aggressive and multifaceted easing policies (IMF 2020). The existence of FX swap agreements has aided central banks in limiting tensions in FX markets, and the fast and aggressive reaction by the main AE central banks stabilized financial markets and contained risk aversion, providing EMs with more policy flexibility. Nonetheless, not all EMs were able to implement policies similar to those of AEs and generate comparable policy outcomes. For instance, Turkey's aggressive easing policy led to a substantial inflation overshoot, contributing to tightening policy in late 2020 to avoid a currency crisis. Brazil, a country with a history of high inflation, less stable inflation expectations, and a fragile fiscal framework, did not purchase government securities despite being given temporary authorization to do so during the pandemic. Russia decided against asset purchases to preserve the credibility of its inflation targeting regime (IMF 2020).

In conclusion, the response of central banks in various countries, including emerging markets, to the market turmoil caused by the Covid-19 pandemic has focused on easing regulatory and macroprudential standards to support the provision of credit. Although the response of emerging market central banks has been similar to that of advanced economies, differences exist across countries regarding the extent of these changes and their corresponding ability to pursue aggressive and multifaceted easing policies. These differences underscore the importance of country-specific factors and the need to tailor policy responses accordingly (IMF 2020).

3.2.1 Difference in approach

In response to the Covid-19 pandemic, central banks globally implemented measures to support credit provision and reduce vulnerability to sudden shocks through an easing of regulatory and macroprudential standards, such as softening capital and liquidity requirements, regulatory forbearance on assets and loan valuations, and encouraging banks to restructure loans and grant moratoria on loan repayments to small businesses and individuals affected by the pandemic. Notably, policymakers chose not to cut rates to negative levels in response to the crisis due to concerns about potential impacts on short-term funding markets and a judgment that asset purchases would be more effective in boosting the recovery.

Most emerging market (EM) central banks were willing to ease monetary policy and allow their exchange rates to depreciate to help cushion their economies from the shock. However, the pass-through to inflation was limited, likely due to the global negative demand shock and Covid restrictions dampening the impact on inflation expectations and aggregate demand. Some EMs and Switzerland used FX reserves to stabilize their exchange rates, while most other countries that used FX intervention did so to moderate currency depreciations. As capital flows quickly stabilized after March, most EMs limited their drawdowns of reserves despite having substantial stockpiles. In conclusion, the response of central banks worldwide to the pandemic primarily focused on easing regulatory and macroprudential standards to support credit provision. Although the response of EM central banks was similar to that of advanced economies, there were differences in the extent of these changes and their corresponding ability to pursue aggressive easing policies. The decision not to use negative rates in some countries was supported by concerns about possible effects in short-term funding markets and the potential for cash withdrawals from banks at a time of fragile sentiment. Overall, the measures taken by central banks were

critical in mitigating the economic impact of the pandemic, and policymakers must continue to carefully monitor the situation in the coming years to ensure that the recovery is sustainable (IMF 2021).

3.3 Open Questions

In general, the actions taken by both advanced economy (AE) and emerging market (EM) central banks were effective in stabilizing financial markets and contributing to a strong global recovery, along with robust fiscal policy responses and containment efforts for the pandemic. However, the landscape for monetary policy and central banks has changed significantly relative to the period prior to the global financial crisis (GFC), raising several issues that central banks must address in the years to come (Rey 2021). Firstly, the persistent low level of interest rates in jurisdictions accounting for over 20% of the world's GDP (and over 10% of the world's population) for more than a decade, and in some areas for substantially longer, could leave central banks without the necessary tools to fulfill their mandates under current policy frameworks. Secondly, the policies implemented in response to the GFC and the Covid-19 shock have resulted in very large balance sheets for central banks, and their limited ability to unwind previous purchases implies that their balance sheets will remain large for several years (Rey 2021).

These observations prompt questions about the management of central banks' balance sheets once the crisis wanes and whether a central bank's balance sheet size imposes a constraint on its policy options. Thirdly, the pandemic crisis has tested the post-GFC regulatory structure, and it is appropriate to evaluate how that structure performed, and whether additional changes are necessary (Rey 2021). Fourthly, the extraordinary actions taken by central banks to support financial markets and economies twice in twelve years may have strengthened the perception of a central bank "put," or the belief that central banks will always intervene to support markets and limit investors' losses, which could lead to increased investor risk-taking and undermine future financial stability. Central banks may need to consider the moral hazard implications of their policies and develop ways to address them. Finally, as central banks have assumed roles that expand their focus beyond meeting inflation and employment goals, they are paying more attention to issues such as inequality and climate change that go beyond their formal mandates. However, it is crucial

to determine how much central banks can be expected to accomplish in addressing broader mandates and whether they have the necessary tools to do so (Rey 2021).

3.3.1 Central Bank's balance sheet

The balance sheet of a central bank is a key tool used to implement monetary policy and influence economic variables such as inflation and employment. The balance sheet is essentially a record of the assets and liabilities held by the central bank, and includes items such as government bonds, foreign currency reserves, and loans to financial institutions. One of the primary ways in which central banks use their balance sheets is through asset purchases. When central banks purchase assets such as government bonds, they inject liquidity into the financial system and lower interest rates. This can stimulate economic activity and promote inflation, which is one of the key objectives of monetary policy. During the Covid-19 pandemic, central banks around the world used their balance sheets to provide emergency liquidity to banks and other financial institutions. This was done in order to prevent a liquidity crisis and ensure that financial markets continued to function smoothly. In addition, central banks also lowered interest rates and launched new asset purchase programs to support their economies during the pandemic. The size and composition of a central bank's balance sheet can have important implications for financial stability. For example, changes in the balance sheet can affect the supply and demand for various financial assets, which can in turn affect asset prices and market volatility. Therefore, understanding how central banks use their balance sheets is critical for policymakers and market participants alike, as it can provide insights into the direction of monetary policy and its potential impact on the broader economy. One potential concern with central bank balance sheets is the risk of inflation. When central banks purchase assets and inject liquidity into the financial system, this can lead to an increase in the money supply and potentially higher inflation. However, central banks have a range of tools at their disposal to manage inflation, including raising interest rates and selling assets from their balance sheets. In addition to asset purchases, central banks can also use their balance sheets to provide emergency support to financial institutions. For example, during the 2008 financial crisis, the Federal Reserve provided emergency loans to financial institutions to prevent a full-scale financial meltdown. This type of support can help to maintain financial stability and prevent the spread of systemic risk throughout the financial system. Another way in which central banks use their balance sheets is through foreign currency reserves. Central banks hold foreign currency reserves as a way to manage exchange rate risk and

provide liquidity in foreign currencies. This is important for countries that rely heavily on exports or have a high level of foreign debt. The use of central bank balance sheets has become increasingly important in recent years, as central banks have been forced to take on a greater role in supporting their economies during times of crisis. The Covid-19 pandemic has highlighted the critical role that central banks play in maintaining financial stability and supporting economic growth. However, there are also risks associated with using central bank balance sheets to support the economy. For example, there is a risk that central banks may become too involved in financial markets, which could lead to distortions and inefficiencies. In addition, there is a risk that central banks may become too reliant on asset purchases and other unconventional monetary policy tools, which could lead to higher inflation or other unintended consequences. In conclusion, the balance sheet of a central bank is a critical tool used to implement monetary policy and support financial stability. Through asset purchases, emergency support to financial institutions, and foreign currency reserves, central banks can influence key economic variables and help to promote economic growth. However, there are also risks associated with using central bank balance sheets, and policymakers must carefully consider the potential consequences of their actions. As such, understanding how central banks use their balance sheets is critical for both policymakers and market participants in assessing the direction of monetary policy and its potential impact on the broader economy. Figure 12 represent the Total Asset value for Central Banks of the Euro Area Member states, high increase can be seen in the year after 2009 and after 2020, latest data for 2023 show the start of a decreasing trend in total value, meaning central banks are starting to lighten their balance sheet.

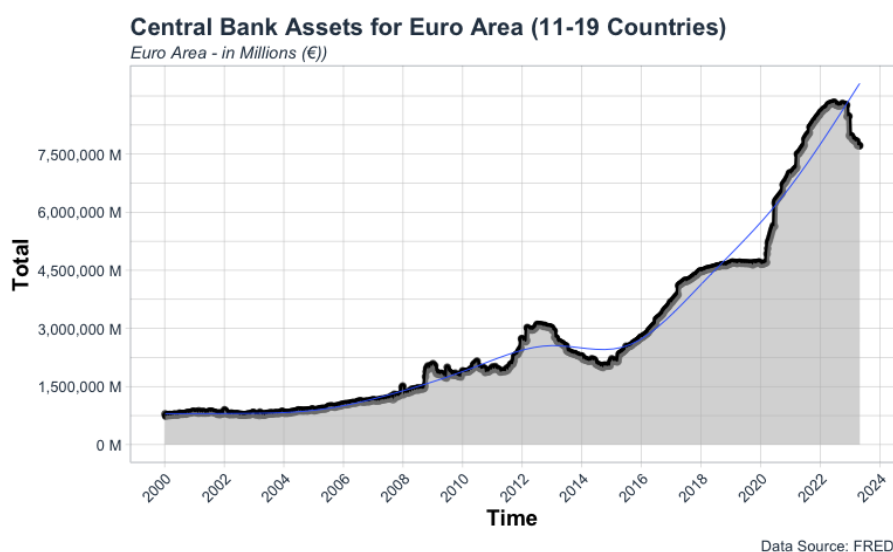


Figure 12: Value in Millions of the European Central Bank balance sheet

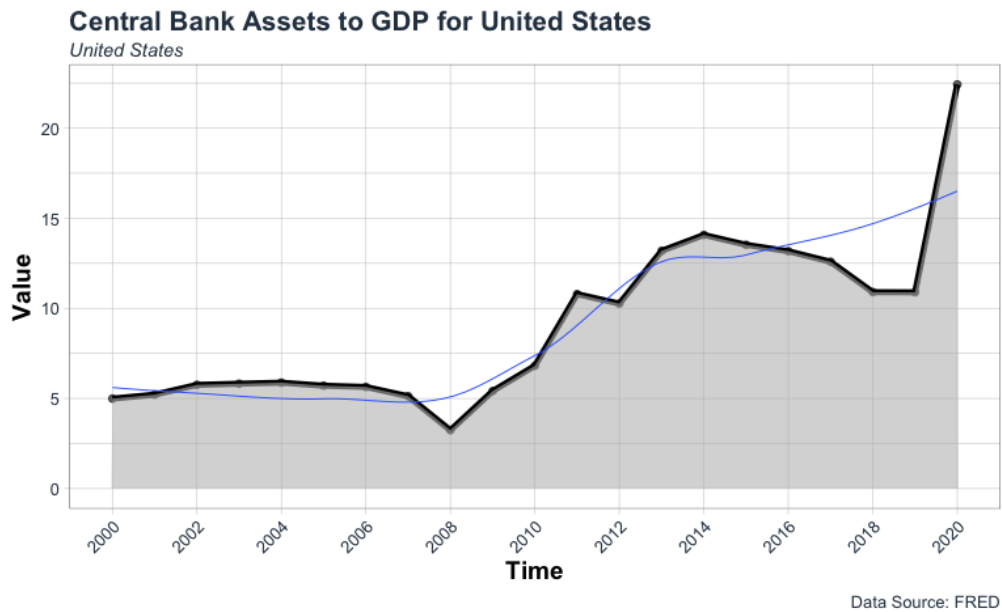


Figure 13: Ratio FED Assets/UDA GDP.

Figure 13 shows the ratio between Federal Reserve Balance sheet and the total GDP for united states, exhibiting a similar behavior to European central banks.

3.3.2 Central banks and “moral hazard”

The Covid-19 pandemic has prompted central banks worldwide to expand their market interventions beyond their conventional role as the 'lender of last resort' to become the 'buyer of last resort' through liquidity and credit schemes, and by expanding the range of assets they were willing to purchase and the markets they were willing to support. This included the Federal Reserve, which expanded its intervention by purchasing unlimited amounts of government bonds, agency mortgage-backed securities, municipal and investment-grade corporate bonds, high-yield debt, and corporate loans instead of a fixed amount of government bonds and agency mortgage-backed securities alone (Abel and Bernstein 2020). Other central banks, such as the Bank of Canada and Riksbank, similarly expanded their range of asset purchases. The ECB suspended its capital key for bond purchases and collateral rating limits, which significantly contributed to the stabilization of peripheral yields. The central banks' strategy of becoming the buyer of last resort was effective in stabilizing markets, sometimes just by announcing the program without even making purchases.

The Federal Reserve stabilized the corporate and municipal bond markets with very few purchases by acting as a backstop, thereby shifting private sector expectations towards a

better equilibrium (Borio and Disyatat 2020). The announcement that central banks were authorized to purchase government debt also appeared to help stabilize markets in Brazil and Chile, even though the authority was never used. However, stabilizing government bond markets required substantial purchases, suggesting that pre-pandemic positions may have been too large given market infrastructure constraints once investors withdrew. Central bank actions also contributed to reducing the impact of the crisis on bankruptcies and defaults, both in financial and non-financial sectors (Borio and Disyatat 2020). The external and exogenous nature of the Covid shock may have mitigated concerns about moral hazard in these markets during this episode.

While the expanded role of central banks in supporting markets during periods of stress was critical in mitigating the economic impact of the pandemic, it may create the expectation of similar interventions in future crises. This could encourage increased risk-taking and potentially undermine financial stability, necessitating improvements in supervision and regulation. Therefore, policymakers must carefully consider the potential long-term consequences of expanding central bank intervention in markets and take steps to ensure that financial stability is maintained.

3.3.3 Deposit Facility Rate for Euro Area

The Deposit Facility Rate (DFR) for the Euro area is the fundamental monetary policy instrument for the European Central Bank (ECB). As a rate of interest established by the ECB, the DFR specifies the return financial institutions receive when depositing excess reserves overnight with the central bank. Along with the Main Refinancing Operations (MRO) rate and the Marginal Lending Facility (MLF) rate, this rate forms the basis of the Euro system's operational framework, influencing short-term market interest rates and directing the overall monetary conditions in the Euro area (ECB, 2011). Throughout the period following the 2008 financial crisis, the DFR has exhibited a notable downward trend, reaching negative territory in June 2014 as part of the ECB's unconventional policy measures designed to combat persistently low inflation and stimulate economic growth (Draghi, 2014). Empirical research has revealed the complex transmission mechanisms of the DFR, which include the bank lending channel, the portfolio rebalancing channel, and the signaling channel.

Furthermore, the DFR's effect on the broader economy is still the subject of ongoing scholarly debate, with some studies contending that the negative DFR has exerted pressure on bank profitability and induced risk-taking behavior among financial institutions, and others arguing that its adverse side effects have been limited, and the overall impact on credit provision and economic activity has been largely positive (Heider et al., 2019; Rostagno et al., 2019).

Nonetheless, the Deposit Facility Rate for the Euro area is an essential component of the ECB's monetary policy framework, with ramifications extending beyond the financial sector and permeating numerous aspects of the Euro area economy.

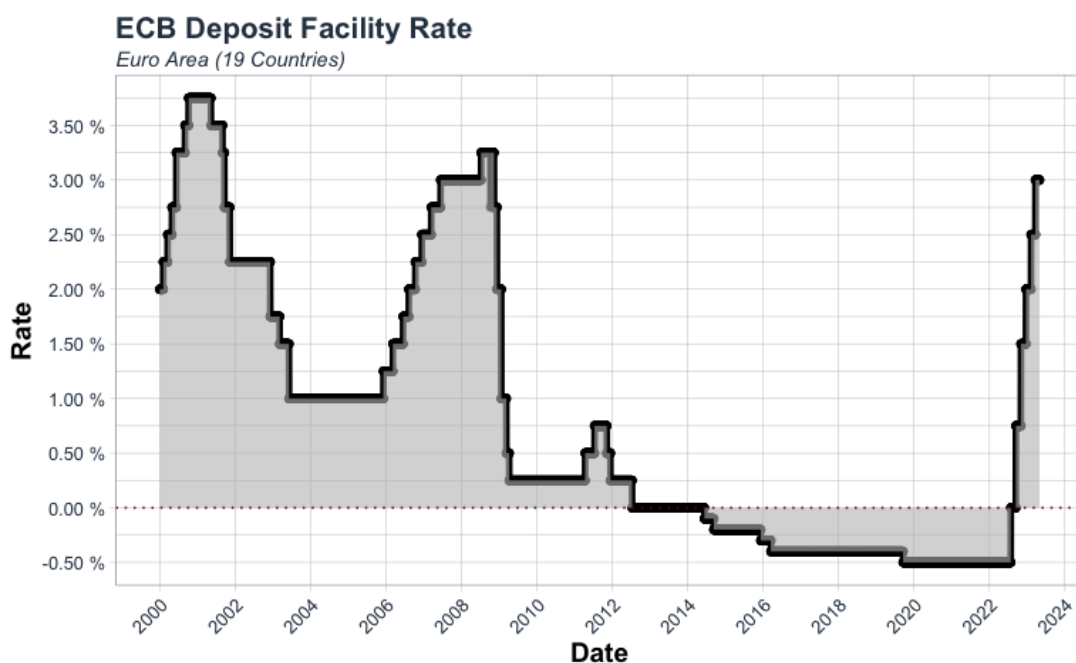


Figure 14: Up to date (June 2023) Representation of EU Deposit Facility Rate.

Figure 14 illustrates the Deposit Facility Rate (DFR) from 2000 to June 2023, revealing a clear correlation between periods of increasing DFR and previous crises, specifically the 'Dot Com Bubble', the Great Financial Crisis, and the Covid Crisis. It may be posited that the ECB adhered to its traditional approach in responding to these significant global crises. However, a notable distinction during the Covid Crisis is the relatively higher and more frequent rate hikes. A plausible explanation for this discrepancy lies in the contrasting origins of the crises. Unlike the two preceding major crises, which stemmed from endogenous factors within the financial system, the Covid Crisis was initiated by exogenous

causes external to the financial system. Consequently, a more direct, prompt, and decisive approach may be deemed more advantageous in addressing the unique nature of this crisis.

4 Analysis on major European Banks

The event of 2020 had a substantial effect on the banking sector in Europe. Financial institutions have had to adjust to changing consumer expectations, new regulations, and an environment that is constantly evolving. This paragraph will examine the effects of COVID-19 on the largest European institutions. The (ECB) has implemented a variety of monetary policies that have had profound effects on the Eurozone banking sector. In particular, the period following the 2008 financial crisis has been characterized by an extended period of ultra-low interest rates, quantitative easing (QE), and targeted longer-term refinancing operations (TLTRO). These policies have generated a complex set of effects, one of which is the compression of commercial banks' net interest margins. The persistence of low interest rates has compelled banks to seek out alternative revenue streams, including fee-based services and trading income. In addition, the ECB's asset purchase program has caused banks' balance sheets to expand, thereby modifying the composition of their asset portfolios. Simultaneously, the regulatory environment has evolved with the establishment of the Single Supervisory Mechanism (SSM) and the implementation of more stringent capital requirements, as outlined by the Basel III framework. This convergence of factors has resulted in a decline in bank profitability, while concurrently fostering financial stability and reducing systemic risk in the banking sector of the Eurozone.

Packages Used

The following packages has been used during the development of this thesis, for data gathering, management and analysis. For utility purpose packages has already been divided in subsection in the .R document.

4.1 Construction of the Banks sample

To obtain a representative sample of banks, a selection criterion based on each member state's Gross Domestic Product (GDP) relative to the complete European Union has been established. This methodology ensures that the sample includes banks from countries with

varying levels of economic output, allowing for a more complete comprehension of the European banking sector. Eurostat provided the data for this analysis¹⁴.

The summary below details the value in millions for every EU state, alongside with the respective share of the total GDP of the European Union.

EU Member State GDP

In Millions (€) and % of total EU GDP

Country	2022Q4	Total%
Germany	989.93K	24,40
France	674.86K	16,64
Italy	491.29K	12,11
Spain	345.46K	8,52
Netherlands	243.50K	6,00
Poland	171.48K	4,23
Belgium	139.99K	3,45
Sweden	138.11K	3,40
Ireland	130.64K	3,22
Austria	114.79K	2,83
Denmark	95.50K	2,35
Romania	73.10K	1,80
Czechia	71.13K	1,75
Finland	67.74K	1,67
Portugal	61.77K	1,52
Greece	53.17K	1,31
Hungary	42.89K	1,06
Slovakia	28.50K	0,70
Bulgaria	22.20K	0,55
Luxembourg	19.30K	0,48
Croatia	17.39K	0,43
Lithuania	17.38K	0,43
Slovenia	15.33K	0,38
Latvia	10.10K	0,25
Estonia	9.40K	0,23
Cyprus	6.97K	0,17
Malta	4.36K	0,11
Total	4.06M	100,00

Table 1: Note that the precise GDP shares should be substituted with the most recent Eurostat data available. This table provides a snapshot of the sampled countries and their respective contributions to the GDP of the European Union. By employing this methodology, a more robust and representative understanding of the dynamics of the banking sector and the effects of ECB policies will be achieved.

¹⁴ Data Source: Eurostat:

https://ec.europa.eu/eurostat/databrowser/view/namq_10_gdp/default/table?lang=en

In order to use a representative example, the top 4 state namely: Germany, France, Italy and Spain have been selected representing 61,67% of the total Gross Domestic Product of the European Union.

4.1.1 Banks in the designated EU Member State

After selecting the top four countries from the preceding table based on their respective GDP proportions, the selection of individual banks from these countries will be based on their Total Assets under Management (AUM), identifying the respective state by their legal headquarters. This methodology guarantees that the sampled banks are both legally domiciled in the selected countries and hold a significant portion of assets, thereby reflecting their significance in their respective national banking sectors.

The following table shows a sample from the world's top 100 bank by AUM for the selected States using the aforementioned criteria.

EU Member State Banks in World's Top 100

In Billions (\$)

Company	Total assets (US\$B)
France	
BNP Paribas SA (BNP-ENXTPA)	2849.61
Crédit Agricole Group	2542.61
Groupe BPCE	1636.35
Société Générale SA (GLE-ENXTPA)	1588.99
Crédit Mutuel Group	1180.22
La Banque Postale SA	796.88
Spain	
Banco Santander SA (SAN-BME)	1853.86
Banco Bilbao Vizcaya Argentaria SA (BBVA-BME)	762.15
CaixaBank SA (CABK-BME)	604.03
Germany	
Deutsche Bank AG (DBK-XTRA)	1428.65
DZ BANK AG Deutsche Zentral-Genossenschaftsbank Frankfurt am Main	670.13
Commerzbank AG (CBK-XTRA)	510.25
Landesbank Baden-Württemberg	346.45
Italy	
Intesa Sanpaolo SpA (ISP-BIT)	1042.73
UniCredit SpA (UCG-BIT)	916.72

Table 2: Selected Country and respective Bank's in the World's Top100.

4.2 Single banks analysis

The European Central Bank's (ECB) monetary policy exerts a multifaceted influence on the banking sector, with both direct and indirect implications for financial institutions.

4.2.1 Stock Price

Examining the stock price movements of publicly traded banks can indeed provide insightful information regarding the market's perception of these institutions and their performance in response to ECB policies. By selecting the first bank in each of the top four countries (France, Germany, Italy, and Spain), we can analyze the following banks' stock price trends:

Germany: Deutsche Bank AG (Ticker: DBK) BNP Paribas SA (Ticker: BNP) of France. The Intesa Sanpaolo SpA (Ticker: ISP). Banco Santander SA of Spain (Ticker: SAN)

By analyzing the stock price movements of Deutsche Bank, BNP Paribas, Intesa SanPaolo, and Banco Santander, we hope to gain insight into the market's perception of these banks' performance and resilience in the face of ECB policies and the broader macroeconomic environment. This analysis may also disclose significant trends, risks, and opportunities for these institutions' investors and stakeholders.

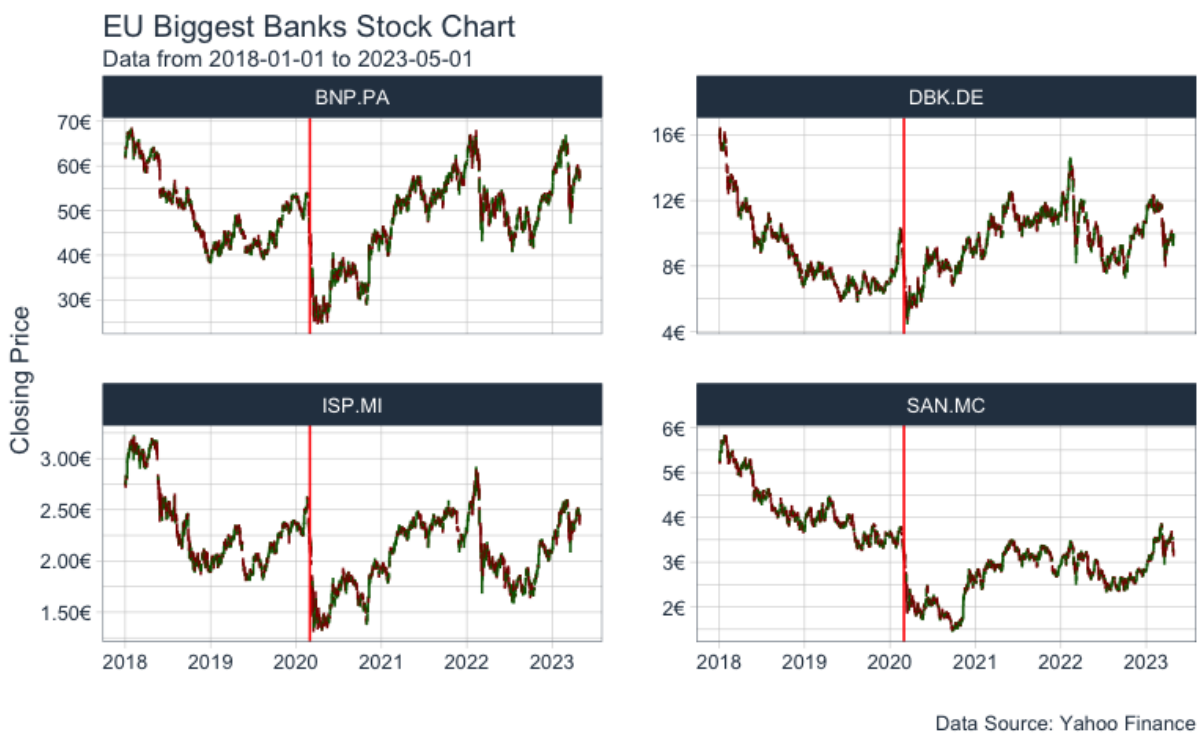


Figure 15: The Graph represent the stock price for the selected banks from 2018 to 2023 up to date.

The empirical analysis reveals a discernible response to the initial shock, characterized by a liquidity contraction and a corresponding 'panic sell' during the first quarter of 2020. This sequence of events precipitated an occurrence akin to a 'Flash Crash' for these banking institutions, resulting in substantial loss of up to 40% in market capitalization within a brief period. Notably, the ensuing recovery in subsequent weeks and months was remarkable, enabling a number of banks to achieve share prices surpassing the pre-shock levels by the second quarter of 2021. This impressive resurgence highlights the resilience of the financial sector and the change in market analysts forecast amidst unparalleled adversity and emphasizes the influence of the implemented policy measures in mitigating the crisis.

In order to better observe this behavior, the following graph delineates the returns of the selected banks' equities during the inception of the COVID-19 pandemic outbreak. This representation is intended to provide a visual illustration of the financial performance and market perception of these companies using a percentual scale, referring to the lowest price point reached during Q1 2020, enabling a fair comparison. By analyzing the trends, patterns, and correlations evident in this graphical analysis, we can gain a more profound understanding of the resilience and adaptability of these banks in response to the exigencies imposed by the pandemic.

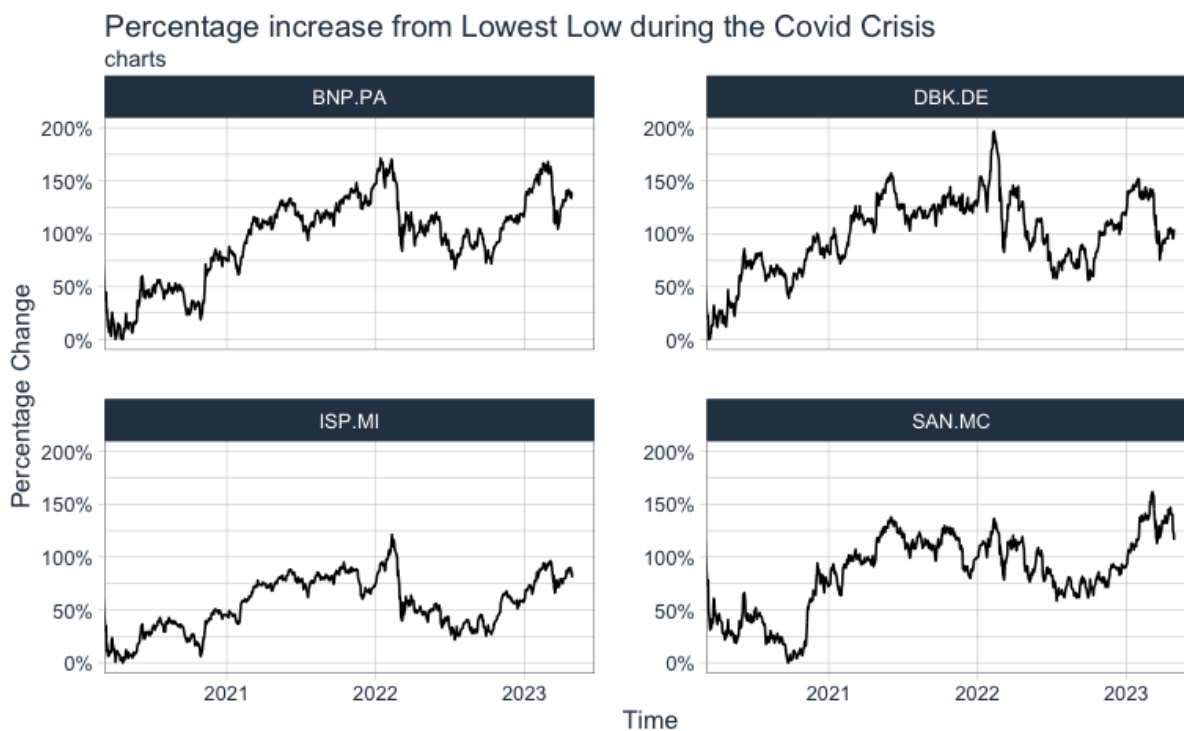


Figure 16 The graph shows the percentage return from the lowest price occurred almost simultaneously during January 2020.

As evidenced by the graphical representation, the returns of the selected banks exhibit a degree of similarity during the initial and also the recovery phase of the COVID-19 pandemic outbreak. To further investigate the relationships between these financial institutions and elucidate potential underlying patterns, a correlation analysis is conducted on the data.

4.2.2 Correlation Analysis

The correlation coefficients between the returns of each pair of institutions are computed as part of a correlation analysis. Typically ranging from -1 to 1, these coefficients represent the strength and direction of the linear relationship between the variables. Values closest to 1 or -1 indicate stronger correlations. A positive correlation indicates that the variables move in the same direction, whereas a negative correlation indicates that the variables move in opposite orientations. The following graph represent the weekly return for each bank's prices time series, exhibiting similarity in cluster presence.

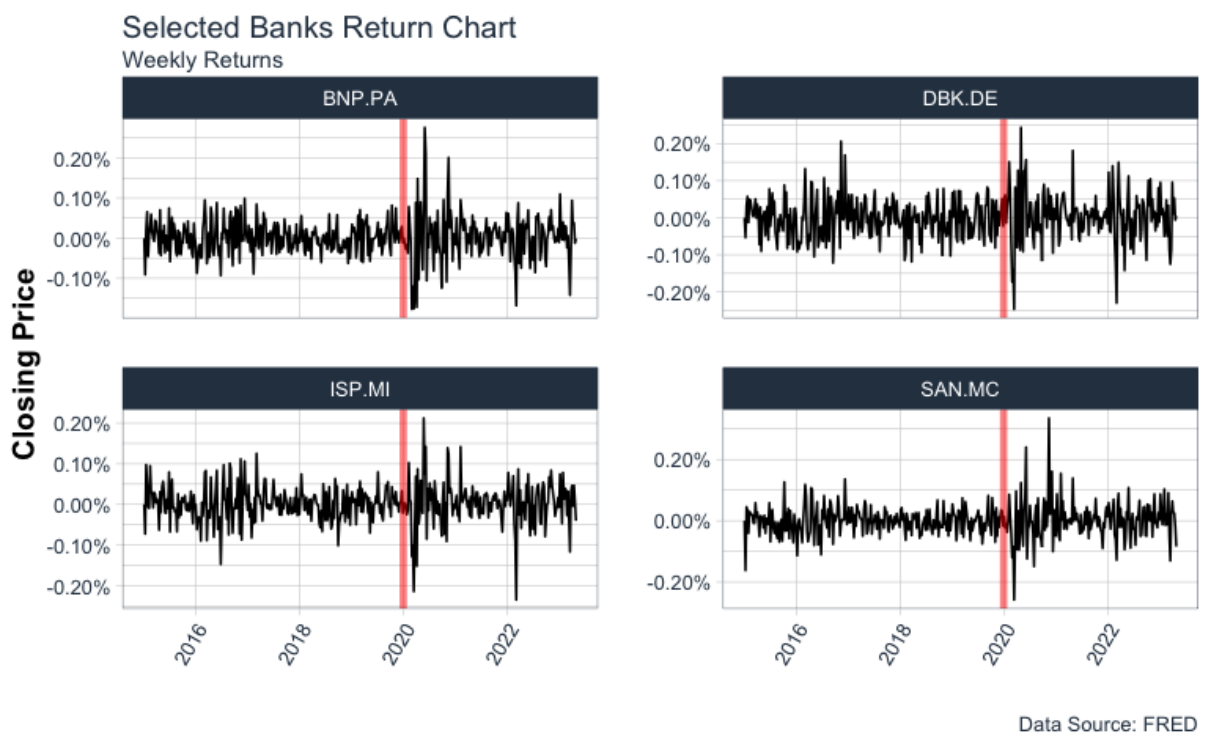


Figure 17: Weekly return for the selected Banks.

By conducting a correlation analysis, we can determine the degree to which the returns of these institutions are correlated and whether their performances are influenced by common factors, such as market sentiment, regulatory changes, or macroeconomic developments.

This information can be invaluable for investors, regulators, and other stakeholders attempting to comprehend the systemic risks and interdependencies within the banking sector, particularly during times of heightened economic uncertainty, such as the early phases of the COVID-19 pandemic.

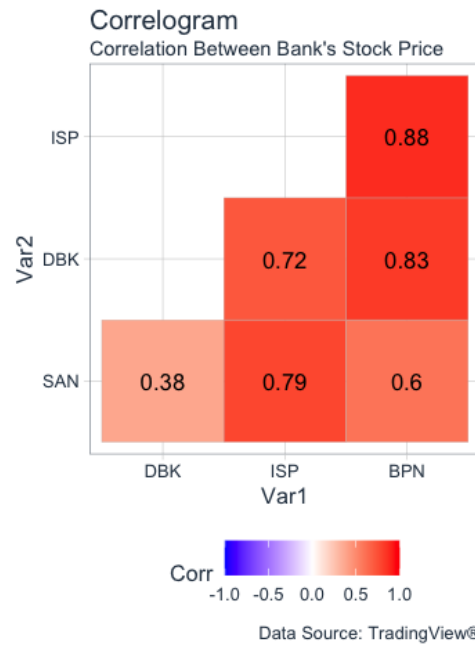


Figure 18 The correlogram shows the positive correlation between the stock price of the sample of banks analyzed.

Different algorithms have been used in order to study correlation in price movements for the selected sample, confirming an always positive and overall high degree of correlation between the time series analyzed. The following graph shows a detailed correlation Matrix.

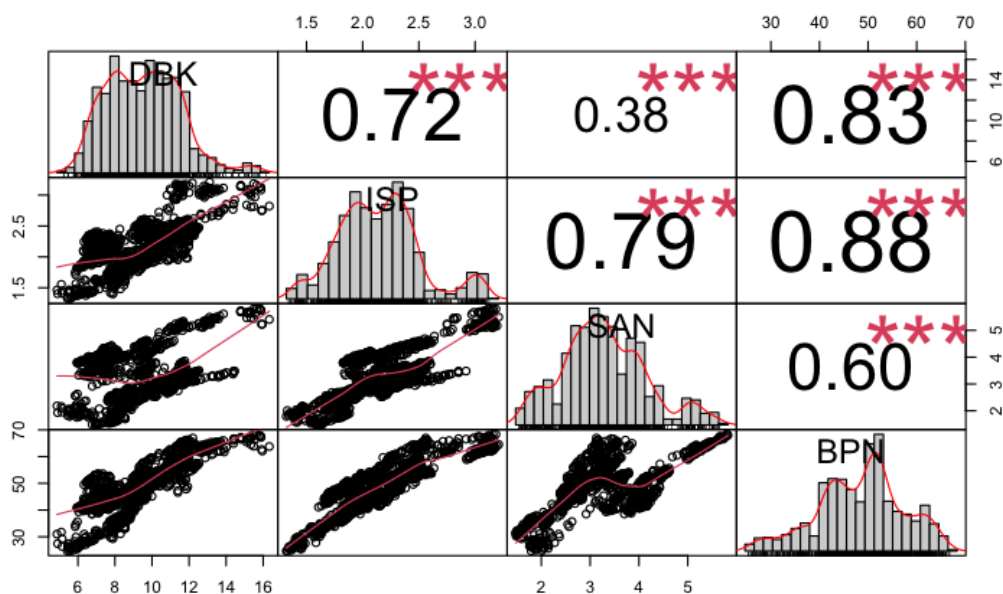


Figure 19: Correlation matrix, with graphical representation of the relation between each pair of time series.

4.2.3 Performance Analysis

In order to analyze the performance of banks, it is multiple balance sheet indicators have been considered in order to provide insights into various aspects of a bank's financial health. The following representation employs an assortment of such indicators, which elucidate the stability, profitability, and efficiency of the banks under consideration.

4.2.3.1 Net Income for Banks

The prolonged adherence to low interest rates has led to a reduction in net interest margins (NIMs) for commercial banks, which is the most significant of these consequences. Financial institutions have been compelled to investigate alternative revenue streams, such as fee-based services, trading income, and the expansion of non-traditional banking activities operations. Concurrently, the implementation of the ECB's asset purchase program has led to an expansion of banks' balance sheets, resulting in a transformation in the asset composition of their portfolios.

The following graph illustrates each bank's net income to facilitate a visual evaluation of the COVID-19 pandemic's effect on their profitability. By comparing the net income figures for financial institutions during the pandemic period (and pre-pandemic with post-pandemic periods) via a graphical representation, we can determine the extent to which their profitability was impacted by the crisis.

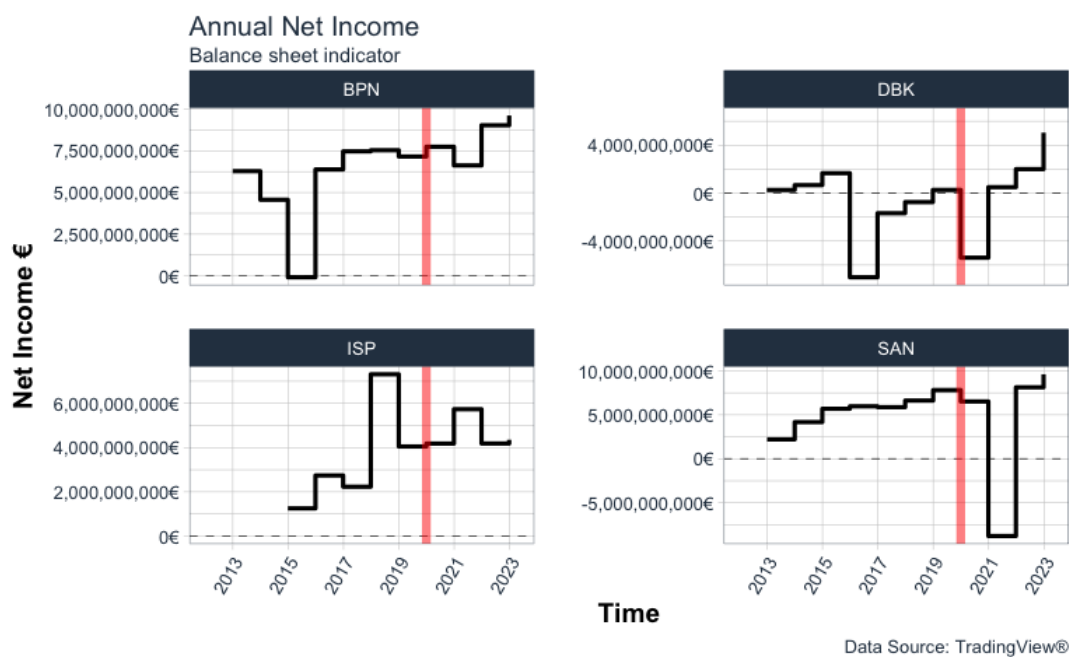


Figure 20: Net Income for the selected Banks.

The examination of the sample reveals that Deutsche Bank and Banco Santander are the sole banks exhibiting negative returns in the aftermath of the pandemic event, culminating in substantial net losses. These losses may be attributable to inadequate risk management techniques or a unique balance sheet composition during the initial downturn. However, this manifestation does not appear to herald the onset of a persistent negative earnings trajectory. In fact, all the banks in the sample swiftly reverted to their pre-pandemic levels of net income, with three out of four surpassing those benchmarks approximately two and a half years after the event. This resilience underscores the robustness of the financial sector and the effectiveness of policy measures in mitigating the crisis's impact.

4.2.3.2 Return on Equity for Banks

Return on Equity (ROE) is a commonly employed financial metric that measures a bank's ability to generate profits from its shareholders' equity. By analyzing the ROE, we can gain insight into the profitability and efficiency of the banks, as well as their ability to generate shareholder value.

ROE is defined as the ratio between Net Income and Shareholder's Equity, namely the residual interest in the assets of the company after deducting liabilities. The resulting value indicates the percentage of profit generated for each unit of equity invested by shareholders.

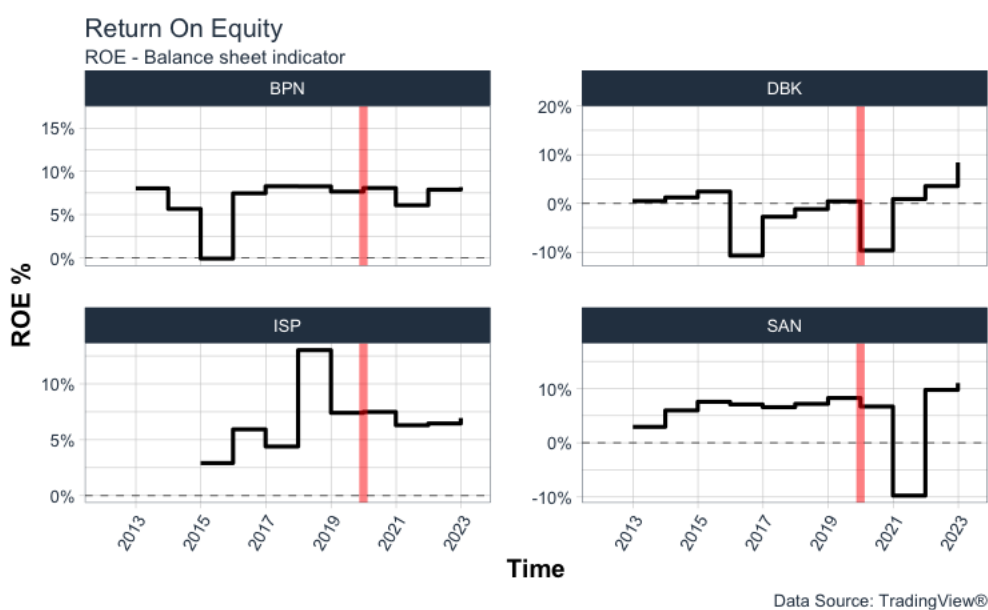


Figure 21: Return on Equity for the selected Banks.

Data related to this indicator show an overall stationary trend in the last few years, remarkably only Banco Santander and Deutsche Bank seems to exhibit a temporary negative impact on their ROE, probably related to the relevant negative Net Income observed in the same period.

4.2.3.3 Current Ratio

Current ratio is another common financial metric used to evaluate the short-term liquidity position of a company by comparing its current assets to its current liabilities. The current ratio can provide insight into a bank's ability to manage its working capital and meet its short-term obligations. The formula for calculating the current ratio is: Current Assets Divided by Current Liabilities. Current liabilities include deposits with short-term maturities, short-term borrowings, and other obligations due within a year. In general, a higher current ratio indicates that a bank has a more favorable liquidity position, as it is better able to satisfy its short-term obligations with its current assets. A lower current ratio, on the other hand, may indicate prospective liquidity issues, as the bank may struggle to cover its short-term liabilities with its available assets.

It is crucial to note that the current ratio should be evaluated in the broader context of a bank's financial position and in conjunction with other ratios to obtain a complete understanding of a bank's performance. While the current ratio can provide some insight into a bank's short-term liquidity management, it may not fully reflect the operational efficiency, risk exposure, or overall financial health of the institution.

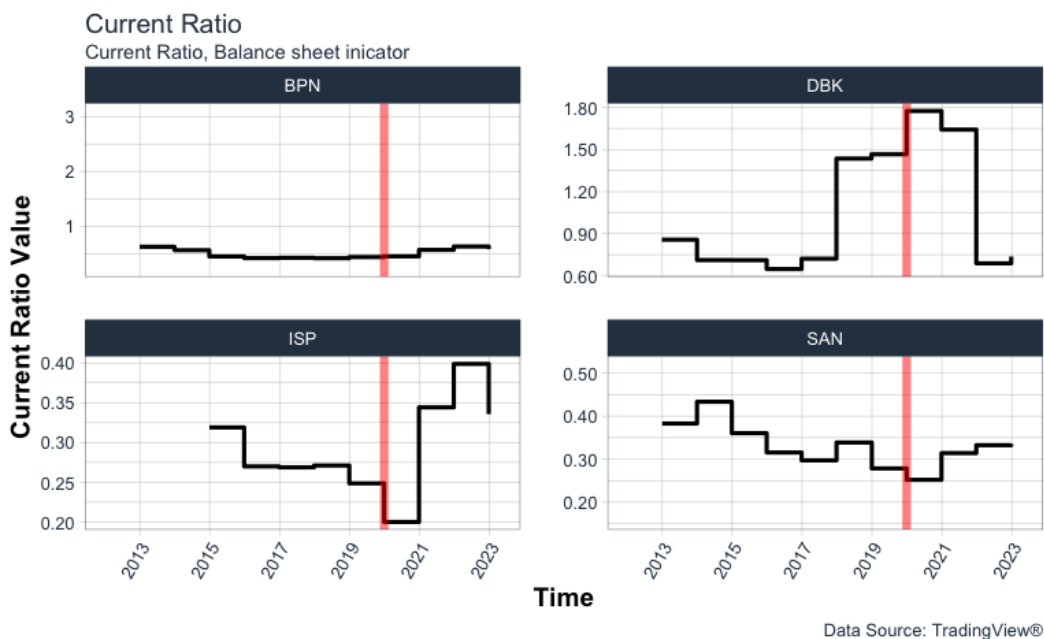


Figure 22: Current Ratio for the selected Banks.

Upon scrutinizing this metric, a modest decline in the overall Current Ratio value is observable. More notably, however, is the discernible shift in trend for Intesa Sanpaolo, Banco Santander, and temporarily in Deutsche Bank. This alteration in trajectory can likely be attributed to a strategic change in internal policy, which aims to shield these institutions from the potential repercussions of loan defaults in subsequent years. Such consequences may arise due to mounting interest rates, elevated inflation, and the gradual reduction of Central Banks' accommodative measures. The observed adjustments in financial institutions' strategies emphasize the dynamic nature of risk management and the importance of adapting to evolving economic conditions.

4.2.3.4 *Capital Asset Pricing Model (CAPM)*

The graph depicts the weekly return of the selected bank's securities alongside the Capital Asset Pricing Model (CAPM) results. The Capital Asset Pricing Model (CAPM) is a popular financial model that determines the relationship between an asset's expected return and its systematic risk, as measured by beta (β). The following equation can be used to represent the model:

$$\text{Return Expected} = \text{Risk-Free Rate} + \beta * (\text{Market Return} - \text{Risk-Free Rate})$$

Where:

Expected Return is the expected return on an investment. Risk-Free Rate refers to the rate of return on a risk-free asset, such as a bond issued by the government. (β) is a measure of the stock's systematic risk or sensitivity to market fluctuations. Market Return is the return on the entire market portfolio, which is typically represented by a comprehensive market index, such as the STOXX50¹⁵ in this case. In this case the 10Y US Treasury is used as Risk Free rate proxy.

¹⁵The EURO STOXX 50 is derived from the EURO STOXX index and represents the performance of the 50 largest companies among the 20 supersectors in terms of free-float market capitalization in the Eurozone. The index has a fixed number of components and is part of the STOXX blue-chip index family. The index captures about 60% of the free-float market cap of the EURO STOXX Total Market Index (TMI).

Capital Asset Pricing Model results.

Active Premium	Alpha	Annualized Alpha	Beta	Beta-	Beta+	Correlation	Correlation-p-value	Information Ratio	R-squared	Tracking Error	Treynor Ratio
BNP.PA											
0.0489	0.0016	0.0844	1.3791	1.1935	1.8170	0.6454	0	0.1749	0.4165	0.2795	0.0582
SAN.MC											
-0.0677	-0.0006	-0.0311	1.4678	1.2558	1.8506	0.6487	0	-0.2275	0.4208	0.2974	-0.0281
DBK.DE											
-0.1167	-0.0013	-0.0638	1.5181	1.3594	1.7920	0.5953	0	-0.3319	0.3544	0.3515	-0.0552
ISP.MI											
0.0431	0.0014	0.0736	1.3078	1.1648	1.5993	0.6428	0	0.1629	0.4132	0.2643	0.0564

Table 3: Result from the CAPM

We can observe the following essential metrics based on the Capital Asset Pricing Model (CAPM) results for our stocks Sample (BNP, SAN, DBK, and ISP):

Active Premium: This is the excess return of an investment over the risk-free rate. Negative values indicate underperformance, whereas positive values indicate a premium.

Alpha measures the risk-adjusted performance of a stock relative to the market. Negative alpha indicates underperformance, whereas positive alpha indicates outperformance.

Annualized Alpha: It is the alpha measure adjusted for the time period, annualizing the result to facilitate comparisons across time periods.

Beta quantifies a stock's systematic risk by evaluating its sensitivity to overall market fluctuations. A beta value greater than 1 indicates greater volatility than the market, whereas a beta value less than 1 indicates reduced volatility. As we can observe from the result, beta always exhibits a value greater than one, indicating a greater volatility with respect to the overall European market

for the sample examined. Further studies could consider a wider dataset coming to affirm this behavior as generalized in the eurozone for the banking industry.

Beta- and **Beta+** represent the minimum and maximum limits of the confidence interval for the beta estimate. They provide a plausible range for the true beta value.

Correlation measures, as precedingly seen, the linear relationship between an investment and the market. A correlation value close to 1 indicates a strong positive correlation, whereas a correlation value close to -1 indicates a strong negative correlation. In this sample all companies result positive correlated with the markets.

The information ratio assesses the risk-adjusted return of a stock relative to a benchmark. A greater information ratio signifies a superior risk-adjusted performance.

R-Squared: R-squared indicates the proportion of the stock's variance that can be accounted for by the market's variance. A greater value implies a greater correlation between the stock's returns and market returns, showing the incidence of the market performance on the single bank market value. Tracking Error: The tracking error gauges the deviation of the stock's returns from the market or benchmark returns. A reduced tracking error indicates greater market alignment.

The Treynor ratio measures excess return per unit of systematic risk (beta). A greater ratio indicates superior performance relative to risk.

These metrics offer valuable insight into the risk, performance, and correlation characteristics of the equities analyzed with the Capital Asset Pricing Model.

4.3 Consumer Price Index: Euro Area

The Consumer Price Index (CPI) data measures changes in the average prices of a basket of products and services utilized by EU households and is a key indicator of inflation. The European Central Bank employs CPI statistics as a key economic indicator to evaluate the success and impact of its monetary policy and to assess the overall health of the EU economy. There are numerous ways to highlight the importance of the EU CPI data when evaluating ECB policy and its repercussions on the economy as a whole.

The European Central Bank's primary mandate is to maintain price stability within the eurozone, mission defined as Inflation targeting, which it defines as a medium-term inflation rate of less than but close to 2%. CPI data is the primary indicator of whether or not the ECB is meeting its inflation target. If CPI data indicate that inflation is persistently off target, the ECB may need to adjust its monetary policy to correct the imbalance. The ECB uses CPI data to inform its monetary policy choices, such as establishing interest rates, implementing its quantitative easing programs, and modifying its forward guidance. By attentively tracking changes in inflation, the ECB can determine the level of policy accommodation required to promote economic growth and preserve price stability. The role of inflation in determining the trajectory of economic development in the EU is substantial. In general, moderate inflation is viewed as a sign of a healthy economy, as it indicates an increase in aggregate demand, which can contribute to increased production and employment.

However, excessively high or low inflation can hinder economic growth by eroding purchasing power, discouraging investment, or inhibiting consumption. Therefore, the CPI data assists policymakers and analysts in evaluating the condition of the EU economy and identifying potential risks and challenges. The CPI data allows comparative analysis of inflation rates across EU member states, shedding light on the relative economic performances and price stability conditions of various nations. This data can assist the ECB in identifying potential imbalances or divergences within the eurozone, which may necessitate targeted policy interventions.

The release of CPI data can have immediate and substantial effects on financial markets, as it influences market participants' expectations regarding the future direction of the ECB's monetary policy and the condition of the economy as a whole. Changes in inflation expectations can impact asset prices, interest rates, and exchange rates, thereby influencing the EU's financial landscape.

In summary, the EU CPI data is indispensable for assessing the efficacy of ECB strategy and its influence on the economy as a whole. The CPI data enables the ECB to make informed monetary policy decisions aimed at accomplishing its price stability goal and promoting sustainable economic growth within the EU by providing a consistent measure of inflation across the eurozone.

4.3.1 Descriptive statistics

The following descriptive statistics refer the CPI times series analyzed, ranging from 2015 to 2023.

Consumer Price Index

Date		Price	
Min.	2015-01-01	Min.	97.87
1st Qu.	2017-01-01	1st Qu.	101.36
Median	2019-01-01	Median	103.41
Mean	2018-12-31	Mean	103.94
3rd Qu.	2021-01-01	3rd Qu.	105.30
Max.	2023-01-01	Max.	113.28

Table 4: Descriptive Statistics on CPI

4.3.2 Data Visualization - inflation

Using information from the Federal Reserve Economic Data website, the following graphical representation shows the Consumer Price Index (CPI) from the year for the timeframe analyzed with the latest available data.

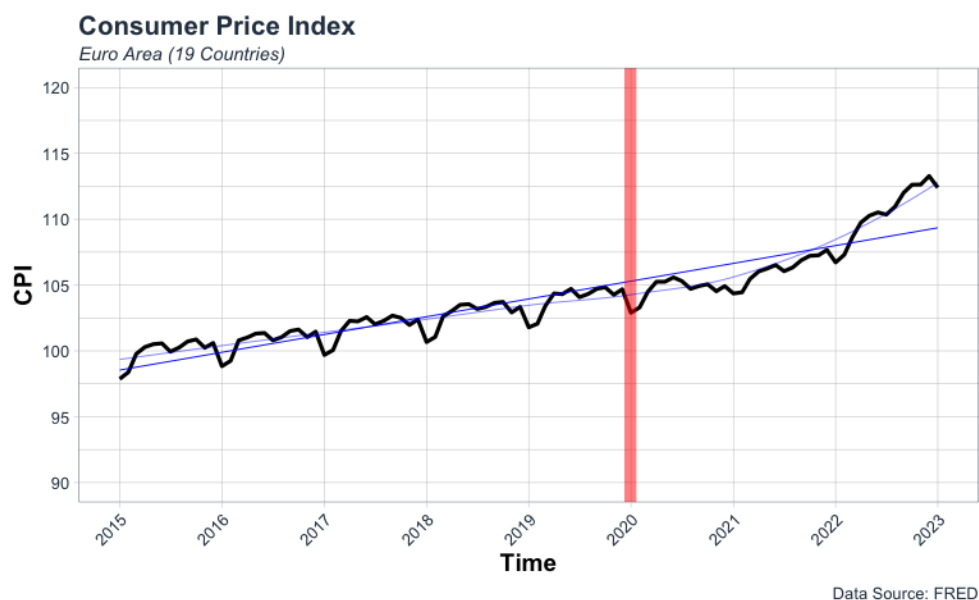


Figure 23: Consumer Price Index for Eurozone

4.3.3 Decomposition of CPI

As the graphical representation shows, the CPI time series is characterized by strong seasonality and trend over the long term. In order to conduct a precise analysis on overtime changes, it is necessary to isolate different components, hence the time series is decomposed to isolate and eliminate the effects of the underlying trend and seasonal variation. This decomposition permits a more precise examination of the data by reducing the influence of these factors on the observed CPI values. The trend effect represents the long-term movement of the data, influenced by the average 2% increase controlled by the ECB. By removing the trend effect, the analysis can concentrate on the short-term fluctuations in the CPI index that are not attributable to these broad trends. Seasonal variance refers to the periodic fluctuations in the CPI data that typically occur annually at regular intervals. These fluctuations may be caused by the annual variations in the index's subcomponents, such as energy prices, which may be influenced by weather patterns, seasonal demand, and geopolitical factors.

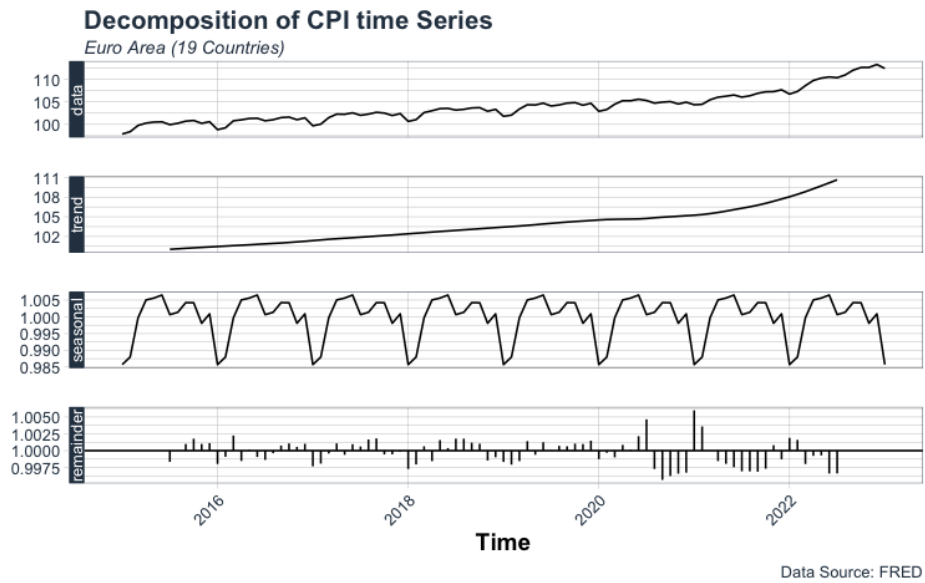


Figure 24: Decomposition of the CPI in Trend, Seasonal and Random component.

4.3.4 Visualization of the Decomposition

The isolated stochastic trend depicts variations in the data that cannot be attributed to seasonal patterns or long-term trends. By isolating this component, the analysis can concentrate on the unpredictable changes in the time series, caused by exogenous factor, in particular we can observe the shocks related to the pandemic event which resulted in increased volatility cluster during 2021, apparently gradually reverting towards its average range. Nonetheless, a comprehensively evaluation of the impact caused by the pandemic on the index may be carried out in the following years.

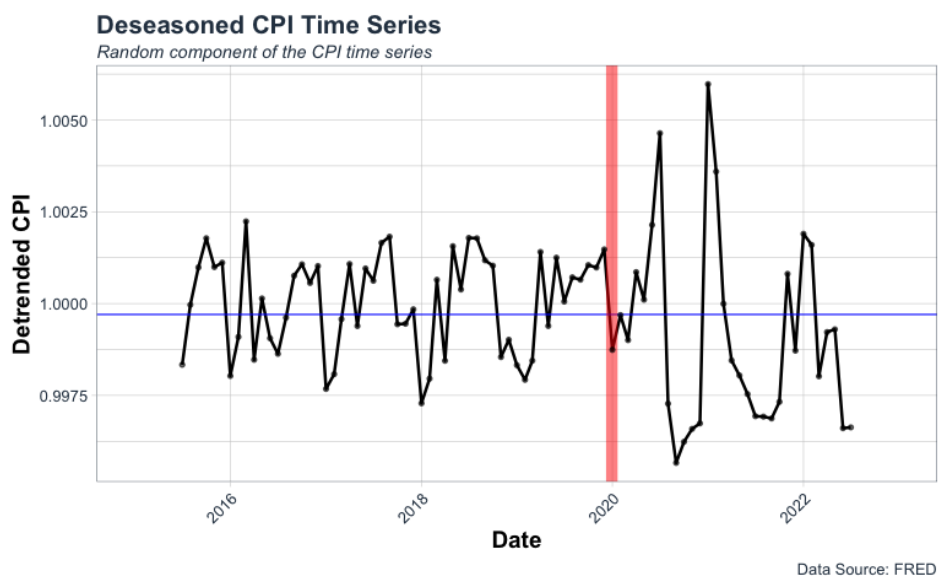


Figure 25 Representation of the random component or “Stochastic Trend”. The impact on CPI of the initial crisis and the sequent rebound of inflation is more visible.

4.4 Inflation

The annual inflation rate is calculated as the percentage change in Consumer Price Index values from one year to the next. This metric captures the relative increase or decrease in the average prices of a basket of products and services over a 12-month period and provides a consistent measure of inflationary pressures within an economy.

$$\text{Annual Inflation Rate} = (\text{CPI-Previous-Year}) / \text{CPI-Previous-Year} \times 100$$

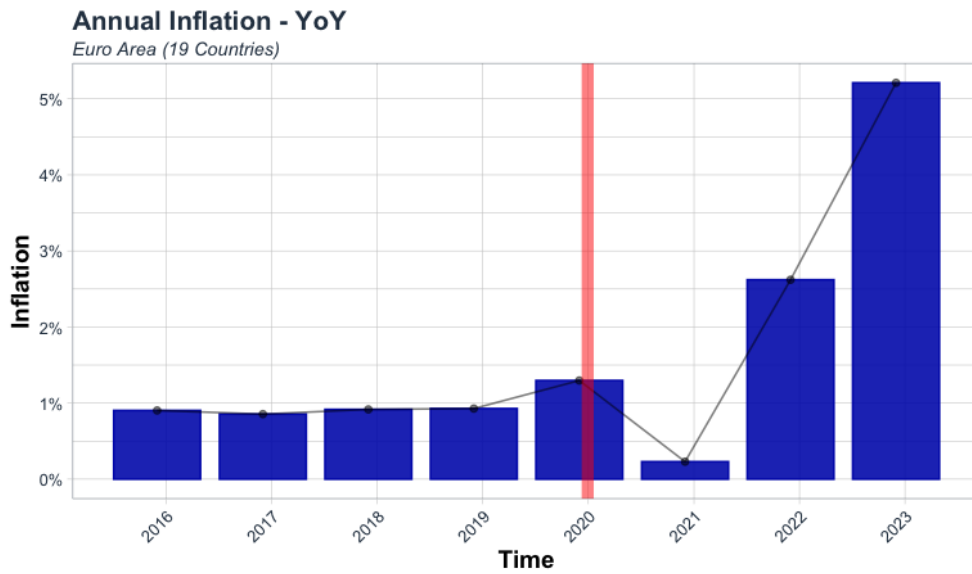
The result of this calculation is the percentage change in the CPI between the two time periods, which quantifies the annual inflation rate. A positive percentage indicates an increase in the average price level, which denotes inflation, whereas a negative percentage indicates a decrease in the average price level, which denotes a deflation stage.

The annual inflation rate is calculated using CPI data obtained from sources such as the Federal Reserve Economic Data (FRED) website. The resultant annual inflation rate allows the evaluation of inflation trends, informing monetary policy decisions and facilitating the evaluation of the economic system's overall health.

4.4.1 *Annual inflation*

The subsequent analysis presents annual inflation rates, computed on a yearly basis. A distinct pattern emerges from the graphical illustration: following a crisis and a year of widespread deflation primarily attributed to demand contraction, the measures instituted by the European Central Bank (ECB) and the European Union (EU) have led to a significant surge in inflation within the Eurozone. This shift in the year-over-year inflation trajectory is markedly different from the four years preceding the 2020 event. The current challenge facing European institutions and central banks globally involves reining in inflation levels and returning them to the target of approximately 2%. By primarily employing progressive rate hike controls, a standard central bank tool—the goal is to avert potential scenarios of hyperinflation or deflation, which may be induced by factors such as the substantial liquidity injections into the financial system that began in 2020.

It can be posited that the Central Bank, when confronted with an unparalleled crisis, implemented measures designed to transfer the issue from the real economy to an inflationary context. This would allow the bank to address the situation using a more manageable element, drawing upon its experience and well-established protocols and tools to handle the inflationary scenario effectively.



Data Source: FRED

Figure 26: The inflation estimation, calculated Year on Year, are presented. The Red line corresponding to the initial Pandemic bakeout mark the start of a new inflationary trend.

4.4.2 Monthly Inflation (YoY)

In order to grasp more granular information on inflation in the Eurozone, the monthly inflation rate was calculated using the Consumer Price Index (CPI) values for the base year 2015 to determine the inflation rate. This metric captures the relative monthly increase or decrease in the average prices of a basket of products and services, providing a consistent indicator of inflationary pressures in an economy.

The formula used to determine the monthly inflation rate based on CPI data is the following:

$$\left(\frac{\text{CPI_current_month} - \text{CPI_base_year}}{\text{CPI_base_year}} \right) \times 100$$

Where: CPI_current_month represents the CPI value for a particular month in any given year. In this case, CPI_base_year corresponds to the average CPI value for 2015, the base year.

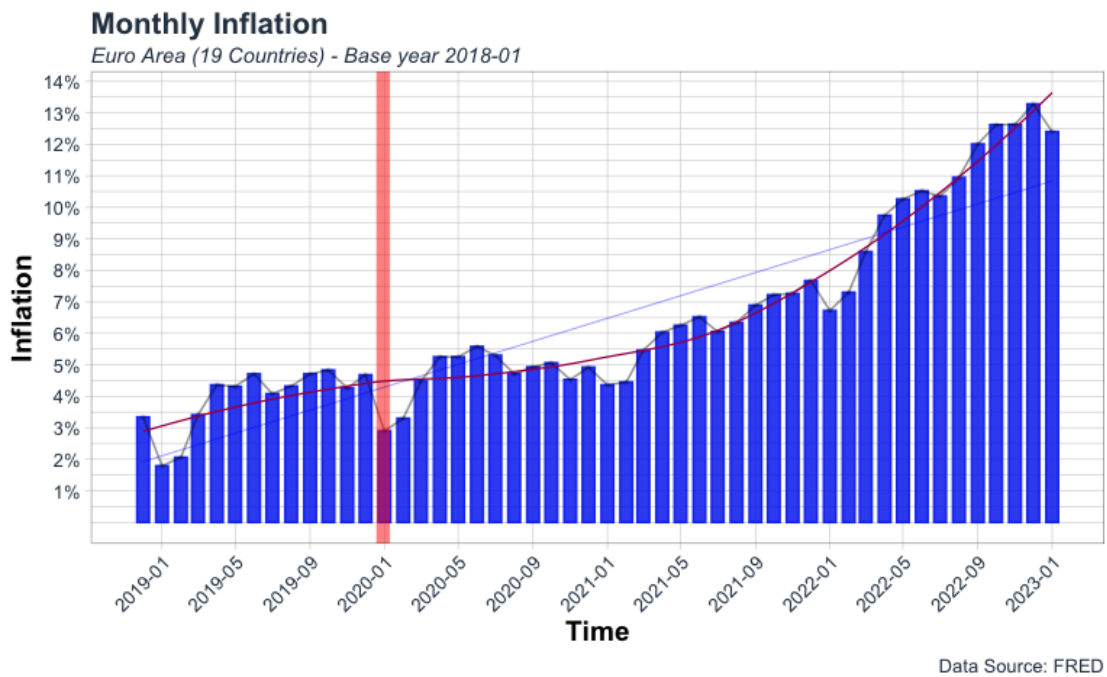


Figure 27: The graph shows monthly inflation calculated considering January 2018 as the base year.

This visualization illustrates the seasonal aspect of inflation, particularly highlighting that the latest inflation measurement exhibits a slight decline, which may be attributed to the seasonality effect. Inflation tends to be lower during the initial months of the year; therefore, it would be inaccurate to interpret this as a reversal in the inflation rate.

The Central Bank's extremely high frequency of interest rate hikes in the later period will result in a time lag before a tangible impact on inflation can be observed. Further research could estimate the duration of this lag time by examining the relationship between the frequency of rate changes, their intensity, and the discernible effect on the overall economy. Scholars may draw upon resources such as Havranek & Rusnak (2013), Friedman (1961), and Gruen et al. (1997), among others, to improve economic forecasts for the upcoming years and contribute to inform policy decisions in the event of additional extraordinary circumstances.

5 Conclusions

This thesis has provided an examination of the banking response in Europe to the 2020 COVID-19 crisis, by delving into the policy measures implemented by European banks and central banks. Aiming to study the impact in mitigating the economic consequences of the pandemic.

The ultimate goal of this research was to offer valuable insights for potential future economic scenarios, recognizing the importance of learning from past historical event in order to develop a more resilient financial system. The event considered have shown that European banking sector's agile and coordinated actions played a central role in preserving financial stability and averting an even more severe economic crisis. The main function of these measures has been to mitigate financial market stress while maintaining the flow of credit to household and businesses. The main policy measures identified in this study include the easing of capital and liquidity requirements, the establishment of comprehensive loan guarantee schemes, and the introduction of substantial monetary stimulus and guarantees programs by central banks. The analysis highlighted the pivotal role of the European Central Bank's proactive approach to monetary policy in mitigating the crisis, specifically the implementation of the programmes such as the Pandemic Emergency Purchase Programme which allowed the ECB to purchase a wide range of public and private assets, maintaining market liquidity and ensuring the smooth transmission of monetary policy. Additionally, the ECB's supervisory function has been crucial in ensuring that European banks maintained adequate capital buffers protocols and continued lending throughout the crisis avoiding a strong contraction in credit. Furthermore, this thesis has emphasized the importance of cooperation and coordination among European members policymakers in addressing the challenges posed by unexpected the pandemic. These initiatives have not only provided essential financial support to businesses and individuals but have also promoted solidarity and unity among the members. By pooling resources and cooperating, European policymakers were able to develop strategies to minimize the economic and social costs of the pandemic. The EU's collaborative response to the COVID-19 crisis serves as a useful example for other regions that may face similar challenges in the future, highlighting the importance of a coordinated approach in addressing large-scale socio-economic disruptions and demonstrates the benefits of international cooperation during crisis management. The research on this topic has wide-ranging implications for policymakers, financial institutions, and academics, as

they provide fundamental contribute to the ongoing debate on crisis management and the ever-evolving development of more effective policies. It is essential to consider the lessons learned from Europe's banking response to the pandemic crisis when preparing for potential future economic shocks. Firstly, has emerged the importance of maintaining robust financial regulations and macroprudential policies, as demonstrated by the events of 2020, well-capitalized and more resilient banks are better prepared to weather economic distress and support the real economy in times of crisis. In the second place, the role of central banks as key players in crisis management has proven to be crucial. The ECB's decisive actions during the pandemic have underscored the importance of central banks' ability to act decisively and responsively in the face of rapidly evolving economic conditions. The experience of the European banking sector during the COVID-19 crisis highlights the need for central banks to be adaptable and proactive when designing and implementing monetary policy measures. The design and calibration of monetary policy tools that can be effectively deployed in times of crisis is an important topic worth the focus for research and discussion. Moreover, the study has revealed the need for a more comprehensive approach to crisis preparedness, encompassing not only financial stability measures but also broader macroeconomic and fiscal policies. The pandemic test has exposed some of the vulnerabilities of certain sectors and countries within the European Union, needing for more targeted policy and support intervention mechanisms. Despite the comprehensive analysis presented in this thesis, there are several limitations due to data availability that need to be acknowledged. Firstly, the unprecedented nature of the COVID-19 crisis and the rapidly evolving policy landscape have made it challenging to access a complete and up-to-date dataset. As a result, the study may not capture the full extent of the banking sector's response to the pandemic or better, the long-term consequences of the implemented policies. Secondly, the lack of granular data at the individual bank level has limited the ability to assess the heterogeneity of banks' responses to the crisis and the differential effects of policy measures on various types of financial institutions.

Future research would benefit from wider and more detailed datasets on bank-level characteristics and actions to better understand the nuances of the European banking sector's response to the pandemic. Another limitation stems from the relatively short time frame covered by the study, which may not allow for a full assessment of the long-term consequences of the policy measures on financial stability and economic growth. Future research should continue to monitor the evolution of the European banking sector and the

lasting effects of the COVID-19 crisis, particularly as new data becomes available. Furthermore, future studies could explore the comparative effectiveness of policy measures across different countries and regions, as well as the interactions between monetary, fiscal, and macroprudential policies in crisis management. Such research would not only enhance our understanding of the European banking sector's response to the pandemic but also inform the design of more effective policy tools and strategies for addressing future crises.

6 Bibliography & Sitography

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Sitography:

- Eurostat (<https://ec.europa.eu/eurostat>)
- European Central Bank Statistical Data Warehouse (<https://sdw.ecb.europa.eu/>)
- Bloomberg (<https://www.bloomberg.com/>)
- World Bank Dataset (<https://data.worldbank.org/>)
- MSCI – Data explorer (<https://dataexplorer.msci.com/ui/home>)
- FRED – (<https://fred.stlouisfed.org/>)
- Yahoo Finance – (<https://it.finance.yahoo.com/>)

ANNEX

Main Package Used

Data Management & Data Science

```
library(tidyverse)
library(tidyr)
library(tidyquant)
library(dplyr)
library(quantmod)
library(forecast)
library(lubridate)
library(zoo)
```

Data Visualization

```
library(ggplot2)
library(ggthemes)
library(ggpubr)
library(scales)
library(data.table)
```

Data Import

```
library(readxl)
```

Markdown and tables

```
require(markdown)
library(gt)
library(gtExtras)
```

Costruction of the Banks sample

#ECB Economy Data

```
EU_data <- read_excel("/Users/Giacomo/Desktop/FINANCE/TESI/Thesis -
864479/Dataset/DATA/4/namq_10_gdp_custom_5988171_page_by_spreadsheet.xlsx", sheet =
"Foglio1")
```

#Data Management

```
EU_data_20 <- EU_data %>%
  select(c('Country', '2022Q4')) %>%
  arrange(desc(`2022Q4`)) %>%
  mutate(`Total%` = `2022Q4`/sum(`2022Q4`)*100) %>%
  bind_rows(summarise(., across(where(is.numeric), sum),
                        across(where(is.character), ~'Total')))
```

#Data Visualization

```
EU_data_20 %>%
  gt() %>%
  tab_header(title = md("**EU Member State GDP**"),
             subtitle = md("**In Millions (€) and % of total EU GDP**")) %>%
  fmt_number(columns = `2022Q4`, suffixing = TRUE) %>%
  fmt_number(columns = `Total%`, dec_mark = ",", decimals = 2, ) %>%
  tab_style(style = list(cell_text(weight = "bold")),
           locations = cells_body(columns = Country)) %>%
  gt_theme_538()
```

EU Member State GDP

Banks in the designated EU Member State

#Loading Data

```
Banks100 <- read_excel("/Users/Giacomo/Desktop/FINANCE/TESI/Materiale/R/DATA/The
World's 100 Largest Banks_2023.xlsx")
```

#Data Management

```
Banks100 %>%
  select(c('Company', 'Headquarters', 'Total assets (US$B)')) %>%
  group_by(Headquarters) %>%
  filter(Headquarters=="Germany" |
         Headquarters=="France" |
```

```

    Headquarters=="Italy"|
    Headquarters=="Spain") %>%
#Data Visualization
gt() %>%
  tab_header(title = md("**EU Member State Banks in World's Top 100**"),
             subtitle = md("**In Billions ($)**")) %>%
  fmt_number(columns = `Total assets (US$B)`, suffixing = FALSE) %>%
  tab_style(style = list(cell_text(weight = "bold")),
            locations = cells_body(columns = Headquarters))%>%
  gt_theme_538()

```

Table 5: EU Member State Banks in World's Top 100

Single banks analysis

#Downloading Data for multiple stocks ('Yahoo')

```

Banks <- tq_get(c("BNP.PA",
                  "SAN.MC",
                  "DBK.DE",
                  "ISP.MI"),
               get = "stock.prices",
               from = "2018-01-01",
               to = "2023-05-01")

```

#Data Management

```
Banks=Banks %>% drop_na(close)
```

#Data Visualization

```

Banks %>%
  ggplot(aes(x = date, y = close, group = symbol)) +
  geom_candlestick(aes(open = open, high = high, low = low, close = close),
                  colour_up = "darkgreen", colour_down = "darkred",
                  fill_up = "darkgreen", fill_down = "darkred") +
  geom_vline(xintercept = as.numeric(as.Date("2020-03-01")), linetype=1, color="red")
+

```

```

labs(title = "EU Biggest Banks Stock Chart",
     subtitle = "Data from 2018-01-01 to 2023-05-01",
     caption= "Data Source: Yahoo Finance",
     y = "Closing Price",
     x = "") +

```

```

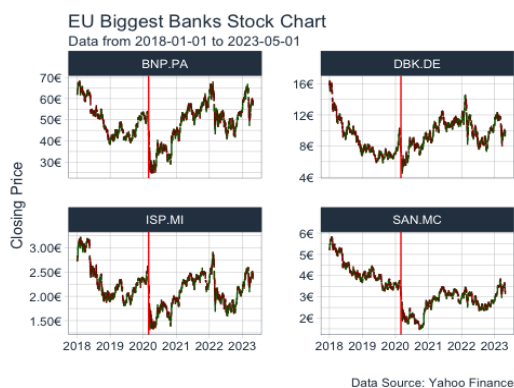
theme(
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=60,hjust=1),
  legend.title = element_text(colour="Black", size=10, face="bold"))+

```

```

scale_y_continuous(labels=dollar_format(suffix="€",prefix=""))+
scale_x_date(date_breaks = "1 year", date_labels = "%Y")+
facet_wrap(~ symbol, ncol = 2, scale = "free_y") +
theme_tq()

```



Percentage change from Epidemic brake out

```
# Data Management
#Banks$percentage_increase <- NA
Banks_groups <- split(Banks, Banks$symbol)

#BNP.PA
for (i in 1:nrow(Banks_groups$BNP.PA)) {
  Banks_groups$BNP.PA$percentage_increase[i] <- (Banks_groups$BNP.PA$close[i] -
min(Banks_groups$BNP.PA$close)) / min(Banks_groups$BNP.PA$close) * 100
}

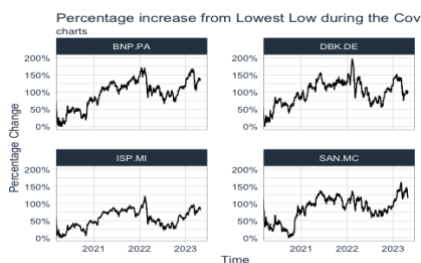
#SAN.MC
for (i in 1:nrow(Banks_groups$SAN.MC)) {
  Banks_groups$SAN.MC$percentage_increase[i] <-
(Banks_groups$SAN.MC$close[i] - min(Banks_groups$SAN.MC$close)) /
min(Banks_groups$SAN.MC$close) * 100
}

#DBK.DE
for (i in 1:nrow(Banks_groups$DBK.DE)) {
  Banks_groups$DBK.DE$percentage_increase[i] <- (Banks_groups$DBK.DE$close[i] -
min(Banks_groups$DBK.DE$close)) / min(Banks_groups$DBK.DE$close) * 100
}

#ISP.MI
for (i in 1:nrow(Banks_groups$ISP.MI)) {
  Banks_groups$ISP.MI$percentage_increase[i] <- (Banks_groups$ISP.MI$close[i] -
min(Banks_groups$ISP.MI$close)) / min(Banks_groups$ISP.MI$close) * 100
}

Banks <- do.call(rbind, Banks_groups)

##Data Visualization
Banks%>%
  ggplot(aes(x = date, y = percentage_increase, group = symbol)) +
  geom_line()+
  labs(title = "Percentage increase from Lowest Low during the Covid Crisis",
        subtitle = "charts",
        y = "Percentage Change", x = "Time") +
  coord_x_date(xlim = c(Banks$date[which.min(Banks$close)]+10,
Banks$date[which.max(Banks$date)]))+
  scale_y_continuous(limits = c(0,200), labels=dollar_format(suffix="%", prefix=""))+
  scale_x_date(date_breaks = "1 year", date_labels = "%Y")+
  facet_wrap(~ symbol, ncol = 2, scale = "free_y") +
  theme_tq()
```



Correlation Analysis

```
# Data Management
dbk <- Banks %>%
  filter(symbol == "DBK.DE") %>%
  select(date, close) %>%
  rename("DBK" = "close")

isp <- Banks %>%
  filter(symbol == "ISP.MI") %>%
```

```

select(date, close) %>%
rename("ISP" = "close")

san <- Banks %>%
  filter(symbol == "SAN.MC") %>%
  select(date, close) %>%
  rename("SAN" = "close")

bpn <- Banks %>%
  filter(symbol == "BNP.PA") %>%
  select(date, close) %>%
  rename("BPN" = "close")

banks_corr <- dbk %>%
  left_join(isp, by = 'date') %>%
  left_join(san, by = "date") %>%
  left_join(bpn, by = "date") %>%
  na.omit()

# Load required packages
library(corrplot)

## corrplot 0.92 loaded

# Subset the dataset to include only the stock prices
stock_prices <- banks_corr[, -1] # Exclude the Date column

# Perform correlation analysis
correlation_matrix <- cor(stock_prices)

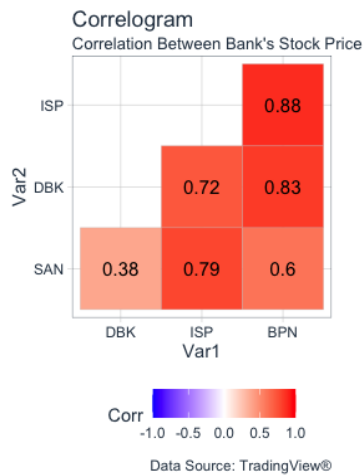
# Print the correlation matrix
print(correlation_matrix)

##           DBK           ISP           SAN           BPN
## DBK 1.0000000 0.7166323 0.3793316 0.8304740
## ISP 0.7166323 1.0000000 0.7864433 0.8786194
## SAN 0.3793316 0.7864433 1.0000000 0.6033828
## BPN 0.8304740 0.8786194 0.6033828 1.0000000

# Visualize the correlation matrix as a heatmap
ggcorrplot::ggcorrplot(correlation_matrix,
  lab= TRUE,
  hc.order = TRUE,
  type = "lower",
  insig = "blank")+
  labs(title = "Correlogram",
  subtitle = "Correlation Between Bank's Stock Price",
  caption= "Data Source: TradingView®") +

  theme(
    plot.title = element_text(face="bold", size = 14),
    plot.subtitle = element_text(face="italic"),
    legend.title = element_text(colour="Black", size=10, face="bold"))+
  theme_tq()

```



Performance Analysis

#Reading economic data from Tradingview

```
BPN = read.csv('/Users/Giacomo/Desktop/FINANCE/TESI/Thesis -
864479/Dataset/DATA/4/Banks/EURONEXT_DLY_BNP, 1W.csv', stringsAsFactors = FALSE)
SAN = read.csv('/Users/Giacomo/Desktop/FINANCE/TESI/Thesis -
864479/Dataset/DATA/4/Banks/BME_DLY_SAN, 1W.csv', stringsAsFactors = FALSE)
DBK = read.csv('/Users/Giacomo/Desktop/FINANCE/TESI/Thesis -
864479/Dataset/DATA/4/Banks/XETR_DLY_DBK, 1W.csv', stringsAsFactors = FALSE)
ISP = read.csv('/Users/Giacomo/Desktop/FINANCE/TESI/Thesis -
864479/Dataset/DATA/4/Banks/MIL_LS_ISP, 1W.csv', stringsAsFactors = FALSE)
```

#Adding a Row in order to identify data

```
BPN$symbol <- "BPN"
SAN$symbol <- "SAN"
DBK$symbol <- "DBK"
ISP$symbol <- "ISP"
```

#Aggregating database vertically

```
Banks_Tw <- rbind(BPN, SAN, DBK, ISP)
```

#Organizing and cleaning Date column

```
Banks_Tw <- separate(data = Banks_Tw, col = time, into = c("time", "timeISO"), sep =
"T")
Banks_Tw <- Banks_Tw[,-2]
Banks_Tw$time <- as.Date(Banks_Tw$time)
```

#Retaining only additional data

```
Banks_Tw_NoNA <- na.omit(Banks_Tw)
```

Net Income for Banks

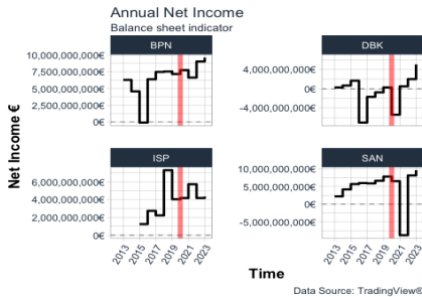
#TW Data Graphs - Net Income

```
Banks_Tw%>%
  drop_na(Net.income) %>%
  ggplot()+
  geom_hline(yintercept=0, size=0.2, linetype= 2) +
  geom_step(aes(x=time,
                y=Net.income,
                group=symbol),
            size=1)+
  geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
            alpha=0.5, size= 2) +
  labs(title = "Annual Net Income",
       subtitle = "Balance sheet indicator",
       caption= "Data Source: TradingView®",
       y = "Net Income €",
       x = "Time") +
  scale_y_continuous(labels=dollar_format(suffix="€", prefix=""))+
```

```

scale_x_date(date_breaks = "2 year", date_labels = "%Y",
             limit=c(as.Date("2012-01-01"),as.Date("2023-05-01"))
            )+
theme_tq() +
theme(
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=60,hjust=1),
  legend.title = element_text(colour="Black", size=10, face="bold"))+
facet_wrap(~ symbol, ncol = 2, scale = "free_y")

```



Return on Equity for Banks

#TW Data Graphs - ROE

```

Banks_Tw%>%
drop_na(ROE...1) %>%
ggplot()+
geom_step(aes(x=time, y=ROE...1, group=symbol), size=1)+
geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1,
color="red", alpha=0.5, size= 2) +
labs(title = "Return On Equity",
      subtitle = "ROE - Balance sheet indicator",
      caption= "Data Source: TradingView®",
      y = "ROE %",
      x = "Time") +

```

```

scale_y_continuous(labels=dollar_format(suffix="%", prefix=""))+
scale_x_date(date_breaks = "2 year", date_labels = "%Y",
             limit=c(as.Date("2012-01-01"),as.Date("2023-05-01"))
            )+
theme_tq() +
theme(
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=60,hjust=1),
  legend.title = element_text(colour="Black", size=10, face="bold"))+
facet_wrap(~ symbol, ncol = 2, scale = "free_y")

```



Current Ratio

#TW Data Graphs - Current.ratio

```

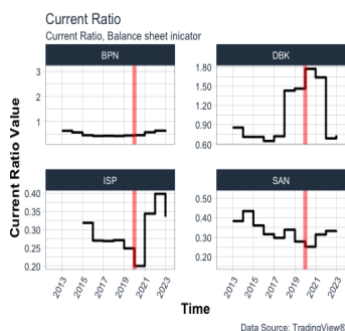
Banks_Tw%>%
drop_na(Current.ratio) %>%
ggplot()+

```

```

geom_step(aes(x=time, y=Current.ratio, group=symbol), linewidth= 1, size=1)+
geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
alpha=0.5, size= 2) +
labs(title = "Current Ratio",
      subtitle = "Current Ratio, Balance sheet indicator",
      caption= "Data Source: TradingView®",
      y = "Current Ratio Value",
      x = "Time") +
scale_y_continuous(labels=dollar_format(suffix="",prefix=""))+
scale_x_date(date_breaks = "2 year", date_labels = "%Y",
             limit=c(as.Date("2012-01-01"),as.Date("2023-05-01"))
             )+
theme_tq() +
theme(
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=60,hjust=1),
  legend.title = element_text(colour="Black", size=10, face="bold"))+
facet_wrap(~ symbol, ncol = 2, scale = "free_y")

```



Capital Asset Pricing Model (CAPM)

#Data, Grouped by symbol, obtain *period* return

```

Ra <- c("BNP.PA",
        "SAN.MC",
        "DBK.DE",
        "ISP.MI") %>%
tq_get(get = "stock.prices",
       from = "2015-01-01",
       to = "2023-05-01") %>%
group_by(symbol) %>%
tq_transmute(select = adjusted,
             mutate_fun = periodReturn,
             period = "weekly",
             col_rename = "Ra")

```

#Plot the period Return

```

Ra %>%
ggplot(aes(x = date, y = Ra, group = symbol)) +
geom_line()+
geom_vline(xintercept = as.numeric(as.Date("2019-12-30")),
linetype=1, color="red", alpha=0.5, size= 1.5) +
labs(title = "Selected Banks Return Chart",
      subtitle = "Weekly Returns",
      y = "Closing Price",
      x = "",
      caption = "Data Source: FRED") +
scale_y_continuous(labels=dollar_format(suffix="%",prefix=""))+
scale_x_date(date_breaks = "2 year", date_labels = "%Y",
             limit=c(as.Date("2015-01-01"),as.Date("2023-05-01"))
             )+
theme_tq() +
theme(

```

```

axis.title.y = element_text(color = "black", size=13, face = "bold"),
axis.title.x = element_text(color = "black", size=13, face = "bold"),
axis.text.x=element_text(angle=60,hjust=1),
legend.title = element_text(colour="Black", size=10, face="bold")+
facet_wrap(~ symbol, ncol = 2, scale = "free_y")

```



```

#STOXX EU50 Index - Benchmark - Return
Rb <- "EUN.MI" %>%
  tq_get(get = "stock.prices",
        from = "2015-01-01",
        to = "2023-05-01") %>%
  tq_transmute(select = adjusted,
              mutate_fun = periodReturn,
              period = "weekly",
              col_rename = "Rb")

#Data.Farme Join
RaRb <- left_join(Ra, Rb, by = c("date" = "date"))

#Retrieve the performance metrics
RaRb_capm <- RaRb %>%
  tq_performance(Ra = Ra,
                Rb = Rb,
                performance_fun = table.CAPM)

#Gt Table
RaRb_capm %>%
  gt()%>%
  tab_header(title = md("**Result from the CAPM**"),
            subtitle = md("*Capital Asset Pricing Model*")
            ) %>%
  tab_style(style = list(cell_text(weight = "bold")),
            locations = cells_body(columns = symbol)
            )%>%
  gt_theme_538()

```

Result from the CAPM

CPI and Inflation

Consumer Price Index: Euro Area

Descriptive statistics

```

##Data Download & Mangement
infl <- tq_get("CPHPLA01EZM661N",
              get= "economic.data",
              from = "2006-01-01",
              to = "2023-06-10") %>%
  tq_mutate(select= price,
            mutate_fun = allReturns) %>%
  filter(date >= '2015-01-01')

#Descriptive statistics
cpi_eu <- infl %>%

```



```

select(date, price)

data_summary <- data.frame(unclass(summary(cpi_eu)), check.names = FALSE)
colnames(data_summary) <- c("Date", "Price")

data_summary <- data_summary %>% separate(col = Date, into = c("Date", "_____"), sep
= ":")
data_summary <- data_summary %>% separate(col = Price, into = c("Price", "_____"), sep
= ":")

#Rendered table
data_summary %>%
  gt() %>%
  tab_header(title = md("**Descriptive Statistics on CPI**"),
             subtitle = md("**Consumer Price Index**")) %>%
  gt_theme_538()

```

Descriptive Statistics on CPI
Consumer Price Index

Date	_____	Price	_____
Min.	2015-01-01	Min.	97.87
1st Qu.	2017-01-01	1st Qu.	101.36
Median	2019-01-01	Median	103.41
Mean	2018-12-31	Mean	103.94
3rd Qu.	2021-01-01	3rd Qu.	105.30
Max.	2023-01-01	Max.	113.28

Data Visualization – Inflation

```

#CPI Visualization
##Data Download & Mangement
infl <- tq_get("CPHPLA01EZM661N",
              get= "economic.data",
              from = "2006-01-01",
              to = "2023-06-10") %>%
tq_mutate(select= price,
          mutate_fun = allReturns) %>%
  filter(date >= '2015-01-01')

#Yearly inflation as percentage value
infl$yearly <- infl$yearly*100

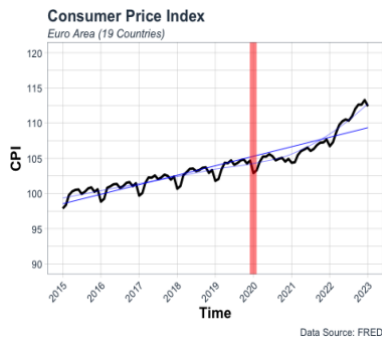
#Data Visualization - CPI
infl %>%
  ggplot()+
  geom_line(aes(x=date, y=price), linewidth= 1)+
  geom_smooth(aes(x=date, y=price), method="lm", se =FALSE, col='blue', size=0.3) +
  geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
alpha=0.5, size= 3) +
  geom_smooth(aes(x=date, y=price), se=FALSE, col='blue', size=0.15) +
  labs(title = "Consumer Price Index",
       subtitle = "Euro Area (19 Countries)",
       caption = "Data Source: FRED",
       y = "CPI",
       x = "Time") +
  scale_y_continuous(breaks = seq(90, 120, 5),
labels=dollar_format(suffix="",prefix=""), limits = c(90,120)) +
  scale_x_date(date_breaks = "1 year",
              date_labels = "%Y") +
  theme_tq() +
  theme(
    plot.title = element_text(face="bold", size = 14),

```

```

plot.subtitle = element_text(face="italic"),
axis.title.y = element_text(color = "black", size=13, face = "bold"),
axis.title.x = element_text(color = "black", size=13, face = "bold"),
axis.text.x=element_text(angle=45,hjust=1)

```



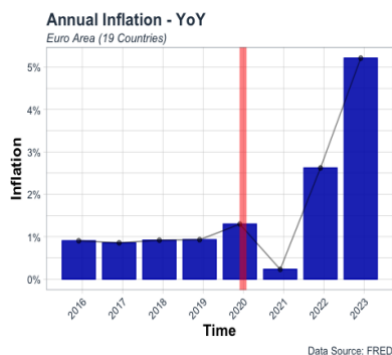
Annual inflation

Inflation - Annual

```

infl %>%
  select(date, yearly) %>%
  na.omit() %>%
  filter(row_number() <= n()-1) %>%
ggplot(aes(date, yearly)) +
  geom_col(width = 300,col="#0424b8", fill="#0424b8", alpha=0.9)+
  geom_line(aes(x=date, y=yearly), alpha=0.5)+
  geom_point(aes(x=date, y=yearly), alpha=0.5)+
  geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
alpha=0.5, size= 3) +
  #geom_smooth(aes(x=date, y=yearly), se=FALSE, col='blue', size=0.15) +
  labs(title = "Annual Inflation - YoY",
  subtitle = "Euro Area (19 Countries)",
  caption = "Data Source: FRED",
  y = "Inflation",
  x = "Time") +
  scale_y_continuous(labels=dollar_format(suffix="%",prefix="")) +
  scale_x_date(date_breaks = "1 year",
  date_labels = "%Y") +
  theme_tq() +
  theme(
  plot.title = element_text(face="bold", size = 14),
  plot.subtitle = element_text(face="italic"),
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=45,hjust=1)

```



Monthly Inflation (YoY)

```

# Convert Date column to Date type
infl$date <- as.Date(infl$date)

#alternative w/ 2018 reference

```

```

infl <- infl %>%
  arrange(date) %>%
  mutate(Return = (price-100)/100)

# Return(Infl) in Percentage (*100)
infl$Return <- infl$Return*100

infl %>%
  select(date, Return) %>%
  filter(date >= '2018-12-01') %>%
  ggplot(aes(date, Return)) +
  geom_col(width = 20, col="#1d43f0", fill="#1d43f0", alpha=0.9) +
  geom_line(aes(x=date, y=Return), alpha=0.4)+
  geom_point(aes(x=date, y=Return), alpha=0.1, size= 0.7)+
  geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
alpha=0.5, size= 3) +
  geom_smooth(aes(x=date, y=Return), se=FALSE, col='#a61255', size=0.4) +
  geom_smooth(aes(x=date, y=Return), method = "lm", se=FALSE, col='blue', size=0.12)
+
  labs(title = "Monthly Inflation",
        subtitle = "Euro Area (19 Countries) - Base year 2018-01 ",
        caption = "Data Source: FRED",
        y = "Inflation",
        x = "Time") +
  scale_y_continuous(breaks = seq(1, 15), labels=dollar_format(suffix="%",prefix=""))
+
  scale_x_date(date_breaks = "4 month",
               date_labels = "%Y-%m") +
  theme_tq() +
  theme(
    plot.title = element_text(face="bold", size = 14),
    plot.subtitle = element_text(face="italic"),
    axis.title.y = element_text(color = "black", size=13, face = "bold"),
    axis.title.x = element_text(color = "black", size=13, face = "bold"),
    axis.text.x=element_text(angle=45,hjust=1))

```



Decomposition of CPI

#Decomposition of the CPI

```

cpi_eu <- infl %>%
  select(date, price)

```

#Data Management

```

cpi_eu_ts <- ts(cpi_eu$price, frequency = 12, start = c(2015, 1,1))
decomposed_ts <- decompose(cpi_eu_ts, type = "multiplicative")

```

#Data visualization

```

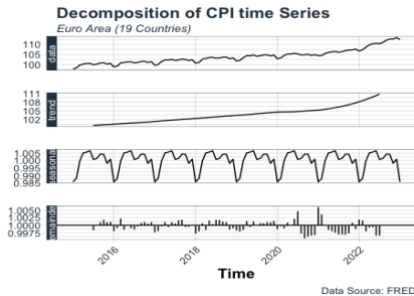
autoplot(decomposed_ts)+
  labs(title = "Decomposition of CPI time Series",
        subtitle = "Euro Area (19 Countries)",
        caption = "Data Source: FRED",
        x = "Time") +
  theme_tq() +

```

```

theme(
  plot.title = element_text(face="bold", size = 14),
  plot.subtitle = element_text(face="italic"),
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=45, hjust=1)

```



Visualization of the Decomposition

```

# Remove Seasonality and Trend

```

```

detrended_ts <- cpi_eu_ts / decomposed_ts$trend / decomposed_ts$seasonal

```

```

# Create a new data frame with detrended data

```

```

detrended_data <- data.frame(date = as.Date(time(cpi_eu_ts)), detrended_cpi =
detrended_ts)

```

```

mean = detrended_data$detrended_cpi %>%
  na.omit()

```

```

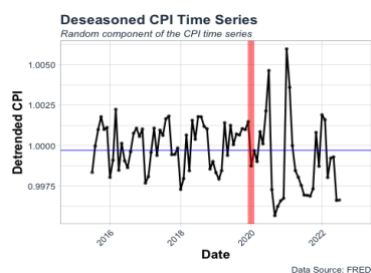
# Remove Seasonality

```

```

detrended_ts <- cpi_eu_ts / decomposed_ts$trend
ggplot(detrended_data, aes(x = date, y = detrended_cpi)) +
  geom_line(size=0.8) +
  geom_hline(yintercept = mean(mean), linetype=1, color="blue", alpha= 0.7,
size=0.5)+
  geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
alpha=0.5, size= 3) +
  geom_point(alpha=0.6, size= 1)+
  labs(title = "Deseasoned CPI Time Series",
  subtitle= "Random component of the CPI time series ",
  x = "Date",
  y = "Detrended CPI",
  caption = "Data Source: FRED")+
  theme_tq() +
  theme(
    plot.title = element_text(face="bold", size = 14),
    plot.subtitle = element_text(face="italic"),
    axis.title.y = element_text(color = "black", size=13, face = "bold"),
    axis.title.x = element_text(color = "black", size=13, face = "bold"),
    axis.text.x=element_text(angle=45, hjust=1)

```



Deposit Facility Rate for Euro Area

```
#ECB Deposit Facility Rate for Euro Area
ECBr <- tq_get("ECBDFR",
  get= "economic.data",
  from = "2000-01-01",
  to   = "2023-05-01")

#Data Visualization
ECBr %>%
  drop_na(price) %>%
  ggplot()+
  geom_step(aes(x=date, y=price), size=1)+
  geom_vline(xintercept = as.numeric(as.Date("2019-12-30")), linetype=1, color="red",
alpha=0.5, size= 3) +
  geom_hline(yintercept = 0, linetype=2, color="red", alpha=0.7, size =0.5) +
  labs(title = "ECB Deposit Facility Rate",
  subtitle = "Euro Area (19 Countries)",
  caption = "Data Source: EUROSTAT",
  x = "Time",
  y="") +
  scale_y_continuous(breaks = seq(-2,4,0.5),
labels=dollar_format(suffix="%",prefix="", )) +
  scale_x_date(date_breaks = "1 year",
  date_labels = "%Y",
  limit=c(as.Date("2015-01-01"),
  as.Date("2023-05-01"))
  )+
  theme_tq() +
  theme(
  axis.title.y = element_text(color = "black", size=13, face = "bold"),
  axis.title.x = element_text(color = "black", size=13, face = "bold"),
  axis.text.x=element_text(angle=60, hjust=1))
```