UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER THESIS

MACROECONOMIC IMPACTS OF MONETARY AND FISCAL POLICY IN THE EURO AREA DURING THE COVID-19 PANDEMIC: A SVAR APPROACH

Ljubljana, October 2022

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sl. – Slovene

APP – (sl. Nakupi vrednostnih papirjev); Asset purchase programme

BoE – (sl. Angleška centralna banka); Bank of England

EA – (sl. Evroobmočje); Euro Area

ECB – (sl. Evropska centralna banka); European Central Bank

EU – (sl. Evropska unija); European Union

FED – (sl. Ameriška centralna banka); Federal Reserve

GDP – (sl. Bruto domači proizvod); Gross domestic product

HICP – (sl. Harmonizirani indeks cen življenjskih potrebščin); Harmonised Index of Consumer Prices

LTROs – (sl. Operacije dolgoročnejšega refinanciranja); Long-term refinancing operations

MROs – (sl. Operacije glavnega refinanciranja); Main refinancing operations

NIRP – (sl. Politika negativnih obrestnih mer); Negative interest rate policy

PELTROs – (sl. izredne operacije dolgoročnejšega refinanciranja ob pandemiji); Pandemic emergency longer-term refinancing operations

PEPP – (sl. Izredni program nakupa vrednostnih papirjev ob pandemiji); Pandemic emergency purchase programme

QE – (sl. Kvantitativno sproščanje); Quantitative easing

SGP – (sl. Pakt za stabilnost in rast); Stability and Growth Pact

SSR – (sl. Senčna obrestna mera); Shadow short rate

SURE – (sl. Instrument za začasno podporo za ublažitev tveganj za brezposelnost v izrednih razmerah); Support to mitigate Unemployment Risks in an Emergency

SVAR – (sl. Strukturna vektorska avtoregresija); Structural Vector Auto-regression

TFEU – (sl. Pogodba o delovanju Evropske unije); Treaty on the Functioning of the European Union

TLTROs – (sl. Ciljno usmerjene operacije dolgoročnejšega refinanciranja); targeted long-term refinancing operations

VAR – (sl. Vektorska avtoregresija); Vector Auto-regression

WHO – (sl. Svetovna zdravstvena organizacija); World Health Organization

INTRODUCTION

At the end of 2019, the world was shaken by the news of an unknown, highly infectious disease outbreak in the Chinese city of Wuhan. Universally, people hoped that the disease caused by the SARS-CoV-2 virus would remain within China. The number of recorded cases and deaths rose quickly whilst the disease spread globally. Consequently, on March 11, 2020, the World Health Organization authorities officially declared a pandemic (WHO, 2022). The lack of knowledge and high uncertainty about the future development of the virus began to reveal several systemic weaknesses and vulnerabilities in European national health care systems (Sagan et al., 2021). Suddenly, the governments were forced to choose whether to prioritize their economies or to save their citizens' lives. To prevent both the collapse of healthcare systems and to protect people, most governments in the European Union (EU) adopted lockdown measures, established travel restrictions, and enforced non-essential business closures (Jackson, 2021).

Although COVID-19 can be identified as a large, symmetric, exogenous shock that impacted all countries defined within the Euro Area (EA), it soon became clear that its consequences would asymmetrically distribute across countries and sectors as a reflection of Member States' economic and structural differences (European Commission, 2022b). These challenges forced the EA monetary and fiscal authorities to take extraordinary and unprecedented measures to mitigate the effects of the pandemic taking into consideration the unique architecture of the EA, which consists of a single monetary authority but includes several decentralized, fiscal authorities (Debrun et al., 2021). The efforts of the EA were further complicated by years of persistently low inflation rates and a declining natural rate of interest.

With policy rates close to the Zero Lower Bound (ZLB), monetary policy was forced to lean on its non-conventional measures. Accordingly, the European Central Bank (ECB) mainly focused on additional asset purchase programmes and targeted long-term refinancing operations (TLTROs). The ECB established its first measures on 12 March 2020. To lower borrowing costs and increase lending, the ECB designed the emergency purchase program PEEP, which initially amounted to 750 billion € but later expanded to 1,850 billion €. This led to more than a 110 billion € increase in the total size of the ECB balance sheet in 2021 compared to 2020 (ECB, 2022a).

The EA economy was also substantially supported on the fiscal policy side, mainly through discretionary actions and automatic stabilizers. In 2020, the aggregate discretionary stimulus for EA represented close to 4.25% of the total GDP. To ensure flexibility for the Member States, EU authorities activated the general escape clause of the Stability and Growth Pact (SGP) in May 2020. This resulted in increased public debts. To support economic recovery, the EU authorities also established a 750 billion € large NextGenerationEu instrument (Debrun et al., 2021).

The objective of this master's thesis is to analyse and capture the impact of extraordinary and unprecedented measures of monetary and fiscal authorities in the EA during the COVID-19 pandemic. Specifically, this master's thesis asks the following research questions:

- Does monetary policy shock affect EA's macroeconomic environment, especially prices (HICP) and real output (GDP)?
- Do fiscal policy shocks affect EA's macroeconomic environment, especially prices (HICP) and real output (GDP)?
- What are the key measures to combat the COVID-19 pandemic on the fiscal policy side?
- What are the key measures to combat the COVID-19 pandemic on the monetary policy side?
- How do monetary and fiscal policies interact with one another in periods of low inflation and interest rates?

Based on the literature and procedures proposed, the objective is to choose appropriate monetary and fiscal policy variables, as well as a suitable econometric model to analyse the relationships between variables. Due to the dynamic and interactive nature of relationships between variables, a structural vector autoregressive (SVAR) approach is chosen as appropriate. Estimating the aggregate effects for the EA assumes that the transmission mechanism for both policies is identical among all EA countries. Nevertheless, the estimation of the individual EA countries to capture cross-country heterogeneity effects extends beyond the scope of this thesis. Therefore, our analysis includes aggregate estimation for the EA.

This master's thesis contributes to the literature on fiscal as well as monetary policy analysis. It does so by integrating both policies within a single SVAR framework and studying their interactions with key macroeconomic variables (output and inflation) for the EA aggregate.

This master's thesis is roughly divided into two parts, theoretical and empirical, respectively. Within the theoretical part, I lean on methods to describe, summarize, compare, and connect concepts. I focus on monetary and fiscal policies in the EA during the pandemic and the existing relations between these policies and macroeconomic variables in the literature. Specifically, the master's thesis consists of four main chapters, whereby the first chapter overviews the COVID-19 pandemic including its macroeconomic impact. This is followed by chapter two where the policy responses to the COVID-19 pandemic are presented in detail, with emphasis on monetary and fiscal measures. The third chapter explains methodological approaches and includes a literature review and a specification of the VAR and SVAR models. In the fourth chapter, the empirical analysis, all specification procedures, diagnostics, and a discussion of results are presented.

1 OVERVIEW OF THE COVID-19 PANDEMIC

1.1 Phases of the COVID-19 outbreak and containment measures in the EU

In December 2019, the Chinese authorities identified one-of-a-kind pneumonia that was of undetermined cause in Wuhan, the capital of the province of Hubei, China. This deadly and highly infectious disease was later labeled “COVID-19” caused by the “SARS-COV-2 virus” (WHO, 2022). Due to the strong integration between China and the rest of the world, the number of cases and deaths persistently grew and started to proliferate both within and beyond the borders of China (Shrestha et al., 2020). On March 11, 2020, the World Health Organization (WHO) declared a pandemic that later resulted in a catastrophic disaster for the global economy and humanity (WHO, 2022). The first case within the EU was reported in France on January 24, 2020. One month later, the Belgian, Finnish, German, Italian, Spanish, and Swedish authorities reported their country’s first cases. Before the end of March 2020, every country within the EU had confirmed multiple cases and deaths due to the COVID-19 disease (Spiteri et al., 2020). Consequently, by the end of April 2020, the European Region transformed into the epicenter of the pandemic, since as much as 63% of COVID-19’s global mortality at that time came from this region (WHO, 2022).

A lack of knowledge combined with high uncertainty about the future development of the virus put national EU healthcare systems to the test revealing several systemic weaknesses and vulnerabilities (Sagan et al., 2021). Governments were suddenly forced to choose whether to prioritize their economies or the lives of their citizens. With both the concern of healthcare systems collapsing and the priority to protect the elder population, governments across the EU adopted several extraordinary lockdown measures and non-essential business closures (Jackson, 2021). Afterward, these were brought to question as an abuse of human rights (Odigbo, Eze & Odigbo, 2020). The measures that each government considered to slow the spread of COVID-19 disease differed across the EU, both in severity and timing. As a method of capturing and tracking those measurements, the Oxford COVID-19 Government Response Tracker (OxCGRT) was constructed. This, among other indexes, calculated responses using a Stringency Index – a composite index that considers nine different response tactics, including restriction on internal movements, closure of schools, closure of workplaces, cancellation of public events, restriction on public gatherings, closure of public transport systems, campaigns for public information, control of international travel, and stay-at-home requirements (Our World in Data, 2022). Stringency Index differed among EA countries and over time since some governments imposed stricter measures than others. On March 9, 2020, Italy was the first EU country to impose a complete lockdown and quarantine for the entire population. The measures that were taken by Italy were eventually and, to a large extent, followed by other EU countries. Soon afterward, EU leaders decided to ban nonessential travel of non-EU citizens in the EU for 30 days with the hope to prevent the spread of the COVID-19 disease (POLITICO, 2020). Over the following two months, the health impacts of the pandemic seemed to have eased. Citizens of the EU hoped they would soon be able to return to “normal life”, one without any restrictions. On 15 May, 2020, Slovenia even became the first country in the EU to declare the “end” of the COVID-19 epidemic (GOV.SI, 2020). Similarly, other EA countries began to relax the measures imposed two months before. This was without sensing that the COVID-19 disease had only appeared in its “first wave” and that a new, even deadlier wave would follow shortly thereafter in the fall of 2020. In September 2020, authorities in the EU reported that the number of confirmed cases had already exceeded the highest number of figures of the first wave, but they partly attributed these statistics to the increased number of tests provided at the time (Vox, 2020). Due to the increased number of confirmed cases, governments again began to impose restrictions and lockdowns but this time, less stringent and at a slower pace (Holder, Stevis-Gridneff, & McCann, 2020). After the 2020 fall wave, the COVID-19 pandemic hit the EU in several more consecutive waves.

It was expected that the virus would evolve as it spread amongst individuals around the world and that several “variants” would emerge, which would differ slightly from each other in composition and severity. In May 2021, the WHO decided to use the Greek alphabet to name these different variants rather than naming them after places where they have been first detected (WHO, 2021). Several prominent variants of concern had been identified in the EU within this period, in particular Alpha, Beta, Gamma, Delta, and Omicron. Simultaneously, the development of the COVID-19 vaccine was highly anticipated and was seen as a light at the end of the tunnel. The vaccination in the EU commenced at the end of December 2020. By August 2021, around 70% of the adult population in the EU had received both doses of the COVID-19 vaccine and were, therefore, fully vaccinated (Euronews, 2022). For vaccines to be still effective, health authorities later recommended a COVID-19 vaccine booster shot – the third dosage. Despite all recommendations of the health authorities, part of the EU population decided not to receive the vaccine since they feared possible side effects because the vaccine was, after all, a very “fresh thing”. Bergmann, Hannemann, Bethmann & Schumacher (2021) researched whether demographic, health, and socio-economic situations for the population above 50 years could reveal any information about that. Their study concluded that population with lower income and with lower education have more frequently refused to be vaccinated and, thus, held the highest levels of skepticism. Similar conclusions were made for population with no pre-existing medical issues and women. On the other hand, people who knew someone that was severely affected by COVID-19 disease were more likely to get vaccinated.

1.2 Macroeconomic impact of the COVID-19 pandemic in the EU and EA

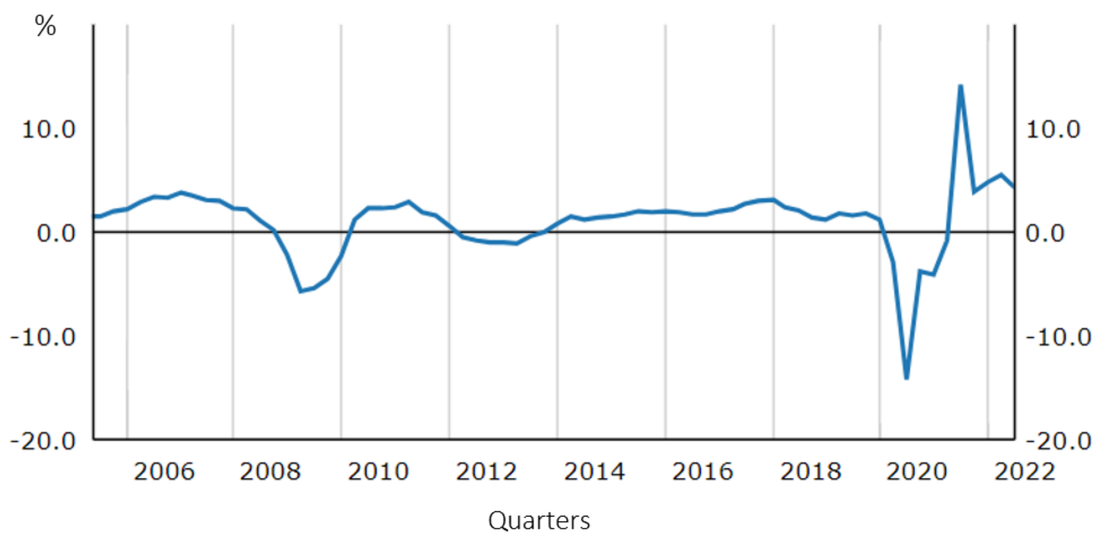
Since the COVID-19 pandemic triggered a substantial health and economic crisis, we have been able to observe enormous changes in key macroeconomic aggregate variables which provide information on economic welfare (Mavroudeas, 2020). In addition to the government’s adoption of several extraordinary measures and their decision to shut down their economies, the global economy faced challenges of disruption in international supply chains. This was largely due to its increasing interconnectedness over the past decades. The lockdown restrictions on regions and sectors that were imposed in China between February and March of 2020 quickly and sharply influenced Chinese production and exports. Strong spillover effects lead to disruption of the global supply chains which were strongly felt especially by intermediate goods producers around the globe (Meier & Pinto, 2020). This also affected producers within the EU considering that in 2021, China held the largest part in EU imports of goods, 22.4% to be specific (Eurostat, 2022c).

In the following subchapters, the trends of key macroeconomic aggregate variables for the EA before and during the COVID-19 pandemic are outlined.

1.2.1 Gross domestic product (GDP)

GDP belongs among the most important and widely used macroeconomic variables that indicate the state of economic performance and economic health in a country (Investopedia, 2022). In Figure 1, the evolution of the EA GDP quarterly growth rates over time can be observed. It can be observed that the EA GDP growth had already fallen due to the global financial crisis in 2008 and later to a somewhat lesser extent due to the debt crisis in 2012. Anyhow, the sharp contraction that EA GDP faced due to the COVID-19 pandemic is clearly unprecedented in comparison to the last few decades.

Figure 1: EA GDP growth rates compared to the same period of the previous year

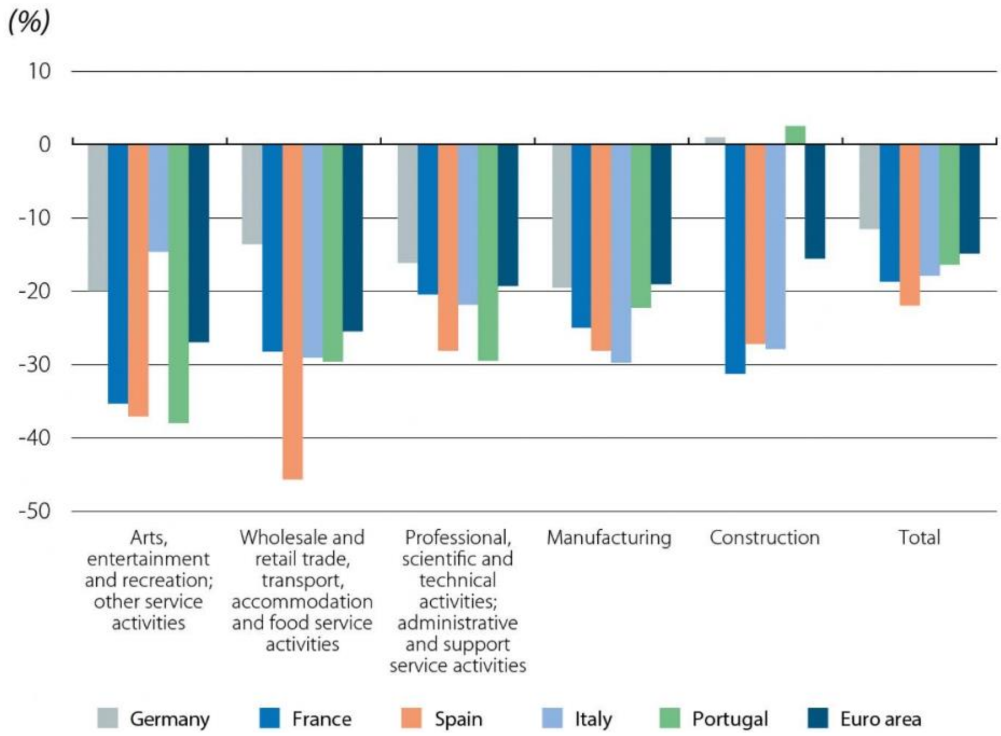


Adapted from ECB Statistical Warehouse (2022).

The growth of the real GDP within the EA in the first quarter of 2020 deteriorated by 3.8% compared to the previous quarter and by 3.3% compared to the same quarter of the previous year. Growth then dropped significantly during the second quarter of 2020 when the EA faced a negative growth rate of 11.5% compared to the previous quarter and a negative growth rate of 14.6% compared to the same quarter of the previous year (Statista, 2022). With the onset of the COVID-19 crisis, forecasts, and predictions about how the EA economy could bounce in upcoming periods arose. Speculations considered either V-shape, L-shape, U-shape, or W-shape recovery patterns whereby we later witnessed a kind of V-shaped recovery (Sharma et al., 2021) since within the second quarter of 2021 real GDP already grew by around 2.2% compared to the previous quarter and by around 14.6% compared to the same quarter of the previous year as it can be well observed in Figure 1.

The intensity of the GDP change during the COVID-19 pandemic differed across member states in the EA and was conditional on the structure of the individual economy, the prevalence of the virus within the country, the measures that were implemented to contain the spread of the virus, and the implemented economic policies (Leandro, 2020). Figure 2 presents one of these aspects, namely changes in gross value added (GVA) in the second quarter of 2020 compared to that of the fourth quarter of 2019. These figures represent states within the EA and in five of its largest economies. It can be observed that in total, Spain faced the largest drop in real GVA for compared periods, followed by France, Italy, and Portugal while Germany faced the smallest drops among all categories. Its values were even under the EA aggregate values, since its economy is not, on a major scale, dependent on sectors that were the hardest hit by the COVID-19 pandemic. Spain, France, Italy, and Portugal, on the other hand, rely importantly on sectors, such as leisure, catering, retail, transport, accommodation, and food services, that all belong amongst the most severely hit sectors.

Figure 2: Change in real GVA for EA aggregate and five of its largest economies in the second quarter of 2020 compared to the fourth quarter of 2019

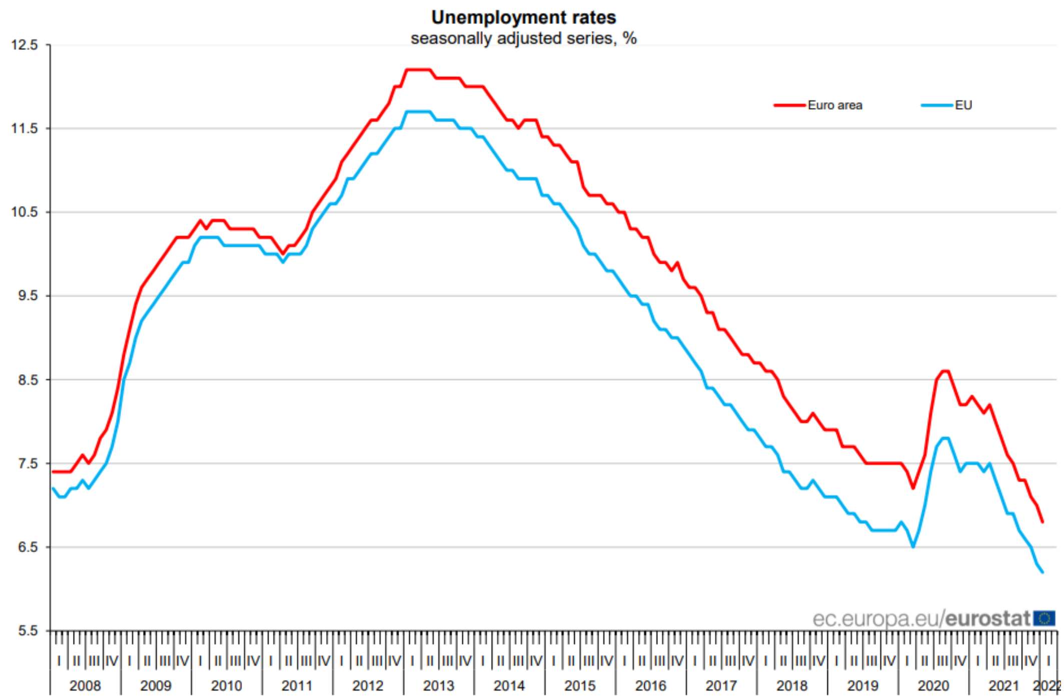


Source: Leandro (2020).

1.2.2 Unemployment

Massive job losses and bankruptcies within the EA have been prevented due to the implemented policies on the member states' national level and the EU level. By supporting measures, such as keeping the financial conditions favorable and dispensing diverse support to firms and households, the EA authorities seemingly succeeded to cushion the destructive consequences of the COVID- 19 pandemic (International Monetary Fund, February 2022). Figure 3 presents changes in the unemployment rates within the EU & EA over the last decade. It can be observed that the unemployment rate started to rise with the onset of the COVID-19 pandemic in 2020 reaching its high at the end of the same year, afterward falling persistently. In January 2022, the EA's "seasonally adjusted" unemployment rate reached the value of 6.8% and 6.2% in the EU compared to the values for January 2021 which were respectively 8.3% and 7.5% for the EA and the EU (Eurostat, 2022b). In January 2022, there were around 11.225 million men and women in the EA and around 13.346 within all EU that fell under the category of unemployed individuals.

Figure 3: EU & EA unemployment rates



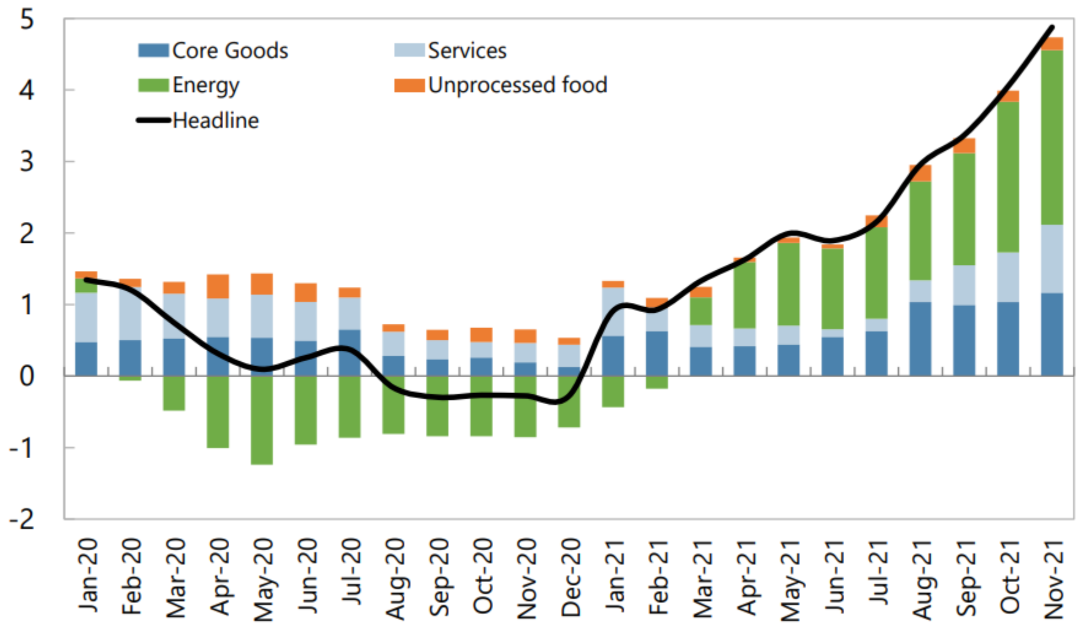
Source: Eurostat (2022b).

The COVID-19 pandemic especially increased the unemployment rate of young people that are under the age of 25. In January 2022, the unemployment rate for these individuals amounted to 14.0% in the EU and 13.9% in the EA. Unemployment was also higher in the female population since its unemployment rate in January 2022 amounted to 6.5% in the EU and 7.1% in the EA while the unemployment rate for men amounted to 6.0% in the EU and 7.1% in the EA.

1.2.3 Prices and inflation

The COVID-19 pandemic has triggered changes in EA prices as shown in Figure 4. A sharp decline at the beginning of 2020 can be attributed to the supply chain disruptions and governments' initiatives to shut down economies, which later resulted in a global slowdown that most severely hit the energy and metals commodities markets (World Bank, 2020). By the end of 2020, both core and headline inflation rebounded due to increased energy prices, demand build up and labour shortages. This revival can also be attributed to one-off events. For instance, the new consumer basket weights of the harmonized index of consumer prices (HICP) and the German authorities' proclamation of a VAT cut expiration. Post-crisis price increases were also accelerated by nonenergy goods inflation together with service price inflation whereby the trimmed-mean rate of inflation in November 2021 amounted to historically high levels close to 5% compared to the same month of the previous year (International Monetary Fund, February 2022).

Figure 4: EA inflation and its key components based on HICP



Source: International Monetary Fund (February 2022).

Despite the demand and supply mismatches in certain sectors that influenced the core inflation, the EA initially faced less severe price increases compared to the USA (Wiseman, 2021). Since the beginning of 2022, inflation in the EA has further increased and is now a major economic problem.

2 POLICY RESPONSES TO THE COVID-19 PANDEMIC

Even though the COVID-19 pandemic can be identified as a large symmetric exogenous shock that impacted every country in the EA, it soon became clear that its consequences would asymmetrically distribute across countries and sectors as a reflection of differences in member states' economic structures (European Commission, 2022b). These challenges forced the EA monetary and fiscal authorities to take extraordinary and unprecedented measures to mitigate the effects of the pandemic taking into consideration the unique architecture of the EA which consists of a single monetary authority and 27 decentralized fiscal authorities (Debrun et al., 2021). Over the past decade, these authorities faced persistently low inflation rates and the declining natural rate of interest.

During the outbreak of the crisis, several critics pointed out that the EU response should be more coordinated and faster, especially due to the urgent public health situation in Italy and Spain which, by that time, seemed to be abandoned by the EU side. This criticism came to the forefront even more when ECB president Christine Lagarde announced in March of 2020 that ECB would offer flexibility but that its mission is not to "close the spreads." This immediately impacted bond yields in the Italian financial markets and, thus, caused a major increase in their price for borrowing money. Due to this increasing uncertainty and market pressures, Lagarde announced shortly thereafter that urgent actions regarding policy stance and instruments will be much needed.

The following subchapters discuss monetary and fiscal policy measures considered as a response to the COVID-19 pandemic.

2.1 Monetary policy responses to the COVID-19 pandemic

The EA consists of 19 EU MS that decided to make a step further in the EU integration by adopting a single currency. Namely, Belgium, Germany, Ireland, Spain, France, Italy, Luxembourg, the Netherlands, Austria, Portugal, Finland, Greece, Slovenia, Cyprus, Malta, Slovakia, Estonia, Latvia, and Lithuania replaced their national currencies with the euro and, therefore, became subject to special rules regarding monetary policy and economic policy making (European Commission, 2022a). Eurosystem is the EA monetary authority and consists of ECB and 19 EU MS national central banks having the euro as their currency. With credibility, trust, accountability, and transparency, it aims at maintaining price stability and financial stability in the EA (ECB, 2022h). Treaty on the Functioning of the European Union (TFEU) defines price stability under Article 127(1) as the primary monetary policy objective whereby the ECB should also consider supporting EU general economic policies within its mandate, including balanced economic growth, full employment, and financial stability but without prejudice to the primary objective in any way (ECB, 2022g).

The ECB monetary policy strategy and its main elements were first agreed upon in 1998. In it, the ECB Governing Council, among other elements, also defined the quantitative definition of price stability, namely by targeting the annual rate of increase in the Harmonized index of consumer prices (HICP) "below 2%" over the medium-term period (European Parliament, 2021c). As Kieler (2003) explains, the critics pointed out this definition as being asymmetric and too ambiguous, but at the same time less effective compared to the point inflation target. As a result, in 2003, the ECB Governing Council agreed on a new quantitative definition of price stability by targeting the annual rate of increase in HICP “below, but close to 2%” over the medium term rather than just “below 2%” as initially agreed. The last change regarding the monetary policy strategy and its review was announced by the ECB in January 2020 and finally completed in 2021. From July 2021 on, the price stability is followed by targeting the annual rate of change in the EA HICP “of 2%” over the medium term (European Parliament, 2021b). The ECB justifies that a symmetric target of ”2%” should provide a safety margin against possible deflationary pressures and, thus, still ensure effective monetary policy and provide a clear anchor for inflationary expectations (ECB, 2022f). Even though the monetary policy strategies and targets changed over the past decades, the primary objective of price stability remains a strong foundation.

For monetary policy to follow defined objectives, it relies on both conventional and unconventional measures. Conventional measures mostly refer to setting key interest rates. With policy rates close to the Zero Lower Bound (ZLB) in the years since the financial crisis and up to the outbreak of the COVID-19 pandemic, the monetary policy in the EA was forced to lean on its non-conventional measures. Accordingly, the European Central Bank (ECB) mainly focused on additional asset purchase programmes and targeted long-term refinancing operations (TLTROs). The ECB established its first measures on March 12, 2020. To lower borrowing costs and increase lending, the ECB designed a pandemic emergency purchase program (PEPP), which initially amounted to 750 billion € but later expanded to 1,850 billion €. This led to more than a 110 billion € increase in the total size of the ECB balance sheet in 2021 compared to 2020 (ECB, 2022a).

2.1.1 Monetary policy functions and transmission mechanism

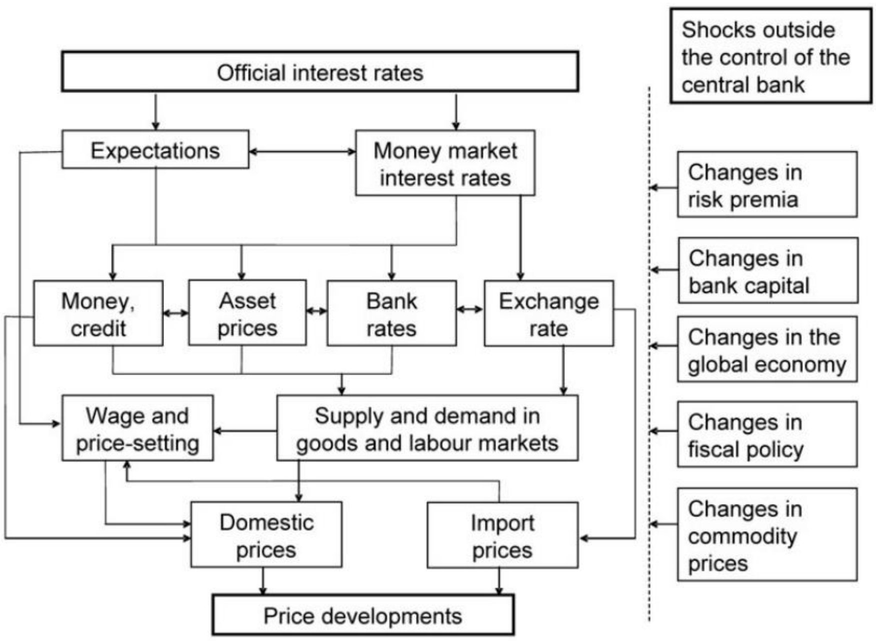
The principal goal of monetary policy is to maintain prices at a stable level and by that, influence job creation by contributing to economic growth. To achieve the target value of inflation at 2% over the medium-term period, monetary authorities will typically rely on a variety of tools and instruments which have been updated and expanded in recent years. This is due to the changes and challenges within the economic environment (ECB, 2022c). Their decisions influence the general economy and in particular price levels through a so-called transmission mechanism, as shown in Figure 5 (ECB, 2022b).

There are five main transmission channels of monetary policy:

- Interest rate channel: Decisions of the monetary policy authorities regarding changes in the official interest rates have a direct impact on money market rates and a subsequent effect on deposits and bank rates on loans. Besides that, a more indirect effect on long-term market rates that influence the costs of borrowing and returns on savings can also be observed. Spending and investment decisions can be additionally influenced by asset prices, potentially affected by the change in discount factors (Strasser, 2018).

- Expectations channel**:** Credible and transparent monetary authorities can influence expectations about future interest rates affecting medium and long-term interest rates that are an important foundation for economic decisions. Other expectations that can be affected are expectations regarding inflation. By anchoring inflation expectations of price stability, monetary policy authorities prevent the fear of deflation or inflation (ECB, 2022b).
- Exchange rate channel: Monetary policy authorities' decisions that influence expectations and financing conditions may affect asset prices (stock market prices) and exchange rates which have an impact on the domestic prices of imported goods, external demand, or domestic demand through wealth effects. If imported goods are used directly for consumption, any change in exchange rates can have a direct impact on the prices, thus inflation (Strasser, 2018).
- Credit Channel: Changes in the interest rates can also influence bank balance sheets and their lending activity. An environment of low-interest rates will increase collateral values, lower the riskiness of loans and, thus, present a higher opportunity to borrow. Reversely in the environment of higher interest rates, the probability of loan defaults increases whereby consequences can be felt in reduction of investments and consumption (ECB, 2022b).
- Risk-taking channel: Decisions of the monetary policy authorities regarding changes in the official interest rates can also influence the attractiveness of risk regarding loans as mentioned above. In the environment of low-interest rates, riskier assets gain more importance. This is due to higher yields which "force" investors to consider those assets by rebalancing their portfolios (Strasser, 2018).

Figure 5: Schematic illustration of the MP policy decision & main transmission channels



Source: ECB (2022b).

In addition to the transmission mechanism described above, transmission channels of unconventional monetary policy introduce important new aspects as well:

– Relation between capital market and borrowing conditions (credit easing): Monetary policy decisions transmit to households and firms through banks, largely by influencing financial and borrowing conditions in capital markets by targeting proper financial instruments (Strasser, 2018).
– The expectation of the market (forward guidance): Another possible channel is to affect market expectations that concern inflation and interest rates. This is done by signaling the credibility and future course of monetary policy actions called forward guidance (Strasser, 2018).
– Open market and its financing conditions (APP): This channel aims to affect financing conditions in the open market directly by using the so-called pricing kernels mechanism and portfolio rebalancing (Strasser, 2018).

2.1.2 Traditional and non-standard monetary policy tools

For EA monetary policy to pursue its primary objective of price stability, the ECB relies on various instruments. These instruments can be categorised as traditional and non-standard measures, as presented in Figure 6.

Figure 6: Traditional and non-standard monetary policy tools of the Eurosystem

TRADITIONAL INSTRUMENTS	**NON-STANDARD MONETARY POLICY MEASURES**
• **a) Open market operations** * Main refinancing operations MROs) * long-term refinancing operations (LTROs) *Fine-tuning operations (smoothing) *Structural operations (adjusting) • **b) Standing facilities** * Marginal lending facility * Deposit facility • **c) Holding of minimum reserves**	• **d) Negative interst rate policy** (NIRP) • **e) Forward guidance** • **f) Long-term refinancing operations** *Targeted long-ter refinancing operations (TLTROs -II, III) *Pandemic emergency long-term refinancing operations (PELTROs) • **g) Asset purchase programmes** *Corporate sector purchase programme (CSPP) *Public sector purchase programme (PSPP) *Asset-backed securities purchase programme (ABSPP) *Third covered bond purchase programme (CBPP3)

Adapted from European Parliament (2021); ECB (2014).

There are three main traditional monetary policy instruments, namely:

- Open market operations are very important since they not only signal the monetary policy stance but also manage the market liquidity situation and steer interest rates. There are several types of open market operations. The first of these are the main refinancing operations (MROs) which are defined as one-week liquidity-providing operations with aim of signalizing EA's monetary policy stance, steering short-term interest rates, and managing the situation regarding liquidity. These are followed by long-term refinancing operations (LTROs) defined as three-month liquidity-providing market operations to provide the financial sector with additional and more long-term refinancing. The last two open market operations are structural operations and fine-tuning operations (European Parliament, 2021a).
- Standing facilities also belong among traditional monetary policy instruments whereby their objectives are to provide and absorb overnight liquidity and steer the Euro Overnight Index Average (EONIA) market rate, as well as to signal policy stance (ECB, 2014). There are two separate standing facilities, namely a deposit facility where banks can deposit excess liquidity with the ECB overnight and a marginal lending facility where banks can acquire overnight liquidity from the ECB (European Parliament, 2021a).
- Holding the minimum number of reserves of banks with the ECB and national central banks is the last traditional instrument of monetary policy to achieve money market interest rates stability, aiming at short-term interest rates and structural liquidity shortage (ECB, 2014). Minimum reserves are a requirement by the ECB for banks and other credit institutions in the EA to hold central bank money for a proportion of their liabilities (in particular, short-term liabilities with maturity of up to 2 years) on accounts with the national central banks.

In addition to the described traditional monetary policy instruments, the ECB also deployed several non-standard monetary policy measures from the global and EA financial crises:

- Long-term refinancing operations (LTRO): From 2007 onwards, the ECB announced several extensions of the LTROs' maturity ranges to ensure enough liquidity for the banks. They first announced supplementary 3-month LTROs and 6-month LTROs. As a response to the global financial crisis, 12-month LTROs at a fix-rate full allotment and 36-month LTROs were introduced. In June 2014, the ECB announced targeted long-term refinancing operations (TLTROs) to improve lending to businesses and consumers in the EA by offering long-term loans to banks at convenient costs. In 2016, TLTRO II came into force and in 2019, the ECB announced TLTRO III to keep borrowing costs low and to affect investment and spending decisions (ECB, 2021). Pandemic emergency longer-term refinancing operations (PELTROs) came into force between May 2020 and December 2021 as a response to the COVID-19 pandemic whereby the interest rate was set 25 basis points below the MRO rate (European Parliament, 2021a).

- Forward guidance concerning interest rates and their future path was implemented within the EA in July 2013 (European Parliament, 2021a). It plays an important role in steering expectations about interest rates. At the same time, it is an important automatic stabilization mechanism (Lane, 2021).
- Asset purchase programmes have been initiated since mid-2014 on and consist of the public sector purchase programme (PSPP), corporate sector purchase programme (CSPP), third covered bond purchase programme (CBPP3), and asset-backed securities purchase programme (ABSPP). As a response to the COVID-19 pandemic, the ECB Governing Council announced a temporary pandemic emergency purchase programme (PEPP) aimed at the public and private sectors (ECB, 2022j).
- Negative interest rate policy (NIRP) was adopted in 2014 (as a response to interest rates being close to zero) to ease the financing conditions even further, thus reducing bank funding costs and stimulating the loan supply. This kind of policy is transmitted through different channels to support economic activity and influence price stability (Boucinha, Burlon & Kapp, 2020).

2.1.3 Monetary policy measures in response to the COVID-19 pandemic

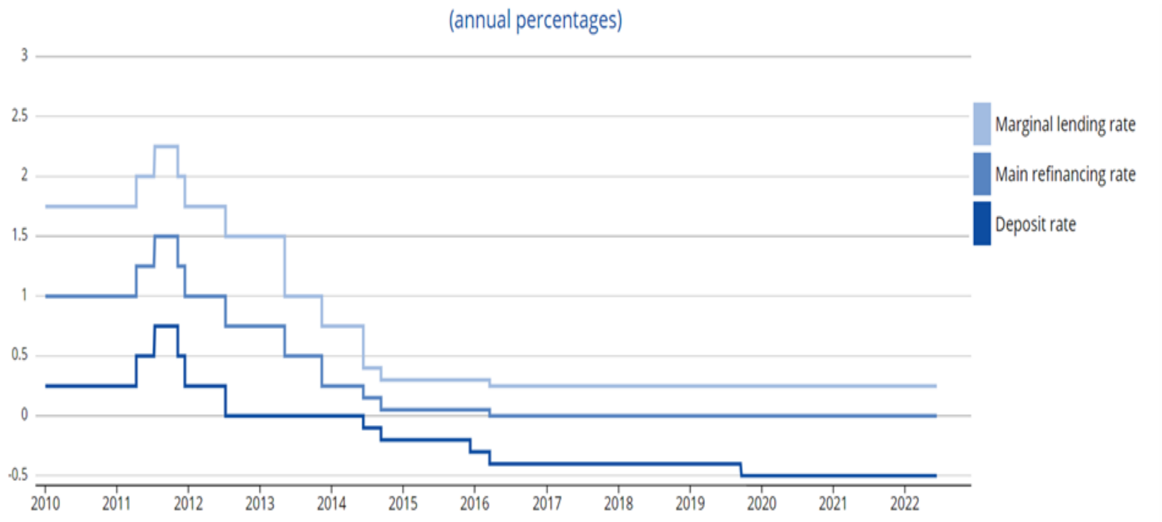
Since the real equilibrium interest rates in the EA were within the last decade on a declining trend , unconventional monetary policy instruments became necessary and more suitable. It can be argued that the equilibrium real interest rate partly reflects policy choices. For example, policies, such as the statutory retirement age and labour force participation impact demographic which afterward, influence equilibrium real interest rates. Besides demographic factors, the declining trend can be attributed to a decline in productivity growth and increased demand for assets, especially liquid and safe ones (ECB, 2022i). Nevertheless, the EA monetary authorities continue to point out that both conventional and unconventional tools are essential monetary policy components and that it is rather important to find the most suitable and effective combination of both to achieve the desired policy stance (Panetta, 2022).

A quick overview of the period before the COVID-19 pandemic outbreak bears witness to accommodative monetary policy based on the response and measures taken due to the persistent below-target rates of inflation. In September 2019, the ECB Governing Council decided to ease the monetary policy stance further. The Governing Council lowered the rate on deposit facility to minus 0.5%, resumed net asset purchases (APP) at a monthly amount of 20 billion €, performed the third series of targeted longer-term refinancing operations (TLTRO III) to support credit supply, and further reaffirmed these measures by forward guidance. Monetary policy authorities responded to the COVID-19 pandemic soon after its outbreak. In the spring of 2020, several measures, packages, and complementary initiatives were considered, among them a 120 billion € extension of the APP on 12 March 2020, the launching of PEPP six days later on 18 March 2020, TLTRO and its revision regarding the structure and pricing, easing of the collateral framework, and several supportive supervisory measures (Lane, 2022).

During the COVID-19 pandemic, we can illuminate three main levers that have been used from the monetary policy side, namely interest rates, asset purchases, and targeted longer-term refinancing operations (Panetta, 2022). Due to the declining trend of neutral (natural) interest rates caused by demographic factors, productivity slowdown, and net demand for safe assets, we have been able to observe historically low levels of interest rates that consequently reflected the decline of the real neutral interest rate in advanced economies to zero or below. This is also the case for the USA real neutral interest rates estimates which, however, remains at higher levels when compared to the EA estimates. A such environment of low real interest reduces the monetary policy space available to achieve the primary objective of price stability, including by countering excessively low or negative inflation (Lane, 2020).

Official key interest rates or key policy rates are traditionally paramount instruments of monetary policy. These are set by the ECB Governing Council every six weeks. As can be observed in Figure 7, there are three main ECB rates. The main refinancing operations (MROs) rate influences the provision of liquidity to the banking systems. The deposit facility rate is the second one and it is defined as a rate that is received by banks for overnight deposition of the money with the Eurosystem . The last one is the marginal lending facility rate that influences the interest rate on Eurosystem overnight credit laid out to the banks. The money market overnight rate (EONIA) fluctuates within a well-known "corridor" defined by the rate on the deposit facility and the rate on the marginal lending facility (Euro Area Statistics, 2022).

Figure 7: Key ECB interest rates

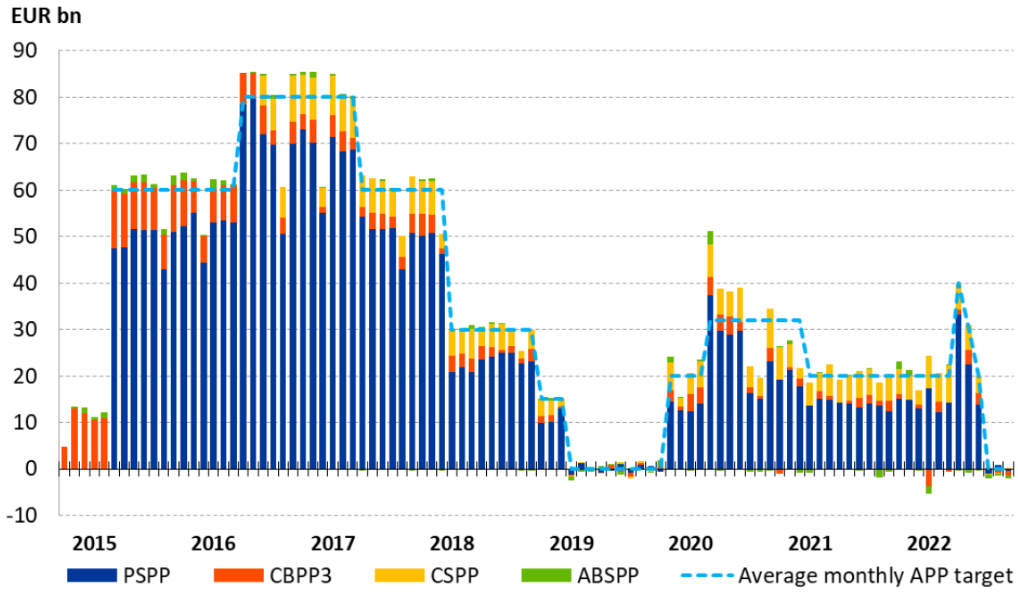


Source: Euro Area Statistics (2022).

Periods of low inflation before the COVID-19 pandemic forced the ECB Governing Council to act towards their main objective of defined price stability by trying to raise inflation. To counter low inflation, they started to implement a reduction of key interest rates in late 2011, as can be well observed in Figure 7 (ECB, 2021). During the period of the COVID-19 pandemic, the ECB kept key interest rates at historically low levels. The ECB then only started raising key interest rates in the aftermath of the COVID-19 pandemic after 11 years due to increasingly persistent inflation. A 25 basis points rise in key interest rates in July 2022 was followed by an even larger 75 basis points rise in September 2022 bringing the MRO rate to 1.25%, the marginal lending facility rate to 1.5%, and the deposit rate to 0.75%. The ECB also scaled back forward guidance stating that further increases will depend on the medium-term inflation outlook (ECB, 2022k). Federal Reserve (FED) and Bank of England (BoE) increased their main rates before the ECB. The hawkish decision of the ECB is, therefore, lagged but can be attributed to record high inflation rates within the EA in the first quarter of 2022 which amounted to almost 7.5% (Arnold, 2022).

Other levers that have been used from the monetary policy side as a response to the COVID-19 pandemic are non-standard monetary policy measures, namely asset purchase programmes (APP) also known as quantitative easing (QE). In Figure 8, we can observe four programmes that form the APP. These are the public sector purchase programme (PSPP), corporate sector purchase programme (CSPP), third covered bond purchase programme (CBPP3), and asset-backed securities purchase programme (ABSPP).

Figure 8: APP by programme (PSPP, CSPP, CBPP3, ABSPP) & average monthly target



Source: ECB (2022d).

APP came into force in mid-2014 intending to support the transmission of monetary policy and to enable price stability by providing the necessary amount of policy accommodation. As can be observed in Figure 8, average net purchases amounted to 80 billion € between April 2016 and March 2017. After 2017, the average amount of asset purchases started to decrease, first to 60 billion €, then to 30 billion €, until finally, between October 2018 and

December 2018 the amounts were lowered to 15 billion €. From the beginning of 2019 until October of the same year, the Eurosystem authorities decided to fully reinvest the principal payments of maturing securities within APP portfolios without further net purchases (ECB, 2022d). Soon after the COVID-19 pandemic started, the Governing Council of the ECB decided to reactivate the existing APP. On 12 March 2020, they approved a 120 billion € overall temporary increase of the APP until the end of 2020 (Benigno, Canofari, Di Bartolomeo, & Messori, 2021).

As observed in Figure 8, the PSPP consists of inflation-linked as well as nominal central government bonds and bonds that are issued by recognized agencies. They cover the major part of all four components of the APP. As a result, from December 2018 on, around 90% of Eurosystem's portfolio in total consisted of government bonds and recognized agencies' securities. Predecessors of the APP were the Securities Markets Programme (SMP) and outright monetary transactions (OMT). To address tensions that impede the transmission of monetary policy in 2010, central banks in Eurosystem began by purchasing securities within the SMP. After two years, Governing Council announced the OMT programme and the termination of SMP (ECB, 2022d).

On 18 March 2020, the ECB Governing Council held an extraordinary meeting where they decided to launch a pandemic emergency purchase programme (PEPP) of 750 billion € to support economic recovery, deliver additional monetary accommodation, and contribute to the primary monetary policy objective of price stability in the medium term. The principles of PEPP were in line with APP regarding purchases of the same type of financial assets with an emphasis on government (Benigno, Canofari, Di Bartolomeo, & Messori, 2021). Additionally, PEEP enabled much-needed flexibility not only across time but also across asset classes and jurisdictions, which allowed the ECB to work efficiently and effectively while stabilizing financial markets. Precisely this ex-ante flexibility that enabled deviation from the ECB capital key was one of the crucial characteristics of PEPP. On the other hand, ex-post deviations from the capital key were not flexible but rather limited as well as self-correlated over time. Forward guidance was linked to the pandemic. Namely, the ECB Governing Council decided that the net PEPP purchases would take place until needed. When the COVID-19 pandemic started, the ECB's expectations and forecasts were that the crisis would be more of a short-term nature (Lane, 2022). Initial PEPP envelope was in June 2020 increased by 600 billion € to 1,350 billion € with net purchases extended until June 2021 and the reinvestment period extended until December 2022. Another extension was made in December 2020 as PEEP expanded to 1,850 billion € with net purchases extended until March 2022 and the reinvestment period extended until December 2023. In December 2021, the reinvestment period was further extended until at least the end of 2024. Russia's aggression in Ukraine importantly influenced EA economies and caused significant inflationary pressures, starting with energy prices and later broadening to other components of the HICP. In March 2022, ECB Governing Council announced to start winding down net purchases under the APP going from 40 billion (April), 30 billion (May), and 20 billion

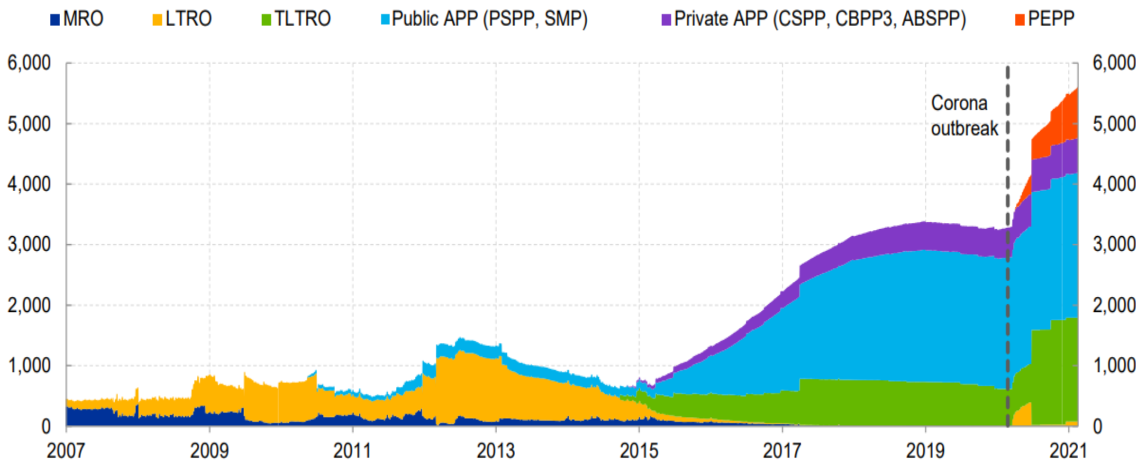
(June), as well as a possibly conclude net asset purchases after the third quarter. In May 2022, the ECB Governing Council announced that the net asset purchase programme under the APP will end indeed in July 2022 and announced to continue with reinvestment of its principal payments from maturing securities. In July 2022, the ECB Governing Council announced a 50 basis points rise of key interest rates, with a further 75 basis points rise announced in September, to make a step closer to its main objective of 2% inflation in the medium term and to continue with reinvestment until needed to ensure liquidity and monetary policy stance.

Another important lever that has been used from the monetary policy side to respond to the COVID-19 pandemic was targeted longer-term refinancing operations (TLTROs). TLTROs are of paramount importance for households and firms because of the favourable borrowing conditions. To support monetary policy transmission, these instruments came into force in 2014. In 2019, the ECB Governing Council announced an extended version, namely TLTRO III. Soon after COVID-19 started, the ECB Governing Council announced important decisions to secure monetary policy transmission via banks. On 12 March 2020 and 30 April 2020, they extended TLTRO III by increasing the borrowing allowance of the banks from 30% to 50% of the eligible loan book, thus increasing leeway by around 1.2 billion €. Additionally, banks that complied with the lending requirements on the mentioned operations were subject to around -1% reduced interest rates until June 2021. At the end of 2020, the ECB Governing Council announced extending the borrowing allowance to 55% of the eligible loan book (Barbiero, Boucinha & Burlon, 2021). The Governing Council of the ECB announced that conditions that were specifically presented within the TLTRO III will end on 23 June 2022. In Figure 9, a 2.2 trillion € TRLTRO III extension during the period of the COVID-19 pandemic can be observed and its contribution to the severe ECB balance sheet increase (Lane, 2022).

Besides TLTROs III, the ECB Governing Council announced the Pandemic Emergency longer-term refinancing operations (PELTROs). The first seven PELTROs were announced on 30 April 2020 to support and provide the financial system with liquidity and provide support to conditions within the money market and compensate for expiring LTROs. ECB Governing Council announced that PELTROs would be designed as fixed rate tender with full allotment and in line with other exceedingly accommodative monetary policy terms. They decided that the average PELTROs interest rate should be 25 basis points below the rate applied to the main refinancing operations within the EA (ECB, 2020). The first seven PELTROs were completed on 10 December 2020 with additional four series to further support the money market and its functioning by working as a kind of liquidity backstop (ECB, 2022e).

Because of all the measures that the ECB undertook to combat the COVID-19 pandemic, we have been able to observe a sharp expansion of its balance sheet. In Figure 9, it can be observed how different measures contributed to the severe increase with an emphasis on APP, TLTRO and PEPP.

Figure 9: ECB balance sheet (€ billion)

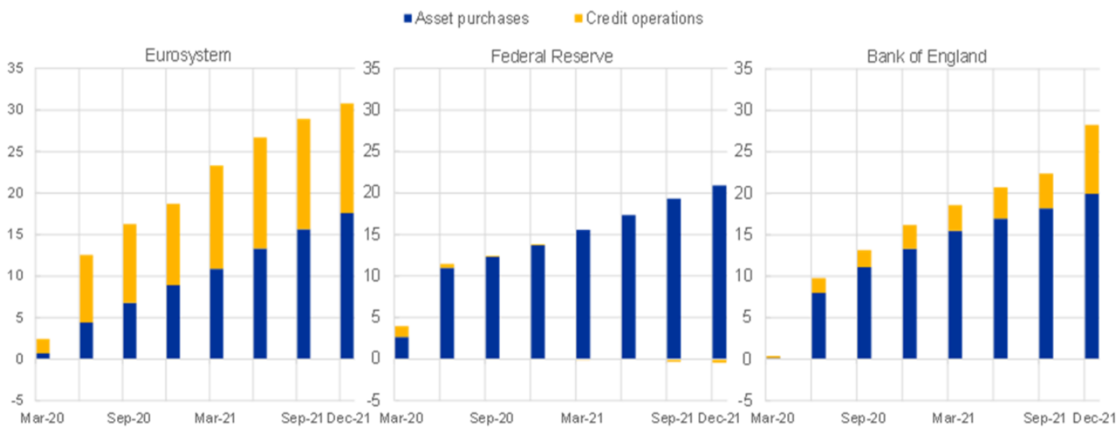


Source: Schnabel (2021).

Similar measures were also considered by other major central banks but with different insensitivity of chosen instruments. Figure 10 shows how the balance sheets of the Eurosystem, FED, and BoE differed whereby nevertheless their actions have surpassed several responses compared to the previous crises.

Figure 10: Eurosystem, FED, and BoE balance sheets change

(cumulative changes relative to January 2020 in terms of percentages of GDP in Q4 2019)



Source: Lane (2022).

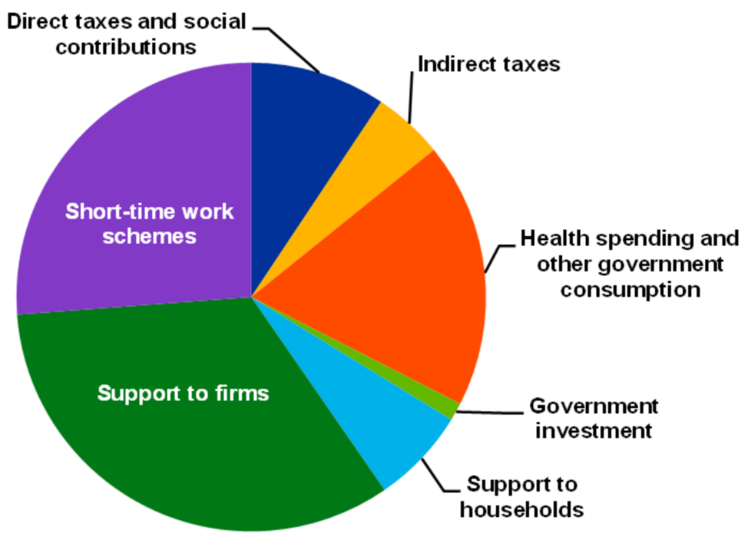
In Figure 10, it can be observed that balance sheet increases of the Eurosystem, FED, and BoE were comparable due to asset purchases. In this case, it is important to illuminate what falls under the category of asset purchases and credit operations. Eurosystem's definition of asset purchases includes all APP and PEPP purchases. The observed difference regarding increases in central banks' balance sheets is due to the credit operations, which in the case of the Eurosystem definition include all PELTROs, TLTROs, MROs, and LTROs.

All measures described above went hand in hand with several ECB monetary policy announcements but we can broadly conclude that monetary policy in the EA responded to the COVID-19 pandemic by intervening on three types of their instruments. Firstly, they relied on asset purchases. By increasing the envelope within APP and introducing PEPP, ECB provided support to the real economy through favourable financing conditions. Secondly, ECB recalibrated existing TLTRO III, intending to support households' and firms' access to credit by supporting banks in secure funding under favorable conditions. Monetary policy response supported by different TLTROs recalibrations represented around 2.2 trillion € injections of liquidity into the EA banking sector, directly from the ECB until June 2021. The above-mentioned ECB liquidity injection was thus unprecedented and one of the largest, historically looking (Barbiero, Boucinha & Burlon, 2021). Accommodative and supportive monetary policy during the COVID-19 pandemic managed to maintain historically low levels of lending rates. The EA average lending rate stayed within the same range as before the crisis, even though credit risk increased due to uncertainty and circumstances in the wider environment (Lane, 2022).

2.2 Fiscal policy response to COVID-19 pandemic

The EA economy was also well supported from the fiscal policy side. Figure 11 shows the estimated composition of discretionary fiscal measures related to the COVID-19 pandemic within the EA in 2020.

Figure 11: Estimated composition of fiscal measures related to the COVID-19 pandemic in 2020 within the EA

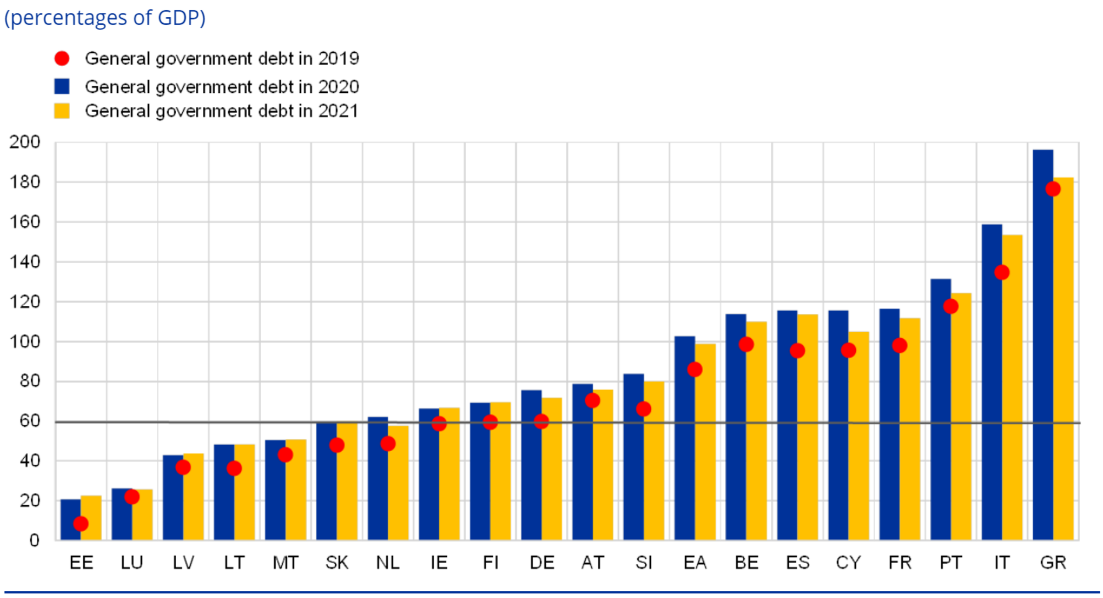


Source: Haroutunian, Osterloh & Sławińska (2021).

From the fiscal policy side, the EU economy was mainly supported through discretionary actions and automatic stabilizers. The latter represent an important "cushion" instrument in periods when the economy experiences diverse shock. However, by affecting both demand and supply simultaneously, with asymmetric effects across sectors and countries, the nature of the COVID-19 pandemic demanded additional discretionary fiscal policy measures besides automatic stabilizers (Haroutunian, Osterloh & Sławińska, 2021). In 2020, the aggregate discretionary stimulus for the EA represented close to 4.25% of the total EA GDP.

To ensure flexibility, the EU authorities activated the general escape clause of the Stability and Growth Pact (SGP) in May 2020, which allowed member states to adopt fiscal measures beyond the SGP deficit and debt limits and resulted in increased public debts. In Figure 12, it can be observed how general government gross debt evolved between 2019 and 2021 among different EU countries.

Figure 12: General government gross debt ratios between 2019 – 2021



Source: Haroutunian, Hauptmeier & Leiner-Killinger (2020).

2.2.1 Fiscal policy role

Very simply said, one could label fiscal policy as a policy that considers government revenues and government spending to impact the economy. The fiscal policy can be neutral, expansionary/contractionary, or countercyclical. It is defined as expansionary when the amount of spending exceeds the collected amounts through taxes, which mostly occurs in periods when the economy is hit by recession and there is a need to support growth and employment. Alternatively, when the amount of collected taxes exceeds government spending, the fiscal policy is labeled as contractionary. Neutral fiscal policy in broad definition means that government decisions regarding spending, taxation, or borrowing should have no impact on the economy. Specifically, theory defines budgetary neutrality, macroeconomic neutrality, and microeconomic neutrality. Budgetary neutrality means that budgetary balance remains unchanged, which means that any government spending decisions need to be offset by generating additional government revenues. Macroeconomic neutrality is defined as when budget deficits or surpluses impact macroeconomic growth through aggregate demand in a countercyclical way, thus, stabilizing the economy. Microeconomic neutrality focuses on the impact of fiscal policy on individual behaviour with an emphasis on taxation mechanisms and prices (Investopedia, 2020). When fiscal authorities consider measures that are against the direction of the economic and business cycle, we talk about countercyclical fiscal policy. In practical terms, this means that when the economy faces a recession, fiscal policy aims at economic recovery by increasing government expenditures or reducing taxes (Shine, 2021).

Together with the Maastricht treaty, which entered into force on November 1, 1993, two integral fiscal policy rules in the EU came to life. Firstly, it was envisioned that a member state's annual budget deficit should not exceed 3% of the GDP. Secondly, a member state's debt to GDP ratio should not go beyond 60%. Countries that would not be able to fulfill these limits would face a specifically defined procedure, namely the Excessive Deficit Procedure. Luxembourg and Sweden were the only EU member states that were not subject to this procedure until the fall of 2020. During the procedure, the European Commission forms recommendations and measures that member states must consider and are monitored and revisited afterward. In 1997 the Stability and Growth Pact came into force and envisioned that the member states' budgets should be “close to the balance or in a surplus” over the business cycle (Bilbiie, Monacelli & Perotti, 2021).

Within this thesis, it was mentioned on several occasions that the EA consist of a single monetary authority but several decentralized fiscal authorities. Within the last decades, several proposals favored the creation of a fiscal union. The centralized fiscal union could be funded from several resources. Usually, proposals mention either a member state’s taxes (excise tax on plastic that is single-used, tax on revenues of digital organizations, etc.), member states' contributions, and, the possibility of issuing a member state’s (EA) debt. The arguments supporting the creation of a fiscal union usually highlight that in a time of uncertainty, such a union would represent a complementary risk-sharing instrument. On the other side, there are mostly core countries that are not supporters of such an idea, mostly due to the distributional implications. However, some advocates of a fiscal union suggest that it could work on a neutral distributional principle in the long run (Bilbiie, Monacelli & Perotti, 2021).

Thus, fiscal policy can be decentralized and implemented through the budgets of the member states or centralized and implemented through the common budget of the fiscal union. Until recent periods, the EU, to a major extent, leaned on the decentralized fiscal policy, run by member states under the rules of the SGP. Nevertheless, the nature of the COVID-19 pandemic had pushed the fiscal policy from being decentralized to a step closer to the centralized fiscal union because of the implemented measures concerning increased common EU budget with the NextGenerationEU instrument in the forefront.

2.2.2 Key fiscal measures of the EU and EA level

Besides the member states' national fiscal policy measures, we have been able to observe pan-European responses that included several centralized short-term and long-term measures. The latter were of the utmost importance due to the different fiscal rooms of member states. Consequently, the joint response at least partly prevented even further fragmentation among the member states. The key fiscal policy measures on the EU level were:

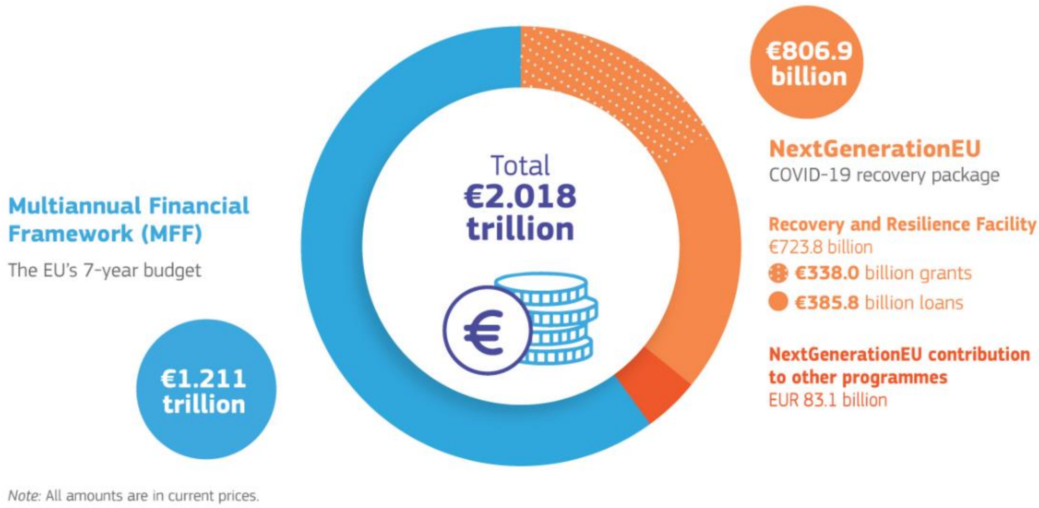
- Activation of the general escape clause of the Stability and Growth Pact (SGP): On 13 March 2020, the European Commission announced the activation of the general escape clause of the SGP. The former came into force in 2011 as a "Six-Pack" reform component. In the case when the EA or EU would face severe economic fallout, the escape clause offers a temporary deviation from the budgetary requirements that are usually considered. Namely, the rules that a member state's annual budget deficit should not exceed 3% of the GDP and a member state's debt to GDP ratio should not go beyond 60%. The decision about activation was of integral importance since it allowed the member states to implement all necessary measures within fiscal policy to combat the consequences due to the COVID-19 pandemic. The European Commission communicated that the activation of the general escape clause will remain in force until needed and will continue to apply also in 2022 but that it should not in any way endanger fiscal sustainability (European Commission, 2020a).
- Coronavirus Response Investment Initiative (CRII) and Coronavirus Response Investment Initiative Plus (CRII+): On 13 March 2020, the European Commission proposed CRII implementation intending to support member states and their responses to the COVID-19 pandemic. The proposal within the EU budget suggested that the cash would be mobilized from the existing funds within the EU, namely 37 billion € of cohesion policy funds that stayed unallocated between 2014-2020 focused on medical equipment purchases, payments of health workers, unemployed, and SMEs. The European Commission announced additionally up to 800 million € from the EU Solidarity Fund (EUSF) which were aimed at the member states that the COVID-19 pandemic hit the most (European Commission, 2020b). Besides CRII, the European Commission proposed a second legislative package CRII+. The latter complemented the CRII and additionally offered extraordinary flexibility intending to enable the entire mobilization of non-utilized cohesion funds (European Structural and Investment Funds, 2022).

In addition to the above measures, four EU-level safety nets were established with indirect or direct fiscal support intending to protect member states' businesses, workers, and access to financing: the EIB loan guarantee scheme, SURE mechanism, ESM crisis support credit line, and the NextGenerationEU and multiannual financial framework:

- European Investment Bank (EIB) loan guarantee scheme: In April 2020, the EIB Group endorsed a 25 billion € large pan-European Guarantee Fund (EGF) as a response to the COVID-19 pandemic. It was aimed at small and medium-sized companies (SMEs) that faced liquidity and solvency issues due to the COVID-19 pandemic but were viable in the long-term period. Until May 2021, the EIB authorities announced that almost half of the EGF funds have already been mobilized, namely 11.7 billion €. The EIB invited all EU countries to contribute to the fund in the form of guarantees or upfront payments, with any losses covered pro rata by member states (European Investment Bank, 2020).
- European Council adoption of Support to mitigate Unemployment Risks in an Emergency (SURE) mechanism: On 2 April 2020, the European Commission came up with the proposal of creating the SURE mechanism, which would offer financial support in the amount of 100 billion € in the form of loans. This mechanism was intended to support and protect work schemes and severe socio-economic effects. It was approved by the Council on 19 May 2020 and officially activated on 22 September 2020. SURE works in a way that provides loans to member states that are granted under favourable terms. For this purpose, the European Commission decided to issue so-called social bonds to provide for the financing of the SURE. Until 22 March 2022, European Commission announced that 91.8 billion € of social bonds have been issued already within the eight consecutive rounds (European Commission, 2022c).
- Pandemic Crisis Support credit line by European Stability Mechanism (ESM): In May 2020, the ESM Board of Governors announced and approved an innovative and flexible instrument, namely the Pandemic Crisis Support credit line based on the ESM Enhanced Conditions Credit Line (ECCL). The Board decided to allocate 240 billion € and provide favourable lending conditions to all 19 EA members amounting to 2% of member states' 2019 GDP without any macroeconomic requirements. Nevertheless, they conditioned the use of this credit line for financing healthcare, cure, and prevention costs concerning the COVID-19 pandemic (ESM, 2020).
- NextGenerationEU instrument and Multiannual Financial Framework (MFF): In May 2020, the European Commission proposed a 750 billion € (806.9 billion € at current prices) large NextGeneration EU recovery instrument as a part of the EU long-term budget on top of the regular multiannual financial framework (European Commission, 25 March 2020). In Figure 13, we can observe that the instrument allocated 723.8 billion € of funds to a Recovery and Resilience Facility, specifically 338 billion € in the form of grants and €385.8 billion in the form of loans, with an emphasis on green and digital investment within the EU and inclusion of challenges recognized in the European Semester. Additionally, the instrument allocated 83.1 billion € to programs, such as REACT-EU (50.6 billion €, crisis cohesion policy), RescEU (2 billion €, civil protection), Horizon Europe (5.4 billion €, research and development), Just transition fund (10.9 billion €, climate change), InvestEU (6.1 billion €) and Rural Development

(8.1 billion €). The European Commission communicated that all funds needed were going to be raised on capital markets on behalf of the EU and should be repaid until 2058 from the EU budgets (European Commission, 2022d). In Figure 13, we can also observe a 1,211 billion € large seven years (2021-2027) long-term budget framework (MFF).

Figure 13: Multiannual Financial Framework & NextGenerationEU instrument



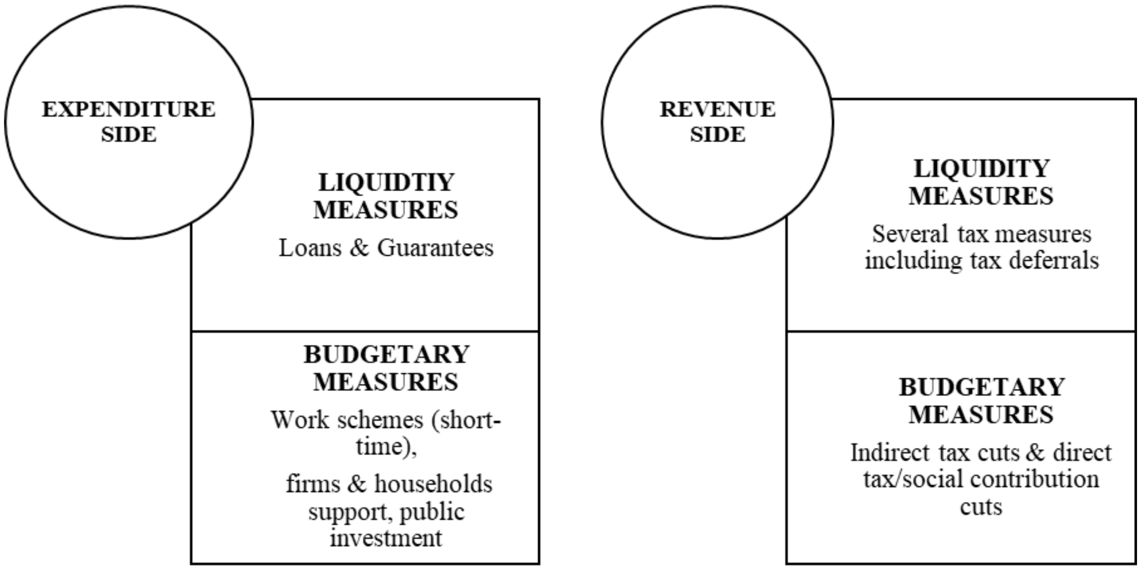
Source: European Commission (2022d).

2.2.3 Key fiscal policy measures on member state level

If we observe key fiscal policy measures within different EA member states, we can notice that especially in the early stages the measures and instruments used were similar. This "homogeneous" response can be attributed to the nature of the COVID-19 pandemic shock that hit the member states' economies practically through the same channels. Nevertheless, EA member states responded with a targeted stimulus of mostly non-temporary nature by taking into consideration their specific fiscal positions. Member states directed the main emergency packages of fiscal policies to limit the consequences of containment measures. Lockdowns triggered a sharp economic fallout and demanded protection, especially for the households and industries that were the most vulnerable due to their nature.

Figure 14 shows that the EA member states fiscal policies focused on budgetary and liquidity measures whereby both types of measures influenced government budgets through expenditure and revenue side (Haroutunian, Osterloh & Sławińska, 2021).

Figure 14: Main fiscal measures used by EU member states during COVID-19 pandemic



Adapted from Haroutunian, Osterloh & Sławińska (2021).

As observed in Figure 14, member states' fiscal policy authorities implemented several liquidities as well as budgetary measures which affected the expenditure side of their budgets. Liquidity measures mainly consisted of loans and guarantees. These have been of paramount importance due to containment and mitigation measures implemented by member states' governments resulting in a sharp fall in the firm's revenues while ongoing costs remained. Consequently, most EA governments considered schemes to provide public guarantees for loans and, thus, transfer part of the credit risk from banks to themselves. Even though the loan guarantee schemes differed among EA countries, they had to comply with the guidelines that the European Commission presented and have been at the same time available only for firms affected by the COVID-19 pandemic without any financial difficulties from the end of 2019 (Falagiarda, Prapiestis & Rancoita, 2020).

Besides measures that affected the expenditure side, member states fiscal policy authorities also implemented several measures affecting the revenue side of their budgets among which many authorities decided on temporary value-added tax (VAT) cuts. Germany, for example, introduced a 3% cut of the standard VAT rate and a 2% cut of the reduced VAT rate in July 2020. Authorities warned that this action could have an impact on the EA HICP. Besides VAT cuts, several EA member states decided to act also on the temporary reduction of direct taxes and social security contributions. Apart from budgetary measures, authorities relied also on liquidity measures including tax deferrals for VAT, corporate tax, social contributions, and personal income tax. These measures were of paramount importance since they provided additional liquidity due to the possibility of shifting the tax payments rather than reducing them (Haroutunian, Osterloh & Sławińska, 2021).

2.3 Key challenges for EA policies in future periods

Based on the constantly evolving situation in the current environment, both fiscal and monetary policy will have to deal with several challenges and issues among which is the effective mix of both policies. The nature of the COVID-19 pandemic has pushed the fiscal policy to the front line with measures focusing on households, and firms and with the power to break the "paradox of thrift" by considering the transfers and social insurance provision. Fiscal policy measures have been strongly supported by monetary policy and their measures of providing favorable conditions for financing. After all the mentioned unprecedented supportive measures, authorities reassured that these would be in force until needed and that the premature withdrawal shall be avoided. Before the COVID-19 pandemic outbreak and tensions on the Russia-Ukraine border commenced, the EU has been dealing with persistently low inflation rates. Today, the situation is reversed with inflation rates reaching numbers well above the defined 2% target, and, therefore, the monetary policy aims to reach the 2% target over the medium-term stays. Both policies should ensure sustainable and uniform economic recovery. Since fiscal policy authorities have presented several programmes, they shall take care that the funds will be effectively absorbed with RRF in the forefront. An additional challenge could also present the deactivation of the SGP escape clause in 2023 and the ensuing counter-cyclical fiscal policies by considering also sustainable levels of debt (Debrun et al., 2021).

3 METHODOLOGICAL APPROACHES TO ESTIMATING THE IMPACTS OF FISCAL AND MONETARY POLICY MEASURES

In the following chapter, methodological approaches to estimate the impact of fiscal and monetary policy measures are presented.

3.1 Literature review and possible research limitations

There is a vast literature that tried to estimate the impact of fiscal and monetary policy measures. Their effects are in some papers estimated together, while some authors performed solo analyses of either fiscal or monetary policy measures and their impact on a chosen domain, including on financial markets, macroeconomic environment or other. The following subchapter focuses on papers that, like this master thesis, estimated the macroeconomic impact of monetary and fiscal policy measures.

3.1.1 Review of relevant empirical studies

To capture the effects of either monetary or fiscal policy shocks on the macroeconomic variables, vector autoregressive models (VAR) present an important if not the main econometrics instrument. Historically there exists a vast array of VAR studies which assessed the effects of monetary policy shocks, but only in the last decade or two studies have tried to assess and provide some robust stylized facts as well with regards to shocks from fiscal policy side (Caldara & Kamps, 2008). As Petrevski, Bogoev & Tevdovski (2016) note, literature considering monetary policy effectiveness points out some general findings. In the long run, empirical literature confirms a firm relationship between prices on the one side and money on the other. This further highlights the neutrality of the monetary policy in the long run, as well as the impact of monetary aggregates and interest rates on output within the short run. It is noted that monetary policy measures impact prices with lags. Peersman & Smets (2001) analysed the monetary transmission mechanism within the EA. Their study concluded that the macroeconomic impact is overall very similar for the EA and the USA, whereby monetary policy shock, which is defined as short-term interest rates, decreases output as well as prices, with prices being more sluggish. Peersman (2011) similarly analysed the macroeconomic effect of monetary policy in the EA between 1999M1 – 2009M12 and concluded that an unexpected fall in the policy rate impacted output with a delay, while reaching a peak after one year. Similarly, Damjanović and Masten (2016) analysed the macroeconomic effects of monetary policy shock in the EA by considering Leo Krippner's (2015) SSR estimates and concluded that monetary policy shock negatively impacts output with delay, after an initial positive but insignificant response.

On the other hand, empirical literature about fiscal policy effects on the economic environment provides divergent results regarding their directions as well as magnitude. Hemming, Kell & Mahfouz (2002) formed a literature overview of how effective fiscal policy measures concerning economic activity are. They firstly consider what are the demand-side effects of fiscal policy measures, whereby the Keynesian approach assumes rigidity of prices and aggregate demand determining the output. Within their model, fiscal policy expansion measures have a multiplier effect on both output and aggregate demand. The so-called "balanced budget multiplier" is reached in the case when an increase in spending matches the tax increase. The non-Keynesian approach is alternatively based on new classical models that are critical of the Keynesian approach, due to its weak microeconomic foundations, and rather emphasize fiscal policy measures` effects on the supply-side. The authors additionally emphasize rational expectations and Ricardian equivalence. The basic assumption of the above-mentioned Keynesian models relates consumption with the current income. This means that forward-looking Ricardian consumers are aware of the fact that government debt leads to an increase in taxes sometime in future periods and thus causes a reduction in consumption and permanent income. Secondly, the authors consider what are the supply-side effects of fiscal policy measures. These play an important role in the long-term, while analyses that study the fiscal policy stabilization role usually rely on effects on the before-described demand side. New classical models attribute the fluctuations in the output to supply-side shock rather than to aggregate demand ones. Fiscal policy measures that do not have an impact on aggregate supply, based on Lucas (1975) as well as Sargent and Wallace (1975) do not affect output growth. Fatás & Mihov (2001) and Galí, López-Salido & Vallés`s (2007) findings on the other hand correspond with the traditional Keynesian view. They confirm that fiscal policy shocks positively affect output, employment, or consumption. Caldara & Kamps (2008) similarly observe that literature, used until their assessment, yielded similar results in the context of government spending shocks, since they observe a positive output effect due to positive government spending shock. This was not the case for the tax shocks whereby they attributed the difference to the estimation or calibration of automatic stabilizers and their positive relation to the tax shocks. Debrun et al. (2021) considered three government shocks, namely direct government taxes shock, indirect government taxes shocks and government spending shocks. The authors highlight several ways through which fiscal policy measures can affect the inflation. In line with New Keynesian models, government-spending shock usually in the short-term to medium-term boosts output. The latter then afterwards increases the inflation rates through aggregate demand. Consumption and prices can be alternatively lowered due to direct government tax rate increase, which negatively influences available income, while indirect government tax rate (among which we count as well VAT) increase should immediately increase the level of prices. The authors conclude that defined three fiscal policy shocks influence inflation rate differently, whereby both indirect government tax shock as well as government spending tax shock positively affect inflation rate, while direct government tax shock lowers it. Blanchard and Perotti (2002), on the other hand provided evidence for the effects of fiscal policy on output and observed that a positive government tax shock yields a negative effect on output, while on the other hand a positive spending shock yields a positive output effect. Perotti (2005) furthermore estimated the effect of fiscal policy measures on inflation, interest rates and output within five OECD countries. His study concluded that fiscal policy effects on the output tend to be small. Additionally, he found no evidence of tax cut measures being quicker or more effective in comparison to the increase in government spending as well as the small effect of the former on inflation. Studies from Blanchard, & Perotti (2002) and Ramey (2011) in line with the neo-classical approach conclude that several macroeconomic variables can face adverse impacts, due to fiscal policy measures that are expansionary.

Empirical studies presented above considered the macroeconomic effects of monetary or fiscal policy measures separately. Jawadi, Mallick & Sousa (2016) on the contrary jointly analysed what impact monetary and fiscal policies have on macroeconomic variables in the BRICS, by using Panel Vector Autoregressive (PVAR) approach. Petrevski, Bogoev & Tevdovski (2016) analysed joint macroeconomic effects of monetary and fiscal policy measures within South-eastern Europe countries, by using a recursive VAR approach. Within their empirical paper, the authors conclude that positive expansionary fiscal policy shocks increase output, whereby on the monetary policy side they observe, that its tightening lowers output. Van Aarle, Garretsen & Gobbin (2003), tried to jointly capture the short-run and medium-term effect of both policies on the EA aggregate level, by employing the SVAR approach. For the EA aggregate, the authors observed that monetary policy shock, i.e. an increase in the interest rate, does not imply a negative impact on output, as is the case for Japan. The authors also analysed the interactions between both policies, by measuring the impact of monetary policy shocks on variables from the fiscal policy side and vice versa. The former showed that monetary policies and revenue policies within the EA hardly interact, but rather work as complements since the authors observed that after restrictive monetary policy shock government spending decreased.

Additionally, several empirical studies tried to capture the effects of both policies and their interaction inlight of the COVID-19 pandemic. Benmelech & Tzur-Ilan (2020) analysed the monetary and fiscal policy impacts for 85 countries on various macroeconomic variables. Debrun et al. (2021) highlighted that fiscal policy interacts with monetary policy in several ways, whereby monetary policy may become constrained in achieving price stability of 2 % over the medium term when it approaches the zero-lower bound. They also throw light on the nature of the COVID-19 pandemic shock that differs from a typical business cycle shock, which is either a demand or a supply one, since it had a different impact between sectors, whereby some faced more severe contraction in comparison to others. Almgren & Holmberg (2021) analysed the effects of monetary and fiscal policy announcements on EA output, by including unconventional/nonstandard monetary policy instruments. In their empirical term paper, Bobeica & Hartwig (2021) presented what are the challenges that the time-series models face due to the COVID-19 pandemic, with a focus on inflation within the EA. They argue that to avoid the instability problem of parameters it is more appropriate to consider the distribution of errors with father tails and thus following the student t-distribution, rather than consider normal Gaussian distribution, due to more likely accommodation of large shock (like it is COVID-19) under errors that follow t-distribution. Besides Bobeica & Hartwig (2021) also make other suggestions regarding how to cope with substantial changes in the parameters. Carriero, Clark, Marcellino & Mertens (2021) similarly highlighted the problem in estimating VAR models for macroeconomic analysis in the case of excessive volatility of observations and propose to include time-varying volatility within their VAR framework, which includes treatment for all extreme observations that appeared due to the COVID-19 pandemic. They use Stock and Watson`s (2016) SVO approach and extend it.

Besides different VAR models, to assess the macroeconomic influence of monetary and fiscal policy measures, several authors relied on New Keynesian (NK) dynamic, stochastic and general equilibrium (DSGE) models, which are basic Real business-cycle (RBC) models with integrated nominal rigidities. Kollmann (2021) for example studied the effects of COVID-19 on EA GDP and inflation via a stylized NK model and included liquidity trap but did not include unconventional monetary policies like Quantitative easing (QE) or for example NIRP. Chan (2022) takes a step further and extends the model, namely he considers a susceptible-infected-removed dynamic stochastic general equilibrium (SIR-DSGE) model with included epidemiology SIR component (susceptible-infected-recovered individuals).

3.1.2 Choosing the appropriate model

As observed within the previous subchapter, there is a vast literature that tried to capture the macroeconomic effects of fiscal and monetary policy, whereby empirical studies mostly focused on either VAR or NK DSGE models. VAR methodology became an important tool to analyse and perform business cycle analysis, due to its flexibility and time series tractability, as well as the possibility to describe dynamic structural relationships among economic variables. As Caldara & Kamps (2008) observe VAR methodology in the past presented an important if not the main econometric tool when analysing the effects of fiscal or monetary policy measures although the empirical studies performed did not reach a consensus concerning the effects of fiscal policy shocks. Petrevski, Bogoev & Tevdovski (2016) justify the choice of using the VAR model with simplicity. They further label variance decomposition and impulse responses as well-suited tools to trace interactions between different defined variables. Using VAR is therefore very practical and appropriate approach when trying to assess the macroeconomic impacts of fiscal and monetary policy measures. VAR models are thus a good tool for forecasting and describing the dynamics of a system of variables, and they can be estimated equation by equation via OLS.

Within this master thesis, the macroeconomic impact of the fiscal and monetary policy measures is considered via the SVAR modelling approach. The estimation procedure is captured in detail within the following chapters, but the basic idea is to firstly set up and estimate the reduced-form VAR. Secondly, to impose restrictions to identify both monetary and fiscal policy shocks and within the third step to present impulse response functions.

3.1.3 Choosing appropriate monetary and fiscal policy variables

Choosing the appropriate EA monetary policy variable can be challenging, especially due to the zero-lower bound environment that came into force in 2009. This forced central banks to rely on their unconventional monetary policy measures. Damjanović & Masten (2016) in line with some other empirical term papers, proposed to consider shadow short rate (SSR), which is based on yield curve information, most commonly provided by Leo Krippner (2013) or Wu and Xia (2016). The authors attribute the main advantage of using SSR as a monetary policy variable to its property of not being constrained by the ZLB environment. In their study, they rely on estimates of Leo Krippner's SSR. The EA macroeconomic effects are analysed within a simple VAR model, whereby authors considered recursive ordering of variables to identify monetary policy shocks. Their SVAR model consists of data on output, price deflator and SSR, whereby they identify the monetary policy shock by placing the SSR in the last place within the model and considering Cholesky decomposition. Damjanović & Masten`s (2016) paper concluded that using the SSR as a monetary policy shock variable yields similar macro responses compared to using standard/conventional policy rate (EONIA) as monetary policy instruments. They show that unanticipated tightening of the monetary policy – increase in interest rate- persistently and with delay leads to declined growth rates in prices as well as in output. They note that most empirical papers with included SSR focus on the U.S. data, rather than on EA, whereby authors emphasize the effects on financial markets rather than on the macroeconomic environment. They highlight that estimates of SSR are derived from financial data, which therefore means that the ECB does not have direct control of it. This, therefore, means that it does not consider direct policy actions but rather includes market expectations related to monetary policy. Damjanović & Masten (2016) present some other alternatives as well, including interest rates of longer maturities. The problem with the latter is that these might not include only monetary policy stance information and thus offer an unclear interpretation. Additionally, several empirical term papers as monetary policy variables used quantity of money.

Benmelech & Tzur-Ilan (2020) analysed the determinants of fiscal and monetary policy measures during the period of the COVID-19 pandemic in their study. As the fiscal policy variable, they choose the ratio of total fiscal spending to GDP.

Blot, Bozou & Creel (2021) analysed monetary policy during the COVID-19 pandemic. They highlight that due to ZLB, the ECB highly relied on its unconventional/non-standard measures, which are well described in chapter 2, with emphasis on APP and liquidity operations (TLTRO). They considered Wu and Xia`s (2016) SSR, to capture all non-standard measures and additionally argue, that empirical studies which tried to estimate and capture non-standard monetary policy measures` impact on the macroeconomic environment, mainly considered the central bank balance sheet. They argue that choosing the latter as a monetary policy instrument can be problematic, due to the possibility of also reflecting other possible shifts in the economy, like uncertainty for example, and thus not identifying the pure shock of a monetary policy to the economy. Nevertheless, the literature provided on central balance sheets as monetary policy instrument is less developed as compared to the literature considering interest rates.

Similarly, Boeckx, Dossche, & Peersman (2017) performed VAR methodology and analysed the impact of unconventional monetary policy measures on prices, output as well as policy rates (EONIA). As a monetary policy instrument, they considered Wu and Xia`s (2016) shadow short rate.

Van Aarle, Garretsen & Gobbin (2003) analysed monetary and fiscal policy transmission within the EA, by applying a SVAR modelling approach and estimating short-term as well as medium- term effects. They included data on real output, real government revenue and spending, short-term interest rates and level of prices. For monetary policy variables, they defined the short-term interest rate, whereby for fiscal policy variables considered government revenue and spending.

While estimating the effects of fiscal policy shocks within the EA, Burriel et al. (2010) relied on the baseline VAR models presented by Blanchard and Perotti (2002) and Perotti (2005), whereby the authors considered data at a quarterly frequency, with included public expenditures (g), GDP (y) and net taxes (t) in real terms. Additionally, authors included data on the 10- year interest rate of government bonds (r) and GDP deflator (p), with all data seasonally adjusted and presented in logs, except for the interest rate on government bonds, which is at levels.

Debrun et.al (2021) analysed the relationship between fiscal policy and inflation within the EA, by employing the VAR approach. The empirical paper relied on assumptions of New Keynesian models, which argue that within the short to medium term, an increase in government spending leads to increased output and thus increased prices, through aggregate demand. Additionally, the authors show that government decisions regarding direct taxes influence consumption and thus prices since these decisions affect disposable income. In doing so they emphasize the role of the price stickiness. As fiscal policy variables, the author defines government spending, direct taxes, and indirect taxes.

3.2 Specifynig VAR model

Vector autoregressive (VAR) models are a multivariate generalization of the autoregressive (AR) models and are defined as workhorse time series models for macroeconomic analysis, with the property of relating observations of each variable in the model in the current period to its past observations but also to the past observations of all other variables that are included in the model. VAR models of order p and with included K variables can be defined in the following way, as shown in equation (1) with only a stochastic part, with a zero mean and no deterministic trend:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + u_t \tag{1}$$

whereby:

- y_t= $[y_{1t}, \dots, y_{Kt}]'$ is a vector of K variables,
- A_i are KxK matrices of coefficients, $i = 1, \dots, p$
- u_t = $[u_{1t,} u_{2t,} \dots, u_{Kt}]'$ is a K vector of i.i.d errors, that are WN $(0, \sum_u)$, not necessarily normal.
- Furthermore, $E(u_{t,} u'_t)$ = $\sum_u$ is positive definite and non-singular, whereby non-singularity comes from the full rank of the variance/covariance matrix of the residual.

For K=3, the VAR(p) model can be defined in the matrix form as:

$$\begin{bmatrix} y_{1t} \\ y_{2t} \\ y_{3t} \end{bmatrix} = \begin{bmatrix} A_1^{11} & A_1^{12} & A_1^{13} \\ A_1^{21} & A_1^{22} & A_1^{23} \\ A_1^{31} & A_1^{32} & A_1^{33} \end{bmatrix} \begin{bmatrix} y_{1t-1} \\ y_{2t-1} \\ y_{3t-1} \end{bmatrix} + \cdots + \begin{bmatrix} A_p^{11} & A_p^{12} & A_p^{13} \\ A_p^{21} & A_p^{22} & A_p^{23} \\ A_p^{31} & A_p^{32} & A_p^{33} \end{bmatrix} \begin{bmatrix} y_{1t-p} \\ y_{2t-p} \\ y_{3t-p} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix} \tag{2}$$

Defined $VAR\ (p)$ is stable if:

$$det\left(I_K - A_1 z - \cdots - A_p z^p\right) \neq 0 \text{ for } |z| \leq 1 \tag{3}$$

In the case when det $A(z) = 0$ for some or more $z = 1$, then the polynomial $A(L)$ has one or more-unit roots, which means that thus some or even all variables are integrated (Masten, 2020).

3.2.1 Limitations of VAR modeling

By employing VAR in the reduced form, our parameters would be subject to Lucas's critique, and we would be able to only summarize the data and its dynamic properties, without the inclusion of any economic meaning. Consequently, a better option would be to apply a structural (identified) VAR model – SVAR (Masten, 2020). Due to the huge variation, that COVID-19 caused in important macroeconomic variables, analysing such an impact might be challenging. Working with data that include extreme observations and movements, put under question standard VAR approaches that empirical literature used so far. Consequently, several authors proposed solutions how to deal with enormous changes in parameters after the outbreak of the pandemic outburst.

3.3 Specifying SVAR model

SVAR models or identified VAR models were presented in the 1980s by Sims and followed by proposals of Bernanke (1986), Shapiro and Watson (1988). The former was at that time an alternative approach to the large-scale models, but with an integral difference of avoiding large and complex structures and rather offering an easier and more available interpretation of the results. As Kotzé (2022) explains, the strategy of forming the SVAR approach consists of several steps. First, it is important to define variables that will be included within the reduced-form VAR model. Furthermore, one should consider the length of the lags, deterministic components, and treatments for possible nonstationary variables. Employing all defined steps leads to appropriate dynamic specification thus enabling interactions between defined variables. This is followed by testing the hypothesis.

SVAR model can be similarly presented in the following form:

$$Ay_t = A_1^* y_{t-1} + A_2^* y_{t-2} + \cdots + A_p^* y_{t-p} + v_t \tag{4}$$

whereby:

- A is defined as a KxK matrix of coefficients, which is of the integral parts since captures contemporaneous relations among the variables,
- y_t= $[y_{1t}, \dots, y_{Kt}]'$ and is a vector of K variables,
- A_i^* are KxK matrices of coefficients, $i = 1, \dots, p$
- $v_t = B\varepsilon_t$ are defined as errors of the structural form and are WN (0, $\sum_v$). The ε_t are structural shocks and are usually treated as being orthogonal among each other. Additionally these have economic meaning and are related to some economic concepts, such as monetary or fiscal policy shocks.

If one afterwards pre-multiply the equation (4) by A^{-1} the corresponding reduced form model is obtained, namely:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + A^{-1} B\varepsilon_t \tag{5}$$

whereby:

- y_t= $[y_{1t}, \dots, y_{Kt}]'$ and is a vector of K variables,
- A_j= $A^{-1}A_j^*, j = 1, \dots. p$,
- $A^{-1}B\varepsilon_t = u_t$. This is of integral importance since it presents a relation between the reduced form and structural errors,
- The ε_t are structural shocks and are usually treated as being orthogonal among each other. Additionally these have economic meaning and are related to some economic concepts, such as monetary or fiscal policy shocks,
- A is defined as a KxK matrix of coefficients, which is of integral importance since it captures contemporaneous relations among the variables based on theoretical (structural) considerations.

As mentioned before, the SVAR model as opposed to the reduced form VAR model includes matrix A, which has the ability to capture the contemporaneous relations among defined variables in the model. One of the integral parts to note here is that reduced form and structural errors are related via $A^{-1}B\varepsilon_t = u_t$, as shown in equation (5) Within the SVAR model the restrictions that one imposes are employed on matrices A and B separately or jointly.

3.3.1 SVAR model identification approaches

Parameters are defined as identified when "the solutions to population-level moment equations are unique and produce the true parameters (Schenk, 2016)." For the SVAR model to be identified, we have to impose appropriate restrictions, since there exist many A and B matrices which are consistent with the same variance-covariance matrix of the reduced form shocks. We thus need further information to obtain unique estimates. One can calculate the number of minimum required restrictions based on the difference between the number of known and unknown elements in the model. Known elements are captured within the variance-covariance matrix of the reduced-form errors. These have only $\frac{n(n+1)}{2}$ known distinct parameters. The unknown elements are captured within the A and B matrices, which have each n^2 parameters. This thus implies that additional restrictions of $n^2 + \frac{n(n+1)}{2}$ need to be placed to obtain unique estimates of matrices A and B from the variance-covariance matrix of the reduced form shock. There exist different SVAR model identifications restrictions, which are presented in Table 1.

Sims (1981) suggested using the recursive ordering of shocks, namely Cholesky decomposition of the $\sum_u$ covariance matrix to get to orthogonalized shocks ε_t:

$$\textstyle\sum_u = BB' \tag{6}$$

$$\varepsilon_t = B^{-1}u_t, \tag{7}$$

whereby:

- B is defined as the lower triangular matrix,
- ε_t are structural orthogonalized shocks, related to economic concepts.

Table 1: Four SVAR model identification approaches

Authors	*Identification approach*
Uhlig (2006)	Sign restrictions
Amisano and Giannini (1997)	AB model
Blanchard and Quah (1990)	Long run restrictions
Sargent (1978) & Sims (1980)	Recursive variables ordering: Cholesky decomposition

Source: Masten (2020).

Within Cholesky orthogonalization, the variable that is ordered first is defined as "the most exogenous" one with contemporaneous effects on all the other variables, and the variable that is ordered second is defined as "less exogenous" with contemporaneous effects on all the other variables, except the first variable, and so on until the variable that is ordered last, which does not have any contemporaneous effects on any other variables in the VAR model. This recursive feature has serious implications since the different ordering of the variables within the model can lead to different estimates of defined structural shocks. This implies that the ordering of our variables should be in line with economic theory whereas different orderings can be considered as a good tool to check whether the results are robust. This approach can be seen as a special and more restricted case of the AB model identification approach (Masten, 2020).

Blanchard and Quah (1989) presented a long-run restrictions approach, whereby they emphasized that shocks on the supply side persistently or permanently impact output, while they labelled demand shocks as transitory ones. Since their approach is restrictive it is not considered within this master thesis, which is in line with the latest literature.

3.3.2 SVAR model of this thesis

Consistently with other authors who estimated individual or aggregate effects of either monetary or fiscal policy, formulation of a VAR model will be considered for studying the macroeconomic effects of monetary and fiscal policy in the EA. By employing VAR in reduced form, we would be only able to summarize the data and its dynamic properties, without considering economically meaningful relationships. Consequently, a better option would be to apply the structural (identified) EA VAR model – SVAR. Estimating aggregate effects for the EA assumes that the transmission mechanism for both policies is identical among all EA countries. Estimation of the individual EA countries to capture cross-country heterogeneity effects goes beyond the scope of this thesis, therefore our analysis includes solely aggregate estimation for the EA.

Based on the review of the empirical literature and to capture the macroeconomic impact of monetary and fiscal policy measures within the EA during the COVID-19 pandemic, five variables are included within the model, namely:

i. Real output (GDP).
ii. Harmonized Index of Consumer Prices (HICP).
iii. Monetary policy instrument: Wu and Xia (2016) shadow short rate.
iv. Fiscal policy instruments: government spending & government expenditure.

The reduced form of VAR (1) therefore includes five variables, and can be presented in the matrix form in the following way:

$$\begin{bmatrix} gov_{spe_t} \\ gov_{rev_t} \\ gdp_t \\ HICP_t \\ SSR_t \end{bmatrix} = \begin{bmatrix} A_1^{11} & A_1^{12} & A_1^{13} & A_1^{14} & A_1^{15} \\ A_1^{21} & A_1^{22} & A_1^{23} & A_1^{24} & A_1^{25} \\ A_1^{31} & A_1^{32} & A_1^{33} & A_1^{34} & A_1^{35} \\ A_1^{41} & A_1^{42} & A_1^{43} & A_1^{44} & A_1^{45} \\ A_1^{51} & A_1^{52} & A_1^{53} & A_1^{54} & A_1^{55} \end{bmatrix} \begin{bmatrix} gov_{spe_{t-1}} \\ gov_{rev_{t-1}} \\ gdp_{t-1} \\ HICP_{t-1} \\ SSR_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \\ u_{4t} \\ u_{5t} \end{bmatrix} \quad (8)$$

whereby, the variance-covariance matrix $\sum_u$ from VAR (1) can be simplified and defined as:

$$\sum_u = \begin{bmatrix} \sigma_{u1}^2 & \sigma_{u1u2}^2 \\ \sigma_{u1u2}^2 & \sigma_{u2}^2 \end{bmatrix} = VAR(u_t) \quad (9)$$

This is a reduced form VAR of order (1). Nevertheless, within the empirical analyses it is presented that by *running var soc* command, we select the appropriate VAR order, which is in our case order 4, as explained in the next chapter. After imposing restrictions on reduced form VAR, the next step is to investigate impulse response functions, that tell us how defined economic variables respond to defined policy shocks.

4 EMPIRICAL ANALYSIS

Based on the theory and empirical literature on fiscal and monetary policy, there are four main hypotheses tested within this master thesis. In line with New Keynesian models, government-spending shock usually in the short-term to medium-term boosts output. This was as well supported by for example empirical term papers of Blanchard and Perotti (2002), Petrevski, Bogoev & Tevdovski (2016) and Debrun et al. (2021). The first hypothesis to be tested is thus:

H1: Positive government spending shock will boost the output in the short to medium term.

Additionally, within the empirical paper of Damjanivić & Masten (2016), authors show that increase in monetary policy instrument persistently, and with delay negatively impacts prices and output. The second and third hypotheses are thus:

H2: monetary policy instrument will persistently and with delay negatively impact prices.

H3: monetary policy instrument will persistently and with delay negatively impact the output.

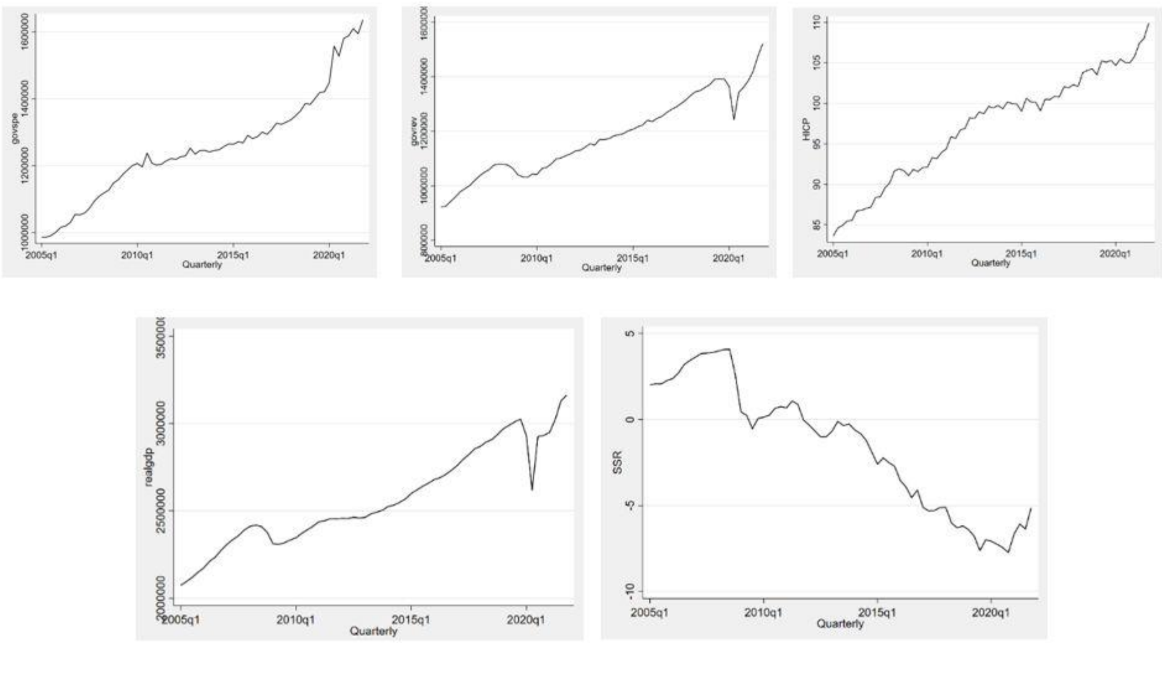
Further on, Blanchard and Perotti`s (2002) study concludes that an unanticipated increase in government revenue affects output negatively, while the Perotti (2005) study does not come to the same conclusion and rather emphasizes that there is no reaction to the output. The fourth hypothesis is thus:

H4: an unanticipated increase in government revenue negatively affects the output.

4.1 Time-series data

There are five endogenous variables modelled in this SVAR, namely: government spending (govspe), government revenue (govrev), real GDP (realgdp), HICP and SSR. Time-series data that is presented in Figure 15 is aggregated for the EA. We used several sources to compile the data, including the ECB Statistical Warehouse, Eurostat and Wu & Xia (2022). The sample size consists of quarterly data for each variable, which spans from the first quarter of 2005 until the last quarter of 2021. This sample period also includes the COVID-19 pandemic period, which is important, since the objective of this master thesis is precisely to analyse and capture the impact of extraordinary and unprecedented measures on monetary and fiscal authorities in the EA, during the COVID-19 pandemic.

Figure 15: Time series data on government spending, government revenue, HICP, realgdp & SSR



Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

4.2 Pre-estimation specification procedure

4.2.1 Stationarity

To estimate a SVAR model, variables included in the model should be stationary (weak stationarity is sufficient). For the process y_t to be weakly stationary it must - based on Lütkepohl & Krätzig (2004) - satisfy two conditions and thus have a time-invariant first moment (constant mean) but also the second moment (constant autocovariance), i.e., when:

$$E(y_t) = \mu_y \tag{10}$$

$$E[(y_t - \mu_y)(y_{t-h} - \mu_y)] = \gamma_y, \tag{11}$$

for all $t \in T$ and $t - h \in T$. These conditions can be interpreted as weak stationarity of the process. Alternatively, strict stationarity requires time-invariance for all joint distributions of the moment conditions $(y_t, \dots y_{t-h})$. Since time-series processes are very rarely stationary, suitable transformations or filters must be applied to make them stationary. One possibility is to take the first differences in the time series. A time series process is said to be integrated of the order d, i.e. $I(d)$ if it needs to be differenced d-times to become stationary. Another one is to perform a log-transformation. However, even though performing the log transformation can influence the variance to be more stable and uniform, the issue with the trend in the time series is still unresolved. This may be resolved by also taking the first differences of the log-transformed data and thus considering $\Delta log\ y_t = log\ y_t - log\ y_{t-1}$. Log differences can be thus labelled as rates of change in the time-series (Lütkepohl & Krätzig, 2004). Yet another possibility is to use a filter (for example, the Hodrick-Prescott filter) to separate the cyclical and trend components in a time series.

To check whether the time series is stationary, the first step is visualization, by plotting the data. Based on the graphs in Figure 15, the time series of our variables, expressed in levels, seem to be non-stationary. To test for the stationarity in the time series, several unit root tests can be applied, among which the most used are the Augmented Dickey Fuller test, Philips Peron test and Kwiatkowski-Phillips-Schmidt-Shin – KPSS test. The latter can be useful when determining the order or integration of time series and differ from each other mainly in the null hypothesis, although the Augmented Dickey Fuller test (ADF) is usually applied. The null hypothesis is that there exists a unit root and thus our time series are non-stationary (Prabhakaran, 2019).

Based on the visual assessment of stationarity, all variables except the SSR are transformed by taking logs and first differences (which essentially translates to growth rates), whereas the SSR is considered in levels and first differences before performing ADF tests to formally test for stationarity. Table 2 shows the results of the ADF unit root tests, for each variable separately and attached results for three critical values with included one lag. As can be observed based on the Z(t) statistics and critical values for 5 % and 10 % statistical significance, the null hypothesis that the time series contains a unit root can be rejected for all log-differenced variables and for the first-differenced SSR variable since the absolute values of test statistic Z (t) are larger than the critical values. The transformed variables are therefore stationary. Alternatively, if the test statistic Z (t) was larger than the critical values, the null hypothesis could not be rejected, and thus unit root could not be excluded. This is the case for the SSR variable in levels, which only becomes stationary after first differencing. Nevertheless, several studies suggested not to transform SSR with first differences, but rather consider it in levels, due to its important explanatory power, which should not affect the consistency of the OLS estimator.

Table 2: Augmented Dickey-Fuller (ADF) unit root test

ADF test, variables, observations and Z (t)	*Test statistics*	*Critical value 1%*	*Critical value 5%*	*Critical value 10%*
dfuller dln_govspe, 65 observations, lags (1), Z (t)	-5.728	-3.559	-2.918	-2.594
dfuller dln_govrev, 65 observations, lags (1), Z (t)	-5.001	-3.559	-2.918	-2.594
dfuller dln_realgdp, 65 observations, lags (1), Z (t)	-6.746	-3.559	-2.918	-2.594
dfuller dln_HICP, 65 observations, lags (1), Z (t)	-4.654	-3.559	-2.918	-2.594
dfuller dSSR, 65 observations, lags (1), Z (t)	-4.209	-3.559	-2.918	-2.594
dfuller SSR, 65 observations, lags (1), Z (t)	-0.872	-3.558	-2.917	-2.594

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

4.2.2 Lag selection based on information selection criteria

Lag length can be determined either by sequential testing for test reduction or by information selection criteria. Even though it is advisable to perform both approaches, this master thesis relies on information selection criteria to choose the number of lags to be included in the model. The most important and most widely used information selection criteria are:

$$\text{Akaike information criterion } AIC\ (m) = \log\det\left(\textstyle\sum_{\tilde{u}}(m)\right) + \frac{2}{T} mK^2 \quad (12)$$

$$\text{Bayesian/Schwarz information criterion } SC\ (m) = \log\det\left(\textstyle\sum_{\tilde{u}}(m)\right) + \frac{\log T}{T} mK^2 \quad (13)$$

$$\text{Hannan-Quinn information criterion } HQ\ (m) = \log\det\left(\textstyle\sum_{\tilde{u}}(m)\right) + \frac{\log\log T}{T} mK^2 \quad (14)$$

whereby:

- $m = 0, \dots p_{max}$, T stands for sample size,
- $\sum_{\tilde{u}}(m) = T^{-1} \sum_{t=1}^{T} \hat{u}_t \, \widehat{u'}_t$ is the residual variance-covariance model,
- mK^2 equals the number of parameters.

Above defined information selection criteria differ from each other based on the sequence that relies on the sample size, whereby the HQ (m) and BIC/SC (m) criteria yield consistent estimates in comparison to the AIC (m), which overestimates p with some positive probability. In a practical example, when $T \geq 16$, the information selection criteria are ordered in the following way, namely $\hat{p}\ (BIC/SC) \leq \hat{p}\ (HQ) \leq\ \hat{p}\ (AIC)$. Table 3 shows the information selection criteria for this model, whereby df presents degrees of freedom (Masten, 2020). The values that are within Table 3 denoted with * present the best model and thus the optimal lag to be included. Based on the result, 4 are included within the SVAR model of this master thesis.

Table 3: Lag selection based on information selection criteria

Sample: 2006q1 thru 2021 q4				Number of observations =61		
Lag	*df*	*p*	*FPE*	*AIC*	*HQIC*	*SBIC*
0			9.1e-17	-22.7418	-22.6062	-22.3957
1	25	0.000	2.7e-17	-23.9541	-23.4794	**-22.7429***
2	25	0.000	1.8e-17	-24.3919	-23.5782	-22.3156
3	25	0.001	1.8e-17	-24.4678	-23.3151	-21.5265
4	25	0.000	**7.3e-18***	**-25.436***	**-23.9442***	-21.6295
5	25	0.016	9.7e-18	-25.313	-23.4821	-20.6414
6	25	0.002	1.3e-17	-25.3111	-23.1412	-19.7744

*optimal lag, endogenous: dln_govspe dln_govrev dln_realgdp dln_HICP SSR, exogenous: Quarterly _cons.

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

4.3 Estimation of the model

After setting up the reduced VAR model, the next step is to perform its estimation. This is followed by imposing identification restrictions. These are of integral part since for parameters in the SVAR to be identified, non-testable restrictions that are motivated by economic theory must be imposed (Masten, 2020).

To estimate the unrestricted VAR and K equations, the individual estimation by OLS can be performed. As Zellner (1962) highlighted, by following this procedure there is no efficiency loss in comparison to the GLS approach. Estimates for both procedures are identical for the VAR models. By rewriting Equation (1) and using a different notation of $Y = AZ + U$, whereby $Y = [\, y_1, y_2, \dots. y_T]$, $A = [\, A_1, A_2, \dots. A_p]$, $Z = [\, Z_0,, \dots. Z_{T-1}]$ and $U = [\, u_1, u_2, \dots. u_T]$, the OLS estimator can be derived in the following form:

$$\hat{A} = \left[\, \hat{A}_1, \hat{A}_2, \ldots \hat{A}_p \right] = YZ'(ZZ')^{-1} \quad (15)$$

A derived estimator can be labelled as asymptotically normal and consistent if it follows the standard OLS assumptions. For the OLS estimator to be unbiased and asymptotically consistent, it should follow the following first four assumptions, presented in Table 4 below.

Table 4: OLS assumptions

Assumptions	*Description*
1. Linearity	The first assumption is the assumption of linearity, not in the variables, but rather in the parameters.
2. No collinearity	The second assumption states that there should be no perfect collinearity.
3. Random sampling	The third assumption require random sampling of the observations.
4. Zero conditional mean of $\boldsymbol{u}$	$E(u \mid for\ all\ of\ the\ data\ in\ X) = 0$. The fourth assumption demand for X to provide no information regarding the mean of the u, whereby the former can be labelled the same as having no correlation.
5. Conditional homoskedasticity	The fifth assumption require $Var(u \mid X) = \sigma^2 I$. Heteroscedastic errors would likely lead to incorrect estimates of standard errors.
6. No autocorrelation	The sixth assumption requires no autocorrelation between the error terms of diverse observations, and thus $\mathrm{Cov}\left(u_t u_j \middle| X\right) = 0, for\ t \neq j$.
7. Normal distribution	The seventh assumption requires normal distribution of the error, but is usefulness is very limited especially for large samples.

Adapted from Masten (2020);Van Oordt (2015) & Albert (2022).

Additionally, for OLS estimator to be Best Linear Unbiased Estimator (BLUE), based on Gauss-Markov Theorem it should also follow the assumption of homoskedasticity and no autocorrelation- thus first six assumptions presented in Table 4 (Van Oordt, 2015). For SVAR to be estimated by the described OLS method, the number of parameters between SVAR and the reduced-form model must be equal. For parameters in the SVAR to be identified, proper identification restrictions that are motivated by economic theory must be imposed in our case via the Cholesky identification approach. As Schenck (2016) notes, utmost frequently approach is to consider a matrix $A_1 = I$ and B_1 (Equation 21) as a lower-triangular matrix, whereby different restrictions are placed on both of the defined matrices, as presented in the matrices below. The former method considers imposing a casual ordering of the variables within the model.

$$A_{1}= \begin{bmatrix} . & 0 & 0 & 0 & 0 \\ 0 & . & 0 & 0 & 0 \\ 0 & 0 & . & 0 & 0 \\ 0 & 0 & 0 & . & 0 \\ 0 & 0 & 0 & 0 & . \end{bmatrix} \quad B_{1}= \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ . & 1 & 0 & 0 & 0 \\ . & . & 1 & 0 & 0 \\ . & . & . & 1 & 0 \\ . & . & . & . & 1 \end{bmatrix} \tag{16}$$

The SVAR model of this master thesis includes five variables, that are based on the economic theory and in line with other studies, ordered in the following form, namely government spending, government revenue, real GDP, HICP and SSR. Since government spending is ordered first it will not contemporaneously react to shocks to other variables that are ordered after. Government revenue is ordered second which implies that it will contemporaneously react to spending shock, but not to either output, inflation or interest rate shocks. The aim of such orderning is to capture discretionary fiscal measures. Further on, inflation is ordered in the fourth place, and thus reacts contemporaneously to government spending, government revenue and output, but not to interest rate shock. SSR is ordered as the last variable within the model, which thus implies that reacts contemporaneously to all shocks in the model. Since within this identification approach, the first variable is the most “exogenous one” and different ordering of variables produce different estimates, in the robustness check the ordering of the defined variables is changed.

Table 5: SVAR model estimation results

Sample: 2006q2 thru 2021q4		Number of obs = 63		
Exactly identified model		Log likelihood = 906.1103		
	Coefficient	*Std.err.*	*z*	*P>|z|*
/A				
1_1	103.4545	9.216461	11.22	0.000
2_1	0	(constrained)		
3_1	0	(constrained)		
4_1	0	(constrained)		
5_1	0	(constrained)		
1_2	0	(constrained)		
2_2	97.9526	8.726311	11.22	0.000
3_2	0	(constrained)		
4_2	0	(constrained)		
5_2	0	(constrained)		
1_3	0	(constrained)		
2_3	0	(constrained)		
3_3	231.2993	20.60578	11.22	0.000
4_3	0	(constrained)		
5_3	0	(constrained)		
1_4	0	(constrained)		

continued

Table 5: SVAR model estimation results (cont.)

Sample: 2006q2 thru 2021q4		Number of obs = 63		
Exactly identified model		Log likelihood = 906.1103		
	Coefficient	*Std.err.*	*z*	*P>|z|*
/A				
2_4	0	(constrained)		
3_4	0	(constrained)		
4_4	284.1082	25.31037	11.22	0.000
5_4	0	(constrained)		
1_5	0	(constrained)		
2_5	0	(constrained)		
3_5	0	(constrained)		
4_5	0	(constrained)		
5_5	-3.192205	.2843843	-11.22	0.000
/B				
1_1	1	(constrained)		
2_1	-.8787091	.1677172	-5.24	0.000
3_1	-2.467737	.4607141	-5.36	0.000
4_1	-.0757172	.1363693	-0.56	0.579
5_1	.0291158	.1377276	0.21	0.833
1_2	0	(constrained)		
2_2	1	(constrained)		
3_2	2.506491	.3399929	7.37	0.000
4_2	.3222604	.1360352	2.37	0.018
5_2	.001952	.1376788	0.01	0.989
1_3	0	(constrained)		
2_3	0	(constrained)		
3_3	1	(constrained)		
4_3	-.2489982	.1298351	-1.92	0.055
5_3	-.0989934	.1376786	-0.72	0.472
1_4	0	(constrained)		
2_4	0	(constrained)		
3_4	0	(constrained)		
4_4	1	(constrained)		
5_4	-.4294063	.1371125	-3.13	0.002
1_5	0	(constrained)		
2_5	0	(constrained)		
3_5	0	(constrained)		
4_5	0	(constrained)		
5_5	1	(constrained)		

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

Table 6 shows the estimated Cholesky decomposition, including of e(Sigma), which is performed after estimates of both matrices are properly stored.

Table 6: SVAR model estimation results

	chol_est [5,5]				
	dln_govspe	*dln_govrev*	*dln_realgdp*	*dln_HICP*	*SSR*
dln_govspe	.00966608	0	0	0	0
dln_govrev	-.00897076	.01020902	0	0	0
dln_realgdp	-.01066902	.01083657	.0043234	0	0
dln_HICP	-.00026651	.00113429	-.00087642	.00351979	0
SSR	-.00912092	-.00061148	.03101096	.13451713	-.31326304
	chol_var [5,5]				
	dln_govspe	*dln_govrev*	*dln_realgdp*	*dln_HICP*	*SSR*
dln_govspe	.00966608	0	0	0	0
dln_govrev	-.00897076	.01020902	0	0	0
dln_realgdp	-.01066902	.01083657	.0043234	0	0
dln_HICP	-.00026651	.00113429	-.00087642	.00351979	0
SSR	-.00912092	-.00061149	.03101097	.13451719	.31326294

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

4.4 Post-estimation test diagnostics

In the following subchapters several post-diagnostic tests are performed.

Granger causality test is performed to test for causality and its direction among defined variables within the model. The results of the former are shown in Table 7 below. When interpreting the results we consider p-values, with the level of significance at 5 % (Chetty & Sajwan, 2018).

Table 6: Granger causality test results

Equation	*Excluded*	*chi2*	*df*	*Prob > chi2*
govspe	govrev	25.44	4	0.000
govspe	realgdp	18.193	4	0.001
govspe	HICP	8.361	4	0.093
govspe	SSR	2.6141	4	0.552
govspe	ALL	36.28	16	0.003
govrev	govspe	4.4333	4	0.274
govrev	realgdp	13.057	4	0.011
govrev	HICP	14.113	4	0.007
govrev	SSR	5.8047	4	0.163

continued

Table 7: Granger causality test results (cont.)

Equation	*Excluded*	*chi2*	*df*	*Prob > chi2*
govrev	ALL	48.718	16	0.000
realgdp	govspe	6.7984	4	0.099
realgdp	govrev	12.31	4	0.015
realgdp	HICP	16.763	4	0.002
realgdp	SSR	7.2843	4	0.076
realgdp	ALL	50.962	16	0.000
HICP	govspe	3.9471	4	0.409
HICP	govrev	10.189	4	0.050
HICP	realgdp	4.2509	4	0.435
HICP	SSR	1.005	4	0.889
HICP	ALL	49.212	16	0.000
SSR	dln_govspe	18.739	4	0.001
SSR	dln_govrev	35.511	4	0.000
SSR	dln_realgdp	33.829	4	0.000
SSR	dHICP	21.628	4	0.000
SSR	ALL	87.396	16	0.000

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

For each equation separately, the null hypothesis is defined, namely:

- Lagged values of government revenue, real GDP, HICP and SSR do not cause government spending.
- Lagged values of government spending, real GDP, HICP and SSR do not cause government revenue.
- Lagged values of government spending, government revenue, HICP and SSR do not cause real GDP.
- Lagged values of government spending, government revenue, real GSP and SSR do not cause HICP.
- Lagged values of government spending, government revenue, real GDP and HICP do not cause SSR.

Based on the null hypothesis and the results presented in Table 7, it can be concluded that for the first equation, the lagged values of government revenue and real GDP cause government spending since the p-value (respectively 0.000 and 0.001) is lower than 0.05. Further on, for the second equation, it can be concluded that the lagged values of real GDP and HICP cause government revenue. For the third equation, it can be concluded that the lagged values of government revenue and HICP cause real GDP. For the fourth equation, it can be concluded that the lagged values of government revenues cause HICP. For the fifth equation, it can be concluded that the lagged values of government spending, government revenue, real GDP and HICP cause SSR.

4.4.1 Lagrange multiplier (LM) residual autocorrelation test

One of the assumptions that need to be satisfied for the OLS estimator to be BLUE, is the assumption that requires no autocorrelation between the error terms. To test whether there is any autocorrelation within the latter, LM residual autocorrelation test is performed. The test statistic is at lag j specified as:

$$LM_s = (T - d - 0.5)ln\left(\frac{|\hat{\Sigma}|}{|\widetilde{\Sigma}_s|}\right), \tag{17}$$

whereby:

- T equals the number of observations within the model,
- d equals the number of estimated parameters within the augmented model,
- Σ presents the variance-covariance matrix that captures the disturbances within the model,
- $\hat{\Sigma}$ is the estimate of Σ, more specifically the maximum likelihood one,
- $\widetilde{\Sigma_s}$ is as well maximum likelihood estimate of Σ, but from augmented model.

Asymptotic distribution of test statistics equals χ^2 with K^2 number of degrees of freedom. The null hypothesis H0 states that there is no autocorrelation at lag order (Stata, 2022).

Table 7: LM residual autocorrelation test

Lagrange-multiplier test			
lag	*chi2*	*df*	*Prob > chi2 |*
1	19.7388	25	0.76039
2	27.9529	25	0.31003
3	19.7341	25	0.76063
4	24.8046	25	0.47336

H0: No autocorrelation at lag order.

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

Table 8 shows the results of performed LM test, whereby it can be noted that for all four lag orders tested, the null hypothesis of having no autocorrelation in the residuals cannot be rejected (all Prob. values are greater than 0.05). The tests thus do not give information or hints about the misspecification of the model, and it can be concluded that there is no autocorrelation in order of the lags and that the model is correctly specified.

4.4.2 Test for normality

Another test performed is the test for normality. More specifically Jarque-Bera test is applied which shows whether the disturbance within the regression follows a normal distribution. The results of the test are presented in Table 9, where the null hypothesis corresponds to normal distribution of the disturbances. Except for government spending, we cannot confirm the normal distribution for the remaining variables (although government revenue is close to being significant). Nevertheless, as Woldridge (2012) argue, based on the Gauss-Markov Theorem, assumption of normality does not influence OLS to be Best Linear Unbiased Estimator (BLUE) or conclusion in respect of unbiasedness. By considering the central limit theorem, the assumption of normality can be dropped, by rather considering the asymptotic normality and thus approximately normally distributed estimators.

Table 8: Estimates of Jarque-Bera test, Skewness test & Kurtosis test

Jarque-Bera test				
Equation		*chi2*	*df*	*Prob > chi2*
govspe		76.476	2	0.00000
govrev		5.781	2	0.05554
realgdp		0.206	2	0.90197
HICP		1.417	2	0.49244
SSR		0.069	2	0.96631
ALL		83.949	10	0.00000
Skewness test				
Equation	Skewness	chi2	df	Prob > chi2
govspe	1.3155	18.170	1	0.00002
govrev	-.64108	4.315	1	0.03777
realgdp	.08258	0.072	1	0.78902
HICP	.26061	0.713	1	0.39840
SSR	.0015	0.000	1	0.99612
ALL		23.270	5	0.00030
Kurtosis test				
Equation	Kurtosis	chi2	df	Prob > chi2
govspe	7.7129	58.305	1	0.00000
govrev	3.7473	1.466	1	0.22596
realgdp	2.7734	0.135	1	0.71355
HICP	2.4823	0.704	1	0.40157
SSR	2.8384	0.069	1	0.79351
ALL		60.678	5	0.00000

Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

4.4.3 Test for stability of the model

After the estimation of the parameters within the VAR and SVAR, a test that consideres eigenvalues stability condition is performed. Stability for the VAR model is defined when the roots of the characteristic polynomial are inside the unit circle, i.e.:

$$\det(I_K - A_1 z - \cdots - A_p z^p) \neq 0, for\ |z| \leq 1 \tag{18}$$

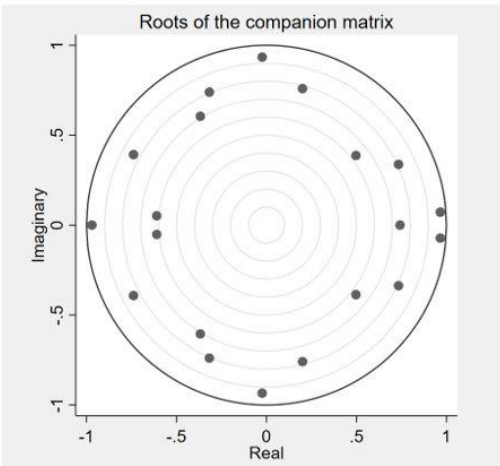
The stability of VAR models is of integral importance, since in that case, both impulse-response functions (IRFs), as well as forecast-error decompositions (FEVD) have known interpretations. Results reported in Figure 16 confirm that our model is stable since modules of each eigenvalue are strictly less than one. The former is additionally visually shown within the graph of the eigenvalues since all the values lie within the unit circle.

Figure 16: Stability test and unit circle graph

Eigenvalue stability condition

Eigenvalue	Modulus
-.9702645	.970264
.9654966 + .0719902*i*	.968177
.9654966 - .0719902*i*	.968177
-.02426929 + .9341128*i*	.934428
-.02426929 - .9341128*i*	.934428
-.7389576 + .3920932*i*	.836538
-.7389576 - .3920932*i*	.836538
.733389 + .3371129*i*	.807158
.733389 - .3371129*i*	.807158
-.3175399 + .7393617*i*	.804666
-.3175399 - .7393617*i*	.804666
.2000521 + .7589441*i*	.784867
.2000521 - .7589441*i*	.784867
.7417165	.741717
-.3679581 + .6048718*i*	.707999
-.3679581 - .6048718*i*	.707999
.4968714 + .3870692*i*	.629844
.4968714 - .3870692*i*	.629844
-.6101795 + .05191519*i*	.612384
-.6101795 - .05191519*i*	.612384

All the eigenvalues lie inside the unit circle.
VAR satisfies stability condition.



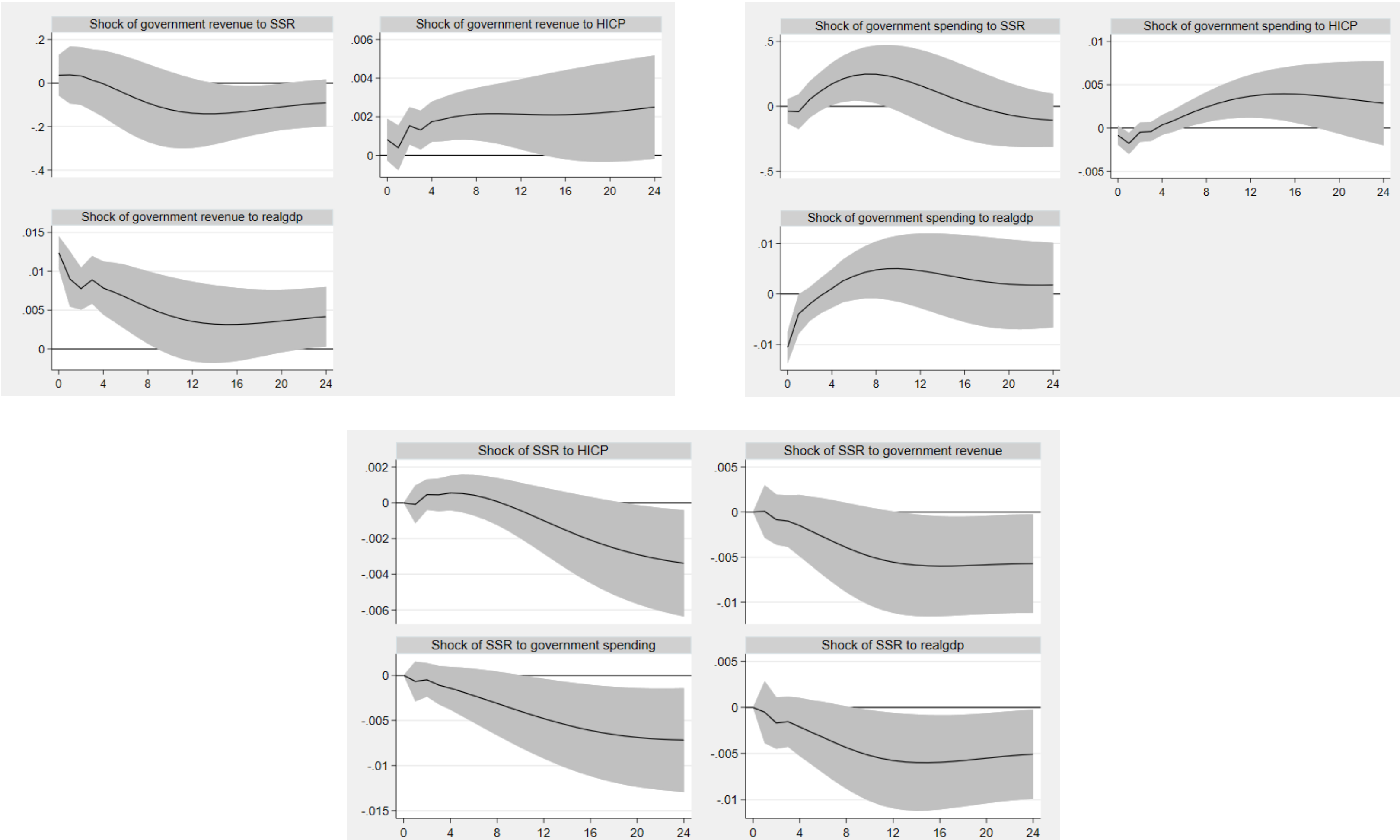
Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

4.5 Impulse response functions

To perform the Impulse response functions (IRFs), all the eigenvalues have to lie inside the unit circle, which thus means that our model satisfies the stability conditions. Based on the result in Figure 16, it can be concluded that this is indeed the case and that we can confirm that our model is stable since modules of each eigenvalue are strictly less than one. By computing the irf command in Stata, five different IRFs may be computed, namely simple IRFs, cumulative IRFs, orthogonalized IRFs, cumulative orthogonalized IRFs and lastly the structural IRFs. The former is of integral importance since it measures what is the impact of a shock on endogenous variables inside the model (Baum, 2013).

Figure 17 shows the structural impulse responses for variables to the SSR, government spending and government revenues shock, whereby the variable that is labelled as the first one in the graph is the impulse variable and the one labelled as the second is the response variable. The magnitude of the shock in one standard deviation, the x-axis represents the periods and the y-axis represents the percentage deviations. All graphs include 24 quarters, which equal eight years. Based on the structural impulse response graphs we can conclude how the variables within our model respond to the shocks. If we first consider the monetary policy instrument, which is defined as the SSR in our model, it can be noted that a one standard deviation shock to the SSR, and thus monetary policy tightening, produces negative and lagged effects on both prices as well as output, whereby it can be observed that in line with the empirical theory the response of output is more significant and less delayed in comparison to the response of the prices.

Figure 17: Structural impulse response functions for defined variables (ordered as: government spending, government revenue, HICP, realgdp & SSR)



Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

While performing the overview of the empirical literature that has been used so far, we have been able to observe a vast number of studies that assessed the effects of the monetary policy shock, but only in a later decade or two studies tried to assess and provide some robust stylized facts as well with regards to the fiscal policy shocks. Nevertheless, the theory is not uniform in how the variables should respond to fiscal policy shocks. For example, the results from Blanchard and Perotti`s (2002) study concluded that an unanticipated increase in government revenue affects output negatively, while Perotti`s (2005) study does not come to the same conclusion and rather emphasizes that there is no reaction to the output. From Figure 17, it can be observed that a fiscal policy shock, concerning government revenue influences output and prices, whereby it decreases output growth and increases inflation. The latter effect could be explained by the fact that a large part of government revenue in the EA can be attributed to indirect taxes, such as the value-added tax, which directly affect prices in the case of changes in tax rates. On the other hand, we can also see that government spending increases output in the short run, which is well supported by the empirical theory. It also produces first neglectable decrease and afterwards an increase in prices.

4.6 Robustness check

In this subchapter, a common empirical exercise is performed, namely the robustness check, to test whether our results from the previous point are still plausible and robust. Since we used as an identification approach , recursive ordering by Cholesky decomposition to obtain orthogonality shock, the ordering of the variables plays an important role since we define the first variable as the "most exogenous one". It is thus of integral importance to also perform different ordering of the variables, to see how this impacts the estimates and thus to check for robustness of our results. Additionally, we include another robustness check and consider two different sub-periods.

4.6.1 Different ordering of the variables for recursive ordering approach

Our original model included variables of government spending, government revenue, real GDP, HICP and SSR, which were modelled in this order, respectively. To test for the robustness of the variables, different ordering is performed. Namely, Caldara and Kamps (2008) and Perotti (2005) ordered variables in the following form: government spending, the output, inflation, tax revenue and monetary policy instrument. Since government spending is ordered first it will not contemporaneously react to shock to other variables that are ordered after. Since output is ordered second, this implies that it will contemporaneously react to spending shock, but not to either government revenue, inflation, and interest rate shocks. Inflation is in the third place, which thus implies that it will not react contemporaneously to tax and interest rate shocks. Government revenues are ordered in the fourth place, and thus react contemporaneously to government spending, output and inflation, but not to interest rate shock. SSR is ordered as the last variable within the model, which thus implies that reacts contemporaneously to all shocks in the model but only affects all other variables with a lag. Mentioned relations can be in matrix form and as Caldara and Kamps (2008) define them written as in equation (23):

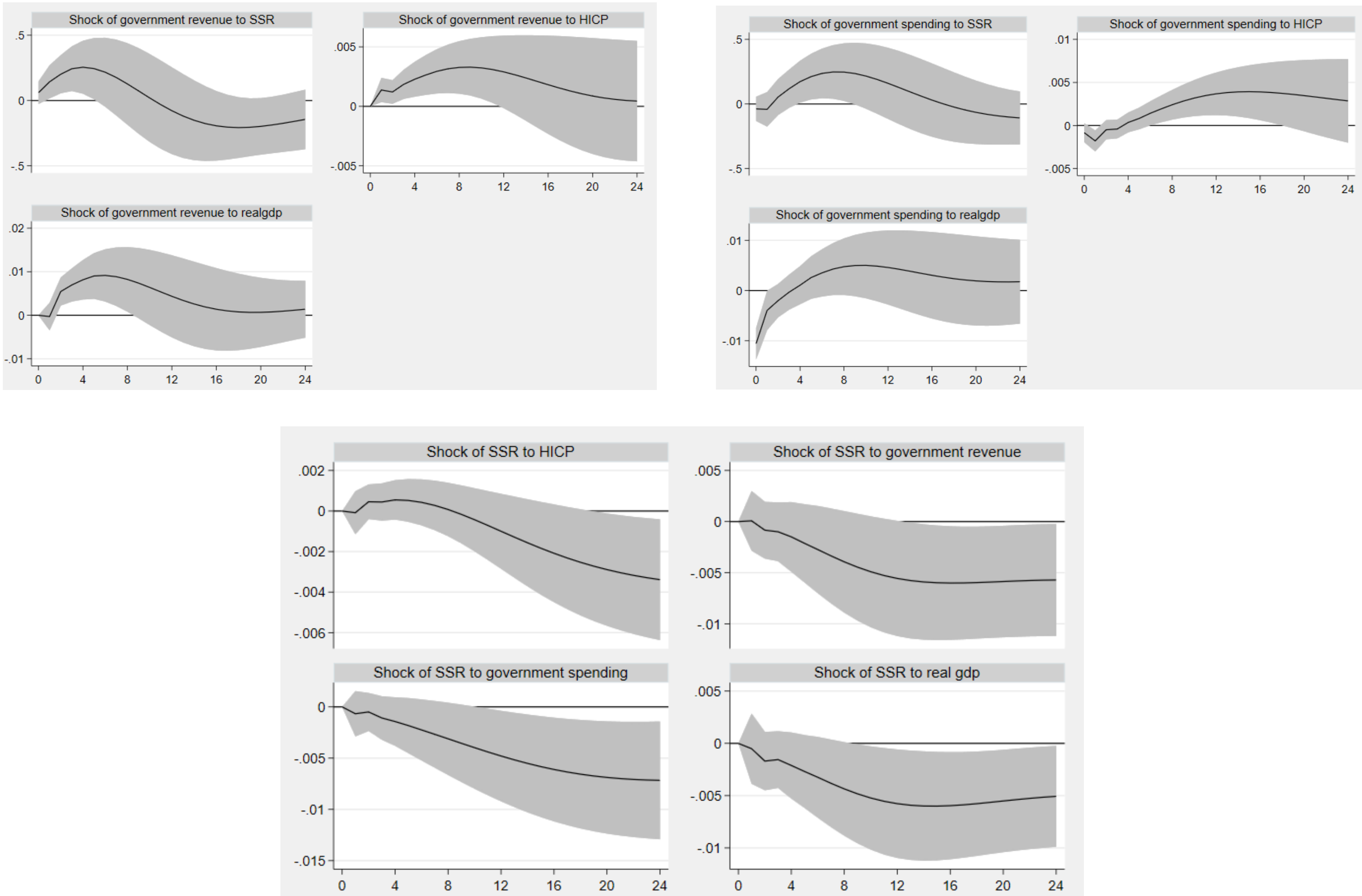
$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ -\alpha_{gdp\_gs} & 1 & 0 & 0 & 0 \\ -\alpha_{HICP\_gs} & -\alpha_{HICP\_gdp} & 1 & 0 & 0 \\ -\alpha_{gr\_gs} & -\alpha_{gr\_gdp} & -\alpha_{gr\_HICP} & 1 & 0 \\ -\alpha_{SSR\_gs} & -\alpha_{SSR\_gdp} & -\alpha_{SSR\_HICP} & -\alpha_{SSR\_gr} & 1 \end{bmatrix} \begin{bmatrix} u_t^{gs} \\ u_t^{gdp} \\ u_t^{HICP} \\ u_t^{gr} \\ u_t^{SSR} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{gs} \\ \varepsilon_t^{gdp} \\ \varepsilon_t^{HICP} \\ \varepsilon_t^{gr} \\ \varepsilon_t^{SSR} \end{bmatrix} \quad (19)$$

Authors motivate selected ordering by saying that the movements that happen in the government spending are not related to the business cycle in comparison to the movements in the government revenues. Additionally, both output and inflation are ordered before the government revenues, which have an impact on the tax base and even further tax receipts. They ordered the interest rate in the fifth place. As the authors emphasise, the defined ordering does not include the impact of discretionary tax changes on both output and inflation but rather captures the effects of automatic stabilizers. Thus, Figure 18 shows the results from estimation where the variables are ordered in line with Caldara and Kamps (2008), namely government spending, output, inflation, tax revenues and monetary policy instrument which is in our case SSR. It can be noted that different ordering of the variables produces different results. With respect to government spending shock and monetary policy SSR shock, the results in Figure 18 remain consistent with earlier estimates in Figure 17, whereby the results for government revenue shock on variables are different. Namely due to the government revenue shock, both prices and output increases.

4.6.2 Robustness check for two sub-periods

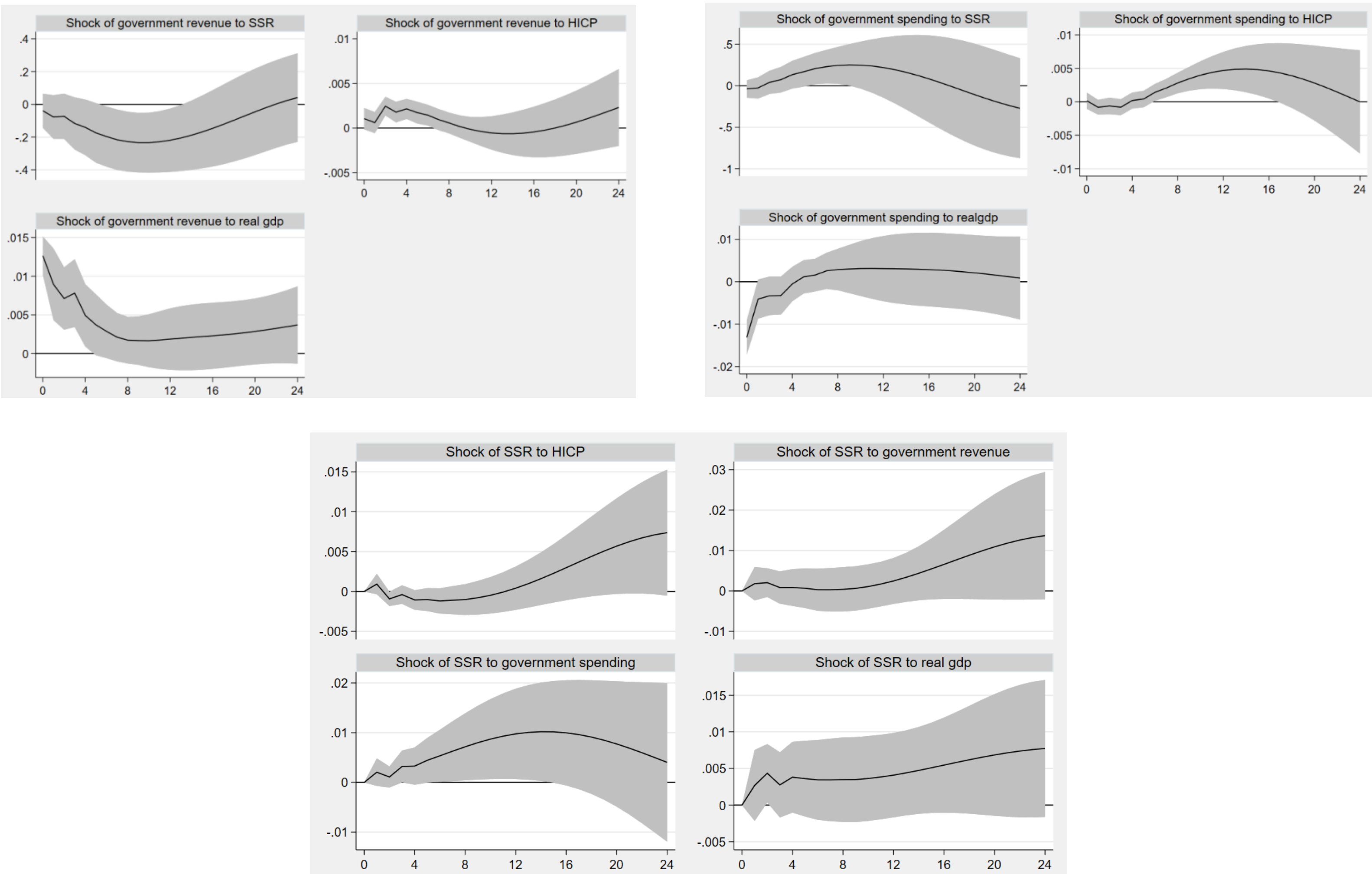
Besides changing the order of the variables, another robustness check is performed, which is also a common practice when dealing with empirical assignments, to see how estimations will behave when certain specifications are modified and to confirm whether the responses will be consistent when the time horizons change. For this purpose, the data is divided into two subperiods, whereby the first subperiod includes data between 2010Q1 and 2021Q4. This subperiod thus includes the period of the COVID-19 pandemic but excludes the period of the global financial crisis. The structural impulse response functions for this subperiod can be observed in Figure 19. Alternatively, the other sub-period tested is the period from 2005Q1 to 2019Q4, which includes the period of the global financial crisis but excludes the periods of the COVID-19 pandemic. The structural impulse response functions for the latter subperiod are presented in Figure 20.

Figure 18: Structural impulse response functions for different ordening of the variables (ordered as: government spending, realgdp, HICP, government revenue & SSR)



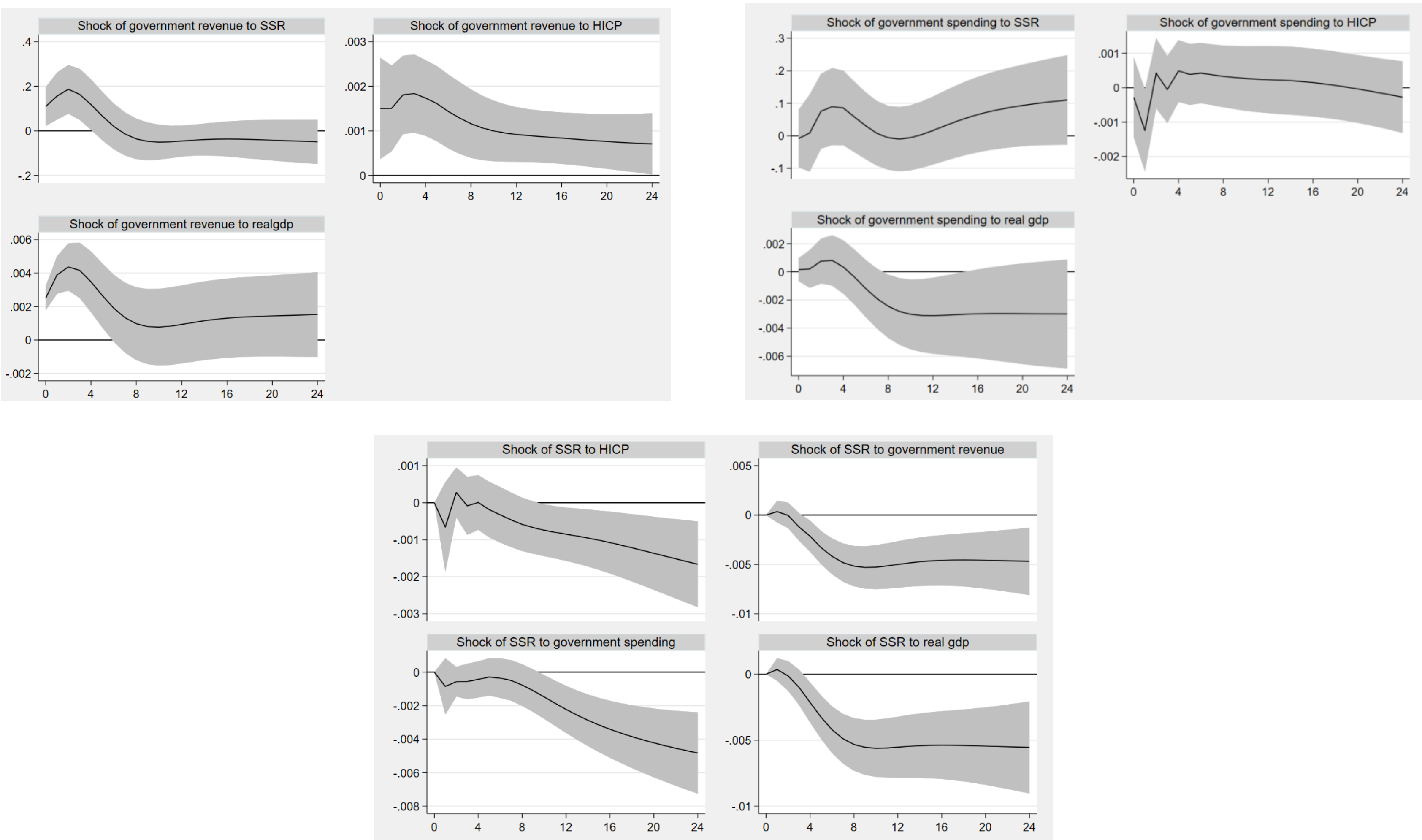
Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

Figure 19: Structural impulse response functions for the first sub-period (2010Q1- 2021Q4)



Adapted from ECB Statistical Warehouse (2022); Eurostat (2022a); Eurostat (2022d) & Wu & Xia (2022).

Figure 20: Structural impulse response functions for the second sub-period (2005Q1-2019Q4)



Adapted from ECB Statistical Warehouse (2022), Eurostat (2022a), Eurostat (2022d) & Wu & Xia (2022).

As mentioned, the chosen time period did not offer a lot of possibilities to perform the robustness check. Nevertheless, based on the structural impulse responses graphs it can be concluded that the responses of the first sub-period are broadly in line with the basic model, especially concerning the government revenue shock and government spending shock, whereby the responses are different for monetary policy (SSR) shock with respect to prices and output.

Concerning the second subperiod, which does not include the observations of the COVID-19 pandemic, it can be observed that the results are again not completely consistent with the original model. It can be observed that this second subperiod model yields different responses for government revenues shocks and government spending shock, whereby the shock in government spending leads to a delayed decrease of output but there is no clear response on prices. The results concerning a monetary policy shock yield consistent results compared to the original model and thus produce negative and lagged effects on both prices as well as output.

4.6.3 Robustness proposition based on Blanchard & Perotti`s (2002) and Perotti`s (2005) two-step approach

Instead of relying on the recursive ordering of the shocks and recursive approach as this master thesis considers, we could consider the two-step approach that was proposed by Blanchard & Perotti (2002) and Perotti (2005). The authors present the relationship between the reduced-form disturbances and the structural ones in the following form:

$$u_t^{gs} = \alpha_{gs\_gdp} u_t^{gdp} + \alpha_{gs\_HICP} u_t^{HICP} + \alpha_{gs\_SSR} u_t^{SSR} + \beta_{gs\_gr} \epsilon_t^{gr} + \epsilon_t^{gs} \quad (20)$$

$$u_t^{gr} = \alpha_{gr\_gdp} u_t^{gdp} + \alpha_{gr\_HICP} u_t^{HICP} + \alpha_{gr\_SSR} u_t^{SSR} + \beta_{gr\_gs} \epsilon_t^{gs} + \epsilon_t^{gr} \quad (21)$$

$$u_t^{gdp} = \alpha_{gdp\_gs} u_t^{gs} + \alpha_{gdp\_gr} u_t^{gr} + \epsilon_t^{gdp} \quad (22)$$

$$u_t^{HICP} = \alpha_{HICP\_gs} u_t^{gs} + \alpha_{HICP\_gdp} u_t^{gdp} + \alpha_{HICP\_gr} u_t^{gr} + \epsilon_t^{HICP} \quad (23)$$

$$u_t^{SSR} = \alpha_{SSR\_gs} u_t^{gs} + \alpha_{SSR\_gdp} u_t^{gdp} + \alpha_{SSR\_HICP} u_t^{HICP} + \beta_{SSR\_gr} \epsilon_t^{gr} + \epsilon_t^{SSR} \quad (24)$$

whereby it should be noted that the variable of government spending is shortened into gs, government revenue into gr and real output into gdp, whereby the HICP and SSR stays the same.

As the authors explain, this approach, in comparison to the recursive ordering approach that was primarily considered in this master thesis, allows imposing restrictions that are different from zero, to achieve identification. Based on the imposed parameter restrictions that are based on the economic theory, the matrix of the reduced-from and structural disturbances relation is defined as follows:

$$\begin{bmatrix} 1 & 0 & 0.5 & 0 & 0 \\ -\alpha_{gdp\_gs} & 1 & 0 & -\alpha_{gdp\_gr} & 0 \\ -\alpha_{HICP\_gs} & -\alpha_{HICP\_gdp} & 1 & -\alpha_{HICP\_gr} & 0 \\ 0 & -1.85 & -1.25 & 1 & 0 \\ -\alpha_{SSR\_gs} & -\alpha_{SSR\_gdp} & -\alpha_{SSR\_HICP} & -\alpha_{SSR\_gr} & 1 \end{bmatrix} \begin{bmatrix} u_t^{gs} \\ u_t^{gdp} \\ u_t^{HICP} \\ u_t^{gr} \\ u_t^{SSR} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ \beta_{gr\_gs} & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_t^{gs} \\ \varepsilon_t^{gdp} \\ \varepsilon_t^{HICP} \\ \varepsilon_t^{gr} \\ \varepsilon_t^{SSR} \end{bmatrix} \quad (25)$$

It can be indeed observed, that comparing matrices in Equation (23) where the recursive ordering approach is considered in Equation (29), we can note that the latter also includes restrictions that are different from zero, more specifically this is the case for three exceptions. Perotti (2005) obtained the output elasticity of government revenues in the amount of 1.85 and additionally for inflation elasticity of government revenue in amount of 1.25. The inflation elasticity of government spending is set to -0.5. The author argues this with nominal wages of employees in governments, which present an integral part of the government consumption, which is thus not contemporaneously affected by the changes caused in price levels. Output elasticity of government spending, interest rate elasticities of government spending and net taxes are set to 0, due to the nature of these variables, whereby government interest payments are not included either in government spending, or in government revenues. Another difference that might be noted, is that Equation (29) in comparison to Equation (23) also includes a parameter β_{gr_gs}, which also equals zero, but Perotti (2005) explains this decision by saying that fiscal authorities consider spending decisions before revenue decisions. As Caldara and Kamps (2008) highlight, this kind of identification may be important in the case that econometric models also include tax shock responses.

4.7 Discussion of results of empirical analysis

Within the empirical part of this master thesis, we tried to capture the monetary and fiscal policy impact on macroeconomic variables within the EA, with an emphasis on the COVID-19 pandemic. For this purpose, the time-horizon ranged between the first quarter of 2005 and the fourth quarter of 2021. The reason for choosing this time period is the availability of the data. In the original model we rely on economic theory and use proper identification restriction via the Cholesky identification approach, by considering $A_1 = I$ and B_1 as the lower-triangular matrix, whereby different restrictions are placed on both defined matrixes. There are five variables included within the model that are based on the economic theory and in line with other studies ordered in the following form, namely government spending, government revenue, output, prices and monetary policy instrument. Within the robustness check, we also perform different ordering of the variables, based on the Caldaraand Kamps (2008) empirical term paper, whereby the variables are ordered as government spending, output, prices, government revenues and monetary policy instrument as the last variable. This alternative ordering can be motivated by saying that putting output and inflation before the government revenues implies its impact on the tax base and even further tax receipts. It can be noted that different ordering of the variables produce different results. An additional robustness check is also performed for two different sub-periods. Since the data range between rather small periods, there are not a lot of possibilities to perform such a robustness check. Consequently, the first sub-period range between the first quarter of 2010 and the last quarter of 2021, and thus also includes the period of the COVID-19 pandemic. The second-sub period ranges from the first quarter of 2005 to the last quarter of 2019, which thus excludes the COVID-19 pandemic observations, but includes the period of the great financial crisis.

Based on the structural impulse response functions graphs, it can be concluded that monetary policy tightening produces negative and lagged effects on both prices as well as output, whereby it can be observed that in line with the empirical theory the response of output is more significant and less delayed in comparison to the response of the prices. This is in line with the New Keynesian theory that supports price stickiness. Alternatively, while considering fiscal policy, the empirical literature is not so advanced in comparison to the monetary policy analyses. It can be observed that fiscal policy shock, regarding government revenue, decreases output and increases prices. Government spending increases output in the short run, which is well supported by the empirical theory. In line with Blanchard and Perotti (2002), we can conclude that a positive government revenue shock negatively affects output, while a positive spending shock increases output. Nevertheless, Blanchard & Perotti (2002) and Ramey (2011) concluded that several macroeconomic variables can face adverse impact, due to expansionary fiscal policy measures.

Alternatively, to the approach of the recursive ordering of the variables, one could use the two-step approach proposed by Blanchard & Perotti (2002) and Perotti (2005), which is considered under 4.6.3. Since the estimation and procedures go beyond the scope of this master thesis, only the initial steps are performed. The main difference is that within the recursive approach and thus relying on Cholesky decomposition, the automatic stabilizers and the size of these are freely estimated, due to imposed zero restrictions on other variables of interest. Nevertheless, as Caldara and Kamps (2008) note, both of the mentioned approaches lead to similar results. Another step further could be to perform SVAR analyses for different EA countries to capture cross-country heterogeneity, but this again goes beyond the scope of this master thesis. Besides that, an improvement of this master thesis would be to consider and estimate a model with an alternative identification approach or by considering different monetary or fiscal policy variables.

CONCLUSION

The objective of this master thesis was to analyse and capture the impact of extraordinary and unprecedented measures of monetary and fiscal authorities in the EA during COVID-19 pandemic. The purpose was to capture the impact of these measures on EA macroeconomic indicators, in particular, on inflation and output.

One can conclude that the COVID-19 pandemic shock caused enormous changes in EA macroeconomic variables and forced monetary and fiscal authorities to take extraordinary and unprecedented measures. Monetary policy with the ECB in the front line responded to the COVID-19 pandemic by intervening with asset purchase programmes, targeted long-term refinancing operations, and maintaining the interest rates at historically low and even negative levels. The nature of the COVID-19 pandemic strengthened the role of fiscal policy, which has been strongly supported by monetary policy and its measures of providing favourable conditions for financing. Fiscal policy supported the EU economy via discretionary actions and automatic stabilizers at both member state and EU levels. Based on all the schemes that were established during and due to the pandemic, the authorities should take care that funds from presented programmes will be effectively absorbed, with the RRF at the forefront.

The macroeconomic impact of the fiscal and monetary policy measures within the empirical part of this master thesis is considered via the SVAR modelling approach. The shadow short rate of Wu and Xia (2016) is considered as the monetary policy instrument. The main advantage of using the SSR as a monetary policy variable is its property of not being constrained by the ZLB environment. Alternatively, one could use interest rates of longer maturities, the quantity of money, or the central bank balance sheet. For fiscal policy instrument, we use government revenue and government spending, which is in line with other empirical literature. We rely on the Cholesky identification approach, whereby the ordering of variables plays an important role. After estimation, the structural impulse response functions are performed to see the impact of a shock on endogenous variables in the model. To test whether results are plausible and robust, three different robustness checks are considered, whereby we can conclude that different ordering of the variables indeed produces different results, this is as well the case for two different sub-periods.

Based on the empirical part results, it can be concluded that one standard deviation shock to the SSR, which corresponds to monetary policy tightening, produces negative and lagged effects on both prices as well as output, whereby it can be observed that in line with the empirical theory, the response of output is more significant and less delayed in comparison to the response of the prices. Results for fiscal policy shock are, as well, broadly in line with the literature overview, since a government revenue shock decreases output and increases prices, which can be in large amounts explained by indirect taxes. A government spending shock alternatively leads to an increase in output.

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APPENDICES

Appendix 1: Povzetek (Summary in Slovene language)

Summary in Slovene language.

Ob koncu leta 2019 je svet pretresla novica, da je v kitajskem mestu Wuhan izbruhnila neznana in visoko nalezljiva bolezen, ki jo povzroča virus SARS-CoV-2. Zaradi enormnega širjena po vsem svetu so bile oblasti 11. marca 2020 primorane uradno razglasiti pandemijo. Slednja je zaradi velike negotovosti glede morebitnega prihodnjega razvoja bolezni pod vprašaj postavila mnoge že tako slabo stoječe zdravstvene sisteme ter razkrila njihove slabosti in ranljivosti. Posledično so se morale vlade odločiti, ali bodo s svojimi ukrepi prioritizirale gospodarstva ali reševale zdravstveno krizo. Da bi preprečili kolaps zdravstvenih sistemov in rešili življenja predvsem starejše populacije, se je večina vlad v EU odločila, da ugasne svoja gospodarstva.

Čeprav lahko pandemijo COVID-19 označimo kot simetrični šok, ki je prizadel vse države evroobmočja, je kmalu po njegovem izbruhu postalo jasno, da se bodo njegove posledice zelo asimetrično razporejale med države članice in sektorje znotraj teh, kot odraz razlike v gospodarskih strukturah držav članic. To je posledično pomenilo dobro podlago za skupno ukrepanje na evropski ravni. V boju proti posledicam COVID-19 in okrevanju panog, ki so znotraj določenih gospodarstev praktično stagnirale, so bile monetarne in fiskalne oblasti prisiljene sprejeti prenekatere ukrepe, pri čemer je oblastem dodaten izziv predstavljala edinstvena struktura EA, ki je sestavljena iz enotne monetarne unije in več decentraliziranih fiskalnih organov.

Zaradi gibanja obrestnih mer blizu ničelne spodnje meje (ZLB) se je bila monetarna politika prisiljena opreti na izvajanje njenih nestandardnih ukrepov. Evropska centralna banka (ECB) se je na posledice pandemije odzvala preko nakupa vrednostih papirjev (APP in PEPP) ter preko operacij dolgoročnejšega refinanciranja (LTRO, TLTRO III in PELTRO). Z zelo prilagodljivo monetarno politiko je tako omogočila likvidnost in nemoteno delovanje finančnih trgov ter ugodnejše pogoje za financiranje, saj je kot odziv na pandemijo COVID-19 sprejela odločitev ohranjanja obrestnih mer na zgodovinsko nizki ravni in tako poskrbela, da so stroški izposojanja ostajali nizki. Povečala je znesek, ki si ga lahko banke izposodijo od ECB, ter tistim, ki jih je kriza najhuje prizadela, ublažila pogoje, pod katerimi si lahko izposodijo sredstva za posojila, zlasti torej malim in srednje velikim podjetjem. Prav tako je bankam ponudila takojšnje refinanciranje po ugodnih obrestnih merah ter na mnogih področjih omilila standarde.

Gospodarstvo EA je bilo dobro podprto tudi s strani fiskalne politike, predvsem preko diskrecijskih ukrepov in avtomatičnih stabilizatorjev. V letu 2020 je skupna diskrecijska spodbuda za EA predstavljala blizu 4,25 % celotnega BDP. Poleg ukrepov fiskalne politike na nacionalnih ravneh znotraj držav članic so bili tako kratkoročni kot tudi dolgoročni ukrepi sprejeti na evropski ravni. Slednji so bili zaradi različnega fiskalnega prostora držav članic izrednega pomena in so vsaj delno preprečili še večjo razdrobljenost med državami članicami. Da bi zagotovili fleksibilnost za države članice, so oblasti v mesecu maju 2020 aktivirale splošno odstopno klavzulo Pakta stabilnosti in rasti, kar je povzročilo povečanje javnih dolgov. V podporo gospodarskemu okrevanju je bil poleg mnogih drugih shem vzpostavljen tudi pomemben, 750 milijard € vreden instrument NextGenerationEU.

To magistrsko delo prispeva k literaturi o analizi fiskalne in monetarne politike z integracijo obeh politik znotraj enotnega okvira Strukturne Vektorske Avtoregresije (SVAR). Ocenjeni so učinki za agregatne podatke na ravni EA, s fokusom na pandemiji COVID-19. Kot identifikacijska shema je uporabljen rekurzivni pristop ortogonalizacije šokov na podlagi razcepa Choleskega, pri katerem pomembno vlogo igra vrstni red endogenih spremenljivk. Te so v magistrskem delu na podlagi ekonomske teorije razvrščene v naslednjem vrstnem redu: državna potrošnja, državni prihodki, realni bruto domači proizvod, cenovni indeks ter instrument monetarne politike, natančneje senčna obrestna mera. Kot instrument monetarne politike je uporabljena senčna obrestna mera Wu and Xia (2016), ki zajema tudi nestandardne ukrepe monetarne politike, saj obrestne mere zaradi ničelne spodnje meje (ZLB) ne kažejo jasne naravnanosti monetarne politike.

Na podlagi sktrukturnih impulznih odzivov lahko zaključimo, da se šok monetarne politike odraža v negativnih in zakasnjenih učinkih tako cen kot tudi bruto domačega proizvoda, pri čemer je v skladu z emipirčno teroijo moč opaziti, da je odziv bruto domačega proizvoda pomembnejši in manj zakasnjen v primerjavi z odzivom cen. Prav tako so odzivi bruto domačega proizvoda in cen kar zadeva šokov fiskalne politke v splošnem v skladu z empirično literaturo. Šok državnih prihodkov se odraža v zmanjšanju bruto domačega proizvoda ter povišanju cen, kar literatura v veliki meri pripisuje posrednim davkom. Alternativno se šok državne potrošnje odraža v povečanju bruto domačega proizvoda. Ob uporabi alternativnega razvrščanja spremenljivk strukturni impulzni odzivi potrjujejo pomen vrstnega reda spremenljivk pri rekurzivnem pristopu.