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Macroeconomic Effects of European Government Bond Demand Shocks and Monetary Policy Shocks

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Abstract

This thesis examines the joint macroeconomic effects of European Government Bond (EGB) demand shocks and monetary policy (information) shocks in Germany, France, and Italy between 2002 and 2025. While fiscal and monetary policy shocks have largely been studied separately, limited research has analysed their interaction, particularly regarding sovereign bond demand fluctuations and the distinction between monetary policy shocks and monetary policy information shocks. We construct country- and maturity-specific EGB demand shocks using sovereign bond auction data and identify monetary policy shocks using the Euro Area Monetary Policy Event-Study Database (EA-MPD). Using a Vector Error Correction Model (VECM), we analyse the effects of these shocks on key macroeconomic variables, including household consumption, private investment, industrial production, core inflation, unemployment rate, and real GDP. Our findings suggest that EGB demand shocks generally have weak and statistically insignificant macroeconomic effects, whereas monetary policy and monetary policy information shocks are occasionally transmitted to the macroeconomy, with varying effects across countries. Overall, the results imply that sovereign bond demand fluctuations are not a major source of macroeconomic instability in the euro area, while monetary policy remains a moderately effective stabilisation tool.

Keywords: EGB demand shocks, monetary policy shocks, VECM, macroeconomic effects, euro area

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AI Disclaimer

AI tools were used in the coding of the VECM, specifically for implementing the long-run restrictions and for computing and visualising the impulse response functions (including the generation of IRF plots). No AI tools were used for the specification of the VECM, including lag selection, the Johansen trace test, or rank determination, nor for data preparation, such as data wrangling, the construction of government bond demand shocks, the identification of monetary policy shocks, or other preliminary data processing steps. Finally, AI tools were used to refine wording and improve clarity in certain sentences and short passages. All substantive content, analysis and conclusions remain our own.

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List of Abbreviations

ADF Augmented Dickey–Fuller.

AIC Akaike information criterion.

AR(p) Autoregressive.

BIC Bayesian information criterion.

CPI Consumer price index.

EA Euro area.

EA-EMPD Euro Area Extended Monetary Policy Event-Study Database.

EA-MPD Euro Area Monetary Policy Event-Study Database.

ECB European Central Bank.

EGB European government bond.

Euribor Euro Interbank Offered Rate.

GDP Gross domestic product.

HFI High-frequency identification.

HQIC Hannan–Quinn information criterion.

IRF Impulse response function.

KPSS Kwiatkowski–Phillips–Schmidt–Shin.

MF-VAR Mixed-frequency vector autoregression.

NK New Keynesian.

OIS Overnight index swaps.

OLS Ordinary least squares.

PP Phillips–Perron.

QE Quantitative easing.

SVAR Structural vector autoregression.

UK United Kingdom.

US United States.

VAR Vector autoregression.

VECM Vector error correction model.

1 Introduction

Over the past two decades, global and domestic crises have severely impacted macroeconomic conditions worldwide (World Bank, 2026). In response, governments and central banks have increasingly relied on fiscal and monetary policy to stabilise the economy. In the euro area (EA), this dual reliance became particularly evident following the Global Financial Crisis and COVID-19 pandemic. EA governments and the European Central Bank (ECB) undertook large-scale interventions to support price stability, employment and output (Rostagno et al., 2019).

On the fiscal side, EA governments implemented extensive debt-financed fiscal stimulus measures aimed at strengthening economic conditions, thereby raising public debt levels (Eurostat, 2026f). As illustrated by the evolution of debt-to-GDP ratios, in Figure 1, France and Italy have experienced more persistent increases, particularly following major economic shocks, while Germany has maintained comparatively more stable debt levels excluding periods of major shocks.

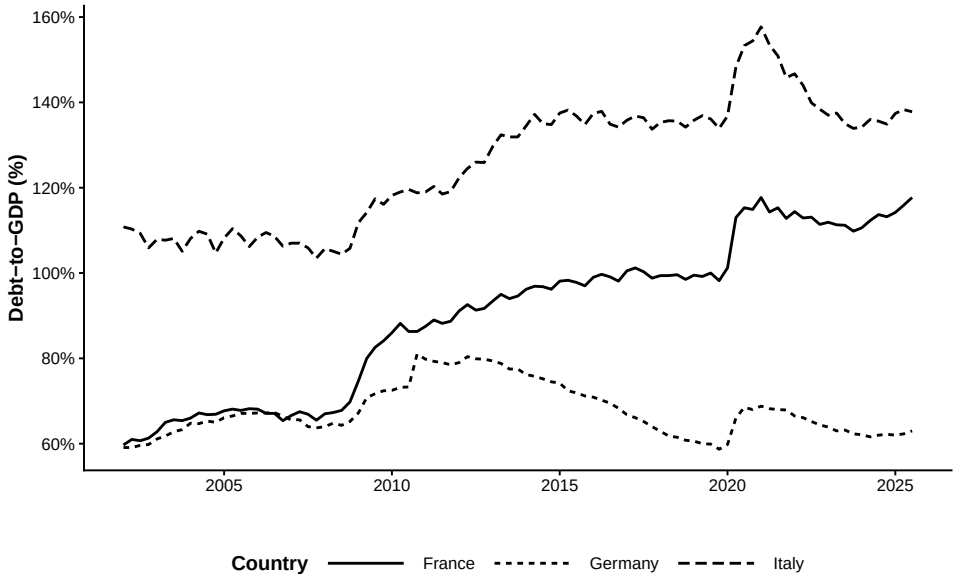

Figure 1: Government debt-to-GDP ratio

Note: Own depiction. Source: Eurostat (2026f)

Importantly, rising public debt levels imply an increasing reliance on government bond markets as a source of financing. Governments typically issue debt securities through auctions, where investors can bid on a quantity of their choice specifying the price and thus the yield they are willing to pay. Consequently, fluctuations in investor demand can generate European government bond (EGB) demand shocks, which affect financing conditions and therefore economic activity independently of fiscal policy decisions themselves. For instance, stronger demand for government bonds raises bond prices and lowers yields, reducing government borrowing costs. As sovereign yields act as a pricing benchmark for private borrowing, lower yields can stimulate investment, consumption and economic activity. Furthermore, EGB demand shocks reflect investor and market sentiment. A shock for short-term bonds may arise if investors aim to

secure their returns in a period of financial stress, whereas a demand shock for long-term EGBs may arise when investors are adapting their investment strategies. Despite their potential macroeconomic effects, demand-driven fluctuations in government securities remain under-explored (Lengyel & Giuliodori, 2022) in comparison to traditional fiscal policy shocks, such as government spending and tax shocks (Afonso & Sousa, 2012; Burriel et al., 2010; Tenhofen et al., 2010).

EA monetary policy has played a central role in stabilising macroeconomic conditions through the use of conventional and unconventional measures, such as changes in policy rates, including negative rates, and launching large-scale asset purchasing programmes (Rostagno et al., 2019). Conventional monetary policy, primarily interest rate changes, has been used extensively, with the ECB deposit rate being one of the main instruments used to conduct monetary policy. As illustrated in Figure 2, which shows the evolution of the deposit rate since the early 2000s, the monetary policy stance has varied substantially, including negative rates. The most pronounced changes occurred in response to major economic shocks, such as the Global Financial Crisis and the COVID-19 pandemic.

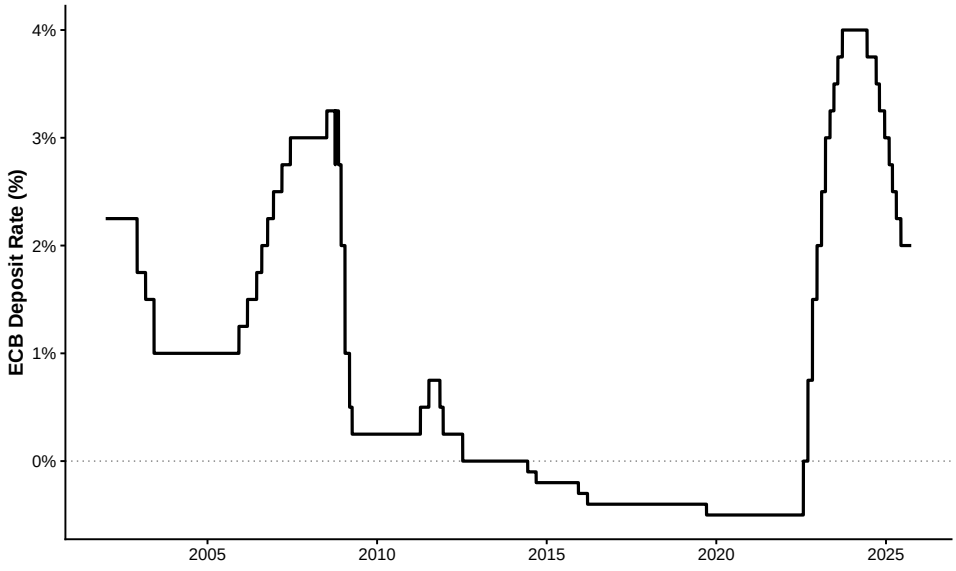

Figure 2: ECB deposit rate (%)

Note: Own depiction. Source: ECB (2026d)

Unexpected changes in monetary policy, referred to as monetary policy shocks, have well-documented effects on the economy. Monetary policy affects macroeconomic outcomes through channels such as interest rates and credit conditions (Mishkin, 1996). Changes in the deposit rate influence borrowing costs and broader macroeconomic activity. For instance, a contractionary monetary policy shock, i.e., an increase in the policy rate, raises borrowing costs, dampening investment and consumption, and slowing economic activity. However, not all shocks identified as monetary policy necessarily reflect the true monetary policy shock. The literature has increasingly focused on disentangling monetary policy shocks from monetary policy information shocks to reveal the true exogenous monetary policy shock (Jarociński, 2022; Jarociński

& Karadi, 2020; Miranda-Agrippino & Ricco, 2021; Nakamura & Steinsson, 2018). Monetary policy information shocks refer to information signalled by the central bank about the state of the economy in its policy announcement.

In numerous studies, researchers have examined the macroeconomic effects of fiscal policy (Afonso & Sousa, 2012; Mountford & Uhlig, 2009; Tenhofen et al., 2010) and monetary policy (Gertler & Karadi, 2015; Jordà, 2005; Romer & Romer, 2004), making significant advances in econometric techniques to investigate the effects of these policies (Altavilla et al., 2019; Blanchard & Perotti, 2002; Nakamura & Steinsson, 2018). However, most of the existing literature studies the effects of fiscal and monetary policy in isolation, even though in practice the two are closely intertwined. Governments issue debt in an environment shaped by monetary policy, and the attractiveness of sovereign bonds depends directly on prevailing interest rates and broader financial market conditions. If government bond yields become relatively unattractive, investors may reallocate their portfolios toward alternative fixed-income assets. Against this background, analysing EGB demand shocks provides a useful lens to capture fluctuations in investor demand for sovereign debt that are not solely driven by fundamentals. Such shocks directly affect sovereign yields and, by extension, the transmission of monetary policy and the financing conditions faced by governments as well as corporations. They may also have broader implications for capital allocation, as sovereign debt issuance can crowd out private borrowing by diverting funds away from corporate debt markets (Becker & Ivashina, 2018; Demirci et al., 2019).

This has become particularly evident in the current context of elevated public debt and ongoing monetary tightening, where shifts in policy rates can quickly affect governments' financing conditions and investor demand. Recent discussions on Eurobonds and EU-level fiscal programmes further highlight the relevance of the potential future intertwinement of fiscal and monetary policies at the European level (Blanchard & Ubide, 2025, 2026; Hildebrand et al., 2026; Lane, 2026). Analysing the two policy areas separately therefore risks missing important interaction effects and may lead to an incomplete understanding of macroeconomic developments. This is especially relevant in the EA, where a single monetary policy under the ECB coexists with national fiscal policies. Furthermore, countries differ in terms of debt levels, economic structure, and economic outlook (Barigozzi et al., 2014), potentially leading to heterogeneous responses across member states.

Taken together, despite the prominent role of fiscal and monetary policy in recent crises, research on their joint macroeconomic effects remains limited, as well as regarding EGB demand shocks. In addition, the disentanglement between true exogenous monetary policy shocks and monetary policy information shocks has not been incorporated into studies of the joint effects, potentially biasing estimated macroeconomic responses. Thus, our research question is:

What are the joint macroeconomic effects of EGB demand shocks and monetary policy shocks?

Under our research question, we develop three hypotheses that guide the empirical analysis. First, we hypothesise that accounting for both EGB demand shocks and monetary policy (information) shocks, the effects of these shocks on the real economy are attenuated compared to a setting with only one type of shock. Second, we hypothesise that, when considering monetary

policy shocks, demand shocks for short-term EGBs have stronger macroeconomic effects than demand shocks for long-term government bonds. Third, we hypothesise that when considering EGB demand shocks, the effects of a true monetary policy shock on macroeconomic variables are larger when monetary policy shocks are disentangled from monetary policy information shocks.

To answer this question, we focus on the three largest EA economies, Germany, France and Italy, over the period from January 2002 to September 2025. To identify EGB demand shocks, we use government securities auction data obtained from national institutions. We estimate country- and maturity-specific ordinary least squares (OLS) regressions of auction weighted prices on the winsorised bid-to-cover ratio, coupon rate, issuance volume, and the volatility index VSTOXX based on the EURO STOXX 50. EGBs are segmented into short-, medium-, and long-term maturities. Furthermore, to isolate exogenous changes in the demand for sovereign debt, the bid-to-cover ratio is modelled as an autoregressive (AR(p)) process. The error term in the AR(p) model, which captures exogenous changes in the demand for EGBs, is multiplied by the estimated sensitivity of prices to bidding conditions from the OLS regression, resulting in an EGB demand shock estimate.

Monetary policy shocks are identified using high-frequency identification (HFI) from the Euro Area Monetary Policy Event-Study Database (EA-MPD) constructed by Altavilla et al. (2019). In addition, we distinguish between monetary policy shocks and monetary policy information shocks to ensure the effect is from the monetary policy shock rather than from signalling the ECB's view of the economy or communication via an information shock.

Using a vector error correction model (VECM), we then examine the effects of these shocks on macroeconomic variables, including household consumption, private investment by households and corporations, industrial production, core inflation, unemployment rate and real gross domestic product (GDP). To check for the robustness of our results, we include foreign EGB demand shocks as controls in a VECM-X model to account for international spillover effects.

For EGB demand shocks, our findings suggest that most of these shocks are not transmitted to the macroeconomy, though the evidence is mostly statistically insignificant. This result holds irrespective of whether monetary policy (information) shocks are included and is robust to controlling for foreign EGB demand shocks, providing limited support for hypotheses 1 and 2. Although international spillovers in EGB demand are present, they are not destabilising domestic macroeconomic conditions, which in itself is an important finding. We find that monetary policy and monetary policy information shocks are sometimes transmitted to the macroeconomy, regardless of whether EGB demand shocks are accounted for, with varying effects across countries. Combined monetary policy and monetary policy information shocks also tend to generate similar response patterns, suggesting that the effects of monetary policy shocks are largely driven by their information component. This provides limited support for hypothesis 1 and no support for hypothesis 3.

Overall, while our findings provide only limited evidence in favour of the proposed hypotheses, they still provide meaningful policy implications. EGB demand shocks are largely weak and

statistically insignificant across the three countries and maturities, implying limited destabilising effects on the EA macroeconomy. However, monetary policy shocks are sometimes transmitted to macroeconomic variables, suggesting that monetary policy functions as a moderately effective macroeconomic stabilisation tool.

The remainder of this thesis is organised as follows. Chapter 2 reviews relevant literature on the effects of fiscal policy shocks, monetary policy shocks, as well as both shocks on macroeconomic variables. Chapter 3 provides a general overview of the institutional and macroeconomic context, and Chapter 4 presents our hypotheses. Chapter 5 describes the data used, including fiscal policy, monetary policy, macroeconomic variables and monetary policy transmission channel variables. Chapter 6 outlines the empirical methodology and utilised models. Chapter 7 presents the results and discusses our findings in relation to the hypotheses. Finally, Chapter 8 discusses the robustness of our findings, policy implications, limitations, validity and future research, and Chapter 9 concludes.

2 Literature Review

Over time, there has been a growing interest in academia to analyse the effects of fiscal policy and monetary policy on the broader economy. However, only a few papers have jointly analysed the effects of both fiscal and monetary policy on the real economy. In this chapter we first review the literature on fiscal policy shocks, followed by the literature on monetary policy shocks, including the distinction between exogenous monetary policy shocks and monetary policy information shocks, before concluding with the limited literature on the joint effects of fiscal and monetary policy shocks.

2.1 Fiscal Policy Shocks

Since very few papers have analysed the macroeconomic effects of changes in the demand for sovereign debt, the subsequent section begins by summarising the research done on fiscal policy shocks in general before focusing on government bond market shocks. The first papers to analyse the macroeconomic effects of fiscal policy shocks differentiated between unexpected increases in government spending and unanticipated changes to the tax regime. Their work built on seminal papers by Blanchard and Perotti (2002), which first applied structural vector autoregression (SVAR) models to identify government spending shocks, and Romer and Romer (2010), who introduced the notion of exogenous tax shocks.

2.1.1 Effects of Fiscal Policy Shocks on Macroeconomic Aggregates

In their seminal paper, Mountford and Uhlig (2009) analyse the effects of three different fiscal policies on the United States (US) economy from 1955 to 2000: a debt-financed increase in government expenditures, higher public spending financed through higher taxes, and an unfunded tax cut raising the sovereign debt level. Both a balanced budget increase and a deficit-financed government spending shock lower output in the long-term and are weakly deflationary (Mountford & Uhlig, 2009). In contrast, a deficit-financed tax cut is deflationary and boosts US GDP (Mountford & Uhlig, 2009). In a follow-up study covering the period from 1981 to 2013, Puonti (2016), accounting for potential cointegration dynamics, also documents that a government spending shock results in a small reduction of US output.

Burriel et al. (2010) extend the rather limited geographical scope of Mountford and Uhlig (2009) by including a synthetic, weighted EA country for the years 1981 to 2007. In contrast to Mountford and Uhlig (2009), Burriel et al. (2010) find that unexpectedly expansionary government budgets result in higher levels of inflation and GDP, but private consumption increases in both Europe and the US. In addition, Burriel et al. (2010) document that the effect on output is more persistent in the US than in the synthetic EA country.

Afonso and Sousa (2012) provide even more cross-country insights compared to Burriel et al. (2010) by analysing the effects of expansionary public budgets on the US, the United Kingdom (UK), Germany and Italy. Afonso and Sousa (2012) observe that government spending shocks result in small increases in output. On the other hand, both inflation and interest rates are higher, except in Germany, where both drop following an expansionary public budget.

Turning to Europe, Tenhofen et al. (2010) focus on the short-term effects of fiscal policy shocks in Germany for the years 1974 to 2008. Tenhofen et al. (2010) refine previous methodologies by decomposing government spending shocks into current (i.e. operating) spending shocks, shocks to the compensation for public employees and public investment shocks. Similar to Afonso and Sousa (2012), Tenhofen et al. (2010) conclude that a government spending shock has a positive effect on the German economy. However, only an operating expense shock significantly boosts GDP, whereas government investment shocks have a weak positive effect only after seven quarters, and shocks to personnel expenditures have no effect on output..

Finally, Cevik and Miryugin (2025) analyse the effects of fiscal policy shocks on inflation across 140 countries for the years 1970 to 2022. Their empirical findings are not statistically significant. Nonetheless, it seems that expansionary public spending increases price levels, but the duration and magnitude of price increases are dependent on the country's initial level of government debt and the business cycle phase.

2.1.2 Effects of Fiscal Policy Shocks on Private Sector Activity

Established by Barro (1974), Ricardian equivalence stipulates that the issuance of (additional) sovereign debt has no effect on aggregate demand in an economy. Instead of increasing their expenditures, rationally behaving households will raise their savings rate and internalise future tax hikes, which are necessary to repay the outstanding debt (Barro, 1974). Even if some researchers subsequently found evidence for household behaviour in line with the Ricardian equivalence principle (Kormendi, 1983), many publications reject this idea (Aschauer, 1985; Bernheim, 1987; Feldstein, 1982).

In their study on the US economy, Mountford and Uhlig (2009) document a crowding-out effect, as both private consumption and non-residential investment decline following a debt-financed government spending shock. On the other hand, a deficit-financed tax cut crowds-in private consumption and investments, contradicting Ricardian equivalence. For an artificially constructed EA, Burriel et al. (2010) also report that private investment is crowded out as a result of larger government budgets, confirming findings by Mountford and Uhlig (2009).

In their cross-country study, Afonso and Sousa (2012) contrast findings by Mountford and Uhlig (2009) and document rising private consumption expenditures and private investment in the US following an expansionary government budget. In Europe, however, Afonso and Sousa (2012) identify significant crowding-out effects in the UK through a decline in corporate investing, in Germany through a drop in both private consumption and investment, and in Italy via reduced household spending and in the long-term lower corporate funding activity.

Finally, Fragetta and Melina (2011) document mixed findings regarding the effects of fiscal policy shocks on private sector activity. In the short term, residential investment is higher, while non-residential investment is lower as a result of a positive shock in government expenditure.

2.1.3 International Spillover Effects of Fiscal Policy Shocks

In times of increasing global trade interdependence and heightened capital mobility, a fiscal policy shock, especially if originating from a major economy, is unlikely to have only national macroeconomic effects, but may instead create at least indirect spillover effects on other countries economies. The magnitude of international spillovers is determined directly by changes in the trade balance and indirectly by a relative price change of domestic products on global markets through the exchange rate and interest rate channels (Ilori et al., 2022). Therefore, academics have examined foreign spillover effects originating from unexpected shifts in US fiscal policy.

From a theoretical perspective, Ilori et al. (2022) rationalise the empirical findings by investigating the spillover effects of US fiscal policy shocks on G7 countries and of German public spending shocks on its European partners. They find that the short-term foreign output response to government spending shocks in the US and Germany is expansionary. Ilori et al. (2022) conclude that the relative size of the country with a fiscal policy shock, its trade openness, the delay in monetary policy response, and the share of government spending on imports are important factors in determining the scale of international spillovers.

2.1.4 High-Frequency Identification of Government Bond Market Shocks

A more recent innovation in fiscal policy shock research is the identification of shocks using high-frequency (i.e. intra-day) government bond futures price data rather than quarterly public accounts data. This methodology was used to assess both the effects of EGB demand shocks (Lengyel & Giuliodori, 2022; Ray et al., 2024) and Treasury supply shocks (Bi et al., 2025; Phillot, 2025).

EGB Demand Shocks

Lengyel and Giuliodori (2022) analyse the effects of unexpected shifts in demand for public debt on sovereign bond yields and equity markets in Germany and Italy. They show that positive demand shocks significantly lower EGB yields. The authors also document substantial cross-market spillovers across EA sovereign bonds, as well as corporate and equity markets. They characterise an increase in demand for German EGBs as flight-to-safety behaviour., leading to falling equity prices and rising credit risk premia. On the other hand, for Italy it signals improved creditworthiness, boosting stock prices and reducing perceived default risk. These effects are stronger during periods of financial stress, highlighting the role of investor perception and market conditions in transmitting EGB demand shocks.

Ray et al. (2024) examine how quantitative easing (QE) affects financial markets. Although QE is not the focus of this thesis, Ray et al. (2024) highlight a relevant investor behaviour: a preference for bonds at specific maturities, known as the preferred habitat channel. The authors show that shifts in demand for bonds at a given maturity mainly affect yields in that same segment of the yield curve, especially when financial markets are under stress. Ray et al. (2024) conclude that QE works partly through this channel, but its overall effects are relatively

modest and depend on market conditions.

Treasury Supply Shocks

Phillot (2025) finds that US Treasury supply shocks put upward pressure on long-term bond yields, resulting in a steepening of the yield curve. Albeit not statistically significant, Phillot (2025) documents a downward trend in equity prices, equity premium and liquidity premium, and an upward trend in stock market volatility, risk premium and inflation expectations. Finally, corporate bond yields rise significantly, resulting in higher borrowing costs for private companies.

In a follow-up paper to Phillot (2025), Bi et al. (2025) refine the methodology and differentiate between shocks to the volume of newly issued US Treasuries and surprise changes to the maturity structure of US public debt. A debt expansion shock puts upward pressure on Treasury yields and term premia, leading to lower corporate investment and weaker business activity. Further, when governments lengthen the maturity profile of their public debt, stock market volatility tends to decrease while stock market prices tend to rise. The excess bond premium falls more sharply for short-term debt than for long-term debt, resulting in lower short-term borrowing costs and thereby benefiting industrial companies. On the other hand, if more short-term debt is issued, equities become more volatile and stock prices tend to decrease. Since the excess bond premium falls more sharply for long-term debt, the volume of business loans increases, benefiting industries alike and boosting economic activity.

2.2 Monetary Policy Shocks

A large body of empirical literature has studied the impact of monetary policy shocks on macroeconomic variables, using a range of different identification strategies, such as narrative approaches (Romer & Romer, 2004), vector autoregression (VAR) analysis (Faust et al., 2004) and local projections (Jordà, 2005). More recent work has questioned whether the traditional strategies capture exogenous monetary policy shocks. One of the main reasons why monetary policy shocks may not be considered exogenous is that the measured monetary policy shock may also include a monetary policy information shock (Jarociński, 2022; Jarociński & Karadi, 2020; Miranda-Agrippino & Ricco, 2021; Nakamura & Steinsson, 2018). Therefore, we divide the literature into two strands: studies that have not disentangled monetary policy shocks and studies that explicitly disentangle true monetary policy shocks from information shocks.

2.2.1 Traditional Monetary Policy Shock Identification

Faust et al. (2004) use federal funds futures to identify monetary policy shocks in a VAR, finding that such shocks lower prices while having an ambiguous effect on industrial production. When following Christiano et al. (1999) recursive identification VAR methodology, Faust et al. (2004) observe that a contractionary monetary policy shock causes the price to increase slightly, then decrease, and industrial production to decrease, with the largest effect occurring approximately 18 months after the shock. These findings align with the results presented by Christiano et al. (1999). However, when employing Faust et al. (2004) own methodology this price puzzle

(prices rise following a contractionary monetary policy shock when in theory they should fall) is removed.

A seminal paper in the literature is by Romer and Romer (2004), who construct a narrative-based measure of US monetary policy shocks that removes the Federal Reserve's systematic response to its own economic forecasts. They report that five months after a contractionary monetary policy shock, industrial production falls and has its largest effect after approximately two years. The authors find that the price level is almost unchanged for the first 22 months after the shock and then falls steadily. Their methodology removes the price puzzle that they otherwise found.

Extending the narrative approach of Romer and Romer (2004) beyond the US, Cloyne and Hürtgen (2016) study the impact of contractionary monetary policy shocks on output and inflation in the UK. They observe a decrease in industrial production, which is only significant between months 9 to 12, with the largest effect after 10 months. Inflation remains relatively constant until 18 months after the shock, when it decreases, having the largest effect after 34 months.

Another seminal paper is by Jordà (2005), who employs local projection methods, an alternative to the well-utilised VARs. They report that in the US, a contractionary monetary policy shock reduces employment, implying an increase in unemployment, and lowers the personal consumption expenditure deflator, a measure of inflation, although the decrease is not statistically significant.

While much of the literature focuses on the US, Barigozzi et al. (2014) examine how ECB monetary policy shocks affect macroeconomic variables across EA countries using a structural dynamic factor model. In response to an ECB contractionary monetary policy shock, they find that consumer price index (CPI) decreases in Germany and France, and the impact is not statistically significant in Italy. Consumption decreases in Germany and Italy, and the impact is not statistically significant in France. The unemployment rate increases in Germany and France and decreases in Italy. GDP and investment decrease in all three countries. However, it should be noted that their analysis is based on quarterly data and the impulse response functions are reported using 68% confidence intervals, which may affect the statistical strength of their results.

Similarly, Ciccarelli et al. (2015) extend their analysis beyond the US to include the EA at an aggregate level rather than country-specific, however this limits the external validity of their study. Ciccarelli et al. (2015) show that a contractionary monetary policy shock leads to a small initial increase in output and prices in the EA, followed by a statistically significant decline in both variables, while output and prices in the US decrease following the shock. Furthermore, the authors demonstrate that when credit channel variables are excluded from the empirical framework, the estimated responses to monetary policy shocks are substantially weakened in both the EA and the US, suggesting that omitting this channel leads to an underestimation of the true effects of monetary policy shocks.

In their seminal paper, Gertler and Karadi (2015) employ an external instrument VAR approach and observe that a contractionary US monetary policy shock leads to a significant decrease in industrial production, with the largest effect approximately 18 months after the shock, and to a non-significant decrease in the CPI. They further show that the credit channel amplifies the magnitude of the economic contraction.

Consistent with these findings, Cesa-Bianchi et al. (2020) state their findings for the UK align with Gertler and Karadi (2015) findings for the US and Cloyne and Hürtgen (2016) findings for the UK. Using a SVAR, Cesa-Bianchi et al. (2020) find that a contractionary monetary policy shock in the UK adversely affects the real economy by increasing unemployment and reducing economic activity, CPI, and bank credit.[1] However, as with Barigozzi et al. (2014), the reported confidence intervals are only 68%.

Finally, a more recent approach is using natural language processing techniques to identify monetary policy shocks. Aruoba and Drechsel (2024) utilise this for the US. Their approach builds on Romer and Romer (2004) by using a broader information set, adding information from the Federal Open Market Committee texts alongside standard forecast variables. Aruoba and Drechsel (2024) find that a contractionary shock increases unemployment and decreases real GDP after a slight increase in the early months after the shock. The GDP deflator, a measure of inflation, increases and then decreases, but the result is not statistically significant.

2.2.2 Disentangling Monetary Policy Shocks and Monetary Policy Information Shocks

In the literature, there have been discussions about whether monetary policy shocks have been correctly identified, or whether it is required to disentangle monetary policy shocks and monetary policy information shocks to reveal the true exogenous monetary policy shocks (Jarociński, 2022; Jarociński & Karadi, 2020; Miranda-Agrippino & Ricco, 2021; Nakamura & Steinsson, 2018). In this context, information shocks arise through information frictions in the economy as the public does not have the same information as the central banks possess. As a result, policy actions may also reveal the central bank's view of the state of the economy. When the central bank raises the interest rate, the public may interpret this as either an unexpected tightening of monetary policy or as a sign that the economy is stronger than they expected. Furthermore, Jarociński and Karadi (2020) discuss how the effects of the two shocks have different and potentially opposing impacts on the economy. Consequently, by not disentangling the shocks, it is likely that the effects of the true monetary policy shock and the information shock are conflated (Miranda-Agrippino & Ricco, 2021). Nakamura and Steinsson (2018) emphasise that this does not imply that monetary policy is ineffective. Even if monetary policy shocks contain an information component, central banks can still influence the economy through the traditional interest rate channel and/or through the information channel.

Utilising a HFI approach, Nakamura and Steinsson (2018) document that in the US, a contrac-

[1] Additionally, Cesa-Bianchi et al. (2020) address the concern that their monetary policy shock may include a monetary policy information shock. They find no statistically significant evidence that their results are biased by central bank information shocks. Monetary policy information shocks are discussed in the next section.

tionary monetary policy shock raises expectations of future output growth, which challenges the conventional interpretation of monetary policy shocks. The authors discuss that this is due to the shock prompting the public to update their beliefs about both future monetary policy and about the state of the economy, with the latter being consistent with an information shock. The authors report that break-even inflation is statistically insignificant until three years after the shock, and then at longer horizons becomes slightly negative and statistically significant. Once the authors allow for information effects, they find that the impact of monetary policy is more difficult to define. Furthermore, they observe strong evidence for both the traditional monetary policy channel and the information effect, showing that the informational content of a monetary shock is important in determining the causal impact.

Extending their analysis to include the EA, Jarociński and Karadi (2020) combine HFI and sign restrictions in their SVAR model to analyse the impact of a contractionary monetary policy shock. Jarociński and Karadi (2020) also find opposing effects on real GDP and the price level when disentangling the true monetary policy shock and the information shock. A monetary policy shock leads to lower output and prices, whereas the opposite effects occur due to an information shock. The authors report this result for both the US and the EA, however these results are small in magnitude and often not statistically significant. Additionally, Jarociński and Karadi (2020) find that the effect of a monetary policy shock on output and the price level are qualitatively similar when comparing a monetary policy shock (which includes the information shock) and a true monetary policy shock (which does not include the information shock) but not quantitatively similar, as the effects are muted when the information shock is not taken into account. These findings for both the US and EA are generally not statistically significant. The authors use this to illustrate how information shocks can reduce the estimated impact of monetary policy.

For the US, Miranda-Agrippino and Ricco (2021) observe that when accounting for the information shock, a contractionary monetary policy shock has a clear and statistically significant contractionary effect, where tight monetary policy lowers real activity and prices. Using a proxy SVAR, they find that a contractionary monetary policy shock decreases industrial production on impact, increases the unemployment rate with a delay and decreases prices more suddenly. Consumption increases on impact and then falls again, although not statistically significant. The authors propose different monetary policy transmission channels aligning with standard channels (Mishkin, 1996), such as the credit channel and asset price channel. As Jarociński and Karadi (2020), Miranda-Agrippino and Ricco (2021) also illustrate that a contractionary monetary policy shock leads to opposing outcomes when disentangling the true monetary policy shock and the information shock. As discussed, industrial production and CPI fall, and the unemployment rate increases in response to a monetary policy shock, whereas the opposite effects occur for the information shock. The authors state that the positive effects of the information shock are due to the public viewing an increase in the interest rate as a sign that the central bank believes the economy will be stronger moving forward.

While much of the literature focuses on country-specific effects, other contributions consider international spillovers, one of which is Jarociński (2022), who studies the impact of ECB and

Fed monetary policy shocks and information shocks. An ECB contractionary monetary policy shock leads to an insignificant effect on US real GDP and the GDP deflator, whereas an ECB information shock leads to US real GDP and the GDP deflator to increase. A Fed contractionary monetary policy shock leads to a slight decrease in EA real GDP and the GDP deflator, a Fed information shock leads to EA real GDP to increase and a statistically insignificant effect on the GDP deflator. This leads Jarociński (2022) to suggest that central bank information shocks are a driver of transatlantic monetary policy spillovers.

Similarly, Pfarrhofer and Stelzer (2025) study the international spillovers of monetary policy and central bank information shocks between the EA and the US. They report that an ECB contractionary monetary policy shock dampens US inflation, and has a statistically insignificant effect on the EA's inflation. The impact on industrial production is insignificant for both the EA and the US. A Federal Reserve contractionary monetary policy shock leads to a decrease in inflation in both areas for a short period of time, a decrease in industrial production in the US and a statistically insignificant effect in the EA. An ECB information shock has an insignificant effect on inflation and industrial production slightly increases in both areas. For an US information shock, price levels rise for a short period in the EA and industrial production increases in the US.

Finally, Altavilla et al. (2025) extend this literature beyond a focus of information shocks occurring during official policy meetings to also include policymakers' communications outside these meetings. Altavilla et al. (2025) extend the EA event study database by Altavilla et al. (2019) to include all speeches given by members of the Executive Board of the ECB since the introduction of the common currency. Altavilla et al. (2025) report that in response to a contractionary monetary policy shock, both industrial production and inflation decrease. However, while policy meetings exert a statistically significant impact on short-term industrial production and medium-term price levels, ECB executives' speeches only affect medium-term inflation and not industrial production. Finally, Altavilla et al. (2025) suggest that failing to account for policy communications outside official meetings results in an underestimation of the economic effects of monetary policy shocks.

2.3 Joint Effects of Fiscal and Monetary Policy Shocks

Analysing the macroeconomic effects of fiscal or monetary policy shocks in isolation is unlikely to accurately capture the impact of either policy. Despite this limitation, only a limited number of studies have examined the joint macroeconomic effects of fiscal and monetary policy shocks.

2.3.1 Effects on Macroeconomic Aggregates

Molteni and Pappa (2017) examine the effects of monetary policy shocks combined with expansionary government spending shocks as well as contractionary tax shocks in the US. Their results show that contractionary monetary policy shocks increase unemployment significantly and persistently, while reducing inflation. Crucially, the impact of monetary policy depends on the fiscal stance: contractionary fiscal policy amplifies, while expansionary fiscal policy dampens, the rise in unemployment and the decline in inflation. The interaction operates through aggreg-

ate demand, with stronger declines in output, consumption, credit, and labour market activity when both policies are contractionary. Similarly, contractionary taxes lead to much sharper increases in unemployment and stronger disinflation. Overall, the findings highlight that the transmission of monetary policy to macroeconomic variables is strongly shaped by fiscal policy conditions.

Rant et al. (2024) analysed the effects of government spending shocks, tax revenue shocks and unexpected monetary policy decisions on GDP and inflation for the EA, instead of its members, limiting the external validity of their study for national policies. As expected, they find that contractionary monetary policy decisions lower both output and price growth in the long term. With respect to fiscal policy, Rant et al. (2024) find that the effect of public expenditure shocks on output is at first negative, then turns positive, and becomes insignificant after a year. Finally, the impact of government spending shocks on inflation is statistically insignificant.

2.3.2 Effects on Macroeconomic Fluctuations

Rossi and Zubairy (2011) study the effects of fiscal and monetary policy shocks on six key macroeconomic variables in the US. They find that monetary policy shocks explain a greater share of macroeconomic variation in the short term (i.e. one year ahead), whereas fiscal policy shocks account for a larger share of fluctuations in the long term (i.e. ten years ahead).

Dery and Serletis (2023) conclude that in the short-term monetary policy shocks have a greater effect on macroeconomic fluctuations in the US than fiscal policy shocks, confirming previous findings documented by Rossi and Zubairy (2011). They find that 26% of GDP variation stems from unexpected monetary policy decisions compared to 20% for government spending shocks. Similar conclusions can be drawn with respect to variations in inflation and consumption. Monetary policy accounts for 38% of fluctuations in price levels and 30% in private consumption compared to fiscal policy decisions, which generate 1% and 4% of variation in inflation and consumption, respectively.

3 Institutional Background and Policy Framework

This chapter provides an overview of the institutional background and policy framework relevant for our analysis, with a focus on government debt issuance and monetary policy in the EA. First, we describe the structure of sovereign bond markets and then we outline the ECB's monetary policy framework, focusing on the timing and communication of the policy decisions.

3.1 Government Debt Issuance and Auction Mechanisms

Fiscal policy in the EA is decentralised and remains the responsibility of individual member states. Thus, Germany, France and Italy independently conduct their own fiscal policies determining taxation, government spending and borrowing decisions to achieve their economic objectives.

Governments finance debt primarily by issuing securities through auctions where investors submit bids. Before each auction, the responsible institution announces characteristics of the issuance, including the issuance volume and the maturity and coupon structure. During the auction, investors submit bids based on their preferences. Importantly, the price and yield of a bond are inversely related. Thus, investors who are willing to pay a high price are also willing to accept a low yield. At the end of the auction, the issued bonds are allotted in a descending order, i.e. investors who submitted the highest bids are the first to receive bonds. Following the auction, results are published, such as the weighted average price, bid-to-cover ratio and yield.

The structure and timing of auctions differ across countries, and debt securities are issued with a range of maturities. For our analysis, we focus exclusively on securities with maturities of 1.5 years or longer. The main reason is that bonds with a maturity of 12 months or less are issued for cash management purposes. Further, the demand for these bonds is significantly driven by money market funds, which, according to European legislation, may not invest in sovereign fixed income securities with a maturity of more than 13 months (Art. 10 para. 1 lit. b of Regulation (EU) 2017/1131). The remainder of this section outlines the characteristics of these securities for the three countries studied.

Germany

Federal Treasury notes (Schatz) are issued with maturities of two years, Federal notes (Bobl) with maturities of five years, and Federal bonds (Bund) with maturities of 7, 10, 15, and 30 years (Bundesrepublik Deutschland Finanzagentur GmbH, n.d.-b). Federal Treasury notes and Federal notes are issued on Tuesdays, and Federal bonds are issued on Wednesdays, with the auction beginning at 8:00 am (Bundesrepublik Deutschland Finanzagentur GmbH, n.d.-a), at irregular frequencies.

France

French government bonds with maturities ranging from 2 to 50 years are issued as fungible medium- and long-term securities known as Obligations assimilables du Trésor (OATs). Before 2013, medium-term securities with maturities of 2 to 5 years were issued as BTANs (fixed-rate

Treasury bills with annual interest), since 2013, OATs include both medium- and long-term securities. Since 2022, auctions for maturities between 2 and 8.5 years have been held on the third Thursday of the month and for maturities of 8.5 years or longer, the auctions are held on the first Thursday; both sets of auctions take place at 10:50 am (Agence France Trésor, n.d.-b).

Italy

Italian Treasury bonds (BTPs) are medium- and long-term securities, with maturities of 18 months and 3, 5, 7, 10, 15, 20, 30 and 50 years. Treasury bond auctions are normally held monthly. For maturities of 3, 7, 15 and 30 years, the auctions are held during the second half of the month. For maturities of 5 and 10 years, the auctions are held during the last week of the month, with the specific maturities issued depending on market demand (Ministero dell'Economia e delle Finanze, n.d.).

3.2 Monetary Policy Framework and Communication

Unlike fiscal policy, monetary policy in the EA is conducted centrally by the ECB. Since its establishment in January 1999, the ECB's main objective has been to maintain price stability, thereby protecting the euro's value and supporting two of the EU's objectives: economic growth and job creation (ECB, 2026i). To achieve this objective, the ECB sets three different key interest rates. The deposit rate is the interest rate that commercial banks receive when they deposit money with the ECB overnight (ECB, 2024a). The marginal lending facility rate is the interest rate applied to overnight borrowing by banks from the ECB (ECB, 2024c). The main refinancing operations rate is the interest rate applied to one-week borrowing by banks from the ECB (ECB, 2024b).

A feature of the ECB's policy framework is how announcements regarding monetary policy decisions occur in two stages. The first stage occurs at 13:45 when a short press release announces the policy decision regarding the three key interest rates without providing any explanation or rationale. The second stage occurs at 14:30 when the ECB president holds a press conference providing an explanation and rationale for the policy decision. The president's explanation lasts for approximately 15 minutes, followed by an approximately 45-minute question-and-answer session with journalists. For a detailed description of the timing, structure and evolution of ECB policy announcements as well as institutional changes over time, see Altavilla et al. (2019).

As discussed by Altavilla et al. (2019), this two-stage structure is useful for identifying and disentangling exogenous monetary policy shocks. Market participants respond not only to the policy decision itself but also to the information signalled by the central bank about the state of the economy in its policy announcement. Furthermore, market participants often interpret this information as signalling the future path of monetary policy. As a result, changes in asset prices around the first stage correspond to a true monetary policy shock, whereas changes around the second stage refer to a monetary policy information shock. Figure 3 provides an overview of the timing of the relevant windows as outlined in Altavilla et al. (2019).

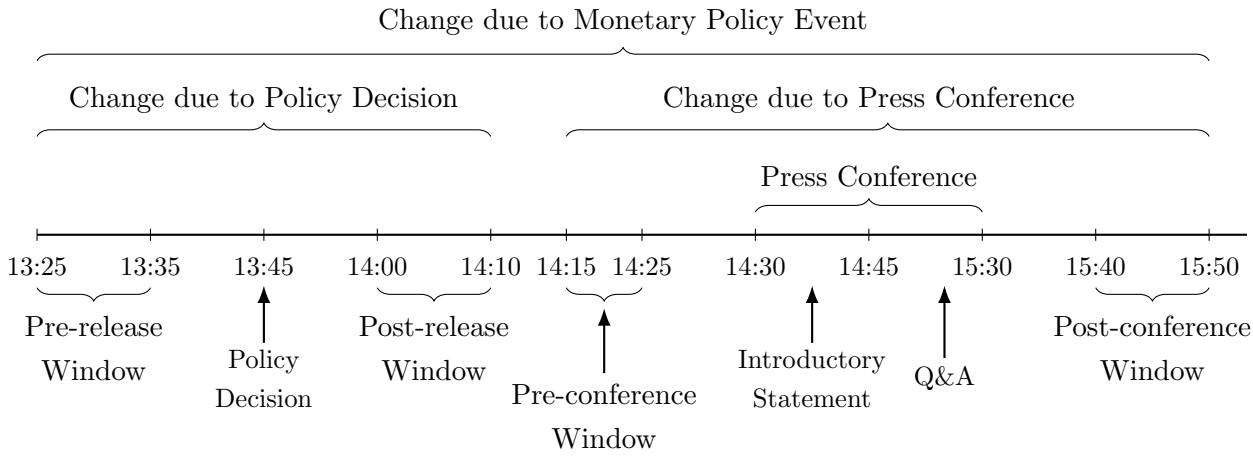

Figure 3: Timeline of a monetary policy event

Note: Figure 3 is our own illustration corresponding to the monetary policy event timeline as outlined in Altavilla et al. (2019).

Section 5.2 outlines how this two-stage structure allows for disentanglement, resulting in identifying the true monetary policy shock and the information shock. The true monetary policy shock is measured over the interval spanning the pre-release to post-release windows, capturing the immediate response to the policy announcement. In contrast, the monetary policy information shock is measured over the pre-conference to post-conference windows, including both the introductory statement and the question-and-answer session.

4 Hypotheses

This chapter presents the three main hypotheses that guide our analysis. The hypotheses are formulated in the same way irrespective of whether they are tested for Germany, France or Italy. Although these countries differ in fiscal policies, macroeconomic conditions and other factors, we assume that the transmission of EGB demand shocks and monetary policy shocks operates similarly for the three largest EA countries.

4.1 Macroeconomic Effects Under a Single Shock vs a Dual-Shock Setting

The existing literature has predominantly analysed the macroeconomic effects of fiscal policy and monetary policy shocks separately, rather than their joint effects. However, governments and central banks operate simultaneously within the economy, jointly impacting economic outcomes and financial conditions. Studies that consider both types of shocks found that analysing them in isolation may lead to biased estimates of their individual effects (Molteni & Pappa, 2017).

Following a government bond auction, an EGB demand shock affects bond yields, which influence both public and private borrowing costs. Similarly, a monetary policy shock changes the policy rate which also affects borrowing costs. As both shocks impact borrowing costs, their effects interact and jointly impact macroeconomic outcomes, such as investment and consumption. For instance, a positive EGB demand shock lowers government bond yields and therefore borrowing costs. A contractionary monetary policy shock increases the policy rate and raises borrowing costs. When these shocks occur simultaneously, their effects may partially offset each other, leading to a reduced overall impact on macroeconomic variables.

Consequently, we expect that when both EGB demand shocks and monetary policy shocks are included in the analysis, the estimated effects of each shock will be attenuated compared to when only one shock is considered.

These arguments motivate the following hypothesis:

Accounting for both EGB demand shocks and monetary policy shocks, the effects of these shocks on the real economy are attenuated compared to a setting with only one type of shock.

4.2 Macroeconomic Effects of Short-Term vs Long-Term EGB Demand Shocks

In a frictionless world, where Ricardian equivalence holds, the maturity structure of government debt is irrelevant and does not affect the real economy. However, once one allows for liquidity premia, market segmentation and financial frictions, this neutrality breaks down. Short- and long-term government securities provide distinct economic services and are priced differently by investors (Greenwood et al., 2015a). The preferred habitat theory stipulates that there are distinct investor clienteles for specific bonds (Boermans et al., 2025; Vayanos & Vila, 2021). Thus, their preferences for bonds of specific maturities are relatively inelastic and investor clienteles are unlikely to substitute.

From the government's perspective, short-term debt is typically cheaper to issue because it

embeds a liquidity premium. Since investors can hold short-term government securities as cash equivalents and earn a return in the form of coupon payments, they value these bonds for their safety and high liquidity, and therefore accept lower yields. On the other hand, governments face greater exposure to refinancing risk, as short-term debt must be rolled over at uncertain future interest rates. By contrast, long-term debt provides governments with insurance against such risks by locking in borrowing costs. However, since investors face duration risk, they demand a higher yield, increasing borrowing costs for governments (Krishnamurthy & Vissing-Jorgensen, 2012).

Critically, these differences imply that demand shocks at different maturities originate from distinct economic forces. Demand for long-term bonds is primarily linked to expectations about future interest rates, inflation and the risk-bearing capacity of duration-sensitive investors, especially institutional investors such as insurance companies or pension funds. In contrast, demand for short-term government securities is driven by fluctuations in the demand for safe and liquid assets, which materialise during periods of financial and/or economic stress. Furthermore, there is evidence from the US that an increase in the supply of short-term Treasuries dampens the issuance of corporate debt and corporate investments (Graham et al., 2014; Greenwood et al., 2015b). Similarly, households that seek to increase the share of safe assets in their portfolio, are likely to reduce their investments and consumption. As a result, industrial production as well as GDP is lower, which results in lower demand for labour, increasing unemployment.

This reasoning leads to the following hypothesis:

When considering monetary policy shocks, demand shocks for short-term EGBs have stronger macroeconomic effects than demand shocks for long-term government bonds.

4.3 Macroeconomic Effects of Monetary Policy (Information) Shocks

As discussed in Section 2.2.2, recent literature has discussed how traditional strategies of identifying monetary policy shocks may fail to identify the true exogenous monetary policy shock. Nakamura and Steinsson (2018), Jarociński and Karadi (2020), Miranda-Agrippino and Ricco (2021), Jarociński (2022) have highlighted that often measures of monetary policy shocks conflate the true monetary policy shock with a monetary policy information shock, and that these two shocks have different effects on macroeconomic variables.

By disentangling the true monetary policy shock from the information shock, we expect our results to differ from those obtained when the two are conflated. Following the literature, as outlined in Section 2.2.2, we expect that the impact of a contractionary monetary policy shock on macroeconomic variables will be contractionary, whereas the impact of an information shock will be expansionary. Furthermore, we expect the true monetary policy shock to have a larger contractionary effect when disentangling the two shocks, as the information shock component, which has been found in the literature to bias estimates towards zero, is removed compared to when the shocks are conflated.

However, the literature has not yet studied this when accounting for EGB demand shocks.

When accounting for EGB demand shocks, we expect these differences to persist, such that our results will still differ in a similar direction from those obtained when monetary policy shocks are not disentangled.

Taken together, these arguments lead to the following hypothesis:

When considering EGB demand shocks, the effects of a true monetary policy shock on macroeconomic variables are larger when monetary policy shocks are disentangled from monetary policy information shocks.

5 Data

This chapter provides an overview of the data used in the empirical analysis. We describe the datasets used to identify EGB demand shocks and monetary policy shocks, as well as the macroeconomic variables and monetary policy transmission channels data. For each dataset, the data source, frequency and description are provided. A complete list of the mnemonics for each dataset can be found in Table 6 in Appendix A.1.

5.1 EGB Demand Data

To identify EGB demand shocks, we compile government bond auction outcomes from Germany, France and Italy, covering the period from January 2002 to September 2025. This sample period is chosen to align with the availability of monetary policy shock data and macroeconomic variables, as discussed in the following subsections.

The data is obtained from the respective national institutions, Finanzagentur – the German Finance Agency (Bundesrepublik Deutschland Finanzagentur GmbH, n.d.-c), Agence France Trésor – the French Debt Agency (Agence France Trésor, n.d.-c), and Banca d'Italia – the Italian Central Bank (Banca d'Italia, n.d.). In line with the auction structure and different maturities discussed in Section 3.1, we include securities with maturities of at least 1.5 years in our analysis. Furthermore, we include data on the auction date, bond maturity, issuance volume, weighted average price, coupon rate and the bid-to-cover ratio. Since France and Italy do not disclose the coupon rate separately, we retrieve it from the bond description using a simple natural language processing algorithm. For Italy, where the bid-to-cover ratio is not published, we also construct the measure manually as the demand for securities divided by the allotment of securities.

Finally, to construct the EGB demand shocks, we also use the VSTOXX volatility index, derived from EURO STOXX 50 option prices (Refinitiv, 2026). This index reflects market expectations of forward volatility (STOXX, 2026b), whereas computing the volatility of a national stock market index based on historical prices would provide information about realised volatility.

5.2 Monetary Policy Data

To identify monetary policy shocks, we utilise the Euro Area Monetary Policy Event-Study Database (EA-MPD) developed by Altavilla et al. (2019). This dataset contains high-frequency intra-day asset price changes. The institutional and policy framework relevant for this is described in Section 3.2 and illustrated in Figure 3. The ECB's two-stage announcement structure and a HFI approach enables the disentanglement between the true exogenous monetary policy shock and the monetary policy information shock. In practice, the monetary policy shocks from the EA-MPD will be used as instruments to identify shocks in the 12-month Euro Interbank Offered Rate (Euribor) rate (Eurostat, 2026c).

To begin constructing their database, Altavilla et al. (2019) clean the data of misquotes. Next,

the data within each event window are discretised by taking the last quote of every minute.[2] By using time windows rather than one specific minute, Altavilla et al. (2019) avoid relying on potentially unrepresentative single quotes. Altavilla et al. (2019) use intra-day changes in overnight index swaps (OIS) on policy announcement days, using changes in the 1-, 3- and 6-month, and 1-, 2-, 5- and 10-year yields.[3]

To identify the monetary policy shocks, Altavilla et al. (2019) estimate latent factors using OIS yield changes. They then rotate these factors so that they are economically interpretable. The press release and press conference windows are analysed separately and therefore have their own latent factors. These latent factors, constructed by Altavilla et al. (2019), are what are used in our analysis.

The EA-MPD contains data since the establishment of the ECB in 1999. However, Altavilla et al. (2019) report that from 1999 to December 2001, the intra-day data for OIS are significantly noisy. Therefore, following Altavilla et al. (2019) and the data availability for some of the macroeconomic variables, the analysis is conducted from the beginning of 2002 to September 2025.

5.3 Macroeconomic Variables and Monetary Policy Channels Data

The data for the macroeconomic variables and monetary policy transmission channels span from January 2002 to September 2025. The starting point aligns with the sample period used by Altavilla et al. (2019) and the end point reflects the most recent available data for some of the variables sourced from Eurostat.

Several variables are reported in real terms, meaning they are adjusted for inflation to reflect real changes in the economy over time in terms of the quantity of goods and services rather than changes in prices. Additionally, some of the data are seasonally and/or calendar adjusted when available. This ensures that regular seasonal patterns, such as increased consumption during holiday periods or lower production in certain months, as well as calendar effects, such as variations in the number of working days or differences in the timing of holidays across periods, do not distort the analysis.

[2]Pre- and post-event quotes are then measured using median quotes over short intervals: 13:25–13:35 for the pre–press release quote and 14:00–14:10 for the post–press release quote. The median price in the 14:15–14:25 interval is used as the pre-conference quote, and the median in 15:40–15:50 serves as the post-conference quote. The timeline is shown in Figure 3.

[3]Intra-day OIS data for maturities of more than 2 years are not available before August 2011. Thus, Altavilla et al. (2019) use yields on German sovereign yields as a proxy. They found no significant difference from using the German yields.

5.3.1 Macroeconomic Variables Data

An overview of the macroeconomic variables, including their frequency, units, adjustments and data sources, is provided in Table 1. The evolution of the macroeconomic variables over time is illustrated in Figure 4. All variables exhibit pronounced fluctuations around major economic shocks, particularly following the Global Financial Crisis and the COVID-19 pandemic. Over the sample period, household consumption and real GDP have tended to increase, whereas private investment appears more volatile. A notable feature is the significant volatility in industrial production around 2020, where all three countries experienced a sharp decline followed by a rapid rebound, reflecting the disruptions caused by the COVID-19 pandemic. Excluding the most recent years, inflation has remained below 4% for all three countries. The unemployment rate has steadily declined in Germany, whereas France and Italy have had more persistent rates. While the three countries exhibit similar trends, there remains heterogeneity both in levels and in the dynamics of certain variables.

Variable	**Frequency**	**Units**	**Adjustment**	**Description**	**Source**
Household Consumption	Quarterly	Chain linked volumes (2015), € millions	Seasonally and calendar	Household and Non-Profit Institutions Serving Households (NPISH) final consumption expenditure	Eurostat (2026a)
Private Investment	Quarterly	Current prices, € millions. Deflated using price index € (2015=100)	Seasonally and calendar	Gross fixed capital formation for the non-financial corporations sector and for Household and Non-Profit Institutions Serving Households (NPISH). Direction of flow is recorded as paid	Investment Data: Eurostat (2026d) Deflator Data: Eurostat (2026a)

Variable	Frequency	Units	Adjustment	Description	Source
Industrial Production	Monthly	Percent	Seasonally and calendar	Production from the industrial sectors, mining and quarrying, manufacturing, electricity, gas, steam and air conditioning supply[4]	Eurostat (2026e)
Core Inflation	Monthly	Percent	N/A	Measured as Headline Inflation, excluding energy, food, alcohol and tobacco[5]	ECB (2026f, 2026g, 2026h)
Unemployment Rate	Monthly	Percent	Seasonally	Unemployment rate for those aged 15–74 years old	Eurostat (2026g)
Real GDP	Quarterly	Chain linked volumes (2015), € millions	Seasonally and calendar	Total value of final goods and services produced within the economy	Eurostat (2026a)

Table 1: Description of the macroeconomic variables data

[4]Industrial production is included as well as real GDP, as industrial production is measured at a higher frequency making it a key short-term indicator used to detect early turning points and provide insight into GDP developments in the future (Eurostat, 2025; Mankiw, 2016)

[5]We opted to analyse core inflation, which excludes energy, food, alcohol and tobacco, instead of headline inflation. These components are typically more volatile and can disproportionately influence headline inflation, therefore, by excluding them, core inflation provides a more stable indicator of inflation trends (Eurostat, 2026b; Mankiw, 2016). Furthermore, including energy price level changes in our analysis would have required including an energy price channel such as oil, gas or electricity prices. This would increase the dimensions of the VECM, and a model with more than eleven variables would not have been feasible.

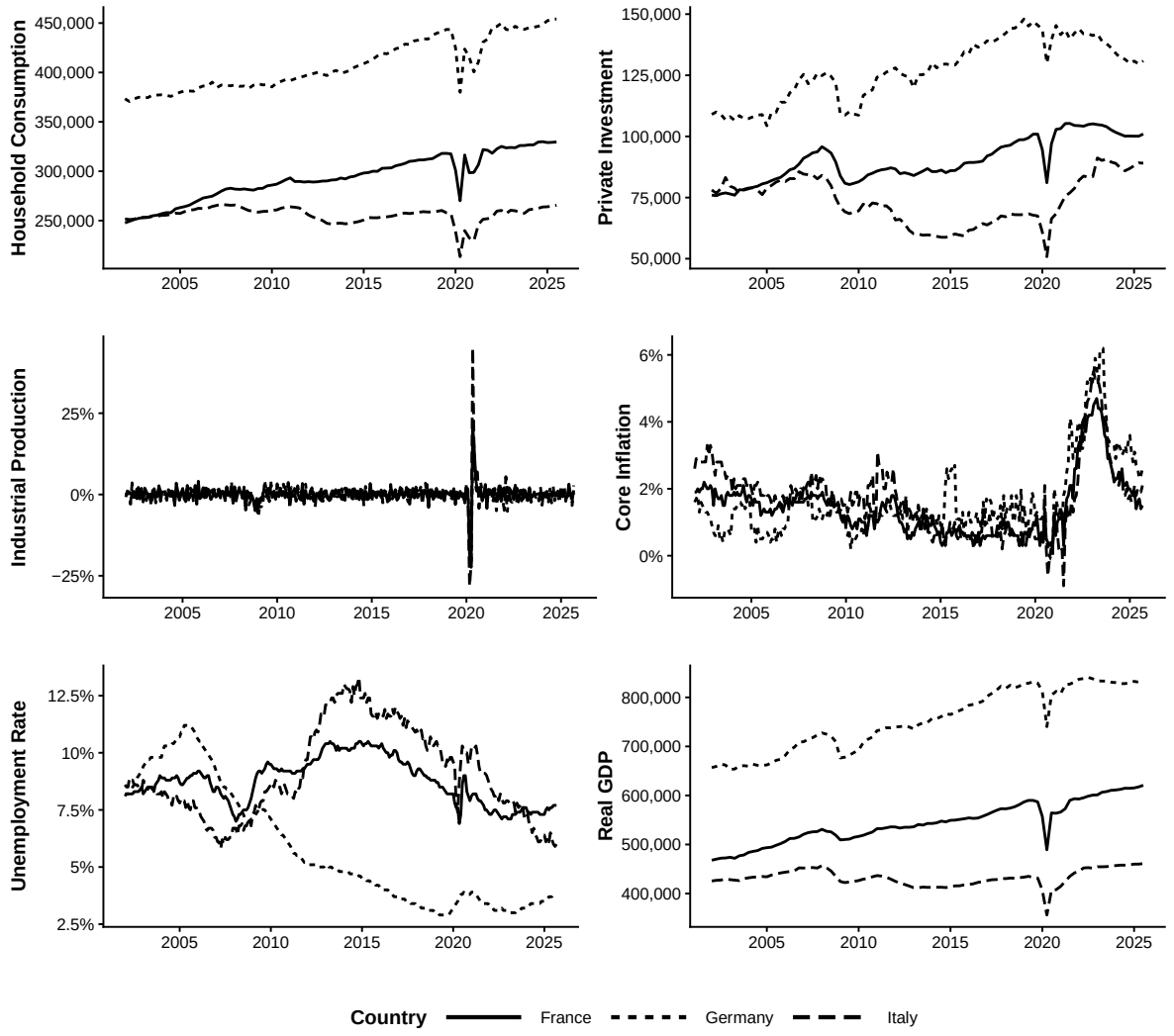

Figure 4: Evolution of macroeconomic variables

Note: Own depiction. Household consumption, private investment and real GDP are measured in millions of euros. Industrial production, core inflation and unemployment are measured in percent. Source: See Table 1.

5.3.2 Monetary Policy Transmission Channels Data

An overview of the monetary policy transmission channel data is provided in Table 2. In line with the literature, including Disyatat and Vongsinsirikul (2003), Li et al. (2021) and Mishkin (1995, 1996), we consider three primary channels — asset prices, credit costs, and exchange rates — that play a central role in transmitting monetary policy shocks to the real economy.

Channel	**Frequency**	**Units**	**Description**	**Source**
Asset Price	Daily	Price	Proxied by each national stock market index: DAX, CAC, and FTSE MIB	S&P Global (2026a, 2026b, 2026c)
Credit Cost	Monthly	Percent	Proxied by bank interest rates on new loans to non-financial corporations	ECB (2026a, 2026b, 2026c)
Exchange Rate	Monthly	Indexed (1999 Q1=100)	Proxied by the euro Real Effective Exchange Rate (REER) for a group of 40 trading partners[6]	ECB (2026e)

Table 2: Description of the monetary policy transmission channel data

[6]Rather than relying on a bilateral exchange rate, such as the EUR/USD, we employ the REER, which measures the value of the euro against a basket of forty currencies weighted by trade shares. Compared to a bilateral rate, one of the main advantages is the reduction in exposure to the appreciation and/or depreciation of a foreign currency. Thus, the REER provides a more accurate representation of the valuation of the euro.

6 Methodology

This chapter presents the empirical strategy used to identify and quantify the effects of EGB demand and monetary policy shocks. Before presenting the methodology used in this thesis, it first outlines the factors preventing an analysis of EGB supply shocks in European countries. Next, it describes the construction of the EGB demand shock measures and the identification of monetary policy (information) shocks. It then explains the procedures used to harmonise data across frequencies and outlines the baseline model specification. Finally, alternative specifications and robustness checks are presented to assess the stability and reliability of the results.

6.1 Replication Constraints for EGB Supply Shock Identification

The first papers to analyse the macroeconomic effects of fiscal policy shocks used a narrative-based identification strategy (Romer & Romer, 2010) or temporal restrictions between fiscal policy and macroeconomic variables (Blanchard & Perotti, 2002). However, the goal of this thesis is not to assess the impact of certain policies, but to investigate the macroeconomic outcomes of debt issuance in general. Recently, researchers have therefore relied on a high-frequency approach to identify Treasury supply shocks (Bi et al., 2025; Phillot, 2025). More specifically, researchers focusing on the US Treasury market compute the price difference in Treasury futures between the start and the end of government bond auctions to identify Treasury supply shocks (Bi et al., 2025; Phillot, 2025). The main advantage of using intra-day Treasury futures price data of front-month contracts, instead of Treasury price data itself, is that coupon payments do not distort prices (Phillot, 2025). We aimed at replicating this methodology using daily price data but were unable to accurately identify Treasury supply shocks. In contrast to monetary policy shocks, for which comparative analyses using intra-day and daily data show no substantial distortions (An et al., 2025), daily data introduces excessive noise and therefore prevents the reliable identification of fiscal policy shocks.

In addition, significant differences in the auction process between European countries and the US challenge the underlying assumptions of these high-frequency identification strategies for Europe. In Germany and Italy, the auction calendar detailing the issuance dates, volume and maturity is published in December of the previous year (Bundesrepublik Deutschland Finanzagentur GmbH, n.d.-a; Ministero dell'Economia e delle Finanze, 2025), and similarly, in France, the yearly auction calendar for the full year is published in advance (Agence France Trésor, n.d.-a). As a result, investors have sufficient foresight and it can be questioned whether a potential EGB supply shock can even emerge. In contrast, the US publishes an auction calendar for the upcoming 6 months, which only discloses the security type (and thus its original maturity), the announcement date, auction date and settlement date. The volume that will be auctioned is only announced a few business days prior to the opening of the bidding. However, certain essential price-relevant information such as the coupon rate is still not published in the Treasury offering announcement (U.S. Department of the Treasury, 2026). Consequently, investors in the US lack complete foresight and, unlike in Europe, Treasury supply shocks may arise. Thus, we will focus on analysing the macroeconomic effects of monetary policy shocks and EGB demand

shocks, instead of EGB supply shocks.

6.2 Construction of EGB Demand Shocks

6.2.1 Set of EGBs Considered

Government bonds are issued in different forms. Most EGBs are auctioned, either as a single security or together with other bonds during the same auction day, while some are distributed to a syndicate of institutional investors responsible for distributing them on the secondary market. Governments may also issue obligations for cash management purposes. To accurately identify EGB demand shocks, we focus only on bonds that were auctioned and exclude syndications as well as issuances for cash management purposes, thereby ensuring that the auction results reflect investors' true demand for government bonds based on their bidding behaviour.

6.2.2 The Bid-to-Cover Ratio as a Measure of EGB Demand

The bid-to-cover ratio is defined as the total value of bids submitted divided by the amount of securities offered. A higher ratio signals stronger demand, as it implies that the auction attracted bids far exceeding the supply of securities, whereas a lower ratio suggests comparatively weaker interest. For example, a bid volume four times larger than the volume of bonds auctioned translates into a bid-to-cover ratio of 4. Baseline levels of demand can vary depending on market conditions and instrument type (Beetsma et al., 2018, 2020). While the bid-to-cover ratio alone does not determine auction outcomes or yields, it signals market appetite. More specifically, when investors expect poor equity market performance or macroeconomic turbulence, they may bid more aggressively in upcoming EGB auctions to obtain these securities as protection against downside risks, resulting in higher bid-to-cover ratios. However, the reported bid-to-cover ratios are not suited to identify EGB demand shocks. While auction days with bid-to-cover ratios above and below a specific threshold could be labelled as issuances with a very high or low demand, respectively, it would not provide a reliable proxy for EGB demand. First, the resulting EGB demand shock measure would be an indicator (1 if the bid-to-cover ratio is above the threshold, 0 otherwise), resulting in a significant loss of information. Furthermore, such an identification strategy would be prone to misspecification, as it disregards, for example, broader dynamics in equity markets. Therefore, using the bid-to-cover ratio alone as a measure of EGB demand shocks would result in biased estimates. However, using the bid-to-cover ratio together with other variables to construct EGB demand shocks will provide an accurate measure. The methodology used to identify EGB demand shocks is explained in the following sections.

6.2.3 Winsorisation

To prevent a distortion of our results by extreme bidding behaviour exhibited on some auctions, we winsorise the bid-to-cover ratio at the one percent threshold – a standard procedure in the literature in this field (Gorodnichenko & Ray, 2017). In practice, we winsorise the bid-to-cover ratio by setting values below the 1% quantile to the 1% quantile and values above the 99% quantile to the 99% quantile. Since the correlation between fixed income securities and equities is very low and can even be negative over certain periods (Molenaar et al., 2024), diversifying

a portfolio through investments in government bonds can provide effective protection against downside risks. Thus, investors may bid more or less aggressively on EGB auctions depending on their expectations of future equity returns. Consequently, the reported bid-to-cover ratios may differ substantially between periods of heightened stock market volatility compared to periods with low stock market volatility. The modelling of EGB demand shocks will account for these potential investment fund reallocation dynamics.

A potential issue arising from winsorisation is a systematic distortion of the bid-to-cover ratios used for the identification of EGB demand shocks. More specifically, if only auctions in a specific year, or auctions of a specific maturity type were winsorised, the constructed EGB demand shock coefficients would be biased if the model does not account for the systematic correlation. For example, government bond auctions scheduled during sovereign debt crises might exhibit significantly lower bid-to-cover ratios. Therefore, auctions with winsorised bid-to-cover ratios are examined more closely. As reported in Tables 7, 8 and 9 in Appendix A.2, no systematic correlation between winsorised bid-to-cover ratios and structural characteristics can be established. In addition, the total number of winsorised bid-to-cover ratios is small compared to the total number of EGB auctions. We are thus confident that the winsorisation will not distort our results.

6.2.4 Model

The goal is to construct an instrument which allows for the clear identification of unexpected changes in EGB demand that materialise during auctions. In theory, bonds are issued at a value of 100 euros per bond given the proposed coupon. However, several factors may motivate investors to bid more or less aggressively, which results in a weighted price across all allotted bids that is lower or higher than 100 euros per bond. We therefore identify these drivers and regress the weighted price on them in an OLS regression. To identify EGB demand shocks, we first regress the weighted price on the winsorised bid-to-cover ratio, the coupon rate and the volume of government bonds auctioned for each subgroup of government bonds issued in each country separately. The EGBs are grouped into three categories, as investors' bidding behaviour differs significantly between the different EGB subgroups (Beetsma et al., 2018, 2020). As only Germany differentiates its bonds between the different maturities (see Section 3.1), the subsequent classification follows Germany's framework to ensure cross-country comparability.

- Short-term EGBs with an original maturity between 1.5 and 2.4 years.
- Medium-term EGBs with an original maturity between 2.5 and 5.4 years.
- Long-term EGBs with an original maturity of more than 5.5 years.

To account for changes in investors' bidding behaviour due to volatility in equity markets, we also include the volatility index of the EURO STOXX 50, VSTOXX. The EURO STOXX 50 comprises the fifty largest companies in the eurozone based on their free-float market capitalisation. However, to limit the concentration risk, the benchmark index provider limits the weight of any company in the EURO STOXX 50 to a maximum of 10% (STOXX, 2026a). From a

modelling perspective, the volatility indexes of national stock market indices would have been optimal. However, the volatility index for the French CAC was discontinued in 2021 (Euronext, 2026). Nonetheless, the VSTOXX represents a suitable alternative and ensures consistent modelling across the different countries.

The subsequent Equation (1) is used to estimate the price sensitivity to EGB demand on auction days.

$$\begin{aligned}\text{Weighted Price}_t^{c,m} = \beta_0^{c,m} + \beta_1^{c,m}\text{Win. BtC}_t^{c,m} + \beta_2^{c,m}\text{Coupon}_t^{c,m} \\ + \beta_3^{c,m}\text{Volume}_t^{c,m} + \beta_4\text{VSTOXX50}_t + u_t^{c,m}\end{aligned} \tag{1}$$

$\beta_1^{c,m}$ from the OLS regression in (1) constitutes the price impact coefficient on EGB auction days. In other words, it measures how much the price changes following a one-unit increase in the bid-to-cover ratio. Regression (1) is performed separately for each country c and maturity subgroup m, that is, for each (c, m) combination.

Furthermore, to identify the exogenous changes in EGB demand that are captured by $\varepsilon_t^{c,m}$, we model the bid-to-cover ratio using an AR(p) model as shown in Equation (2).

$$\text{Win. BtC}_t^{c,m} = c + \sum_{i=1}^{p} \phi_i \text{Win. BtC}_{t-i}^{c,m} + \varepsilon_t^{c,m} \tag{2}$$

Again, the AR(p) model in (2) is estimated separately for each (c, m) combination. $\varepsilon_t^{c,m}$ captures unexpected auction-specific changes in investor demand. The optimal number of lags is chosen based on the Bayesian information criterion (BIC). If the Ljung-Box test rejects the number of lags suggested by the BIC, the Akaike information criterion (AIC) determines the optimal number of lags.

Next, we compute the changes in maturity-specific EGB demand by multiplying the fitted $\beta_1^{c,m}$ coefficient from Equation (1) with the residuals from the AR(p) model in Equation (2). As a result, we obtain the unexpected auction-specific changes in EGB demand, i.e. $\beta_1^{c,m} \cdot \varepsilon_t^{c,m}$. This is different from aggregate demand for European sovereign bonds. The model specification in Equation (1) allows us to discern unexpected changes in EGB demand from changes in demand for government debt driven by risk shocks in equity markets, whereas the AR(p) model specified in Equation (2) enables the disentanglement of unexpected changes in EGB demand from changes in EGB demand driven by strategic bidding from investors.

6.2.5 Aggregation on a Monthly Basis

Since there may be more than one bond auction per month, the EGB auction data are more granular than our macroeconomic variables, which are available on a monthly or quarterly basis. Therefore, we sum the unexpected auction-specific changes in sovereign debt demand coefficients per month to get the total EGB demand shock in a month, e.g. Tot EGBDS_t. In months with only a single auction, the sum equals the coefficient of that auction, whereas in

months without any auction, no EGB demand shock can occur and Tot $\text{EGBDS}_t = 0$. Since differences in auction volumes may bias our results, we perform a volume-weighted sum instead of an unweighted sum, i.e.:

$$\text{Tot EGBDS}_t = \frac{\sum_{i \in \mathcal{A}_t} (\beta_1^{c,m} \cdot \varepsilon_t^{c,m} \cdot \text{Volume}_{i,t})}{\sum_{i \in \mathcal{A}_t} \text{Volume}_{i,t}}, \mathcal{A}_t = \{i : \text{auction } i \text{ occurs in month } t\}. \quad (3)$$

Given the regular issuance of EGBs (see Section 3.1), the number of auctions per month is unlikely to introduce a bias. Finally, to compare EGB demand shocks across maturities and countries, we standardise the coefficients using the z-score method with mean zero and standard deviation of one. Thus, every impulse response function (IRF) of an EGB demand shock illustrates the effects of a one-standard-deviation increase in the bid-to-cover ratio.

6.3 Construction of Monetary Policy Shocks

Numerous methods exist to identify monetary policy (information) shocks (Altavilla et al., 2019, 2025; Gertler & Karadi, 2015; Gürkaynak et al., 2005; Kuttner, 2001; Nakamura & Steinsson, 2018). We opted for the methodology of Altavilla et al. (2019), as they compiled the EA-MPD. Since the data on the monetary policy shocks is regularly updated by one of the researchers of Altavilla et al. (2019), we used the most recent version provided (Ragusa, 2026a, 2026b). We tested the implementation of the methodology developed by Gertler and Karadi (2015) but found that the monetary policy (information) shocks displayed weak instrument strength based on the F-statistics. Furthermore, it is worth noting that the different monetary policy shock identification methods seem to produce heterogeneous results with respect to the effects of monetary policy shocks (Brennan et al., 2024).

Unlike Altavilla et al. (2019), who compute the effects of the different latent factors of monetary policy shocks individually, we identify the macroeconomic effects of combined monetary policy shocks and monetary policy information shocks. Consequently, we sum all four components identified by Altavilla et al. (2019), i.e. Target, Timing, Forward Guidance, and Quantitative Easing to get a combined monetary policy shock parameter, as well as all three monetary policy information components, i.e. Timing, Forward Guidance and Quantitative Easing, resulting in a measure of monetary policy information shocks. The goal of this thesis is not to identify the macroeconomic effects of the different latent components of monetary policy shocks. Due to the methodology employed by Altavilla et al. (2019) to construct the shocks, the aggregation of the different factor loadings is unlikely to distort the results. To accurately capture the macroeconomic effects of monetary policy information shocks, the 12-month Euribor rate is used as the policy instrument, rather than the 1-, 3-, or 6-month rates, since the information communicated during the ECB's press conferences is intended to provide guidance on the ECB's policy path over the coming quarters rather than months. We rescaled the monetary policy shocks to represent the effects of an increase in the 12-month Euribor rate by 1 percentage point, e.g. 100 basis points.

6.4 Data Frequency Harmonisation

Due to the frequency misalignment between the different data series employed for this analysis, interpolation techniques were applied. Alternatively, a mixed-frequency vector autoregression (MF-VAR) model, which allows the use of data of different frequencies, could have been used, but such models are prone to over-parameterisation (Foroni & Marcellino, 2016; Götz et al., 2016; Kuzin et al., 2011). Since only core inflation, unemployment rate and industrial production data are published on a monthly basis, the quarterly variables, all of which are GDP components, must be interpolated. The interpolation was performed using a Denton algorithm (Denton, 1971). It is crucial that the interpolation does not result in higher levels, i.e. that the sum of three months of interpolated data is not larger than the original quarterly data that was used for the interpolation. The Denton methodology ensures that the resulting monthly series aggregates to the original quarterly data while preserving short-term dynamics, unlike a uniform distribution method. On the other hand, in contrast to the Chow-Lin (Chow & Lin, 1971), Fernández (Fernández, 1981) or Litterman (Litterman, 1983) approaches, which are regression-based methods, the Denton technique is not sensitive to model misspecification and issues with small samples.

6.5 Baseline Model

For a multivariate setting, two families of models may be employed: a VAR for stationary variables that satisfy the required unit-root conditions and a VECM for non-stationary variables. A VECM describes the joint dynamics of a set of non-stationary variables that share a long-run equilibrium relationship, while allowing for short-run deviations from that equilibrium. Alternatively, a set of non-stationary parameters may be transformed to be stationary by first-differencing and then used as inputs to a VAR at the expense of losing long-run cointegration dynamics. As a result, the resulting system would nevertheless be misspecified, as it does not account for cointegration dynamics (Enders, 2015). We therefore verify whether the variables are stationary on their own. The unit-root properties of the variables are verified using Augmented Dickey–Fuller (ADF), Phillips–Perron (PP), and Kwiatkowski–Phillips–Schmidt–Shin (KPSS) tests. The results are reported in Appendix A.3.1.

EGB demand shocks and monetary policy shocks could be identified as structural shocks in a Structural VECM by imposing identifying restrictions on the contemporaneous impact matrix and/or the long-run impact matrix, provided that a variable exists that would clearly capture the respective shocks. However, since no parameters allow for a clean identification of true monetary policy shocks or true EGB demand shocks, an instrument-based identification strategy is used. More specifically, policy instruments are employed to isolate the surprise component of the movement in these policy indicators that is purely due to a monetary policy or EGB demand shock. The policy instruments used in this setting are the 12-month Euribor rate and the bid-to-cover ratio, respectively.

Hereinafter, the empirical strategy will be outlined. First, we estimate a co-integrated system comprised of 11 variables. These variables are the 12-month Euribor rate, the bid-to-cover ratio, the average price of the national stock market index, interest rates on new business loans, the

real effective exchange rate, the natural logarithm of household consumption expenditures, the natural logarithm of private investment, industrial production, core inflation, the unemployment rate, and the natural logarithm of real GDP.

The subsequent model specification in (4) details the VECM used in the empirical analysis.

$$\Delta \mathbf{y}_t = \boldsymbol{\alpha} \left(\boldsymbol{\beta}' \mathbf{y}_{t-1} + \boldsymbol{\rho} t \right) + \sum_{i=1}^{p-1} \boldsymbol{\Gamma}_i \Delta \mathbf{y}_{t-i} + \boldsymbol{u}_t \quad ; \quad \boldsymbol{u}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Sigma}_u) \tag{4}$$

In Equation (4), the dependent variable $\Delta \mathbf{y}_t$ represents the short-run changes in the 11 variables of interest. These changes are decomposed into three main components. First, the term $(\boldsymbol{\alpha}\boldsymbol{\beta}'\mathbf{y}_{t-1} + \boldsymbol{\rho} t)$ captures the long-run equilibrium relationship. The expression inside the parentheses is the error correction term, which measures the extent to which the system deviates from its long-run equilibrium in the previous period. $\boldsymbol{\beta}$ defines the cointegrating relationships, while $\boldsymbol{\rho} t$ allows for a deterministic trend. The coefficients in $\boldsymbol{\alpha}$ represent the speed of adjustment, indicating how strongly each variable responds to deviations from equilibrium. Next, $\sum_{i=1}^{p-1} \boldsymbol{\Gamma}_i \Delta \mathbf{y}_{t-i}$ captures the short-run dynamics. It reflects how past changes in the variables affect current changes, independently of the long-run relationship. Finally, $\boldsymbol{u}_t$ is a vector of error terms with zero mean and covariance matrix $\boldsymbol{\Sigma}_u$.

The cointegration rank r is defined by the Johansen Trace test, whereas the number of lags p is determined using the Hannan–Quinn information criterion (HQIC). In this model, $\boldsymbol{\alpha}$ is the adjustment/loading matrix of dimension $11 \times r$ and $\boldsymbol{\beta}$ is the cointegration matrix of dimension $11 \times r$. Within a standard New Keynesian (NK) framework, the equilibrium dynamics are characterised by fluctuations around a well-defined steady state, with nominal rigidities and forward-looking behaviour of agents governing short- and medium-term adjustments. Monetary policy is typically represented by a systematic interest-rate rule subject to exogenous shocks that follow stationary, mean-reverting processes. As a result, monetary policy decisions generate temporary fluctuations in output and inflation but are neutral in the long run, leaving the steady-state allocation unaffected (Casares, 2007; Smets & Wouters, 2003). Furthermore, antecedent research has found EGB demand shocks to be temporary (Lengyel & Giuliodori, 2022). Given the transitory nature of both monetary policy and EGB demand shocks, long-run restrictions are imposed such that $\boldsymbol{\alpha}'_{\perp}\mathbf{b} = \mathbf{0}$, ensuring that $\boldsymbol{b}$ captures only transitory (mean-reverting) dynamics and has no impact on the long-run stochastic trends of the system.

Next, impulse responses are computed based on the reduced-form residuals $\boldsymbol{u}_t$. The goal is to determine the contemporaneous impact matrix $\mathbf{B}$, which links the reduced-form residuals to the structural shocks $\boldsymbol{\varepsilon}_t$, such that $\boldsymbol{u}_t = \mathbf{B}\,\boldsymbol{\varepsilon}_t$. The impact vectors are normalised with respect to each policy variable. The identification is achieved with proxies, which must be $I(0)$, i.e., stationary, to ensure an accurate identification. In intuitive terms, this approach uses external information (proxies) to disentangle the observed residuals into economically meaningful shocks. This allows the impulse responses to be interpreted as the causal effect of a specific policy shock rather than a mixture of different shocks in other variables. Again, the unit-root properties of the instruments are verified using ADF, PP, and KPSS tests. The results are reported in

Appendix A.3.2.

In addition, the instruments must respect the following two conditions:

- Relevance: The instrument is highly correlated with the policy variable (residuals), i.e.:
  - the EGB demand shock proxy is highly correlated with the respective country- and maturity-specific bid-to-cover ratio,
  - the monetary policy shock proxy is highly correlated with the residuals of the 12-month Euribor rate.
- Exogeneity: The EGB demand shock proxy and monetary policy shock proxy are exogenous/orthogonal to any other shock.

The relevance condition is verified using heteroscedastic-robust, Newey-West F-test statistics, which are reported in Table 19 in the Appendix A.5. On the other hand, the exogeneity condition cannot be confirmed with statistical tests, and therefore remains an assumption (Kilian & Lütkepohl, 2017). Nonetheless, it should be noted that the methodology employed by Altavilla et al. (2019) for their latent factor model forces the factor loadings to be orthogonal to each other due to their model specification. In addition, we note that the EGB demand shocks and monetary policy (information) shocks are only weakly correlated, as subsequently reported in Table 3. Thus, except for medium-term EGB demand shocks in Italy, our instruments are bilaterally exogenous and consequently our EGB demand shocks are not contaminated by monetary policy shocks, and vice-versa.

	Combined Monetary Policy Shock	Monetary Policy Information Shock
Germany		
Short-term EGB demand shock	-0.0378	-0.0413
Medium-term EGB demand shock	0.0023	-0.0308
Long-term EGB demand shock	-0.0289	-0.0904
France		
Short-term EGB demand shock	0.0039	-0.0270
Medium-term EGB demand shock	-0.0599	-0.0512
Long-term EGB demand shock	-0.0035	-0.0451
Italy		
Short-term EGB demand shock	-0.0217	-0.0084
Medium-term EGB demand shock	0.1210	0.0999
Long-term EGB demand shock	0.0081	0.0017

Table 3: Correlations between EGB demand shocks and monetary policy (information) shocks

6.6 Single Shock Model Specification

The first hypothesis is that accounting for both EGB demand shocks and monetary policy shocks, the effects of these shocks on the real economy are attenuated compared to a setting with only one type of shock. To verify this, we restrict the baseline model by including only one of the two shocks and policy variables. Thus, instead of 11 variables, only 10 are included. If

we only consider EGB demand shocks, the 12-month Euribor rate is removed from the baseline VECM, and if we only consider monetary policy (information) shocks, the bid-to-cover ratio is removed from the baseline model.

6.7 Robustness Checks with an Extended Model

Previous research has documented international spillover effects in EGB demand arising on auction dates (Beetsma et al., 2018, 2020; Lengyel & Giuliodori, 2022). To explicitly account for such cross-border transmission channels, we augment the baseline VECM with weakly exogenous foreign auction shocks, yielding a VECM-X specification. $\boldsymbol{x}_t$ is a vector collecting exogenous foreign EGB demand shocks constructed from foreign EGB auction data. The resulting VECM-X specification can be written as

$$\Delta \mathbf{y}_t = \boldsymbol{\alpha}\big(\boldsymbol{\beta}'\mathbf{y}_{t-1} + \boldsymbol{\rho}\, t\big) + \sum_{i=1}^{p-1} \boldsymbol{\Gamma}_i \Delta \mathbf{y}_{t-i} + \boldsymbol{\Psi}\boldsymbol{x}_t + \boldsymbol{u}_t, \quad \boldsymbol{u}_t \sim \mathcal{N}(\mathbf{0}, \boldsymbol{\Sigma}_u) \tag{5}$$

where $\boldsymbol{\Pi} = \boldsymbol{\alpha}\boldsymbol{\beta}'$ captures the long-run equilibrium relationships, $\boldsymbol{\Gamma}_i$ are short-run adjustment matrices, and $\boldsymbol{u}_t$ is a vector of reduced-form innovations.

The key modification in contrast to the baseline VECM in Equation (4) lies in the inclusion of the exogenous component $\boldsymbol{x}_t$, which enters the system contemporaneously through the coefficient matrix $\boldsymbol{\Psi}$. $\boldsymbol{x}_t$ consists of contemporaneous foreign EGB demand shocks at the same maturity segment as the domestic instrument of interest (e.g., short-, medium-, or long-term), thereby isolating maturity-specific spillovers. Other maturity groups are not included as controls due to the preferred habitat theory, which stipulates that investors have preferences for specific maturities and are unwilling to substitute bonds across maturities (Vayanos & Vila, 2021). These shocks are treated as weakly exogenous, ensuring that they affect the short-run dynamics without altering the estimated cointegration space. The IRFs resulting from the VECM-X model are presented in Section 8.1 and are compared with our main results.

7 Results

This chapter presents the results structured around our three hypotheses outlined in Section 4. We analyse the macroeconomic effects of EGB demand shocks, and both combined monetary policy shocks and monetary policy information shocks. First, we assess whether accounting for both types of shocks leads to attenuated effects compared to a setting with only one type of shock. Second, we examine whether demand shocks for short-term EGB exhibit more significant effects than those with longer maturities. Third, we assess whether when accounting for EGB demand shocks, the macroeconomic effects of a true monetary policy shock are larger when disentangled from monetary policy information shocks.

The results are presented using impulse response functions, tracing the responses of the macroeconomic variables for 24 months following the shock. Since both EGB demand shocks and monetary policy (information) shocks are transitory, no effects will materialise at a longer horizon, as long-run restrictions were imposed in the VECM. Each IRF associated with EGB demand shocks shows the effects of a one-standard-deviation increase in the bid-to-cover ratio. The IRFs for monetary policy shocks illustrate the impact of a combined monetary policy shock or monetary policy information shock corresponding to a one-unit increase in the Euribor rate (i.e., a 1 percentage point, or 100 basis points, rise).

When interpreting all of the IRFs in this chapter, the solid lines denote the point estimates. Darker shaded areas represent 90% confidence intervals, while lighter shaded areas represent 95% confidence intervals. Household consumption, private investment and real GDP are measured in logs of millions of euros. Industrial production, core inflation and unemployment are measured in percent.

After presenting the results, the remainder of this chapter summarises our findings related to the hypotheses in a table for ease of reference and then discusses the possible determinants behind the frequent lack of statistical significance observed in our empirical results.

7.1 Macroeconomic Effects Under a Single Shock vs a Dual-Shock Setting

This section evaluates the first hypothesis, which is:

Accounting for both EGB demand shocks and monetary policy shocks, the effects of these shocks on the real economy are attenuated compared to a setting with only one type of shock.

7.1.1 Macroeconomic Effects of EGB Demand Shocks

This subsection analyses the macroeconomic effects of EGB demand shocks in isolation. It establishes a benchmark for comparison with the subsequent dual-shock specification that incorporates both EGB demand and monetary policy shocks, as outlined in Section 7.2.

Macroeconomic Effects in Germany

Figure 5 and Figure 6 illustrate the impulse responses of German macroeconomic variables to EGB demand shocks for short- and long-term bonds (i.e. Schatz and Bund).

An increase in the demand for short-term EGBs by one standard deviation results in a decrease in household consumption in the first two months. The crowding-out effect on private investment, which drop by approximately 15%, is even more pronounced. This suggests a high sensitivity of investment decisions to short-term financial conditions, as investors' appetite for safe assets is stronger. Consequently, real GDP declines as well, reaching its lowest point within the first quarter, before gradually reverting towards baseline. The decline in private investment is in line with previous research that found evidence for a crowding-out of corporate debt issuance as a result of government debt issuance (Demirci et al., 2019; Greenwood et al., 2015b), as investors value the safety of sovereign issuers (Krishnamurthy & Vissing-Jorgensen, 2012). Industrial production declines by as much as 10 percentage points, followed by an increase before reverting to zero. The effect on price levels and the labour market response are statistically insignificant.

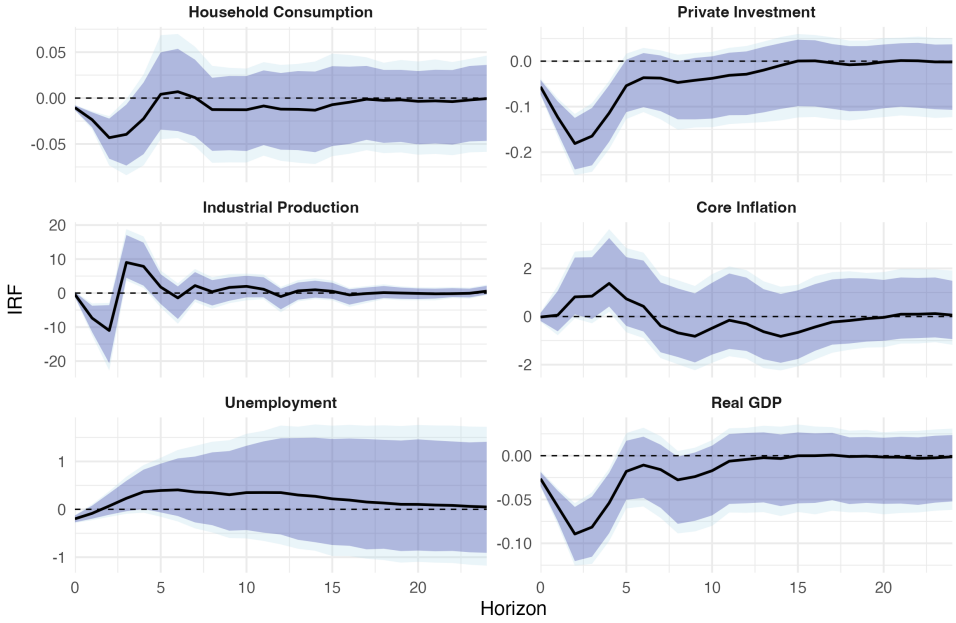

Figure 5: Germany – IRFs of a demand shock to short-term EGBs

When comparing the single shock setting in Figure 5 with a model specification accounting for monetary policy shocks (see Figure 17), the macroeconomic effects of demand shocks for German Schatz are larger if monetary policy shocks are not included in the model.

If only EGB demand shocks are considered, a higher demand for German Bund bonds has no measurable effect on any macroeconomic variable, as illustrated in Figure 6. A potential explanation is that investors' core beliefs about the future economic prosperity of Germany are not altered. Thus, investors may not seek to secure their portfolio returns against downside risk and instead may bid more aggressively on auctions of German long-term EGBs due to strategic fund reallocations.

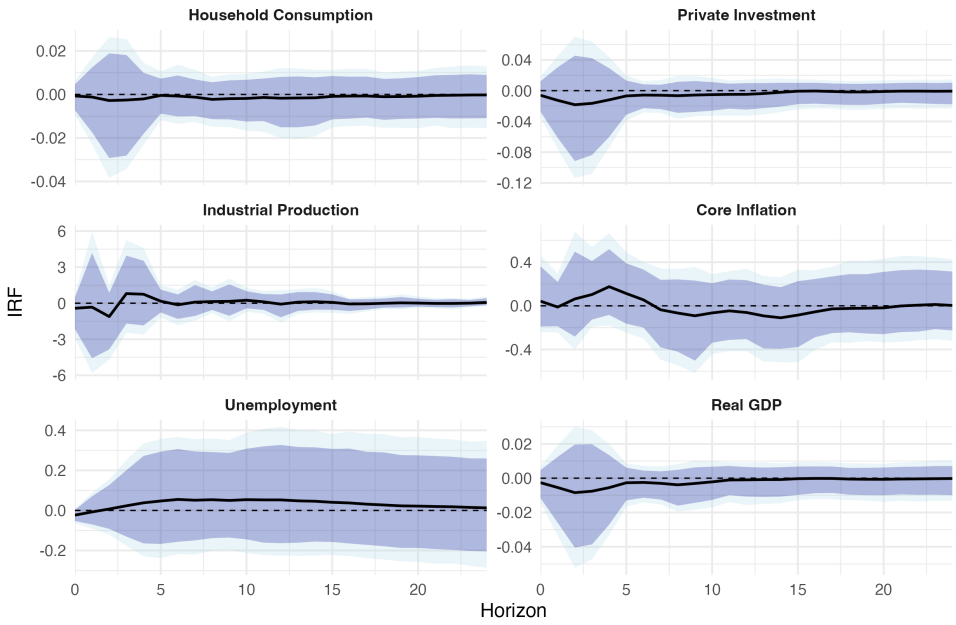

Figure 6: Germany – IRFs of a demand shock to long-term EGBs

This explanation seems to be confirmed when comparing Figures 6 and 18, which account for monetary policy shocks. The sign and the magnitude of the point estimates are similar between the two figures, signalling that changes in EGB demand for long-term bonds are not affecting the broader economy. Finally, with respect to medium-term EGB demand shocks, the shocks have a greater magnitude under a single shock setting, as can be seen by comparing the point estimates in Figure 35 and Figure 38 in Appendix A.6.1. However, with the exception of unemployment upon impact, the IRFs are not statistically significant.

In summary, in the case of Germany, the hypothesis is confirmed with respect to the short-term horizon of the maturity spectrum, but not with respect to the medium- and long-term spectrum. Without accounting for monetary policy shocks, short-term EGB demand shocks have contractionary effects on household consumption, industrial production and real GDP, and crowd out private investment. However, when both shocks are considered, the effects are more attenuated. On the other hand, medium- and long-term EGB demand shocks are not more pronounced when disregarding the effects of monetary policy shocks.

Macroeconomic Effects in France

Figures 7 and 8 display the impulse responses of French macroeconomic variables to EGB demand shocks for short- and long-term bonds.

As illustrated by Figure 7, impulse responses across macroeconomic variables are generally small and statistically insignificant, with the exception of core inflation, where the effect upon impact is statistically significant, although economically negligible at -0.02. Household consumption and private investment are not affected by a one-standard-deviation increase in demand for short-term French EGBs. Likewise, the effects on industrial production, unemployment rate

and output are insignificant.

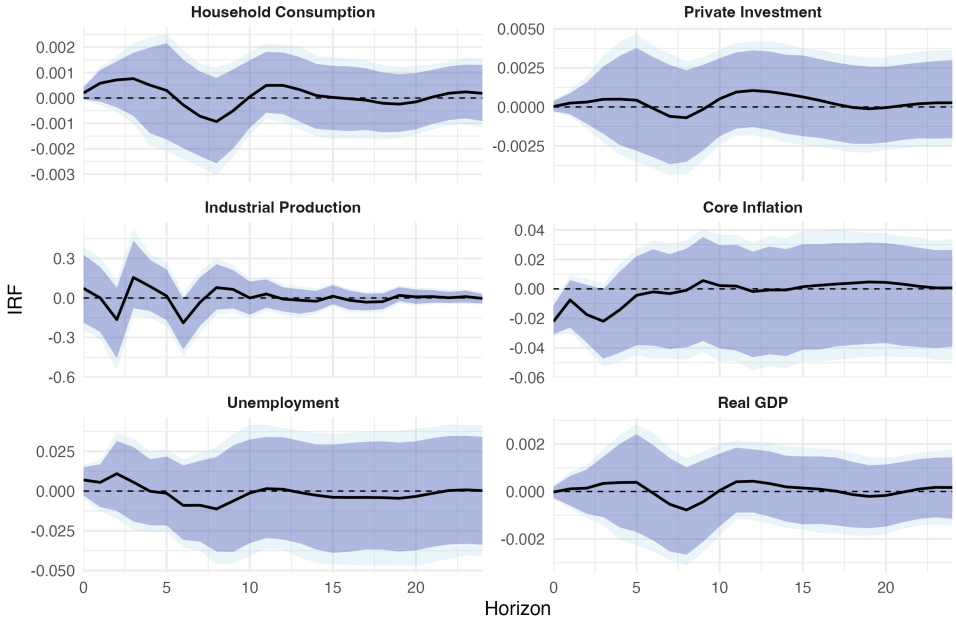

Figure 7: France – IRFs of a demand shock to short-term EGBs

Furthermore, the effects displayed in Figure 7 are not larger than the IRFs obtained when accounting for both EGB demand shocks and monetary policy shocks (see Figure 19). The regular auctioning of French short-term EGBs, which occurs on every Thursday of the month, limits transmission effects in the real economy as the issuance is predictable to investors.

Similarly, the macroeconomic effects of higher demand for French long-term EGBs are economically negligible, as shown in Figure 8. The impact on household consumption and industrial production is statistically insignificant. While the immediate effect on private investment, price levels, unemployment rate, and real GDP is statistically significant, it remains economically negligible.

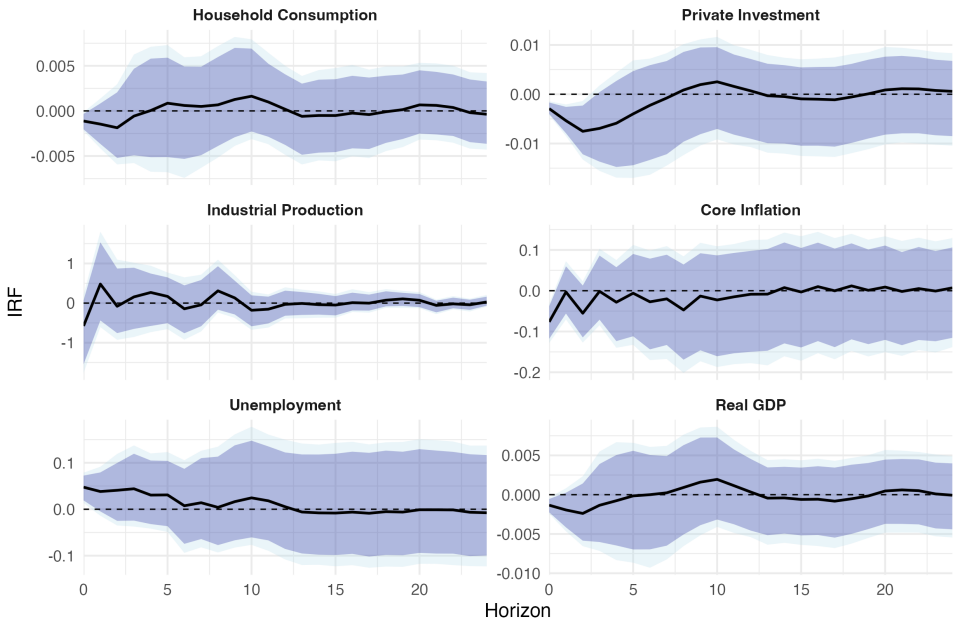

Figure 8: France – IRFs of a demand shock to long-term EGBs

Moreover, compared to the dual-shock setting (see Figure 20), the point estimates in Figure 8 are not larger. By contrast, the IRFs in Figure 36 (see Appendix A.6.1) show that medium-term EGB demand shocks exert statistically significant contractionary effects on industrial production, household consumption, private investment and, consequently, real GDP, whereas the effects on price levels and the labour market are statistically insignificant. Furthermore, compared to the specification including both shocks, as illustrated in Figure 39, the point estimates in Figure 36 are larger in magnitude.

Overall, the hypothesis cannot be confirmed for short- and long-term EGB demand shocks in France, as the estimates from the specification including only EGB demand shocks are not larger than the IRFs obtained from the specification that also accounts for monetary policy shocks. However, the hypothesis is confirmed in the case of medium-term EGB demand shocks.

Macroeconomic Effects in Italy

Figures 9 and 10 show how Italian macroeconomic variables respond to EGB demand shocks for both short- and long-term bonds.

Similar to France, an increase in demand for Italian short-term EGBs by one standard deviation has no effect on any GDP component or on real GDP, industrial production, core inflation and the unemployment rate.

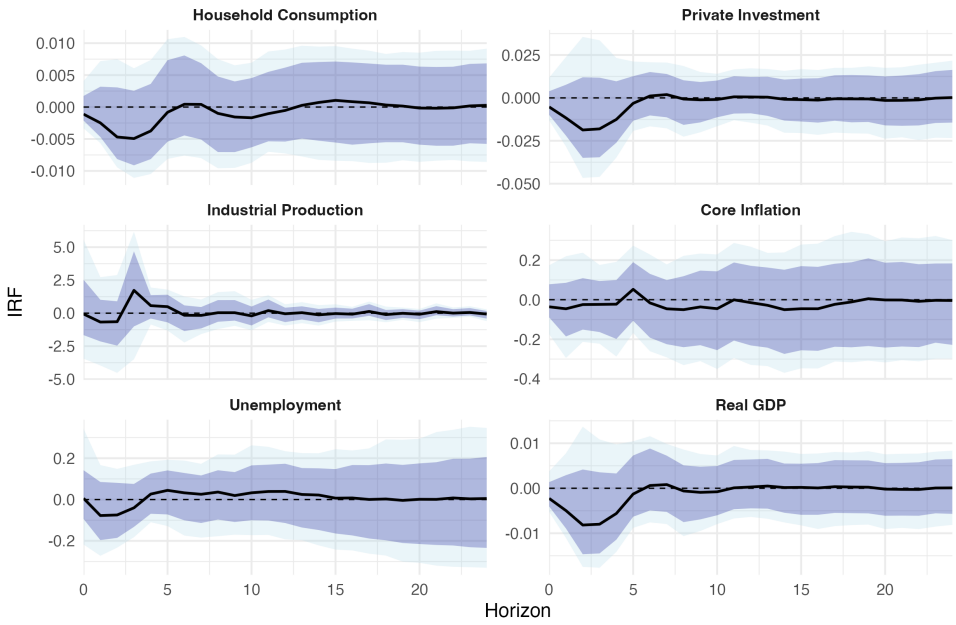

Figure 9: Italy – IRFs of a demand shock to short-term EGBs

In addition, the magnitudes of the IRFs in Figure 9 are broadly similar to those in Figure 21, where monetary policy shocks are accounted for. The monthly issuance of short-term Italian sovereign bonds gives investors sufficient foresight and provides stability to the country's debt management system. Therefore, irrespective of monetary policy shocks, the transmission effects to the broader economy are limited.

Likewise, an increased demand for long-term Italian EGBs is not transferred onto the wider economy, as illustrated by Figure 10. Similar to France, Italy holds monthly auctions of long-term bonds, providing investors foresight into the country's debt issuance.

Figure 10: Italy – IRFs of a demand shock to long-term EGBs

The estimates from a single shock setting and a model accounting for both monetary policy and EGB demand shocks (see Figure 22) are similar, providing additional evidence that the EGB demand shocks are not propagating through the economy. This conclusion also holds when comparing the effects of medium-term EGB demand shocks in Figure 37, which considers only EGB demand shocks, with those in Figure 40 in Appendix A.6.1, which additionally accounts for monetary policy shocks.

In short, the findings for Italy are not consistent with the underlying hypothesis. Regardless of whether monetary policy shocks are considered in the VECM, the macroeconomic impact of EGB demand shocks remains insignificant in magnitude and statistical power. Italy's debt issuance framework provides transparency to investors, which limits the transmission of changes in the demand for sovereign debt onto the wider economy.

7.1.2 Macroeconomic Effects of Monetary Policy (Information) Shocks

This subsection analyses the macroeconomic effects of monetary policy (information) shocks in isolation. It establishes a benchmark for comparison with the subsequent dual-shock specification that incorporates both EGB demand and monetary policy shocks, as outlined in Section 7.3.

Macroeconomic Effects in Germany

Figure 11 and Figure 12 present impulse responses of a combined monetary policy shock and monetary policy information shock for German macroeconomic variables.

Following a combined monetary policy shock, shown in Figure 11, German macroeconomic variables exhibit expansionary effects. Household consumption and private investment increase

on impact, reaching a peak within the first few periods before gradually declining towards zero. Real GDP displays the same dynamics. Industrial production exhibits a short-lived increase, followed by a pronounced decline and a gradual return to zero. Core inflation and unemployment fluctuate above and below zero, but their effects are statistically insignificant at the 95% level.

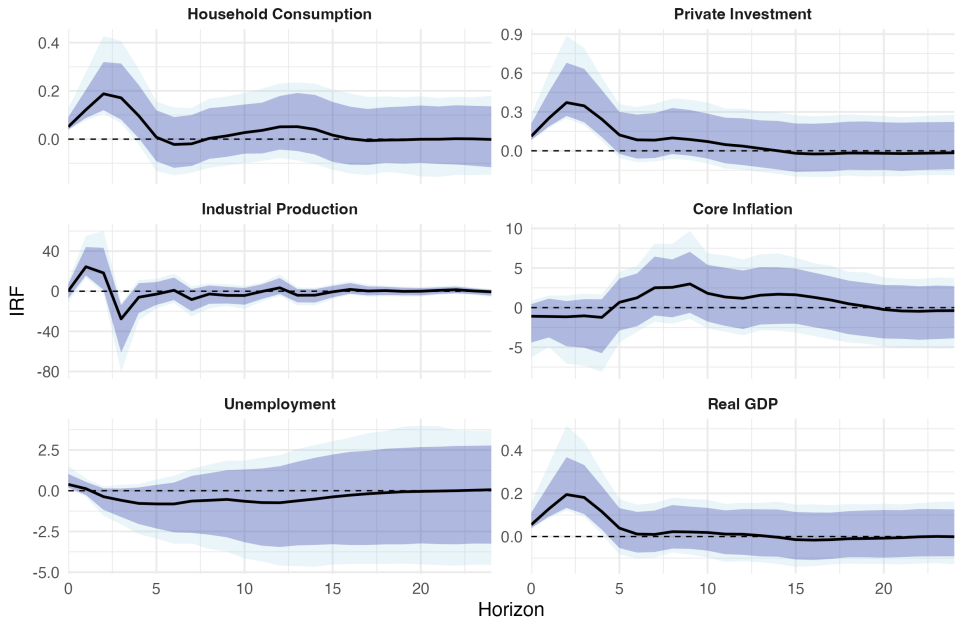

Figure 11: Germany – IRFs of a combined monetary policy shock

Comparing these findings with the responses to a combined monetary policy shock that accounts for demand shocks to short-, medium-, and long-term EGBs (Figures 23, 41 and 24), the effects appear larger when such demand shocks are not accounted for. In particular, the increases in household consumption, private investment, industrial production, and real GDP are more pronounced and remain statistically significant for longer when EGB demand shocks are excluded, although the macroeconomic effects become statistically insignificant when accounting for demand shocks to medium-term EGBs. The effects on core inflation are insignificant in all cases. Unemployment responses are statistically insignificant except when accounting for demand shocks to short- and long-term EGBs, where there is a slight significant increase during the first few months following the shock.

Figure 12 shows that a monetary policy information shock produces impulse responses for German macroeconomic variables that follow the same pattern as the combined monetary policy shock. Despite following the same pattern, none of the effects are statistically significant, except for a brief increase in industrial production.

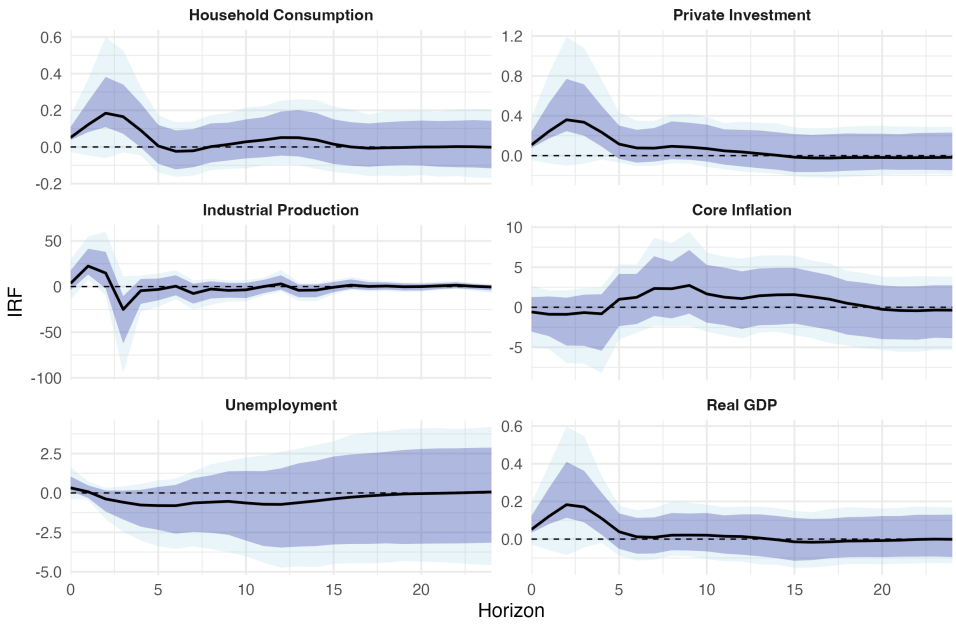

Figure 12: Germany – IRFs of a monetary policy information shock

Relative to the specification that incorporates demand shocks to short-, medium- and long-term EGBs (Figures 25, 42 and 26), the estimated effects are more pronounced when these demand shocks are excluded. However, neither the single shock nor the dual-shock specifications yield statistically significant results (except for a brief increase in industrial production when demand shocks are not included).

The results for Germany provide some support for Hypothesis 1. Consistent with the hypothesis, the estimated effects of monetary policy shocks are attenuated when EGB demand shocks are included in the specification. In particular, the responses of household consumption, private investment, industrial production and real GDP are larger and more persistent when demand shocks are excluded, while they become smaller and less statistically significant once these shocks are accounted for. The attenuation mainly affects the magnitude rather than the direction of the responses, as the overall dynamics remain similar across specifications. However, many effects are not statistically significant at the 95% level, suggesting that the attenuation effect is modest and should be interpreted with caution.

Macroeconomic Effects in France

Figures 13 and 14 show the responses of French macroeconomic variables to a combined monetary policy shock and a monetary policy information shock.

Figure 13 shows that a combined monetary policy shock generates fluctuating, insignificant and short-lived macroeconomic effects. All French macroeconomic responses remain statistically insignificant over the sample period and the confidence intervals are wide.

Figure 13: France – IRFs of a combined monetary policy shock

When comparing the responses in Figure 13 with those to a combined monetary policy shock that accounts for demand shocks to short-, medium-, and long-term EGBs (Figures 27, 43 and 28), the effects appear smaller and are not statistically significant when these demand shocks are not taken into account. In contrast, when accounting for these shocks, household consumption, private investment, industrial production and real GDP all decrease significantly, regardless of the maturity of the EGB demand shock.

Figure 14 illustrates the same, but for the impact of monetary policy information shocks on French macroeconomic variables. The responses follow the same pattern as with the combined monetary policy shock, and also has no statistically significant effects.

Figure 14: France – IRFs of a monetary policy information shock

When comparing the responses in Figure 14 with those in Figures 29, 44 and 30, which account for demand shocks to short-, medium-, and long-term EGBs, the inclusion of these demand shocks leads to more pronounced contractionary responses in key macroeconomic variables. When EGB demand shocks are included, household consumption, private investment, industrial production and real GDP decline on impact and gradually return to baseline, though the effects are statistically significant only in the short term.

The results for France do not support Hypothesis 1 and instead indicate the opposite. When EGB demand shocks are not included, the estimated effects of monetary policy shocks are small, statistically insignificant and have wide confidence intervals. In contrast, when demand shocks are accounted for, the responses of household consumption, private investment, industrial production and real GDP become more pronounced and display a clear contractionary pattern, with several effects reaching statistical significance in the short term. This suggests that for France, omitting EGB demand shocks leads to an underestimation of the effects of monetary policy rather than attenuation. Furthermore, the direction of some responses differs across specifications, indicating that the inclusion of additional shocks affects both the magnitude and dynamics of the results.

Macroeconomic Effects in Italy

Figure 15 and Figure 16 capture responses of Italian macroeconomic variables to combined monetary policy and monetary policy information shocks. However, evidence from Table 19 in Appendix A.5 indicates that the Italian instruments are weak, as the F-statistics fall below the conventional threshold of 10 (Kilian & Lütkepohl, 2017). Therefore, the associated IRFs should be interpreted with caution.

Following a combined monetary policy shock, as shown in Figure 15, the two statistically significant responses indicate that household consumption declines on impact, while core inflation increases initially, with both variables subsequently converging to zero. The responses of the remaining macroeconomic variables are not statistically significant.

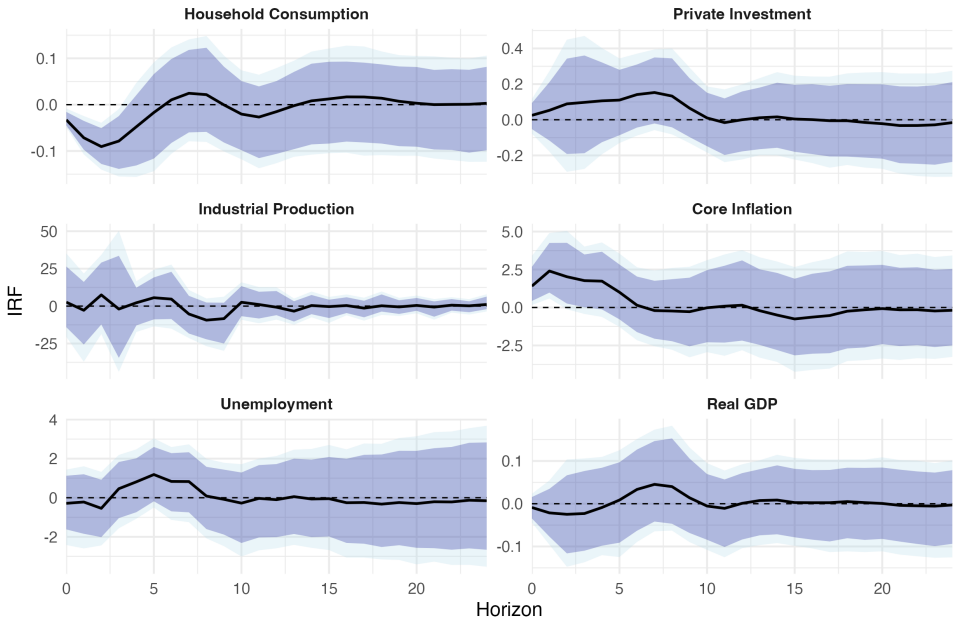

Figure 15: Italy – IRFs of a combined monetary policy shock

When comparing these findings with the responses to a combined monetary policy shock that incorporates demand shocks to short-, medium-, and long-term EGBs (Figures 31, 45 and 32), the estimated effects exhibit greater statistical significance when such demand shocks are not accounted for, although only household consumption and core inflation exhibit significant effects. When accounting for EGB demand shocks, all responses are insignificant.

Figure 16 shows that a monetary policy information shock generates responses that are similar to those of a combined monetary policy shock. As in the case of the combined monetary policy shock, the only statistically significant responses are observed for household consumption and core inflation.

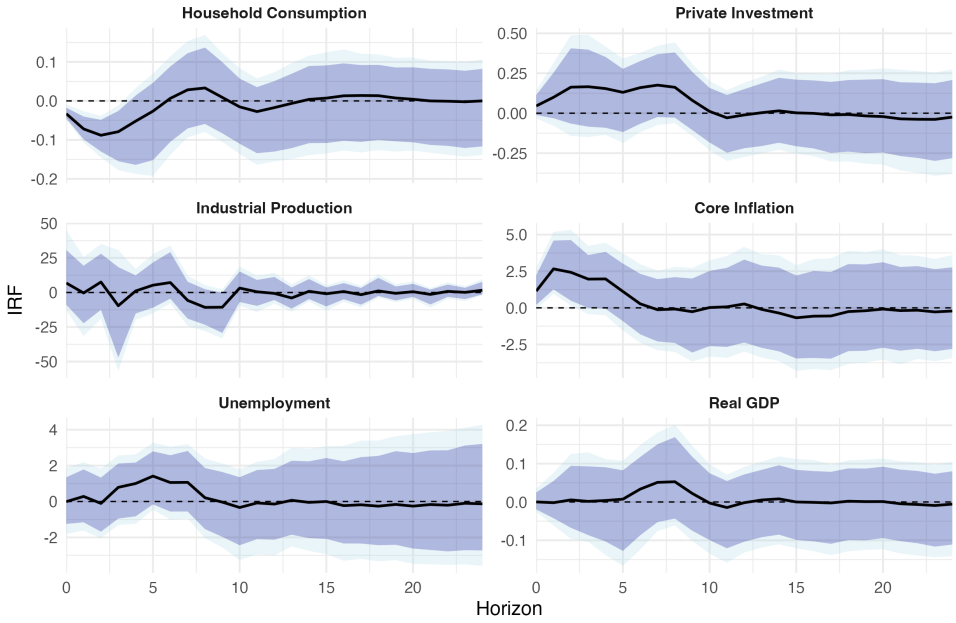

Figure 16: Italy – IRFs of a monetary policy information shock

Relative to the specification that incorporates demand shocks to short-, medium-, and long-term EGBs (Figures 33, 46 and 34), the estimated responses are largely statistically insignificant overall, except for two variables, when EGB demand shocks are not accounted for. When demand shocks are included, the responses of all variables are statistically insignificant.

The results for Italy provide limited and inconclusive evidence in relation to Hypothesis 1. As noted, the instruments used for Italy are weak and the impulse responses should therefore be interpreted with caution. When EGB demand shocks are not included, household consumption and core inflation show statistically significant effects on impact, while the remaining variables are largely insignificant. In contrast, when EGB demand shocks are accounted for, the estimated effects become statistically insignificant across all variables. This suggests some degree of attenuation when EGB demand shocks are included, in line with Hypothesis 1. However, given the overall lack of statistical significance and the weakness of the instruments, this evidence is not robust.

7.2 Macroeconomic Effects of Short-Term vs Long-Term EGB Demand Shocks

The following three subsections aim to provide an answer to the second hypothesis, i.e.:

When considering monetary policy shocks, demand shocks for short-term EGBs have stronger macroeconomic effects than demand shocks for long-term government bonds.

Macroeconomic Effects in Germany

Figure 17 and Figure 18 illustrate the impulse responses of key German macroeconomic variables to EGB demand shocks for short- and long-term bonds, respectively, while controlling for monetary policy shocks. The responses are small in magnitude and statistically insignificant.

Figure 17 shows that a demand shock for German Schatz generates economically insignificant macroeconomic effects. Unlike household consumption, the negative response of private investment and real GDP is statistically significant upon impact, though economically negligible. Industrial production, core inflation, and unemployment appear unaffected by an EGB demand shock for short-term German bonds.

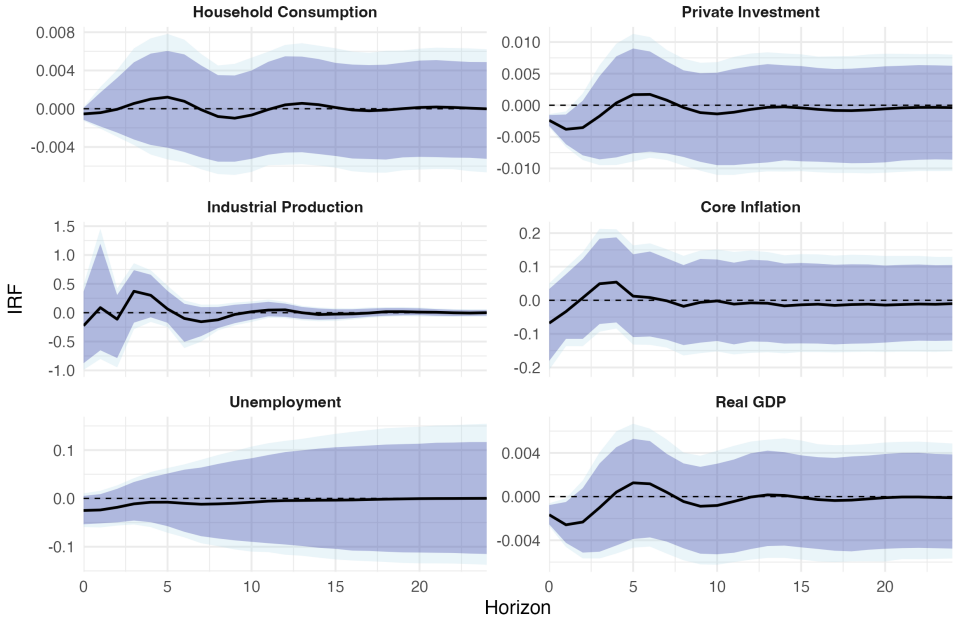

Figure 17: Germany – IRFs of a demand shock to short-term EGBs, accounting for monetary policy shocks

Figure 18 presents the responses to a demand shock for long-term German bonds. The qualitative patterns remain broadly similar to those illustrated in Figure 17. However all IRFs are statistically insignificant. Similar conclusions can be drawn from analysing the macroeconomic effects of EGB demand shocks on Bobl, i.e. medium-term German bonds, as depicted in Figure 38 in Appendix A.6.1.

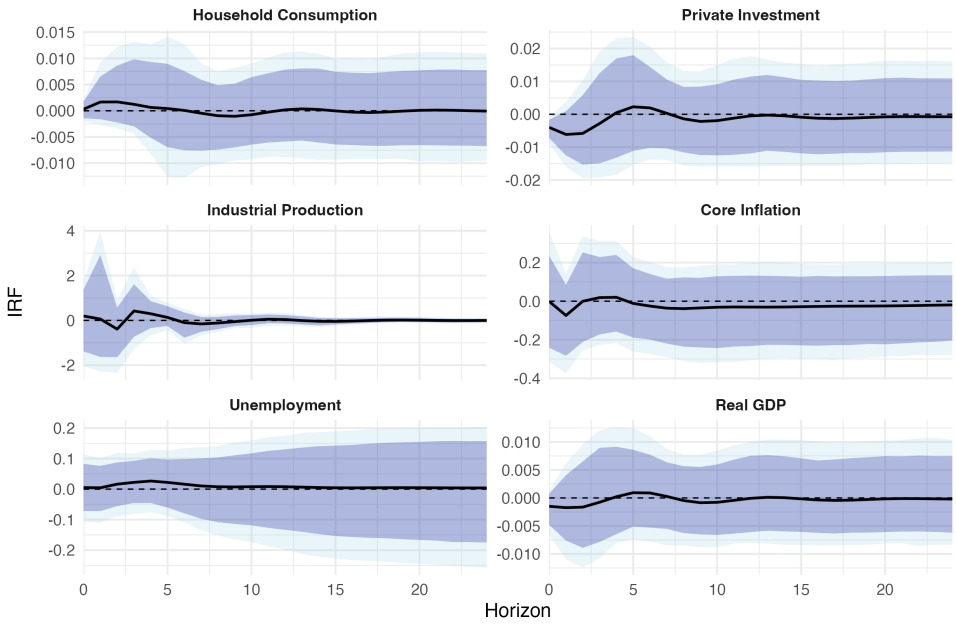

Figure 18: Germany – IRFs of a demand shock to long-term EGBs, accounting for monetary policy shocks

In summary, the results indicate that EGB demand shocks have limited and statistically weak effects on German macroeconomic aggregates, and do not corroborate the underlying hypothesis. Albeit focusing on different aspects of fiscal policy, it is noticeable that these findings contrast previous research by Afonso and Sousa (2012) and Tenhofen et al. (2010), who found that government spending shocks have positive macroeconomic effects for Germany. Furthermore, Lengyel and Giuliodori (2022) document that EGB demand shocks in Germany result in rising risk premia. These findings suggest that private investment would decline as borrowing costs increase. However, we cannot confirm that private investment activities are significantly lower.

Macroeconomic Effects in France

Figure 19 depicts the impulse responses of key macroeconomic variables in France to an EGB demand shock for short-term bonds, whereas Figure 20 illustrates the macroeconomic effects of a demand shock for long-term bonds.

An EGB demand shock at the short end of the maturity spectrum generates muted macroeconomic effects, as shown by Figure 19. No variable seems to be impacted by such a shock. The primary reason is likely France's regular issuance of short-term maturity bonds. As explained in Section 3.1, these bonds are auctioned every third Thursday of the month. Therefore, investors' appetite for short-term EGBs is unlikely to vary substantially from month to month.

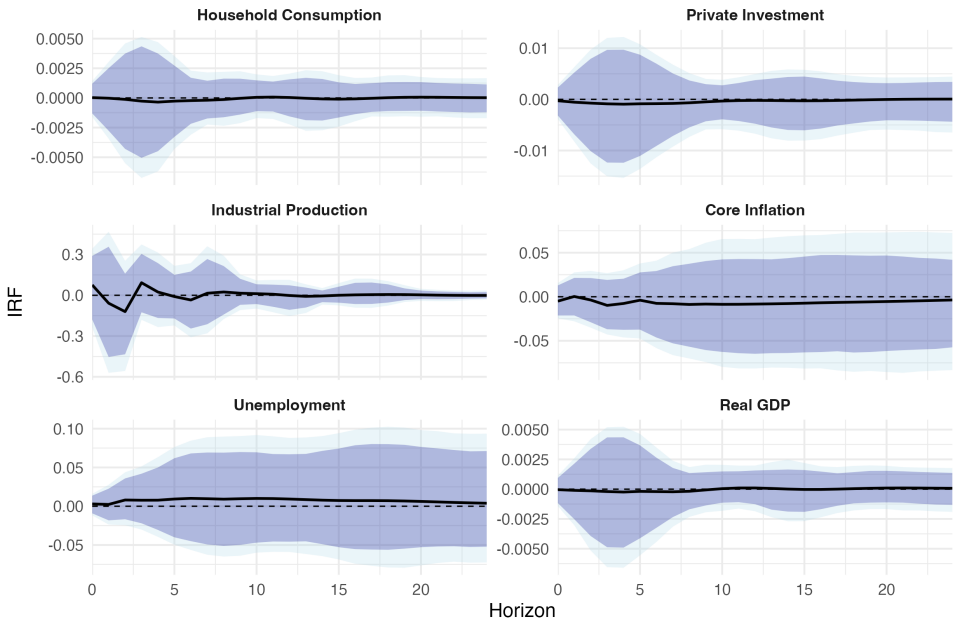

Figure 19: France – IRFs of a demand shock to short-term EGBs, accounting for monetary policy shocks

In contrast, shocks to demand for long-term bonds produce more pronounced point estimates, as depicted in Figure 20, although the results are mostly statistically insignificant. Only the effect on the unemployment rate is statistically significant upon impact, though an increase of approximately 0.05 percentage point is economically negligible. With respect to the macroeconomic effects of EGB demand shocks for medium-term bonds, the conclusions are similar, as illustrated in Figure 39 in Appendix A.6.1. In this case as well, only the response of unemployment is statistically significant upon impact, with the estimated increase of approximately 0.04 percentage point remaining economically insignificant.

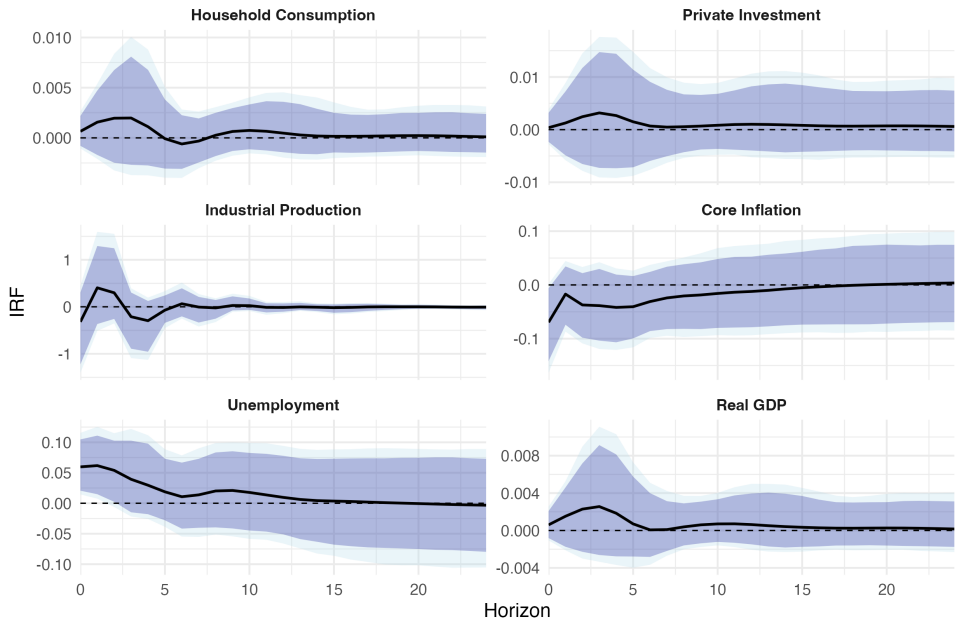

Figure 20: France – IRFs of a demand shock to long-term EGBs, accounting for monetary policy shocks

In summary, the empirical evidence suggests that EGB demand shocks have a weak and broadly statistically insignificant influence on key macroeconomic variables in France. Thus, the results presented fail to substantiate the hypothesis. France's long-standing tradition of issuing sovereign debt to finance government budgets and the country's formalised debt issuance process provides a clear framework to investors (see Section 3.1), and thus EGB demand shocks do not affect the real economy.

Macroeconomic Effects in Italy

Figure 21 and Figure 22 present impulse responses for Italy following an EGB demand shock, distinguishing between short-term and long-term bonds, respectively, while controlling for monetary policy shocks. Since the F-statistics, shown in Table 19 in Appendix A.5, for the strength of the monetary policy shock instruments are below the threshold value of 10 (Kilian & Lütkepohl, 2017), the subsequent IRFs must be interpreted cautiously.

As seen in Figure 21, the point estimates indicate a broadly contractionary effect in the first months following an auction, as household consumption, private investment and real GDP decline on impact, though they lack statistical significance. Furthermore, the magnitude of the effects is negligible for all variables.

Figure 21: Italy – IRFs of a demand shock to short-term EGBs, accounting for monetary policy shocks

Similarly, shocks to long-term EGB demand generate muted real effects, as shown in Figure 22. Household consumption and private investment responses are neutral throughout the horizon, with no statistically significant deviations. Consequently, real GDP remains unaffected. Industrial production is also not affected in a way that is statistically significant, reinforcing the notion of limited transmission to real activity. Core inflation and unemployment again show economically small effects that are statistically indistinguishable from zero. EGB demand shocks for medium-term bonds produce similar impulse responses, as illustrated in Figure 40 in Appendix A.6.1.

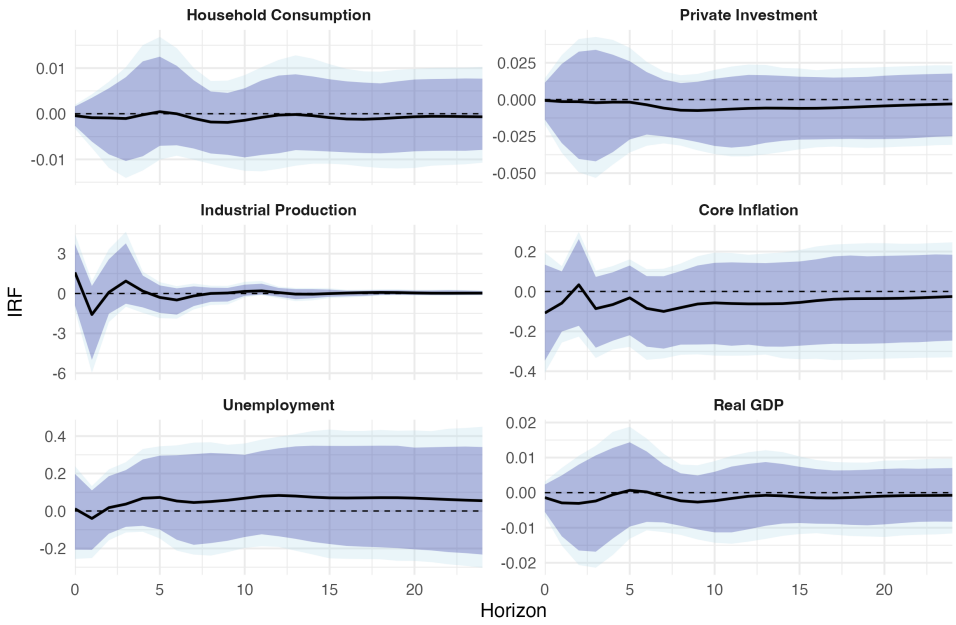

Figure 22: Italy – IRFs of a demand shock to long-term EGBs, accounting for monetary policy shocks

Overall, the figures do not support the underlying hypothesis in the case of Italy. The evidence suggests that EGB demand shocks, whether concentrated at the short or long end of the maturity spectrum, have relatively weak macroeconomic effects in Italy once monetary policy shocks are accounted for. These findings contrast with previous research by Afonso and Sousa (2012), which focuses on the effects of government spending shocks and documents positive effects on investment and output. Although Lengyel and Giuliodori (2022) find that borrowing costs should decline following a demand shock for Italian bonds, thereby suggesting higher investment, we document a decline in private investment, although our findings are statistically insignificant. Similar to France, Italy holds regular monthly auctions, which provides foresight to investors and thus, shifts in investors' demand for Italian sovereign debt are less likely to transmit to macroeconomic variables.

7.3 Macroeconomic Effects of Monetary Policy (Information) Shocks

The following three subsections address the third hypothesis, namely:

When considering EGB demand shocks, the effects of a true monetary policy shock on macroeconomic variables are larger when monetary policy shocks are disentangled from monetary policy information shocks.

Macroeconomic Effects in Germany

Figure 23 and Figure 24 illustrate the impulse responses of German macroeconomic variables to a combined monetary policy shock, accounting for demand shocks to either short- or long-term German EGBs. Figure 25 and Figure 26 present the corresponding responses to a monetary policy information shock.

Figure 23 shows that a combined monetary policy shock, when accounting for demand shocks to short-term EGBs, generates small and short-lived macroeconomic effects. Household consumption, private investment and real GDP increase slightly on impact before gradually converging back to baseline. Industrial production reacts more strongly, displaying a significant sharp initial increase followed by a short-lived negative period. Changes in core inflation are statistically insignificant, and unemployment briefly increases.

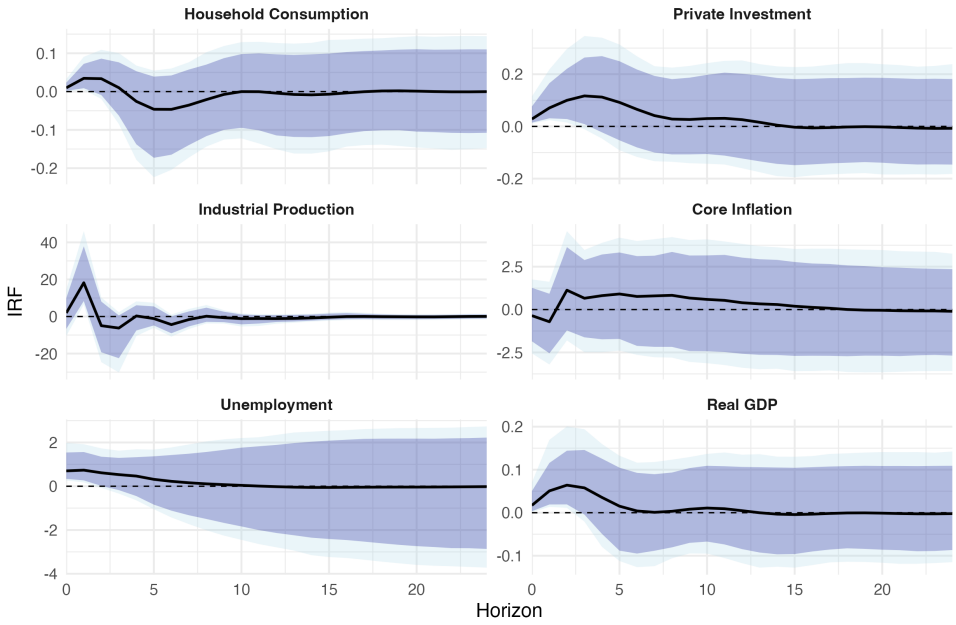

Figure 23: Germany – IRFs of a combined monetary policy shock, accounting for demand shocks to short-term EGBs

Figure 24 presents the responses when accounting for demand shocks to long-term EGBs. The overall dynamics remain broadly similar, though the responses are somewhat more persistent. Household consumption, private investment, unemployment and real GDP remain positive for longer before gradually converging to zero. Industrial production again exhibits a significant initial spike and the effect on core inflation remains insignificant.

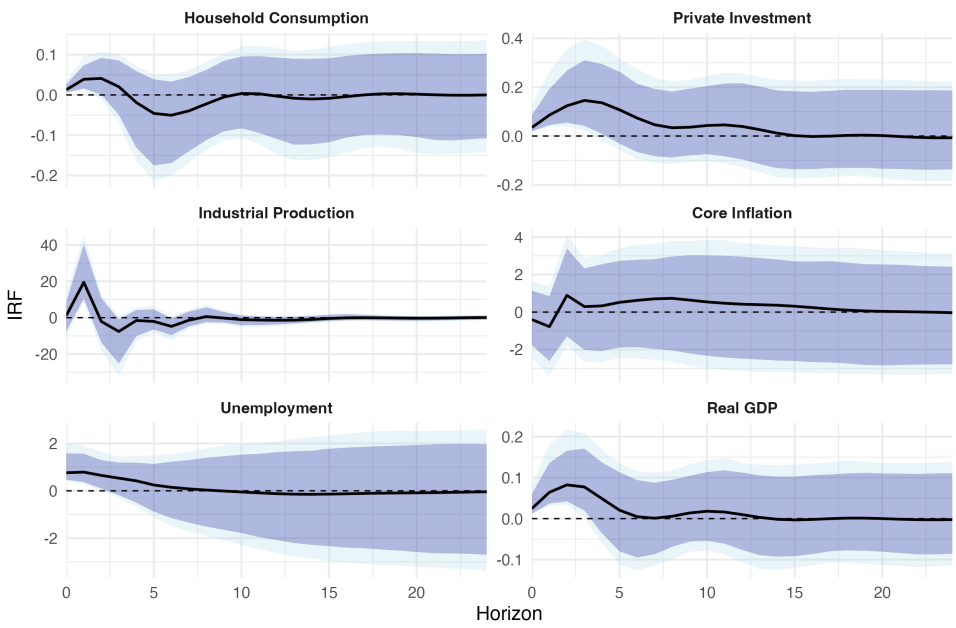

Figure 24: Germany – IRFs of a combined monetary policy shock, accounting for demand shocks to long-term EGBs

Similar patterns are observed when accounting for demand shocks to medium-term EGBs, as illustrated in Appendix A.6.2, indicating that the maturity structure does not materially affect the transmission of combined monetary policy shocks. However, none of the effects on the macroeconomic variables are statistically significant at the 95% level.

Figure 25 shows that a monetary policy information shock, when accounting for demand shocks to short-term EGBs, produces impulse responses that are almost identical to those of a combined monetary policy shock under the same specification. However, the confidence intervals are wider and none of these effects are statistically significant over the sample period.

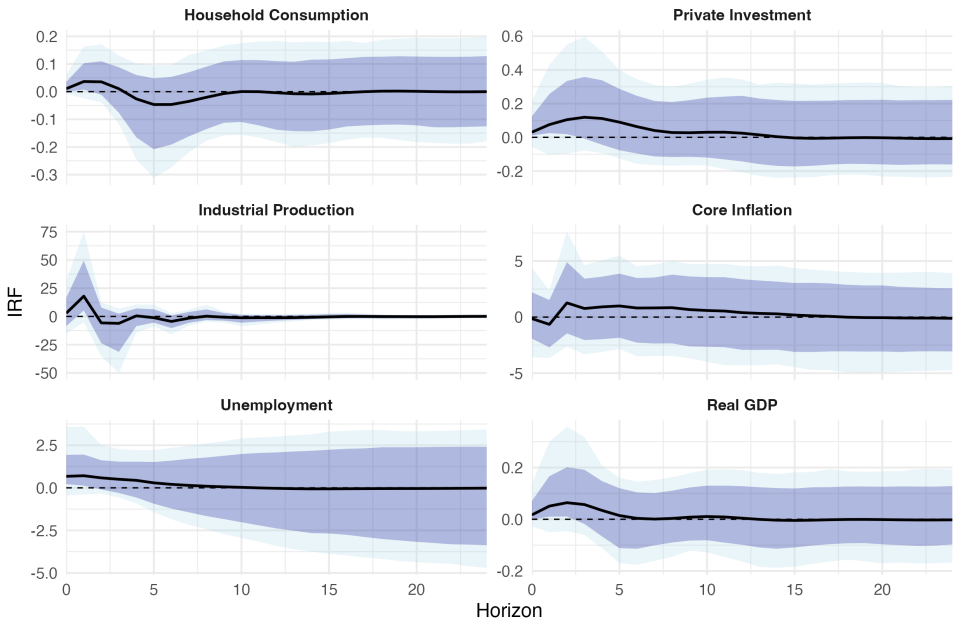

Figure 25: Germany – IRFs of a monetary policy information shock, accounting for demand shocks to short-term EGBs

Figure 26 shows that a monetary policy information shock, when accounting for demand shocks to long-term EGBs, produces impulse responses that follow the same pattern as in the short-term case. Again, none of these effects are statistically significant. Additionally, for demand shocks to medium-term EGBs, the impulse responses are almost identical to those of short- and long-term EGBs in response to a monetary policy information shock, as illustrated in Appendix A.6.2.

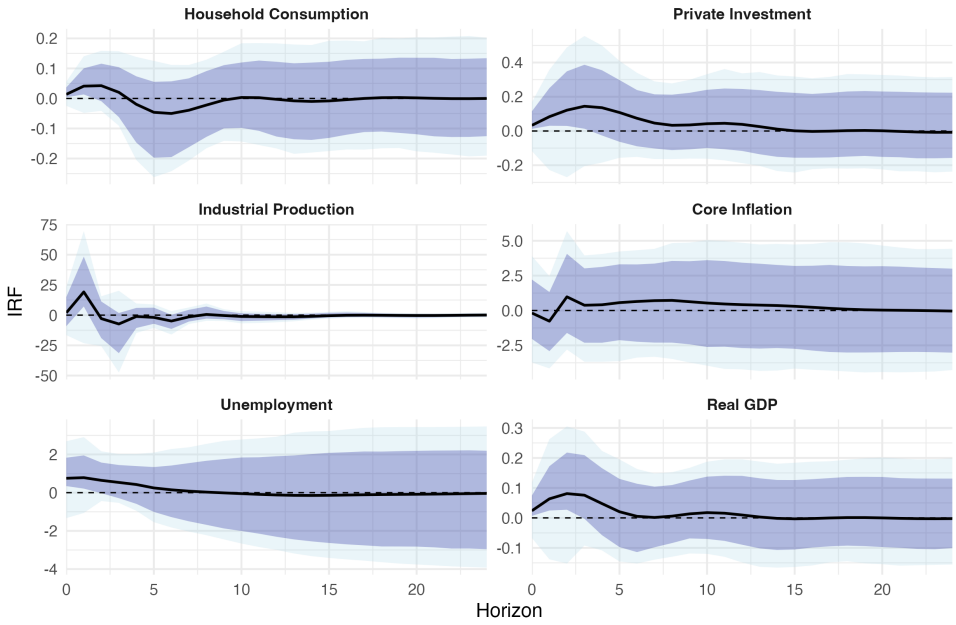

Figure 26: Germany – IRFs of a monetary policy information shock, accounting for demand shocks to long-term EGBs

Taken together, the results suggest that both combined monetary policy and monetary policy information shocks have limited expansionary macroeconomic effects in Germany, with only minor differences across EGB maturities. Disentangling the shocks does not materially change the estimated responses once EGB demand shocks are accounted for. Responses of monetary policy information shocks closely resemble combined monetary policy shocks in both pattern and magnitude, though effects are weaker and statistically insignificant at the 95% confidence level. Therefore, Hypothesis 3 is not supported, as disentangling monetary policy and monetary policy information shocks does not produce larger or statistically significant macroeconomic effects once EGB demand shocks are accounted for.

Overall, this contrasts with the findings discussed in Section 2.2.2, where the literature often finds opposing effects of monetary policy and monetary policy information shocks. Instead, the results suggest that the combined shock is largely driven by the information component rather than the policy rate component, which is consistent with Altavilla et al. (2019) findings for the EA. It is worth noting that the generally insignificant responses resemble the muted or statistically insignificant effects reported in Jarociński and Karadi (2020) and Pfarrhofer and Stelzer (2025) for EA macroeconomic variables.

Macroeconomic Effects in France

Figure 27 and Figure 28 show the impulse responses of French macroeconomic variables to a combined monetary policy shock accounting for demand shocks to short- or long-term French EGBs, while Figure 29 and Figure 30 display the responses to a monetary policy information shock.

Figure 27 shows that a combined monetary policy shock, when accounting for demand shocks to short-term EGBs, generates contractionary effects in the short run. Household consumption, private investment and real GDP decline on impact, reaching a trough within the first few periods before gradually converging towards zero. Industrial production exhibits a pronounced negative response on impact, later followed by a slight significant increase above zero and eventual convergence, indicating short-run volatility. The effects on unemployment remain statistically insignificant, except for a brief period around six months after the shock.

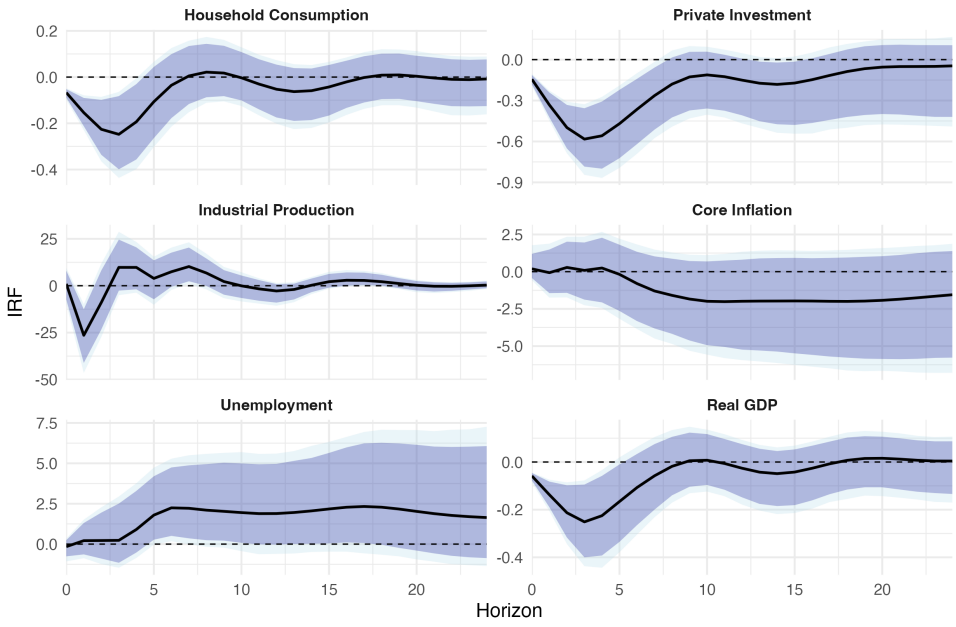

Figure 27: France – IRFs of a combined monetary policy shock, accounting for demand shocks to short-term EGBs

Figure 28 presents the responses when accounting for demand shocks to long-term EGBs. The qualitative patterns remain similar to those when accounting for short-term EGBs, though the effects are somewhat less pronounced and more short-lived. Consumption, investment and real GDP again decline on impact but recover more quickly. Industrial production shows the same sharp initial drop.

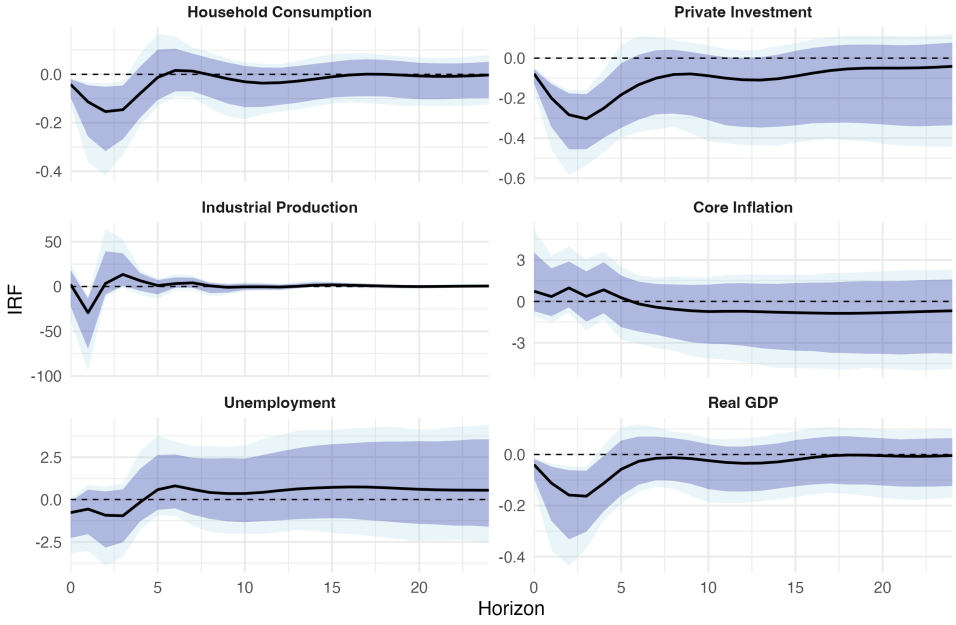

Figure 28: France – IRFs of a combined monetary policy shock, accounting for demand shocks to long-term EGBs

Similar dynamics are observed for demand shocks to medium-term EGBs as for short- and long-term EGBs, shown in Appendix A.6.2, suggesting that different maturities do not substantially alter the transmission of combined monetary policy shocks.

Figure 29 indicates that, once demand shocks to short-term EGBs are taken into account, a monetary policy information shock generates impulse responses that are almost identical in direction and magnitude to those of a combined monetary policy shock under the same specification.

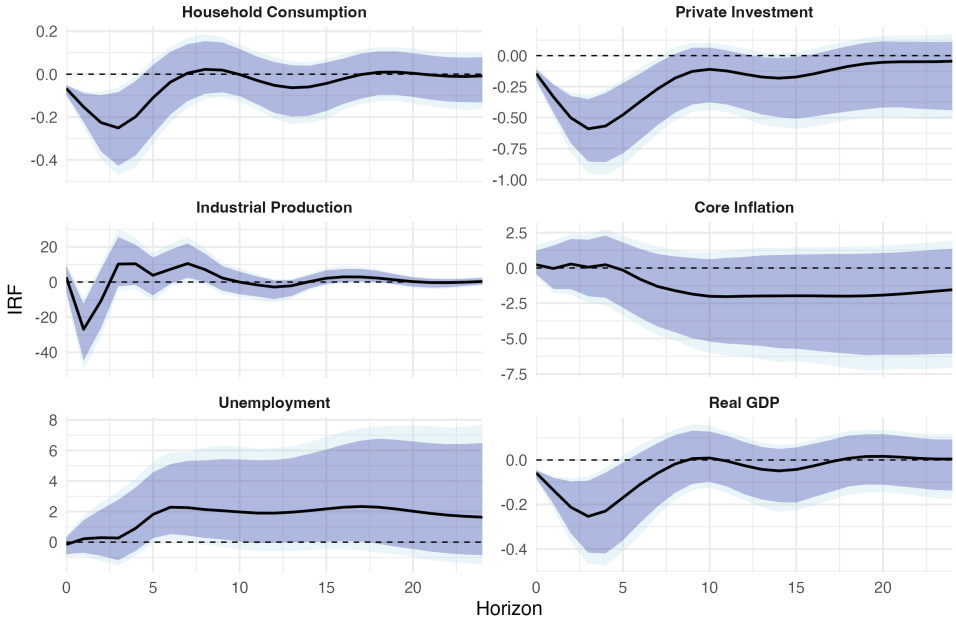

Figure 29: France – IRFs of a monetary policy information shock, accounting for demand shocks to short-term EGBs

Figure 30 shows that, when accounting for demand shocks to long-term EGBs, a monetary policy information shock produces impulse responses that follow a similar pattern to the short-term case (except for unemployment), but with different magnitudes and no statistically significant effects for any of the macroeconomic variables. The confidence intervals for industrial production and core inflation are significantly wider. Furthermore, as illustrated in Appendix A.6.2, when accounting for demand shocks to medium-term EGBs, the responses exhibit similar magnitudes, directions and lack of significance as long-term EGB responses.

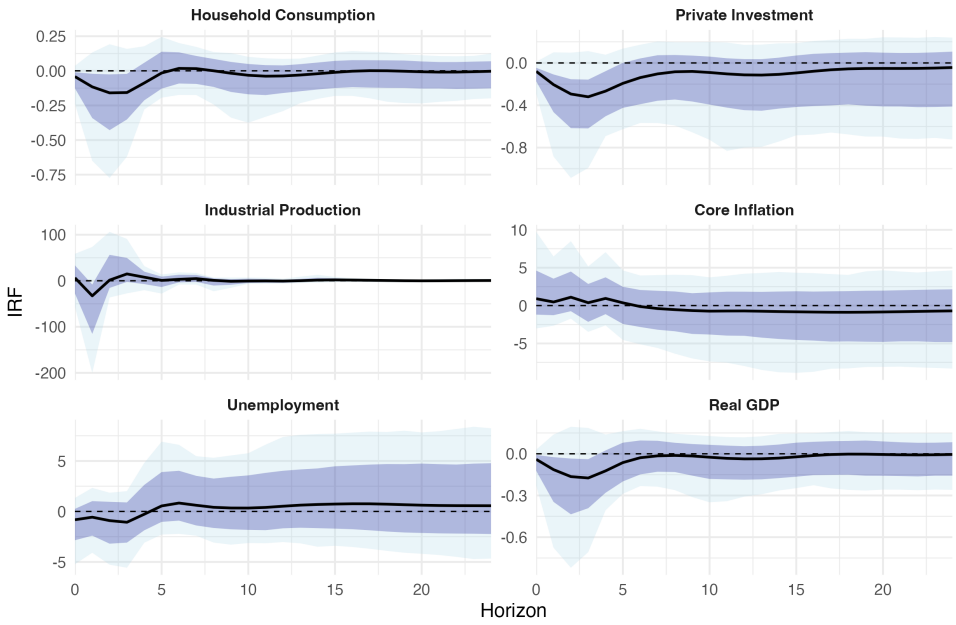

Figure 30: France – IRFs of a monetary policy information shock, accounting for demand shocks to long-term EGBs

The results for France indicate that both combined monetary policy shocks and monetary policy information shocks generate contractionary effects in the short run when accounting for EGB demand shocks, particularly for household consumption, private investment, industrial production and real GDP. When disentangling the shocks, the responses of macroeconomic variables follow similar responses, although the effects are less pronounced when accounting for demand shocks to long-term EGBs. In summary, the findings for France do not support Hypothesis 3, as disentangling monetary policy and monetary policy information shocks when accounting for EGB demand shocks does not produce larger effects.

As with Germany, the findings for France contrast the expected opposing direction of effects when disentangling monetary policy and monetary policy information shocks, as discussed in Section 2.2.2. As the responses of both the combined monetary policy shock and monetary policy information shock follow the same direction, the information component is driving the response of the combined shock, consistent with Altavilla et al. (2019) findings for the EA.

Macroeconomic Effects in Italy

Figure 31 and Figure 32 present the impulse responses of Italian macroeconomic variables to a combined monetary policy shock accounting for demand shocks to short- or long-term Italian EGBs, while Figure 33 and Figure 34 display the responses to a monetary policy information shock. However, as seen in Table 19 in Appendix A.5, the Italian F-statistics for instrument strength fall below the conventional threshold of 10 (Kilian & Lütkepohl, 2017). Therefore, the resulting IRFs should be interpreted with caution.

Figure 31 shows that a combined monetary policy shock, when accounting for demand shocks to Italian short-term EGBs, generates fluctuating, statistically insignificant and short-lived mac-

roeconomic effects. Industrial production exhibits a minor but statistically significant positive effect around 2 months after the shock.

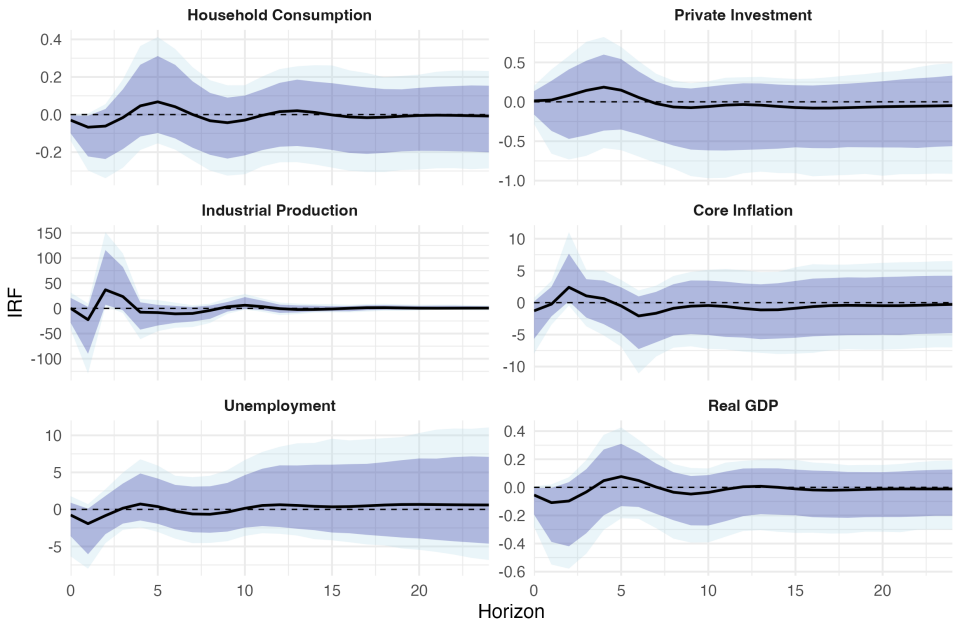

Figure 31: Italy – IRFs of a combined monetary policy shock, accounting for demand shocks to short-term EGBs

Figure 32 presents the responses when accounting for demand shocks to long-term EGBs. The responses in terms of direction and magnitude are almost identical to those when accounting for demand shocks to short-term EGBs. The same is true for demand shocks to medium-term EGBs, as shown in Appendix A.6.2. All responses to the combined monetary policy shock, when accounting for demand shocks to short-, medium- and long-term EGBs, are statistically insignificant, excluding the slight increase in industrial production when accounting for demand shocks to short-term EGBs.

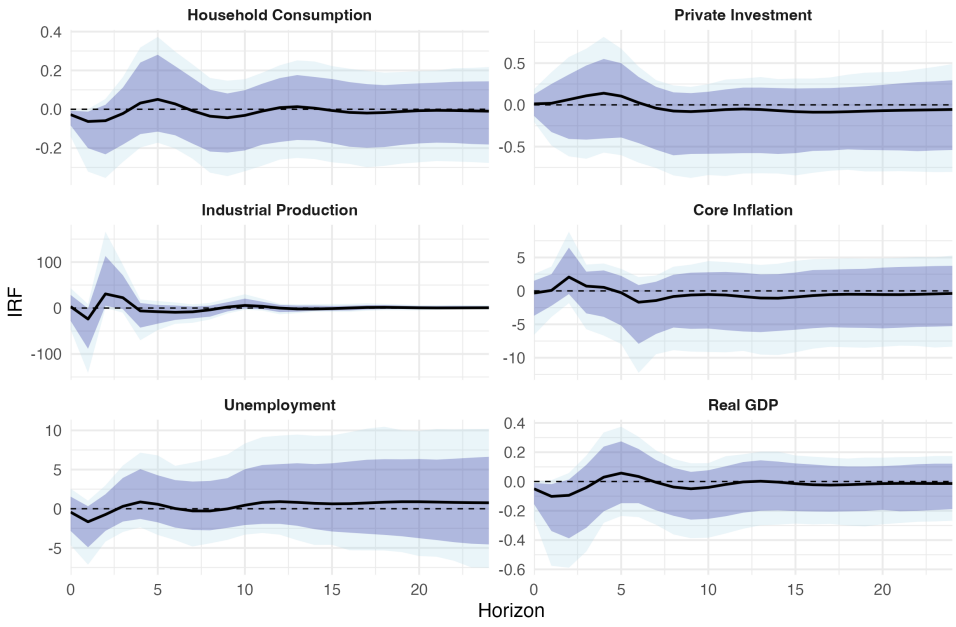

Figure 32: Italy – IRFs of a combined monetary policy shock, accounting for demand shocks to long-term EGBs

Figure 33 shows that a monetary policy information shock, when accounting for demand shocks to short-term EGBs, produces small, insignificant and short-lived responses. In comparison to the effects of combined monetary policy shocks under the same specification, the responses are nearly identical, but the confidence intervals are wider.

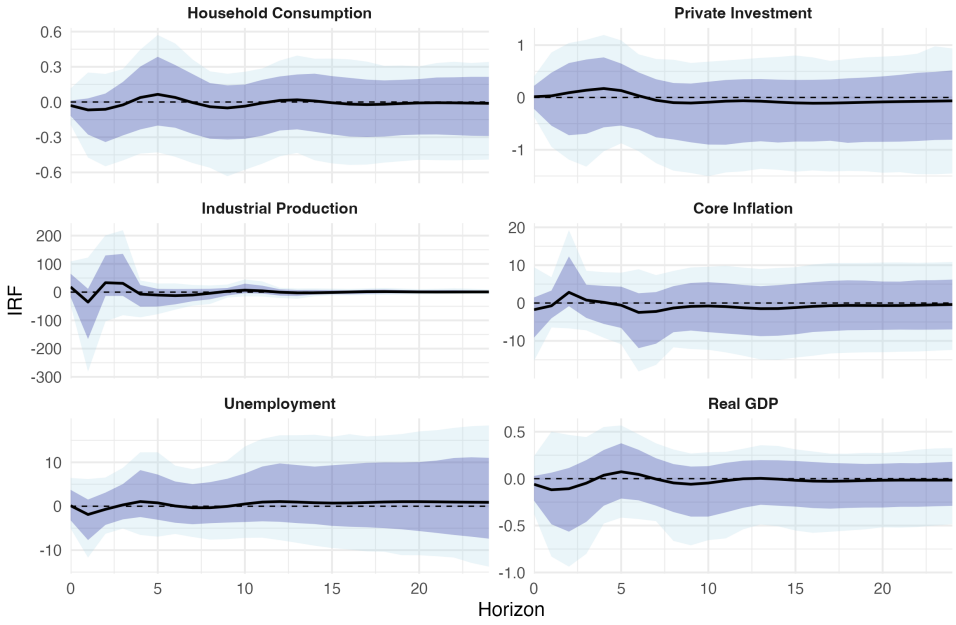

Figure 33: Italy – IRFs of a monetary policy information shock, accounting for demand shocks to short-term EGBs

Figure 34 illustrates that, when accounting for demand shocks to long-term EGBs, a monetary

policy information shock produces impulse responses that follow a similar pattern to the short-term case. As when accounting for demand shocks to short-term EGBs, none of the responses are statistically significant. As illustrated in Appendix A.6.2, the responses when accounting for demand shocks to medium-term EGBs are almost identical to the responses when accounting for demand shocks to long-term EGBs.

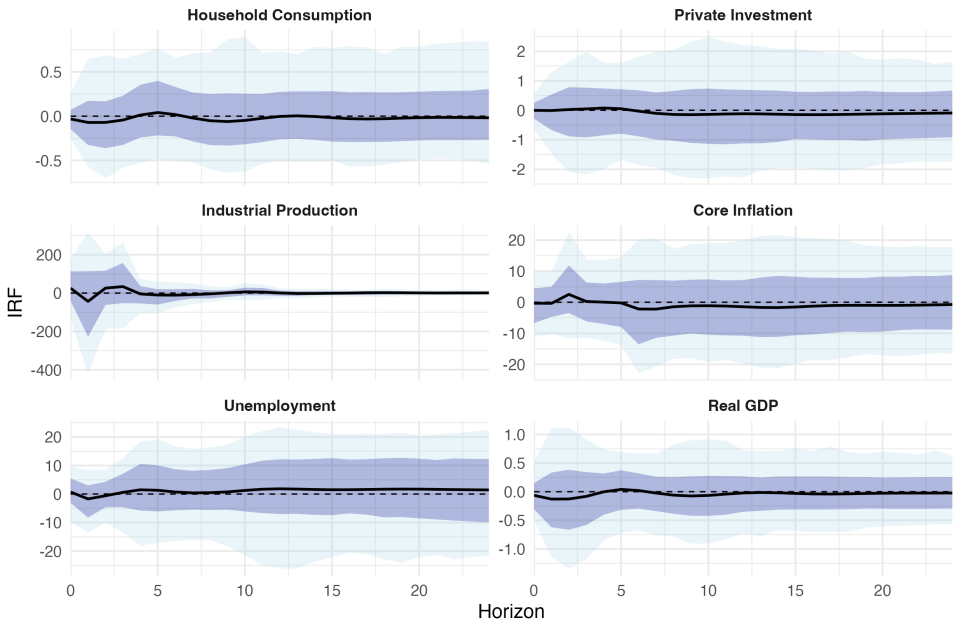

Figure 34: Italy – IRFs of a monetary policy information shock, accounting for demand shocks to long-term EGBs

The evidence for Italy indicates that both combined monetary policy shocks and monetary policy information shocks generate very limited and short-lived macroeconomic effects when accounting for EGB demand shocks, irrespective of the maturity. Compared to Germany and France, the responses for combined monetary policy shocks and monetary policy information shocks are weaker, less persistent and statistically insignificant. However, due to the weak instrument, as shown in Table 19 in Appendix A.5, these results must be interpreted with caution. Consequently, the findings for Italy do not support Hypothesis 3, as disentangling monetary policy and monetary policy information shocks while accounting for EGB demand shocks does not generate larger macroeconomic effects.

When disentangling the shocks, the responses are very similar, except the confidence intervals for monetary polciy information shocks are wider, indicating a higher degree of uncertainty. As with Germany and France, the responses for combined monetary policy and monetary policy information shocks move in the same direction, contrasting the literature discussed in Section 2.2.2, which finds opposing directions. Therefore, as with the other two countries studied, the information component is driving the response of the combined monetary policy shock, aligning with Altavilla et al. (2019) findings for the EA. Furthermore, other studies in the EA (Jarociński and Karadi (2020) and Pfarrhofer and Stelzer (2025)) have found this lack of statistical significance.

7.4 Results Overview

This section summarises the main empirical findings of the analysis, highlighting the estimated macroeconomic effects of EGB demand shocks and monetary policy (information) shocks across Germany, France, and Italy, as well as the extent to which the empirical results support the proposed hypotheses.

7.4.1 EGB Demand Shocks

Across the three countries, the results point to a broadly consistent pattern: EGB demand shocks appear to exert only limited and statistically weak effects on macroeconomic aggregates, especially once monetary policy shocks are taken into account. The empirical evidence suggests that fluctuations in investor demand for sovereign bonds do not meaningfully transmit to the real economy. The point estimates for Germany and Italy suggest that EGB demand shocks exert moderately negative effects on impact. By contrast, in France, short-term EGB demand shocks appear to exert only negligible effects, whereas long-term EGB demand shocks are generally positive, except with respect to inflation, for which the effect is disinflationary. Nonetheless, the cross-country evidence suggests that EGB demand shocks are not a major driver of macroeconomic fluctuations in the three economies considered, as their macroeconomic effects remain economically negligible and statistically weak.

7.4.2 Monetary Policy (Information) Shocks

Our findings indicate that both combined monetary policy shocks and monetary policy information shocks generate relatively modest and short-lived macroeconomic effects across Germany, France, and Italy. While France exhibits more pronounced contractionary responses to combined monetary policy shocks, the effects in Germany are weaker and largely statistically insignificant, while those in Italy are negligible. The impulse responses to monetary policy information shocks closely mirror those of combined monetary policy shocks in all three countries, often displaying similar directions and magnitudes, although with greater uncertainty. This suggests that the combined monetary policy shock is mainly driven by the information component rather than the policy rate component. Moreover, there are only limited differences in the estimated effects when accounting for EGB demand shocks across short-, medium-, and long-term maturities, indicating that maturity-specific demand effects have only a limited influence on the transmission of monetary policy shocks in these economies.

7.4.3 Hypothesis Summary

Table 4 provides a summary of the empirical support for each hypothesis discussed in the previous sections of this chapter across Germany, France and Italy. Overall, the results offer only limited support for our hypotheses, with several findings differing across countries and specifications. We find limited support for Hypothesis 1, while Hypotheses 2 and 3 are generally not supported.

Country	Hypothesis 1	Hypothesis 2	Hypothesis 3
Germany	EGBDS: Weakly supported	Not supported	Not supported
	MPS: Weakly supported		
France	EGBDS: Not supported	Not supported	Not supported
	MPS: Contradicted		
Italy	EGBDS: Not supported	Not supported	Not supported
	MPS: Weakly supported		

Table 4: Summary of hypothesis results

Note: EGBDS refers to EGB demand shocks, and MPS refers to monetary policy shocks.

7.5 Possible Determinants of Statistical Insignificance in Empirical Results

This section discusses potential explanations for why many of the estimated IRFs for EGB demand shocks and monetary policy (information) shocks across countries and maturities are statistically insignificant.

One possible explanation for the large number of statistically insignificant results is the broad time horizon considered in our analysis. Our sample spans more than 23 years, covering multiple crises, the COVID-19 pandemic and periods of economic expansion. It is plausible that the transmission of EGB demand and monetary policy shocks differs across these periods. Since our analysis focuses on the full sample rather than specific periods, such as the Global Financial Crisis or the COVID-19 pandemic, period-specific effects may be averaged out over time, potentially contributing to weaker statistical significance.

With respect to EGB demand shocks, a first explanation relates to the institutional structure of sovereign debt issuance in the EA. As discussed in Section 3.1, the issuance of government debt in Germany, France and Italy follows an auction calendar that is published well in advance. This transparency and predictability in countries' debt management reduces the potential sources of EGB demand shocks. Since investors receive detailed forward guidance regarding issuance volumes, maturities, coupon rates and auction dates, EGB demand shocks are unlikely to originate from informational frictions. Furthermore, in line with the preferred habitat theory (Greenwood et al., 2015b; Vayanos & Vila, 2021), shifts in underlying investor preferences are also unlikely to impact bid-to-cover ratios on auction days. However, EGB demand shocks may well arise in periods of increased uncertainty in financial markets, especially if investors seek to protect themselves against downside risks. Thus, the identified EGB demand shocks may primarily reflect temporary portfolio reallocations rather than persistent changes in economic fundamentals. Investors may have a higher demand for sovereign debt due to short-term liquidity preferences, maturity-specific investment strategies or flight-to-safety considerations, without materially revising their expectations regarding future economic activity. From the perspective of private debt issuers, firms can adjust the timing of their bond issuance well in advance in response to EGB auction schedules to mitigate crowding-out effects and thereby limit

transmission to aggregate private investment, as investors tend to prefer sovereign over corporate debt (Becker & Ivashina, 2018; Demirci et al., 2019). In such an environment, although EGB demand shocks may affect auction outcomes and sovereign yields contemporaneously, the transmission to household consumption, private investment, industrial production and real GDP may remain weak and short-lived. This is particularly relevant given that the VECM imposes long-run restrictions, implying that transitory shocks are not expected to generate persistent macroeconomic effects.

From an econometric perspective, the findings are robust to the inclusion of foreign EGB demand shocks, providing evidence that the statistical insignificance is not the result of a misspecified model, but instead reflects the absence of systematic transmission effects of EGB demand shocks onto the broader economy.

Furthermore, the EGB demand shocks and monetary policy shocks may be too small in magnitude to generate sizeable macroeconomic effects. Although both types of shocks influence financial conditions, their transmission to macroeconomic variables may be limited or offset by other economic and financial factors.

It is worth noting that previous studies on monetary policy transmission in the EA report similarly mixed and often statistically insignificant results. Barigozzi et al. (2014) find that the macroeconomic effects following monetary policy shocks often differ across countries. For Germany, France and Italy they find varying results in terms of both statistical significance and direction of the responses. When studying the EA, Jarociński and Karadi (2020) and Pfarrhofer and Stelzer (2025) find that the estimated effects are small and often statistically insignificant. Furthermore, different monetary policy shock identification methods tend to generate heterogeneous results regarding the effects of monetary policy shocks (Brennan et al., 2024). Together, these studies provide evidence relevant to our analysis and illustrate that our lack of significant findings is not unusual or unexpected in this strand of the literature for the EA.

8 Discussion

This chapter reviews the empirical findings presented in Chapter 7. It begins by evaluating the robustness of the estimated effects of EGB demand and monetary policy shocks, assessing their sensitivity to the inclusion of foreign EGB demand shocks. The analysis then turns to the policy implications of the results. This chapter further addresses potential limitations of the empirical approach, reviewing its internal validity. Additionally, the external validity of the findings is assessed as well as their relevance for different institutional settings. Finally, we present areas and extensions relevant for future research.

8.1 Robustness Checks

To assess the robustness of the baseline results and account for potential international spillover effects, we extend the baseline VECM by incorporating foreign EGB demand shocks within a VECM-X specification, as presented in Equation (5). Including these foreign shocks allows us to evaluate whether the estimated macroeconomic effects of domestic EGB demand shocks or monetary policy (information) shocks are sensitive to developments in foreign sovereign bond markets for Germany, France and Italy.

Importantly, the broadly insignificant responses remain stable across the VECM-X framework. This consistency suggests that the absence of strong macroeconomic effects is unlikely to be solely driven by omitted international spillovers.

8.1.1 Sensitivity of EGB Demand Shock Effects Across the Maturity Spectrum to Foreign EGB Demand Shocks

In response to EGB demand shocks, across all three countries, the results from the VECM-X specification were found to be robust and thus the macroeconomic effects of EGB demand shocks across the maturity spectrum do not seem to be sensitive to foreign demand shocks. The IRFs generated by the VECM-X specification remain qualitatively similar to the baseline VECM responses discussed in Section 7.2, with the direction and persistence across variables remaining largely unchanged. Real activity indicators remain weakly responsive and largely statistically insignificant, and core inflation and unemployment responses are unchanged. Overall, the inclusion of foreign EGB demand shocks does not materially alter the transmission mechanism, confirming the robustness of the baseline results, and suggests that the estimated effects are primarily driven by domestic dynamics rather than international spillover effects.

Nonetheless, there is evidence for international spillover effects from foreign EGB auctions, which Lengyel and Giuliodori (2022) also documented. Although foreign EGB demand shocks have insignificant effects on domestic macroeconomic variables and monetary policy channels, they can exert an effect on domestic bid-to-cover ratios, as reported in Table 5. Since bidding on domestic EGBs is also open to foreign investors, these investors may reallocate funds towards sovereign debt perceived as safer than that issued by their home governments, a phenomenon commonly referred to as flight to safety. The average effects of foreign EGB demand shocks on domestic bid-to-cover ratios are reported in the subsequent Table 5.

Country	Domestic EGB Shock	Foreign EGB Shock	Estimate	Std Error	p-value
Germany	Short-term	FR – Short-term	0.06	0.05	0.26
		IT – Short-term	-0.19	0.04	0.00***
	Medium-term	FR – Medium-term	-0.02	0.06	0.72
		IT – Medium-term	-0.00	0.05	0.97
	Long-term	FR – Long-term	0.14	0.04	0.00***
		IT – Long-term	-0.03	0.05	0.56
France	Short-term	DE – Short-term	-0.31	0.10	0.00***
		IT – Short-term	-0.22	0.09	0.02**
	Medium-term	DE – Medium-term	-0.04	0.07	0.60
		IT – Medium-term	-0.14	0.07	0.04**
	Long-term	DE – Long-term	0.03	0.07	0.64
		IT – Long-term	-0.07	0.05	0.18
Italy	Short-term	DE – Short-term	0.10	0.08	0.22
		FR – Short-term	0.04	0.03	0.28
	Medium-term	DE – Medium-term	0.08	0.06	0.21
		FR – Medium-term	-0.05	0.04	0.22
	Long-term	DE – Long-term	0.06	0.04	0.14
		FR – Long-term	-0.03	0.03	0.31

Table 5: International spillover estimates of foreign EGB demand shocks on domestic EGB demand shocks

Note: DE, FR, and IT denote Germany, France, and Italy, respectively. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

8.1.2 Sensitivity of Monetary Policy (Information) Shock Effects Across the Maturity Spectrum to Foreign EGB Demand Shocks

Following monetary policy (information) shocks, the results discussed in Section 7.3 remain broadly robust for the three countries when extending the baseline specification from the VECM to the VECM-X to account for foreign EGB demand shocks. The macroeconomic effects of monetary policy (information) shocks do not appear to be highly sensitive to the inclusion of foreign EGB demand shocks, but they are more sensitive than domestic EGB demand shocks, as discussed in Section 8.1.1.

Monetary policy (information) shocks lead to more significant findings, although similar magnitudes for German household consumption, private investment and real GDP when accounting for domestic and foreign demand shocks to short-term EGBs. When accounting for domestic and foreign demand shocks to long-term EGBs, household consumption, private investment, industrial production, unemployment rate and real GDP have more significant findings and larger magnitudes. Monetary policy (information) shocks, when accounting for domestic and foreign demand shocks to short-term EGBs, lead to almost identical responses on French macroeconomic variables as when foreign EGB demand shocks are excluded. When accounting for

demand shocks to long-term EGBs, the responses follow a similar pattern, but the magnitude of responses for household consumption, private investment and real GDP are larger and some become more statistically significant. The responses of Italian macroeconomic variables following a monetary policy (information) shock are robust when accounting for foreign EGB demand shocks regardless of maturity.

Overall, the inclusion of foreign EGB demand shocks in the VECM-X specification does not materially alter the effects of monetary policy (information) shocks across the three countries, providing some support for the robustness of the baseline results. However, the larger magnitudes and increased statistical significance observed in several macroeconomic variables for Germany and France, particularly when accounting for long-term EGB demand shocks, suggest that excluding foreign EGB demand shocks may underestimate the transmission of monetary policy (information) shocks to the real economy.

8.2 Policy Implications

It is important to note that we considered the effects of monetary policy shocks and EGB demand shocks. Since EGB demand shocks are driven by investors' portfolio preferences rather than policy actions (Vayanos & Vila, 2021), they do not constitute a direct policy instrument, as they cannot be directly influenced by policy decisions. Nonetheless, some important insights for policymakers can be derived from this research, as the findings carry indirect implications for governments' debt management. Indeed, there is evidence that the issuance of additional government debt can crowd-out corporate debt (Becker & Ivashina, 2018; Demirci et al., 2019). Thus, even if investors may be willing to acquire additional sovereign debt, governments may adversely affect the real economy, as debt-financed corporate investments may not materialise. Furthermore, even if governments may prefer to issue long-term debt in periods of heightened volatility to avoid refinancing risks, it is crucial to account for preferred habitat among investors (Vayanos & Vila, 2021). In practice, if governments were to issue long-term bonds instead of short-term EGBs, it is unlikely that investors' needs would be fully met. Overall, these results underscore the value of stable, rules-based issuance strategies that prioritise consistency and market clarity over attempts to influence macroeconomic outcomes through demand-side dynamics.

The findings presented in this thesis also have implications for monetary policy in the EA. We found evidence that the responses to monetary policy shocks and monetary policy information shocks differ when accounting for EGB demand shocks. For Germany, we found some evidence of attenuation when including EGB demand shocks, while for France we found evidence that excluding them may lead to an underestimation of the effects, and for Italy the evidence is inconclusive (noting that for all countries, many results are insignificant). A key policy implication of these findings is that the transmission of monetary policy may depend on conditions in sovereign bond markets, and that failing to account for EGB demand dynamics can lead policymakers to misjudge the strength of monetary policy transmission across EA economies. Furthermore, they suggest that the ECB should account for these dynamics when assessing the likely effects of policy interventions, as the interaction between monetary policy and government

bond demand may contribute to heterogeneous transmission across EA countries.

Our results suggest that the combined monetary policy shock was primarily driven by the information component. Although many of our results were not statistically significant, they nonetheless highlight the importance of policymakers taking into account the effects of monetary policy information shocks. Policymakers should recognise that households and financial markets respond not only to the policy decision itself, but also to the information communicated alongside it, which provides signals about their economic outlook. This also suggests that policymakers are able to influence the economy through communication, thereby allowing information itself to serve as an additional policy tool alongside other tools such as forward guidance.

Overall, while the results provide only limited support for the proposed hypotheses, they still offer meaningful policy insights. EGB demand shocks are broadly weak and statistically insignificant across countries and maturities, suggesting that they do not constitute a major macroeconomic destabilising force in the EA. By contrast, monetary policy shocks sometimes transmit to macroeconomic variables and exhibit more significant effects, indicating that monetary policy remains a moderately effective macroeconomic stabilisation instrument.

8.3 Limitations and Internal Validity

The construction of monthly macroeconomic control variables involves the interpolation of GDP components from quarterly to monthly frequency. While this is a common practice in empirical macroeconomics, it introduces a potential source of measurement error and bias. Nevertheless, this limitation is likely to be of secondary importance, as GDP and its components typically exhibit limited variation within a given quarter, mitigating the extent of distortion introduced by temporal disaggregation.

With respect to EGB demand shocks, the analysis is based on government bond auction results. An alternative would be to use a high-frequency identification strategy based on intra-day government futures price data. Bi et al. (2025) and Phillot (2025) first applied this method to identify Treasury supply shocks in the US. However, this approach would not allow an analysis over the same time horizon, as sufficiently long time series of futures prices are only available for Germany, but not for France and Italy. This limits its applicability in the present setting and motivated the use of auction results to identify EGB demand shocks.

The identification of monetary policy shocks does not account for monetary policy information shocks arising from speeches by members of the ECB Executive Board, only for monetary policy information shocks materialising during press conferences following an ECB Executive Board meeting. Recent work by Altavilla et al. (2025) introduces a novel methodology and provides the Euro Area Extended Monetary Policy Event-Study Database (EA-EMPD), which systematically captures such communication-driven policy signals. The omission of these information shocks may, in theory, lead to an incomplete measurement of the monetary policy stance, particularly in periods where forward guidance and central bank communication play a central role, though the resulting bias is likely limited.

8.4 External Validity

The external validity of the empirical findings depends on the extent to which the identified shocks and institutional settings can be generalised beyond Germany, France and Italy.

Regarding EGB demand shocks, the study achieves a relatively high degree of external validity within Europe by incorporating countries with different traditions in fiscal policy. In particular, the sample includes both high-debt-to-GDP countries, such as France and Italy, as well as Germany, which is a large low-debt-to-GDP benchmark country. This cross-country variation strengthens external validity by capturing different fiscal environments within the EA. However, the sample does not include countries that were severely affected by the European sovereign debt crisis such as Greece and Portugal. Investors' beliefs about countries that experienced acute sovereign stress in the past may fundamentally change, affecting their bidding behaviour for many years, even after a sovereign debt consolidation. The exclusion of these cases implies that the findings may not fully capture dynamics present in periods or jurisdictions affected by sovereign debt crises, thereby limiting external validity in such contexts.

Furthermore, comparability with the United States remains limited due to fundamental differences in sovereign debt management frameworks. As explained in Section 3.1, EGB issuance in the EA countries that were analysed is highly formalised and provides significant forward guidance to investors. On the other hand, the US Treasury operates under a different framework, which allows Treasury supply shocks to arise, as investigated by Bi et al. (2025) and Phillot (2025). In addition, unlike the euro, the US dollar serves as a reserve currency, which makes it more attractive to foreign investors and thus affects bidding behaviour during auctions. These institutional discrepancies constrain the extent to which the results can be extrapolated to the US setting.

With respect to monetary policy shocks, external validity is strong within the EA context. The analysis relies on the high-frequency identification approach developed by Altavilla et al. (2019), which has become a standard methodology for isolating exogenous monetary policy shocks in the EA. Because this framework is explicitly designed around the institutional features of the ECB and EA financial markets, the resulting estimates can be considered broadly applicable across EA countries. However, the same does not hold for non-EA jurisdictions such as the United States, the United Kingdom, or Japan, where differences in monetary policy implementation and market structure limit direct comparability.

8.5 Future Research

A natural extension would be applying this framework to the remaining 18 EA countries. While this thesis focuses on the three largest EA economies, the results indicate heterogeneity in the macroeconomic effects of EGB demand shocks and monetary policy shocks across countries. Extending the analysis to the remaining EA countries would therefore provide further insight into the transmission of these shocks.

Our methodological framework could be applied to the US (and other countries with the same institutional setup) by replacing Treasury demand shocks with Treasury supply shocks, build-

ing on the high-frequency identification approaches used in studies such as Bi et al. (2025) and Phillot (2025). Given the greater availability of high-frequency Treasury futures data in the US compared to the EA, this would allow for a more reliable identification of supply-side sovereign debt shocks while simultaneously accounting for maturity-specific effects and disentangled monetary policy and monetary policy information shocks.

Furthermore, Bi et al. (2025) consider two different types of Treasury supply shocks: debt volume shock (related to the level of public debt) and maturity adjustment shock (related to the maturity structure). Incorporating these into our framework could provide additional insight into whether changes in the quantity of debt issued or shifts in the maturity composition of sovereign debt have differing macroeconomic effects and transmission channels, particularly when analysed jointly with monetary policy (information) shocks.

Another extension would be to account for monetary policy information shocks arising from speeches by members of the ECB Executive Board outside the regular press conferences following ECB Executive Board meetings, using the event study database constructed by Altavilla et al. (2025). The authors argue that including these speeches in the analysis helps capture a more complete view of the impact of monetary policy on the real economy.

9 Conclusion

Motivated by the increasing reliance of governments and central banks on both fiscal and monetary policy to stabilise the EA economy, we analysed the joint effects of EGB demand shocks and monetary policy (information) shocks on key macroeconomic variables in Germany, France and Italy between January 2002 and September 2025. While the literature on fiscal and monetary policy individually is extensive, studies analysing these shocks together within the same empirical framework remain limited. Furthermore, we contribute to the literature by studying the combined impacts of EGB demand shocks and monetary policy information shocks, which appears to be absent from the existing literature.

Using EGB auction data and high-frequency monetary policy event data from the EA-MPD developed by Altavilla et al. (2019), we construct EGB demand shocks for short-, medium- and long-term securities as well as monetary policy and monetary policy information shocks. These shocks were incorporated into a VECM framework to evaluate their effects on household consumption, private investment, industrial production, core inflation, unemployment rate and real GDP.

Regarding our first hypothesis, we find only limited support for the effects of both EGB demand shocks and monetary policy (information) shocks. EGB demand shocks exhibit heterogeneous effects across countries, maturities, and model specifications. In Germany, short-term demand shocks generate significant contractionary effects, especially in a single shock setting, while these effects are attenuated when monetary policy shocks are included; long-term shocks remain negligible in both settings. In contrast, for France and Italy, EGB demand shocks across all maturities are statistically insignificant and robust to the inclusion of monetary policy shocks, providing no support for the hypothesis. For monetary policy shocks, Germany shows some evidence of attenuation, as the estimated effects of monetary policy shocks become smaller and less persistent when EGB demand shocks are included, although most effects remain statistically weak. In contrast, the French results point in the opposite direction, suggesting that excluding EGB demand shocks underestimates the impact of monetary policy, while the Italian evidence is inconclusive due to weak instruments and a general lack of statistical significance.

Across Germany, France and Italy, the results provide no empirical support for the second hypothesis that, when considering monetary policy shocks, demand shocks for short-term EGBs have stronger macroeconomic effects than those for long-term bonds. Instead, impulse responses across all maturities are generally small, statistically insignificant, and economically negligible, with no consistent differences between short- and long-term shocks. Overall, EGB demand shocks appear to have limited macroeconomic relevance irrespective of bond maturity, likely reflecting stable demand conditions shaped by regular sovereign debt issuance frameworks.

Finally, we do not find support for our third hypothesis. In all three countries, responses of combined monetary policy shocks and monetary policy information shocks move in the same direction rather than the expected opposing direction, suggesting that the effects of monetary policy shocks are largely driven by their information component. While the responses differ across countries – with mildly expansionary effects in Germany, contractionary effects in

France, and insignificant effects in Italy – the responses to combined monetary policy shocks and monetary policy information shocks remain broadly similar within each country.

Overall, the results provide limited support for the proposed hypotheses but still offer important policy insights. EGB demand shocks are generally weak and statistically insignificant across the three countries and maturities, suggesting limited macroeconomic destabilising effects in the EA. In contrast, monetary policy shocks sometimes exert measurable effects on macroeconomic variables, suggesting that monetary policy serves as a moderately effective instrument for macroeconomic stabilisation.

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Appendix

A.1 Data Mnemonics

Variable	Source	Mnemonic
Asset Price	DE: S&P Global (2026c)	^DAXK
	FR: S&P Global (2026a)	^PX1
	IT: S&P Global (2026b)	^FTSEMIB
Core Inflation	DE: ECB (2026g)	HICP.M.DE.N.XEF000.4D0.ANR
	FR: ECB (2026f)	HICP.M.FR.N.XEF000.4D0.ANR
	IT: ECB (2026h)	HICP.M.IT.N.XEF000.4D0.ANR
Credit Cost	DE: ECB (2026b)	MIR.M.DE.B.A2A.A.R.A.2240.EUR.N
	FR: ECB (2026a)	MIR.M.FR.B.A2A.A.R.A.2240.EUR.N
	IT: ECB (2026c)	MIR.M.IT.B.A2A.A.R.A.2240.EUR.N
Debt-to-GDP Ratio	Eurostat (2026f)	gov_10q_ggdebt
Deflator Data	Eurostat (2026a)	namq_10_gdp
Deposit Rate	ECB (2026d)	FM.D.U2.EUR.4F.KR.DFR.LEV
Euribor 12M rate	Eurostat (2026c)	irt_st_m
Exchange Rate	ECB (2026e)	EXR.M.E03.EUR.ERC0.A
Household Consumption	Eurostat (2026a)	namq_10_gdp
Industrial Production	Eurostat (2026e)	sts_inpr_m
Private Investment	Eurostat (2026d)	nasq_10_nf_tr
Real GDP	Eurostat (2026a)	namq_10_gdp
Unemployment Rate	Eurostat (2026g)	une_rt_m
VSTOXX	Refinitiv (2026)	.V2TX

Table 6: Data mnemonics

Note: DE, FR and IT refer to Germany, France and Italy, respectively.

A.2 Winsorised Bid-to-Cover Ratios

	Type	Date	BtC	WinBtC	UpperWinTail	LowerWinTail
1	FGBS	3 April 2002	4.20	3.94	0.26	0.00
2	FGBS	10 July 2002	4.40	3.94	0.46	0.00
3	FGBS	10 October 2007	4.00	3.94	0.06	0.00
4	FGBS	23 May 2018	1.00	1.10	0.00	-0.10
5	FGBS	17 May 2022	1.00	1.10	0.00	-0.10
6	FGBM	12 May 2004	3.30	3.25	0.05	0.00
7	FGBM	7 June 2023	3.60	3.25	0.35	0.00
8	FGBM	21 October 2025	4.00	3.25	0.75	0.00
9	FGBL	16 September 2015	1.00	1.10	0.00	-0.10
10	FGBL	11 April 2018	1.00	1.10	0.00	-0.10
11	FGBL	11 March 2020	1.00	1.10	0.00	-0.10
12	FGBL	7 April 2020	5.00	4.99	0.01	0.00
13	FGBL	18 October 2022	1.00	1.10	0.00	-0.10
14	FGBL	22 November 2023	5.90	4.99	0.91	0.00
15	FGBL	29 May 2024	8.40	4.99	3.41	0.00
16	FGBL	7 August 2024	5.10	4.99	0.11	0.00
17	FGBL	4 September 2024	5.50	4.99	0.51	0.00
18	FGBL	26 March 2025	7.80	4.99	2.81	0.00
19	FGBL	28 May 2025	5.80	4.99	0.81	0.00
20	FGBL	18 June 2025	7.40	4.99	2.41	0.00
21	FGBL	20 August 2025	1.00	1.10	0.00	-0.10

Table 7: German EGB auction dates with winsorised bid-to-cover ratios

Note: FGBS, FGBM and FGBL refer to short-, medium- and long-term bonds respectively.

	Type	Date	BtC	WinBtC	UpperWinTail	LowerWinTail
1	FRSTT	18 July 2002	5.66	5.46	0.20	0.00
2	FRSTT	17 November 2005	1.55	1.78	0.00	-0.23
3	FRSTT	18 October 2007	5.51	5.46	0.05	0.00
4	FRSTT	18 March 2010	1.72	1.78	0.00	-0.06
5	FRMTT	19 June 2003	1.33	1.52	0.00	-0.19
6	FRMTT	16 June 2005	1.52	1.52	0.00	-0.00
7	FRMTT	15 June 2006	5.75	5.44	0.31	0.00
8	FRMTT	20 March 2008	6.62	5.44	1.18	0.00
9	FRMTT	17 July 2008	1.41	1.52	0.00	-0.11
10	FRMTT	16 October 2008	6.75	5.44	1.31	0.00
11	FRMTT	21 January 2010	1.49	1.52	0.00	-0.03
12	FRMTT	20 January 2011	5.44	5.44	0.00	0.00
13	FRMTT	20 June 2013	1.43	1.52	0.00	-0.09
14	FRMTT	19 February 2015	1.37	1.52	0.00	-0.15
15	FRMTT	20 June 2019	6.26	5.44	0.82	0.00
16	FRMTT	20 May 2020	7.62	5.44	2.18	0.00
17	FRLTT	9 January 2003	5.46	5.04	0.42	0.00
18	FRLTT	19 February 2004	1.29	1.41	0.00	-0.12
19	FRLTT	16 September 2004	6.96	5.04	1.92	0.00
20	FRLTT	19 April 2007	6.60	5.04	1.56	0.00
21	FRLTT	6 March 2008	1.20	1.41	0.00	-0.21
22	FRLTT	16 October 2008	6.15	5.04	1.11	0.00
23	FRLTT	6 November 2008	5.15	5.04	0.11	0.00
24	FRLTT	20 November 2008	5.63	5.04	0.59	0.00
25	FRLTT	5 March 2009	5.09	5.04	0.05	0.00
26	FRLTT	2 September 2010	1.28	1.41	0.00	-0.13
27	FRLTT	2 December 2010	5.06	5.04	0.02	0.00
28	FRLTT	6 November 2014	1.39	1.41	0.00	-0.02
29	FRLTT	19 March 2015	5.37	5.04	0.33	0.00
30	FRLTT	2 July 2015	1.35	1.41	0.00	-0.06
31	FRLTT	1 February 2018	1.34	1.41	0.00	-0.07
32	FRLTT	1 February 2018	1.24	1.41	0.00	-0.17
33	FRLTT	3 May 2018	1.35	1.41	0.00	-0.06
34	FRLTT	5 July 2018	1.39	1.41	0.00	-0.02
35	FRLTT	2 August 2018	1.31	1.41	0.00	-0.10
36	FRLTT	6 September 2018	1.38	1.41	0.00	-0.03
37	FRLTT	4 October 2018	1.39	1.41	0.00	-0.02
38	FRLTT	6 June 2019	5.77	5.04	0.73	0.00
39	FRLTT	5 September 2019	1.35	1.41	0.00	-0.06
40	FRLTT	19 March 2020	1.28	1.41	0.00	-0.13
41	FRLTT	6 February 2025	5.73	5.04	0.69	0.00
42	FRLTT	17 April 2025	5.25	5.04	0.21	0.00
43	FRLTT	19 June 2025	5.70	5.04	0.66	0.00
44	FRLTT	16 October 2025	5.15	5.04	0.11	0.00

Table 8: French EGB auction dates with winsorised bid-to-cover ratios

Note: FRSTT, FRMTT and FRLTT refer to short-, medium- and long-term bonds respectively.

	Type	Date	BtC	WinBtC	UpperWinTail	LowerWinTail
1	ITSTT	31 January 2008	9.64	7.35	2.29	0.00
2	ITMTT	14 November 2003	8.70	8.46	0.24	0.00
3	ITMTT	14 July 2006	8.88	8.46	0.42	0.00
4	ITMTT	31 March 2008	11.27	8.46	2.81	0.00
5	ITMTT	30 April 2008	9.55	8.46	1.09	0.00
6	ITMTT	31 July 2008	8.78	8.46	0.32	0.00
7	ITMTT	30 September 2008	8.52	8.46	0.06	0.00
8	ITMTT	15 October 2008	9.49	8.46	1.04	0.00
9	ITMTT	15 October 2008	9.96	8.46	1.50	0.00
10	ITMTT	31 January 2012	9.33	8.46	0.88	0.00
11	ITMTT	13 April 2012	8.62	8.46	0.17	0.00
12	ITMTT	30 April 2012	9.29	8.46	0.83	0.00
13	ITLTT	13 September 2002	8.95	7.69	1.26	0.00
14	ITLTT	14 September 2005	7.70	7.69	0.01	0.00
15	ITLTT	27 February 2007	8.25	7.69	0.57	0.00
16	ITLTT	28 June 2007	10.72	7.69	3.04	0.00
17	ITLTT	31 January 2008	9.30	7.69	1.61	0.00
18	ITLTT	29 February 2008	8.82	7.69	1.14	0.00
19	ITLTT	31 March 2008	8.20	7.69	0.51	0.00
20	ITLTT	30 September 2008	7.88	7.69	0.19	0.00
21	ITLTT	15 July 2009	8.28	7.69	0.60	0.00
22	ITLTT	15 July 2009	9.55	7.69	1.87	0.00
23	ITLTT	14 March 2011	8.23	7.69	0.55	0.00
24	ITLTT	14 September 2011	8.70	7.69	1.01	0.00
25	ITLTT	14 September 2011	7.93	7.69	0.25	0.00
26	ITLTT	30 April 2012	9.52	7.69	1.83	0.00
27	ITLTT	1 July 2016	8.20	7.69	0.51	0.00
28	ITLTT	14 June 2019	8.13	7.69	0.44	0.00

Table 9: Italian EGB auction dates with winsorised bid-to-cover ratios

Note: ITSTT, ITMTT and ITLTT refer to short-, medium- and long-term bonds respectively.

A.3 Unit Root Test Results

A.3.1 Unit Root Test Results for Monetary Policy Channel Variables and Macroeconomic Variables

	ADF			PP			KPSS		
Variable	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV
LogDAX	-0.99	-2.87	-2.57	-0.90	-2.87	-2.57	3.79	0.46	0.35
DECreditCost	-1.71	-2.87	-2.57	-1.76	-2.87	-2.57	1.64	0.46	0.35
REER40	-2.58	-2.87	-2.57	-2.40	-2.87	-2.57	2.21	0.46	0.35
DELogHHFCE	-2.55	-2.87	-2.57	-1.10	-2.87	-2.57	4.41	0.46	0.35
DELogGFCF	-2.53	-2.87	-2.57	-1.59	-2.87	-2.57	3.88	0.46	0.35
DELvlIndPro	-14.47	-2.87	-2.57	-16.86	-2.87	-2.57	0.11	0.46	0.35
DELvlCCPI	-2.21	-2.87	-2.57	-2.50	-2.87	-2.57	1.87	0.46	0.35
DELvlU	-0.66	-2.87	-2.57	-0.60	-2.87	-2.57	4.31	0.46	0.35
DELogRGDP	-1.79	-2.87	-2.57	-1.18	-2.87	-2.57	4.61	0.46	0.35

Table 10: ADF, PP, and KPSS tests with 5% and 10% critical values for Germany's monetary policy channel variables and macroeconomic variables

Note: The null hypothesis of both the ADF and PP test is that the series has a unit-root. The null hypothesis of the KPSS test is that the series is stationary. LogDAX denotes the logarithm of the German DAX index. DECreditCost refers to credit costs in Germany. REER40 is the real effective exchange rate (based on a 40-country basket). DELogHHFCE denotes the logarithm of German household final consumption expenditure. DELogGFCF is the logarithm of gross fixed capital formation. DELvlIndPro represents the level of industrial production. DELvlCCPI refers to core inflation. DELvlU denotes the unemployment rate. DELogRGDP is the logarithm of real gross domestic product.

	ADF			PP			KPSS		
Variable	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV
LogCAC	-1.20	-2.87	-2.57	-1.12	-2.87	-2.57	2.89	0.46	0.35
FRCreditCost	-1.52	-2.87	-2.57	-1.66	-2.87	-2.57	1.31	0.46	0.35
REER40	-2.58	-2.87	-2.57	-2.40	-2.87	-2.57	2.21	0.46	0.35
FRLogHHFCE	-2.61	-2.87	-2.57	-1.64	-2.87	-2.57	4.41	0.46	0.35
FRLogGFCF	-3.00	-2.87	-2.57	-1.76	-2.87	-2.57	3.59	0.46	0.35
FRLvlIndPro	-16.11	-2.87	-2.57	-16.90	-2.87	-2.57	0.04	0.46	0.35
FRLvlCCPI	-1.67	-2.87	-2.57	-2.07	-2.87	-2.57	0.65	0.46	0.35
FRLvlU	-1.75	-2.87	-2.57	-1.30	-2.87	-2.57	1.13	0.46	0.35
FRLogRGDP	-2.41	-2.87	-2.57	-1.38	-2.87	-2.57	4.38	0.46	0.35

Table 11: ADF, PP, and KPSS tests with 5% and 10% critical values for France's monetary policy channel variables and macroeconomic variables

Note: The null hypothesis of both the ADF and PP test is that the series has a unit-root. The null hypothesis of the KPSS test is that the series is stationary. LogCAC denotes the logarithm of the French CAC index. FRCreditCost refers to credit costs in France. REER40 is the real effective exchange rate (based on a 40-country basket). FRLogHHFCE denotes the logarithm of French household final consumption expenditure. FRLogGFCF is the logarithm of gross fixed capital formation. FRLvlIndPro represents the level of industrial production. FRLvlCCPI refers to the consumer price index. FRLvlU denotes the unemployment rate. FRLogRGDP is the logarithm of real gross domestic product.

	ADF			PP			KPSS		
Variable	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV
LogMIB	-1.51	-2.87	-2.57	-1.56	-2.87	-2.57	0.83	0.46	0.35
ITCreditCost	-1.70	-2.87	-2.57	-1.75	-2.87	-2.57	1.26	0.46	0.35
REER40	-2.58	-2.87	-2.57	-2.40	-2.87	-2.57	2.21	0.46	0.35
ITLogHHFCE	-5.79	-2.87	-2.57	-2.87	-2.87	-2.57	0.44	0.46	0.35
ITLogGFCF	-2.58	-2.87	-2.57	-1.22	-2.87	-2.57	0.96	0.46	0.35
ITLvlIndPro	-15.58	-2.87	-2.57	-17.87	-2.87	-2.57	0.06	0.46	0.35
ITLvlCCPI	-2.55	-2.87	-2.57	-2.52	-2.87	-2.57	0.59	0.46	0.35
ITLvlU	-0.50	-2.87	-2.57	-0.51	-2.87	-2.57	1.04	0.46	0.35
ITLogRGDP	-4.69	-2.87	-2.57	-2.34	-2.87	-2.57	0.53	0.46	0.35

Table 12: ADF, PP, and KPSS tests with 5% and 10% critical values for Italy's monetary policy channel variables and macroeconomic variables

Note: The null hypothesis of both the ADF and PP test is that the series has a unit-root. The null hypothesis of the KPSS test is that the series is stationary. LogMIB denotes the logarithm of the Italian FTSE MIB index. ITCreditCost refers to credit costs in Italy. REER40 is the real effective exchange rate (based on a 40-country basket). ITLogHHFCE denotes the logarithm of Italian household final consumption expenditure. ITLogGFCF is the logarithm of gross fixed capital formation. ITLvlIndPro represents the level of industrial production. ITLvlCCPI refers to the consumer price index. ITLvlU denotes the unemployment rate. ITLogRGDP is the logarithm of real gross domestic product.

A.3.2 Unit Root Test Results for Instruments and Policy Variables

	ADF			PP			KPSS		
Variable	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV
TotMPS	-15.25	-2.87	-2.57	-20.32	-2.87	-2.57	0.51	0.46	0.35
TotMPIS	-14.64	-2.87	-2.57	-19.55	-2.87	-2.57	0.22	0.46	0.35
MonthlyInnovFGBS	-12.57	-2.87	-2.57	-16.41	-2.87	-2.57	0.05	0.46	0.35
MonthlyInnovFGBM	-11.59	-2.87	-2.57	-16.21	-2.87	-2.57	0.14	0.46	0.35
MonthlyInnovFGBL	-13.76	-2.87	-2.57	-17.57	-2.87	-2.57	0.29	0.46	0.35
Euribor12M	-2.15	-2.87	-2.57	-1.71	-2.87	-2.57	1.54	0.46	0.35
BtCFGBS	-14.20	-2.87	-2.57	-18.04	-2.87	-2.57	0.87	0.46	0.35
BtCFGBM	-10.69	-2.87	-2.57	-15.05	-2.87	-2.57	2.14	0.46	0.35
BtCFGBL	-9.16	-2.87	-2.57	-13.67	-2.87	-2.57	2.87	0.46	0.35

Table 13: ADF, PP, and KPSS tests with 5% and 10% critical values for Germany's instruments and policy variables

Note: The null hypothesis of both the ADF and PP test is that the series has a unit-root. The null hypothesis of the KPSS test is that the series is stationary. TotMPS and TotMPIS refer to the combined monetary policy shock and monetary policy information shock respectively. MonthlyInnovFGBS, MonthlyInnovFGBM and MonthlyInnovFGBL denote to short-, medium- and long-term EGB demand shocks respectively. Euribor12M refers to the 12-month Euribor rate. BtCFGBS, BtCFGBM and BtCFGBL denote the bid-to-cover ratio for short-, medium- and long-term bonds respectively.

	ADF			PP			KPSS		
Variable	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV
TotMPS	-15.25	-2.87	-2.57	-20.32	-2.87	-2.57	0.51	0.46	0.35
TotMPIS	-14.64	-2.87	-2.57	-19.55	-2.87	-2.57	0.22	0.46	0.35
MonthlyInnovFRSTT	-12.17	-2.87	-2.57	-16.59	-2.87	-2.57	0.32	0.46	0.35
MonthlyInnovFRMTT	-11.96	-2.87	-2.57	-16.79	-2.87	-2.57	0.23	0.46	0.35
MonthlyInnovFRLTT	-10.32	-2.87	-2.57	-16.30	-2.87	-2.57	0.37	0.46	0.35
Euribor12M	-2.15	-2.87	-2.57	-1.71	-2.87	-2.57	1.54	0.46	0.35
BtCFRSTT	-8.66	-2.87	-2.57	-13.49	-2.87	-2.57	3.54	0.46	0.35
BtCFRMTT	-12.38	-2.87	-2.57	-16.10	-2.87	-2.57	0.45	0.46	0.35
BtCFRLTT	-13.47	-2.87	-2.57	-16.66	-2.87	-2.57	0.15	0.46	0.35

Table 14: ADF, PP, and KPSS tests with 5% and 10% critical values for France's instruments and policy variables

Note: The null hypothesis of both the ADF and PP test is that the series has a unit-root. The null hypothesis of the KPSS test is that the series is stationary. TotMPS and TotMPIS refer to the combined monetary policy shock and monetary policy information shock respectively. MonthlyInnovFRSTT, MonthlyInnovFRMTT and MonthlyInnovFRLTT denote to short-, medium- and long-term EGB demand shocks respectively. Euribor12M refers to the 12-month Euribor rate. BtCFRSTT, BtCFRMTT and BtCFRLTT denote the bid-to-cover ratio for short-, medium- and long-term bonds respectively.

	ADF			PP			KPSS		
Variable	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV	Statistic	5% CV	10% CV
TotMPS	-15.25	-2.87	-2.57	-20.32	-2.87	-2.57	0.51	0.46	0.35
TotMPIS	-14.64	-2.87	-2.57	-19.55	-2.87	-2.57	0.22	0.46	0.35
MonthlyInnovITSTT	-10.78	-2.87	-2.57	-15.73	-2.87	-2.57	1.19	0.46	0.35
MonthlyInnovITMTT	-11.86	-2.87	-2.57	-15.79	-2.87	-2.57	1.10	0.46	0.35
MonthlyInnovITLTT	-11.86	-2.87	-2.57	-17.58	-2.87	-2.57	0.67	0.46	0.35
Euribor12M	-2.15	-2.87	-2.57	-1.71	-2.87	-2.57	1.54	0.46	0.35
BtCITSTT	-7.13	-2.87	-2.57	-11.68	-2.87	-2.57	1.71	0.46	0.35
BtCITMTT	-11.59	-2.87	-2.57	-16.49	-2.87	-2.57	0.33	0.46	0.35
BtCITLTT	-12.32	-2.87	-2.57	-16.92	-2.87	-2.57	0.06	0.46	0.35

Table 15: ADF, PP, and KPSS tests with 5% and 10% critical values for Italy's instruments and policy variables

Note: The null hypothesis of both the ADF and PP test is that the series has a unit-root. The null hypothesis of the KPSS test is that the series is stationary. TotMPS and TotMPIS refer to the combined monetary policy shock and monetary policy information shock respectively. MonthlyInnovITSTT, MonthlyInnovITMTT and MonthlyInnovITLTT denote to short-, medium- and long-term EGB demand shocks respectively. Euribor12M refers to the 12-month Euribor rate. BtCITSTT, BtCITMTT and BtCITLTT denote the bid-to-cover ratio for short-, medium- and long-term bonds respectively.

A.4 Johansen Trace Cointegration Test Results

Total Monetary Policy Shock			**X**		**X**		**X**	
Monetary Policy Information Shock				**X**		**X**		**X**
Treasury Demand Shock Type			**ST**	**ST**	**MT**	**MT**	**LT**	**LT**
H_0	**5% CV**	**10% CV**	**Trace-Test Results**					
r = 0	**310.81**	**303.13**	596.89	596.89	624.82	624.82	607.15	607.15
r ≤ 1	**263.42**	**256.72**	396.33	396.33	422.12	422.12	407.02	407.02
r ≤ 2	**222.21**	**215.17**	293.14	293.14	316.88	316.88	296.45	296.45
r ≤ 3	**182.82**	**176.67**	202.3	202.3	216.6	216.6	213.38	213.38
r ≤ 4	**146.76**	**141.01**	146.93	146.93	149.45	149.45	146.45	146.45
r ≤ 5	**114.9**	**110.42**	101.02	101.02	102.3	102.3	101	101
r ≤ 6	**87.31**	**83.2**	73.15	73.15	72.74	72.74	72.26	72.26
r ≤ 7	**62.99**	**59.14**	47.27	47.27	47.32	47.32	46.31	46.31
r ≤ 8	**42.44**	**39.06**	26.82	26.82	26.58	26.58	25.62	25.62
r ≤ 9	**25.32**	**22.76**	11.09	11.09	10.63	10.63	10.33	10.33
r ≤ 10	**12.25**	**10.49**	2.69	2.69	2.6	2.6	2.46	2.46

Table 16: Johansen Trace test results for Germany

Note: The null hypothesis is that the number of cointegrating relationships is less than or equal to r. ST, MT and LT refer to the type of EGB considered based on their original maturity: ST stands for short-term, MT for medium-term and LT for long-term. Albeit being similar within maturities, the reported Trace test results are correct.

Total Monetary Policy Shock			**X**		**X**		**X**	
Monetary Policy Information Shock				**X**		**X**		**X**
Treasury Demand Shock Type			**ST**	**ST**	**MT**	**MT**	**LT**	**LT**
H0	**5% CV**	**10% CV**	**Trace-Test Results**					
r = 0	**310.81**	**303.13**	688.9	688.9	685.72	685.72	661.43	661.43
r ≤ 1	**263.42**	**256.72**	427.79	427.79	420.53	420.53	399.3	399.3
r ≤ 2	**222.21**	**215.17**	288.2	288.2	286	286	283.28	283.28
r ≤ 3	**182.82**	**176.67**	214.33	214.33	214.47	214.47	212.07	212.07
r ≤ 4	**146.76**	**141.01**	155.96	155.96	155.51	155.51	153.76	153.76
r ≤ 5	**114.9**	**110.42**	110.98	110.98	109.05	109.05	107.43	107.43
r ≤ 6	**87.31**	**83.2**	73.96	73.96	72.87	72.87	73.72	73.72
r ≤ 7	**62.99**	**59.14**	46.87	46.87	46.24	46.24	47.25	47.25
r ≤ 8	**42.44**	**39.06**	26.06	26.06	26.19	26.19	26.5	26.5
r ≤ 9	**25.32**	**22.76**	13.94	13.94	14.05	14.05	14.09	14.09
r ≤ 10	**12.25**	**10.49**	4.23	4.23	4.09	4.09	4.2	4.2

Table 17: Johansen Trace test results for France

Note: The null hypothesis is that the number of cointegrating relationships is less than or equal to r. ST, MT and LT refer to the type of EGB considered based on their original maturity: ST stands for short-term, MT for medium-term and LT for long-term. Albeit being similar within maturities, the reported Trace test results are correct.

Total Monetary Policy Shock			**X**		**X**		**X**	
Monetary Policy Information Shock				**X**		**X**		**X**
Treasury Demand Shock Type			**ST**	**ST**	**MT**	**MT**	**LT**	**LT**
H0	**5% CV**	**10% CV**	**Trace-Test Results**					
r = 0	**310.81**	**303.13**	673.5	673.5	672.43	672.43	673.98	673.98
r ≤ 1	**263.42**	**256.72**	472.88	472.88	476.93	476.93	478.71	478.71
r ≤ 2	**222.21**	**215.17**	352.22	352.22	356.22	356.22	355.43	355.43
r ≤ 3	**182.82**	**176.67**	251.1	251.1	254.77	254.77	253.89	253.89
r ≤ 4	**146.76**	**141.01**	180.24	180.24	182.62	182.62	182.1	182.1
r ≤ 5	**114.9**	**110.42**	124.83	124.83	126.14	126.14	126	126
r ≤ 6	**87.31**	**83.2**	80.18	80.18	80.98	80.98	81.33	81.33
r ≤ 7	**62.99**	**59.14**	53.79	53.79	53.89	53.89	53.94	53.94
r ≤ 8	**42.44**	**39.06**	31.74	31.74	31.94	31.94	31.73	31.73
r ≤ 9	**25.32**	**22.76**	16.4	16.4	16.58	16.58	16.35	16.35
r ≤ 10	**12.25**	**10.49**	3.38	3.38	3.37	3.37	3.3	3.3

Table 18: Johansen Trace test results for Italy

Note: The null hypothesis is that the number of cointegrating relationships is less than or equal to r. ST, MT and LT refer to the type of EGB considered based on their original maturity: ST stands for short-term, MT for medium-term and LT for long-term. Albeit being similar within maturities, the reported Trace test results are correct.

A.5 F-Test Results for the Instrument Relevance

Country	Instrument	Regressor	NW F-statistics	NW p-value
Germany	TotMPIS	resids of Euribor12M	18.53	0.00
	MonthlyInnovFGBL	resids of BtCFGBL	11.21	0.00
	TotMPIS	resids of Euribor12M	19.42	0.00
	MonthlyInnovFGBM	resids of BtCFGBM	61.09	0.00
	TotMPIS	resids of Euribor12M	18.78	0.00
	MonthlyInnovFGBS	resids of BtCFGBS	146.83	0.00
Germany	TotMPS	resids of Euribor12M	11.25	0.00
	MonthlyInnovFGBL	resids of BtCFGBL	11.21	0.00
	TotMPS	resids of Euribor12M	9.70	0.00
	MonthlyInnovFGBM	resids of BtCFGBM	61.09	0.00
	TotMPS	resids of Euribor12M	10.58	0.00
	MonthlyInnovFGBS	resids of BtCFGBS	146.83	0.00
France	TotMPIS	resids of Euribor12M	12.62	0.00
	MonthlyInnovFRLTT	resids of BtCFRLTT	48.40	0.00
	TotMPIS	resids of Euribor12M	11.80	0.00
	MonthlyInnovFRMTT	resids of BtCFRMTT	64.98	0.00
	TotMPIS	resids of Euribor12M	14.48	0.00
	MonthlyInnovFRSTT	resids of BtCFRSTT	37.87	0.00
France	TotMPS	resids of Euribor12M	9.49	0.00
	MonthlyInnovFRLTT	resids of BtCFRLTT	48.40	0.00
	TotMPS	resids of Euribor12M	9.54	0.00
	MonthlyInnovFRMTT	resids of BtCFRMTT	64.98	0.00
	TotMPS	resids of Euribor12M	10.54	0.00
	MonthlyInnovFRSTT	resids of BtCFRSTT	37.87	0.00
Italy	TotMPIS	resids of Euribor12M	8.50	0.00
	MonthlyInnovITLTT	resids of BtCITLTT	17.86	0.00
	TotMPIS	resids of Euribor12M	9.19	0.00
	MonthlyInnovITMTT	resids of BtCITMTT	7.39	0.01
	TotMPIS	resids of Euribor12M	7.93	0.00
	MonthlyInnovITSTT	resids of BtCITSTT	246.61	0.00
Italy	TotMPS	resids of Euribor12M	6.45	0.01
	MonthlyInnovITLTT	resids of BtCITLTT	17.86	0.00
	TotMPS	resids of Euribor12M	6.71	0.01
	MonthlyInnovITMTT	resids of BtCITMTT	7.39	0.01
	TotMPS	resids of Euribor12M	6.14	0.01
	MonthlyInnovITSTT	resids of BtCITSTT	246.61	0.00

Table 19: F-test for H_0 that the instrument is irrelevant

Note: See the notes under Table 13, 14 and 15 for the acronyms related to Germany, France and Italy, respectively.

A.6 Impulse Responses Relating to Medium-term Sovereign Bonds

When interpreting all of the IRFs in this subsection the solid lines denote the point estimates. Darker shaded areas represent 90% confidence intervals, while lighter shaded areas represent 95% confidence intervals. Household consumption, private investment and real GDP are measured in logs of millions of euros. Industrial production, core inflation and unemployment are measured in percent.

A.6.1 Impulse Responses of a Medium-Term EGB Demand Shock

Single Shock Setting

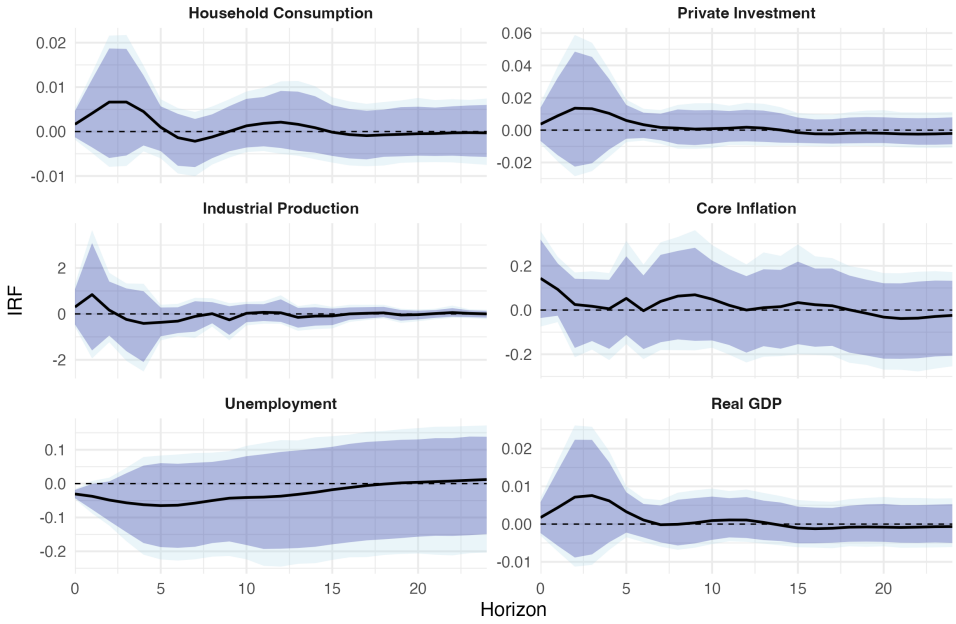

Figure 35: Germany – IRFs of a demand shock to medium-term EGBs

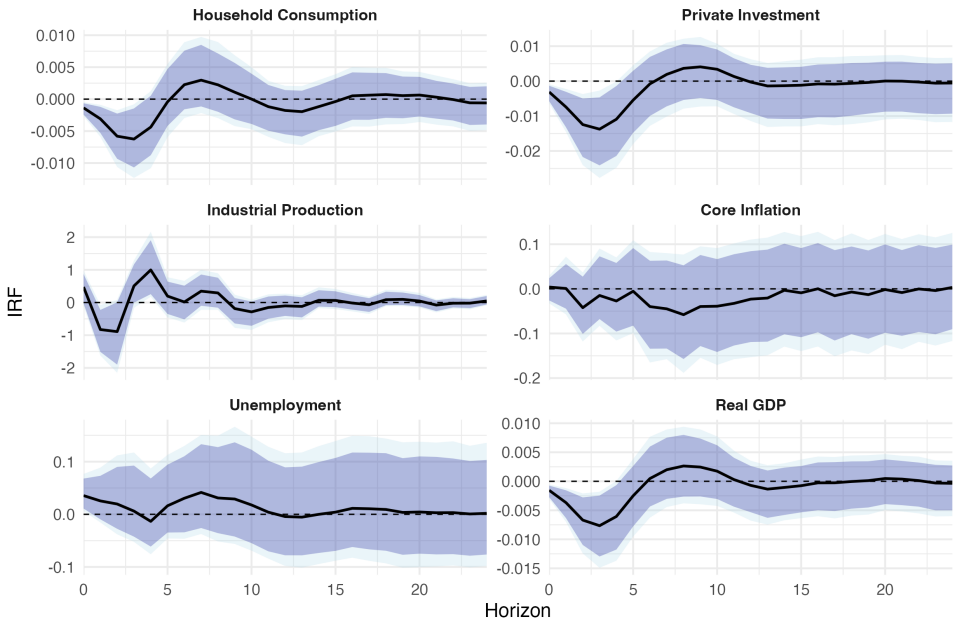

Figure 36: France – IRFs of a demand shock to medium-term EGBs

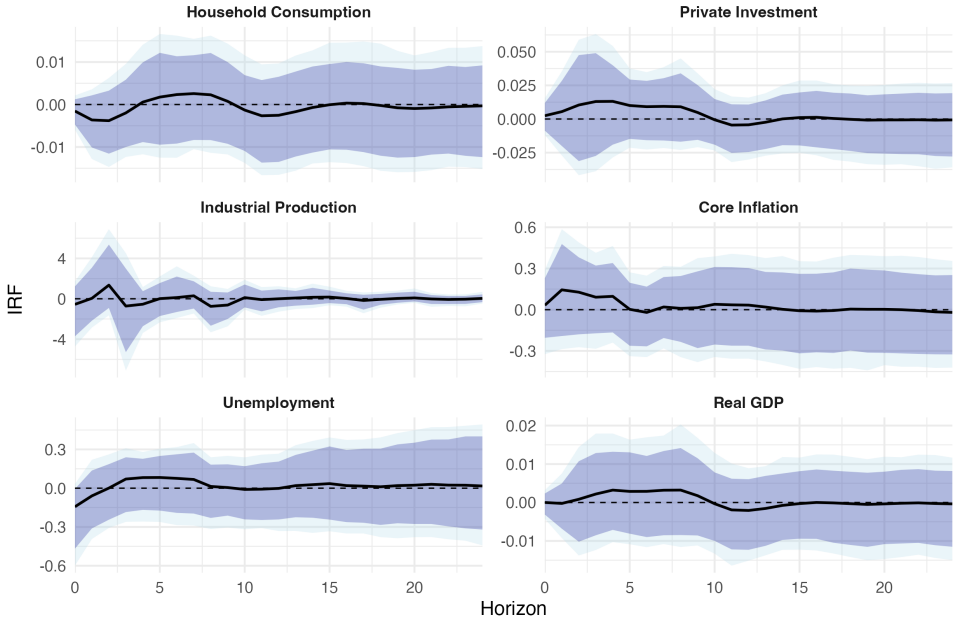

Figure 37: Italy – IRFs of a demand shock to medium-term EGBs

Dual Shock Setting

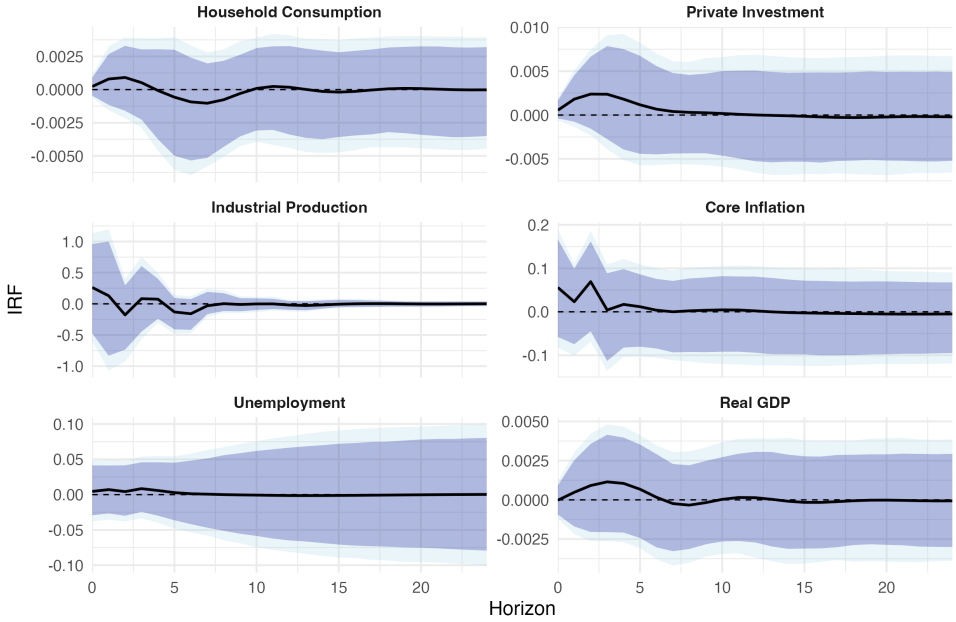

Figure 38: Germany – IRFs of a demand shock to medium-term EGBs, accounting for monetary policy shocks

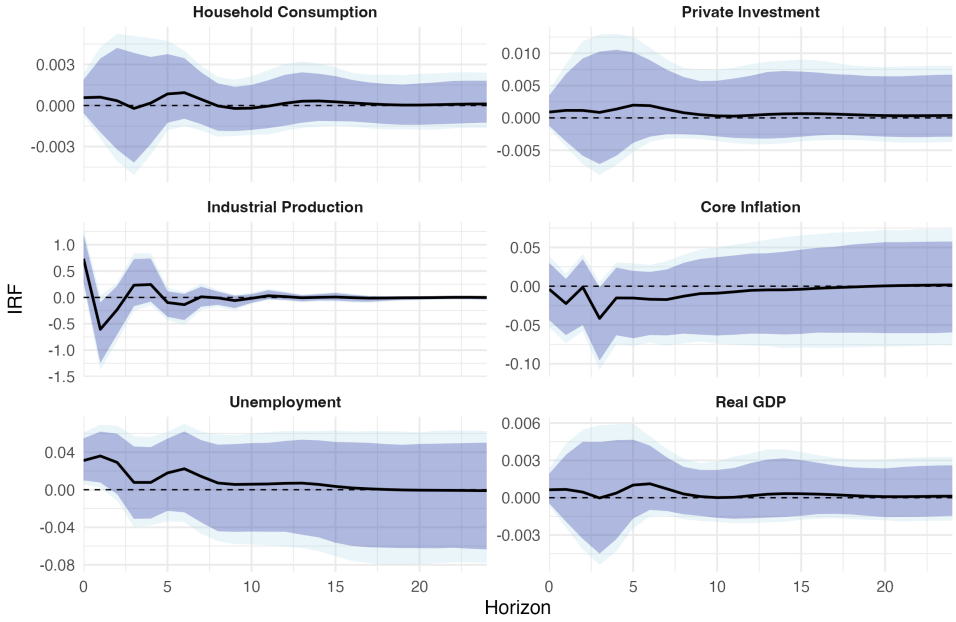

Figure 39: France – IRFs of a demand shock to medium-term EGBs, accounting for monetary policy shocks

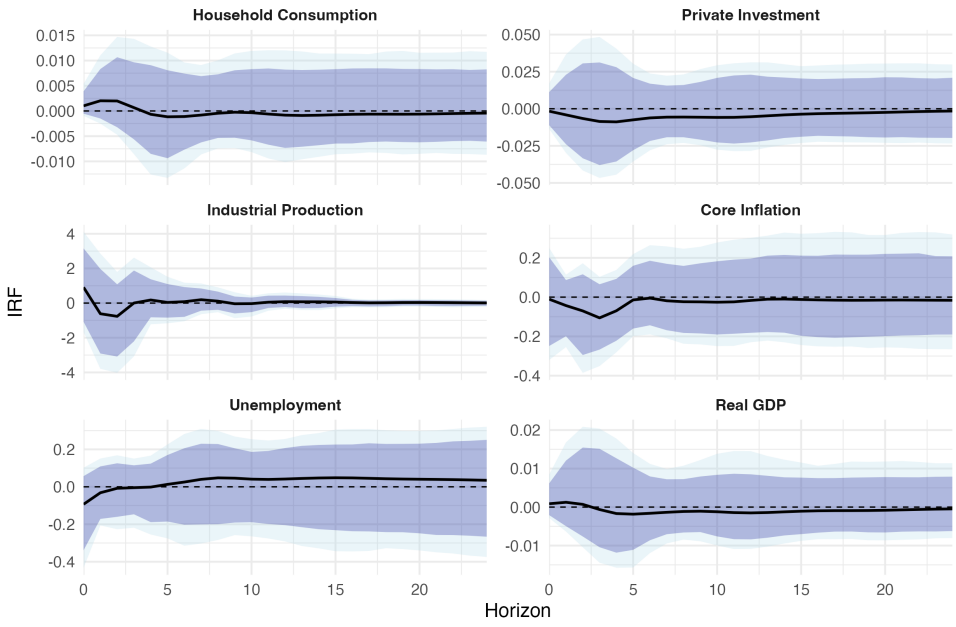

Figure 40: Italy – IRFs of a demand shock to medium-term EGBs, accounting for monetary policy shocks

A.6.2 Impulse Responses of Monetary Policy (Information) Shocks

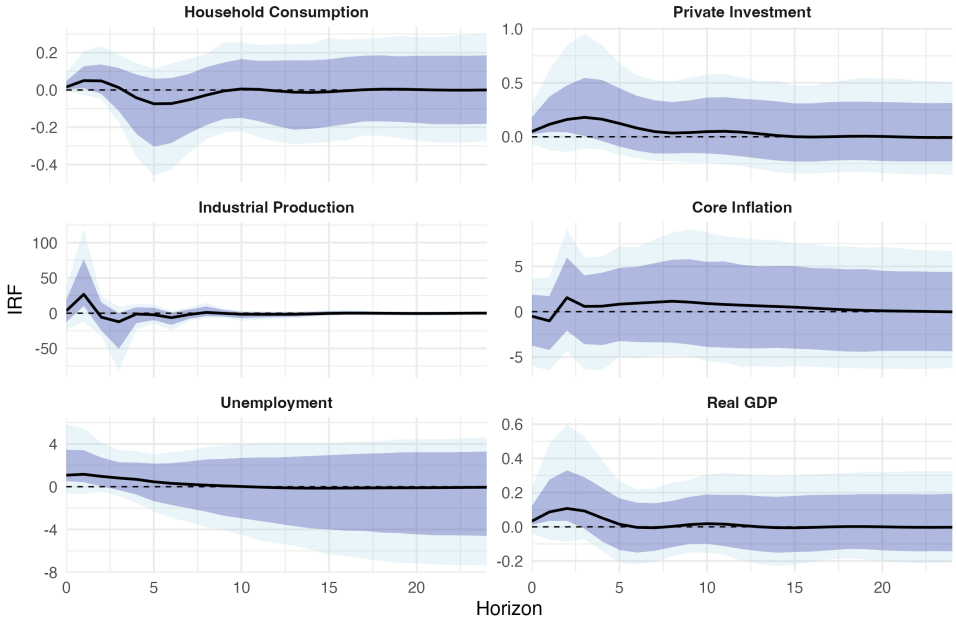

Figure 41: Germany – IRFs of a combined monetary policy shock, accounting for demand shocks to medium-term EGBs

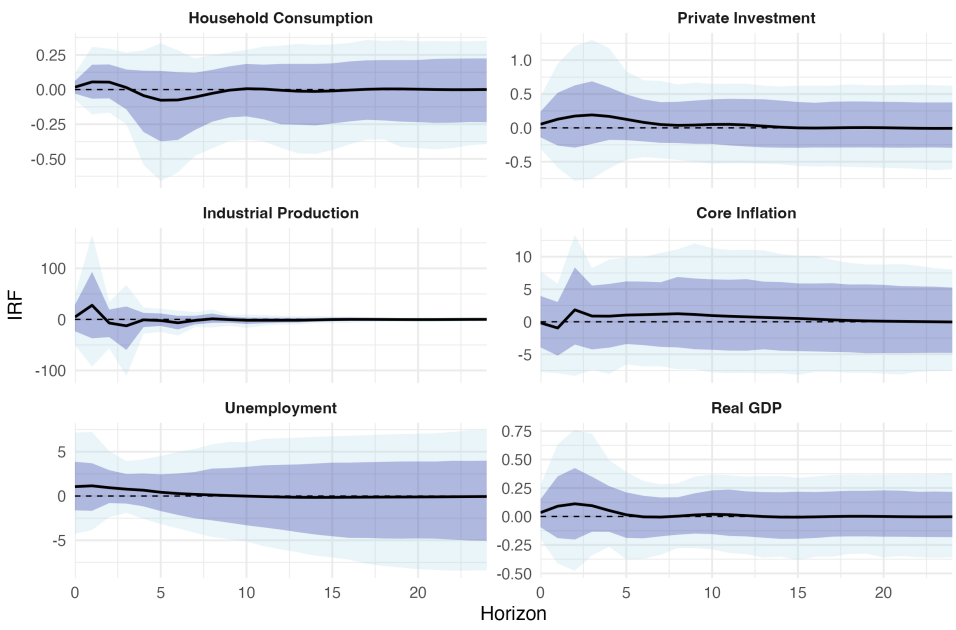

Figure 42: Germany – IRFs of a monetary policy information shock, accounting for demand shocks to medium-term EGBs

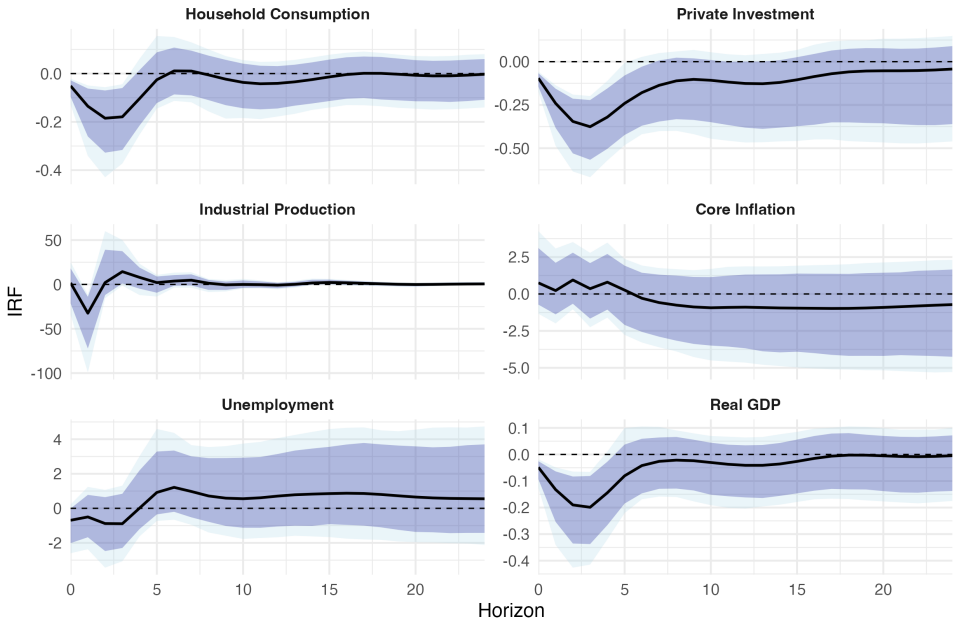

Figure 43: France – IRFs of a combined monetary policy shock, accounting for demand shocks to medium-term EGBs

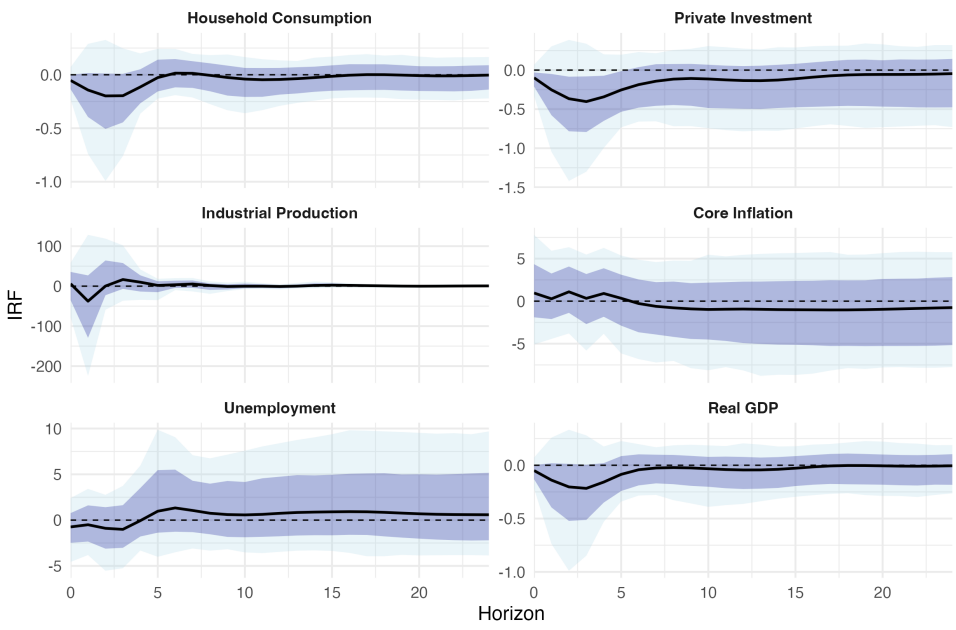

Figure 44: France – IRFs of a monetary policy information shock, accounting for demand shocks to medium-term EGBs

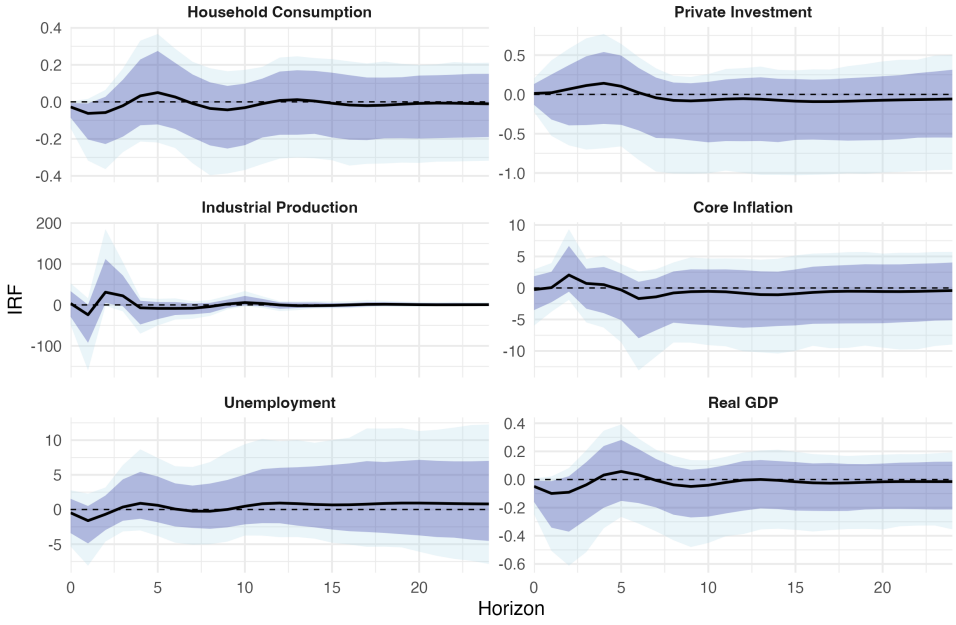

Figure 45: Italy – IRFs of a combined monetary policy shock, accounting for demand shocks to medium-term EGBs

Figure 46: Italy – IRFs of a monetary policy information shock, accounting for demand shocks to medium-term EGBs