Monetary Policy Shocks and Consumer Expectations in the Euro Area*

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Abstract

We study how consumers assess the effects of monetary policy shocks in euro area countries using survey data. Our findings provide evidence that consumers form their expectations in a way that is consistent with empirical and theoretical models of the monetary transmission mechanism, both at the aggregate level and at the country level. Monetary policy is particularly effective in coordinating consumer price expectations, while the updating of unemployment expectations is more disperse across countries. We also find that consumption plans respond heterogeneously and not necessarily in line with revisions in consumer price expectations and unemployment expectations.

Keywords: macroeconomic expectations, FAVAR, monetary policy, high-frequency identification

JEL codes: E31, E32, E21

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1 Introduction

Central banks increasingly focus on communication and the steering of private sector expectations as policy tools.[1] And these tools should be more effective when the private sector has a better understanding of how monetary policy works.[2] In this paper, we use survey data from euro area member countries to characterize consumers' beliefs about the effects of monetary policy and compare these expected effects to the predictions of standard macroeconomic models and the actual macroeconomic dynamics induced by monetary policy shocks.

The euro area represents a particularly interesting setting to study the effect of policy shocks on expectations. Although the member countries are subject to a common monetary policy, perceptions of this policy may vary across countries. Heterogenous beliefs about the monetary policy transmission mechanism potentially complicate the communication and implementation of the common monetary policy and may, ultimately, contribute to differences in the transmission mechanisms across the member countries. In fact, several studies document that the transmission of monetary policy is to some degree heterogeneous across the member countries due to differences in e.g. institutional environments and economic structures (e.g. Ciccarelli et al., 2013; Almgren et al., 2021; Corsetti et al., 2021; Mandler et al., 2021). Our paper sheds light on the question whether consumers' beliefs about the monetary transmission mechanism are characterized by similar heterogeneities.

To study the responses of macroeconomic variables and survey expectation measures to monetary policy shocks, we estimate a factor-augmented vector autoregression (FAVAR) as in e.g. Bernanke et al. (2005), Forni et al. (2009), and Forni and Gambetti (2010). The FAVAR

[1] Bems et al. (2021) show that central banks increasingly manage to anchor inflation expectations and Diegel and Nautz (2021) show that monetary policy can effectively steer inflation expectations in the U.S. Although Coibion et al. (2020, 2021) point out that central banks' capacity to influence expectations is limited, they identify potential leverage for the management of expectations as a policy strategy.

[2] Haldane and McMahon (2018) discuss the desirability of central bank communication with the general public. Eusepi and Preston (2010) analyze monetary policy in a model where subjective beliefs are not necessarily consistent with the true structure of the model.

methodology allows us to approximate the information set of the ECB by including a large amount of information and we are able to take inter-country dependencies into account (see e.g. Boivin et al., 2008; Barigozzi et al., 2014; Corsetti et al., 2021). Our dataset includes macroeconomic and financial time series as well as survey data obtained from the Joint Harmonized EU Programme of Business and Consumer Surveys (BCS) of the European Commission for the euro area aggregate and for 11 member countries from 2003 to 2019. We identify euro area monetary policy shocks using high-frequency interest rate surprises that occur within a tight time window around ECB announcements from the Euro Area Monetary Policy Event-Study Database of Altavilla et al. (2019).[3]

Our results suggest that survey respondents generally revise inflation and unemployment expectations in the directions predicted by standard macroeconomic models (see e.g. Smets and Wouters, 2007). Moreover, the responses of consumers' expectations are in line with actual macroeconomic dynamics following a monetary policy shock. This is the case for the euro area and the majority of member countries, despite a certain degree of heterogeneity. In this sense, we conclude that consumers' subjective models are in general aligned with empirical and theoretical models of the monetary transmission mechanism.

At the country-level, we find that contractionary policy shocks give rise to lower expected price pressure in all countries in our sample and although unemployment expectations respond only weakly or with a negative sign in a few countries, unemployment expectations are revised upward in the majority of countries. In countries where unemployment expectations are adjusted in a way that is at odds with the standard theoretical transmission mechanism, the revisions in expectations are still consistent with the responses of the actual unemployment rates in these

[3]To ensure that we do not capture so-called information effects associated with information about the ECB's assessment of the economic outlook (see e.g. Campbell et al., 2012; Cieslak and Schrimpf, 2019; Nakamura and Steinsson, 2018; Miranda-Agrippino and Ricco, 2021), we use interest rate surprises that are orthogonal to information effects (Jarocinski and Karadi, 2020; Jarociński, 2020; Andrade and Ferroni, 2021).

countries. Nevertheless, we also find that planned major purchases, which we interpret as a proxy for consumers' consumption plans, respond only heterogeneously and not necessarily in line with consumer price and unemployment expectations.

From a policy perspective, our results suggest that ECB announcements manage to influence expectations relatively symmetrically across the euro area. This is especially the case for consumer price expectations. Yet, the adjustment of consumption plans is characterized by more pronounced heterogeneity, which suggests that there are limits to how much the management of inflation expectations can achieve in terms of influencing aggregate demand, since revised expectations do not appear to fully feed through to consumption plans.

Our analysis is closely related to several contributions that study how consumers interpret monetary policy in the U.S. To characterize consumers' subjective models of the economy, Andre et al. (2021) conduct a survey experiment and show that respondents expect inflation to increase after an unexpected interest rate hike and to decline after a surprise interest rate decrease, in contrast to theoretical models. In addition, consumers expect the unemployment rate to remain unchanged after an unexpected interest rate decrease. Geiger and Scharler (2021) study observational data from the Michigan survey and find that consumers revise unemployment and inflation expectations roughly in line with standard macroeconomic models. Dräger et al. (2016) show that central bank communication increases consumers' understanding of macroeconomic relationships and Carvalho and Nechio (2014) find that consumers update expectations consistent with a Taylor rule. Apart from methodological differences, we contribute to this literature by studying euro area data and in particular heterogeneity across the euro area countries.

A number of papers study inflation expectations in the euro area. Łyziak and Paloviita (2017) find that inflation expectations have become less anchored since the 2008 financial crisis. Similarly, Miccoli and Neri (2019) analyze financial market-based measures of inflation expecta-

tions and find that inflation expectations responded more strongly to surprise inflation releases during the financial crisis and the sovereign debt crisis. However, this sensitivity disappeared after the ECB launched its Expanded Asset Purchase Program. Eminidou et al. (2020) show that contractionary ECB announcements reduce inflation expectations of consumers in the euro area only if their information set is well aligned with the ECB's information set. Aßhoff et al. (2021) find that although unconventional ECB policy manages to influence inflation expectations, the effect is mostly transitory. In contrast to these studies, we do not only analyze the effects on inflation expectations, but use the responses of survey variables to characterize consumers' subjective models of the transmission mechanism.

Finally, several contributions emphasize heterogeneities in the monetary transmission mechanism in the euro area. From a methodological point of view, the paper closest to ours is Corsetti et al. (2021), who also estimate a FAVAR model and use a high-frequency approach for identification of monetary policy shocks. Barigozzi et al. (2014) use a FAVAR model and impose sign restrictions to identify policy shocks. Both these papers find substantial heterogeneities in the responses of prices and unemployment across euro area member countries. Hachula et al. (2020) document asymmetric reactions in response to unconventional monetary policy shocks. Almgren et al. (2021) estimate local projection regressions with high-frequency shocks and conclude that liquidity constraints can explain heterogenous output effects. Mandler et al. (2021) estimate a large-scale Bayesian VAR model to study the effects of contractionary euro area policy shocks in Germany, France, Italy and Spain. While GDP declines somewhat less in Spain than in the other countries, the price decrease is weakest in Germany. Burriel and Galesi (2018) estimate a global VAR and identify expansionary unconventional policy shocks in the euro area. Their results suggest that the output gains from unconventional policy measures are smaller in countries with weaker banking systems. Heterogenous responses to common monetary shocks

are also found in Georgiadis (2015) using a global VAR model. In a panel-VAR setting, Ciccarelli et al. (2013) investigate the role of financial fragility of banks, households, firms and governments for the monetary transimission in the euro area and find that monetary policy has larger output effects in countries with increased sovereign financial stress.

The remainder of the paper is structured as follows: Section 2 first describes the dataset, the FAVAR, and the identification approach. Section 3 presents our main results for the euro area aggregate and at the country level. In Section 4, we present a battery of robustness checks. Finally, Section 5 concludes the paper.

2 Data and Empirical Framework

2.1 Survey Data

We use consumer survey data provided through the Joint Harmonized EU Programme of Business and Consumer Surveys (BCS). The monthly consumer survey, which has been included in the BCS since 1972, is conducted based on harmonized questionnaires and a common timetable by national partner institutes. The data are made available through the European Commission. Sample sizes of consumer surveys per country are large by international standards and typically exceed 1 000 respondents. The average sample size for the euro area as a whole is 24 200 participants.[4]

To infer respondents' expectations of the future macroeconomic development following monetary policy shocks, we use the following two questions to measure consumer price and unemployment expectations:

By comparison with the past 12 months, how do you expect that consumer prices will develop

[4]For a detailed description of the survey, please see https://ec.europa.eu/info/sites/default/files/bcs_user_guide.pdf. BCS data is used in e.g. Duca-Radu et al. (2020), Eminidou et al. (2020), and D'Acunto et al. (2021).

in the next 12 months? They will...

How do you expect the number of people unemployed in this country to change over the next 12 months? The number will...

Survey respondents provide qualitative answers to these questions according to a five-option ordinal scale. For the question about consumer prices, respondents have the following options: prices will increase more rapidly, increase at the same rate, increase at a slower rate, stay about the same, and fall. For the unemployment question, the options are increase sharply, increase slightly, remain the same, fall slightly, and fall sharply. Moreover, respondents can indicate that they do not know.

In addition to expected consumer price and unemployment dynamics, we study how consumers' consumption plans are influenced by policy shocks. To do so, we use answers to the question about planned major purchases:

Compared to the past 12 months, do you expect to spend more or less money on major purchases (furniture, electrical/electronic devices, etc.) over the next 12 months? I will spend...

Survey respondents have again six options for answering this question: much more, a little more, about the same, a little less, much less, and don't know.

Given the qualitative nature of the survey answers, we use scores to aggregate the data. The seasonally adjusted monthly scores, which we include in the VAR model, are provided by the European Commission. For instance, as a measure of consumer price expectations in each period t, $PEXP_t$, the score is calculated as

$$PEXP_t = (PP_t + 1/2P_t) - (1/2M_t + MM_t),$$

where PP_t denotes the percentage of respondents having chosen the option 'increase more

rapidly', P_t is the percentage of respondents who answered 'increase at the same rate', M_t is the percentage of respondents with 'stay about the same', and MM_t is the percentage of respondents who indicated 'fall'. The balance score that summarizes responses to the consumer price question, $PEXP_t$, increases if the weighted share of respondents who expect increasing prices, at least at the same rate compared to the last 12 months, increases more strongly than the weighted share of those respondents who expect either constant or lower prices. Aggregated measures of unemployment expectations, $UEXP_t$, and consumption plans, $MPUR_t$, are obtained analogously.

Table 1 shows means, standard deviations, and pair-wise correlations of the survey measures. With respect to prices, Panel (A) suggests that consumers in Germany, Austria and Finland tend to expect prices to increase at least at the same rate more often than in other countries, while the opposite is true for Italian households. With respect to unemployment, Panel (B) illustrates that households across the euro area expect an increase in unemployment more often than a decrease, with Greece standing out in particular in this context. For price as well as unemployment expectations, the balance scores are positively correlated across all member countries, which suggests that household expectations in the euro area are to some extent synchronized. When looking at planned major purchases in Panel (C) instead, we can regularly detect negative correlations between consumption plans in different euro area countries. Also, the largest standard deviation exceeds the smallest one by a factor of almost 10, while this number is around 2 for price and unemployment expectations. While we cannot draw definitive conclusions from Table 1, this might suggest that the potential for a heterogeneous transmission of monetary policy is largest for consumption plans. Consistent with unemployment expectations, however, consumers in all member countries are planning less major purchases on average.

2.2 High-Frequency Data

To identify monetary policy shocks, we use high-frequency data from Altavilla et al. (2019), who provide changes in interest rates and asset prices between 15 minutes before the ECB press release and 15 minutes after the end of the following press conference.[5] These high-frequency changes should capture only the effect of the monetary policy announcement and can be plausibly viewed as exogenous from non-policy developments (e.g. Kuttner, 2001; Gürkaynak et al., 2005). Rather than deriving an interest rate surprise from a single interest rate, we use the first principal component of the high-frequency changes in different Overnight Index Swap (OIS) rates with maturity between 1 month and 1 year as the interest rate surprise, which we denote by i_t. OIS rates capture market expectations on the future level of the Euro Overnight Index Average (EONIA). Given the maturities of up to one year, the interest surprise i_t captures forward guidance to some extent, in addition to conventional monetary policy (e.g. Gürkaynak et al., 2005; Nakamura and Steinsson, 2018).

While macroeconomic shocks, such as aggregate demand or supply shocks, should not occur systematically within the short time window selected around monetary policy announcements, several contributions stress that the central bank announcements typically convey information about the central bank's assessment of economic situation (e.g. Campbell et al., 2012; Nakamura and Steinsson, 2018; Jarocinski and Karadi, 2020). Since a policy rate increase will often be a reaction to an improved economic outlook of the central bank, the associated announcement might therefore lead to increased optimism among market participants and counteracting effects. To avoid that our policy surprise measure is contaminated by these information effects, we follow Jarocinski and Karadi (2020) and Jarociński (2020) and use stock market data to obtain a pure policy surprise, m_t, that is orthogonal to the central bank information surprise (see

[5] We use interest rate surprises from the 'monetary event' window. In addition, we delete the observation on 08/10/2008, as in Jarociński (2020), since this surprise is the result of a coordinated action with the Federal Reserve.

also Miranda-Agrippino and Ricco, 2021; Andrade and Ferroni, 2021). The main identifying assumption is that a contractionary pure policy shock reduces the present value of expected future dividends and ultimately results in lower stock market prices. Instead, an information shock which is associated with higher interest rates would lead market participants to adopt a more optimistic outlook, which transmits to an increase in the Stoxx 50 Index. Thus, we impose the restrictions that interest rates and stock prices move in opposite directions following a policy shock, but in the same direction in response to an information shock.

We use the high-frequency change in the Stoxx 50 Index around ECB announcements form Altavilla et al. (2019) as the stock market surprise, and impose these identifying assumptions using rotational sign restrictions as in Jarociński (2020).[6] Once we have estimated the pure monetary policy surprise, we include this policy surprise measure as an internal instrument in our FAVAR model, as we will discuss below. An advantage of this approach are efficiency gains since the number of endogenous variables in the model can be kept low.[7]

2.3 Estimation and Identification

In this section we describe the FAVAR model, its estimation, and the identification of the policy shocks. We use a large dataset that consists of $M = 181$ financial and macroeconomic series for the euro area and individual member countries ranging from 2003M1 to 2019M4.[8] In addition to these series, the dataset includes the survey expectation measures discussed in Section 2.1. As it is standard, we transform each series to induce stationarity prior to the estimation,[9] and

[6] A detailed discussion of this approach is available in the supplementary material.

[7] Alternatively, the approach proposed in Jarocinski and Karadi (2020), can be used to take information effects into account using the same identifying assumptions. With this strategy, two internal instruments instead of only one are needed. As a robustness check, we estimate the model with the approach of Jarocinski and Karadi (2020) and find that although the median responses closely resemble our baseline results, the credible sets are somewhat larger.

[8] The sample is mainly determined by data availability, since several time series, particularly at the member country level, are not available for earlier periods and the intraday data, which is used to calculate the surprises, is rather noisy before 2002 (see Altavilla et al., 2019). In addition to euro area aggregates we use data from Germany, Austria, Belgium, Spain, Finland, France, Ireland, Italy, Netherlands, Portugal, and Greece, where the selection of countries is determined by data availability.

[9] A detailed data description and the transformation codes are available in the supplementary material.

combine the macroeconomic data and the survey data in a vector x_t with dimension $M \times 1$.

Assuming that the information contained in the series in x_t can be summarized by L unobserved common factors, we model the joint dynamics of these factors and the policy instrument m_t as

$$y_t = c + \sum_{j=1}^{p} B_j y_{t-j} + u_t, \tag{1}$$

where $y_t = [m_t, f_t']'$ and f_t is a $L \times 1$ vector of factors, c is a vector of constants, the B_j are matrices of autoregressive coefficients, and $u_t \sim \mathcal{N}(0, \Sigma)$ is a vector of error terms. In our baseline model, we set $p = 6$.[10]

The observed series in x_t are related to the common factors and idiosyncratic components according to:

$$x_t = \lambda_f f_t + \lambda_m m_t + e_t, \tag{2}$$

where λ_m, which is $M \times 1$, and λ_f, which is $M \times L$, contain the loadings on m_t and f_t, respectively. For the vector of idiosyncratic components e_t, we assume $e_t \sim \mathcal{N}(0, R)$, where R is a diagonal matrix.[11]

Equations (1) and (2) represent a FAVAR model (see e.g. Bernanke et al., 2005; Stock and Watson, 2005; Forni and Gambetti, 2010). As a first step, and prior to the estimation of the dynamic system in Equation (1), we estimate the L common factors.

As an initial estimate of the factors, which we denote as $\tilde{f}_t^0$, we calculate the first L principal components from x_t. Note that although m_t is treated as a common factor in the factor equation (2), it is not included in the principal components analysis. Hence, without any correction, its influence would be captured by the estimated principal components. Therefore, we follow Buch

[10] To explore the robustness with respect to the lag order, we consider different values for p in the supplementary material.

[11] This assumption implies that all the commonalities between the variables in y_t are captured by λy_t, while e_t instead involves the idiosyncratic component of each variable.

et al. (2014) and use the iterative procedure proposed in Boivin and Giannoni (2007) to remove m_t from the factor space: We regress x_t on $\tilde{f}_t^0$ and m_t to obtain initial estimates of the factor loadings $\tilde{\lambda}_m^0$ and $\tilde{\lambda}_f^0$. Based on these estimates, we calculate $\tilde{x}_t^0 = x_t - \tilde{\lambda}_m^0 m_t$, i.e. we remove the part in x_t explained by the observed factor. In the next step of the iteration, we extract a new set of L principal components from $\tilde{x}_t^0$ and repeat the procedure until convergence is achieved.[12]

Based on the information criterion of Bai and Ng (2002), we set the number of factors to $L = 8$.[13] Table 2 shows the percentage of variance explained by the unobserved factors. In sum, the unobserved factors account for 67% of the variance in the dataset. Table 3 illustrates the variance explained in the HICP, the unemployment rate, and the survey measures. Although there are some cases where the factors explain smaller shares of the variance, e.g. the unemployment rates in Austria and Belgium, for the majority of the series, in particular for the survey measures, the factors explain a reasonable amount of the variance.

After the estimation of the factors, we combine the estimated factors with the policy instrument in the vector of endogenous variables and estimate the model in Equation (1). To do so, we define $z_t = [I_N, I_N \otimes y'_{t-1}, ..., I_N \otimes y'_{t-p}]'$, where $N = 1 + L$ and $\beta = (c', vec(B'_1)', ..., vec(B'_p)')'$, and rewrite the model in Equation (1) more compactly as:

$$y_t = z'_t \beta + u_t, \tag{3}$$

where z_t is $K \times N$, $K = (Np + 1)N$, β is $K \times 1$ and u_t is $N \times 1$.

Given the short sample period and since our model contains 9 endogenous variables and 6 lags in the baseline, meaningful inference may be complicated by imprecisely estimated parameters (e.g. Sims 1980; Giannone et al. 2015). Therefore we estimate the model with Bayesian methods

[12] We consider this process as being converged if the sum of squared residuals of $x_t = \tilde{\lambda}_f^j \tilde{f}_t^j + \tilde{\lambda}_m^j m_t + e_t$, where j denotes the current iteration number, changes by less than 0.000001 compared to the previous iteration.

[13] In the supplementary material, we evaluate the sensitivity of our results with respect to the number of factors.

and add prior information for the estimation of the models' parameters (see also Mumtaz and Surico, 2009; Korobilis, 2013).[14]

More precisely, specify a Minnesota type prior for the means and variances of the VAR coefficients with $\beta \sim \mathcal{N}(\underline{\beta}, \underline{V})$ and $\Sigma \sim iW(\underline{\Sigma}, \underline{\nu})$ (Doan et al., 1984; Litterman, 1986). Since the variables in the dataset are transformed to be stationary, we set the prior means of the autoregressive coefficients in $\underline{\beta}$ to zero. $\underline{\Sigma}$ is an $N \times N$ diagonal matrix and the elements on the main diagonal, σ_i, are estimated as the residuals of univariate autoregressions with p lags for each variable in y_t. Following Kadiyala and Karlsson (1997), we allow for only a small influence of the prior on the posterior distribution of Σ by setting the prior degrees of freedom in the inverse Wishart distribution to $\underline{\nu} = N + 2$, which is the smallest possible value for which the first two moments of the distribution are well-defined.

$\underline{V}$ is a $K \times K$ diagonal matrix with $\frac{\alpha\sigma_i}{r^2\sigma_j}$ on the main diagonal for $i, j = 1, ..., N$ and r is the lag order of each coefficient. Thus, we assume that the prior variance of the autoregressive coefficients becomes smaller as the lag order increases, which is a standard assumption in the literature and implies that these coefficients are shrunk towards zero more aggressively (see e.g. Koop and Korobilis, 2010; Blake and Mumtaz, 2017). Finally, we set the tightness parameter $\alpha = 0.2$, which implies a relatively loose specification, i.e. the prior should have only a rather influence on the results, as it is common in the literature (see e.g. Jarocinski and Karadi, 2020; Bańbura et al., 2010).[15]

We use a Gibbs Sampler for posterior simulation to sequentially draw from $p(\beta|y, \Sigma)$ and $p(\Sigma|y, \beta)$, where y is a $T \times N$ matrix comprising observations $t = 1, ..., T$ of the endogenous variables. In sum, we simulate 6000 Gibbs Sampler iterations, of which we reject the first 2000

[14] Figures A.2 to A.6 in the supplementary material show that although our baseline results remain robust with an uninformative prior, the responses are less precisely estimated.

[15] Similarly, we choose a loose prior on the intercepts in Equation (1), setting them to 100^2.

as burn-in and save every second draw afterwards. To account for uncertainty in the estimation of the loadings, we draw the loadings and the corresponding covariance matrix in the factor equation (2) at each iteration from a normal distribution with a loose prior centered at zero. [16]

Since the policy instrument m_t should be exogenous with respect to the macroeconomic environment, identify the monetary policy shock using a Cholesky decomposition with m_t ordered first in the vector of endogenous variables as suggested in Plagborg-Møller and Wolf (2021).[17] Based on the estimated factor loadings, we obtain the impulse response functions of the underlying macroeconomic and financial variables for the euro area and for the individual member countries.

3 Results

3.1 Euro Area Results

As a first analysis, we present results for the euro area as a whole in Figure 1, where Panel (A) shows the responses of key macroeconomic variables to a contractionary monetary policy shock: the harmonized index of consumer prices (HICP) as a price measure, the unemployment rate (UNEMP) and industrial production (IP) as proxies for economic activity and the overnight index swap rates with maturities of 2 years (OIS2Y) and 10 years (OIS10Y) as proxies for risk-free interest rates. Similar variables are typically analyzed in small-scale monetary VAR models (see e.g. Altavilla et al., 2019; Hachula et al., 2020; Andrade and Ferroni, 2021). Panel (B) presents the responses of the scores summarizing consumer price expectations (PEXP), unemployment expectations (UEXP), and consumption plans, captured by the planned major

[16] A detailed discussion is available in the supplementary material.

[17] Alternatively, the purged surprise could be used as an instrumental variable in a proxy VAR as in Gertler and Karadi (2015). Plagborg-Møller and Wolf (2021) show that structural estimation can also be implemented with an appropriately ordered recursive model. Results based on an estimation using this proxy VAR approach for identification are shown in the supplementary material in Figures A.2 to A.6.

purchases score (MPUR).[18]

We see from Panel (A) that consumer prices start to decline immediately following a contractionary shock. The unemployment rate increases slowly and reaches a peak after about 12 months. Similarly, the response of industrial production is u-shaped. The two interest rates increase on impact, albeit only marginally systematically. And although the 10-year rate remains persistently above its pre-shock level, the increase is only short-lived in case of the 2-year rate.[19] Overall, these responses are in line with the predictions of standard models and with the existing evidence on the effects of monetary policy shocks in the euro area (Barigozzi et al., 2014; Corsetti et al., 2021; Jarocinski and Karadi, 2020; Hachula et al., 2020).

Panel (B) shows that consumers in the euro area expect the policy shock to be followed by downward pressure on consumer prices and an increase in unemployment. These responses are consistent with the macroeconomic dynamics shown in Panel (A) and with the transmission mechanism incorporated in standard New Keynesian models (see e.g. Smets and Wouters, 2007).

The score summarizing consumer price expectations responds only slowly, while the score associated with unemployment expectations increases already on impact. The maximum effects occur roughly 6 months after the shock and both variables are close to their pre-shock levels again about 2 years after the shock. Thus, the expectation measures respond less persistently than the macroeconomic variables, which is in line with the forecasting lead of the survey, where respondents are asked about their assessment during the next 12 months.

Using consumer survey data and a different identification approach, Geiger and Scharler (2021) show that although U.S. consumers generally interpret the consequences of macroeco-

[18]Note that since the survey variables are summarized in balance scores, we cannot compare the magnitude of their responses with those of macroeconomic variables.

[19]Corsetti et al. (2021) include the response of the German 2-year rate and find a more pronounced response (see also Barigozzi et al., 2014). We also estimated German bond yield responses and found them to be almost identical to those of the OIS rates in Figure 1 (not shown here).

nomic shocks in line with theoretical predictions, their interpretation of monetary policy shocks is less clear. Similarly, Andre et al. (2021) find that U.S. households predict the sign of the inflation response to a policy shock incorrectly in a survey experiment. Lamla and Vinogradov (2019) find that FOMC announcements are followed by only small effects on average expectations. While these results are not fully comparable due to differences in samples and methodologies, it appears that euro area consumers' subjective models of the monetary transmission mechanism are better aligned with theoretical predictions and actual dynamics.

Do consumers adjust their consumption plans in line with their expectations about the macroeconomic effects of the policy shock? Given the increase in the measure of unemployment expectations, and assuming that higher expected unemployment in the economy coincides with a less optimistic personal outlook,[20] consumers may plan to reduce their planned consumption. The effect of price expectations is ambiguous and depends on how the real interest rate is expected to change.[21] If the real rate increases, which is typically assumed in standard models, consumption should decline.

According to Panel (B), the measure associated with consumption plans declines on impact but the response is generally unsystematic.[22] Thus, it appears that despite the expected economic contraction and lower consumer price expectations, respondents in the aggregate tend to adjust their consumption only to a limited extent.[23]

[20] Roth and Wohlfart (2020) examine how individuals extrapolate macroeconomic expectations to personal economic prospects.

[21] Unfortunately, the BCS does not include any information about interest rate expectations.

[22] The survey includes another question that asks about current major purchases rather than over the next 12 months. Figure A.1 in the supplementary material shows that we obtain similar results regardless of the time horizon of the question.

[23] A similar finding is reported in Geiger and Scharler (2021) for U.S. consumers.

3.2 Country Effects

We now come to the main part of our analysis and study the responses to a contractionary monetary policy shock at the country level. Figure 2 displays the pointwise median impulse responses of the HICP for each euro area member country in Panel (A) and Panel (B) shows the responses of the price expectations measure. For ready comparisons, both panels include the corresponding response for the euro area aggregate from Figure 1 as well as the 68% and 90% credible sets of the euro area aggregate response.

We see from Panel (A) that in most of the countries prices decline already on impact. The exceptions are Ireland and Portugal, where we detect a small price puzzle. Over the medium run, prices decline in all countries. In general, country responses do deviate only to a limited extent from the euro area aggregate response, being mostly within its one standard deviation credible set. These results are in line with Barigozzi et al. (2014) who find a declining price level in all countries except Italy, Greece and Portugal. Corsetti et al. (2021) find a larger degree of heterogeneity and more pronounced price puzzles in several countries.[24] Burriel and Galesi (2018) and Hachula et al. (2020) study the effects of unconventional monetary policy shocks and find that the maximum price level responses to expansionary shocks are positive in almost all the euro area countries that they consider in their analysis.

Panel (B) shows that the score associated with consumer price expectations decreases in all member countries over the medium run. The responses mostly follow a u-shaped pattern, where the maximum decline occurs about half a year after the shock and the expectation measure is almost back at the pre-shock level after around two years in most countries. The short-run responses are somewhat more disperse. In comparison, the updating of consumer price expectations is more homogeneous over the medium run, where, with the exception of Ireland,

[24] In contrast to our analysis, Corsetti et al. (2021) do not take central bank information effects into account, which could counteract the effect of monetary policy on the price level (see e.g. Jarocinski and Karadi, 2020).

all responses are within the 68% credible set of the euro area aggregate response. The maximum responses are particularly pronounced in Finland and the Netherlands, while consumer price expectations in Greece respond to a lesser degree.

Figure 3 displays the responses of the unemployment rate in Panel (A) and the responses of the balance scores associated with unemployment expectations in Panel (B). The unemployment rate increases after a contractionary policy shock in most member countries. Although the unemployment rate declines on impact in Belgium and Ireland, the effect is transitory and over time we also observe higher unemployment rates in these two countries. In Italy and Greece, the contractionary shock leads to more persistent declines in the unemployment rate. Corsetti et al. (2021) show that unemployment rates increase over time, despite rather heterogeneous responses on impact. Barigozzi et al. (2014) find that contractionary policy shocks reduce the unemployment rate in Italy, and in the very short run also in Belgium and the Netherlands. Hachula et al. (2020) show that the peak responses of industrial production to unconventional monetary policy shocks for Greece and Italy were negative during the period from 2014 to 2016. Although not directly comparable to our results, due to their focus on unconventional policy and their short and specific sample, their results suggest that macroeconomic activity in these two countries may respond in a non-standard way to monetary policy.

Panel (B) shows that the measure of unemployment expectations increases in almost all countries, where the peak response is usually reached about half a year after the shock. In Greece and Italy, unemployment expectations responses are near zero. In Portugal and Spain the responses are positive but less pronounced and less persistent than in the other countries. In contrast, unemployment expectations in Germany, the Netherlands, and Austria adjust more strongly than in the euro area on average. In case of unemployment as well as unemployment expectations, more country responses lie outside the 68% and the 90% credible set of the

corresponding euro area responses than we saw in the previous Figure with the HICP and price expectations. Since this suggests an increased amount of heterogeneity, we will analyse this question in more detail in the following section.

To summarize and compare the results, Figure 4 shows the responses averaged over the first 12 periods after the shock. Panel (A) confirms that the measure of consumer price expectations decline on average in all countries, which is consistent with the actual price level developments and also with the predictions of standard New Keynesian models.

Panel (B) shows that unemployment expectations increase on average in most countries, in line with the standard view of the monetary transmission mechanism. In Italy and Greece, the averaged responses are slightly negative, although only imprecisely estimated. Nevertheless, the responses of the expectation measures in these countries are still consistent with the actual unemployment dynamics that we observe in the aftermath of the policy shock. In other words, although the consumers' subjective models of unemployment dynamics do not appear to be aligned with the standard view of the monetary transmission mechanism, they are consistent with the actual transmission mechanism in these two countries. In Belgium, unemployment expectations increase on average over the medium run, although the average actual unemployment rate declines slightly. Although the unemployment rate initially declines according to Panel (A) in Figure 3, it increases over time and exceeds its pre-shock level roughly eight months after the shock. Thus, although consumers expect a faster increase of the unemployment rate, the view that the shock will eventually result in a higher unemployment rate is still consistent with the actual dynamics.

Overall, the joint responses of the scores summarizing consumer price expectations and unemployment expectations are largely in line with the predictions of the New Keynesian model and with the actual macroeconomic dynamics induced by the policy shock in the majority of

euro area countries. Although we find deviations for consumer price expectations in a few cases, these deviations tend to be transitory. For unemployment expectations, deviations from predictions of theoretical models are more persistent in a few cases, but in these cases, revisions of expectations in response are still aligned with the actual macroeconomic responses.

Finally, we assess to what extent survey participants revise their consumption plans in response to monetary policy shocks. Figure 5 presents the pointwise median country-level responses of planned major purchases in Panel (A), while Panel (B) displays responses averaged over the horizons 0 to 12 after the shock. We see that the responses are more diverse than those of consumer price expectations and unemployment expectations. Thus, the rather unsystematic response at the euro area level is probably the result of counteracting effects at the country-level. The medium-run effects, summarized in Panel (B), suggest that consumers in several countries plan to increase spending, although the effects are particularly pronounced only in Portugal and Greece. In these two countries, unemployment expectations respond only little or negatively to the shock. A similar pattern can be observed in Italy, although the response of consumption plans is more imprecisely estimated in this case. We observe that respondents systematically plan to reduce consumption vis-à-vis lower expected prices and higher expected unemployment only in Germany, Austria and Finland. In Greece, the response of the consumption plan measure is in line with the responses of price and unemployment expectations, but inconsistent with the theoretical predictions. In the remaining countries, the responses of consumption plans are either imprecisely estimated or do not appear to mirror the corresponding responses of price and unemployment expectations.

3.3 Country Heterogeneity

Although consumers' subjective models of the monetary transmission mechanism are generally consistent with the actual and theoretical transmission mechanisms in the euro area, the results

presented so far suggest a certain degree of heterogeneity across countries. In this section, we take two different approaches to analyse these heterogeneities in more detail. First, we follow Barigozzi et al. (2014) and calculate for each model draw the deviation of country responses from the euro area response and afterwards plot the pointwise median with corresponding credible sets in Figures 6 to 8. We interpret credible sets not including the zero line at least at some horizons as evidence for a systematic difference between country level and euro area response.[25]

Panel (A) of Figure 6 shows that for most countries, the zero line is within the credible sets of the consumer price response differentials. In line with Figure 2, we observe systematic differences from the euro area response in the short run in Ireland and Portugal and in the long run in Greece. Panel (B) suggests that consumer price expectations are statistically different from the euro area response in more countries than in case of actual consumer prices. Especially for Greece, we observe a substantially less contractionary effect of policy on price expectations, while the deviations in other countries seem to be rather small in comparison.

Panel (A) of Figure 7 indicates pronounced deviations from the euro area unemployment response in Belgium, Italy and especially Greece. As in the previous figure, however, cross country heterogeneities seem to be more systematic with respect to the corresponding survey variable. Actually, panel (B) shows that the zero line is outside the credible set of the response differential in almost all countries at least at some horizons.

Finally, Figure 8 presents the deviations of country level consumption plan responses from the corresponding euro area response. Again, we can see systematic differences in the majority of the countries. From a quantitative perspective, the large deviation in Greece stands out.

The response differential analysis in the previous figures indicates that consumers adapt

[25]Country responses being outside the credible sets in Figures 2, 3 and 5 in the previous section also provide suggestive evidence in that direction but are less suitable to evaluate systematic differences, since distribution percentiles are calculated from impulse responses themselves instead of from differences between responses.

their expectations systematically different compared to the euro area as a whole. However, the magnitudes of these heterogeneities are difficult to compare across variables such as HICP and price expectations based on these figures, since they depend on the responses of variables measured in different units. To quantify heterogeneities and to make them comparable across variables, we therefore calculate coefficients of variation as in Corsetti et al. (2021) as a measure for the overall heterogeneity in the responses of a specific variable such as price expectations. Specifically, we use the standard deviation of the difference between member country responses and the corresponding euro area aggregate response. In the process, we scale the responses such that the euro area response equals 1 in absolute value for comparability.

Table 4 shows the pointwise median coefficients of variation for the HICP and the unemployment rate in Panel (A) and for the aggregated survey measures in Panel (B). One standard deviation credible sets are shown in brackets. We calculate the coefficients of variation on impact and for horizons of 6 months and 12 months.[26]

Panel (A) shows that the coefficients of variation for the HICP are smaller than those for the unemployment rate across all horizons. Also, we observe that the heterogeneity is largest on impact and tends to decrease at later horizons. Both these results are in line with Corsetti et al. (2021).

Panel (B) shows that the responses of consumer price expectations exhibit a larger degree of heterogeneity than those of unemployment expectations on impact, somewhat in contrast to the underlying macroeconomic variables. At later horizons, however, price expectation responses sharply converge and are less heterogeneous than unemployment expectation responses, which are themselves less heterogeneous after the impact period. Thus, it appears that the updat-

[26]The impulse response functions and response differentials in the previous figures might indicate that the coefficients of variation are somewhat inflated by the responses of Greece. For this reason, we report coefficients of variation, where we drop Greek responses in Table A.1 in the supplementary material. Although some of the coefficients there are considerably larger than in Table 4, results are qualitatively similar.

ing of expectations is characterized by a convergence process, in particular when it comes to price expectations. In comparison, the responses of survey variables tend to be somewhat less heterogeneous than those of macroeconomic variables, although there are exceptions to this. Given that we saw survey variable country responses deviating more often from the euro area response than macroeconomic variable responses in Figures 6 and 7, this finding might seem surprising at first sight. However, this can be explained with survey variable responses having smaller credible sets than the responses of macroeconomic variables, such that there is more likely a systematic difference to the euro area response.

Especially the relatively homogeneous responses of price expectations suggests that the ECB is able to effectively coordinate these expectations. This capacity to coordinate expectations can also be interpreted as an indication for the credibility of the central bank to control inflation expectations in the sense of Bems et al. (2021). Moreover, our results suggest a certain degree of effectiveness of monetary policy to steer inflation expectations towards the desired policy target in line with Diegel and Nautz (2021).

The coefficients of variation associated with consumption plans exceed the corresponding coefficients of variation of the other two survey variables. Thus, consumers across euro area countries adjust their consumption plans rather heterogeneously in response to policy shocks. Interestingly, after being more homogeneous at horizon 6 than on impact, consumption plan responses become less homogeneous again at horizon 12. In this sense, the convergence process we detected for the responses of the other two survey variables cannot be observed for consumption plan responses.

4 Robustness Analysis

In this section, we present a variety of robustness checks to support our main results. Figures 9 to 13 show euro area and country level responses based on different models for HICP, price expectations, unemployment rate, unemployment expectations and consumption plans. In addition, the figures show 68% and 90% credible sets of the baseline model.

First, we re-estimate the model with data starting in 2008 since the switch to unconventional monetary policy measures in the aftermath of the global financial crisis may have influenced consumers' beliefs about the monetary transmission mechanism. Qualitatively, the results in Figures 9 and 10 for the HICP and the measure of consumer price expectations closely resemble those obtained with the full sample. And although Figures 11 and 12 show that unemployment expectations and to a lesser extent the unemployment rate respond somewhat weaker during this sample, the overall patterns are similar to what we observe for the full sample. We conclude that the implementation of monetary policy primarily through unconventional policy measures left the responses of macroeconomic variables as well as consumers' subjective models largely unchanged.

Next, we disentangle monetary policy shocks and information shocks using the approach suggested by Jarocinski and Karadi (2020). Specifically, we include interest rate as well as stock market surprises as endogenous variables in the FAVAR and impose the sign restrictions discussed in Section 2.2 on the impact horizon of their responses. Figures 9 to 13 show responses similar to our baseline results. If anything, HICP and price expectation responses are somewhat weaker but are still within the 90% credible set in almost all countries across the horizons considered.

The next two robustness checks address our surprise measures. First, we check the sensitivity of our results to using weighted surprises, which take into account the day of the month on

which an announcement occurs. Let tt denote the day on which an announcement occurs and let TT be the total number of days in that specific month, then the announcement is included with a weight of $(TT - tt + 1)/TT$ in the month of the announcement and with a weight of $1 - (TT - tt + 1)/TT$ in the following month. Looking at the results, we see that our main conclusions are robust with respect to the exact timing of announcement. Next, we calculate the interest rate surprise as the principal component of high frequency changes in OIS rates with maturity up to 10 years instead of only 1 year. This surprise should capture unconventional policy effects to a larger extent than our baseline measure. The yellow responses in Figures 9 to 13 are for almost all variables and countries within the one standard deviation credible set of the baseline model, suggesting robust results.

Finally, we also estimate the model with 10 factors instead of 8 and a lag length of 12 instead of 6. The results depicted in Figures 9 to 13 suggest that our benchmark findings are not sensitive to these changes. In the supplementary material in Figures A.2 to A.6, we report further robustness checks. In two of them, we use high frequency changes in the 3 month OIS rate respectively the 1 year OIS rate as an interest surprise. Another sensitivity check uses a proxy VAR identification as for instance in Gertler and Karadi (2015). Next, we start our sample already in 2000M1, where we use an EM-algorithm as in McCracken and Ng (2016) to estimate the missing data before 2003. Finally, we also report results based on a model where we replace the Minnesota prior on the VAR coefficients with a flat prior. All of these models yield results in line with our baseline findings. Still, it is noteworthy that many of the responses based on the proxy VAR model are quite jagged, which is a result also familiar from Corsetti et al. (2021).

5 Conclusion

The expectation formation of private market participants is widely seen as a central part in the monetary transmission mechanism (Blinder, 1998; Hoeberichts et al., 2009). In this paper, we investigate the effects of common euro area monetary policy on consumer expectations in the euro area and its member countries.

Our analysis yields several findings. In all euro area member countries considered, consumers' inflation expectations decline in response to a contractionary monetary policy shock, in line with theoretical models. With respect to unemployment expectations, results are somewhat more mixed. Interestingly though, inflation and unemployment expectations in almost all countries tend to respond in the same direction as actual consumer prices and unemployment rates.

Although a contractionary policy shock tends to worsen the economic outlook of consumers in almost all countries, the estimated responses of consumption plans are characterized by a higher degree of heterogeneity across countries: While households in some countries plan a reduction in major purchases in response to the shock, consumers in other countries tend to increase planned consumption. In comparison, the responses of inflation and unemployment expectations are subject to less heterogeneity. Especially for consumer price expectations, the responses in different euro area member countries seem to be closely aligned to the euro area average response.

While it is generally acknowledged that monetary policy is more effective when the public is informed about the goals and strategies of the central bank, successful communication also depends on how people interpret the macroeconomic environment in which monetary policy operates. Despite the central role of private sector expectations for monetary transmission in general, evidence on the effects of euro area monetary policy on household expectations has been scarce so far. Our results suggest that the ECB and its communication are relatively successful

in managing expectations and explaining their policies. Especially the relatively homogenous responses of price expectations suggests that the ECB is able to effectively coordinate and steer expectations towards desired policy targets. Nevertheless, ECB announcements are less effective in influencing spending behavior of consumers, since revisions in consumption plans are less homogenous.

References

Almgren, M., Gallegos, J.-E., Kramer, J., and Lima, R. (2021). Monetary policy and liquidity constraints: Evidence from the euro area. *American Economic Journal: Macroeconomics*, forthcoming.

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., and Ragusa, G. (2019). Measuring euro area monetary policy. *Journal of Monetary Economics*, 108:162–179.

Andrade, P. and Ferroni, F. (2021). Delphic and Odyssean monetary policy shocks: Evidence from the euro area. *Journal of Monetary Economics*, 117:816–832.

Andre, P., Pizzinelli, C., Roth, C., and Wohlfart, J. (2021). Subjective Models of the Macroeconomy: Evidence from experts and a representative sample. *Review of Economic Studies*, forthcoming.

Aßhoff, S., Belke, A., and Osowski, T. (2021). Unconventional monetary policy and inflation expectations in the euro area. *Economic Modelling*, 102(1):55–64.

Bai, J. and Ng, S. (2002). Determining the number of factors in approximate factor models. *Econometrica*, 70(1):191–221.

Bańbura, M., Giannone, D., and Reichlin, L. (2010). Large Bayesian vector autoregressions. *Journal of Applied Econometrics*, 25(1):71–92.

Barigozzi, M., Conti, A. M., and Luciani, M. (2014). Do euro area countries respond asymmetrically to the common monetary policy? *Oxford Bulletin of Economics and Statistics*, 76(5):693–714.

Bems, R., Caselli, F., Grigoli, F., and Gruss, B. (2021). Expectations' anchoring and inflation persistence. *Journal of International Economics*, 132:103516.

Bernanke, B. S., Boivin, J., and Eliasz, P. (2005). Measuring the effects of monetary policy: A factor-augmented vector autoregressive (FAVAR) approach. *The Quarterly Journal of Economics*, 120(1):387–422.

Blake, A. and Mumtaz, H. (2017). *Applied Bayesian econometrics for central bankers*. Bank of England: Centre for Central Banking Studies.

Blinder, A. S. (1998). *Central banking in theory and practice*. Cambridge, MA: MIT Press.

Boivin, J. and Giannoni, M. P. (2007). Global forces and monetary policy effectiveness. In *International Dimensions of Monetary Policy*, pages 429–478. University of Chicago Press.

Boivin, J., Giannoni, M. P., and Mojon, B. (2008). How has the euro changed the monetary transmission mechanism? *NBER macroeconomics annual*, 23(1):77–126.

Buch, C., Eickmeier, S., and Prieto, E. (2014). Macroeconomic factors and microlevel bank behavior. *Journal of Money, Credit and Banking*, 46(4):715–751.

Burriel, P. and Galesi, A. (2018). Uncovering the heterogeneous effects of ECB unconventional monetary policies across euro area countries. *European Economic Review*, 101:210–229.

Campbell, J. R., Evans, C. L., Fisher, J. D., Justiniano, A., Calomiris, C. W., and Woodford, M. (2012). Macroeconomic effects of Federal Reserve forward guidance. *Brookings Papers on Economic Activity*, 42(1):1–80.

Carvalho, C. and Nechio, F. (2014). Do people understand monetary policy? *Journal of Monetary Economics*, 66:108–123.

Ciccarelli, M., Maddaloni, A., and Peydró, J.-L. (2013). Heterogeneous transmission mechanism: Monetary policy and financial fragility in the eurozone. *Economic Policy*, 28(75):459–512.

Cieslak, A. and Schrimpf, A. (2019). Non-monetary news in central bank communication. *Journal of International Economics*, 118:293–315.

Coibion, O., Gorodnichenko, Y., Kumar, S., and Pedemonte, M. (2020). Inflation expectations as a policy tool? *Journal of International Economics*, 124:103297.

Coibion, O., Gorodnichenko, Y., and Weber, M. (2021). Monetary policy communications and their effects on household inflation expectations. *Journal of Political Economy*, forthcoming.

Corsetti, G., Duarte, J. B., and Mann, S. (2021). One money, many markets: Monetary transmission and housing financing in the euro area. *Journal of the European Economic Association*, forthcoming.

D'Acunto, F., Hoang, D., and Weber, M. (2021). Managing households' expectations with unconventional policies. *Review of Financial Studies*, forthcoming.

Diegel, M. and Nautz, D. (2021). Long-term inflation expectations and the transmission of monetary policy shocks: Evidence from a SVAR analysis. *Journal of Economic Dynamics and Control*, 130:104192.

Doan, T., Litterman, R., and Sims, C. (1984). Forecasting and conditional projection using realistic prior distributions. *Econometric Reviews*, 3(1):1–100.

Dräger, L., Lamla, M. J., and Pfajfar, D. (2016). Are survey expectations theory-consistent? The role of central bank communication and news. *European Economic Review*, 85:84–111.

Duca-Radu, I., Kenny, G., and Reuter, A. (2020). Inflation expectations, consumption and the lower bound: Micro evidence from a large multi-country survey. *Journal of Monetary Economics*, forthcoming.

Eminidou, S., Zachariadis, M., and Andreou, E. (2020). Inflation expectations and monetary policy surprises. *The Scandinavian Journal of Economics*, 122(1):306–339.

Eusepi, S. and Preston, B. (2010). Central bank communication and expectations stabilization. *American Economic Journal: Macroeconomics*, 2(3):235–271.

Forni, M. and Gambetti, L. (2010). The dynamic effects of monetary policy: A structural factor model approach. *Journal of Monetary Economics*, 57(2):203–216.

Forni, M., Giannone, D., Lippi, M., and Reichlin, L. (2009). Opening the black box: Structural factor models with large cross sections. *Econometric Theory*, 25(5):1319–1347.

Geiger, M. and Scharler, J. (2021). How Do People Interpret Macroeconomic Shocks? Evidence from U.S. Survey Data. *Journal of Money, Credit and Banking*, forthcoming.

Georgiadis, G. (2015). Examining asymmetries in the transmission of monetary policy in the euro area: Evidence from a mixed cross-section global VAR model. *European Economic Review*, 75:195–215.

Gertler, M. and Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, 7(1):44–76.

Gürkaynak, R. S., Sack, B., and Swanson, E. T. (2005). Do actions speak louder than words? The response of asset prices to monetary policy actions and statements. *International Journal of Central Banking*, 1(1):55–93.

Hachula, M., Piffer, M., and Rieth, M. (2020). Unconventional monetary policy, fiscal side effects, and euro area (im)balances. *Journal of the European Economic Association*, 18(1):202–231.

Haldane, A. and McMahon, M. (2018). Central bank communications and the general public. *AEA Papers and Proceedings*, 108:578–83.

Hoeberichts, M., Tesfaselassie, M. F., and Eijffinger, S. (2009). Central bank communication and output stabilization. *Oxford Economic Papers*, 61(2):395–411.

Jarociński, M. (2020). Central bank information effects and transatlantic spillovers. ECB Working Paper 2482/2020, European Central Bank.

Jarocinski, M. and Karadi, P. (2020). Deconstructing monetary policy surprises – the role of information shocks. *American Economic Journal: Macroeconomics*, 12(2):1–43.

Kadiyala, K. R. and Karlsson, S. (1997). Numerical methods for estimation and inference in Bayesian VAR-models. *Journal of Applied Econometrics*, 12(2):99–132.

Koop, G. and Korobilis, D. (2010). Bayesian multivariate time series methods for empirical macroeconomics. *Foundations and Trends in Econometrics*, 3(4):267–358.

Korobilis, D. (2013). Assessing the transmission of monetary policy using time-varying parameter dynamic factor models. *Oxford Bulletin of Economics and Statistics*, 75(2):157–179.

Kuttner, K. N. (2001). Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. *Journal of Monetary Economics*, 47(3):523–544.

Lamla, M. J. and Vinogradov, D. V. (2019). Central bank announcements: Big news for little people? *Journal of Monetary Economics*, 108:21–38.

Litterman, R. B. (1986). Forecasting with Bayesian vector autoregressions—five years of experience. *Journal of Business & Economic Statistics*, 4(1):25–38.

Łyziak, T. and Paloviita, M. (2017). Anchoring of inflation expectations in the euro area: Recent evidence based on survey data. *European Journal of Political Economy*, 46:52–73.

Mandler, M., Scharnagl, M., and Volz, U. (2021). Heterogeneity in euro area monetary policy transmission: Results from a large multicountry BVAR model. *Journal of Money, Credit and Banking*, forthcoming.

McCracken, M. W. and Ng, S. (2016). FRED-MD: A monthly database for macroeconomic research. *Journal of Business & Economic Statistics*, 34(4):574–589.

Miccoli, M. and Neri, S. (2019). Inflation surprises and inflation expectations in the euro area. *Applied Economics*, 51(6):651–662.

Miranda-Agrippino, S. and Rey, H. (2020). U.S. monetary policy and the global financial cycle. *The Review of Economic Studies*, 87(6):2754–2776.

Miranda-Agrippino, S. and Ricco, G. (2021). The transmission of monetary policy shocks. *American Economic Journal: Macroeconomics*, 13(3):74–107.

Mumtaz, H. and Surico, P. (2009). The transmission of international shocks: A factor-augmented var approach. *Journal of Money, Credit and Banking*, 41(s1):71–100.

Nakamura, E. and Steinsson, J. (2018). High-frequency identification of monetary non-neutrality: The information effect. *The Quarterly Journal of Economics*, 133(3):1283–1330.

Plagborg-Møller, M. and Wolf, C. K. (2021). Local projections and VARs estimate the same impulse responses. *Econometrica*, Forthcoming.

Roth, C. and Wohlfart, J. (2020). How do expectations about the macroeconomy affect personal expectations and behavior? *The Review of Economics and Statistics*, 102(4):731–748.

Smets, F. and Wouters, R. (2007). Shocks and frictions in us business cycles: A Bayesian DSGE approach. *American Economic Review*, 97(3):586–606.

Stock, J. H. and Watson, M. W. (2005). Implications of dynamic factor models for VAR analysis. Working Paper 11467, National Bureau of Economic Research.

Table 1: Descriptive statistics table, survey variables

(A) Price expectations

	Mean	Std	EA19	GER	AUT	BEL	ESP	FIN	FRA	IE	IT	NED	POR
EA19	17	10											
GER	30	12	0.91										
AUT	28	9	0.80	0.63									
BEL	17	11	0.77	0.59	0.83								
ESP	7	15	0.72	0.66	0.41	0.42							
FIN	29	16	0.88	0.75	0.82	0.70	0.55						
FRA	18	10	0.84	0.68	0.80	0.75	0.40	0.83					
IE	22	14	0.57	0.52	0.44	0.50	0.67	0.51	0.38				
IT	-5	11	0.82	0.67	0.73	0.68	0.38	0.71	0.70	0.23			
NED	18	16	0.75	0.57	0.71	0.65	0.48	0.65	0.63	0.35	0.65		
POR	21	17	0.68	0.57	0.54	0.49	0.50	0.74	0.63	0.53	0.52	0.34	
GRE	18	16	0.39	0.35	0.19	0.19	0.43	0.38	0.11	0.36	0.25	0.27	0.51

(B) Unemployment expectations

	Mean	Std	EA19	GER	AUT	BEL	ESP	FIN	FRA	IE	IT	NED	POR
EA19	25	15											
GER	24	20	0.78										
AUT	23	18	0.66	0.73									
BEL	27	20	0.93	0.76	0.67								
ESP	15	19	0.73	0.32	0.15	0.61							
FIN	17	17	0.81	0.59	0.81	0.78	0.47						
FRA	30	18	0.91	0.62	0.67	0.84	0.57	0.86					
IE	17	25	0.62	0.37	0.06	0.50	0.76	0.31	0.45				
IT	26	15	0.73	0.21	0.18	0.63	0.78	0.52	0.65	0.55			
NED	16	30	0.92	0.65	0.62	0.87	0.61	0.81	0.88	0.52	0.66		
POR	37	28	0.73	0.36	0.19	0.65	0.76	0.48	0.58	0.78	0.74	0.71	
GRE	55	20	0.53	0.10	0.24	0.39	0.47	0.41	0.52	0.33	0.72	0.51	0.51

(C) Planned major purchases

	Mean	Std	EA19	GER	AUT	BEL	ESP	FIN	FRA	IE	IT	NED	POR
EA19	-17	3											
GER	-11	5	0.04										
AUT	-17	4	0.30	0.72									
BEL	-15	4	0.67	-0.01	0.09								
ESP	-30	11	0.89	0.03	0.27	0.71							
FIN	-17	3	0.54	-0.21	0.06	0.44	0.45						
FRA	-4	2	0.53	0.23	0.33	0.37	0.62	0.05					
IE	-12	8	0.82	-0.35	-0.08	0.68	0.80	0.51	0.37				
IT	-27	11	0.55	-0.67	-0.34	0.26	0.30	0.54	-0.08	0.65			
NED	-20	5	0.50	0.54	0.55	0.28	0.46	0.04	0.34	0.18	-0.14		
POR	-31	9	0.71	-0.54	-0.20	0.51	0.65	0.54	0.16	0.81	0.77	0.12	
GRE	-48	19	0.46	-0.72	-0.45	0.26	0.38	0.36	0.12	0.64	0.73	-0.16	0.78

Notes: The table shows descriptive statistics for consumer price expectations, Panel (A), unemployment expectations, Panel (B), and consumption plans, Panel (C). The first three columns in each panel show the country code, the mean, and the standard deviation. The remaining columns show bivariate correlations.

Table 2: Variance in data explained by principal components

	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8	Σ
% explained	22.3	13.7	9.9	7.3	4.8	3.5	3.1	2.0	66.6

Notes: The table presents the percentage share of the variation in our dataset (without instrument) explained by each of the first 8 principal components.

Table 3: Explained variance in selected time series

Country	HICP	UNEMP	PEXP	UEXP	MPUR
EA19	0.85	0.71	0.93	0.95	0.88
GER	0.55	0.34	0.74	0.85	0.81
AUT	0.56	0.12	0.84	0.73	0.56
BEL	0.64	0.11	0.80	0.85	0.67
ESP	0.69	0.79	0.81	0.79	0.88
FIN	0.40	0.51	0.85	0.79	0.63
FRA	0.64	0.40	0.79	0.88	0.53
IE	0.43	0.61	0.79	0.89	0.87
IT	0.44	0.16	0.83	0.85	0.84
NED	0.38	0.39	0.85	0.89	0.68
POR	0.31	0.43	0.72	0.94	0.84
GRE	0.34	0.56	0.68	0.67	0.74

Notes: The table shows the share of the variance in selected key variables for the euro area aggregate and the different member countries explained by the first 8 principal components.

Table 4: Coefficients of variation

(A) Macroeconomic Variables

Variable	Horizon 0	Horizon 6	Horizon 12
HICP	5.77	2.95	1.74
	(3.39, 17.41)	(1.60, 9.02)	(1.05, 4.22)
Unemployment rate	14.06	3.42	3.26
	(7.41, 42.79)	(2.39, 5.82)	(2.10, 6.41)

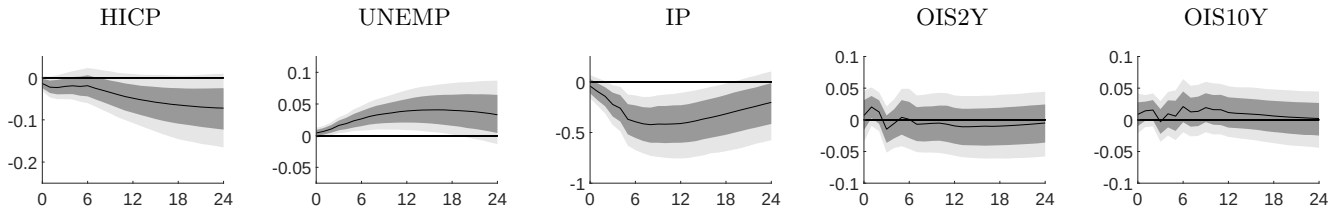
(B) Survey variables

Variable	Horizon 0	Horizon 6	Horizon 12
Price expectations	11.67	1.30	0.95
	(5.88, 36.52)	(1.02, 1.81)	(0.79, 1.33)
Unemployment expectations	8.24	2.34	3.00
	(4.02, 26.47)	(1.63, 3.97)	(1.93, 5.16)
Consumption plans	18.79	10.21	18.69
	(9.34, 66.11)	(5.17, 31.15)	(7.82, 66.26)

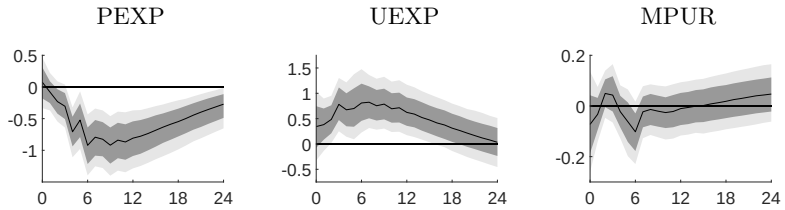
Notes: The table shows the coefficient of variation for the responses of various variables calculated using the pointwise median responses at horizons $h = 0$, $h = 6$, and $h = 12$, together with the 68% credible set in brackets. Panel (A) shows results for macroeconomic variables and Panel (B) presents results for survey variables. The coefficient of variation is calculated as the standard deviation of the member country response with respect to the euro area aggregate response. The responses are scaled such that the euro area aggregate response equals 1 in modulus.

Figure 1: IRFs, euro area aggregates

(A) Macroeconomic variables

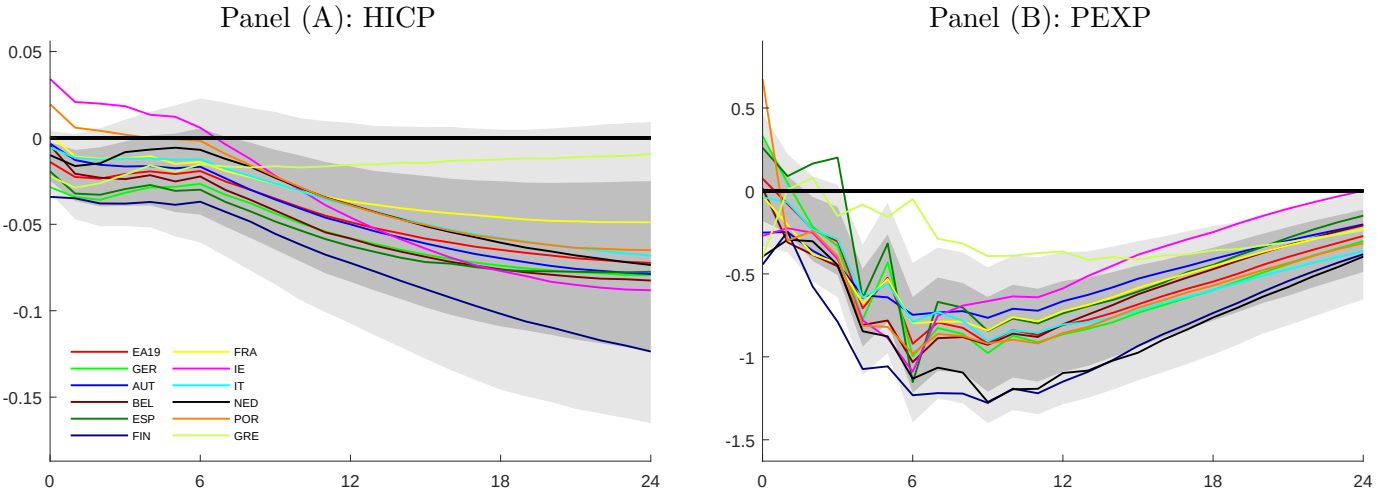


(B) Survey measures



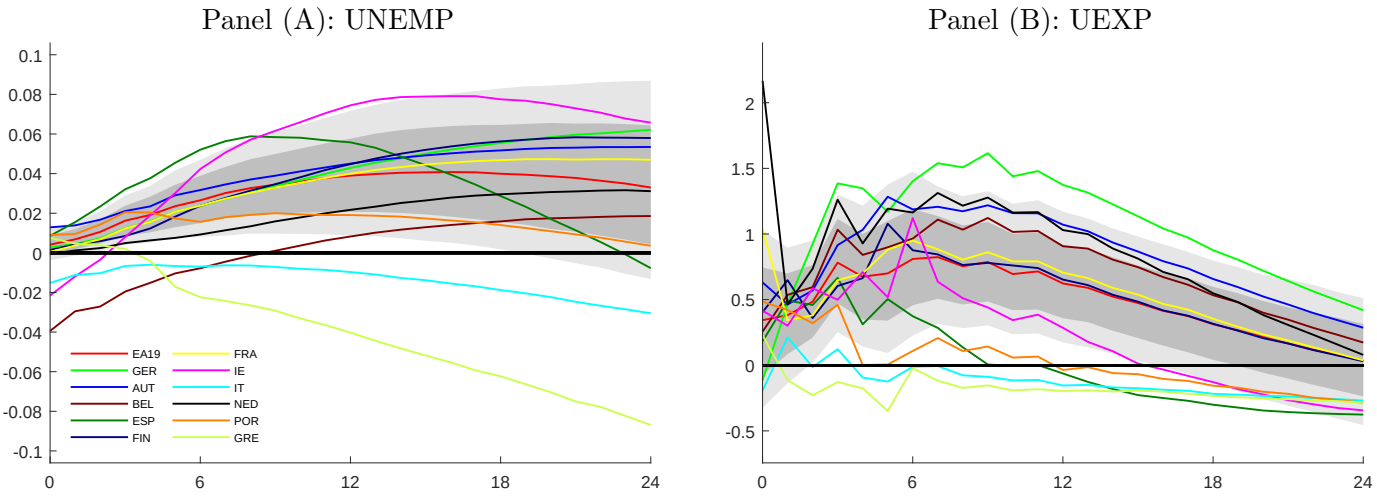
Notes: The figure shows pointwise median impulse response functions (black line) of euro area aggregate variables over a 2-year horizon as well as 68%- and 90%-credible sets (shaded areas) to a contractionary monetary policy shock. While Panel (A) presents responses of macroeconomic variables, the responses of survey variables are shown in Panel (B). The underlying sample runs from 2003M1 to 2019M4.

Figure 2: Country IRFs, HICP and consumer price expectations



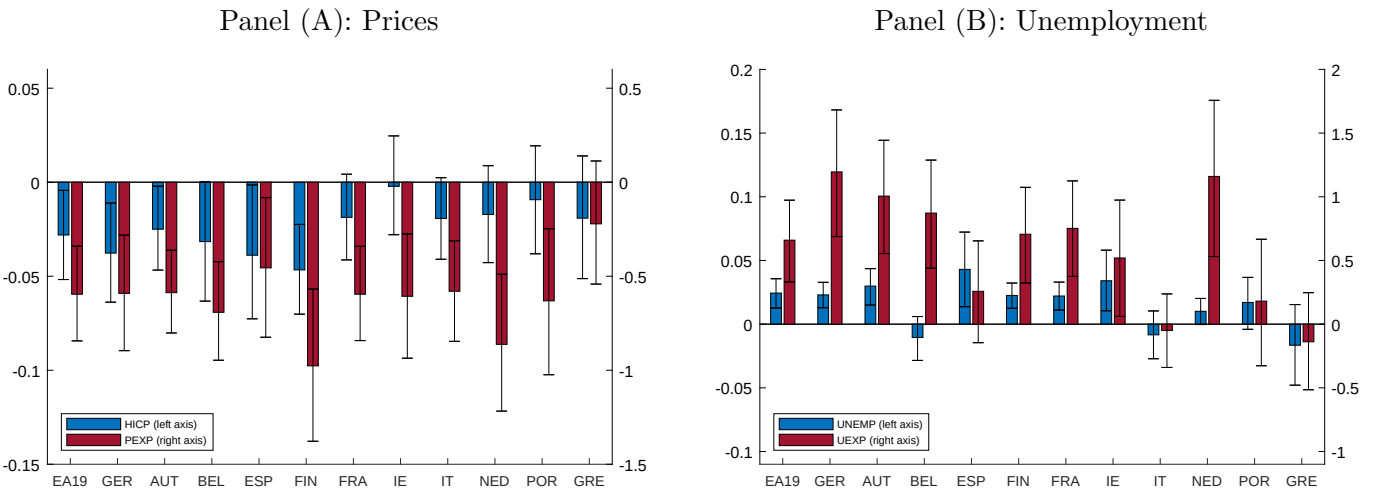
Notes: Panel (A) illustrates pointwise median IRFs of the HICP to a pure monetary policy shock for all member countries in the sample including the EA aggregate. Panel (B) presents pointwise median IRFs of consumer price expectations to a pure monetary policy shock for the same countries. The shaded areas in both panels refer to the 68% and 90% credible set of the EA response. The sample runs from 2003M1 to 2019M4.

Figure 3: Country IRFs, unemployment rate and unemployment expectations



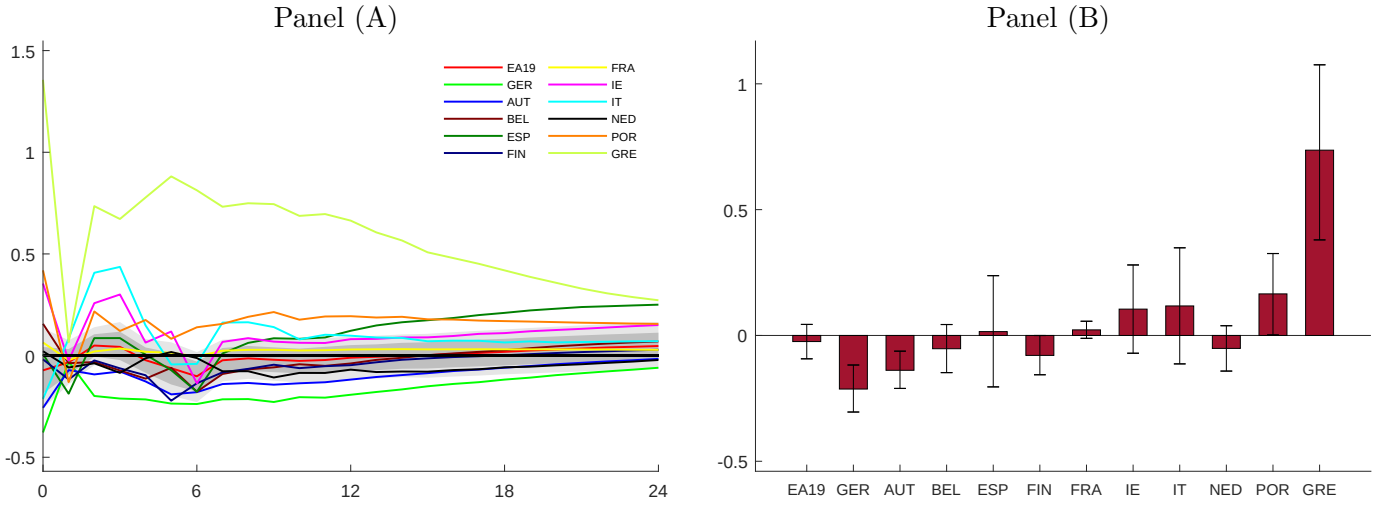
Notes: Panel (A) illustrates pointwise median IRFs of the unemployment rate to a pure monetary policy shock for all member countries in the sample including the EA aggregate. Panel (B) presents pointwise median IRFs of unemployment expectations to a pure monetary policy shock for the same countries. The shaded areas in both panels refer to the 68% and 90% credible set of the EA response. The sample runs from 2003M1 to 2019M4.

Figure 4: Averaged responses



Notes: Panel (A) shows bar plots of the median responses of the HICP (blue) and consumer price expectations to a pure monetary policy shock across different euro area member countries. The bars are calculated as the average response of horizons 0 to 12. Panel (B) presents the corresponding responses of the unemployment rate (blue) and unemployment expectations to a pure monetary policy shock across different euro area member countries. The whiskers refer to the 68% credible sets. The sample runs from 2003M1 to 2019M4.

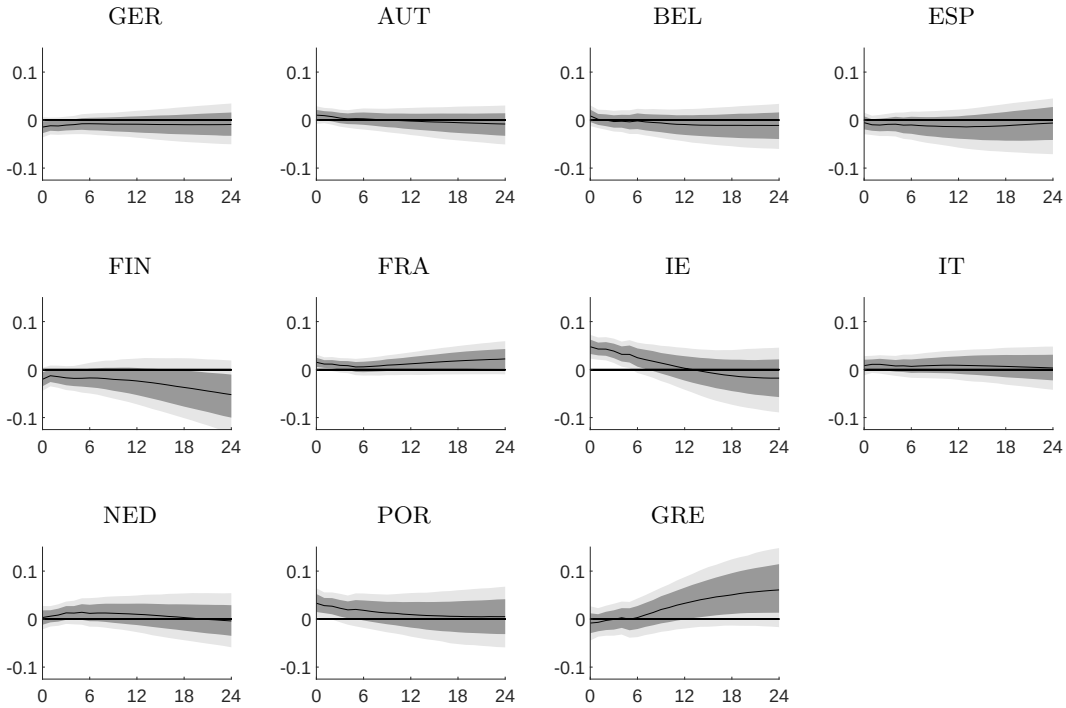
Figure 5: Country IRFs, consumption plans



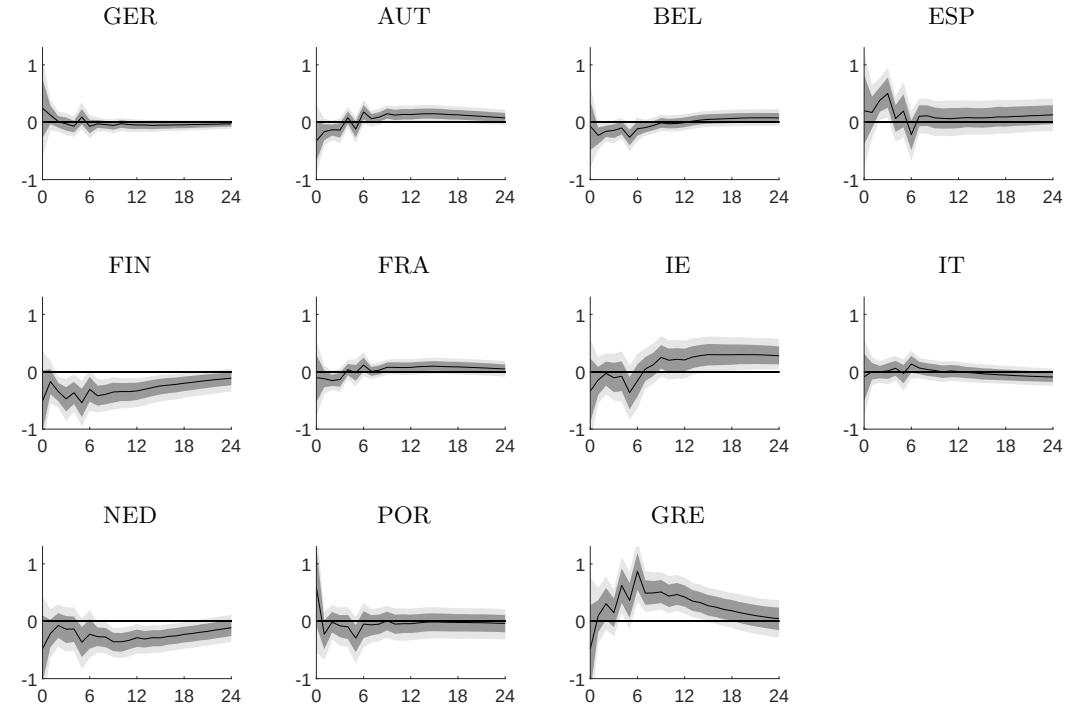
Notes: Panel (A) illustrates pointwise median IRFs of planned consumer major purchases to a pure monetary policy shock for all member countries in the sample including the EA aggregate. The shaded areas refer to the 68% and 90% credible set of the EA response. Panel (B) shows bar plots of the median responses of planned consumer major purchases to a pure monetary policy shock, calculated as the average of horizons 0 to 12. The whiskers refer to the 68% credible sets. The sample runs from 2003M1 to 2019M4.

Figure 6: Differences of country responses to EA response, HICP and consumer price expectations

Panel (A): HICP



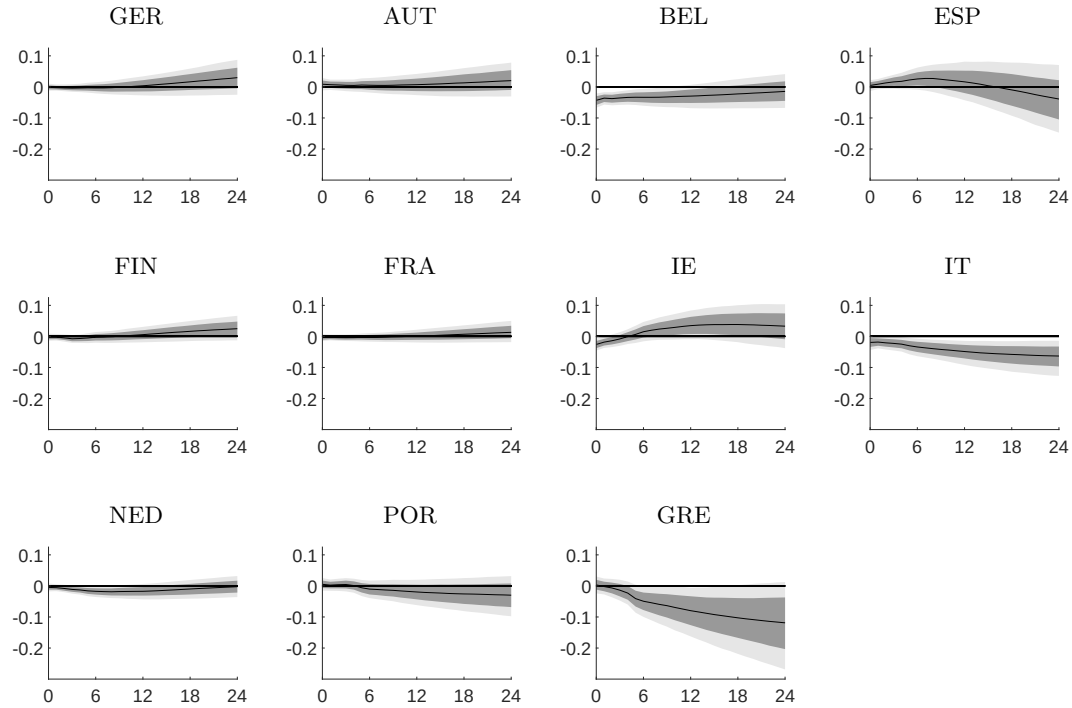
Panel (B): PEXP



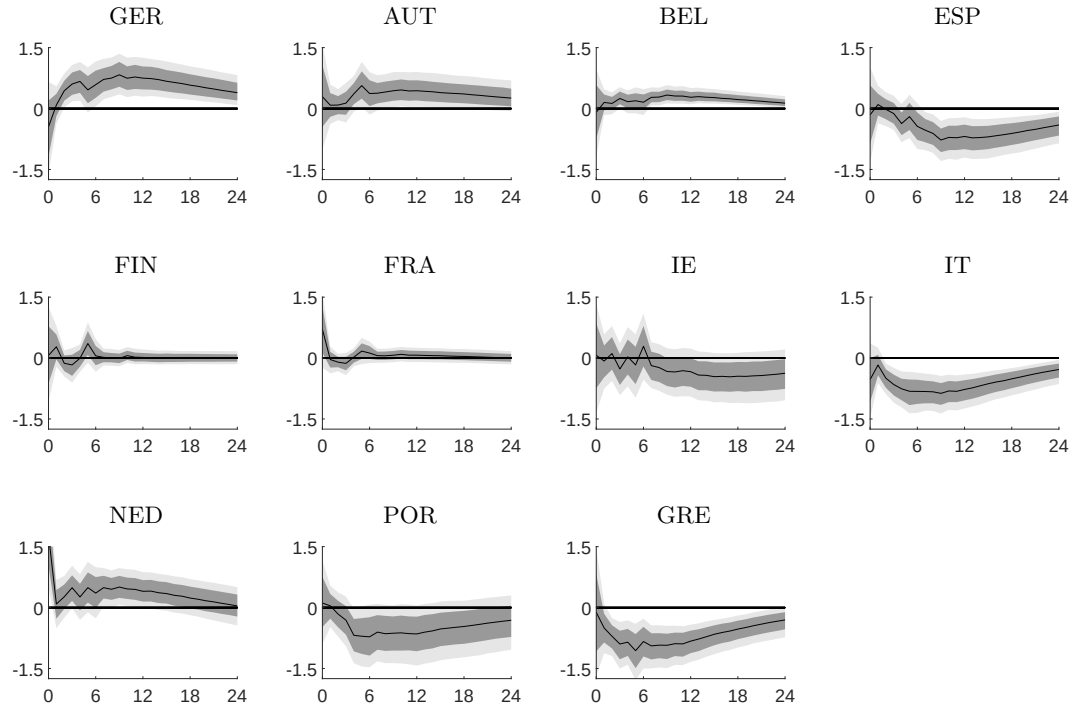
Notes: The figure shows the pointwise median (black line) as well as the 68%- and 90%-credible sets (shaded areas) of differences between impulse response functions to a contractionary policy shock of a specific country and the euro area aggregate. While Panel (A) presents responses of the HICP, the responses of consumer price expectations are shown in Panel (B). The underlying sample runs from 2003M1 to 2019M4.

Figure 7: Differences of country responses to EA response, unemployment rate and unemployment expectations

Panel (A): UNEMP

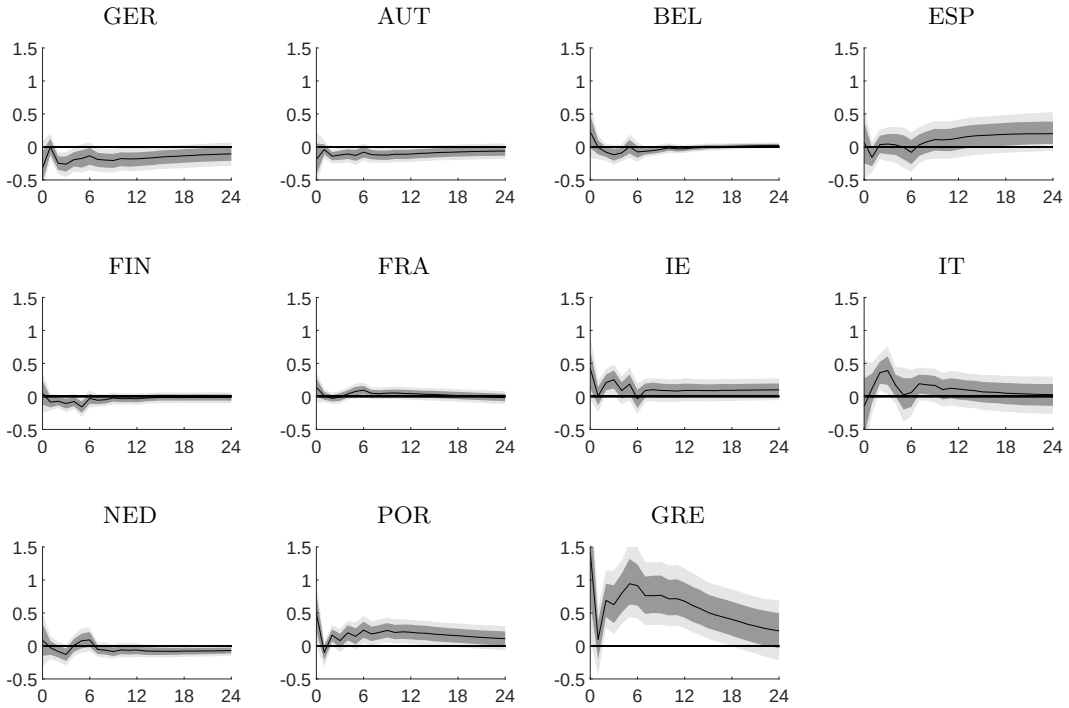


Panel (B): UEXP



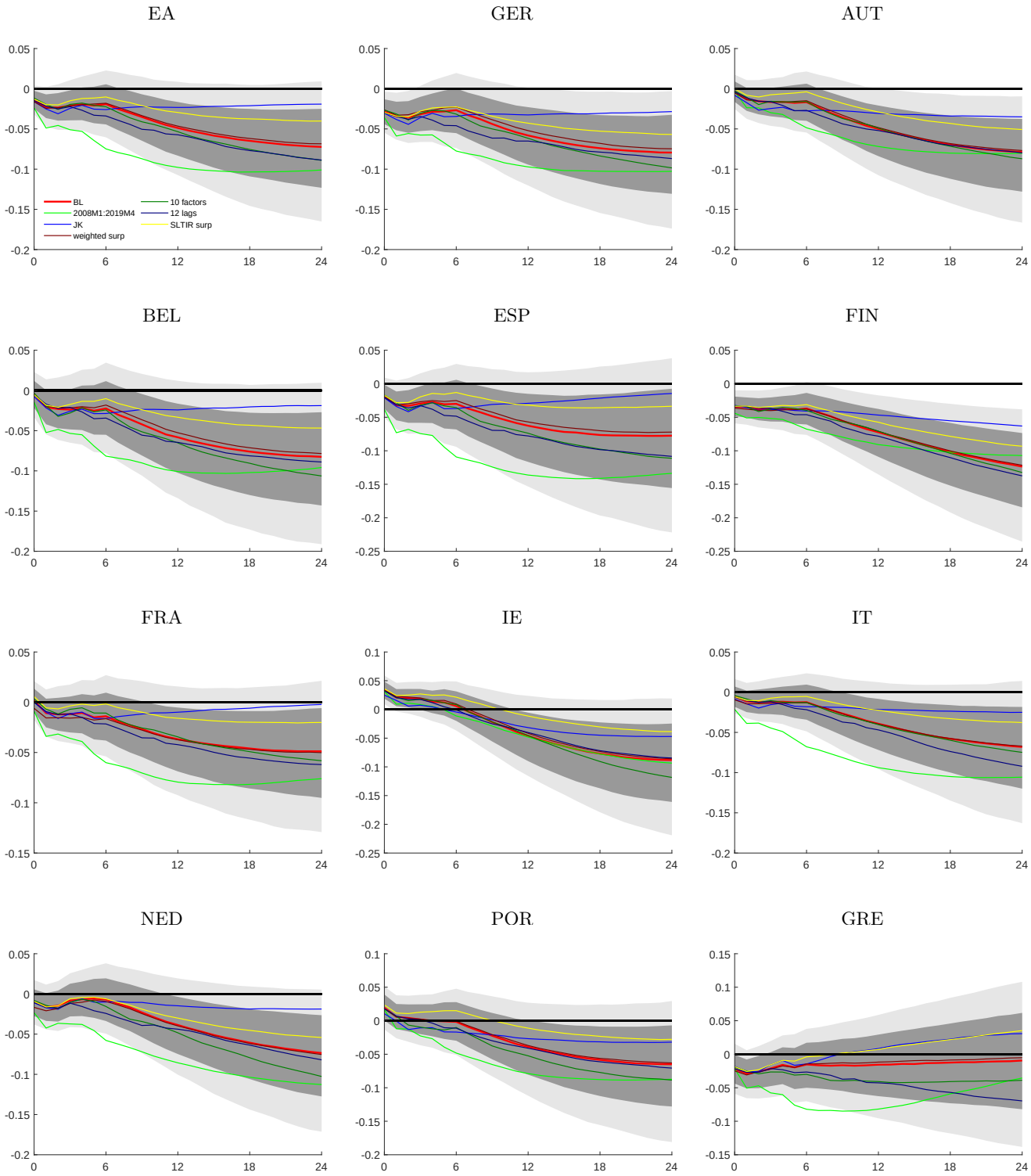
Notes: The figure shows the pointwise median (black line) as well as the 68%- and 90%-credible sets (shaded areas) of differences between impulse response functions to a contractionary policy shock of a specific country and the euro area aggregate. While Panel (A) presents responses of the unemployment rate, the responses of unemployment expectations are shown in Panel (B). The underlying sample runs from 2003M1 to 2019M4.

Figure 8: Differences of country responses to EA response, consumption plans



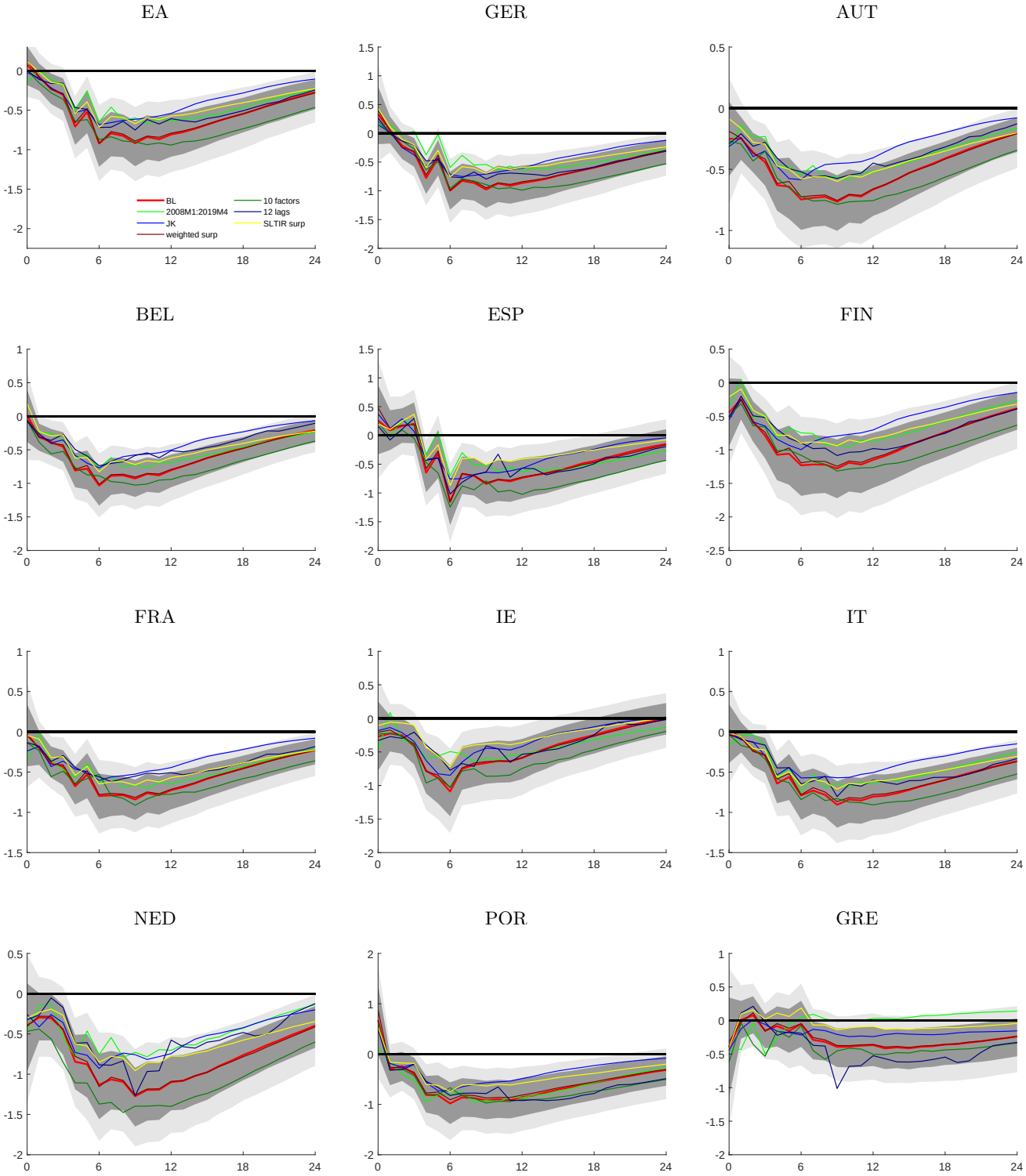
Notes: The figure shows the pointwise median (black line) as well as the 68%- and 90%-credible sets (shaded areas) of differences between impulse response functions to a contractionary policy shock of planned consumer major purchases in a specific country and the euro area aggregate. The underlying sample runs from 2003M1 to 2019M4.

Figure 9: IRFs HICP, robustness checks



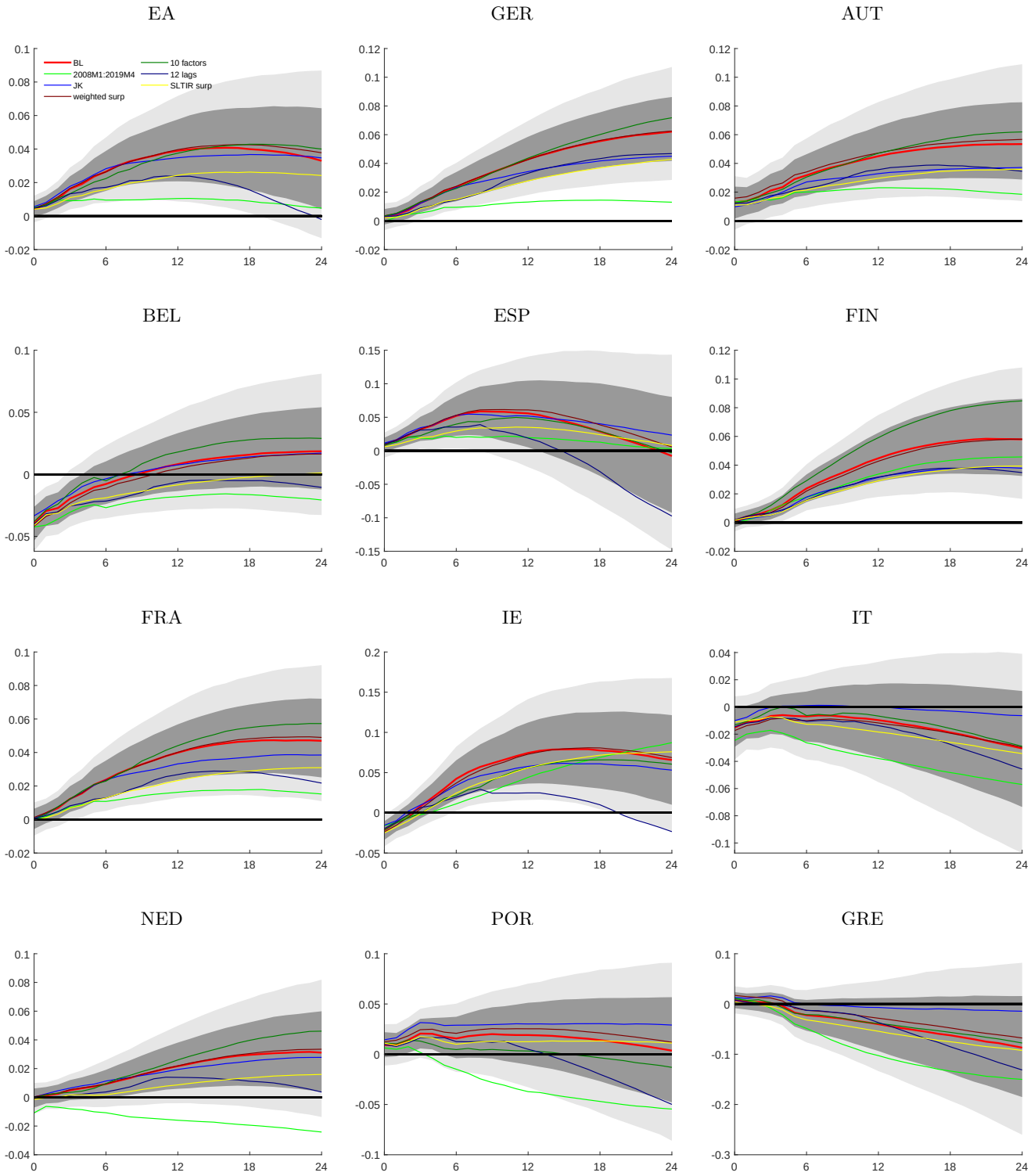
Notes: The figure presents pointwise median responses of the HICP in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure 10: IRFs consumer price expectations, robustness checks



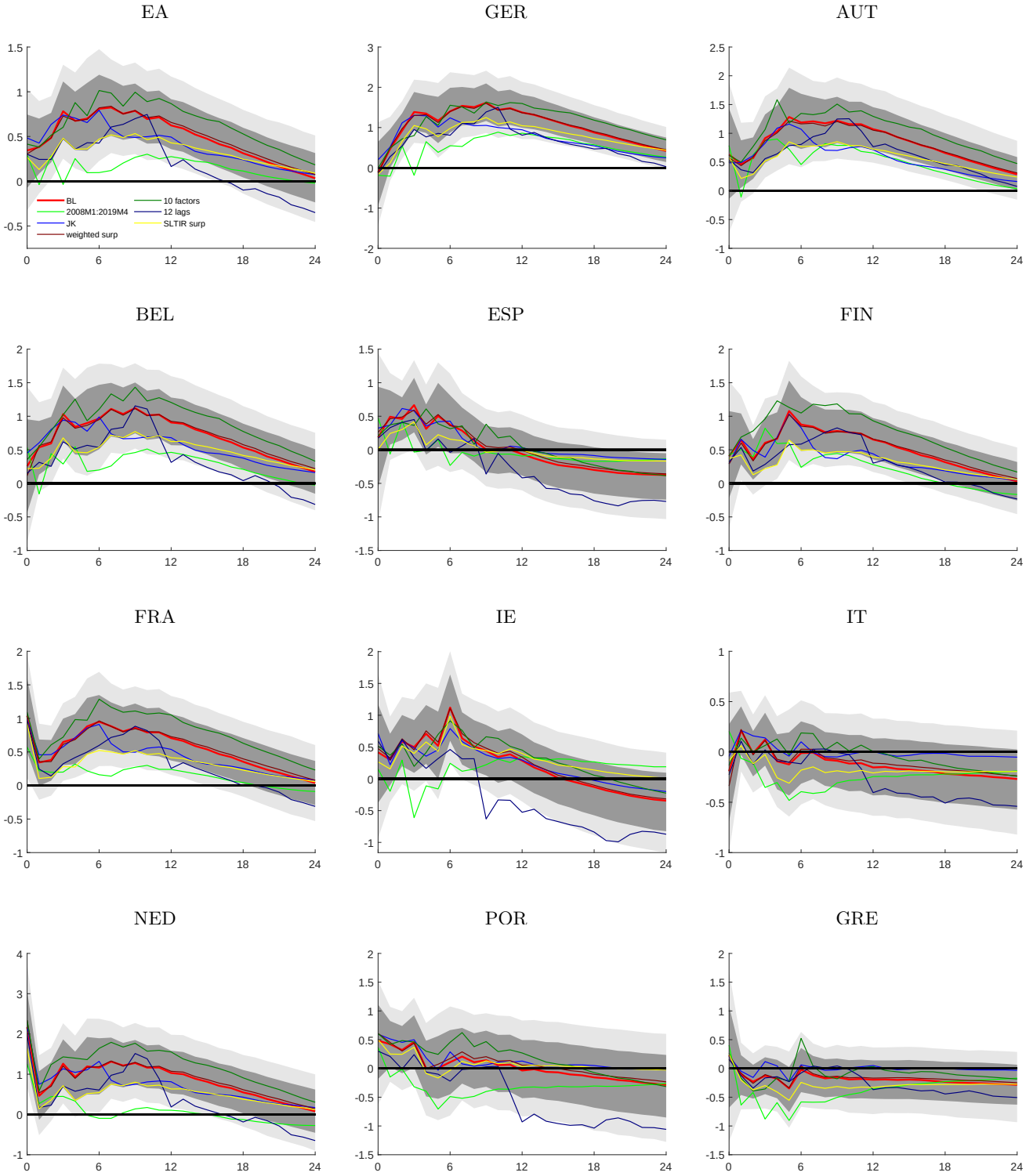
Notes: The figure presents pointwise median responses of consumer price expectations in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure 11: IRFs unemployment rate, robustness checks



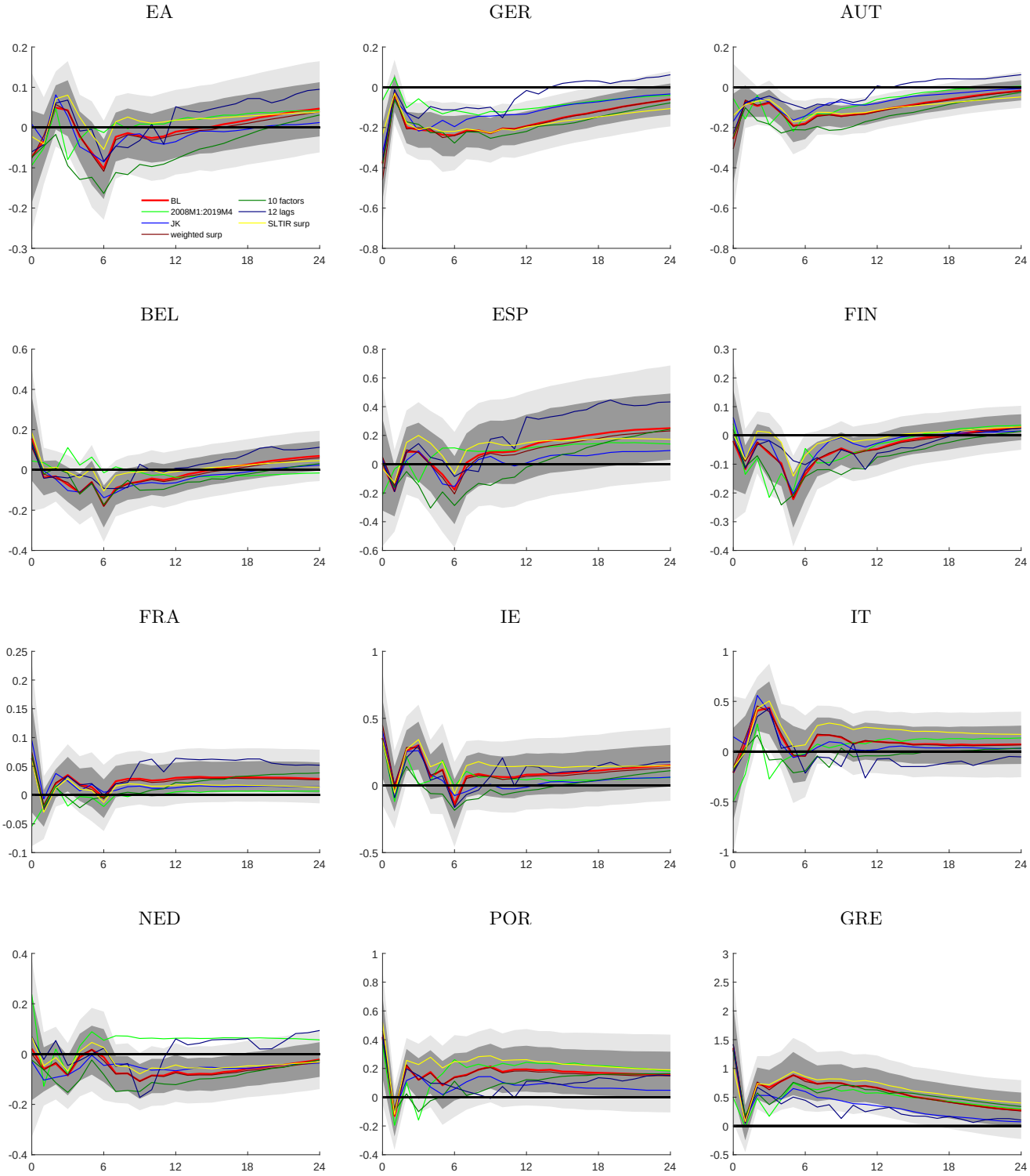
Notes: The figure presents pointwise median responses of the unemployment rate in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure 12: IRFs unemployment expectations, robustness checks



Notes: The figure presents pointwise median responses of consumer unemployment expectations in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure 13: IRFs consumption plans, robustness checks



Notes: The figure presents pointwise median responses of planned consumer major purchases in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

A Supplementary Material

A.1 Data

Table A.1 lists all variables together with a description of the variables, , the geographic area for which the variables are available, the data source, and the time span for which the variable is available, and the transformation code (column labeled T):

- 1 - no transformation
- 2 - first difference
- 3 - second difference
- 4 - log levels
- 5 - first log difference
- 6 - second log difference
- 7 - first difference of percent change

In the table, we use the following country abbreviations:

- EA - Euro Area (changing composition)
- EA19 - Euro Area (19 countries)
- MU - Euro Area 11 member countries (AUT, BEL, ESP, FIN, FRA, GER, GRE, IE, IT, NED, POR)
- U.S. - United States

Table A.1: Variable description and data sources

Variable	Description	T	Country	Source	Sample
1M OIS surprise	1M OIS surprise from the EA-MPD database of Altavilla et al. (2019) in basis points, monetary event window (measured 30 minutes around ECB announcement), NSA, monthly average	1	EA	Altavilla et al. (2019)	1999M1:2019M12
3M OIS surprise	3M OIS surprise from the EA-MPD database of Altavilla et al. (2019) in basis points, monetary event window (measured 30 minutes around ECB announcement), NSA, monthly average	1	EA	Altavilla et al. (2019)	1999M1:2019M12
6M OIS surprise	6M OIS surprise from the EA-MPD database of Altavilla et al. (2019) in basis points, monetary event window (measured 30 minutes around ECB announcement), NSA, monthly average	1	EA	Altavilla et al. (2019)	1999M1:2019M12
1Y OIS surprise	1Y OIS surprise from the EA-MPD database of Altavilla et al. (2019) in basis points, monetary event window (measured 30 minutes around ECB announcement), NSA, monthly average	1	EA	Altavilla et al. (2019)	1999M1:2019M12
Euro Stoxx 50 surprise	Euro Stoxx 50 surprise from the EA-MPD database of Altavilla et al. (2019) in percentage points, monetary event window (measured 30 minutes around ECB announcement), NSA, monthly average	1	EA	Altavilla et al. (2019)	1999M1:2019M12
2Y OIS Rate	2Y OIS rate in percentage points, monthly average, NSA	1	EA	Bloomberg	2007M1:2019M12

Notes: OIS - Overnight index swap; SDW - ECB Statistical Data Warehouse; MFI - Monetary Financial Institute; NFC - non-financial corporation; FRED - Federal Reserve Bank of St. Louis Economic Data; SA - seasonally adjusted; SA* - downloaded as non seasonally adjusted and then adjusted on our own using X-13 ARIMA-SEATS in Matlab; NSA - non seasonally adjusted;

Table A.1: Variable description and data sources (continued)

Variable	Description	T	Country	Source	Sample
10Y OIS Rate	10Y OIS rate in percentage points, monthly average, NSA	1	EA	Bloomberg	2008M12:2019M12
2Y Bond Yield	2Y member country Bond Yield in percentage points, monthly average, NSA	1	MU[1]	Bloomberg	2002M1:2019M12
10Y Bond Yield	10Y member country Bond Yield in percentage points, monthly average, NSA	1	MU[2]	Bloomberg	2002M1:2019M12
2Y EA Bond Yield	2Y EA Bond Yield in percentage points, GDP-weighted average of member state bond yields, monthly average, NSA	1	EA	Bloomberg, own calculations	2002M1:2019M12
10Y EA Bond Yield	10Y EA Bond Yield in percentage points, GDP-weighted average of member state bond yields, monthly average, NSA	1	EA	Bloomberg, own calculations	2002M1:2019M12
NFC Credit Spread	MFIs margins on loans to NFCs in percentage points, NSA	1	MU	SDW	2003M1:2019M12
NFC EA Credit Spread	MFIs margins on loans to NFCs in percentage points, GDP-weighted average of member state NFC spreads, NSA	1	EA	SDW, own calculations	2003M1:2019M12
Euro High Yield Spread	ICE BofA Euro High Yield Index Option-Adjusted Spread on below investment grade corporate debt publicly issued in the euro domestic or eurobond markets in percentage points, monthly average, NSA	1	EA	FRED	1999M1:2019M12
Euro Stoxx 50 Index	Dow Jones Euro Stoxx 50 Price Index - historical close, monthly average, NSA	5	EA	SDW	1999M1:2019M12

Notes: OIS - Overnight index swap; SDW - ECB Statistical Data Warehouse; MFI - Monetary Financial Institute; NFC - non-financial corporation; FRED - Federal Reserve Bank of St. Louis Economic Data; SA - seasonally adjusted; SA* - downloaded as non seasonally adjusted and then adjusted on our own using X-13 ARIMA-SEATS in Matlab; NSA - non seasonally adjusted;

[1] IE, GRE missing
[2] GRE missing

Table A.1: Variable description and data sources (continued)

Variable	Description	T	Country	Source	Sample
National Stock Indices	- ATX (AUT), BEL20 (BEL), IBEX35 (ESP), OMX Helsinki Index (FIN), CAC40 (FRA), DAX (GER), ISEQ All Share (IE), FTSE MIB Index (IT), AEX (NED), PSI20 (POR), historical close, monthly average, NSA	5	MU[3]	yahoo finance, stooq	1999M1:2019M12
CISS Index	Composite Indicator of Systemic Stress, monthly average, NSA	1	EA	SDW	1999M1:2019M12
CLIFS Index	Country-Level Index of Financial Stress (CLIFS) Composite Indicator, index, NSA	1	MU	SDW	1999M1:2019M12
Nominal effective exchange rate	Nominal effective exchange rate of the euro area - 42 trading partners (industrial countries), index 2010=100, NSA	5	EA19	Eurostat	1999M1:2019M12
NFC Loan Volume	Loans to euro area NFCs reported by MFI in the euro area, outstanding amounts at the end of the period, SA*	1	EA	SDW	1999M1:2019M12
M1	Monetary aggregate M1 vis-a-vis euro area non-MFI in the euro area, end of period, million euro, SA	5	EA	SDW	1999M1:2019M12
Building Permits	Building permits - number of dwellings, residential buildings, except residences for communities, index 2015=100, SA	5	MU[4] + EA19	Eurostat	1999M1:2019M12
IP	Industrial Production index, excl. construction, index 2015=100, SA	5	MU + EA19	Eurostat	1999M1:2019M12

Notes: OIS - Overnight index swap; SDW - ECB Statistical Data Warehouse; MFI - Monetary Financial Institute; NFC - non-financial corporation; FRED - Federal Reserve Bank of St. Louis Economic Data; SA - seasonally adjusted; SA* - downloaded as non seasonally adjusted and then adjusted on our own using X-13 ARIMA-SEATS in Matlab; NSA - non seasonally adjusted;

[3] GRE missing
[4] AUT, IE, IT, NED missing

Table A.1: Variable description and data sources (continued)

Variable	Description	T	Country	Source	Sample
Unemployment Rate	Harmonised unemployment rate in percentage points of active population, ILO definition, SA	2	MU + EA19	Eurostat	1999M1:2019M12
Labour Productivity	Real labour productivity per hour worked, index 2015=100, SA*, interpolated to monthly frequency following Miranda-Agrippino and Rey (2020)	1	MU[5] + EA19	Eurostat	1999Q1:2019Q4
HICP	Harmonized consumer price index: Total all items, index 2015=100, SA*	5	MU + EA19	Eurostat	1999M1:2019M12
Producer Prices	Producer prices in industry (except construction, sewerage, waste management and remediation activities), index 2015=100, SA*	5	MU[6] + EA19	Eurostat	2000M1:2019M12
Inflation Expectations	Survey-based consumer expectations about price trends over next 12 months, balance scores, SA	1	MU + EA19	European Commission	1999M1:2019M12
Unemployment Expectations	Survey-based consumer expectations about unemployment trends over next 12 months, balance scores, SA	1	MU + EA19	European Commission	1999M1:2019M12
Current major Purchases	Survey-based consumer expectations about current major purchases, balance scores, SA	1	MU + EA19	European Commission	1999M1:2019M12
Major Purchase Expectations	Survey-based consumer expectations about own major purchases over next 12 months, balance scores, SA	1	MU + EA19	European Commission	1999M1:2019M12

Notes: OIS - Overnight index swap; SDW - ECB Statistical Data Warehouse; MFI - Monetary Financial Institute; NFC - non-financial corporation; FRED - Federal Reserve Bank of St. Louis Economic Data; SA - seasonally adjusted; SA* - downloaded as non seasonally adjusted and then adjusted on our own using X-13 ARIMA-SEATS in Matlab; NSA - non seasonally adjusted;

[5] BEL missing
[6] IE, POR missing

Table A.1: Variable description and data sources (continued)

Variable	Description	T	Country	Source	Sample
Oil Price	Crude oil price: Brent - Europe, Dollars per barrel, monthly average, SA*	5		FRED	1999M1:2019M12
1Y U.S. Treasury Yield	1-year treasury constant maturity rate in percentage points, monthly average, NSA	1	U.S.	FRED	1999M1:2019M12
2Y U.S. Treasury Yield	2-year treasury constant maturity rate in percentage points, monthly average, NSA	1	U.S.	FRED	1999M1:2019M12
10Y U.S. Treasury Yield	10-year treasury constant maturity rate in percentage points, monthly average, NSA	1	U.S.	FRED	1999M1:2019M12
U.S. High Yield Spread	ICE BofA U.S. High Yield Index Option-Adjusted Spread on below investment grade corporate debt publicly issued in the U.S. domestic or U.S. markets in percentage points, monthly average, NSA	1	U.S.	FRED	1999M1:2019M12
S&P500	S&P500 Index, monthly average of daily close values, NSA	5	U.S.	Yahoo Finance	1999M1:2019M12
U.S. IP	Industrial Production: Total index, index 2012=100, monthly, SA	5	U.S.	FRED	1999M1:2019M12
U.S. CPI	U.S. Consumer Price Index: Total all items for the United States, index 2015=100, SA	5	U.S.	FRED	1999M1:2019M12
GFC Factor	Global financial cycle Factor from Miranda-Agrippino and Rey (2020), is the first principal component of various global asset prices	1		Eurostat	1999M1:2019M12

Notes: OIS - Overnight index swap; SDW - ECB Statistical Data Warehouse; MFI - Monetary Financial Institute; NFC - non-financial corporation; FRED - Federal Reserve Bank of St. Louis Economic Data; SA - seasonally adjusted; SA* - downloaded as non seasonally adjusted and then adjusted on our own using X-13 ARIMA-SEATS in Matlab; NSA - non seasonally adjusted;

A.2 Rotational Sign Restrictions

We follow Jarociński (2020) and use rotational sign restrictions to purge the interest rate surprise from information effects. Let U be a $T \times 2$ matrix containing the first principal component of high frequency changes in the 1-, 3- and 6-month and the 1-year OIS rate, i, and high frequency changes in the Stoxx50 index, s, both aggregated to monthly frequency. To decompose i into a pure policy policy surprise, m, and a central bank information surprise, cbi, which are orthogonal, we first calculate the QR-decomposition of U to receive an orthonormal matrix Q and an upper-triangular matrix C, of which the diagonal elements are restricted to be positive.

Next, we calculate the following matrix to rotate the orthogonal components in Q:

$$P = \begin{pmatrix} cos(\alpha) & sin(\alpha) \\ -sin(\alpha) & cos(\alpha) \end{pmatrix}, \tag{A.1}$$

where α equals the inverse cosine of $\sqrt[2]{\gamma}$. To obtain γ, we first define a new vector which equals i if interest rate surprise and stock market surprise have different signs and which contains zeros otherwise. γ is calculated as the variance of the non-zero elements in this new vector divided by the total variance of the interest rate surprise i. We obtain a value of 0.64 for γ, which indicates that the m_t accounts for 64 percent of the variance of i. Next, we calculate α and the matrix P, which we use to rotate Q such that the columns of the resulting matrix fulfil the identifying assumptions. As a result, we receive the two orthogonal vectors m_t and cbi_t, of which we use the former as an instrument for the monetary policy shock. Finally, we scale m_t and the cbi_t with $c_{11}cos(\alpha)$ respectively $c_{22}sin(\alpha)$, where c_{11} and c_{22} are the diagonal elements in C, such that the two orthogonal components add up to i_t.

A.3 MCMC Algorithm

We use a Gibbs Sampler to sequentially draw from $p(\beta|y,\Sigma)$ and $p(\Sigma|y,\beta)$. Thereby, $p(\beta|y,\Sigma) = N(\overline{\beta},\overline{V})$, where

$$\overline{V} = (\underline{V}^{-1} + \sum_{t=1}^{T} z_t'\Sigma^{-1}z_t)^{-1}, \tag{A.2}$$

$$\overline{\beta} = \overline{V}(\underline{V}^{-1}\underline{\beta} + \sum_{t=1}^{T} z_t'\Sigma^{-1}y_t), \tag{A.3}$$

and $p(\Sigma|y,\beta) = iW(\overline{S},\overline{\nu})$, with

$$\overline{\nu} = T + \underline{\nu}, \tag{A.4}$$

$$\overline{S} = \underline{S} + \sum_{t=1}^{T}(y_t - z_t'\beta)(y_t - z_t'\beta)'. \tag{A.5}$$

In addition to the FAVAR equation parameters β and Σ, we draw the parameters of the factor equation, λ and R, at each iteration. For this purpose, we rewrite Equation 2 more compactly:

$$x_t = \lambda y_t + e_t, \tag{A.6}$$

where $\lambda = [\lambda_m\ \lambda_f]$ contains the factor loadings. For each row λ_j, $j = 1,...,M$, the posterior is $\lambda_j \sim \mathcal{N}(\overline{\lambda_j},\overline{W})$, with

$$\overline{W} = (\underline{W}^{-1} + R_{jj}^{-1}y'y)^{-1}, \quad j = 1,...,M \tag{A.7}$$

$$\overline{\lambda_j} = (\overline{W}(\underline{W}^{-1}y'x_j))', \quad j = 1,...,M, \tag{A.8}$$

where x_j contains observations $t = 1,...,T$ of the j^{th} variable in x and $\underline{W} = 4I_N$. The diagonal

elements in R are the variances of the idiosyncratic components in the factor equation. The first element on the main diagonal of R is set to zero and for the remaining $j = 1, ..., M$ diagonal elements we assume $R_{jj} \sim iG(\overline{r_1}, \overline{r_2})$, where

$$\overline{r_2} = (\underline{r_2}/2 + (x_j - y\lambda_j')'(x_j - y\lambda_j')/2)^{-1}. \quad j = 1, ..., M. \tag{A.9}$$

$$\overline{r_1} = \underline{r_1}/2 + T/2, \tag{A.10}$$

Finally, we set the prior scale parameter in Equation (A.9) to $\underline{r_2} = 0.01$ and the prior shape parameter in Equation (A.10) to $\underline{r_1} = 0.01$, where the latter implies a very loose prior, as for instance in Korobilis (2013).

A.4 Additional Tables and Figures

Table A.1: Coefficients of variation, without Greece

(A) Macroeconomic variables

Variable	Horizon 0	Horizon 6	Horizon 12
HICP	5.48	2.78	1.49
	(3.32, 16.52)	(1.50, 8.48)	(0.92, 3.65)
Unemployment rate	13.54	2.74	2.48
	(7.17, 41.92)	(2.01, 4.40)	(1.73, 4.35)

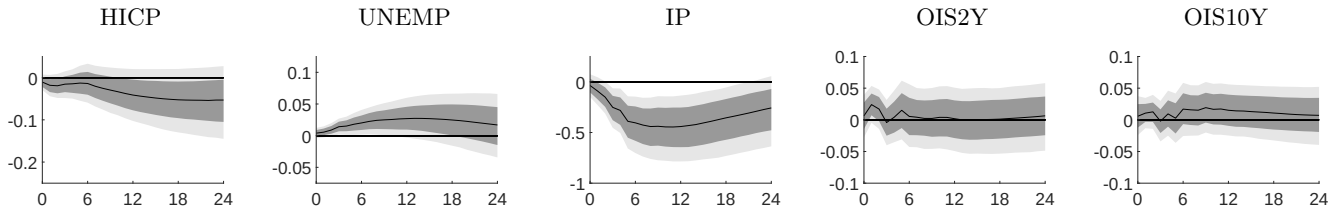
(B) Survey variables

Variable	Horizon 0	Horizon 6	Horizon 12
Price expectations	10.53	0.85	0.77
	(5.33, 33.76)	(0.65, 1.24)	(0.65, 1.03)
Unemployment expectations	7.85	2.08	2.65
	(3.79, 25.15)	(1.44, 3.59)	(1.69, 4.66)
Consumption plans	11.68	4.62	10.21
	(6.11, 39.03)	(2.71, 14.57)	(3.89, 34.97)

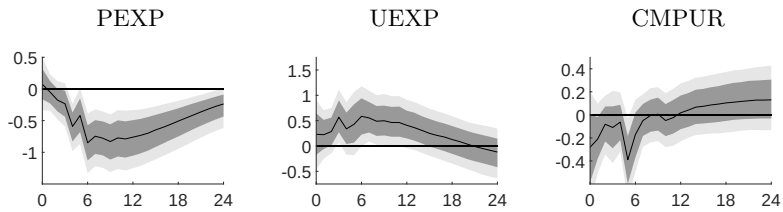
Notes: The table shows the coefficient of variation for the responses of various variables calculated using the pointwise median responses at horizons $h = 0$, $h = 6$, and $h = 12$, together with the 68% credible set in brackets. Panel (A) shows results for macroeconomic variables and Panel (B) presents results for survey variables. The coefficient of variation is calculated as the standard deviation of the member country response with respect to the euro area aggregate response. The responses are scaled such that the euro area aggregate response equals 1 in modulus.

Figure A.1: IRFs, euro area aggregates, with current major purchases

(A) Macroeconomic variables

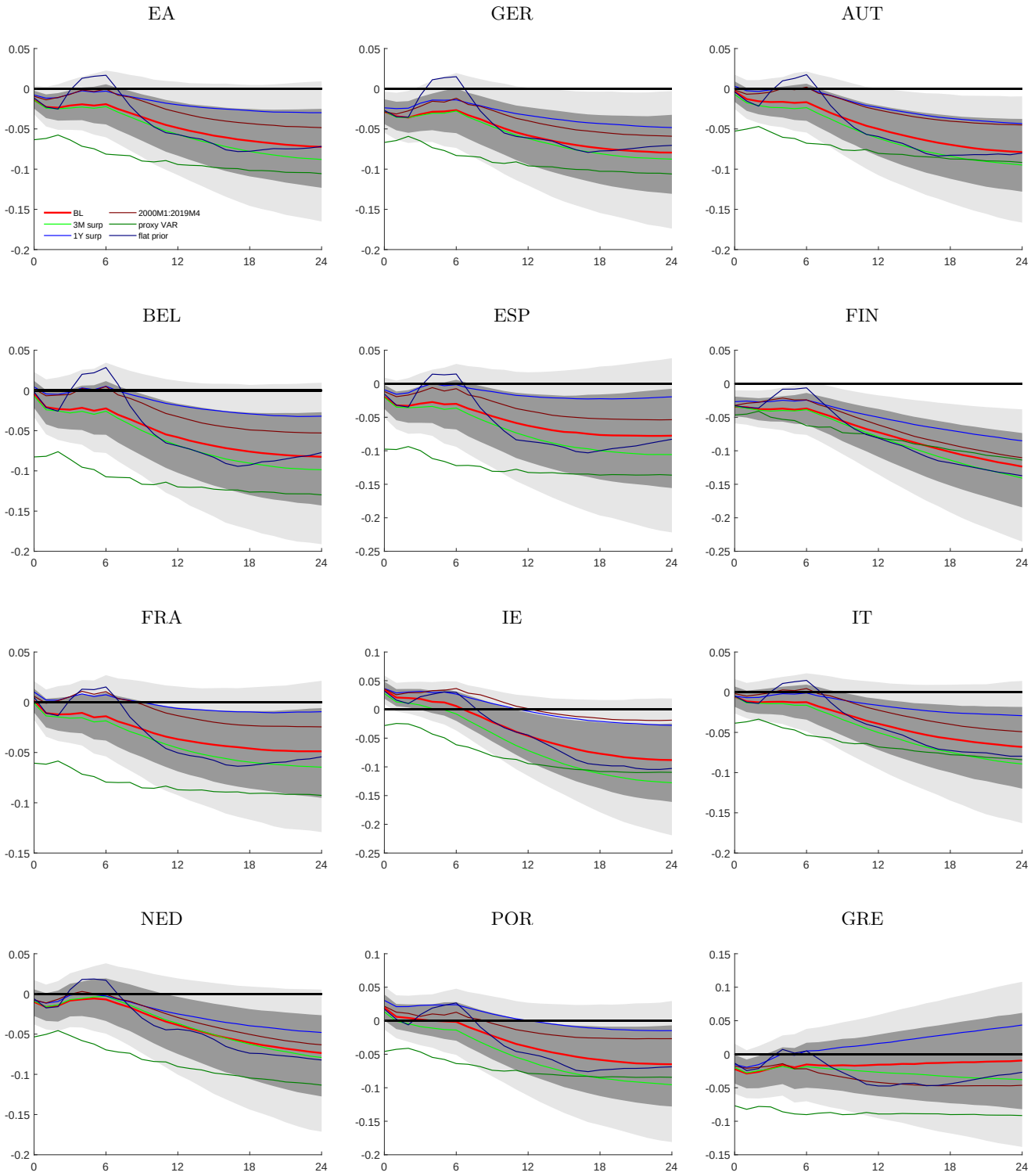


(B) Survey variables



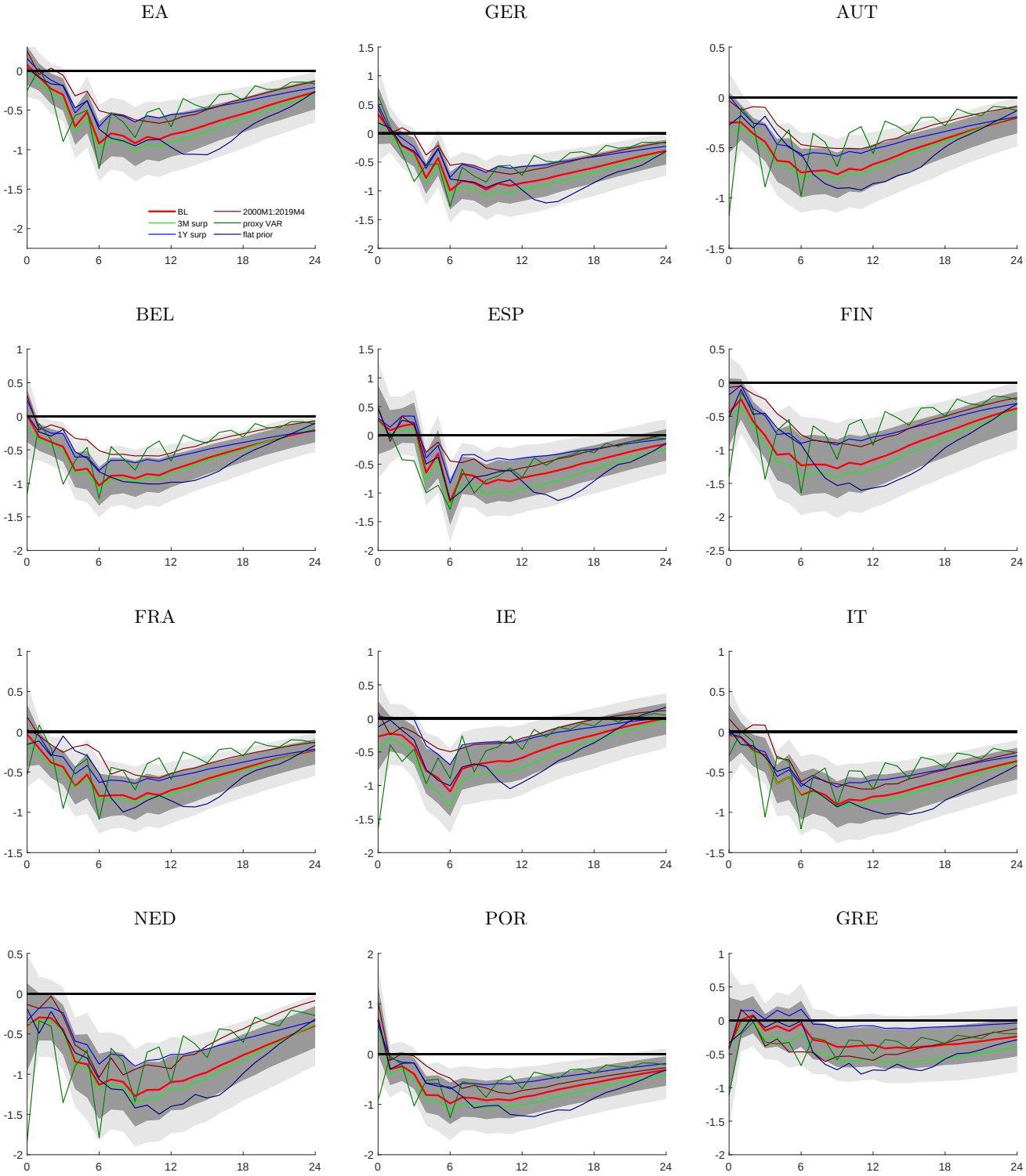
Notes: The figure shows pointwise median impulse response functions (black line) of euro area aggregate variables over a 2-year horizon as well as 68%- and 90%-credible sets (shaded areas) to a contractionary monetary policy shock. While Panel (A) presents responses of macroeconomic variables, the responses of survey variables are shown in Panel (B). The underlying sample runs from 2003M1 to 2019M4.

Figure A.2: IRFs HICP, additional robustness checks



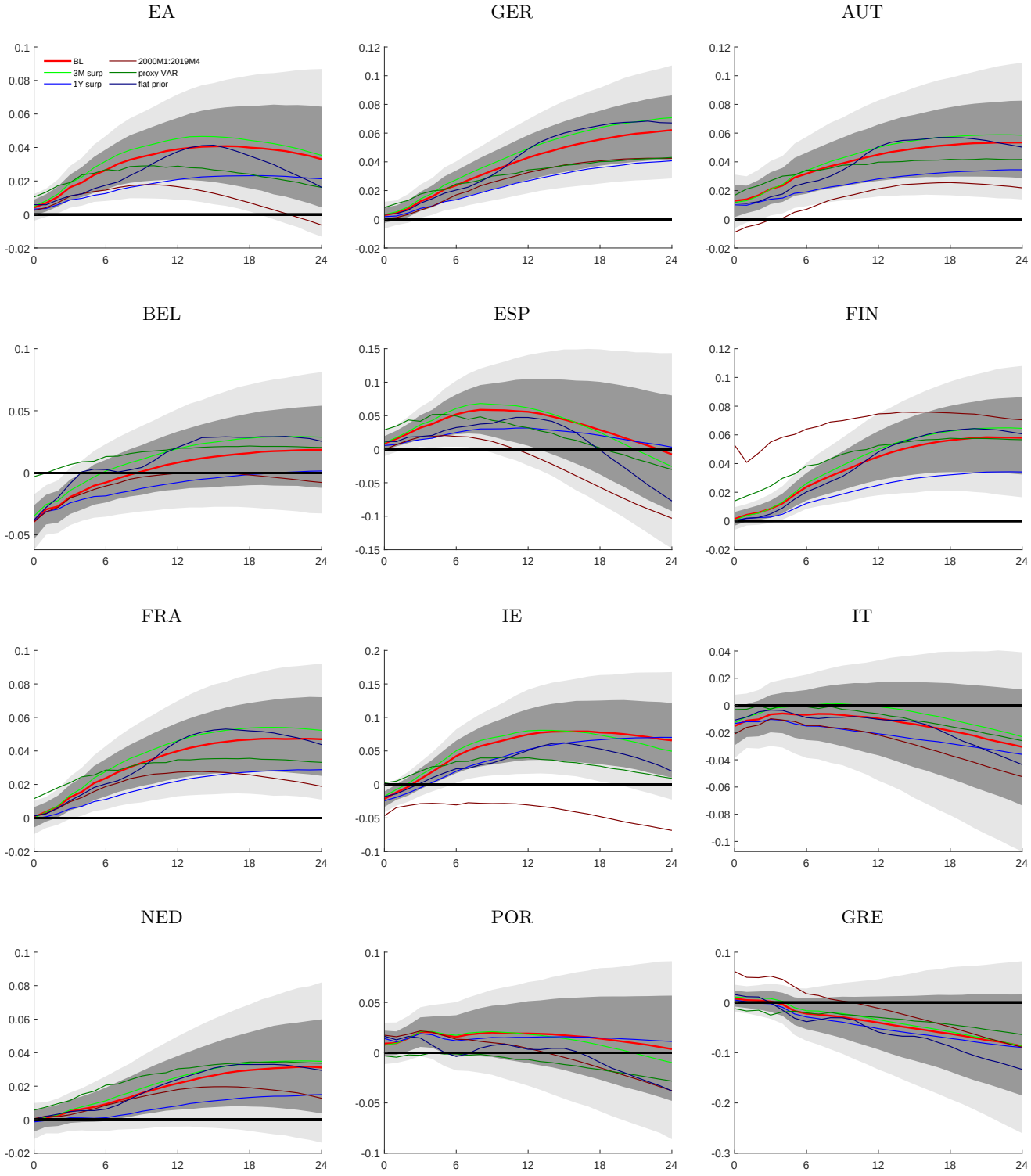
Notes: The figure presents pointwise median responses of the HICP in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure A.3: IRFs consumer price expectations, additional robustness checks



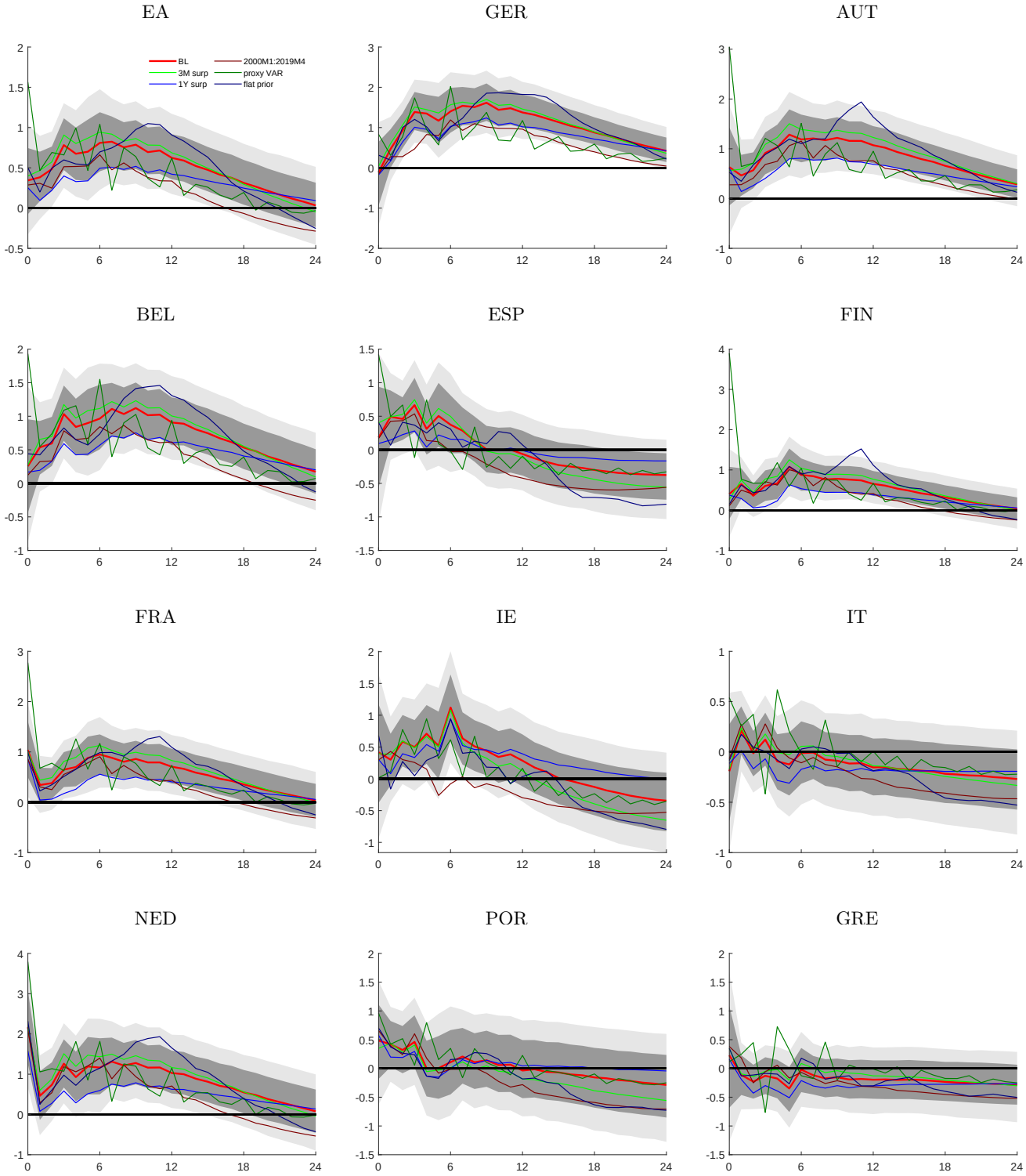
Notes: The figure presents pointwise median responses of consumer price expectations in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure A.4: IRFs unemployment rate, additional robustness checks



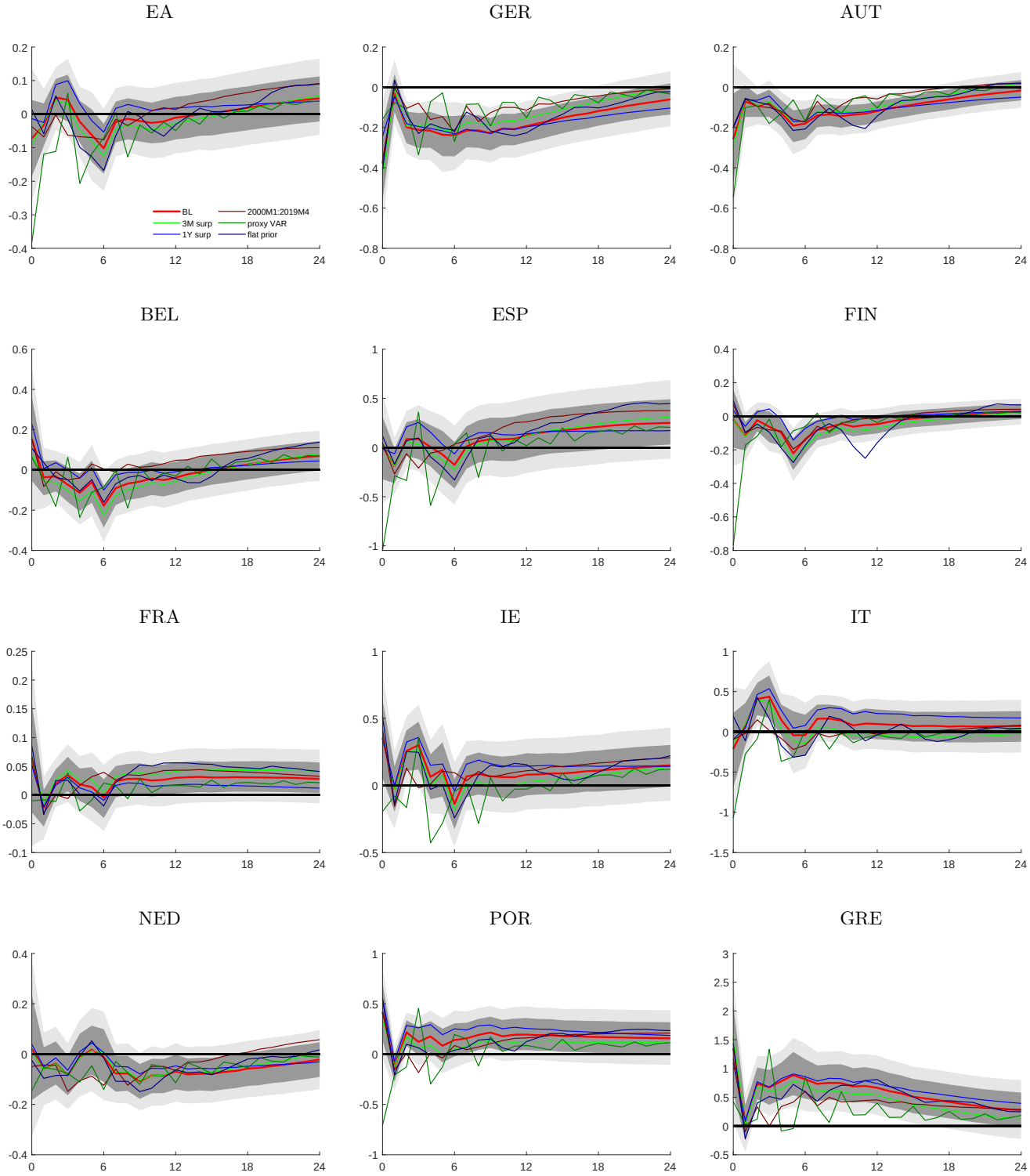
Notes: The figure presents pointwise median responses of the unemployment rate in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure A.5: IRFs unemployment expectations, additional robustness checks



Notes: The figure presents pointwise median responses of consumer unemployment expectations in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.

Figure A.6: IRFs consumption plans, additional robustness checks



Notes: The figure presents pointwise median responses of planned consumer major purchases in different EA member countries including the EA aggregate to a contractionary monetary policy shock. The coloured lines refer to the responses based on different models, while the shaded areas show the 68%- and 90%-credible sets in the baseline model.