Belke, Ansgar; Beckmann, Joscha; Dubova, Irina

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What drives updates of inflation expectations?

A Bayesian VAR analysis for the G-7 countries

by

Joscha Beckmann (Ruhr-University of Bochum and Kiel Institute of the World Economy)

Ansgar Belke (University of Duisburg-Essen, Centre for European Policy Studies, Brussels, Institute for the Study of Labor, Bonn)

Irina Dubova (Ruhr-University of Bochum and Ruhr Graduate School)*

Abstract

Inflation expectations play a crucial role for monetary policy transmission, having become even more important since the emergence of unconventional monetary policy. Based on survey data provided by Consensus Economics, we assess determinants of professional inflation expectations for the G7 economies. We emphasize the role of international spillovers in inflation expectations stemming from monetary policy decisions in the US. We also consider several possible determinants, such as changes in the path of monetary policy, oil price shocks and uncertainty measures. Based on a Bayesian VAR, we find significant evidence for international spillovers stemming from expectations about US monetary policy based on impulse-response functions and forecast error decompositions. We also provide similar evidence on spillovers from the dispersion across inflation forecasts.

JEL codes: C22, E31, E52

Keywords: Bayesian VAR, expectations, inflation, survey data, updating

*Corresponding author: Joscha Beckmann, Ruhr University Bochum/Germany, Room GC, 3/145 (GC 3/145), phone: +49 (0)234 32-22902. Email: joscha.beckmann@rub.de.

Introduction

Inflation expectations play a crucial role for the transmission of monetary policy shocks. The capability of a central bank to affect inflation expectations are a direct measure of central bank credibility. The recent period of unconventional monetary policy after the emergence of the zero lower bound has made signaling and reputation effects the most important tool for monetary policymakers. Well-anchored inflation expectations are a key factor for achieving economic stability since inflation expectations are also important for decisions of investors, firms and negotiations of labor contracts (Mehrotra and Yetman, 2014).

The importance of monetary policy coordination has also increased in recent years. While Eurozone members have opted for a common monetary policy, central bank interest rates in general have been strongly affected by the international environment (Taylor, 2013). Major central banks have shown a high level of synchronicity in their response to the recent financial crisis, resulting in a potential need to coordinate on an exit from unconventional monetary policy. There is also an increasing literature on various effects of global liquidity, for example on the global business cycle and commodity prices (Beckmann et al., 2014).

This paper contributes to the literature by analyzing determinants of inflation updates in the G7 with a focus on international spillovers in expectations stemming from the US. Despite the rich literature on the international character of monetary policy, this issue has yet to be explicitly addressed. Previous research has analyzed monetary policy spillovers in the context of extended Taylor rule specifications (Taylor, 2013) or in the form of aggregated global liquidity measures (Belke et al., 2010). However, all such settings do not disentangle the role of expectations. We do not only focus on the mean forecast of professionals but also concentrate on the dispersion across professionals forecasts. This is an important element of the analysis since reducing uncertainty regarding the future inflation rate is an important target of monetary policymakers.

A functioning signaling channel is of great importance since it reduces uncertainty among market participants about the future inflation rate (Haldane et al., 2016).

In our study, we rely on survey data from Consensus Economics for inflation and GDP expectations and also take policy uncertainty, interest rates and the current inflation rate into account. This dataset enables us to analyze the question whether professionals' expectations incorporate international spillovers in the sense that changing inflation expectations in the US also result in inflation expectation changes in other G7 economies. Another question we tackle is whether expectation spillovers are more important than the outlook on the domestic economy. Finally, we analyze whether determinants of inflation dynamics have changed over the recent sample to account for potential changes in monetary policy after 2008. .

Figures 1 and 2 provide a graph of expected inflation and disagreement among forecasters for the G7 economies. Both figures suggest a high level of synchronicity and point at the importance of potential international spillovers. Several established stylized facts also become evident, such as the increase of uncertainty around the final crisis and the convergence of inflation expectations in the euro area.

There is no unique measure of inflation forecasts. In a nutshell, survey measures and market based measures are both considered. There is strong evidence that the average (mean) forecast across professional forecasters is a better predictor of future inflation compared to stock markets or macroeconomic indicators (Ang et al., 2007). Since the participants of the survey conducted by Consensus Economics include major financial institutions, it is reasonable to assume that we are also able to capture reputation and credibility effects stemming from policymakers' decisions. In addition to the mean, the dispersion across professional forecasts is frequently used as a measure of uncertainty and a potential measure for coordination effects stemming from policy shocks. Inflation and GDP disagreement are affected by business cycles but also display different dynamics over the business cycle (Dovern et al., 2011).

Finally, it is worth mentioning that inflation expectations are analyzed over different horizons and in terms of fixed event (for the next year) and fixed horizon (for the next quarter) forecasts. We mostly focus on medium-run inflation expectations which correspond to inflation over the next year. The data we rely on reflects expectations related to inflation and the current and the upcoming year which are consequently updated. This implies that a change of those expectations reflects an update of inflation expectations for a given horizon.

The remainder of the paper is organized as follows. The next section summarizes the existing literature related to inflation expectations. Section 3 provides data and describes our empirical methodology. Section 4 presents our results while Section 5 concludes.

2. Determinants of inflation expectations

2.1 Basic considerations

Despite the fact that there is no unique theory for determinants of inflation expectations, several potential drivers can be derived from macroeconomic theory (Areosa, 2016). The simple Phillips curve argues that inflation expectations are driven by the current inflation rate and the deviations from the natural rate of unemployment.

$$\pi^e = a(U - \bar{U}) + \pi + \varepsilon_{\pi^e} \tag{1}$$

where 1/a is equal to the Phillips-Curve coefficient and ε_{π^e} denotes an i.i.d error term. Taking the inverse relationship between unemployment and GDP into account, the latter can be used interchangeably with unemployment. The role of monetary policy can easily be introduced based on a conventional Taylor reaction function which proposes a relationship between the central bank's policy rate, inflation and the output gap:

$$i_t = r^* + \pi^* + \alpha_1(\pi_t - \pi^*) + \alpha_2 y_t + \varepsilon_{i_t} \tag{2}$$

where *i* is the nominal policy determined interest rate, *r** is the long-run equilibrium real interest rate, π^* stands for the central bank's inflation objective assumed to be 2% in the following, π represents the actual inflation rate, and *y* is the output gap. If market participants believe that the monetary policy setup follows such a Taylor rule, the current interest rate and its corresponding expectations should also affect expectations about future inflation.

The Taylor reaction function and the Phillips curve are also both part of the time inconsistency framework in monetary policy. Based on the pioneer work of Kydland and Prescott (1977), Barro and Gordon (1983) have introduced a loss function which is based on the idea that the government minimizes deviations of output and inflation from target values

$$L_t = \frac{(U_t - U^*)^2}{2} + \theta * \frac{(\pi_t - \pi^*)^2}{2} + \epsilon_t, \quad (3)$$

where L_t denotes losses, U_t unemployment, π_t inflation, while π^* and U^* refer to target values. In such a framework, the Phillips curve acts as a secondary condition under which the government is operating.

If market expectations include such potential government incentives and market participants believe in a Taylor rule framework, the (expected) path of GDP or unemployment will be incorporated in inflation expectations. Overall, there is plenty of reason to believe that inflation expectations should incorporate the path of the real economy.

2.2 Inflation expectations and disagreement among forecasters

A more general specification of long-run inflation expectations is based on the idea that agents expect the long-run inflation rate to be constant but form expectations about the short-term component (Carvalho et al., 2015):

$$\mathbb{E}_t[\pi_{t+T}] = \bar{\pi}_t + \omega\, \mathbb{E}_t[\varphi_{t+T}], \quad (4)$$

where $\bar{\pi}_t$ denotes the long-run inflation equilibrium while $\mathbb{E}_t[\varphi_{t+T}]$ reflects expectations about the short-run component φ_{t+T}. This simple framework can be extended in various ways, for example by specifying the drivers of long-run inflation expectations or the determinants of expected short-run shocks.

There is plenty of evidence that inflation forecasts differ across agents and are subject to substantial forecast errors. Common expectation models include adaptive leaning and bounded rationality. When assessing information rigidities, a common distinction in the context of expectation models corresponds to noisy versus sticky information models. The underlying idea of a sticky price information model in the spirit of Reis (2006) is that the average forecast at time T $\mathbb{E}_t[\pi_{t+T}]$ is given by a weighted average of current and past information with a certain probability of an information update.

Woodford (2003) analyses noisy information models which are based on the idea that the development of a macroeconomic variable is subject to idiosyncratic shocks (Coibon and Gorodnichenko, 2014). In this case, inflation can be expressed as a simple AR(1) model :

$$\pi_t = \rho\pi_{t-1} + \epsilon_t \,, \tag{5}$$

where $0< \rho<1$.

Assuming that π_t is not directly observable, agents observe a signal x_t instead:

$$x_t = \pi_t + w_t \,, \tag{6}$$

where w_t represents a normally distributed error term. In such a model, the relative weight placed on new information or signals is of great importance. Forecasts are achieved via Kalman filtering. Such a framework also provides an explanation for the disagreement among forecasters. Dispersion among forecasters can either arise due to differences in information

signals or as a result of different prior beliefs in economic or econometric models for the long-run (Patton and Timmermann, 2010).

In this context, Coibon and Gorodnichenko (2016) show that information rigidities can be derived from both full and noisy information models.[1] Earlier work by Coibon and Gorodnichenko (2014) also demonstrates that both models have different implications for the disagreement among forecasters. Disagreement among agents should rise after any economic shock in case of a sticky information model while disagreement does not respond to shocks (except in the case heterogeneous signal-to-noise ratios) in a noisy information model.

A common feature of general expectation and disagreement model is that they do not specify the source of expected shocks or signals. The importance of interest rates, GDP and unemployment as potential drivers of inflation expectations can be derived from various angles which have partly been discussed in the previous section. In the same vein, expectations about these variables should also drive inflation expectations. We therefore also incorporate GDP expectations in our empirical framework. Apart from the expected slow global recovery, the drop in oil prices is also often blamed for the recent decline in the inflation expectations. Badel and McGillicuddy (2015) and Sussman and Zohar (2015) found that since the outbreak of the global financial crisis market-based measures of inflation expectations are highly correlated with the oil-related shocks, whereas in the pre-crisis period the correlation was weaker. Elliot et al. (2015) show that changes in oil prices have significant impact also on the medium term inflation expectations at least for the euro area and the US. Additionally, the past inflation realizations should be also taken into account for assessing the persistence or inertia in the building of expectations (Patra and Ray, 2010; Cerisola and Gelos, 2009). In light of the recent growing evidence on the importance of uncertainty shocks for the economic outcomes, Istrefi

[1] Coibin and Gordonichenko (2016) show that both sticky and noisy information models result in a link between the ex post mean forecast error and the ex-ante mean forecast revision.

and Piloiu (2016) argue that policy-driven uncertainty alters also agents' expectations, and in particular, those about inflation, posing upward risks to the anchoring of long-term inflation expectations.

There is also plenty of evidence for spillovers in international inflation expectations based on other measures than survey data. Netšunajev and Winkelmann (2014) rely on medium- and long-run market based measures and identify spillovers of inflation expectations between the Euro area and the United States and suggest that such spillovers of inflation expectations increase during times of macroeconomic stress. The authors thus highlight the role of the inflation expectations spillovers in explaining a global inflation factor, whereas the latter is shown to largely affect the national inflation rates (Ciccarelli and Mojon, 2010; Mumtaz and Surico, 2012; Neely and Rapach, 2011). Ciccarelli and García (2015) also rely on market based inflation measures and employ a FAVAR model to extrapolate international spillovers in inflation expectations. Their findings also point to the need of taking into account international effects in the analysis of the inflation expectations' formation. Despite previous additional studies which consider inflation expectations, US spillovers have yet to be analysed in the context of survey data. These effects are potentially of great relevance given the ongoing discussion about monetary policy spillovers which have so far been analyzed for observed interest rates rather than expectations.

3. Data and empirical methodology

3.1 Data

The economies under observation here include the G7 economies: US, UK, Germany, France, Italy, Japan and Canada. The main sample period runs from 1989 until 2016. However, the sample length differs across countries due to the availability of the uncertainty measure

discussed below.[2] We use data from Consensus Economics for annual GDP and inflation expectations for the current and the next year. At each month, the forecast for the current and the next calendar year is provided. Hence, we analyse changes in expectations over a fixed horizon. Our main estimations correspond to the expected inflation rate in t+1. The simple reason is that changes in inflation expectations for the current period t do not reflect true updates since the incoming information set includes actual realizations of the variable being forecasted. The fact that the name of contributors is published increases the credibility of the forecast due to reputation effects.

The Economic Policy Uncertainty Index (EPUI) provided by Baker et al. (2013) is based on text-searching in the large newspapers. For the US, those newspapers include the USA Today, Miami Herald, Chicago Tribune, Washington Post, Los Angeles Times, Boston Globe, San Francisco Chronicle, Dallas Morning News, New York Times, and the Wall Street Journal. To account for the zero lower bound of monetary policy in the US, Euro area, and United Kingdom we rely on the monetary policy shadow rate by Wu and Xia (2016), whereas the shadow rate for Japan is taken from Krippner (2016)[3]. For Canada we rely on the 3-month money market rate. For the Euro area countries, we extend the Euro area shadow rate with the corresponding national conventional interest rates. Our findings are not affected by the choice of the interest rates and are unaffected if we use the main central bank interest rates for all countries. The price of oil is reflected by the West Texas Intermediate denominated in US dollar per barrel[4].

[2] Full samples are as follows (based on the availability of individual EPU indices data): US, France, and Canada – from Oct. 1989 till Oct. 2016; Japan - from Oct. 1989 till Apr. 2016 Germany – from Feb. 1993 till Oct. 2016; Italy and UK – from Feb. 1997 till Oct. 2016.

[3] Wu-Xia shadow rates are estimated from three-factor shadow/lower-bound term structure model (S and available only for US, Euro area and UK, but not for Japan. Krippner (2016) obtains his estimates of the shadow rates for US, Euro area, UK and Japan using shadow/lower bound framework with two factors. Using shadow rates provided by Krippner (2016) instead of Wu and Xia (2016) shadow rates do not change the results significantly. The results are available upon request.

[4] The data apart from Economic Policy Uncertainty Index, shadow rates, and forecasts for GDP and inflation is taken from Thomson Reuters Datastream

3.2 Empirical methodology

Given the fact that no unique theory determines inflation expectations and that inflation and GDP expectations are simultaneously determined, it seems natural to rely on a framework where all variables are considered as endogenous. However, the potential set of VAR frameworks for assessing spillovers is huge and a full description is beyond the scope of this paper. In a nutshell, three frameworks to assess international spillovers can be distinguished. One idea is to rely on Global VAR models which introduce some kind of shrinkage to reduce the computational burden. Another idea is to rely on FAVAR models where international dynamics are accounted for by principal components. Finally, country-by-country models which include foreign variables can be estimated. See Kilian and Luekepohl (2017) for a thorough and excellent discussion of different VAR approaches and details on the advantage of the Bayesian method we adopt in the following.

Our empirical methodology is based on a Bayesian VAR approach for country-by-country models which is estimated via Gibbs sampling. The main advantage of the Bayesian estimations lies in the reduction of substantial parameter uncertainty inherent to a high-dimensional VAR estimations. We estimate two different models. The first one includes the mean expectations and consists of the following set of variables for each model:

$$x_{it} = \left[dOil_t, PU_t^i, dE\pi_{t,t+1}^{US}, dEY_{t,t+1}^i, dE\pi_{t,t+1}^i, \pi_t^i, di_t^i \right] \quad . \tag{7}$$

By analysing the change of expected US and domestic inflation ($dE\pi_{t,t+1}^{US}$ and $dE\pi_{t,t+1}^{i}$) and GDP ($dEY_{t,t+1}^{i}$) expectations, we capture changes in expectations for a given point in time. Policy uncertainty (PU_t^i) is stationary in levels with a specification in first differences not changing the overall findings. Interest rate changes (di_t^i) reflect the stance of economic policy and π_t^i denotes the inflation rate of the previous months while oil price ($dOil_t$) changes are commonly used to account for global shocks.

The second model differs in the sense that we analyse disagreement measured by the standard deviation across forecasters instead of mean expectations and construct oil price, CPI, and interest rate shocks using the modified identification approach of Hamilton (1996)[5]. The reason is that the literature usually does not distinguish between positive and negative economic shocks when analysing disagreement. In both configurations, we rely on a Minnesota prior specification and a burn-in period of 500 observations. We put our focus on selected impulse-response functions in the following to tackle the major questions of interest, such as the global impact of shocks to inflation expectations.

4. Empirical findings

4.1 Determinants of inflation updates

We start our empirical analysis by considering impulse-response functions for inflation expectations. Taking into account the substantial changes over the recent period, we provide both estimates over the full sample and the recent period. We start by assessing the model which reflects average forecasts before turning to the findings related to disagreement.

Figure 3 provides country-by-country impulse-response functions for updates of inflation expectations for the period t+1. The first column reflects updates in US expectations where international spillovers are not included. Each graph provides impulse-response functions for both the full sample and the post-crisis period with the latter reflected by dotted lines.

A few general results are worth mentioning. There is throughout a response of inflation expectations to oil price changes. The idea that inflationary expectations are affected by changes in the oil prices is long-established (Cavallo, 2008). The fact that such effects are also observed

[5] As for robustness checks we have also examined model specifications with the absolute changes of interest rates, CPI prices and the price of oil; as well as oil price shocks identified by using the original Hamilton (1996) approach. More details of our robustness checks are described in section 4.3.

in the second sample and that they even increase for some countries like Japan is in line with the findings of Badel and McGillicuddy (2015) and Sussman and Zohar (2015).

The second column provides the effect of policy uncertainty on inflation expectations. There is hardly any evidence for significance, in particular compared to other shocks, over the full sample. Hence, newspaper-based uncertainty seems to contribute little to inflation expectation update by professionals. For some countries like the UK or Japan, increasing uncertainty seems to reduce inflation expectations. However, this finding is not systematic. Overall, it seems more natural to link policy uncertainty to inflation uncertainty rather than to average inflation forecasts. We will come back to this question at a later stage.

We now turn to our shock of main interest by assessing the impact of US inflation updates on domestic inflation updates. For all countries, we find a clear positive response which dies out after a few months but shows some persistence. The positive effect is observed for both the full sample and the sub-sample. For Japan and Canada and to a lesser degree for Germany, the effect increases for the post-crisis period, suggesting stronger international spillovers for the recent sample. Comparing this effect to domestic GDP expectation updates provided in the next column yields that the spillover effect is quite strong and of similar importance. Those findings point at the strong importance of US expectations. At the same time, our empirical results for the United States show that there is hardly a unique explanation for updates in US inflation expectations which drive those spillovers. Oil price shocks and updates on GDP expectations seem to be the most important determinants.

On the opposite, the effects of consumer price and interest rate changes do not provide an unambiguous pattern. In many cases, the effects on consumer price changes turn out to be insignificant. In case of the CPI, this can be explained by the fact that changes in the current CPI are not necessarily informative regarding expectations of inflation for the next year. This conclusion is also supported by our variance decomposition provided in Figure 4. The current

inflation rate is not relevant for the short horizon but becomes important over longer horizons. This suggests that professionals take the lead-lag relationship between the current inflation rate and future realized inflation into account. This is also intuitively plausible if we take into account that we analyze the expected inflation rate between t and t+1. The variance decomposition also shows that both inflation spillovers and GDP expectations are important over all horizons. Policy uncertainty hardly gains any importance while the relative contribution of oil prices shocks slightly decreases over time.

Interest rate changes only display some importance over longer horizons. Generally, monetary policy might have opposite effects on inflation expectations. On the one hand, if a forecaster considers central bank's actions to be credible and to have an impact upon economic activity and inflation, then this would lead him to revise inflation expectations accordingly. Thus, an increase in the nominal interest rate is followed by lower inflation expectations. On the other hand, if the policymaker has superior information then by observing the realization of the central bank's monetary policy, a forecaster receives the information about the actual economic stance and will revise his inflation expectations accordingly. In this case, the effect of an unanticipated increase of the interest rate might be considered as positive news about the state of the economy and lead to the increase of inflation expectations. Since we have the aggregated data at hand, the two effects might offset each other. The other possible explanation for the limited role of the monetary policy is that it might be to a large extent anticipated by the forecasters, and thus, this information is already embedded in the inflation expectations.

4.2 Disagreement among inflation forecasters

Taking the established importance of oil price shocks for inflation updates into account, we have considered different measures when analyzing potential drivers of inflation disagreement based on Figure 5. Besides employing absolute changes of oil prices shocks (similar to CPI and interest rate changes), we also take the measure of oil shocks surprises by Hamilton (1996) into

account. We identify shocks as episodes when the respective variable (oil price, CPI, interest rate) exceeds its maximum or falls behind its minimum over the last twelve months. When this is the case, we denote the shock as the absolute value of the difference between the current price and the maximum or minimum over the last twelve months, and zero otherwise. Thus, in our modeling approach we allow for the shocks associated with both a substantial increase and a pronounced decrease of associated variables.

The findings display quite a few similarities with our findings for the average forecast. Changes in oil prices still capture important dynamics and result in increasing disagreement among inflation forecasters. The effects increase in the second sample period for Japan and Germany while the effect does not seem to be relevant for the United Kingdom and Canada. An overall pattern is that the confidence bands widen significantly for the second sub-sample.

Policy uncertainty turns out to be slightly more important compared to the effects on average inflation forecasts. However, there is no systematic evidence since the sign frequently switches for both samples according to the impulse-response functions. There is reason to believe that the overall weak effects of policy uncertainty is due to the fact that inflation expectations are less forward looking compared to asset prices where an effect of uncertainty has been established. Another explanation is that the policy uncertainty measure also incorporates a lot of fiscal policy uncertainty by construction.

What is more, we are able to establish evidence that inflation uncertainty related to the US also has important effects on the remaining G7 economies. Such effects are mostly stable for both samples except for the United Kingdom and Italy where the effect becomes slightly negative after the crisis. Hence, inflation uncertainty is also characterized by significant spillovers. In comparison to spillovers in terms of mean expectations, the effect also seems to be more persistent since it dies out gradually. Spillover effects again seem to be relatively important compared to changing expectations about domestic GDP which mostly display a positive effect.

Taking the theoretical discussion in Section 2 into account from a broader perspective, the observed effects on disagreement provide evidence for sticky information or heterogeneous signal-to-noise ratios.

4.3 Robustness tests

Our VAR framework also allows for several robustness tests. While we have compared estimates for the full sample with post-crisis estimates, we have also performed estimations whose underlying time period ends prior to the recent crisis. We have unified our sample by relying on the same policy uncertainty measures for all economies. In both cases, the significance changes while our main findings related to the characterization of international expectation spillovers remain unaffected. The same holds for alternative prior specifications[6]. Figure 6 provides a robustness check of the model which explains US disagreements based on a comparison of impulse-responses for different model specifications. In Model I the oil price, CPI and interest rate shocks are identified by modifying the Hamilton (1996) approach allowing for the shocks associated with the substantial decrease of associated variables. In Model II we identify the oil price, CPI, and interest rate shocks according to the Hamilton (1996) suggestion for oil price shocks. In Model III we use the absolute change to the previous month for the identification of shocks associated with oil prices, CPIs and interest rates. The models provide similar results for the full sample period, but contain some differences for the sub-sample period estimations, e.g. in the significances of after-crisis reactions to oil price shock, standard deviation of expected GDP growth[7].

5. Conclusions

This paper has analyzed the determinants of inflation expectation updates for the G7 economies and selected Eurozone countries based on survey data from Consensus economics. While

[6] All results mentioned are available upon request.
[7] Figure 6 provides the results for the US. The results for other countries are available upon request.

previous research has focused on monetary policy spillovers based on global liquidity measures, we are able to illustrate that inflation expectations are also closely connected across countries. We find significant evidence that domestic inflation updates are significantly affected by changing expectations about US inflation. Such international spillovers are often more important than changing expectations about domestic GDP. A somehow puzzling finding is that interest rate changes hardly affect inflation update in the short run.

Our estimates for the post-crisis period suggest that the importance of international spillovers has often increased over the recent period of unconventional monetary policy. This is in line with existing evidence of international spillover effects from Quantitative Easing (Neely, 2014). Finally, we have illustrated that spillovers do not only exist in the expectations mean by also focusing on disagreement across inflation forecasters. This opens the possibility to reduce (global) inflation uncertainty by monetary policy coordination. This is of particular importance when it comes to an exit from unconventional monetary policy However, the fact that disagreement on future US inflation is hardly explained within our framework and not affected by interest rate changes complicates this task.

Our findings also point to several open issues, such as analyzing the time varying determinants of inflation expectations or assessing professional long-term inflation forecasts. It is important to keep in mind that we have focused on inflation expectations by professionals. The question whether spillovers can also be identified for private households is a completely different issue which remains on the agenda for further research. Despite the fact that we have assessed both mean expectations and disagreements across forecasters, we haven't addressed the question whether individual forecasters update their expectations. Taking the existing evidence for time-varying (relative) forecasting performances of professionals into account (El-Shagi et al., 2016), another natural exercise would be to analyze drivers of inflation expectations in a time-varying fashion beyond the sample split we conduct.

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Figures

Figure 1: Next year's inflation expectations

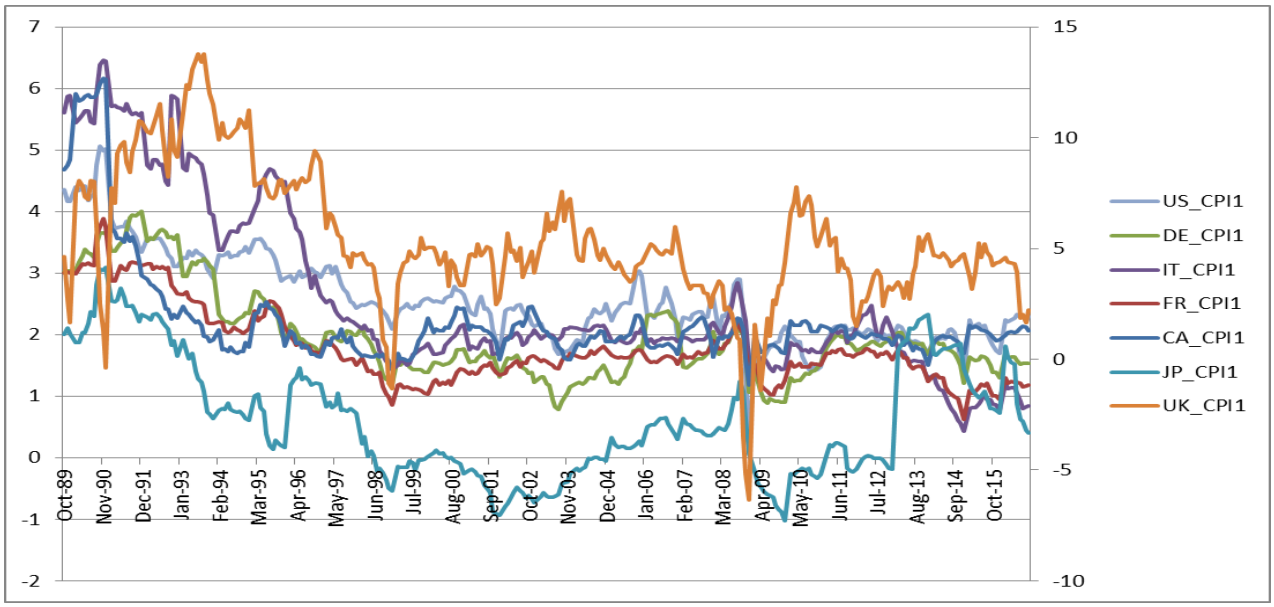


Figure 2: Standard deviations of next year's inflation expectations

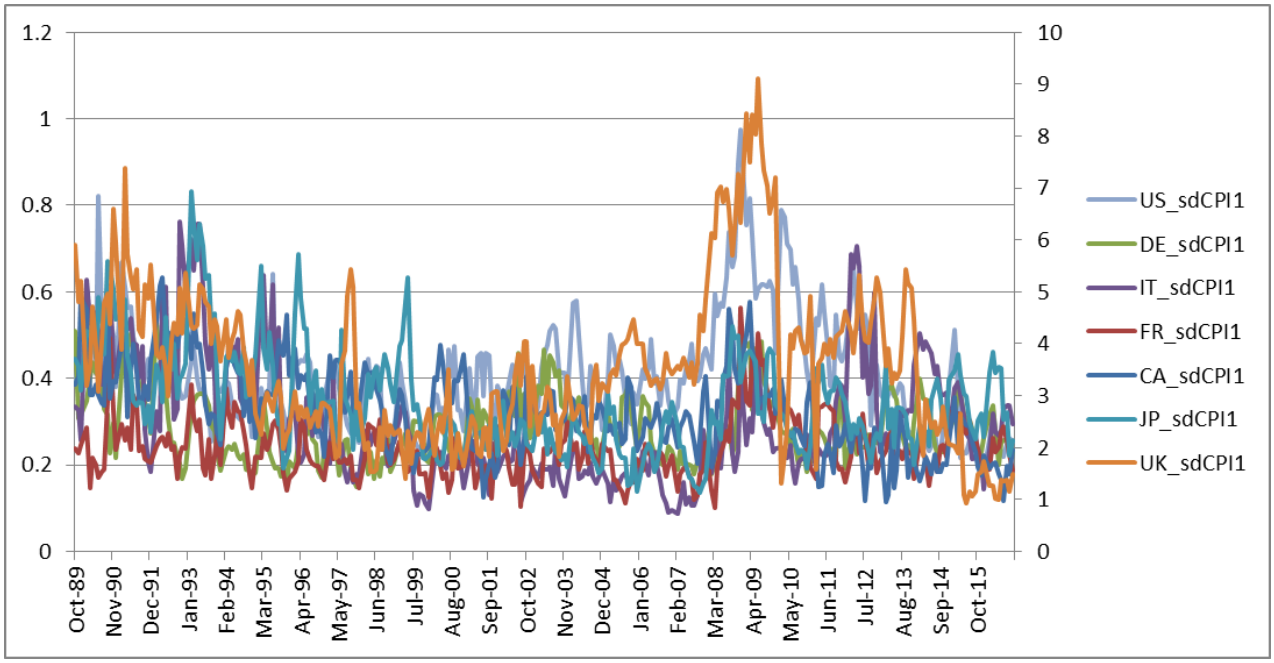
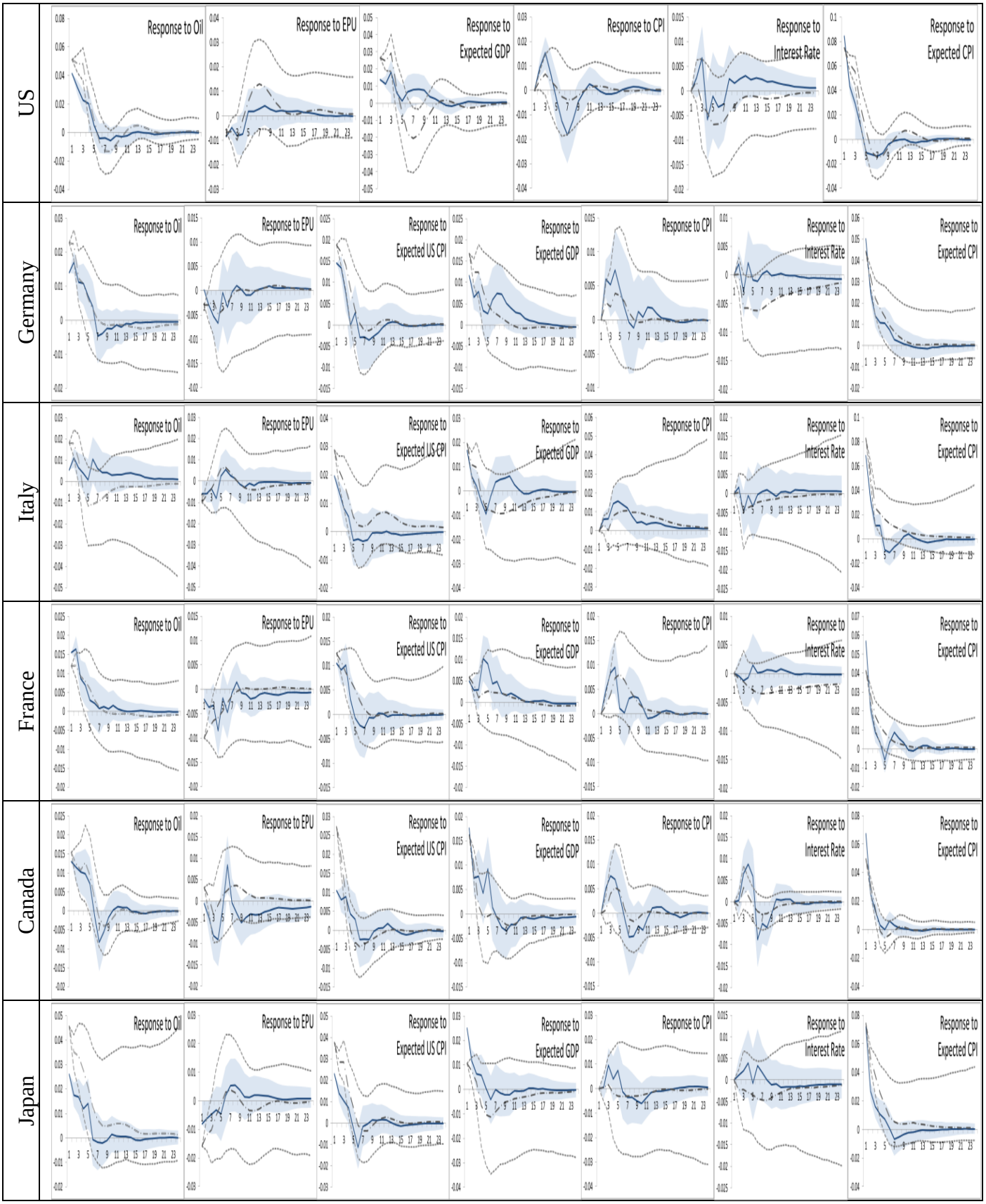
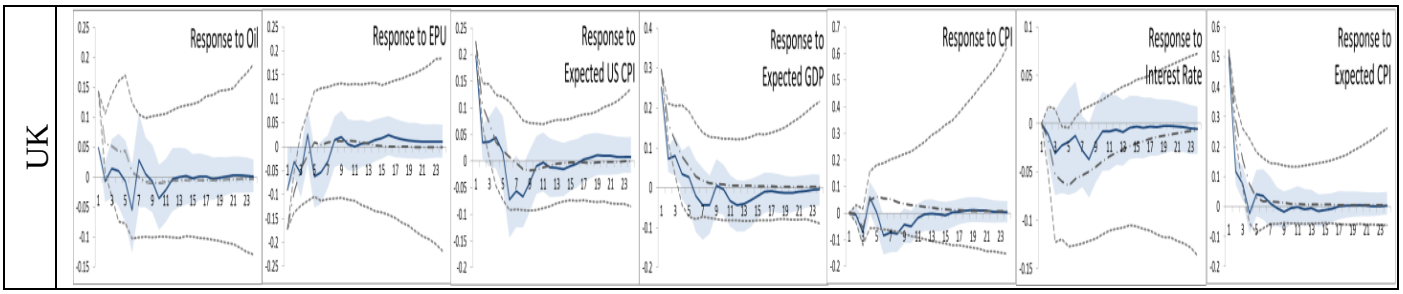


Figure 3: Impulse-responses of the next year expected inflation updates to different shocks



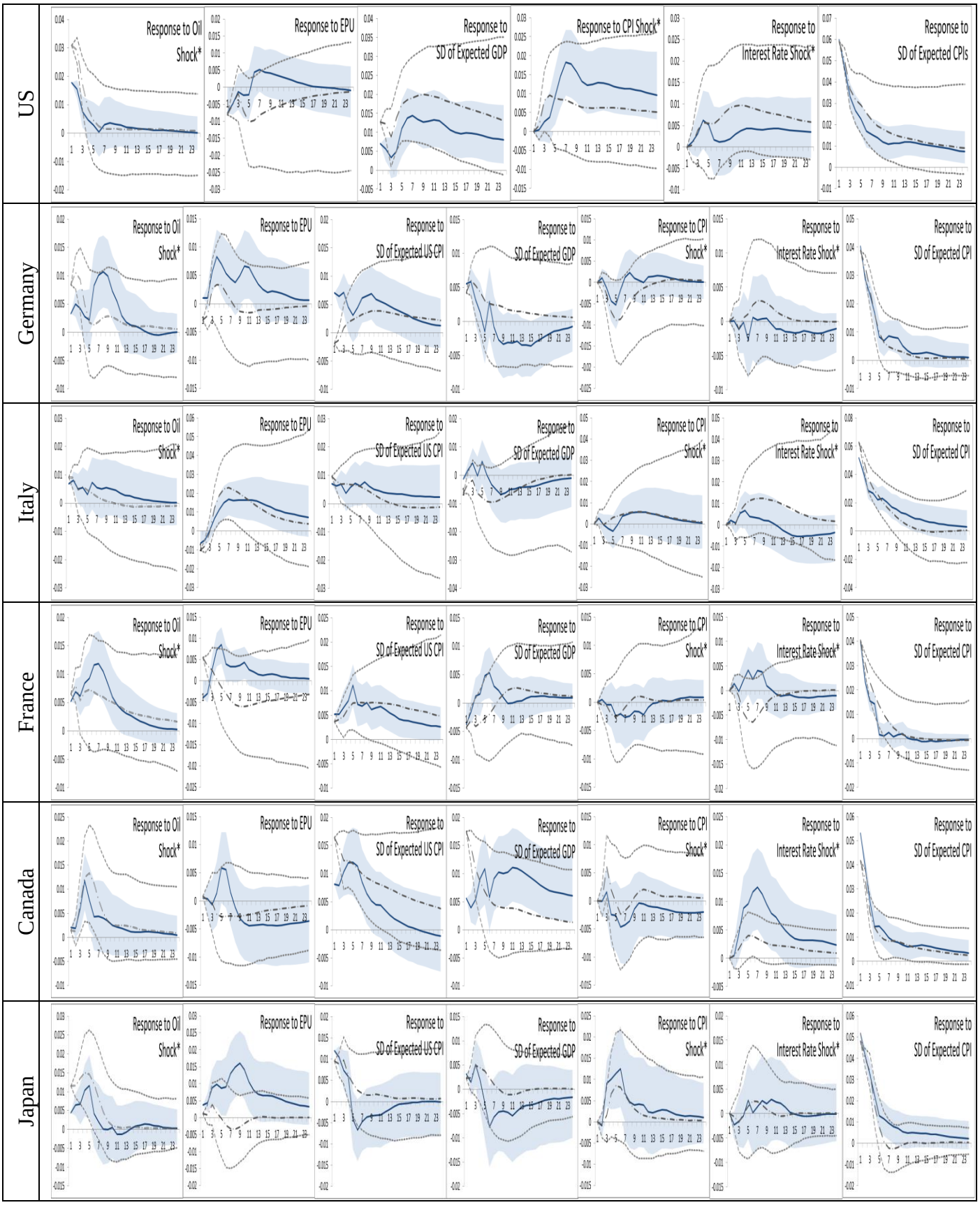


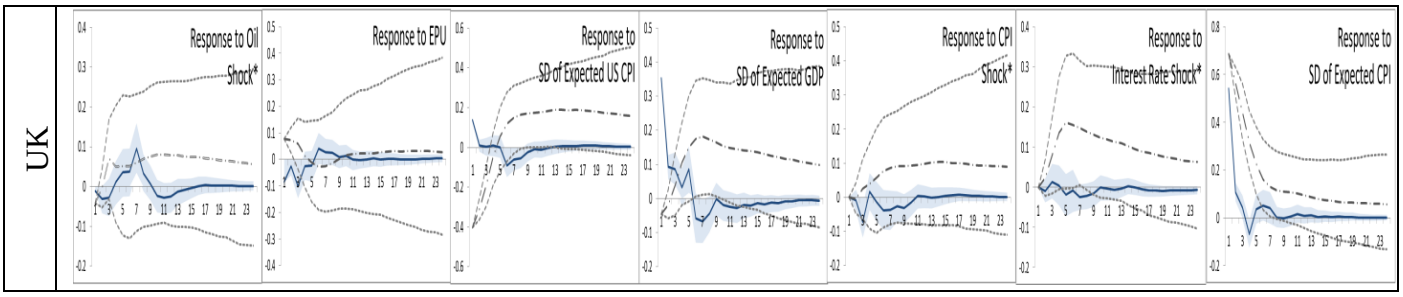
Note: The results for the full samples are depicted by blue lines (impulse-responses) and shadow areas (90% confidence bands). The results for the sub-samples starting in the year 2008 are depicted with grey dash-dot lines (impulse-responses) and dotted lines (90% confidence bands). Full samples are as follows (based on the availability of individual EPU indices data): US, France, and Canada – from Oct. 1989 until Oct. 2016; Japan - from Oct. 1989 until Apr. 2016 Germany – from Feb. 1993 until Oct. 2016; Italy and UK – from Feb. 1997 until Oct.2016.

Figure 4: Forecast error variance decompositions for next year's inflation expectation

Note: Own innovations are omitted for illustrative purposes.

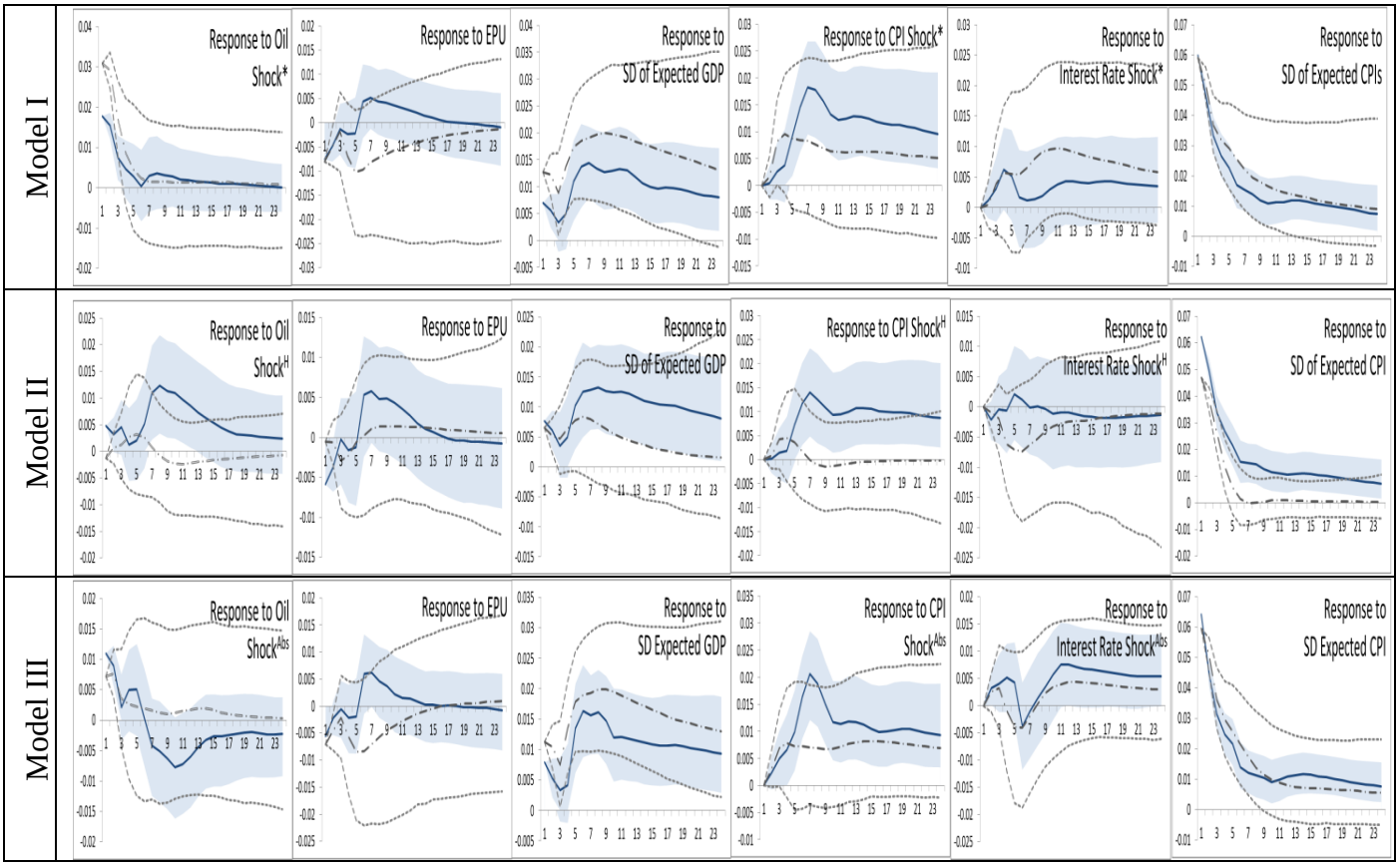
Figure 5: Impulse-responses of the next year inflation expectation standard deviations to different shocks





Note: The results for the full samples are depicted with blue lines (impulse-responses) and shadow areas (90% confidence bands). The results for the sub-samples starting in the year 2008 are depicted with grey dash-dot lines (impulse-responses) and dotted lines (90% confidence bands). Full samples are as follows (based on the availability of individual EPU indices data): US, France, and Canada – from Oct. 1989 until Oct. 2016; Japan - from Oct. 1989 until Apr. 2016 Germany – from Feb. 1993 until Oct. 2016; Italy and UK – from Feb. 1997 until Oct.2016. * The oil price, CPI and interest rate shocks are identified by modifying the Hamilton (1996) approach.

Figure 6: Comparison of impulse-responses of the next year US inflation expectation standard deviations for different model specifications



Note: In model I the oil price, CPI and interest rate shocks are identified by modifying the Hamilton (1996) approach allowing for the shocks associated with the substantial decrease of associated variables. In model II the oil price, CPI and interest rate shocks are identified according to the Hamilton (1996) suggestion for oil price shocks. In model III we use the differences to the previous

month of corresponding variables taken in absolute values for the identification of shocks associated with oil prices, CPIs and interest rates. The results for the full samples are depicted with blue lines (impulse-responses) and shadow areas (90% confidence bands). The results for the sub-samples starting in the year 2008 are depicted with grey dash-dot lines (impulse-responses) and dotted lines (90% confidence bands).