Economic Policy Uncertainty and Inflation Expectations

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In an environment of well-anchored inflation expectations, temporary economic shocks should not affect agents' long term inflation expectations. Our estimated structural VARs show that both long- and short-term inflation expectations are sensitive to transitory shocks to the uncertainty about the stance and perceived effectiveness of policy. While economic activity contracts, long-term inflation expectations rise in response to an increase in policy uncertainty. These results underline that policy uncertainty poses upward risks to the anchoring of long-term inflation expectations and to central banks' credibility.

JEL: E02, E31, E58, E63, P16

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I. Introduction

Policy-related uncertainty is seen by some academics and market participants as a prominent contributor to the overall economic uncertainty observed during the recent crisis. In the World Economic Outlook of October 2012, the IMF states: "The biggest factor weighing on the world economy was uncertainty among investors over whether policymakers in advanced economies will deliver on promises." These worries are supported by a rapidly growing theoretical and empirical literature suggesting that uncertainty has recessionary effects on economic activity.[1] To date, the literature has focused on the effects of policy uncertainty on real economic outcomes, such as output, investment, consumption and unemployment (see among others (Baker, Bloom and Davis 2012) and (Fernandez-Villaverde et al. 2013)). However, whether such uncertainty affects agents' expectations, and more specifically those about inflation is not yet documented. In this paper, we investigate this question empirically, by studying the dynamic relationship between policy-related uncertainty and inflation expectations of professional forecasters.

Our investigation comes at times of unusual high policy uncertainty. At least with respect to monetary policy, central banks have been center stage to resolve the recent crisis using both standard and non-standard measures. Some observers have criticized them for this, some have claimed they are going beyond their mandate and the general public shares the feeling they have not done enough to prevent the crisis.[2] At the same time, some measures of credibility and trust of agents in central banks seem to have eroded. Regular surveys on public opinion and attitudes in Europe show a clear declining trend of trust and satisfaction with the way central banks have been doing their job (see Figure 2 in Appendix

[1]Theoretically, uncertainty is supposed to reduce hiring, investment and consumption of durables in the presence of adjustment costs ((Bernanke 1983), (Dixit and Pindyck 1994), (Bentolila and Bertola 1990), (Bloom 2009)), financial frictions ((Arellano, Bai and Kehoe 2011), (Gilchrist, Sim and Zakrajsek 2010) and (Christiano, Motto and Rostagno 2010)), managerial risk aversion ((Panousi and Papanikolaou 2011)) and precautionary motives.

[2]This is based on the results from the FT/Harris poll, conducted online among 6,237 adults in France, Germany, the UK, Spain, Italy and the US, April 2008, August 2008 and February 2009.

B). On the other hand, academics and policymakers often state that the extent to which inflation expectations are anchored is the best measure of the credibility of monetary policy. Given this situation, our hypothesis is that in the light of increased overall policy uncertainty (not necessarily only uncertainty about monetary policy) agents begin to question the ability (expertise) of policy makers as well as their commitment to their promises (targets). Shedding light on this issue is of great importance, considering the role that credibility and reputation have for policy effectiveness.[3]

We estimate structural Bayesian VARs, linking policy uncertainty with inflation expectations while accounting for a measure of economic activity and monetary policy, for the US and the euro area, during 1999Q1-2012Q3. We use the index of Baker et al. (2012) as a measure of policy uncertainty. This index captures uncertainty about what policy action the decision makers will undertake, uncertainty about the economic effects of current and future actions and/or inactions. This can be uncertainty about different economic policies altogether but in our estimations we provide evidence even for specific types of uncertainties related to fiscal and monetary policy. Regarding inflation expectations, we use short- and long-term survey-based inflation expectations of professional forecasters as measured by Consensus Economics and Survey of Professional Forecasters, of the Federal Reserve Bank of Philadelphia and of the European Central Bank.

We find that a transitory increase in policy uncertainty has the following effects. First, it contracts the economic activity as well as short-term inflation expectations. So, we find, as in previous literature, that policy uncertainty shocks are contractionary. As expected, in response to the contractionary shock the central bank lowers the interest rate. Second, long-term inflation expectations increase in response to increased policy uncertainty. For policy uncertainty shocks of the size observed during the recent period, the increase is about 10 basis points,

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[3]The importance of reputation and credibility of central banks is well-recognized in theoretical works, starting with (Kydland and Prescott 1977) and (Barro and Gordon 1983).

enough to miss the ECB's "below, but close to, 2 %" or Fed's 2 % (medium- to long- term) inflation objective. The magnitude is also substantial given the low variation of long-term inflation expectations in the studied period; such shocks account for up to 28 percent of their variation. Third, both monetary policy- and fiscal policy-related uncertainty are important for the observed dynamics of inflation expectations. Fourth, monetary policy appears to face a trade-off between responding to the state of the economy and to long-run inflation expectations. While stabilizing the economy, the central bank is paying a cost, that of disanchored expectations.

Conventional wisdom in the literature suggests that in an environment of well-anchored expectations, temporary shocks should not have an effect on long-run inflation expectations. However, we show that they increase in response to policy uncertainty shocks. This result is robust to several alternative specifications in terms of using specific policy-related uncertainties, different measures of inflation expectations, different orderings of the variables in the structural VARs, and different periods covered by the sample. Also we show that long-term inflation expectations are responsive to uncertainty surrounding policy but not necessarily to other types of uncertainty. A rise in long-term inflation expectations at times of economic contraction suggests that heightened policy uncertainty indeed raises concerns about an increase in inflation in long-run. Overall, these results support our hypothesis that, in an environment of increased policy uncertainty, agents begin to question the ability and the commitment of policy makers to deliver on their promises.

Our work relates to different strands of the literature. First we relate to the theoretical and empirical literature on the macroeconomic effects of policy uncertainty ((Fernandez-Villaverde et al. 2013), (Born and Pfeifer 2014), (Alexopoulos and Cohen 2009), (Baker, Bloom and Davis 2012), (Leduc and Liu 2012), (Bachmann, Elstner and Sims 2013) and (Mumtaz and Zanetti 2013) among others). For example, using DSGE models, (Fernandez-Villaverde et al.

2013) and (Born and Pfeifer 2014) show the effect of policy uncertainty shocks (defined as shocks to the stochastic volatility of policy instruments) on several real variables and prices. Under their parameterizations of the model, an increase in policy uncertainty induces a decline in output and a rise in inflation. This effect on prices is explained by an upward pricing bias dominating the aggregate demand effects of uncertainty shocks. However, the empirical evidence on the US data provided by (Fernandez-Villaverde et al. 2013) shows that in response to fiscal policy uncertainty shocks the realized inflation falls. On the other hand, (Leduc and Liu 2012) show theoretically (a DSGE model with search frictions) and empirically (on US and UK data) that uncertainty shocks are demand shocks, with inflation and output falling when uncertainty increases. Our investigation on US and euro area data shows that both monetary policy- and fiscal policy-related uncertainty shocks are contractionary in output and in one-year ahead expected inflation. In addition, and new to the literature, we provide evidence on the effect of policy uncertainty on long-term inflation expectations, a variable that is closely related to what the policymakers will do.

Second, our work relates also to the empirical literature of inflation expectations, which in itself has spread in different strands, from those studying their relationship with macroeconomic variables and those studying their formation process (see (Clark and Davig 2008), (Mankiw, Reis and Wolfers 2004), (Gurkaynak, Levin and Swanson 2010), (Coibion and Gorodnichenko 2012), (Andrade and Bihan 2013)). We bridge this literature with that of macroeconomic effects of policy uncertainty by highlighting a new channel through which policy uncertainty can affect the macroeconomy. To our knowledge, our paper is the first to look at the effects of policy-related uncertainty shocks on inflation expectations. Furthermore, we are the first to provide empirical evidence on the impact of different types of policy-related uncertainty on economic activity. We confirm previous findings that uncertainty shocks generate economic contractions, for the US and the euro area. Our finding that policy uncertainty shocks pose upward

risks to the anchoring of long-term inflation expectations is new to the literature.

The structure of the paper is as follows. Section 2 presents the policy uncertainty measure and an overview of the recent developments in inflation expectations. Section 3 presents the empirical methodology (structural VAR estimations) and the discussion of results. Section 4 concludes.

II. Economic policy uncertainty and inflation expectations: a first look

In this section we discuss how economic policy-related uncertainty and inflation expectations are measured. We also show their evolution throughout the years and point out main episodes associated with increases in policy uncertainty.

A. Measuring economic policy uncertainty

Uncertainty is hard to quantify and most of the literature that studies how it impacts economic activity has relied on proxy measures for it. These proxies can be divided in different categories: uncertainty measures based on surveys (business surveys or professional forecasters surveys), on the corporate bond spread over treasuries, on stock market volatility and on stochastic volatility of macroeconomic variables. We use the index of economic policy uncertainty (hereafter EPU) proposed by Baker et al. (2012). The EPU index is constructed for several developed countries and is based on two components[4]: newspaper coverage of policy-related economic uncertainty and the disagreement of professional forecasters on expected inflation and government expenditures. This measure captures uncertainty about what policy actions the decision makers will undertake and uncertainty about the economic effects of current and future actions and/or inactions. This can be uncertainty about fiscal, monetary or other regulatory policies. Usages of the EPU index are found as well in recent empirical and theoretical works, see for example (Leduc and Liu 2012), (Bachmann, Elstner and

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[4]For the US it has an additional component, the number of federal tax code provisions set to expire in future years. For more information, visit www.policyuncertainty.com.

Sims 2013) and (Fernandez-Villaverde et al. 2012).

In our estimations we use only the news-based component of EPU for several reasons.[5] First, we want to avoid a potential link between the "disagreement" component of the index with the inflation expectations we use in our VAR estimation. They are based on expectations of professional forecasters, either from Consensus Economics or Survey of Professional Forecasters. Furthermore, working with the news-coverage component allows us to distinguish between uncertainties coming from monetary, fiscal or labor market policies, for example. In this way, we are able to study whether other types of policy uncertainty are affecting the beliefs of agents about inflation expectations and about the ability of central bankers to deliver on their mandates.

However, the EPU index is a proxy variable and subject to measurement errors. For example, it is often questioned whether this index is just another measure of the state of the economy or whether it suffers from political slant. Certainly, policy uncertainty is part of overall economic uncertainty and Baker et al. (2012) show that at certain times, it is its main contributor. In response to potential measurement errors, they evaluate the index in several ways and argue that, although present to a small extent, these issues do not undermine the accuracy of the index. For example, they find a strong correlation between the computerized newspaper component of the EPU index and a measure of what a human reader would call economic policy uncertainty.[6] They also show that the EPU index is consistent with the frequency of the word "uncertain" in the FOMC Beige Book and with the responses of the stock market generated by policy news. Moreover, the EPU index does not appear to be strongly affected by newspaper political slant.

In our analysis we also use specific measures of monetary policy- and fiscal

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[5]Uses of narrative as variables are known to the literature: (Romer and Romer 1989) and (Romer and Romer 2004) to identify monetary policy shocks, (Ramey and Shapiro 1998) and (Ramey 2011) for fiscal policy shocks and (Doms and Morin 2004) explore the linkages between media coverage of economic events, consumers' perceptions, and economic outcomes.

[6]The newspaper component of the EPU index is based on automatic searches of specific terms related to economic uncertainty and policy in the largest newspapers for each country.

policy-related uncertainty constructed by Baker et al. (2012), which are currently available only for the US and Germany.[7] To our knowledge we are the first to use this novel data set in the empirical literature on the macroeconomic effects of uncertainty. In our estimations we use the measures for Germany as proxies for the euro area. One should keep in mind that these measures capture the policy uncertainty as discussed in the German media. This uncertainty is often related with important policies or developments outside the country as well. For the monetary policy-related uncertainty the approximation seems reasonable, given that there is a single monetary policy in the euro area. With respect to fiscal policy this match might appear weak at first sight. However, especially during the last years, fiscal issues across the euro area have been closely followed by the German public and heavily discussed in the media. Observing the evolution of the German index for fiscal policy uncertainty (Figure 1, panel b, in Appendix B) after 2008 one can see that it spikes around the Greek bailout at the beginning of 2010, the rating cuts of periphery countries in 2011, and the call of the prime minister of Greece for referendum on a new bailout at the end of 2011. This shows that the German measure is picking up the main concerns about fiscal policy in the euro area.

Figure 1 shows the evolution of the news-based overall policy uncertainty for the US and the euro area. This measure varies over time and increases sharply during the recent crisis. High levels of policy-related uncertainty are observed especially around events with unpredictable outcomes. For the euro area and the US one can identify common spikes corresponding to 9/11, the Gulf War II in 2003, the Lehman Brothers collapse in 2008 and the intensification of the European debt crisis in 2012. Specific spikes for the euro area appear around events related with the Treaty referendums in 2001 and 2005, the Greek bailout in 2010, the rating cuts in 2011, and the call for referendum by Greece's prime minister in 2011. For the US they correspond to the presidential elections in 1992, 2000 and 2008, and

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[7]Details on the construction of each index are presented in Appendix A.

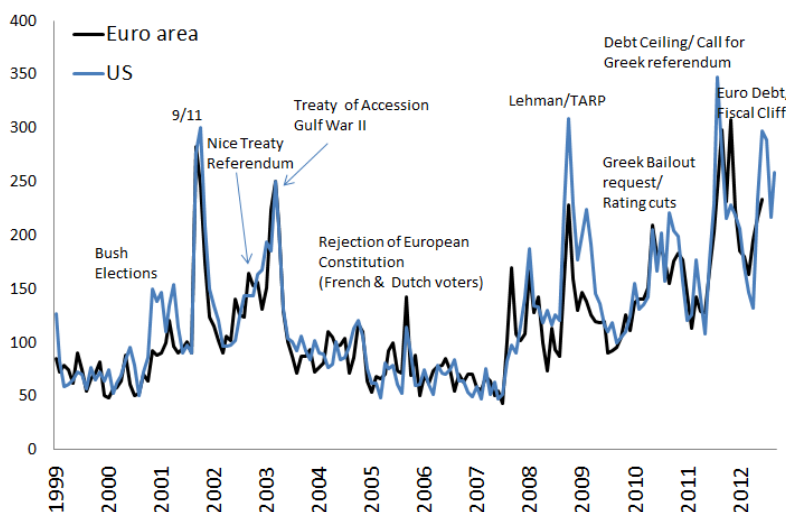to the debates on the fiscal stimulus (2008), on the debt ceiling (2011) and on the fiscal cliff (2012).

Figure 1. : News-based component of EPU for US and the euro area

Source: Baker, Bloom and Davis (2012) and http://www.policyuncertainty.com/

Especially in recent years, we have observed policies that have generated uncertainty about future inflation. For instance, there has been criticism towards the ECB potentially acting beyond its mandate through the bond-buying programs, first announced in 2010. These programs raised concerns about the ECB being at risk of operating under fiscal dominance, thereby harming its independence. This, in turn, would lead to a difficulty for the ECB to ensure price stability. Policy uncertainty that might feed into expectations about future inflation has also arisen from the discussions about the exit strategies of the central banks that implemented quantitative easing. If not done carefully, exit from massive monetary stimulus could jeopardize future price stability. Moreover, uncertainty arising from fiscal pressures in the US, also raises concerns about the Fed being able to deliver price stability in the future. Therefore, it seems important to investigate whether in an environment of high policy-related uncertainty, these concerns have

fed into agents' perceptions regarding policy makers and their policies.

B. *Inflation expectations*

There are different measures of inflation expectations: survey-based expectations of general public or professional forecasters, and financial market-based ones. Differences among them might reflect heterogeneities in the expectation formation mechanism across agents. Survey-based expectations are beliefs of professional forecasters (i.e., banks, research institutions) about what inflation will be in the future, from one quarter ahead up to ten years ahead. Financial market-based inflation expectations, the so-called breakeven inflation rates (BEIRs), result from the difference between nominal Treasury bonds and Treasury inflation-protected securities. In our study, we focus on the survey-based measures of inflation expectations since they reflect the beliefs of the agents only on inflation and do not include financial market-related risks. BEIRs are available at higher frequency but incorporate other factors in addition to concerns about inflation, such as information on risk premia as well as changes related to the trading conditions. Even though the literature offers methods to distinguish the inflation expectations component from the other two risks, there is still no consensus about the best way of doing this.

Inflation expectations are measured at different horizons. Usually, expectations up to two years ahead are referred as short-term expectations and expectations five years ahead and more as long-term inflation expectations. Short-term expectations are vulnerable to temporary shocks and more volatile than long-term ones. Because long-term expectations can profoundly influence current economic behavior, monetary authorities monitor them carefully with the aim to provide a long-term nominal anchor for the economy. Economic behavior could be affected by changes in expectations through multiple channels. Higher inflation expectations put upward pressure on wages, as workers demand increases in wages to offset the expected loss of purchasing power in the future, and on prices, as

firms try to raise the prices to offset the expected rise in their marginal costs. Moreover, asset prices and investment plans are affected by changes in inflation expectations. Well-anchored long-term inflation expectations are key to the functioning of the monetary policy transmission mechanisms and they appear to be a crucial indicator of central bank credibility and, indirectly, of central banks' success (ECB, Monthly Bulletin, May 2009). This becomes especially central in periods characterized by large shocks to the economic and financial activity, and also in periods with extraordinary levels of uncertainty.[8]

In this paper we use survey-based measures of long-term inflation expectations for the US and the euro area, from two sources, the Consensus Economics (CE) and the Survey of Professional Forecasters (SPF) of the Fed of Philadelphia and of the ECB, respectively. In both, CE and SPF, the respondents are usually banks, universities, financial firms, consulting groups, and economic forecasters at large companies. Sometimes the respondents overlap between these two sources but in general the composition is different. Furthermore, the number of respondents in these surveys is different. CE surveys report the inflation expectations of about 240 respondents compared to about 90 respondents for the Fed's SPF and about 40 respondents for the ECB's SPF. Figure 2 shows that long-term inflation expectations in the euro area have generally been lower than in the US and have moved within a narrow band. However, they have been more volatile after the Lehman bankruptcy. On the other hand, long-term BEIRs show a greater volatility throughout the whole sample (see Figure 3 in Appendix B). They are especially more responsive to news in the post-Lehman period, reflecting liquidity and risk premia concerns in financial markets. Several analyses on the development of inflation expectations during the crisis show that long-term inflation expectations have become less firmly anchored, to a larger extent in the UK and in the US, relative to the euro area (see among others, (Galati, Poelhekke and Zhou 2011)).

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[8]Policy makers acknowledge that well-anchored inflation expectations provide an assessment of the suitability of the monetary policy stance: *"Ultimately, the firm anchoring of inflation expectations remains the best way to check the appropriateness of monetary policy in an uncertain environment."*
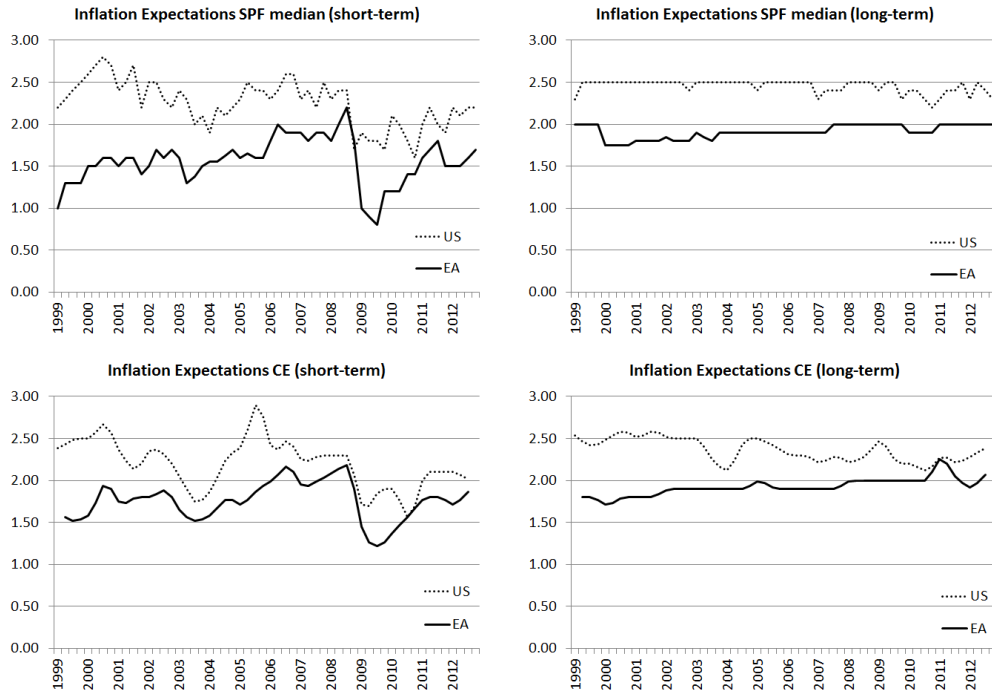
Figure 2. : Recent developments of short- and long-term inflation expectations

Note: Long-term (5 years ahead) and short-term (1 year ahead) survey-based inflation expectations obtained from the Survey of Professional Forecasters (SPF) and from the Consensus Economics (CE).

III.   Policy uncertainty shocks - a VAR analysis

In this section we study the effects of policy-related uncertainty shocks on inflation expectations using VAR techniques. We first introduce the estimation methodology and the data. The results and a discussion of them follows.

A.   The model, data and estimation

To study our question of interest we estimate a panel-VAR with fixed effects and two country-individual VARs, for the US and the euro area. We employ the panel-VAR in order to get more statistical power and to increase the precision of our estimates, given the relatively short data sample for the euro area (starting

(Bini-Smaghi 2009).

in 1999). This approach allows us to uncover common dynamic relationships for the US and the euro area while accounting for country-specific fixed effects. The standard representation of such a model is given below.[9]

$$(1) \qquad y_{i,t} = A_{0i} + A_1 y_{i,t-1} + ... + A_p y_{i,t-p} + B_0 z_{i,t} + u_{i,t}$$

for $t = 1, ..., T$, where $i = 1, ..., I$ is the number of cross-sections, $y_{i,t}$ is a $n \times 1$ vector of endogenous variables, $z_{i,t}$ is a $m \times 1$ vector of exogenous variables, A_{0i} are unit specific intercepts that also include unit-fixed effects, and $u_{i,t}$ represents the reduced-form errors,

$$(2) \qquad u_{i,t}|y_{i,t-1} \sim iid \ N(0, \Sigma_i).$$

We employ Bayesian techniques for estimation following (Uhlig 2005). The VAR coefficients are drawn from a normal-inverse-Wishart distribution with flat prior. A flat prior allows us to use the benefits of the Bayesian techniques while having our results more data-driven, making them easily comparable with results in the related literature that do not use such methods for estimation. The optimal lag is selected based on the BIC information criteria and reported below each figure of results.

Our estimations include the following vector of endogenous variables: $y_t = (epu_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t)$, with epu_t being the news-based economic policy uncertainty, gdp_t the real GDP, $\pi^e_{long|t}$ and $\pi^e_{short|t}$ being the long- and short-term inflation expectations, respectively and i_t being the short-term interest rate. The individual VARs also include a constant and an exogenous variable, either the oil prices or the US industrial production, depending on the country-specific VARs. This specification of the model allows us to study the impact of policy

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[9]More details about the model representation and the estimation technique can be found in the Appendix C.

uncertainty on inflation expectations, while accounting for a measure of economic activity and monetary policy, in a parsimonious way.

The overall policy uncertainty measure of (Baker, Bloom and Davis 2012), epu_t, incorporates uncertainty about different types of policy altogether, like fiscal, monetary, financial or any other type of regulatory policies. However, we are interested in studying the effects of uncertainty related with specific policies separately, as well. If the structural VAR estimations show that the overall policy uncertainty is significant for the dynamics of inflation expectations, being able to identify the specific policy responsible for these dynamics is important. On the other hand, specific-types of policy uncertainty could have a higher relevance for the dynamics of certain variables, even when the overall policy uncertainty does not. To this aim we also estimate the above model with the policy uncertainty variable being the measure of (Baker, Bloom and Davis 2012) specific to monetary and fiscal policy, respectively.

As mentioned before, we use survey-based measures of inflation expectations from two sources, Consensus Economics (CE) and the Survey of Professional Forecasters (SPF) of the Fed of Philadelphia and of the ECB, respectively. In our estimations, the short-term inflation expectations refer to the expected inflation one year ahead, $\pi^e_{short|t} = \pi^e_{t+1|t}$. On the other hand, the long-term inflation expectations refer to the expected inflation five years ahead, $\pi^e_{long|t} = \pi^e_{t+5|t}$. Only in the case of the Fed's SPF, long-term inflation expectations refer to expectations over the next ten years.[10] That is, for the case of the US, the period for which long-term expectations are measured differs between CE and the Fed's SPF, making the results not directly comparable.

Our variables of interest are available in different frequencies, monthly (policy uncertainty), quarterly (real GDP, SPF short- and long-term inflation expectations, CE short-term inflation expectations) and biannual (CE long-term inflation expectations). We use them all at quarterly frequency.[11] Biannual data are lin-

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[10]Starting from 2005, Fed's SPF is also collecting the inflation expectations over the next five years.
[11]We have estimated our BVARs in monthly and biannual frequency as well and main results are

early interpolated to monthly frequency. Then, for all monthly series we use the end of quarter observation. In general, data aggregation or interpolation pose additional difficulties for the researcher that wants to identify structural shocks based on timing restrictions. The interpolation of CE long-term inflation expectations might hinder our identification strategy as a two-sided filter might destroy the temporal ordering. To check if our results are sensitive to this issue, we have also estimated our BVARs with CE long-term expectations at quarterly frequency constructed differently, with the value for the missing quarter being substituted with the value of the previous quarter. The interpolation of the CE inflation expectations from semi-annual to quarterly frequency does not seem to be innocuous to our main results.

Policy uncertainty and real GDP enter the estimation in log levels, and inflation expectations and interest rates in percent. For the panel-BVAR estimation, the period covered is 1999Q1-2012Q3, constrained by the availability of data for the euro area. For the US VAR, the period covered is 1991Q4-2012Q3. We provide inference through the median response and its 68 percent posterior distribution, based on 2000 draws. We also calculate the forecast error variance decomposition (hereafter FEVD) in order to assess the relative contribution of the policy uncertainty shock to fluctuations in our chosen variables.

B. Identification strategy

The identification of uncertainty shocks is recent in the empirical literature and most of the studies have identified them using the recursive Cholesky decomposition, see (Alexopoulos and Cohen 2009), (Baker, Bloom and Davis 2012), (Leduc and Liu 2012) and (Bachmann, Elstner and Sims 2013)[12], among others. We use this identification strategy with the following ordering of variables: $epu_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t$. Under this ordering, policy uncertainty does not con-

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comparable. Results from these estimations are available upon request.

[12](Bachmann, Elstner and Sims 2013) have used in addition long-term restrictions to identify uncertainty shocks.

temporaneously respond to other shocks while an innovation to it can have an immediate effect on the variables ordered after. This assumption is broadly in line with how uncertainty is treated in theoretical models. For example, in (Fernandez-Villaverde et al. 2013), the process for policy uncertainty, represented by the stochastic volatility of the policy instrument, is exogenous and an innovation to it has an immediate impact on economic activity.

Under our identification strategy, we relax the exogeneity restriction on policy uncertainty (observed in theoretical works) and allow it to respond (with delay) to other shocks through the lag polynomial. Policy uncertainty, as measured by the EPU index, could arise not only from unexpected innovations to policy but also as a response to other shocks in the economy. For example, a contractionary shock hitting the economy could also lead to a rise in policy uncertainty if the public does not know how policy will respond. In the benchmark BVAR we assume that uncertainty about policy is affected only with delay to such shocks.

In our estimations, a policy uncertainty shock corresponds to an increase of two standard deviations in the policy uncertainty measure. Although not standard in the VAR literature, this size is still underestimating the policy uncertainty variation that both the US and the euro area have faced, especially during the recent crisis. For example, (Baker, Bloom and Davis 2012) use the increase in the overall policy uncertainty from 2006 to 2011 as the size of the policy uncertainty shock. In our case, this corresponds to a four standard deviations shock, for the US. Since the VAR responses are linear, one could simply multiply our responses by two in order to quantify the effects of such large shocks.

C. *Results and discussion*

In the following segment we present the results from the estimation of the panel-BVAR with country fixed effects and from the individual country-BVARs. In all figures, the solid line, in black, denotes the point-wise posterior median impulse response from the estimated BVARs and the shaded area represents the

corresponding 68 percent posterior distribution. In order to get a general overview of the effect of the policy uncertainty shock in the model, we start by showing the responses of all our variables from the estimation of the panel-BVAR with CE expectations, given a shock to the overall policy uncertainty (see Figure 3). Then we focus only on the results for inflation expectations (Figures 4 to 6) along three dimensions, (1) the source of inflation expectations, (2) the type of policy uncertainty and, (3) the term-structure of the inflation expectations (long and short-term). More specifically, in each of these figures, the left column shows the responses to inflation expectations from the CE and the right column the responses of the expectations from the SPF. In all figures, panel (a) presents the responses to an overall policy uncertainty shock and panels (b) and (c) the responses to a monetary policy- and to a fiscal policy-related uncertainty shock, respectively.[13]

In Figure 3 we observe that in response to an innovation in the EPU measure, real GDP contracts and short-term inflation expectations and interest rates fall. On the other hand, long-term inflation expectations rise. This response (IE long) peaks around the third quarter (about 5 basis points) and dies out in two years. Similar patterns are observed even when looking at the responses of inflation expectations along our different dimensions. In all panels of Figure 4, an innovation in the respective measure of policy uncertainty induces an increase in the median response of long-term inflation expectations, peaking in about three quarters irrespective of the source, SPF or CE. In magnitude the peak is higher for CE expectations but one should bear in mind that for the case of US, the SPF long-term refers to inflation expectations over a longer period (next 10 years). Along the shock dimension, the rise of long-term inflation expectations appears slightly stronger given a monetary policy-related uncertainty shock. Differently, the response of short-term inflation expectations to policy uncertainty shocks remains

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[13]We show the complete set of responses of all our variables to policy uncertainty shocks in Appendix D.

on the negative side. When compared with the response of long-term inflation expectations, they show a higher degree of responsiveness (up to 15 basis points) and volatility. They are also more responsive to the overall policy uncertainty and to fiscal policy uncertainty. As before, expectations from CE respondents appear to react stronger in magnitudes than the SPF ones.
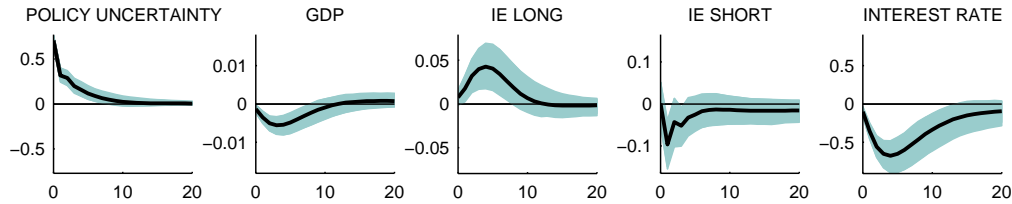

Figure 3. : IRFs to overall EPU shock for the panel-BVAR with CE expectations

Note: The solid line in black denotes median impulse response from the estimated panel-BVAR(2) and the shaded area the corresponding 68 percent credible band. BVARs include a constant and an exogenous variable, log level of crude oil prices. Policy uncertainty and GDP are in log levels. IE Long and IE Short represent five- and one- year ahead inflation expectations, in percent. Source of inflation expectations: Consensus Economics. Period: 1999Q1-2012Q3. Horizontal axis is lag horizon in quarters.

When looking at the response of the respective EPU measures to their own exogenous innovations one observes differences on their persistence (see Figure 1-6 in Appendix D). They have comparable rise on impact but it seems that monetary policy uncertainty is short-lived (the effect of the shock dies out fairly quickly, in one - two quarters). Instead, the response of the overall- and the fiscal-policy uncertainty is slow and persistent with the reversion to initial levels taking up to ten quarters.

Figure 5 and 6 report the results from the estimation of the individual BVARs, for the US and euro area, respectively. In general the results are qualitatively similar with those from the panel-BVAR, with certain differences. For the US, the median response of long-term inflation expectations (5 years ahead) from CE is positive given an overall and a monetary policy uncertainty shock.[14] However, the respective 68 percent credible bands do include zero in the first quarters. The

[14]Note that the sample period for individual BVARs for US starts in 1991 instead of 1999 for panel-BVARs.

Consensus Economics   Survey of Professional Forecasters

(a) Overall policy uncertainty

(b) Monetary policy uncertainty

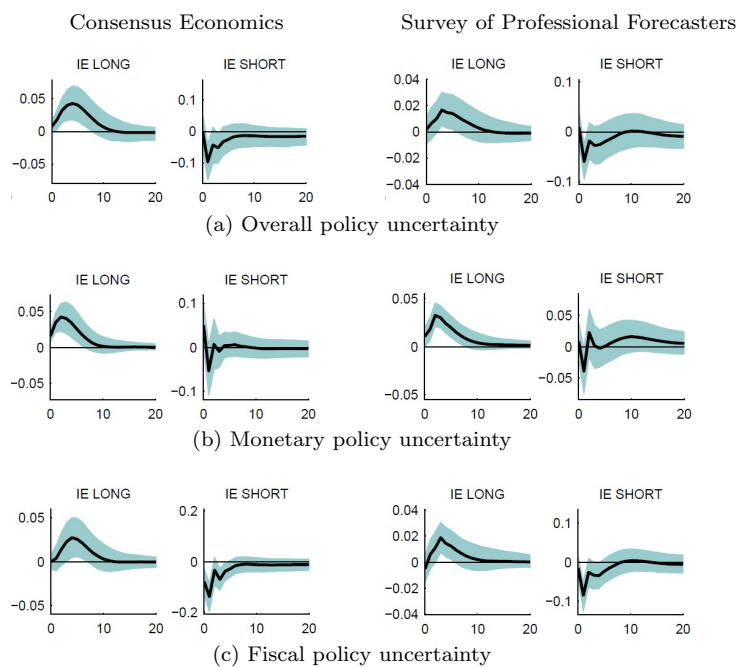(c) Fiscal policy uncertainty

Figure 4. : IRFs of inflation expectations to EPU shocks for the panel-BVAR

Note: The solid line in black denotes median impulse response from the estimated panel-BVAR(2), with $y_t = (epu_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t)$, a constant and log level of crude oil prices as an exogenous variable. The shaded area corresponds to the 68 percent credible set. Policy uncertainty and GDP are in log levels. IE Long and IE Short represent five- and one- year ahead inflation expectations, in percent. For Fed SPF, IE Long represents the expectations over the next 10 years. The period: 1999Q1-2012Q3. Horizontal axis is lag horizon in quarters.

median response peaks in the tenth quarter, about 3 basis points. SPF long-term inflation expectations (over the next 10 years) respond more strongly and persistently to the monetary policy uncertainty shock. The posterior impulse response is sharper when compared with the responses to other uncertainty shocks. The median response goes up to 5 basis points and does not revert back to its initial levels even after 20 quarters.
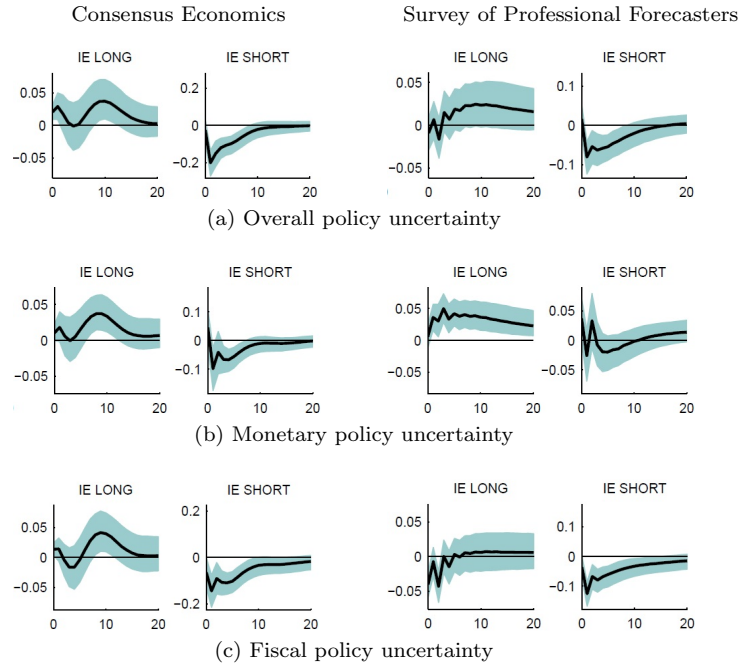

Figure 5. : IRFs of inflation expectations to EPU shocks for the US

Note: The solid line in black denotes median impulse response from the estimated BVARs(2) for the US, with $y_t = (epu_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t)$, a constant and log level of crude oil prices as an exogenous variable. The shaded area corresponds to the 68 percent credible set. Policy uncertainty and GDP are in log levels. IE Long and IE Short represent five- and one- year ahead inflation expectations, in percent. For Fed SPF, IE Long represents the expectations over the next 10 years. *The period: 1991Q4-2012Q3.* Horizontal axis is lag horizon in quarters.

Responses to an overall policy and a fiscal policy uncertainty shock indicate more uncertainty about the sign and the magnitude of the effect of these shocks on the long-term inflation expectations of professional forecasters. The reaction of short-term inflation expectations to policy uncertainty shocks for the US is

on the negative side. A stronger response is observed for the CE expectations, with a fall of up to 20 basis points in the first two quarters. These responses are especially sharper given an overall policy and a fiscal policy uncertainty shock.
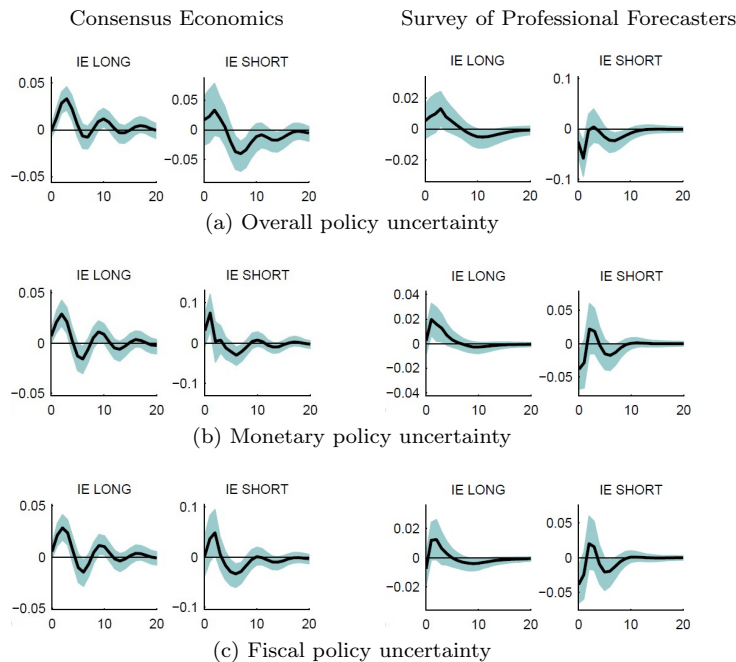

Figure 6. : IRFs of inflation expectations to EPU shocks for the euro area

Note: The solid line in black denotes median impulse response from the euro area BVARs(2), with $y_t = (epu_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t)$, a constant and log level of US industrial production as an exogenous variable. The shaded area corresponds to the 68 percent credible set (posterior distribution). Policy uncertainty and GDP are in log levels. IE Long and IE Short represent five- and one- year ahead inflation expectations, in percent. The period: 1999Q1-2012Q3. Horizontal axis is lag horizon in quarters.

Figure 6 reports the results from the estimation of the BVAR for the euro area. The response of long-term inflation expectations (5 years ahead) from CE is slightly stronger and sharper than the response of SPF expectations. The posterior median is positive for at least 5 quarters given all three types of policy uncertainty shocks. Here again we observe a peak response of about 3 basis points, which reverts fast and then bounces around the zero line. In the case of the SPF expectations the reversion is slower and smoother. The immediate response of

the SPF short-term inflation expectations to policy uncertainty shocks is negative. Conversely, the CE short-term inflation expectations increase in response to such shocks. However, the increase of the median is short-lived, lasting only about two to three quarters. The response is slightly sharper given a monetary policy uncertainty shock.

With respect to other variables, we observe that in all estimations a policy uncertainty shock is associated with an economic contraction. The GDP contraction appears on impact and up to 1 percent in the case of the US, and delayed and muted for the euro area (see Appendix D, Figures 3 to 6).[15] For the US, real GDP declines for about three quarters and the recovery phase lasts up to ten quarters. Specific policy uncertainty shocks produce qualitatively comparable responses for the real GDP. On the other hand, central banks in both economies respond with lowering interest rates strongly given a positive innovation to all types of policy uncertainty measures that we consider. If we take into account that short-term inflation expectations are highly correlated with actual inflation (about 60 to 70 percent in our sample), then this move resembles the response of a central bank that follows a typical Taylor rule, accommodating the economy in response to falling output and prices.

The GDP decline, immediate or not, and its relatively quick reversal seem to be in line with previous findings in both the theoretical and the empirical literature on the macroeconomic effects of uncertainty shocks. The magnitudes are also comparable. The empirical finding on the effect of specific types of policy uncertainty is new to the literature. We find that monetary- and fiscal policy-related uncertainties are equally harmful to economic growth. Different channels through which policy uncertainty affects economic activity could be at work, such as the precautionary saving motive or the "wait and see" dynamics, the former negatively affecting aggregate consumption and the latter affecting

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[15]Although comparable in the magnitude of the impact response, euro area measures of policy uncertainty are less persistent to its own exogenous innovations compared to the US measures.

investment. The idea behind the "wait and see" effect is that in the presence of high uncertainty and adjustment frictions, firms pause hiring and investment, and wait for calmer periods to expand. Under these conditions, production falls but pick-ups quickly due to pent-up demand for production factors ((Bernanke 1983), (Dixit and Pindyck 1994), (Bloom 2009) and (Bloom et al. 2012)).

With regard to long-term inflation expectations, conventional wisdom in the literature suggests that in an environment of well-anchored expectations, temporary news or shocks to economic variables, should not have an effect on them. However, they are responsive to policy uncertainty shocks in our BVAR analysis. We observe that long-term inflation expectations increase.[16] Although the quantitative response might not seem big at first glance, one should take into account that policy uncertainty shocks in our sample have been up to 4 standard deviations, and shocks of such size induce a high enough rise on long-term inflation expectations (about 10 basis points) to miss the ECB's "below, but close to, 2 %" or Fed's 2 % inflation objective. In addition, in Table 1 we show that policy uncertainty shocks account for up to 28 percent of the variation of long-term inflation expectations. This contribution is not negligible having in mind the small variation of long-term inflation expectations in our sample and that the majority of it is explained by its own shocks.[17]

Table 1—: FEVD (posterior median) of long-term inflation expectations

	Overall EPU	MP Uncertainty	FP Uncertainty
Consensus Economics			
10 - 20 quarters	**13.59**	**11.11**	**6.71**
	(4.56,26.61)	(4.36,22.30)	(2.15,16.05)
SPF			
10 - 20 quarters	**8.66**	**17.14**	**7.67**
	(3.34,9.52)	(8.04,28.03)	(3.16,16.19)

Note: Posterior median of FEVD from the panel-BVAR. In brackets its 68% posterior distribution.

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[16]The effect is stronger for the case of the US. (Gurkaynak, Sack and Swanson 2005) and (Gurkaynak, Levin and Swanson 2010) show as well that market-based long - term inflation expectations in the US are not perfectly anchored.

[17]As parallelism, the VAR literature on effects of monetary policy shocks has estimated not more than 10 and 20 percent contribution of monetary shocks on FEVD of output and prices, respectively.

A rise of long-term inflation expectations in times of economic contraction suggests that heightened policy uncertainty indeed raises concerns about an increase in future inflation. Furthermore, we show that monetary policy-related uncertainty does not seem to always be the reason for this. This result is new to the empirical literature and compatible with the predictions of recent theoretical models that study inflation expectations in relation with changes in policy (see (Eusepi and Preston 2010) and (Bianchi and Melosi 2012), among others). For instance, (Bianchi and Melosi 2012) build a DSGE model where under incomplete information, inflation expectations risk becoming unanchored as monetary policy shifts between periods of active inflation stabilization (active regime) and periods during which the emphasis is mainly on output stabilization (passive regime). Deviations from low inflation policies are not penalized immediately because agents are "optimistic" that the deviation is short lasting. Once there is uncertainty about the duration of the passive regime, inflation expectations rise.

Moreover, the opposite directions of the responses of short- and long-term inflation expectations to a policy uncertainty shock provide us with further evidence on low probability events (i.e. policy regime switches) being taken into account when forming expectations. For example, agents might believe that there is a likelihood of switching to a high inflation regime, hence long-term inflation expectations rise. But because this regime has very low probability of occurring it is unlikely that we observe it in our data sample (known as peso problem in the literature). Therefore, short-term inflation expectations do not rise on medium-term.

Overall, we argue that even though the commitment of central banks to a stable and low inflation has not changed, agents seem to perceive that it would be more difficult for central banks to achieve their targets. Such a scenario is likely when taking into account the unprecedented policies monetary authorities took in response to the recent crisis and the problems arising from large fiscal deficits; if they are not well-managed they risk fueling inflationary pressures.

D.   Robustness checks

In the following we examine whether our main results are sensitive to issues related with the identification of the policy uncertainty shocks, to the sample used for estimation and to the measure of uncertainty.

ALTERNATIVE ORDERING. — As discussed above, the identification of uncertainty shocks is recent and a consensus on the best identifying restrictions is yet to be reached in the literature. In our benchmark identification, policy uncertainty responds immediately only to its own innovations and with a period delay to other shocks. Here we relax this assumption and allow the EPU measures to be contemporaneously responsive to all the shocks. Under this specification, the order of the variables in the BVAR is: $gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t, epu_t$. Results from the panel-BVAR with Consensus Economics expectations are shown in the first column of Figure 7. We observe that exogenous innovations to the EPU measure induce an increase in the median response of long-term inflation expectations. However, compared to the benchmark estimation there is more uncertainty around the median response. The median response of SPF long-term expectations is more precisely estimated and only slightly lower in magnitude compared to the benchmark BVARs (see Appendix E). The responses of the real GDP and the interest rate are also qualitatively the same as in the benchmark analysis.[18]

SELECTED SAMPLE FOR ESTIMATION. — In our benchmark estimations we include short-term interest rates to account for the reaction of monetary policy. However, starting from the fourth quarter of 2008 both the Fed and the ECB turned to unconventional policies. To account for this, we include a dummy variable in our BVARs that takes the fourth quarter of 2008 as the starting value. We also check if our main results hold when the period corresponding to the recent crisis

[18]These results are available upon request.

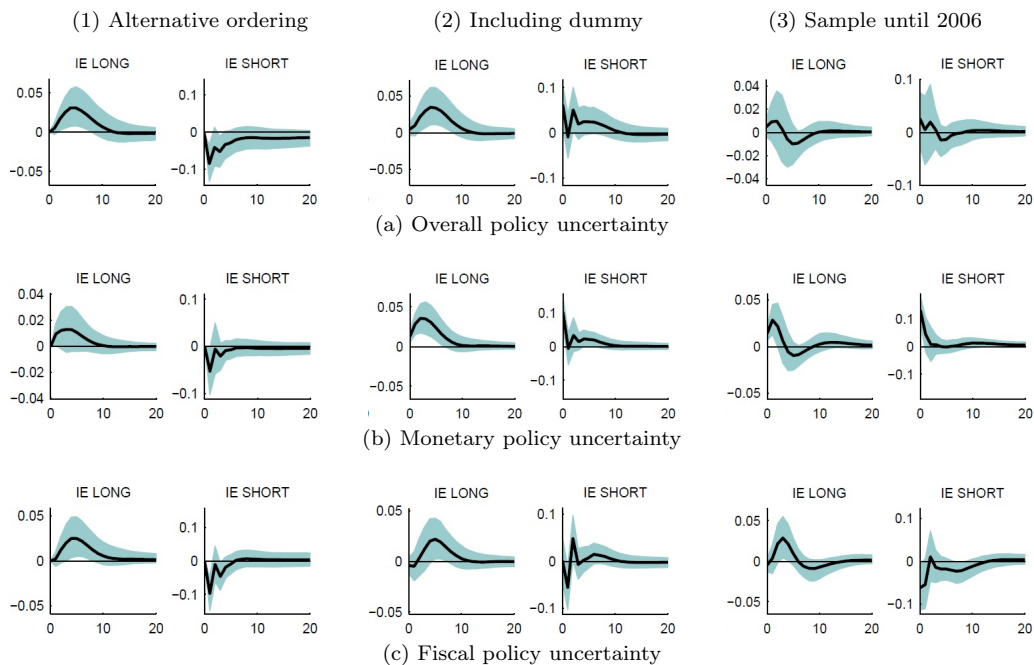is excluded. To this aim, we estimate our BVARs with the data sample ending in the fourth quarter of 2006.

Figure 7. : IRFs of inflation expectations to EPU shocks, panel-BVAR with CE expectations

Note: The solid line in black denotes median impulse response from the panel-BVAR(2), with $y_t = (epu_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t)$, a constant and log level of crude oil prices as an exogenous variable. The shaded area corresponds to the 68 percent credible set (posterior distribution). Policy uncertainty and GDP are in log levels. IE Long and IE Short represent five- and one- year ahead inflation expectations, in percent. Period: 1999Q1-2012Q3. Horizontal axis is lag horizon in quarters. We show the results of three robustness checks: (1) reordering the endogenous variables, $y_t = (gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t, epu_t)$; (2) including a dummy that takes the value of one starting from 2008Q4; (3) splitting the sample until 2006Q4.

The results pertaining to these two specifications are presented in the second and the third column of Figure 7. When accounting for the period of unconventional monetary policy (inclusion of the dummy) the responses of long-term inflation expectations are similar to the benchmark estimation. However, the median response of short-term inflation expectations, although estimated with high uncertainty, reverses to the positive side given shocks to the overall and to the

monetary policy uncertainty. The same result is observed even when the recent crisis is excluded from the estimation (sample until 2006), although these results should be taken with care given the short sample used for estimation.

STOCK MARKET VOLATILITY AS A MEASURE OF UNCERTAINTY. — We also estimate our panel-BVARs using the stock market volatility index, often used in the literature as a proxy measure for uncertainty. For the US and the euro area we use the respective 30-days option-implied expected volatility indices, VIX and VSTOXX. Stock market volatility indices and the EPU measures share common spikes (the correlation between them stands at 0.4 - 0.6) but also substantial individual variation. The variation of VIX and VSTOXX is mainly driven by financial market conditions whereas the variation of the EPU measure is mostly driven by policy aspects. Baker, Bloom and Davis (2012) also discuss the longer time frame nature of the EPU measure relative to the stock market volatility indices.

In Figure 8 we show the results of the panel-BVAR estimation using a recursive identification and the following order of the variables, $VIX_t, gdp_t, \pi^e_{long|t}, \pi^e_{short|t}, i_t$. The effects of an unexpected inovation to the stock market volatility on output, short-term inflation expectations and interest rate are qualitatively and quantitatively similar to those from the EPU. However, the effect on long-term inflation expectations is different. The median response of long-term inflation expectations from CE is on the upper side but its credible set includes zero, while in the case of expectations from SPF the posterior response is centered around zero. This result suggests that: (1) long-term inflation expectations, as a measure that contains information about the beliefs of agents about (monetary) policy, are responsive to the stock market volatility indices to the extent that these indices reflect policy considerations and, (2) the responsiveness of long-term inflation expectations in our sample is not necessarily related to the state of the economy but mainly to beliefs about policies and policymakers.

After performing the sensitivity checks described above, we observe that our
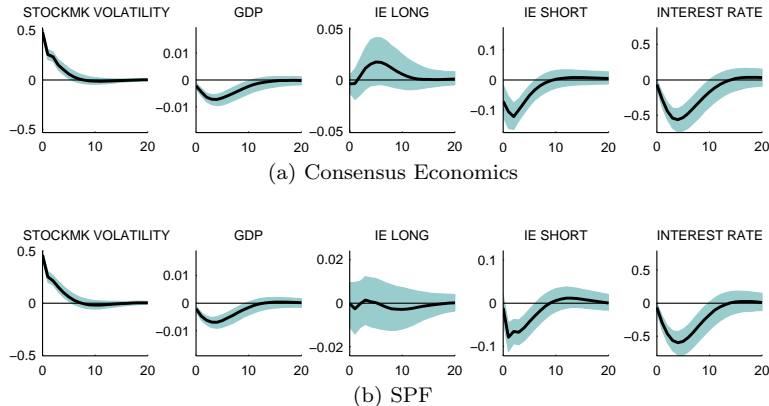
Figure 8. : IRFs to stock market volatility shocks for the panel-BVAR

Note: The solid line in black denotes median impulse response to a 2 sdt. dev. shock from the estimated VAR(2) for the US - euro area panel and the shaded area the corresponding 68 percent error band. BVARs include a constant and an exogenous variable, log level of crude oil prices. Stock market uncertainty (VIX for US and VSTOXX for EA) and GDP are in log levels. IE Long and IE Short represent five- and one-year ahead inflation expectations, in percent. Period: 1999Q1-2012Q3. Horizontal axis is lag horizon in quarters.

main result from the benchmark analysis holds: innovations to policy uncertainty induce an increase in the median response of long-term inflation expectations. We also show that long-term inflation expectations are not necessarily responsive to other types of uncertainty, unless they capture as well policy considerations. On the other hand, the response of short-term inflation expectations is sensitive to the sample period taken into account.

IV. Concluding remarks

We bridge the existing empirical literature on the macroeconomic effects of uncertainty shocks and the literature on inflation expectations and provide first evidence on the effects of policy-related uncertainty, coming from extraordinary events and actions of decision makers, on inflation expectations. Previous studies have shown that policy uncertainty is harmful for investments, consumption and employment. In this paper we show that the observed uncertainty about the stance and perceived effectiveness of policy should be troubling for central

bankers[19] as it seems to entail additional risks to their hard-won inflation credibility.

Using BVARs we investigate whether policy-related uncertainty, as quantified by (Baker, Bloom and Davis 2012), has fed into inflation expectations in the US and the euro area. We find that while economic activity contracts, long-term inflation expectations rise in response to a policy-related uncertainty shock. This finding is robust across the two countries, different specifications, more specific measures for policy uncertainty, different measures of inflation expectations, and different orderings of the variables in the BVARs. Our results show that long-term inflation expectations of professional forecasters are not perfectly anchored and that policy-related uncertainty poses upside risks to them.

Given that well-anchored long-term inflation expectations reflect the credibility of monetary policy, we find support for the hypothesis that, in an environment of increased policy uncertainty, agents begin to question the ability and the commitment of policy makers to deliver on their promises. This result is of current relevance especially for central banks conducting policy in an environment of near-zero interest rates. The credibility of central bank's commitment in the eyes of the public becomes crucial for the success of monetary policy at the zero lower bound. But this credibility is in doubt when there exists uncertainty about the details of the policy put in place, its effectiveness, the firmness of the commitment to future policies but also about other policies (i.e. fiscal). A clear communication on what policy makers can do and what they know, a prompt response to present challenges, and a long-term consistency of policies would help reduce policy uncertainty.

In this paper we study the expectations of professional forecasters, which are some of the most informed agents in the economy. However, it would also be interesting to study how general public's expectations and perceptions towards

[19]Governor of Bank of Canada, Mark Carney, made such a remark on policy uncertainty in his speech "Uncertainty and Global Recovery" in October 2012, at Vancouver Island Economic Summit.

central banks are affected by policy uncertainty. Examining this issue is of interest for several reasons: the general public constitutes a large proportion of the agents in the economy, they are generally less financially literate than the professional forecasters, and they are more likely to be influenced by the media. Particularly, one could study the role of policy uncertainty for the dynamics of trust in the ECB and of satisfaction with the way Bank of England is doing its job to preserve price stability, given the negative trends observed in these measures during the last years. We plan to investigate these issues in future works.

REFERENCES

Alexopoulos, Michelle, and Jon Cohen. 2009. "Uncertain Times, Uncertain measures." Working Papers 352, University of Toronto.

Andrade, Philippe, and Herve Le Bihan. 2013. "Inattentive professional forecasters." *Journal of Monetary Economics*, 60(8): 967–982.

Arellano, Cristina, Yan Bai, and Patrick Kehoe. 2011. "Financial Markets and Fluctuations in Uncertainty." Society for Economic Dynamics, 2011 Meeting Papers 896.

Bachmann, Rüdiger, Steffen Elstner, and Eric R. Sims. 2013. "Uncertainty and Economic Activity: Evidence from Business Survey Data." *American Economic Journal: Macroeconomics*, 5(2): 217–249.

Baker, Scott, Nicholas Bloom, and Steven J. Davis. 2012. "Measuring Economic Policy Uncertainty." Stanford mimeo.

Barro, Robert, and David Gordon. 1983. "Rules, Discretion, and Reputation in a Model of Monetary Policy." *Journal of Monetary Economics*, 12(1): 101–121.

Bentolila, Samuel, and Giuseppe Bertola. 1990. "Firing Costs and Labour Demand: How Bad Is Eurosclerosis?" *Review of Economic Studies*, 57(3): 381–402.

Bernanke, Ben. 1983. "Irreversibility, Uncertainty, and Cyclical Investment." *The Quarterly Journal of Economics*, 98(1): 85–106.

Bianchi, Francesco, and Leonardo Melosi. 2012. "Constrained Discretion and Central Bank Transparency." Mimeo.

Bloom, Nicholas. 2009. "The Impact of Uncertainty Shocks." *Econometrica*, 77(3): 623–685.

Bloom, Nicholas, Max Floetotto, Nir Jaimovich, Itay Saporta-Eksten, and Stephen J. Terry. 2012. "Really Uncertain Business Cycles." NBER

Working Papers 18245 77(3).

Born, Benjamin, and Johannes Pfeifer. 2014. "Policy Risk and the Business Cycle." *Journal of Monetary Policy*, 68: 68–85.

Christiano, Lawrence, Roberto Motto, and Massimo Rostagno. 2010. "Financial Factors in Economic Fluctuations." European Central Bank, Working Paper Series 1192.

Clark, Todd E., and Troy Davig. 2008. "An Empirical Assessment of the Relationships Among Inflation and Short and Long term Expectations." Federal Reserve Bank of Kansas City, Research Working Paper RWP 08-05.

Coibion, Olivier, and Yuriy Gorodnichenko. 2012. "What can survey forecasts tell us about informational rigidities?" *Journal of Political Economy*, 120: 116–159.

Dixit, Avinash, and Robert S. Pindyck. 1994. In *Investment under Uncertainty*. Princeton University Press, Princeton, New Jersey.

Doms, Mark, and Norman Morin. 2004. "Consumer sentiment, the economy, and the news media." Working Papers in Applied Economic Theory, Federal Reserve Bank of San Francisco.

Eusepi, Stefano, and Bruce Preston. 2010. "Central Bank Communication and Expectations Stabilization." *American Economic Journal: Macroeconomics*, 2(3): 235–71.

Fernandez-Villaverde, Jesus, Pablo Guerron-Quintana, Keith Kuester, and Juan Rubio-Ramirez. 2012. "Fiscal Volatility Shocks and Economic Activity." NBER Working Papers 17317.

Fernandez-Villaverde, Jesus, Pablo Guerron-Quintana, Keith Kuester, and Juan Rubio-Ramirez. 2013. "Fiscal Volatility Shocks and Economic Activity." Mimeo.

Galati, Gabriele, Steven Poelhekke, and Chen Zhou. 2011. "Did the Crisis Affect Inflation Expectations?" *International Journal of Central Banking*,

7(1): 167–207.

Gilchrist, Simon, Jae W. Sim, and Egon Zakrajsek. 2010. "Uncertainty, Financial Frictions and Investment Dynamics." Society for Economic Dynamics, Meeting Papers 1285.

Gurkaynak, Refet S, Andrew Levin, and Eric Swanson. 2010. "Does Inflation Targeting Anchor Long-Run Inflation Expectations? Evidence from the U.S., UK, and Sweden." *Journal of the European Economic Association*, 8(6): 1208–1242.

Gurkaynak, Refet S, Brian Sack, and Eric Swanson. 2005. "The Sensitivity of Long-Term Interest Rates to Economic News: Evidence and Implications for Macroeconomic Models." *American Economic Review*, 95(1): 425–436.

Kydland, Finn, and Edward Prescott. 1977. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy*, 85(3): 473–492.

Leduc, Sylvain, and Zheng Liu. 2012. "Uncertainty Shocks are Aggregate Demand Shocks." Federal Reserve Bank of San Francisco, Working Paper Series, 2012-10.

Mankiw, N. Gregory, Ricardo Reis, and Justin Wolfers. 2004. "Disagreement about Inflation Expectations." In *NBER Macroeconomics Annual 2003, Volume 18. NBER Chapters*, 209–270. National Bureau of Economic Research, Inc.

Mumtaz, Haroon, and Francesco Zanetti. 2013. "The Impact of the Volatility of Monetary Policy Shocks." *Journal of Money, Credit and Banking*, 45(4): 535–558.

Panousi, Vasia, and Dimitris Papanikolaou. 2011. "Investment, Idiosyncratic Risk, and Ownership." *Journal of Finance*, 67: 1113–1148.

Ramey, Valerie A. 2011. "Identifying Government Spending Shocks: It's All in the Timing." *The Quarterly Journal of Economics*, 126(1): 1–50.

Ramey, Valerie A., and Matthew D. Shapiro. 1998. "Costly Capital Reallocation and the Effects of Government Spending." *Carnegie-Rochester Conference Series on Public Policy*, 48(1): 145–194.

Romer, Christina D., and David H. Romer. 1989. "Does Monetary Policy Matter? A New Test in the Spirit of Friedman and Schwartz." *NBER Macroeconomics Annual*, 4: 121–170.

Romer, Christina D., and David H. Romer. 2004. "A New Measure of Monetary Shocks: Derivation and Implications." *American Economic Review*, 94: 1055–1084.

Uhlig, Harald. 2005. "What are the Effects of Monetary policy on Output? Results from an Agnostic Identification Procedure." *Journal of Monetary Economics*, 52.