Economics Letters ▮ (▮▮▮▮) ▮▮▮–▮▮▮

Contents lists available at ScienceDirect

Economics Letters

journal homepage: www.elsevier.com/locate/ecolet

Uncertainty and the real effects of monetary policy shocks in the Euro area☆

Giovanni Pellegrino

University of Melbourne, Australia

HIGHLIGHTS

- An Interacted-VAR analyzes uncertainty-dependent monetary policy for the Euro area.
- GDP generalized IRFs to monetary shocks are weaker during Euro area uncertain times.
- Extreme events allow not to miss statistical evidence in favor of nonlinearities.
- Uncertainty significantly affects the historical contribution of monetary stimuli.

ARTICLE INFO

Article history:
Received 31 January 2017
Received in revised form 24 July 2017
Accepted 5 October 2017
Available online xxxx

JEL classification:
C32
E32
E52

Keywords:
Monetary policy shocks
Non-linear structural vector auto-regressions
Interacted-VAR
Generalized impulse response functions
Historical decomposition
Uncertainty

ABSTRACT

This paper estimates a nonlinear Interacted-VAR model to investigate whether the effectiveness of monetary policy shocks in the Euro area is influenced by the level of European uncertainty. Generalized Impulse Response Functions à la Koop et al. (1996) suggest that the peak and cumulative effects of monetary policy shocks are lower during uncertain times than during tranquil times, and significantly so once times of very high and very low uncertainty are considered. The influence of uncertainty on the historical contribution of monetary stimuli is shown to be empirically relevant.

1. Introduction

This paper investigates whether the level of European uncertainty influences the effectiveness of monetary policy shocks in the Euro area. Aastveit et al. (2017), Pellegrino (2017) and Eickmeier et al. (2016) have recently shown that the effectiveness of monetary shocks in the US is significantly reduced in a context of high uncertainty. This finding corroborates the predictions of several theoretical studies (see Bloom, 2009, Vavra, 2014, and Aastveit et al., 2017 among others). However, to our knowledge no evidence is available as regards the Euro area as a whole. This paper fills this gap by modeling a vector of Euro area macroeconomic data with a nonlinear Interacted-VAR model (i.e., a standard VAR model plus an interaction term) for the period 1995–2008. Such framework allows us to analyze the possibly nonlinear real effects of monetary policy shocks conditional on different levels of uncertainty. We combine this Interacted-VAR with nonlinear Generalized IRFs (GIRFs) à la Koop et al. (1996). This methodology extends the one by previous studies working with I-VAR models which compute conditionally-linear IRFs. This extension allows us both i) to precisely estimate responses (by considering the endogenous reaction of uncertainty to the shock and its feedbacks on the economy) and ii) to recover time-varying responses (by allowing initial conditions at the time of the shock to play a nontrivial role).

Following the seminal work by Bloom (2009) we focus on financial uncertainty. This is important since, on the basis of Ludvingson et al.'s (2016) findings, indicators proxying this type of uncertainty

☆ We thank Pierre-Daniel Sarte (Editor) and an anonymous referee for their very useful feedback. We are also grateful to Giovanni Caggiano and Efrem Castelnuovo for very useful comments and suggestions. Financial support from the Australian Research Council via the Discovery Grant DP160102281 is gratefully acknowledged.

E-mail address: giovanni.pellegrino@unimelb.edu.au.

https://doi.org/10.1016/j.econlet.2017.10.006

are likely to capture movements in uncertainty which are relevant to explain the evolution of the real GDP at business cycle frequencies.

We find evidence of state-dependent effects of monetary policy shocks. Both the peak and the 5-year cumulative real effects triggered by unexpected movements in the policy rate are documented to be lower during uncertain times than during tranquil times. Moreover, we show that these differences are statistically relevant when comparing times of very high and very low uncertainty. Finally, we document that the influence of uncertainty on the contribution of monetary policy shocks to the business cycle is empirically relevant in a historical perspective.

The papers closest to ours are Aastveit et al. (2017) and Pellegrino (2017). Working with Interacted-VARs, Aastveit et al. (2017) find US uncertainty to influence the effects of monetary policy shocks in the US, Canada, UK and Norway.[1] Differently from our work, they do focus neither on European uncertainty nor on the Euro area. Furthermore, differently from them, our work endogenizes uncertainty and computes GIRFs. The computation of GIRFs is also present in Pellegrino (2017), who focuses on the US case only.

The paper is structured as follows. Section 2 presents the empirical model and the data, and discusses identification and statistical motivation. Section 3 documents our empirical findings. Section 4 concludes.

2. Empirical strategy

***Interacted-VAR**.* The I-VAR is a nonlinear VAR model which augments a standard linear VAR model with an interaction term to determine how the effects of a shock in one variable depend on the level of another variable. Our estimated I-VAR reads as follows:

$$\mathbf{Y}_t = \boldsymbol{\alpha} + \sum_{j=1}^{L} \mathbf{A}_j \mathbf{Y}_{t-j} + \left[\sum_{j=1}^{L} \mathbf{c}_j i_{t-j} \cdot unc_{t-j} \right] + \mathbf{u}_t \tag{1}$$

$$E(\mathbf{u}_t \mathbf{u}_t') = \Omega \tag{2}$$

where $\mathbf{Y}_t$ is the vector of the endogenous variables, $\boldsymbol{\alpha}$ is a vector of constant terms, $\mathbf{A}_j$ are matrices of coefficients, $\mathbf{u}_t$ is the vector of error terms whose variance–covariance (VCV) matrix is Ω. The interaction term includes a vector of coefficients, $\mathbf{c}_j$, the policy rate, i_t, i.e., the variable capturing the stance of monetary policy whose exogenous variations we aim at identifying, and a measure of uncertainty, unc_t, that will serve as our conditioning variable.

The vector of endogenous variables modeled by our I-VAR reads as follows: $\mathbf{Y}_t = [unc_t, 100 \cdot \ln P_t, 100 \cdot \ln GDP_t, i_t]'$, where unc stands for uncertainty, P for the price level, GDP for real output and i for the policy rate. We proxy European financial uncertainty with the quarterly average of the VDAX implied volatility index retrieved from the Bloomberg database. This is the German-analogous to the VIX index for the US (the index used in Bloom's (2009) seminal work) and it has been used in other works to proxy uncertainty (e.g., Bachmann et al., 2013 and Popescu and Smets, 2010). The reason why we use the German-analogous rather than the European-analogous to the VIX index, i.e. the VSTOXX index, is to maximize the already-low number of available observations. The VSTOXX is available only from 1999, but it correlates 0.99 with the VDAX over our sample period. To capture the stance of monetary policy, we use the overnight interest rate (EONIA), while GDP and prices (measured by the GDP deflator) are aggregates for the Euro area (source: ECB website).[2] We use 3 lags to ensure that residuals are not serially correlated. The model is estimated by OLS. A multivariate LR test rejects the null of linearity against our I-VAR (p-value $= 0.04$).

We study the period 1995Q1–2008Q3. The starting date is dictated by the availability of our series and the ending date is motivated by some recent evidence documenting a policy shift by the ECB after the bankruptcy of Lehman Brothers in September 2008 (Gerlach and Lewis, 2014; Castelnuovo, 2016). The ending date also allows us to focus on conventional monetary policy shocks. In fact, after the collapse of Lehman Brothers, the ECB has adopted a large number of non-standard policy measures as a complement to conventional monetary policy (see Cour-Thimann and Winkler, 2013). Provided the small number of observations in the sample, the use of a parsimonious I-VAR model is an efficient choice relatively to more parametrized nonlinear state-dependent model like Smooth Transition- and Threshold-VARs.

***GIRFs**.* We compute GIRFs à la Koop et al. (1996) to account for the endogenous response of uncertainty to the monetary shock and the feedbacks this can have on the dynamics of the economy. GIRFs acknowledge the fact that, in a fully nonlinear model, responses depend on the sign of the shock, the size of the shock, and initial conditions. Theoretically, the GIRF at horizon h of the vector $\mathbf{Y}_t$ to a shock of size δ computed conditional on an initial history $\boldsymbol{\varpi}_{t-1} = \{\mathbf{Y}_{t-1}, \ldots, \mathbf{Y}_{t-L}\}$ is given by the following difference of conditional expectations:

$$GIRF_{Y,t}(h, \delta_t, \varpi_{t-1}) = E\left[\mathbf{Y}_{t+h} \mid \delta, \varpi_{t-1}\right] - E\left[\mathbf{Y}_{t+h} \mid \varpi_{t-1}\right].$$

The algorithm at the basis of the simulation of our GIRFs is provided in the online Appendix. In computing the responses, we consider a structural shock. Monetary policy shocks are identified by means of a Cholesky decomposition as commonly done in the literature (the recursive structure is given by the ordering of the variables in the vector Y_t above, i.e. $[unc, P, GDP, i]'$).[3] For the period before 1999, year in which the ECB become to operate, our estimated reactions to an identified monetary policy shock can be interpreted as the average reaction across countries belonging to the Euro area (see Smets and Wouters (2003) and Castelnuovo (2016)).

3. Empirical results

***Time-varying real effects of monetary policy shocks**.* Fig. 1 depicts the response of real GDP to an equally-sized expansionary shock equal to a 1 percentage point decrease in the EONIA rate. The upper panel plots the temporal evolution of the GIRFs for each given quarter t in our estimation sample, while the mid and bottom panels contrast, respectively, the peak and 5-year cumulative reactions for a shock happening in t with the initial level of uncertainty at time $t-1$. Two considerations are in order. First, there is evidence of a time-varying impact of monetary policy shocks over the sample period considered. Second, both the GDP peak and the cumulative responses suggest that the effectiveness of monetary

[1] For the evidence regarding Canada, UK and Norway please refer to their working paper version (Aastveit et al., 2013).

[2] The use of synthetic European data is common among researchers (see, e.g., Smets and Wouters, 2003 and Castelnuovo, 2016). The mnemonics for GDP, prices and Eonia are respectively given by MNA.Q.Y.I8.W2.S1.S1.B.B1GQ._Z._Z._Z.EUR.LR.N, MNA.Q.Y.I8.W2.S1.S1.B.B1GQ._Z._Z._Z.IX.D.N and FM.M.U2.EUR.4F.MM.EONIA.HSTA.

[3] Since uncertainty is ordered first, it is assumed that it cannot contemporaneously react to interest rate and price moves. The reason for this choice is because of our main concern to identify monetary policy shocks which are safely purged from moves in all variables, included the uncertainty measure, since, in case the monetary policy systematic conduct responded also to uncertainty (as recently argued by Evans et al., 2015 and Caggiano et al., 2017), its missed consideration may potentially affect our results. This notwithstanding, the baseline ordering may still be problematic given the high frequency measure of uncertainty used. A robustness check available in the online Appendix documents that our baseline results are quantitatively similar to the case uncertainty was placed as the last variable in the vector $\mathbf{Y}_t$, so that to maximize its degree of endogeneity and allowing uncertainty to respond on impact to monetary policy shocks. The results from this check reassure about the potentially relevant problems just stated. They do not appear as quantitatively important for our empirical application.