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Dynamic Effects of Monetary Policy Shocks on Macroeconomic Volatility in the United Kingdom

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Abstract

We use constant and time-varying parameters vector autoregressive models that allow the estimation of the impact of monetary policy shocks on volatility of macroeconomic variables in the United Kingdom. Estimates suggest that an increase in the policy rate by 1% is associated with a rise in unemployment and inflation volatility of about 10% on average, with peaks observed during episodes of local and global crises.

Keywords: Non-Linear SVAR, Stochastic Volatility, Monetary Policy Shock

JEL Codes: C32, E30, E40, E52

1. Introduction

There is widespread international evidence that uncertainty shocks can cause business cycle fluctuations (see for example, Bloom (2014, 2017), Gupta et al., (2018, 2019, 2020), and references cited therein) and drive policy decisions (Christou et al., 2019a; Çekin et al., (forthcoming)). However, as recently pointed out by Ludvigson et al., (forthcoming) uncertainty is not necessarily exogenous, and hence what factors drive it is an important issue for the policymakers. In this regard, as shown empirically for the United States (US) by Mumtaz and Theodoridis (2019), (contractionary) monetary policy shocks itself can lead to changes (increase) in uncertainty. As Mumtaz and Theodoridis (2019) points out using a New-Keynesian model (with search and matching labour frictions and Epstein-Zin preferences), theoretically this is the case since these volatility effects are driven by the coexistence of agents' fears of unemployment and concerns about the (in) ability of the monetary authority to

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reverse deviations from the policy rule (with the impact magnified by the agents' preferences).

In this short note, we aim to analyse the same issue empirically for the United Kingdom (UK) – another major country in the global economic system, using structural vector autoregressions (SVAR) with stochastic volatility (extended to allow for feedback from the endogenous variables to the volatility). While there does exist papers that have analysed the impact of uncertainty shocks on macroeconomic variables and monetary policy for the UK (see for example, Redl (2017), Christou et al., (2019b) for a review), to the best of our knowledge, this is the first attempt to study the impact of monetary policy shocks on the volatility of its macroeconomic variables.

The remainder of the paper is organized as follows: Section 2 presents the data and methodology, while Section 3 discusses the results, with Section 4 concluding the paper.

2. Data and Methodology

Our study proceeds along two lines; one, estimating the level and volatility effects of monetary policy shocks on macroeconomic variables; two, adopting both constant parameter and time-varying parameter SVAR denoted as CP-VAR and TVP-VAR respectively. Mumtaz and Theodoridis (2019) suggest that monetary policy uncertainties can drive volatilities in the variables and we can expect some feedback.

Thus, we define a vector of endogenous variables z_t as $z_t = \left[urate_t \;\; \inf_t \;\; prate_t \;\; tspread_t \right]'$ where the observables are unemployment rate ('urate'), inflation rate ('inf'), monetary policy rate ('prate') and term spread ('tspread'). Data on civilian unemployment rate, annual CPI inflation, an interest rate representing the policy instrument and the spread of 10 year government bonds over the three-month Treasury bill rate is derived primarily from the Main Economic Indicators database of the OECD. The data is monthly and runs from 1960m1 to 2019m10, with the start and end dates being purely driven by data availability at the time of writing this paper. The first ten years are used as a training sample with estimation carried out over the period 1970m1 to 2019m10. Note that since our sample period involves the zero lower bound and unconventional monetary policy period, we use the three-month Treasury bill rate as the measure of monetary policy till 2008m12, and then the shadow short rate (SSR) of Wu and Xia (2016),[1] derived from a three-factor shadow rate term structure model (SRTSM), over the period of 2009m1 to the end of the sample period.

The CP-VAR and TVP-VAR for the level dynamic effects are among the observables are respectively specified in Eq. (1) and Eq. (2) as follows:

$$z_t = c_0 + \sum_{i=1}^{p} \varpi_i z_{t-i} + \varepsilon_t \qquad (1)$$

$$z_t = c_{0,t} + \sum_{i=1}^{p} \varpi_{i,t} z_{t-i} + \varepsilon_t \qquad (2);\ for\ t = 1, 2, \ldots T.$$

where $c_{0,t}$ is a 4x1 vector of time-varying coefficients of constants like its fixed counterpart (c_0); $\varpi_{i,t}$ are 4x4 matrices of time-varying coefficients of the lagged observables analogous to the constant coefficients, ϖ_i; p is the optimal lag length of the VAR model chosen with Schwarz Information Criterion (SIC).

We augment Eq. (2) to account for stochastic volatilities in endogenous variables and express dynamic relationships with the level of endogenous variables as follows:

$$z_t = c_{0,t} + \sum_{i=1}^{p} \varpi_{i,t} z_{t-i} + \sum_{j=1}^{q} \omega_j \tilde{h}_{t-j} + \zeta_t \qquad (3)$$

$$\tilde{h}_t = c + \rho \tilde{h}_{t-1} + \sum_{j=1}^{q} \delta_j z_{t-j} + v_t \qquad (4);\ \mathrm{E}(\varepsilon_t, v_t) = 0$$

where $\tilde{h}_t$ is the 4x1 vector of stochastic volatilities; $\zeta_t = \Omega_t^{1/2} \varepsilon_t$; the matrix of covariance residuals, Ω_t is decomposed as $\Omega_t = \Lambda^{-1} H \Lambda^{-1\prime}$ for H being a diagonal matrix of orthogonalised volatility shocks and Λ the matrix of contemporaneous effects.

[1] The SSR is available for download from: https://sites.google.com/view/jingcynthiawu/shadow-rates?authuser=0.

The Eqs. (3) and (4) are specified to ensure feedbacks between level and volatilities of the observables with the presence of $\sum_{j=1}^{q} \delta_j z_{t-j}$ and $\sum_{j=1}^{q} \omega_j \tilde{h}_{t-j}$ in the specifications, in line with the study's objective.

The estimation process of the model parameters considers 5000 replications and 4000 burn-ins, leaving 1000 estimates from where the parameter values were averaged. The final VAR model was estimated with optimal lag length: $p = 12$, lags 3 for the observables in both transition and volatility equations. From the resulting constant parameter and time-varying parameter models, we obtain impulse response functions for both the level and volatility responses of the observables to policy shocks as follows: sixty (60 months) forecast horizon, 100 model simulations and 500 retained Gibbs draws.

The monetary policy identification scheme uses contemporaneous sign restrictions. We assume that a contractionary policy shock increases the short-term interest rate on impact and leads to a rise in unemployment and a fall in CPI inflation. We evaluate the various outcomes of the estimations in the subsequent section.

3. Results

In this section, we present empirical evidence on the first- and second-moments impact of a monetary policy shock. In Figure 1, we document the results of the impulse responses for the CP-VAR model with stochastic volatility following a monetary policy shock. Subsequently, we present the same for the TVP-VAR model as an extension in Figure 2.

Figure 1 presents the impulse response to a contractionary monetary policy shock normalised to increase the short term interest rate by 100 basis points. The unemployment rate rises by about 0.35 percentage points at the three year horizon, though inflation does not display a significant impact, barring the first couple of months. Finally, the term spread falls by about 80 basis points on impact. The last three rows of the figure present the response of the unconditional volatility to this shock. It is clear from the figure that the volatility of all endogenous variables rises in response to this shock, but in a slightly delayed fashion. This is reflected in the measure of overall volatility, the log determinant of the covariance matrix of the endogenous variables which shows a significant increase between 3- to 24-month-ahead, with the magnitude of the response of all the variables being quantitatively similar and around 10% (barring inflation variance, for which the effect is slightly lower) after 6 months following the shock.[2] Note that, this value is similar in comparison to the corresponding estimates for the US as obtained by Mumtaz and Theodoridis (2019).

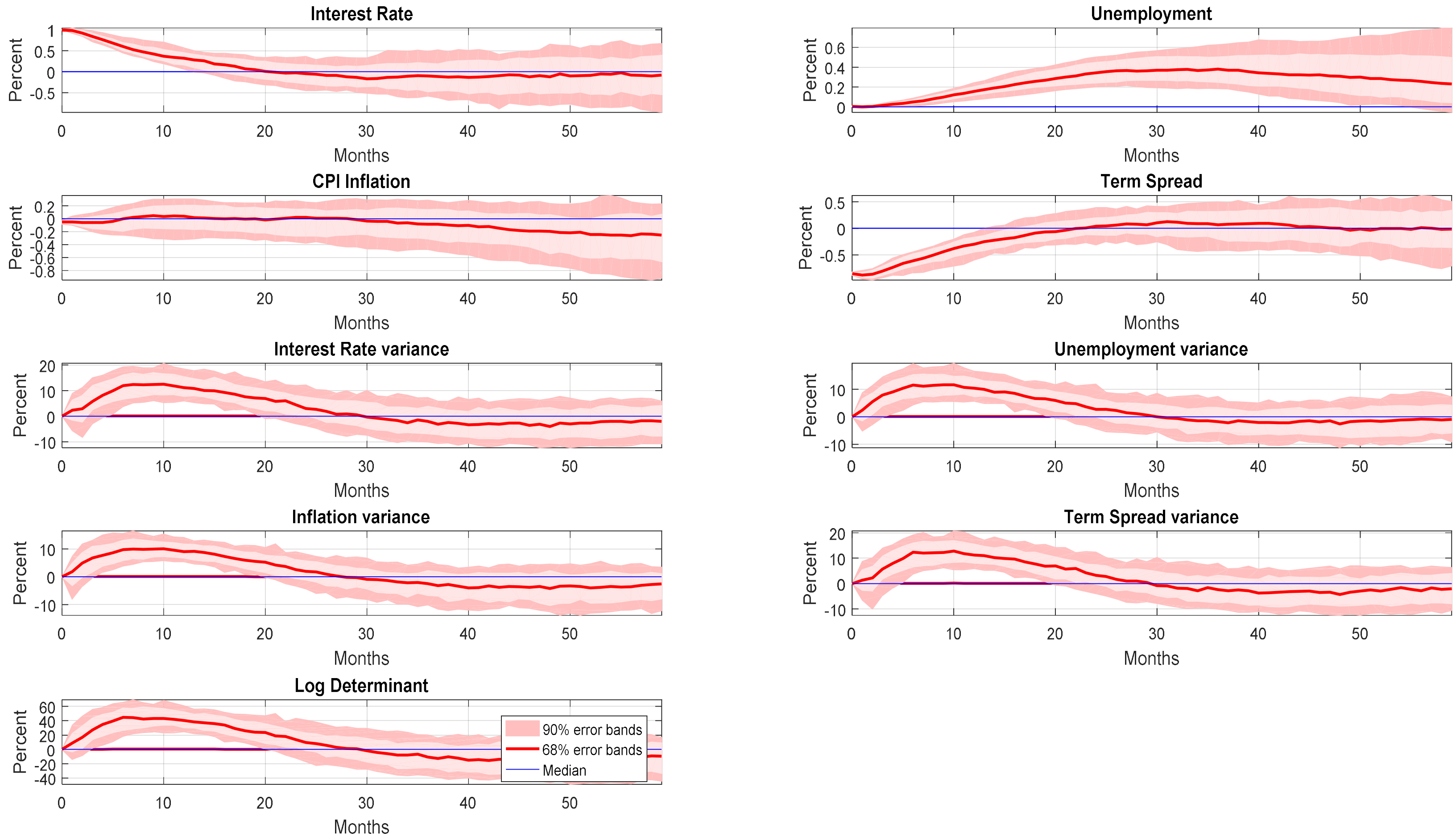
[INSERT FIGURE 1]

The time-varying impulse responses of volatility to a 1 unit monetary contraction (based on sign restrictions to identify the policy shock) are shown in Figure 2, with the impact on unemployment being exceptionally high in the 1990s, following the adoption of inflation targeting by the Bank of England, and also in the wake of the global financial crisis of 2007-2008 and the European sovereign debt crisis of 2010, and the Brexit vote in 2016. A similar picture also emerges for the inflation rate. More importantly, the impact on volatility remains positive and persistent throughout the sample period, with highest levels reached during the various recent global and local crises.

[INSERT FIGURE 2]

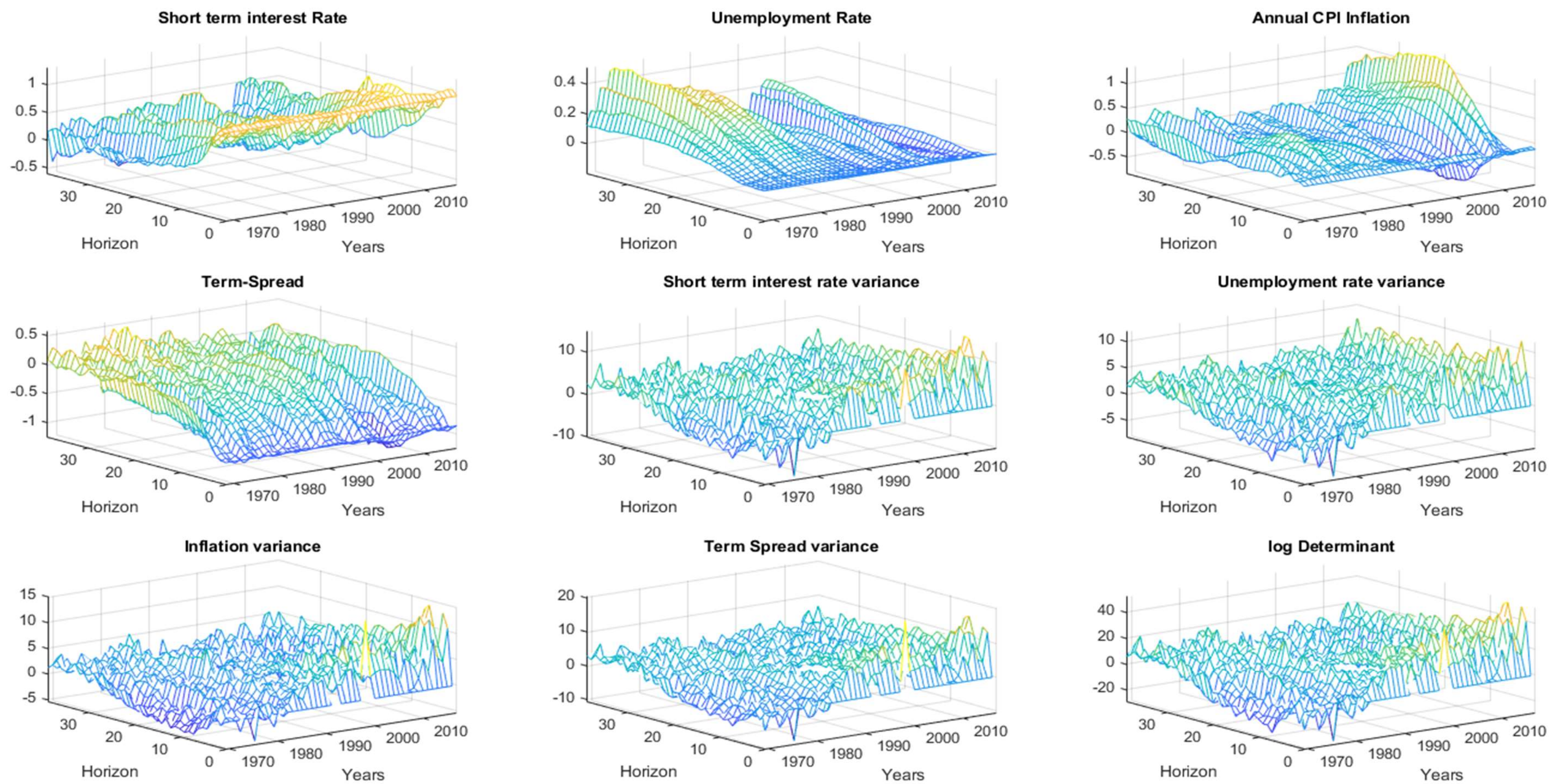
[2] Our results are qualitatively similar when the monetary policy shock is identified based on a recursive (Cholesky) decomposition scheme, with the variables ordered as unemployment rate, inflation, policy rate, and the term-spread. Complete details of these results are available upon request from the authors.

Figure 1: Sign-Restricted IRF Plots from the Constant Parameter VAR Model



Notes: The solid line is the median. The light shaded area is the 68% error band while the dark shaded area is the 90% error band.

Figure 2: Sign-Restricted IRF Plots from the Time-Varying Parameter VAR Model



Notes: Plots correspond to posterior median impulse response. The impulse response is calculated every 12th month in the sample.

4. Conclusion

This study investigates the response of macroeconomic volatility of the UK to an unexpected increase in the monetary policy rate. For this purpose we develop an empirical model that allows us to estimate the response of macroeconomic volatility to a monetary policy shock. The empirical model suggests that a 100 basis points increase in the policy rate causes unemployment and inflation volatility to rise by around 10% on average above its unconditional value, with peaks observed during the global financial and sovereign debt crises, and also in the wake of the Brexit vote. Our results imply that under episodes of heightened uncertainty, loose monetary policy can assist in reviving the economy by not only reducing unemployment in the UK, but by also reducing overall volatility associated with macroeconomic variables.

As part of future research, it would be interesting to extend our study to other developed and emerging markets. Moreover, one could also analyse the role of US monetary policy shocks, given its importance in affecting macroeconomic aggregates around the world (Iacoviello and Navarro, 2019), in impacting uncertainty of other economies over and above domestic monetary policy changes.

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