A Unified Measure of ECB Monetary Policy Shocks. A Proxy-SVAR and Local Projection approach

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01/01/2025

Abstract

This paper extends Chunya Bu, John Rogers, and Wenbin Wu's paper[1], to the Euro area. The methodology leverages a heteroskedasticity-based partial least squares approach and Fama-MacBeth style regressions to create a comprehensive monetary policy shock series. Unlike prior measures, this series is effectively devoid of the central bank information effect, making it more robust for analyzing the macroeconomic transmission of monetary policy. The Proxy-SVAR approach reveals that these monetary policy shocks primarily impact industrial production. Local Projection methods yield consistent results. Further analysis has been made using a measure of uncertainty derived from estimated volatility of the MP series. These findings underscore the robustness and relevance of the proposed methodology for understanding monetary policy dynamics in the Euro area.

1 Introduction

Identifying monetary policy shocks from European Central Bank (ECB) actions has been challenging, especially during the Zero Lower Bound (ZLB) period (2008-2018), when unconventional policies such as forward guidance and asset purchases dominated. Traditional methods often rely on high-frequency changes in bond yields around policy announcements, but these approaches are susceptible to distortions from the central bank information effect, where private economic insights revealed by the ECB confound the interpretation of pure policy shocks. This short paper adopts a novel econometric approach that combines heteroskedasticity-based instrumental variables and partial least squares regressions to estimate monetary policy shocks with greater precision. By filtering out non-policy noise and minimizing the influence of the information effect, this method produces a clean series of shocks and allows for a detailed analysis of their macroeconomic impacts.

I investigate the macroeconomic impacts of monetary policy shocks using a Proxy-SVAR. To complement the results the LP method is employed for cross-validation. The analysis also includes robustness checks with alternative proxy instruments to validate findings. Confidence intervals for IRFs are estimated using advanced codes like Plagborg-Møller's sup-t and

[1] A Unified Measure of Fed Monetary Policy Shocks, Journal of Monetary Economics (2021)

Sidak ones. Additionally, the potential role of uncertainty, modeled through a GARCH-based proxy, is explored.

2 Data

This paper utilizes two unique datasets[2]. The first dataset, constructed entirely from the ECB Data Warehouse, includes yield curves necessary to replicate the BRW[3] monetary policy shock series.

The second dataset, comprising macroeconomic variables, was built using data from Eurostat and the ECB Data Warehouse. All series are monthly, seasonally adjusted, and constructed with a fixed composition reflecting the Euro Area 20 countries as of January 1, 2023. Industrial production excludes the construction sector, while labor costs were interpolated to a monthly frequency (from quarterly wages dataset), reflecting business economy wages. The house price variable summarizes the costs of water, electricity, gas and fuels. Additional variables include the unemployment rate, loan rate, inflation, and the FTSE MIB index. The latter has been excluded from the analysis due to singularity issues in the VAR's Wold representation. The analysis is constraint from October 2004 until October 2024.

3 Methodology

3.1 Fama-MacBeth meets Rigobon-Sack

In this section, we detail the methodology employed to derive the monetary policy (MP) shock series. The process is rooted in the identification of MP shocks using a heteroskedasticity-based instrumental variable (IV) regression framework, inspired by Rigobon and Sack (2003, 2004), and extends this with the Fama-MacBeth two-step procedure for constructing sensitivity coefficients across the yield curve. This approach ensures robust identification of MP shocks while accounting for potential endogeneity and noise contamination in high-frequency financial data.

At the core of this methodology is the identification of monetary policy shocks (e_t), which are unobservable and extracted from changes in bond yields around policy announcement days. These changes are assumed to result from both monetary policy shocks (e_t) and non-policy disturbances (η_t), with the monetary policy shock normalized to have a one-to-one relationship with the 5-year bond yield. By employing a two-step procedure, we first estimate the sensitivity of bond yields to policy shocks and then isolate the common component across maturities, filtering out noise and addressing potential endogeneity [4]. This framework provides a robust and unbiased series of monetary policy shocks that I use for the analysis in the next paragraph.

[2] All materials and replication files are available on my Riccardo Negrisoli Github Repository

[3] Referring to the authors of the original paper

[4] For further details on the construction and the replication files look at the Financial Econometric paper

3.2 Proxy-SVAR and LP methods

The analysis proceeds with the implementation of the Proxy-SVAR and Local Projection (LP) as distinct econometric approaches to estimate impulse response functions (IRFs). Proxy-SVAR estimates a VAR model where an external instrumental variable (proxy) identifies the structural shocks. Economically, this assumes a valid instrument that isolates the shock of interest, enabling the decomposition of reduced-form residuals into structural components. The IRFs in Proxy-SVAR are derived by first estimating by ordinary least squares the VAR(p) process using the Wold representation obtained through the `WoldBoot` function. In this way we end up with the vector of residuals (`res`). These residuals represent the innovations in the system and are linked to the structural shocks via the instrumental variable (Z). The structural shocks are identified by regressing the residuals onto the instrument, computed as:

$$b = (Z'Z)^{-1}Z' \times \text{ res}$$

and normalizing the coefficient vector by scaling it with respect to a chosen variable (e.g., IP in the code). This normalized vector is then used to compute the structural IRFs by multiplying it with the Wold representation of the VAR:

$$\text{MP\_IRFs} = \text{Wold representation\_IRFs } \times b$$

This procedure ensures that the IRFs represent the dynamic effects of the structural shocks on the system's variables over the specified horizon.

In contrast, LP directly estimates IRFs through a sequence of regressions, where values of each variable are regressed on lagged endogenous variables and the instrument. Econometrically, Local Projections do not impose the dynamic structure of a VAR but estimate impulse response functions by directly regressing future values of the dependent variable on the shock of interest and controls. LP is more robust to model misspecification as it does not require a full specification of the underlying data-generating process, but this comes at the cost of potential inefficiency due to estimating separate regressions at each horizon. In contrast, Proxy-SVAR relies on the dynamic consistency of the VAR structure to estimate IRFs, which embeds the entire dynamic system of equations. LP is particularly useful when the VAR assumptions may not hold, isolating horizon-specific effects directly, while Proxy-SVAR emphasizes structural interpretation through a model-driven approach. Both methods aim to estimate dynamic responses, but they differ in their balance of flexibility and structural assumptions.

3.3 Uncertainty measure as a Proxy

In recent literature, researchers have utilized various indexes and proxies to isolate the exogenous component of monetary policy (MP) uncertainty and evaluate its impact on the economy. For example, Husted, Rogers, and Sun (2020) developed an MP uncertainty index, Bekaert, Hoerova, and Lo Duca used the VIX index alongside high-frequency data, and Baker, Bloom, and Davis (2016) created an Economic Policy Uncertainty (EPU) index based on newspaper frequency analysis.

In this study, I employ a GARCH(1,1)-t model to estimate the volatility of MP shocks as a proxy for MP uncertainty. Specifically, the procedure extracts the conditional variance of the MP shock applied to the 2-year yield curve[5]. This approach assumes that the derived series are exogenous, allowing the variance to reflect the market's perceived uncertainty related specifically to MP shocks, providing a direct measure of their economic influence. The GARCH-t specification is sensible to outliers but still seems to fit the data[6]. The Uncertainty measure is used as a proxy to analyze its effect on the economy.

4 Evidence on the ECB shock series

The empirical findings derived from the Proxy-SVAR and LP models reveal similar but distinguishable dynamics of economic variables in response to structural shocks. As shown in Figure 1, the Proxy-SVAR model (left panel) produces smoother and more stable IRFs, reflecting a well-identified and consistent dynamic relationship across variables. Since the IRFs are normalized with respect to Industrial production the interpretation is that the MP shock easing causing an increase of 1% (at time 0) in IP does not cause any other relevant effects on the variables taken into account[7].

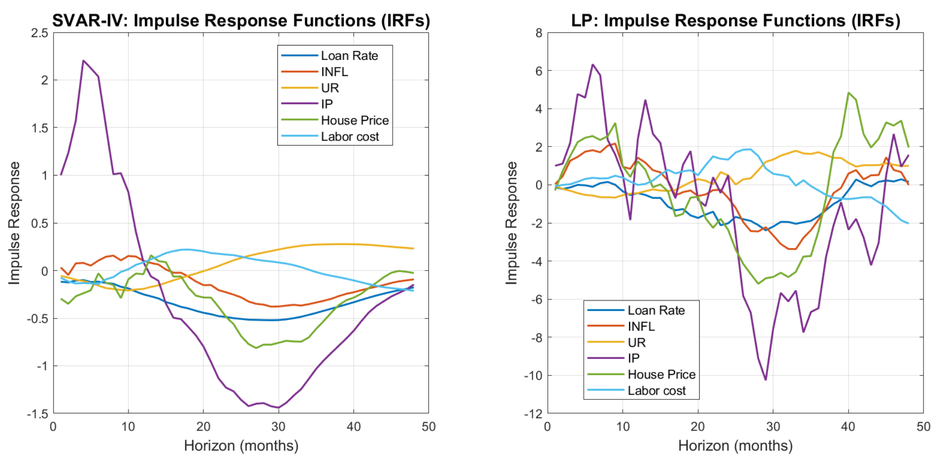


Figure 1: Comparison of IRFs from Proxy-SVAR (left panel) and LP (right panel). Horizon is 48 months and IRFs are scaled by IP.

In contrast, the LP model (right panel) generates IRFs that are more volatile and display larger magnitudes. For instance, IP exhibits significantly higher peaks and sharper reversals, while house prices also show larger swings. These differences suggest that the LP model, while flexible, may introduce overfitting or sensitivity to specification choices. The interpretation of the right panel is the same as in the Proxy-SVAR. Here house prices seem to be affected positively in the medium-short run and negatively in the long run by the MP shock.

[5]The uncertainty has been estimated in the Financial Econometrics code. The series has been transformed into monthly and added to the MacroData(set) used for the Proxy-SVAR and LP

[6]The Ljung-Box test on the standardized residuals has been implemented

[7]The robustness and accuracy of the results will be discussed in the next section

Finally, Figure 2 presents the IRFs when monetary policy uncertainty, derived from a GARCH(1,1)-t model, is used as the shock. Here, the dynamics shift significantly, with house prices experiencing a sharp initial decline, reflecting heightened sensitivity to uncertainty. Inflation, unemployment rate, loan rate and labor costs demonstrate muted responses compared to the Proxy-SVAR specification. These differences underscore the distinct economic effects of policy uncertainty versus direct policy shocks.

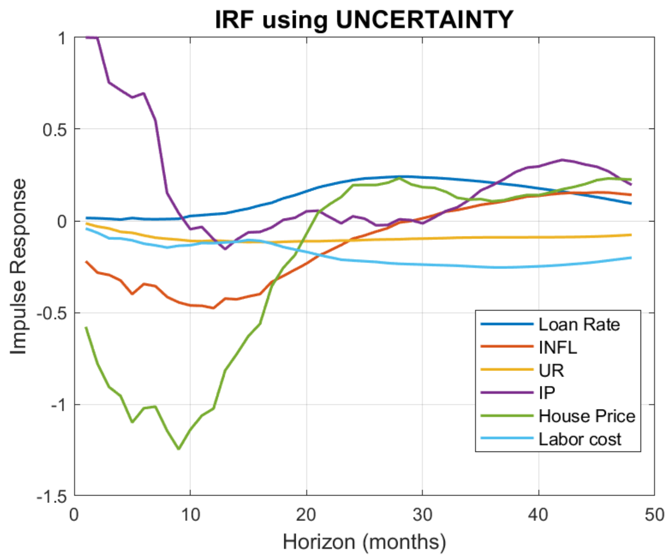


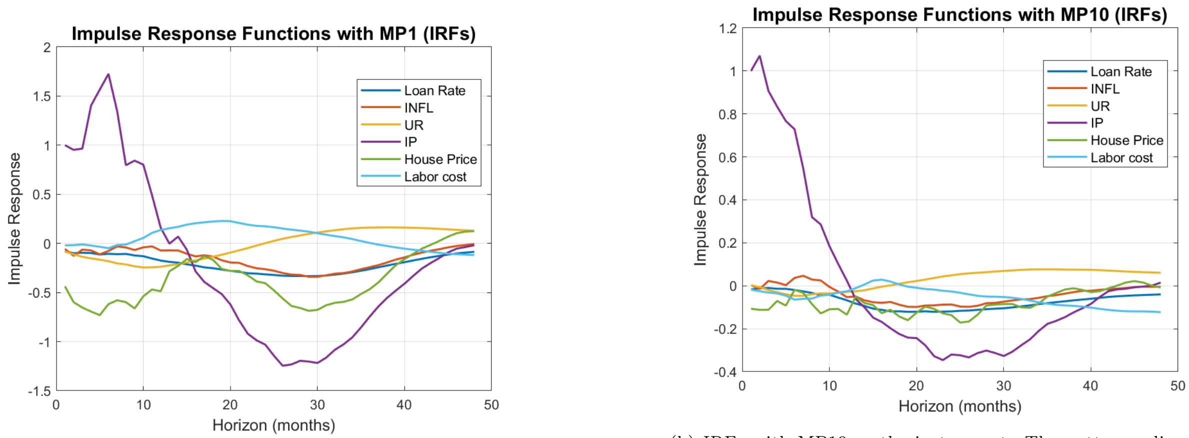
Figure 2: IRFs using monetary policy uncertainty as the instrument. The responses highlight the differential impact of uncertainty on economic variables over the horizon.

Together, these findings highlight the importance of methodological choice in interpreting the dynamics of economic variables in response to shocks. Overall both Proxy-SVAR and LP produce similar directional responses. What differs the most is the persistency and the magnitude of the IRFs.

5 Robustness Checks

The robustness checks reveal several important findings regarding the consistency of the results. Unfortunately, the correlation between the MP series and its U.S. counterpart is only 0.19 using the 30-year yield curve and 0.11 using shorter period yield curves excluding months with no official announcements from the FED or ECB. The correlation should be higher to be able to ensure a correct procedure in deriving the MP shocks in the correct way. This is probably why the responses of the MP shock onto inflation and unemployment are weak and insignificant.

To prove robustness of the monetary economics application I implemented the Proxy-SVAR using different proxies and also confidence interval bands. Figure 3a and Figure 3b examine the IRFs using different monetary policy proxies, MP1 and MP10, respectively. These proxies are built using the same approach described in the previous section, this time using 1 or 10-year yield curves. Both exhibit broadly consistent patterns in the impulse responses across variables, for example, the MP shock induces a sharp response of industrial production in the first months consistently followed by a significant contraction, indicating the robustness of this result to alternative policy instruments.



(a) IRFs with MP1 as the instrument. The responses remain consistent with key dynamics observed across other MP measures.

(b) IRFs with MP10 as the instrument. The patterns align with those seen using MP1, showcasing robustness across different maturities.

Figure 3: Impulse Response Functions (IRFs) using different monetary policy instruments.

The Local Projection (LP) approach and the use of uncertainty as an alternative instrument further support the robustness of the findings. Both methods produce IRFs that capture broadly similar dynamics, although with some differences in magnitude and variance. These results suggest that the core dynamics identified are not overly dependent on the specific econometric framework or choice of instrument.

Finally I used Plagborg Moller codes to compute the Proxy SVAR with bands. Figure 4 highlights the confidence intervals only for industrial production which is the only one exhibiting statistically significant responses within the bands, underscoring its role as the most sensitive indicator to monetary policy shocks. This finding aligns with theoretical expectations, given IP's direct connection to economic activity. Conversely to my results, here the response is positive both in the short and in the long run.

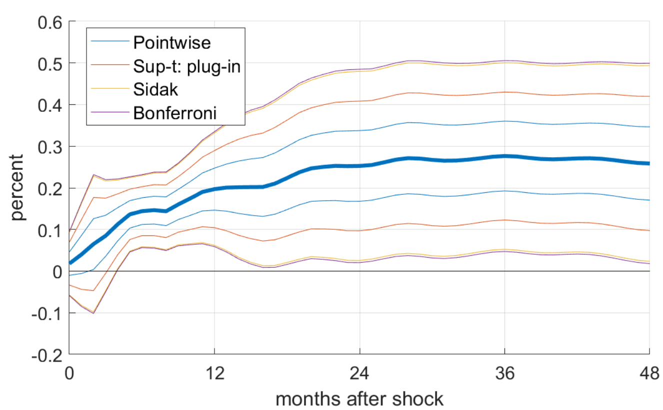


Figure 4: Confidence bands for Proxy-SVAR IRF of IP. Sup-t bands, derived using plug-in techniques and bootstrapping, provide robust inference for the entire IRF trajectory, Sidak bands offer a balance by adjusting for multiple comparisons under an independence assumption, and Bonferroni bands provide the most conservative adjustments at the cost of wider intervals.

6 Conclusion

The analysis provides critical insights into the dynamic effects of monetary policy shocks on key macroeconomic variables, leveraging both Proxy-SVAR and Local Projection (LP) methodologies. The results emphasize the importance of methodological choice, with Proxy-SVAR demonstrating smoother and more stable impulse response functions compared to the more volatile and sensitivity-prone LP approach. Robustness checks confirm the reliability of the findings across different monetary policy instruments and uncertainty measures. Notably, industrial production consistently emerges as the most responsive variable to monetary policy shocks, with statistically significant responses.

Future research could expand the use of more identification strategies and bring the bias–variance trade-off in impulse response estimation to the attention of applied ECB researchers [8] .

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