Unemployment level and the non-linear effects of monetary policy in Poland - supplementary material

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Extending the sample period and mitigating the influence of extreme outliers

As discussed in subsection 3.4 of the paper, we conduct a robustness check in which our sample is extended to include years 2020-2024. This period, however, is marked with extreme outliers associated with the COVID-19 pandemic and the Russian invasion of Ukraine.

To address this issue, we applied an extension of the method developed by Lenza and Primiceri (2022), also employed in the work of Eo and Morley (2023), with modifications to accommodate two distinct periods characterized by extreme outliers. Specifically, we assumed that the vector $\{s_t\}_{t=1}^{T}$, which is used to scale the residuals for the outlier periods, takes the following form:

$$s_t = \begin{cases} 1 & \text{for } 1 \leq t < \bar{t} \\ \bar{s}_j & \text{for } t = \bar{t} + j, \text{ where } j \in \left\{0, 1, ..., \bar{j} - 1\right\} \\ 1 + \left(\bar{s}_{\bar{j}-1} - 1\right) \cdot (\bar{\rho})^{t-(\bar{t}+\bar{j}-1)} & \text{for } \bar{t} + \bar{j} \leq t < \tilde{t} \\ \tilde{s}_k + \left(\bar{s}_{\bar{j}-1} - 1\right) \cdot (\bar{\rho})^{t-(\bar{t}+\bar{j}-1)} & \text{for } t = \tilde{t} + k, \text{ where } k \in \left\{0, 1, ..., \tilde{k} - 1\right\} \\ 1 + \left(\bar{s}_{\bar{j}-1} - 1\right) \cdot (\bar{\rho})^{t-(\bar{t}+\bar{j}-1)} + \left(\tilde{s}_{\tilde{k}-1} - 1\right) \cdot (\tilde{\rho})^{t-(\tilde{t}+\tilde{k}-1)} & \text{for } \tilde{t} + \tilde{k} \leq t \leq T. \end{cases}$$

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Here, $\bar{t}$ ($\tilde{t}$) denotes the starting point of the COVID-19 pandemic (the inflation surge associated with the Russian invasion of Ukraine). The parameters $\bar{j}$ and $\tilde{k}$ represent the lengths of the respective periods characterized by extreme outliers, which are scaled using the vectors $\{\bar{s}_j\}_{j=0}^{\bar{j}-1}$ and $\{\tilde{s}_k\}_{k=0}^{\tilde{k}-1}$, respectively. In our computations, we set $\bar{j} = 3$ and $\tilde{k} = 3$ but we also experimented with various other combinations. The results appear robust to these alternative specifications. Finally, $\bar{\rho}$ and $\tilde{\rho}$ denote the corresponding decay rates.

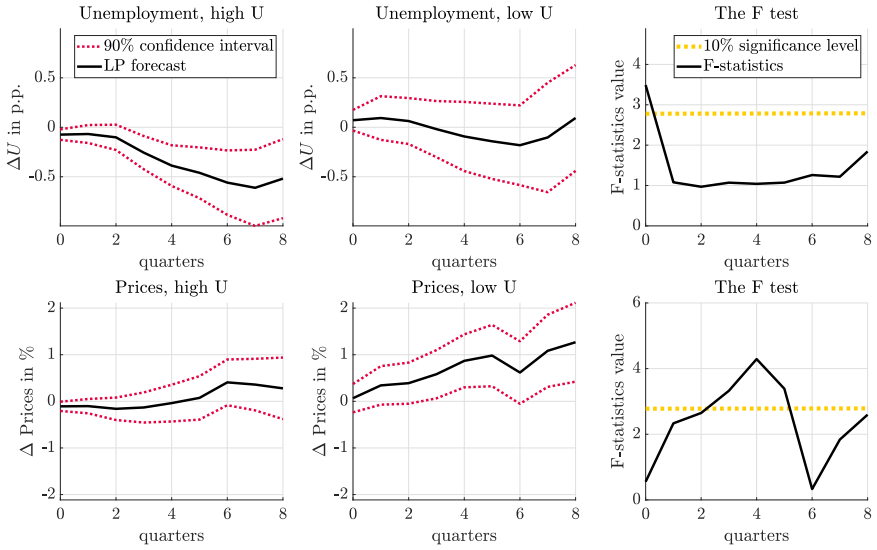
It is worth noting that while Lenza and Primiceri (2022) primarily illustrate their approach using a VAR model estimated within a Bayesian framework, they also propose a frequentist version of their outlier-adjustment method. We adopt this frequentist approach to estimate the vector of parameters:

$$\Theta = \left[\{\bar{s}_j\}_{j=0}^{\bar{j}-1}, \bar{\rho}, \{\tilde{s}_k\}_{k=0}^{\tilde{k}-1}, \tilde{\rho}\right]$$

together with the remaining model parameters from the baseline estimation, i.e., the vector $\left\{\alpha_j^l, \beta_j^l, \gamma_j^l\right\}$, where $j = 0, ..., 8$ and $l \in \{L, H\}$.

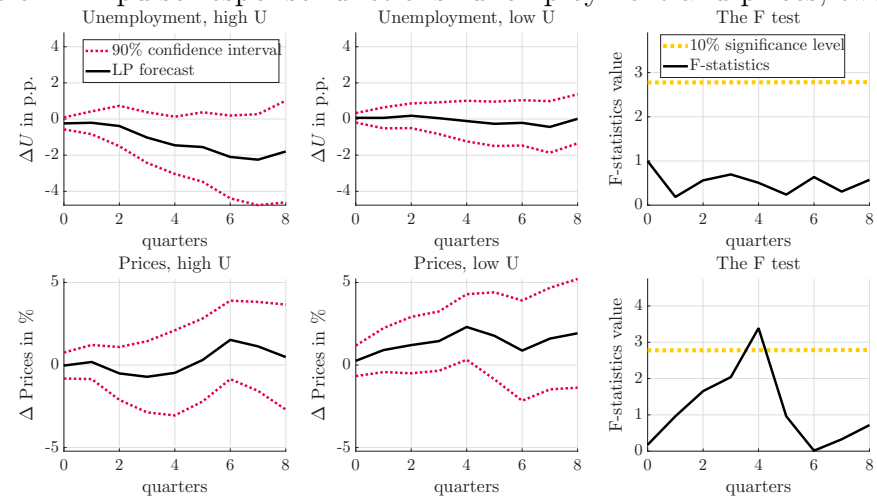
Additional figures

Figure 1: Impulse response functions: unemployment and prices, alternative standardization of the monetary policy shock size



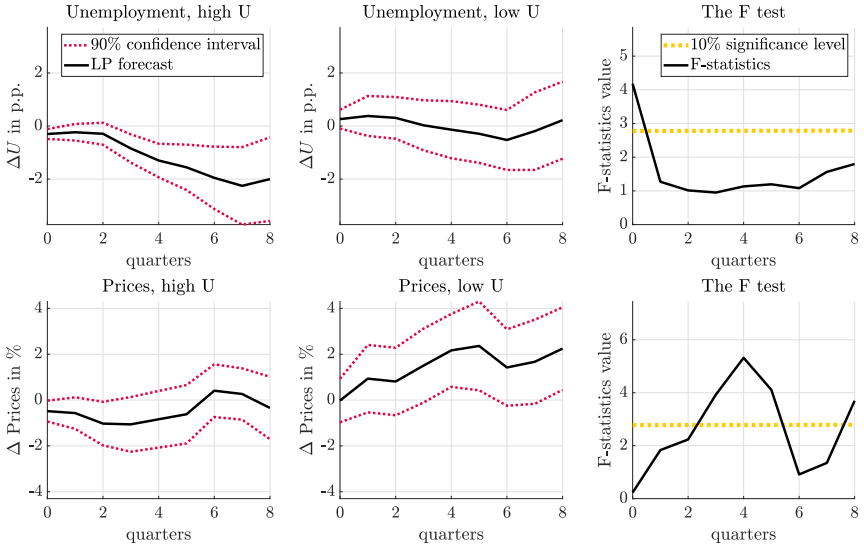
Notes: The first two columns show the impulse responses to a monetary policy shock that decreases the short-term interest rate by one standard deviation in the high- and low-unemployment regime, respectively. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

Figure 2: Impulse response functions: unemployment and prices, two lags



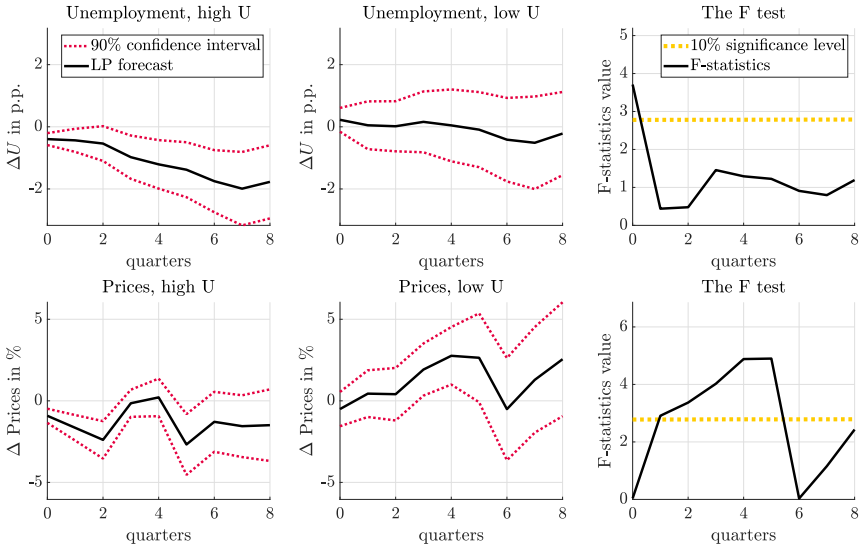
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

Figure 3: Impulse response functions: unemployment and prices, linear detrending



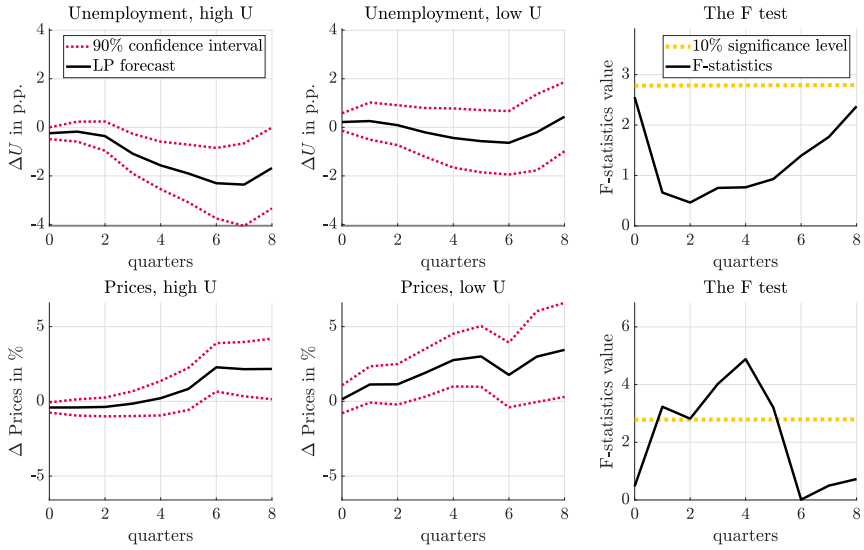
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero. The control variables (REER, VIX, EA output and the unemployment rate in the model for inflation) are detrended using a linear trend.

Figure 4: Impulse response functions: unemployment and prices, data detrended with the HP filter with breaks



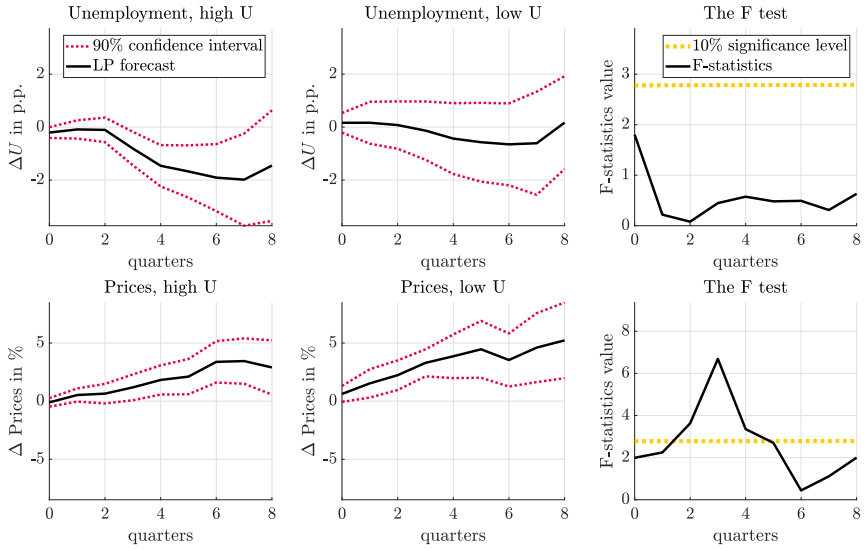
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero. The control variables (REER, VIX, EA output and the unemployment rate in the model for inflation) are detrended using the HP filter with sturcutral breaks developed by Maranzano and Pelagatti (2025).

Figure 5: Impulse response functions: unemployment and prices, data detrended with the one-sided HP filter



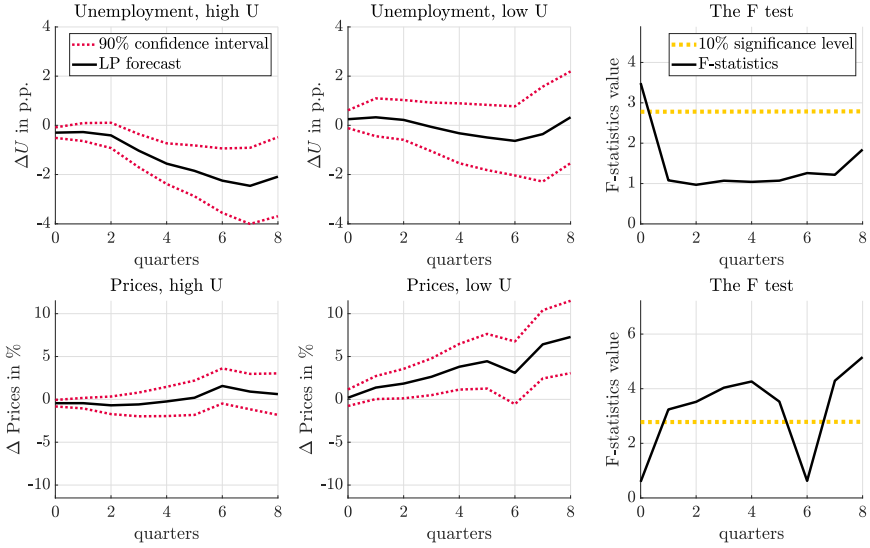
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero. The control variables (REER, VIX, EA output and the unemployment rate in the model for inflation) are detrended using the one-sided HP filter.

Figure 6: Impulse response functions: unemployment and prices, oil prices as a control variable



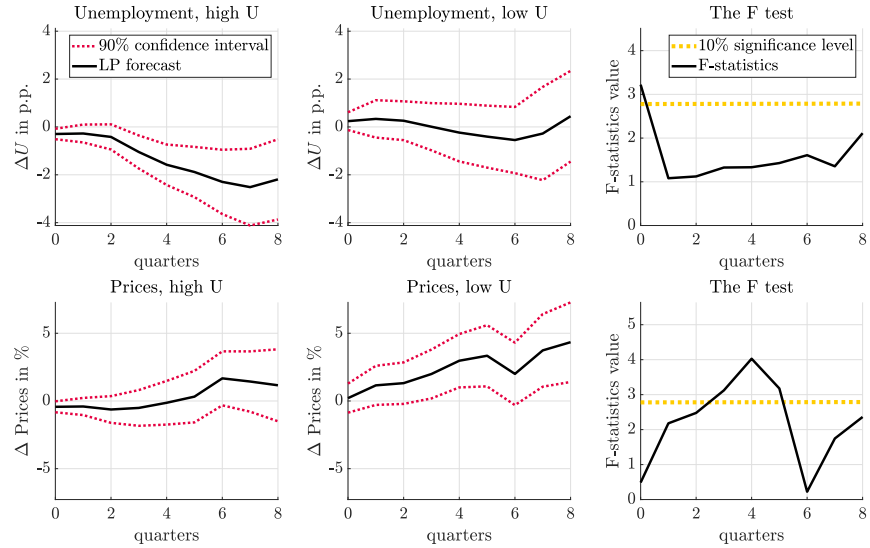
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero. The set of control variables additionally includes the quarterly changes in log oil prices.

Figure 7: Impulse response functions: unemployment and prices, level of unemployment as a control variable in the model for inflation



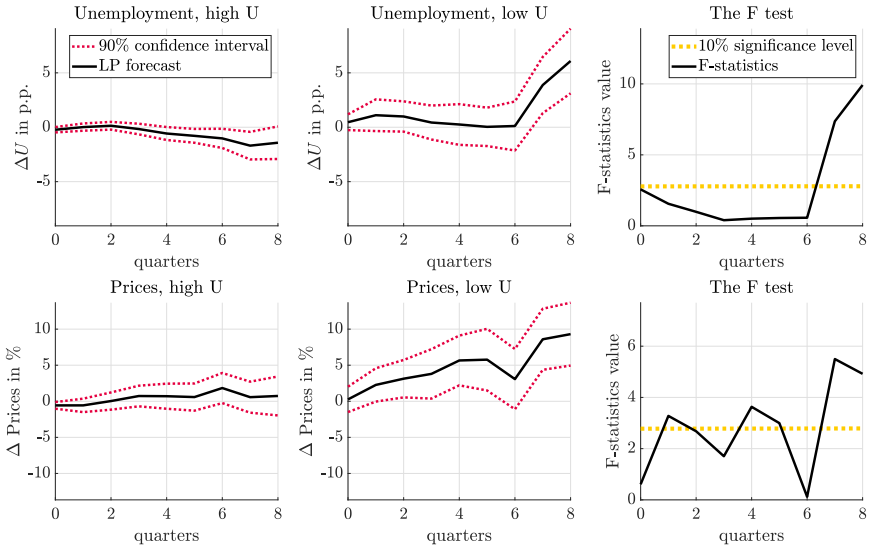
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero. The set of control variables in the model for inflation includes the level of the unemployment rate instead of the HP-detrended unemployment rate.

Figure 8: Impulse response functions: unemployment and prices, regional state-dependent trends



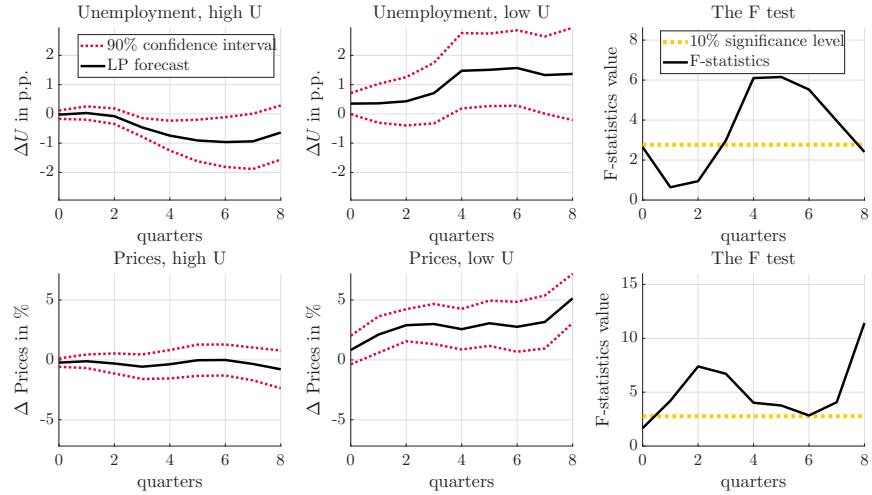
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

Figure 9: Impulse response functions: unemployment and prices, unit-level parameters c_i and $\sigma_{u,i}$



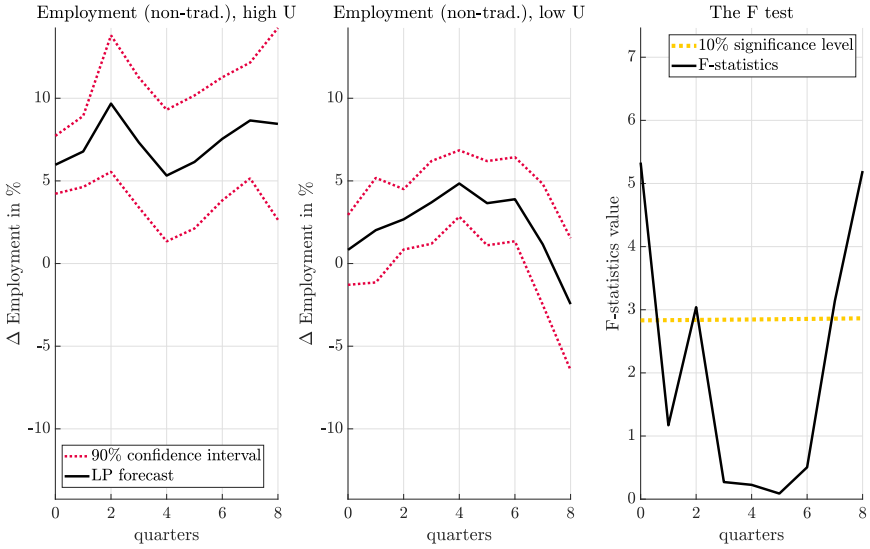
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

Figure 10: Impulse response functions: unemployment and prices, sample: Q1 2001 - Q4 2024



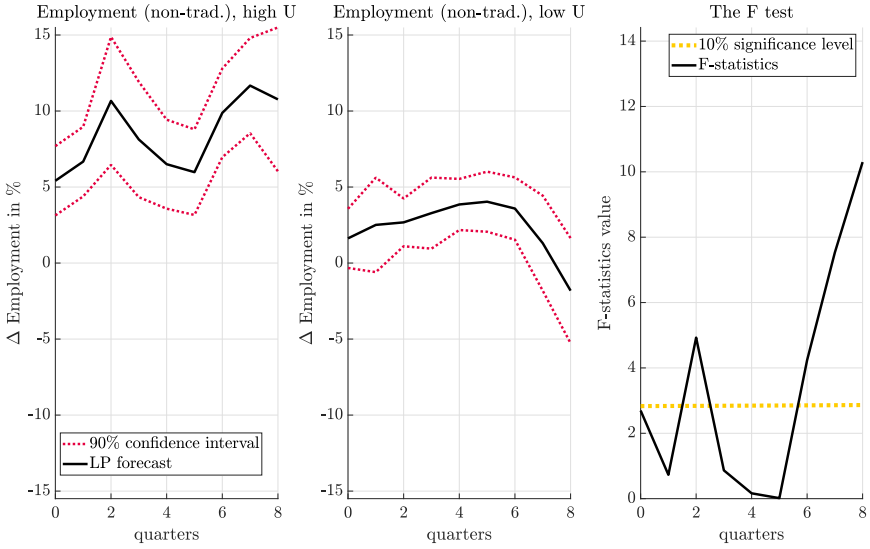
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero. The estimation is conducted using the method developed by Lenza and Primiceri (2022) to address the problem of extreme outliers related to the COVID-10 pandemic and the high-inflation periods.

Figure 11: Impulse response functions: employment in non-tradable sectors, excluding specialized construction activities



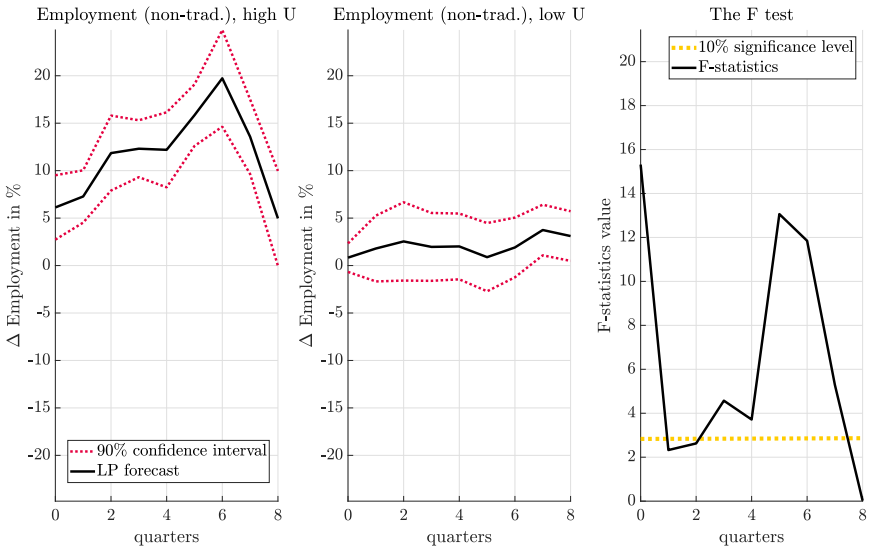
Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

Figure 12: Impulse response functions: employment in non-tradable sectors, excluding accommodation and food service activities



Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

Figure 13: Impulse response functions: employment in non-tradable sectors, excluding administrative and support service activities



Notes: The first two columns show the impulse response to a monetary policy shock that decreases the short-term interest rate by 1 percentage point on impact. The standard errors are calculated using the Driscoll-Kraay method. The third column shows F-statistics testing the hypothesis that the difference between the coefficients under high and low unemployment is zero.

References

Eo, Y. and Morley, J. (2023). Does the survey of professional forecasters help predict the shape of recessions in real time? *Economics Letters*, 233(C):None.

Lenza, M. and Primiceri, G. E. (2022). How to estimate a vector autoregression after march 2020. *Journal of Applied Econometrics*, 37(4):688–699.

Maranzano, P. and Pelagatti, M. (2025). A hodrick - prescott filter with automatically selected breaks. *Economic Modelling*, 150(C):107132.