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

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Usual disclaimer applies

Motivation

Firms' reaction to positive demand shocks according to standard textobook intuition:

- hiring new workers when unemployment is high
- an upward adjustment of prices when hiring new workers is hard (low unemployment)

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Consequences for the effects of monetary policy shocks:

- larger adjustments in quantities when unemployment is high than during periods of low unemployment
- price adjustments are more likely to be substantial when resources in the economy are scarce

What we do?

Q: What is the impact of labor market slack on monetary policy transmission in Poland?

- Workhorse
  - local projections based on Jorda (2005)
  - panel: $N = 16$ voivodships, 2001q1-2019q4
  - exogenous monetary policy shocks based on Kapuściński (2023)
  - state dependence (high vs. low unemployment)
- State-dependent effects of monetary policy
  - unemployment
  - prices
- An alternative explanation/additional support for our finding
  - different types of monetary policy shocks under high/low unemployment
  - differences in the responses of employment in tradable and non-tradable sectors
  - retail sales as an alternative measure of economic slack

Literature

State-dependent effects of monetary policy: Weise (1999), Peersman and Smets (2002), Lo and Piger (2005), Tenreyro and Thwaites (2016), Burgard et al. (2019), Jorda et al. (2020), Alpanda et al. (2021)

State-dependent effects of fiscal policy: Auerbach and Gorodnichenko (2012), Owyang et al. (2013), Michaillat (2014), Ramey and Zubairy (2018)

High-frequency identification of MP shocks: Bagliano and Favero (1999), Kuttner (2001), Gürkaynak et al. (2005), Altavilla et al. (2019), Swanson (2021), Kapuściński (2023), Kightley and Suda (2023), Kolasa et al. (2025)

Non-linear Phillips curves: Benigno and Eggertsson (2023), Cerrato and Gitti (2023), Benigno and Eggertsson (2024), Karadi et al. (2024)

Phillips curves and SOE: Borio and Filardo (2007), Szafranek (2017), Łyziak (2019)

Non-linear monetary policy effects in Poland: Bielecki et al. [2025], Kopiec [2025]

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Estimated equation

$$y_{i,t+j} - y_{i,t-1} = \delta_{ij} + F\left(u_{i,t-1}\right) \cdot \left(\alpha_j^H + \beta_j^H \cdot \epsilon_t + \gamma_j^H \cdot x_{i,t}\right)$$
$$+ \left(1 - F\left(u_{i,t-1}\right)\right) \cdot \left(\alpha_j^L + \beta_j^L \cdot \epsilon_t + \gamma_j^L \cdot x_{i,t}\right) + \xi_{i,t}$$

where:

- $y_{i,t}$ - registered unemployment rate / log CPI
- δ_{ij} - voivodship-level fixed effect (trend)
- α_j^H / α_j^L- country-level trends
- ϵ_t - monetary policy shock, high-frequency data identification by Kapuściński (2023)
- $x_{i,t}$ - controls:
  - 4 lags of quarterly changes in unemployment rate / quarterly CPI inflation
  - 4 lags of quarterly CPI inflation / HP-filtered unemployemnt rate
  - 4 lags of short-term interest rate
  - 4 lags of HP-filtered REER
  - contemporaneous and 4 lags of HP-filtered EA GDP
  - contemporaneous and 4 lags of HP-filtered VIX

Function of the unemployment level

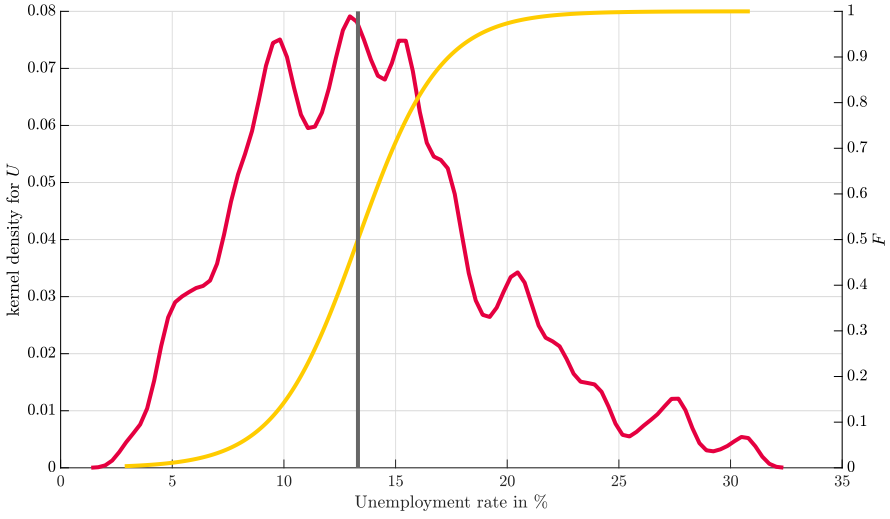
$F\left(u_{i,t}\right)$ - logistic function (like in Tenreyro and Thwaites (2016)):

$$F\left(u_{i,t}\right) = \frac{exp\left(\theta \frac{u_{i,t}-c}{\sigma_u}\right)}{1 + exp\left(\theta \frac{u_{i,t}-c}{\sigma_u}\right)}$$

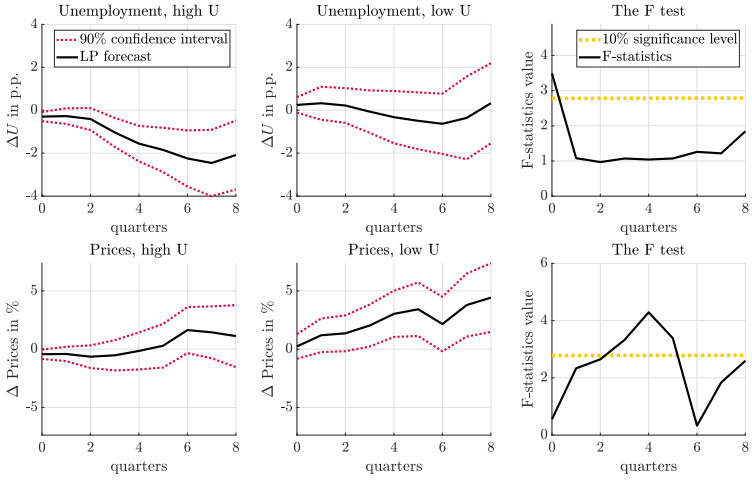
where:

- θ: governs the pace at which a unit switches from high to low unemployment ($\theta = 3$ in the baseline)
- c: determines the location of the function (c - median $u_{i,t}$ in the baseline)
- σ_u : denotes the standard deviation of $u_{i,t}$

Function of the unemployment level



Main result


Unemployment, high U
90% confidence interval
LP forecast
ΔU in p.p.
quarters
Unemployment, low U
ΔU in p.p.
quarters
The F test
10% significance level
F-statistics
F-statistics value
quarters
Prices, high U
Δ Prices in %
quarters
Prices, low U
Δ Prices in %
quarters
The F test
F-statistics value
quarters

Robustness of the main result

- Number of lags: details
- Detrending: details
- Different controls: details
- Regional state-dependent trends α_{ij}^{H} and α_{ij}^{L}: details
- Unit-specific values c_i and $\sigma_{u,i}$: details
- Longer sample (2001-2024): details
- Estimated parameters of the F function: details

Addressing an alternative explanation for our finding

Finding: the effects of monetary policy depend on the unemployment level

Alternative explanation: different distribution of monetary shocks across unemployment regimes

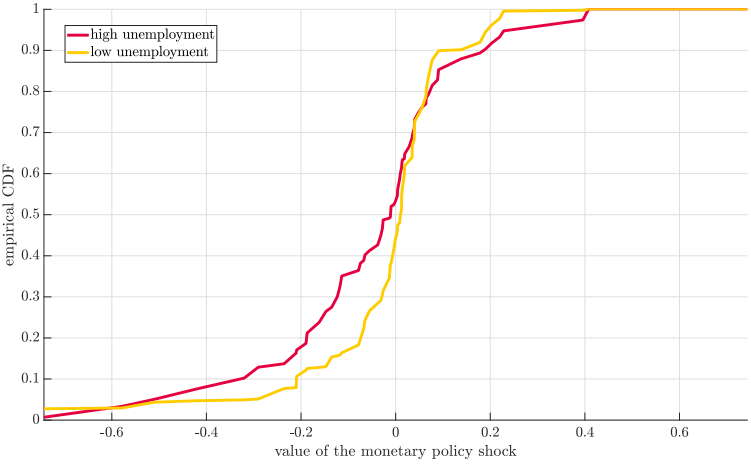
- Positive shocks might be more common when unemployment is low
- Positive shocks might affect prices more than negative shocks
- Positive shocks might affect unemployment less than negative shocks

Alternative explanation: different distribution of monetary shocks across unemployment regimes

- **Q:** Are distributions of monetary shocks in the high/low unemployment regime different?

- To check this, we use the Kolmogorov-Smirnov test
- We cannot reject the hypothesis that the distributions of monetary shocks in both unemployment regimes are identical (p-value: 0.22)

Alternative explanation: CDFs of shocks in two regimes



Additional evidence supporting our finding

- **Finding:** the effects of monetary policy depend on the unemployment level
- **Q:** How to additionally support this claim?

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- **Four premises:**
  - monetary policy shock can be classified as a demand shock
  - $\Delta E_t \propto -\Delta U_t$
  - non-tradable employment relies heavily on local demand (see Mian and Sufi (2014))
  - the local unemployment level is an important factor influencing household demand at the voivodeship level

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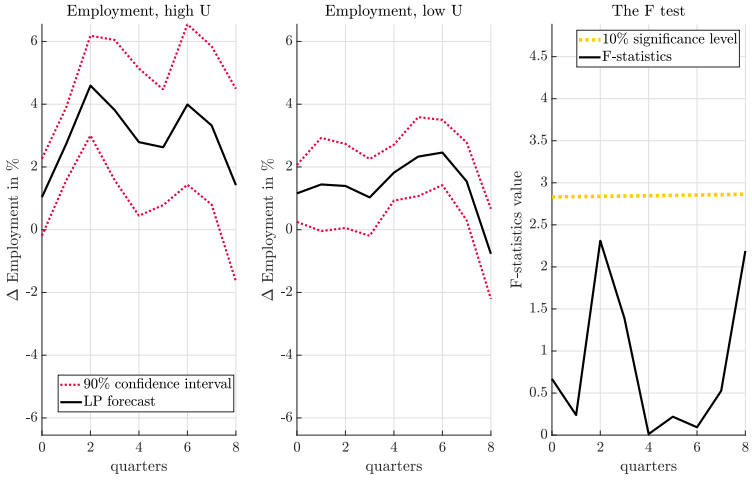
  - non-tradable employment relies heavily on local demand (see Mian and Sufi (2014))
  - the local unemployment level is an important factor influencing household demand at the voivodeship level
- **Thus:** if our main result holds, then the difference in the response of non-tradable employment to monetary policy shocks between periods of high and low unemployment should be larger than the corresponding difference for tradable employment

Additional evidence supporting our finding

- Local projections for employment in tradable and nontradable sectors
- Dependent variable: (log) number of employed persons in the enterprise sector:
  - tradable: industry
  - non-tradable: construction of buildings + specialised construction activities + retail sales + accomodation and food service activities + real estate activities + administrative and support service activities
  - time span: 2008q2-2019q4
  - specification analogous to the model for the unemployment rate

Additional evidence supporting our finding



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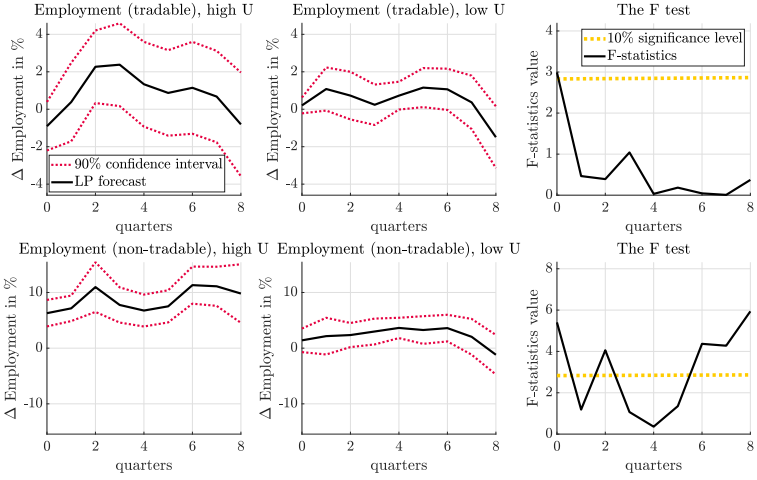


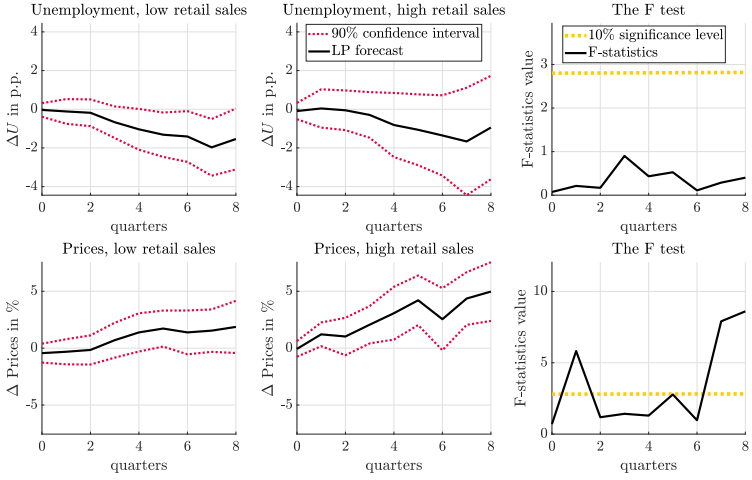
Robustness of additional evidence

- Excluding specialised construction activities: details
- Excluding accomodation and food service activities: details
- Excluding administrative and support service activities: details

Retail sales as an alternative measure of economic slack

- **Finding:** the effects of monetary policy depend on the unemployment level
- **Q:** Are the findings robust to a change in the measure of economic slack?
  - We verify this by replacing the lagged voivodship-level unemployment rates with lagged HP-filtered voivodship-level retail sales as the argument of the regime-switching function F.

Retail sales as an alternative measure of economic slack



Summary

- Exploration: the relationship between labor market slack and monetary policy transmission in Poland
- Econometric framework:
  - local projections
  - panel structure
  - state dependence
- Results: voivodship-level responses of unemployment and prices
- Conclusions:
  - the effects of monetary policy in Poland seem to feature state dependence
  - the patterns of state-dependence are in line with economic intuition
  - statistical significance of outcomes is more apparent in the case of prices

The end

THANK YOU FOR YOUR ATTENTION!

References

Alpanda, S., Granziera, E., and Zubairy, S. (2021). State dependence of monetary policy across business, credit and interest rate cycles. *European Economic Review*, 140(C).

Altavilla, C., Brugnolini, L., Gürkaynak, R. S., Motto, R., and Ragusa, G. (2019). Measuring euro area monetary policy. *Journal of Monetary Economics*, 108(C):162–179.

Auerbach, A. J. and Gorodnichenko, Y. (2012). Measuring the Output Responses to Fiscal Policy. *American Economic Journal: Economic Policy*, 4(2):1–27.

Bagliano, F. C. and Favero, C. A. (1999). Information from financial markets and var measures of monetary policy. *European Economic Review*, 43(4):825–837.

References ii

Benigno, P. and Eggertsson, G. B. (2023). It is Baaack: The Surge in Inflation in the 2020s and the Return of the Non-Linear Phillips Curve. NBER Working Papers 31197, National Bureau of Economic Research, Inc.

Benigno, P. and Eggertsson, G. B. (2024). The Slanted-L Phillips Curve. NBER Working Papers 32172, National Bureau of Economic Research, Inc.

Borio, C. E. V. and Filardo, A. (2007). Globalisation and inflation: New cross-country evidence on the global determinants of domestic inflation. BIS Working Papers 227, Bank for International Settlements.

Burgard, J. P., Neuenkirch, M., and Noeckel, M. (2019). State-Dependent Transmission of Monetary Policy in the Euro Area. *Journal of Money, Credit and Banking*, 51(7):2053–2070.

Cerrato, A. and Gitti, G. (2023). Inflation Since COVID: Demand or Supply. mimeo.

References iii

Gürkaynak, R. S., Sack, B., and Swanson, E. (2005). Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking*, 1(1).

Jorda, O. (2005). Estimation and inference of impulse responses by local projections. *American Economic Review*, 95(1):161â182.

Jorda, O., Schularick, M., and Taylor, A. M. (2020). The effects of quasi-random monetary experiments. *Journal of Monetary Economics*, 112(C):22–40.

Kapuściński, M. (2023). Updated estimates of the role of the bank lending channel in monetary policy transmission in Poland. NBP Working Papers 359, Narodowy Bank Polski.

Karadi, P., Nakov, A., Barrau, G. N., Pasten, E., and Thaler, D. (2024). Strike while the iron is hot: optimal monetary policy with a nonlinear Phillips curve. BIS Working Papers 1203, Bank for International Settlements.

References iv

Kightley, M. and Suda, J. (2023). The impact of monetary policy on employment in Poland through the lens of disaggregated data. In for International Settlements, B., editor, *Inflation and labour markets*, volume 127 of *BIS Papers chapters*, pages 251–263. Bank for International Settlements.

Kolasa, M., Walerych, M., and Wesołowski, G. (2025). Monetary-fiscal interactions during large-scale asset purchase programs. mimeo, Narodowy Bank Polski.

Kuttner, K. (2001). Monetary policy surprises and interest rates: Evidence from the fed funds futures market. *Journal of Monetary Economics*, 47(3):523–544.

Lo, M. C. and Piger, J. (2005). Is the Response of Output to Monetary Policy Asymmetric? Evidence from a Regime-Switching Coefficients Model. *Journal of Money, Credit and Banking*, 37(5):865–886.

Łyziak, T. (2019). Do global output gaps help forecast domestic inflation? Evidence from Phillips curves for Poland. *International Journal of Forecasting*, 35:1032–1041.

References v

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

Mian, A. and Sufi, A. (2014). What Explains the 2007–2009 Drop in Employment? *Econometrica*, 82:2197–2223.

Michaillat, P. (2014). A Theory of Countercyclical Government Multiplier. *American Economic Journal: Macroeconomics*, 6(1):190–217.

Owyang, M. T., Ramey, V. A., and Zubairy, S. (2013). Are Government Spending Multipliers Greater during Periods of Slack? Evidence from Twentieth-Century Historical Data. *American Economic Review*, 103(3):129–134.

Peersman, G. and Smets, F. (2002). *Are the effects of monetary policy in the euro area greater in recessions than in booms?* Monetary Transmission in Diverse Economies. Cambridge University Press.

Ramey, V. A. and Zubairy, S. (2018). Government Spending Multipliers in Good Times and in Bad: Evidence from US Historical Data. *Journal of Political Economy*, 126(2):850–901.

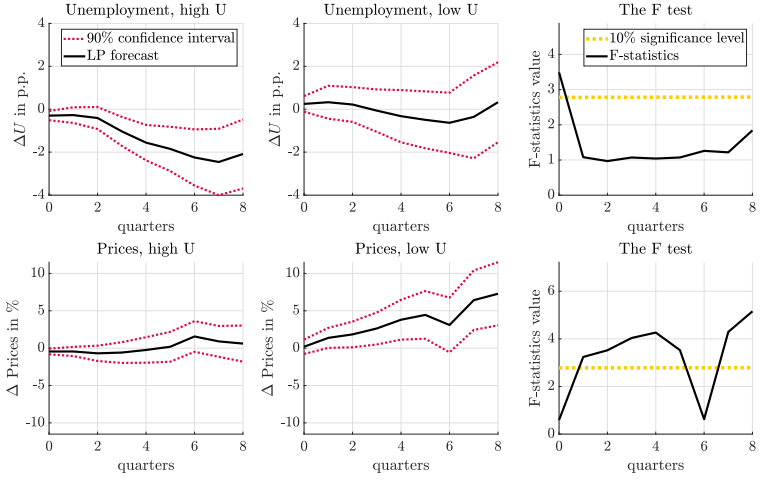
Swanson, E. T. (2021). Measuring the effects of federal reserve forward guidance and asset purchases on financial markets. *Journal of Monetary Economics*, 118(C):32–53.

Szafranek, K. (2017). Flattening of the New Keynesian Phillips curve: Evidence for an emerging, small open economy. *Economic Modelling*, 63(C):334–348.

Tenreyro, S. and Thwaites, G. (2016). Pushing on a String: US Monetary Policy Is Less Powerful in Recessions. *American Economic Journal: Macroeconomics*, 8(4):43–74.

Weise, C. L. (1999). The Asymmetric Effects of Monetary Policy: A Nonlinear Vector Autoregression Approach. *Journal of Money, Credit and Banking*, 31(1):85–108.

Robustness: two lags



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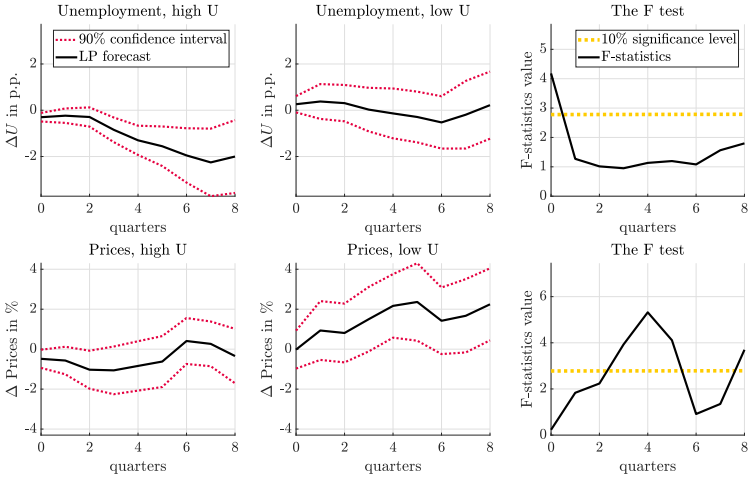
Robustness: linear detrending



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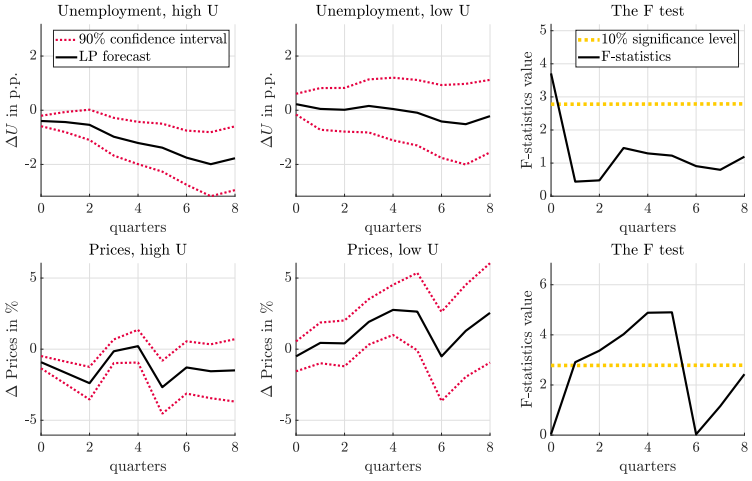
Robustness: HP filter with structural breaks by Maranzano and Pelagatti (2025)



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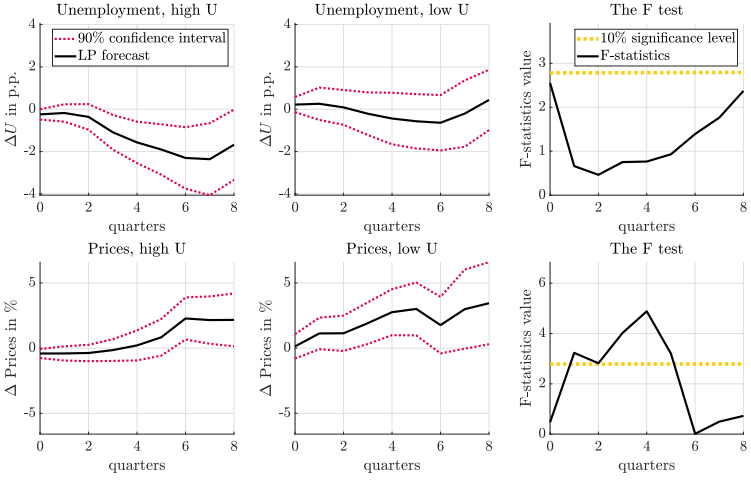
Robustness: one-sided HP filter



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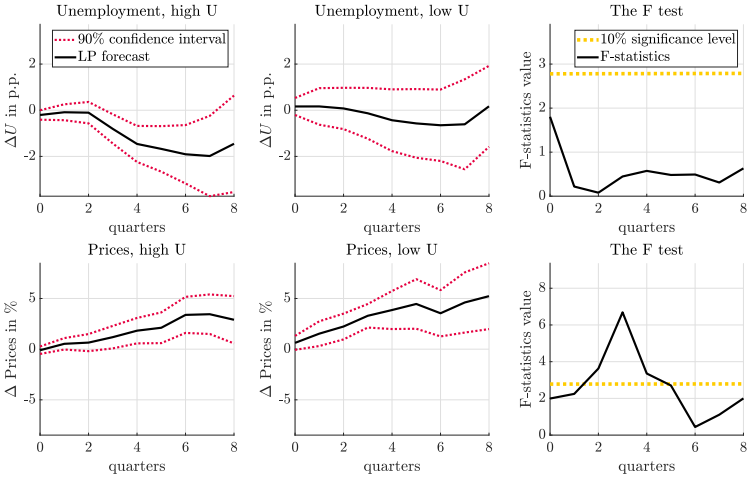
Robustness: controlling for oil prices



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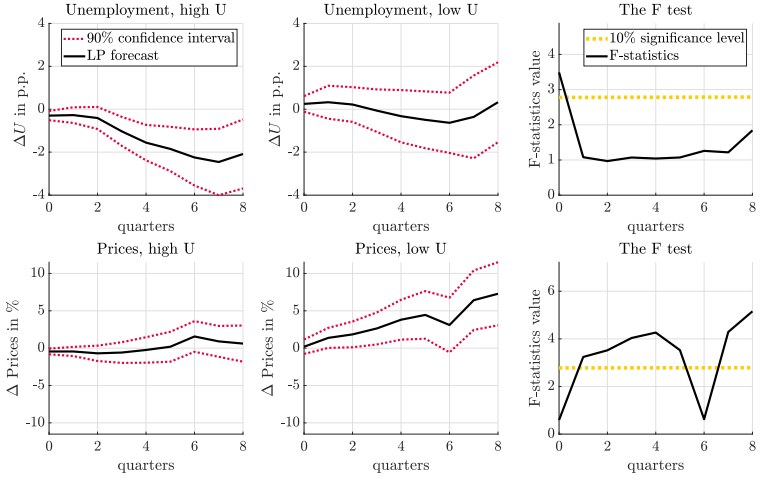
Robustness: level of unemployment as a control in LP for prices



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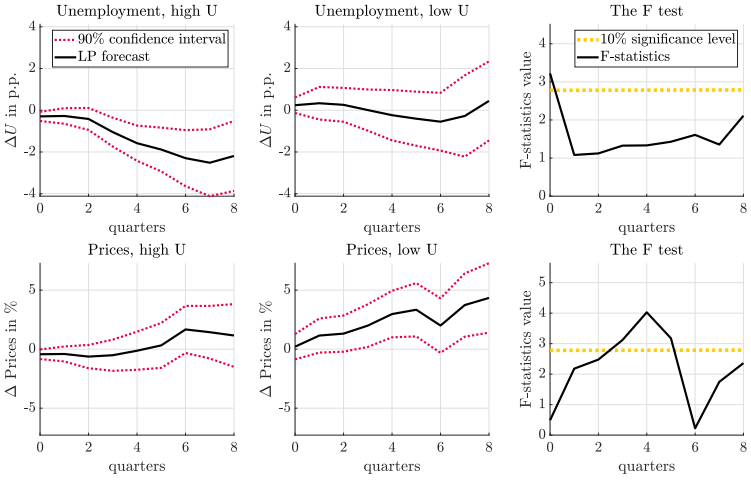
Robustness: regional state-dependent trends α_{ij}^H and α_{ij}^L



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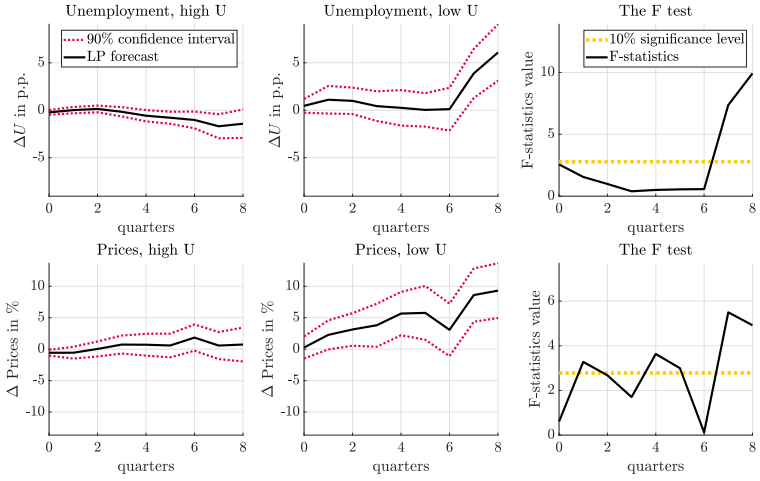
Robustness: unit-specific values c_i and $\sigma_{u,i}$



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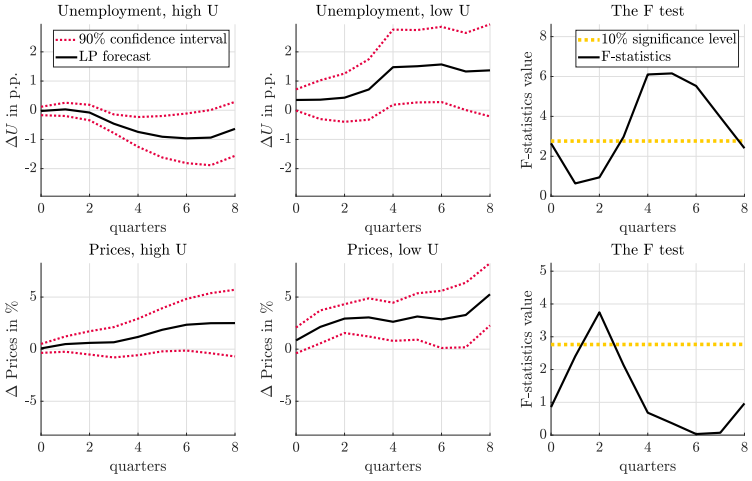
Robustness: sample 2001-2024



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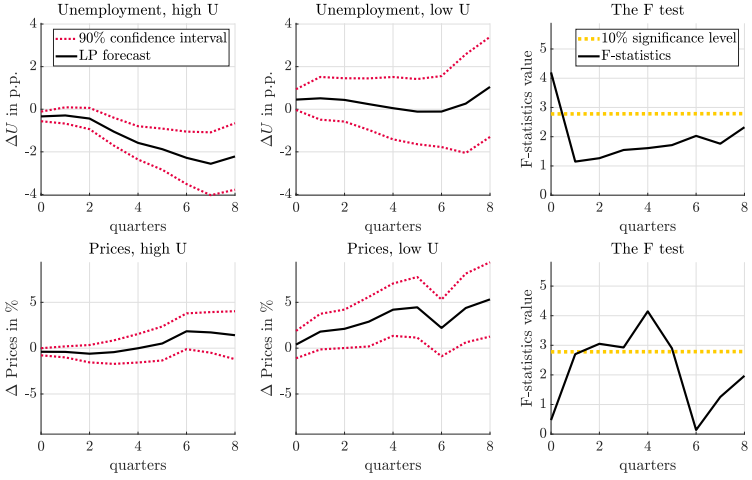
Robustness: estimated parameters of the F function



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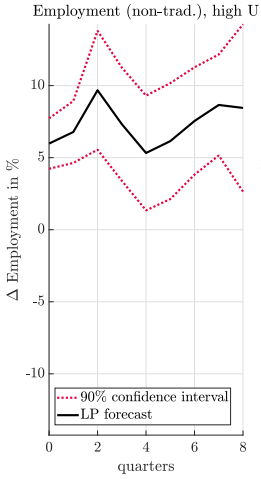
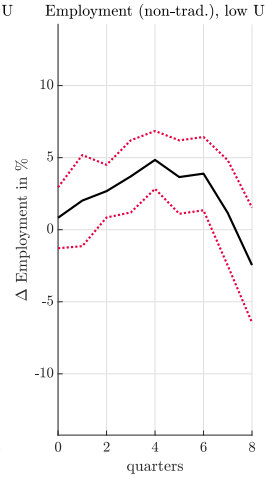
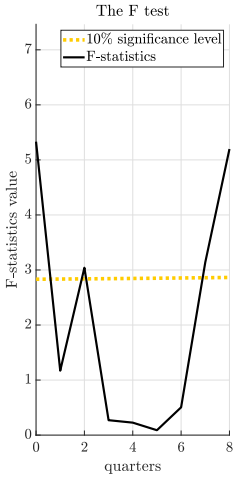
Robustness: excluding specialised construction activities







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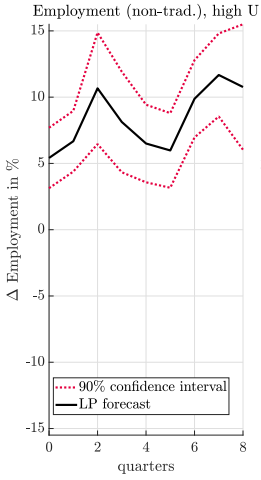
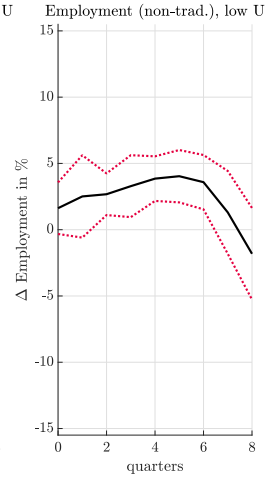
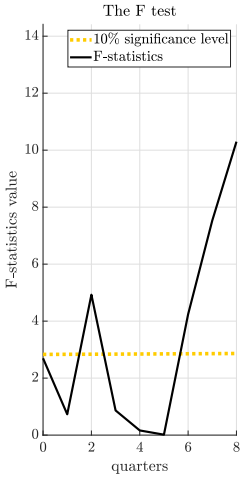
Robustness: excluding accomodation and food service activities







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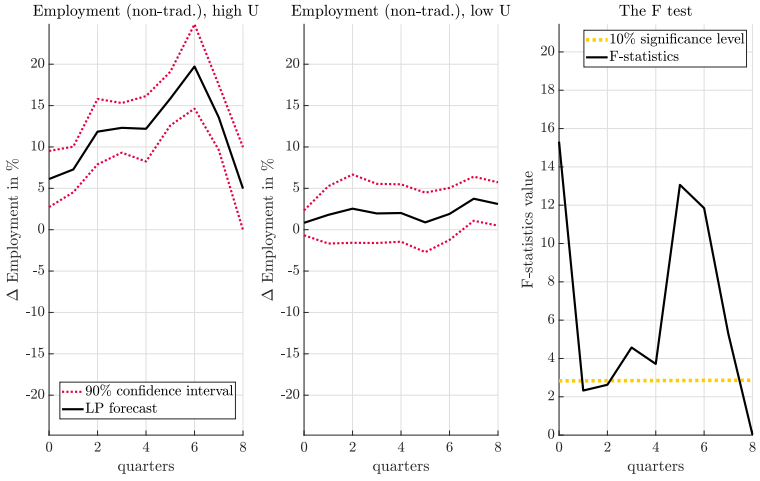
Robustness: excluding administrative and support service activities



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