

Non-linear effects of monetary policy shocks on housing: evidence from a CESEE country

Carlos Cañizares Martínez¹, Alicia Aguilar², Adriana Lojschová³

¹ RCEA

² Banco de España

³ National Bank of Slovakia

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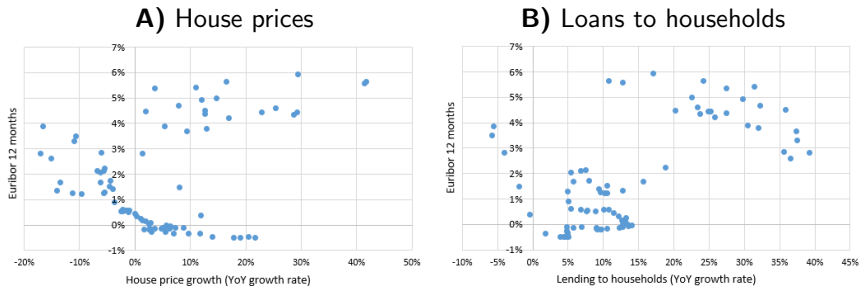
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- ▶ Results for Slovakia may be relevant for **other CESEE countries**.
- ▶ **Anecdotal evidence** suggest that the relationship between interest rates and housing variables may exhibit non-linearities (see Figure 1).

Motivation (cont.)

Figure 1: Euribor 12 m. versus house prices and loans to households, Slovakia.



Notes: House prices and loans to households are in year-on-year quarterly growth rates. The sample spans from 2003 Q1 to 2023 Q2.

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▶ Main results:

- ▶ Yes, the effects of standard monetary policy shocks on Slovak housing exhibit non-linearities across different states of economic growth, interest rates and HICP inflation.
- ▶ Standard monetary policy in Slovakia is less powerful in states characterized by low economic growth, low interest rates and high inflation.

Relationship with the literature

- 1 **Theoretical channels** that have been suggested to rationalize nonlinear effects of standard monetary policy:
 - ▶ Economic growth (Bernanke et al., 1996; Alpanda et al., 2021).
 - ▶ Interest rates (Dieckelmann et al., 2023; Borio and Hofmann, 2017).
 - ▶ Inflation (Alvarez and Lippi, 2020; Sims, 2010; Benigno and Eggertsson, 2023).
- 2 **Empirical** papers that assess non-linearities in the **effects** of monetary policy shocks:
 - ▶ Economic growth (Tenreyro and Thwaites, 2016; Alpanda et al., 2021; De Santis and Tornese, 2024; Jordà et al., 2020; Burgard et al., 2019; Garcia and Schaller, 2002; Weise, 1999; Peersman and Smets, 2002).
 - ▶ Interest rates (Dieckelmann et al., 2023; Ahmed et al., 2024; Borio and Hofmann, 2017; Cao et al., 2023; Battistini et al., 2022).
 - ▶ Inflation (Ascari and Haber, 2022; Canova and Forero, 2024; Gargiulo et al., 2024).

Modeling framework

► **Smooth transition local projection model** (Tenreyro, Thwaites, 16').

We analyze the response of output variable y_t such that:

$$y_{t+h} = \tau t + F(z_t)(\alpha_h^b + \beta_h^b \epsilon_t + \gamma^{b'} x_t) + (1 - F(z_t))(\alpha_h^b + \beta_h^b \epsilon_t + \gamma^{b'} x_t) + u_t \quad (1)$$

where β_h^b is our coefficient of interest.

$F(z_t)$ is a logistic function that depends on the state of the economy z_t :

$$F(z_t) = \frac{\exp\left(\theta \frac{(z_t - c)}{\sigma_z}\right)}{1 + \exp\left(\theta \frac{(z_t - c)}{\sigma_z}\right)} \quad (2)$$

where:

θ = speed of transition switch across states.

c = proportion of time spent in either state.

σ_z = standard deviation of the state variable z .

Characteristics of the Slovak housing market

- ▶ **Privatization** of housing assets in the 90s (CESEE transition).
- ▶ Joined the **Eurozone** in 2009.

Table 1: Structural differences across euro area housing sectors.

	DE	FR	IT	ES	SK
Housing tenure					
Owner-occupied accommodation (%) ^a	44	57	73	80	87
Rented accommodation (%) ^a	56	43	18	14	8
Housing finance					
Owner with mortgage (%) ^b	18	23	11	26	19
Share of adjustable-rate mortgages (%) ^c	11	2	24	36	2
Business environment					
Building permits (days) ^d	128	189	213	172	300

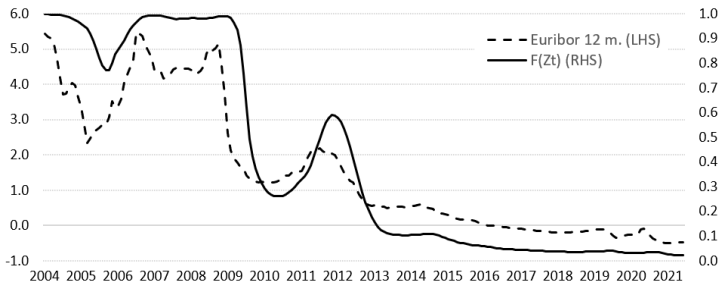
Source: ECB Statistical Data Warehouse, [WB, 2020](#), [Muellbauer, 2022](#) and [OECD, 2022](#). This table builds on [Cañizares Martínez, 2024](#) and [Cañizares Martínez et al., 2023](#). ^a = average 1999-2019, ^b = 2020, ^c = average 2019-2020, ^d = average 2006-2020.

Empirical specification

- ▶ **Model:** Smooth transition local projection ([Tenreyro, Thwaites, 16'](#)).
- ▶ **Monthly** data.
- ▶ **Policy rate:** Euribor 12 months.
- ▶ **Slovak macro variables:** industrial production, HICP price index, business investment, private consumption, loans to NFCs, loans to households, house prices, housing investment, housing starts, compensation per employee, households savings ratio and employees.
- ▶ **Standard monetary policy shock proxy:** 1-month OIS rate changes around the press release window (EA-MPD of [Altavilla et al., 2019](#)).

Non-linearity: high vs low interest rates

Figure 2: State variable (Euribor 12 months) and regime changes.

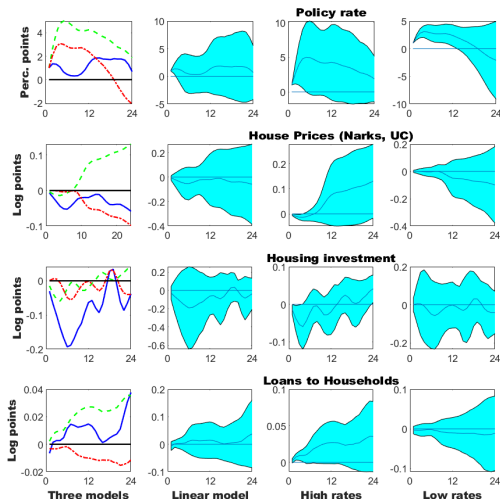


Notes: $F(Z_t)$ refers to the probability of being in the high interest rate state.

- ▶ State variable: **Euribor 12 months**, 7-month moving average, no lags.
- ▶ Low state: lowest 64% (about a 2% Euribor 12 months).
- ▶ Intensity of regime switching $\theta = 3$.

Non-linearity: high vs low interest rates (cont.)

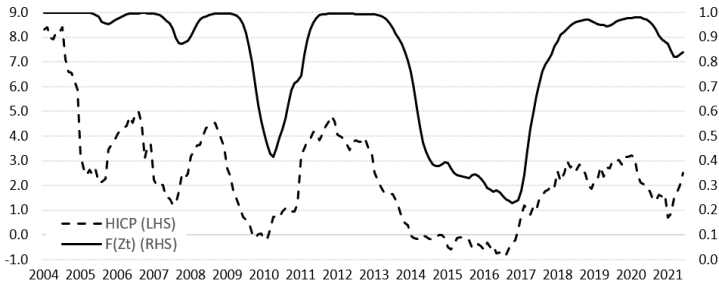
Figure 3: IRFs to a monetary policy shock (+100 bp)



+ IRFs

Non-linearity: high vs low inflation

Figure 4: State variable (HICP inflation) and regime changes.

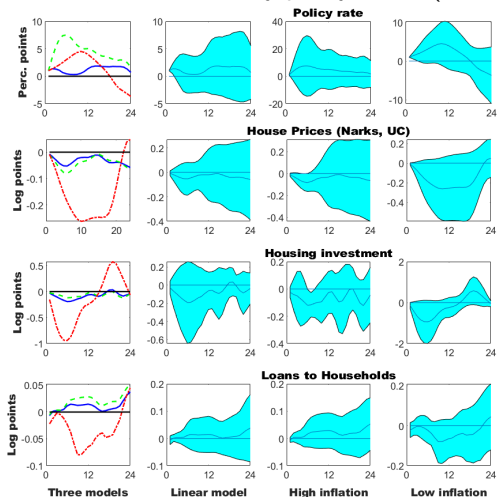


Notes: $F(Z_t)$ refers to the probability of being in the high inflation state.

- ▶ State variable: **HICP inflation** (YoY), 7-month moving average, no lags.
- ▶ Low state: worst 19% (about a 0% HICP inflation).
- ▶ Intensity of regime switching $\theta = 3$.

Non-linearity: high vs low inflation (cont.)

Figure 5: IRFs to a monetary policy shock (+100 bp)



+ IRFs

Rationalizing results (without a DSGE model)

- ▶ Very **low housing supply** starting point.
- ▶ **Slow housing construction**.
- ▶ **High** proportion of **fixed-rates mortgages**.
- ▶ Policy rates lower than **neutral interest rates** in Slovakia.
- ▶ **Low productivity** of firms.
- ▶ Different **credit supply** to firms versus households: Increases in interest rates may make borrowing to firms relatively less appealing for banks than borrowing to households, given:
 - ▶ Low productivity of firms.
 - ▶ Low indebtedness of households.
 - ▶ Strong collateral (house price growth).

Conclusions

- ▶ In this study we explore three **asymmetries** in the impact of **standard monetary policy** shocks in **Slovakia**, with a focus on the housing sector: high versus low economic growth, interest rates, and inflation.
- ① The reaction of house prices and housing investment during periods of economic growth, high rates and high inflation is only **contractionary** in the **very short run**.

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- ② During **recessions** and a **low interest rates** state, monetary policy has **muted effects** on house prices and housing investment.

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- ② During **recessions** and a **low interest rates** state, monetary policy has **muted effects** on house prices and housing investment.
- ③ Monetary policy is **less powerful** during **high inflation** regime.
- ④ **Loans to households expands** after a monetary policy shocks during **expansions** and **high interest rates** states.

Thanks for your attention

Q&A

- ▶ Did you find **similar results** working with data from your respective countries?
- ▶ How are **neutral interest rates** in your country of interest compared to policy rates?
- ▶ Which **macro models** do you think might be useful to rationalize our results?

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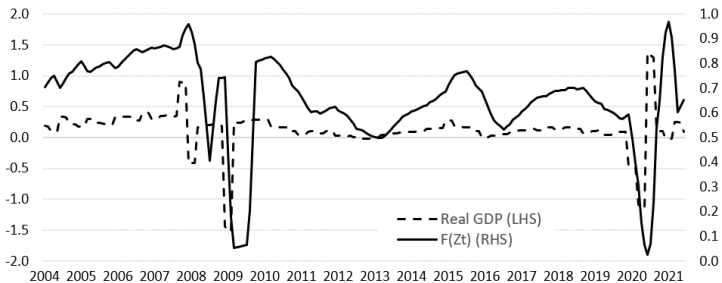
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Data

- ▶ **Slovak macro data**, from January 2003 to June 2023, in real terms (deflated with the private consumption deflator).
- ▶ **Monthly** frequency (quarterly variables converted to monthly frequency using [Chow and Lin, 1971](#)).
- ▶ **Empirical specifications** include:
 - ▶ Policy rate: Euribor 12 months.
 - ▶ Macro variables: industrial production, HICP price index, business investment, private consumption, loans to NFCs, loans to households, house prices, housing investment, housing starts, compensation per employee, households savings ratio and employees.
- ▶ **Standard monetary policy shock proxy**: 1-month OIS rate changes around the press release window (EA-MPD of [Altavilla et al., 2019](#)).

Non-linearity: high vs low real GDP growth

Figure 6: State variable (real GDP growth) and regime changes.

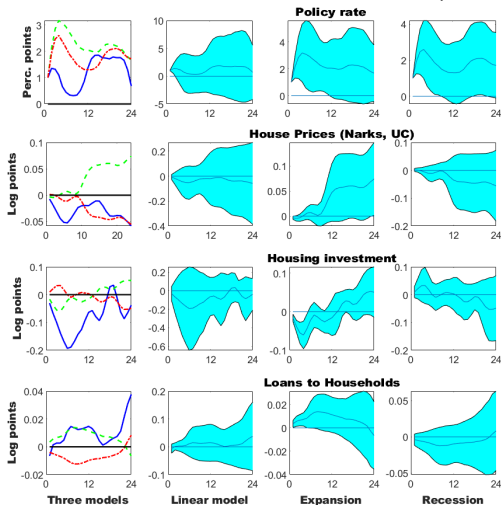


Notes: $F(Z_t)$ refers to the probability of being in the high real GDP growth state.

- ▶ State variable: Real GDP growth, 7-month moving average, no lags.
- ▶ Low state: lowest 9% (about a 0% real GDP growth).
- ▶ Intensity of regime switching $\theta = 1$.

Non-linearity: high vs low real GDP growth (cont.)

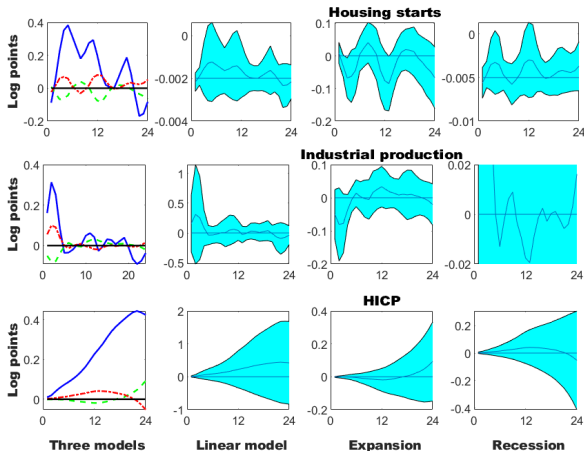
Figure 7: IRFs to a monetary policy shock (+100 bp)



+ IRFs

Appendix A: Additional IRFs non-linearity GDP

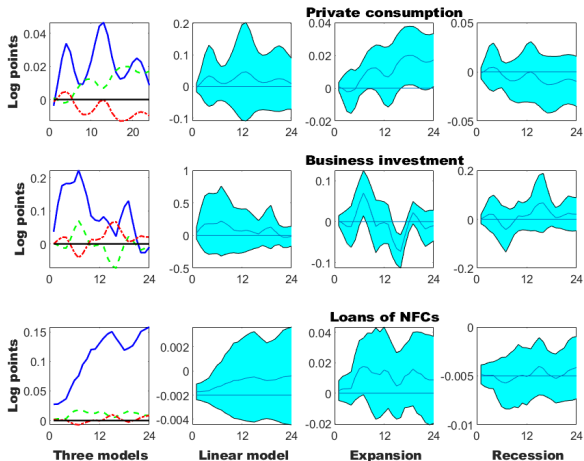
Figure 8: IRFs to a monetary policy shock (+100 bp)



◀ Main IRFs

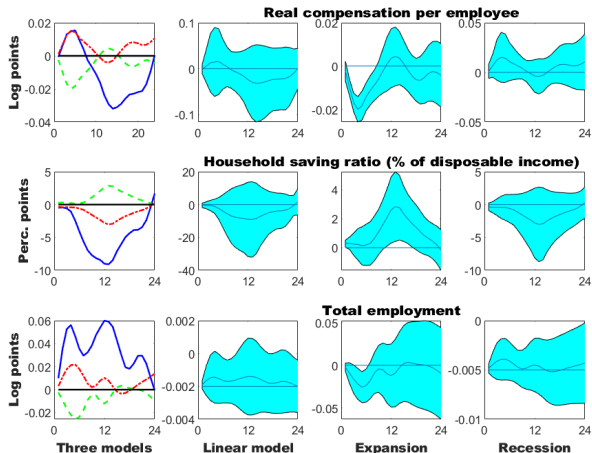
Appendix A: Additional IRFs non-linearity GDP (cont.)

Figure 8 (cont.): IRFs to a monetary policy shock (+100 bp)



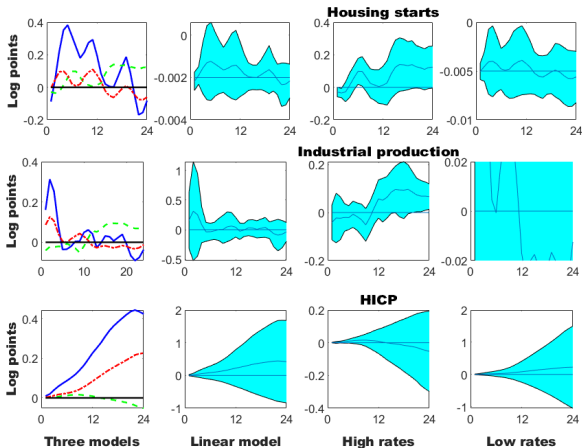
Appendix A: Additional IRFs non-linearity GDP (cont.)

Figure 8 (cont.): IRFs to a monetary policy shock (+100 bp)



Appendix B: Additional IRFs non-linearity Euribor

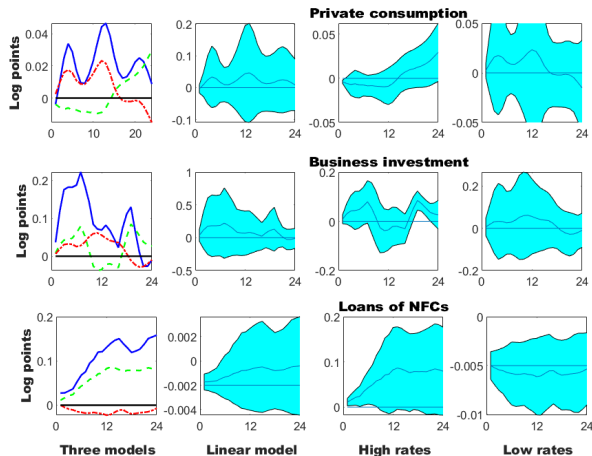
Figure 9: IRFs to a monetary policy shock (+100 bp)



◀ Main IRFs

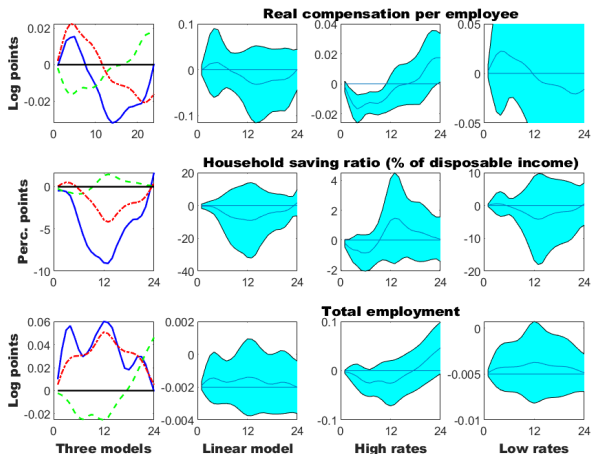
Appendix B: Additional IRFs non-linearity Euribor (cont.)

Figure 9 (cont.): IRFs to a monetary policy shock (+100 bp)



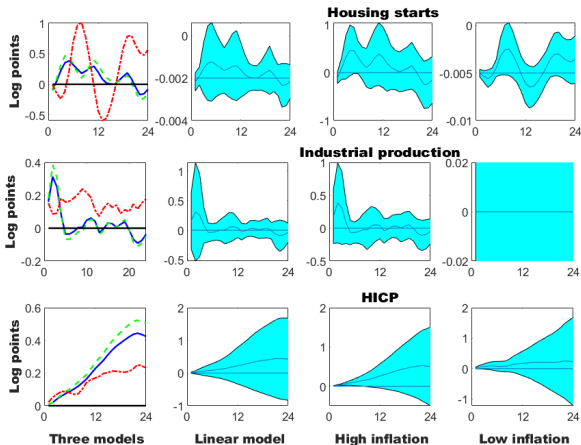
Appendix B: Additional IRFs non-linearity Euribor (cont.)

Figure 9 (cont.): IRFs to a monetary policy shock (+100 bp)



Appendix C: Additional IRFs non-linearity inflation

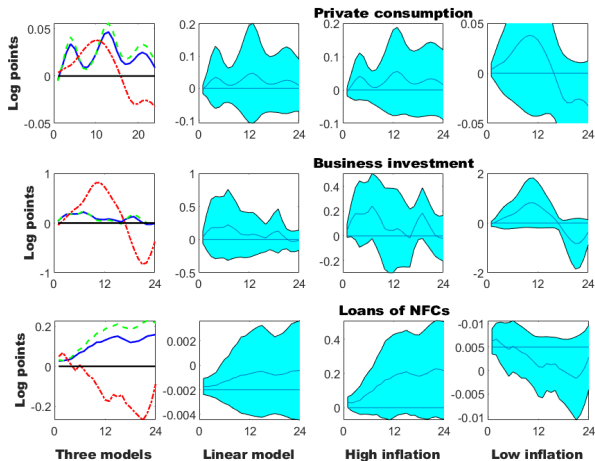
Figure 10: IRFs to a monetary policy shock (+100 bp)



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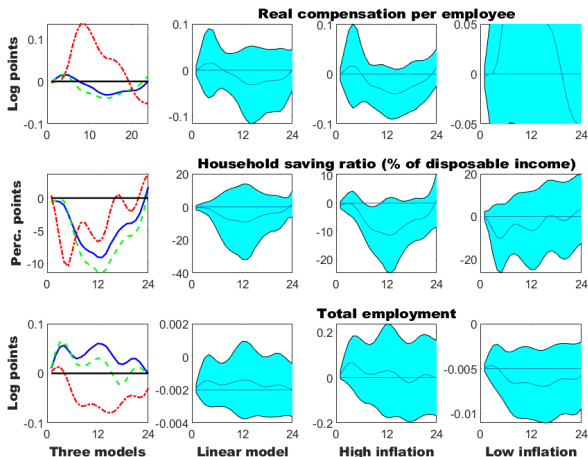
Appendix C: Additional IRFs non-linearity inflation (cont.)

Figure 10 (cont.): IRFs to a monetary policy shock (+100 bp)



Appendix C: Additional IRFs non-linearity inflation (cont.)

Figure 10 (cont.): IRFs to a monetary policy shock (+100 bp)



Robustness exercises

- ▶ Re-estimating the models with alternative measures of house prices (Eurostat), wages, real disposable income, ...
- ▶ alternative standard monetary policy shock proxy (3 months OIS rate changes), ...
- ▶ excluding Covid-19 data.

Policy implications

- ▶ Insufficient housing supply and loans to households for house purchase being too low at the beginning of our sample. Insufficient **housing policy**?
- ▶ **Macroprudential policy** being necessary before 2015.
- ▶ **Fiscal policy** being not countercyclical (housing taxation?).
- ▶ **Fixed-rate mortgages** being overwhelmingly predominant. Trade-off between financial stability and monetary policy effectiveness?
- ▶ Euro area **policy rates** being lower than neutral interest rate in SK.
- ▶ Question: Can we learn something from this experience that may be useful for other CESEE countries ([Hildebrandt et al., 2012](#))?

Caveat: A structural macro model is necessary to assess these points.

Ways forward

- ▶ Estimating a Threshold VAR to check robustness ([Gonçalves et al., 2024](#)).
- ▶ Rationalizing our results empirically.
- ▶ Alternatively, estimating an appropriate DSGE model to rationalize our results (time-permitting).
- ▶ Considering an additional nonlinearity: household debt growth.