Impact of Monetary Policy Shocks on House Prices: A Structural VAR Approach

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Outline

1. Introduction & Motivation
2. Literature
3. Methodology
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Motivation-I

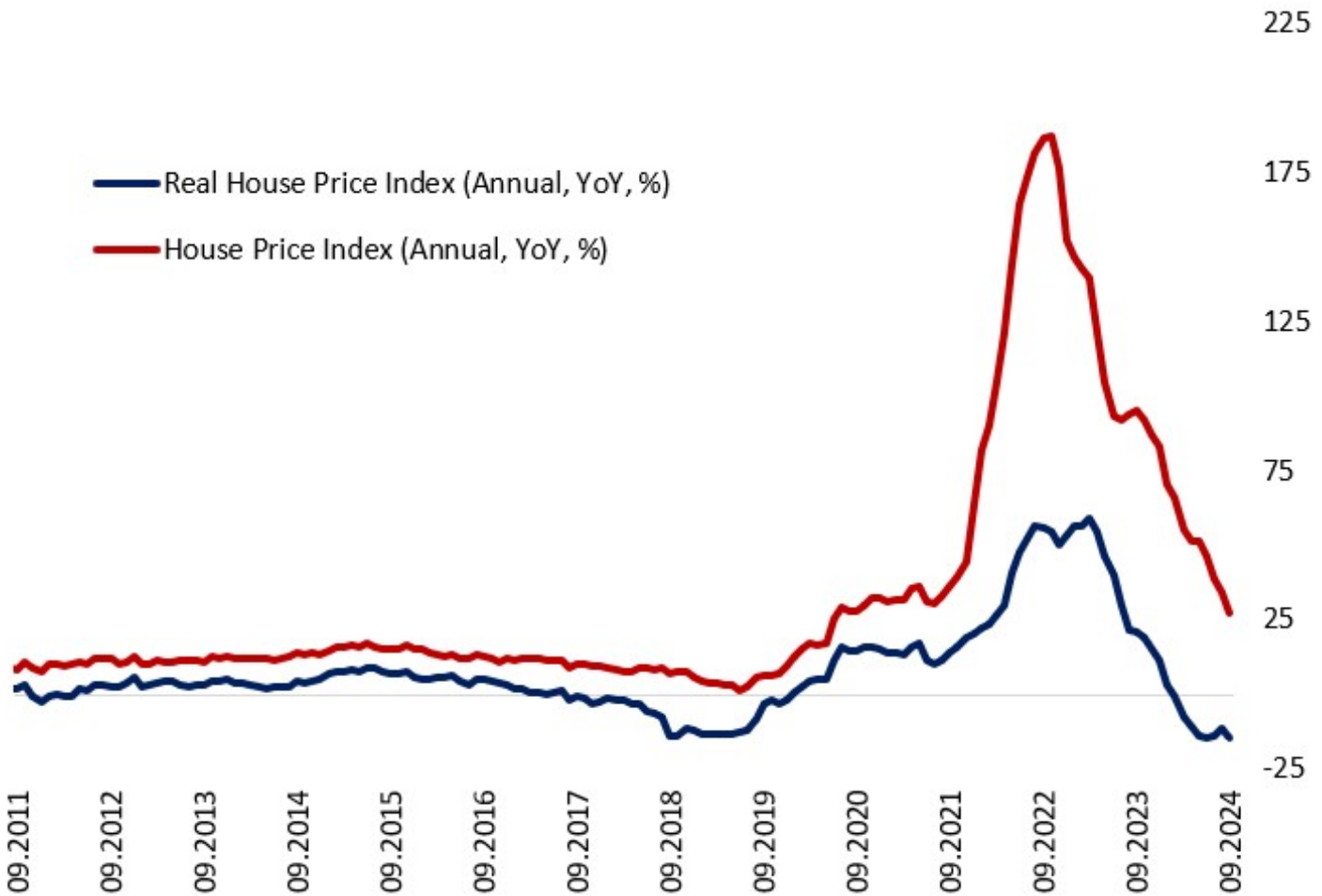


Figure 1: House Price Index

- Recent surge and fall in real and nominal house prices?
- House prices and its relationship with the CBRT policy rates?

Motivation-II

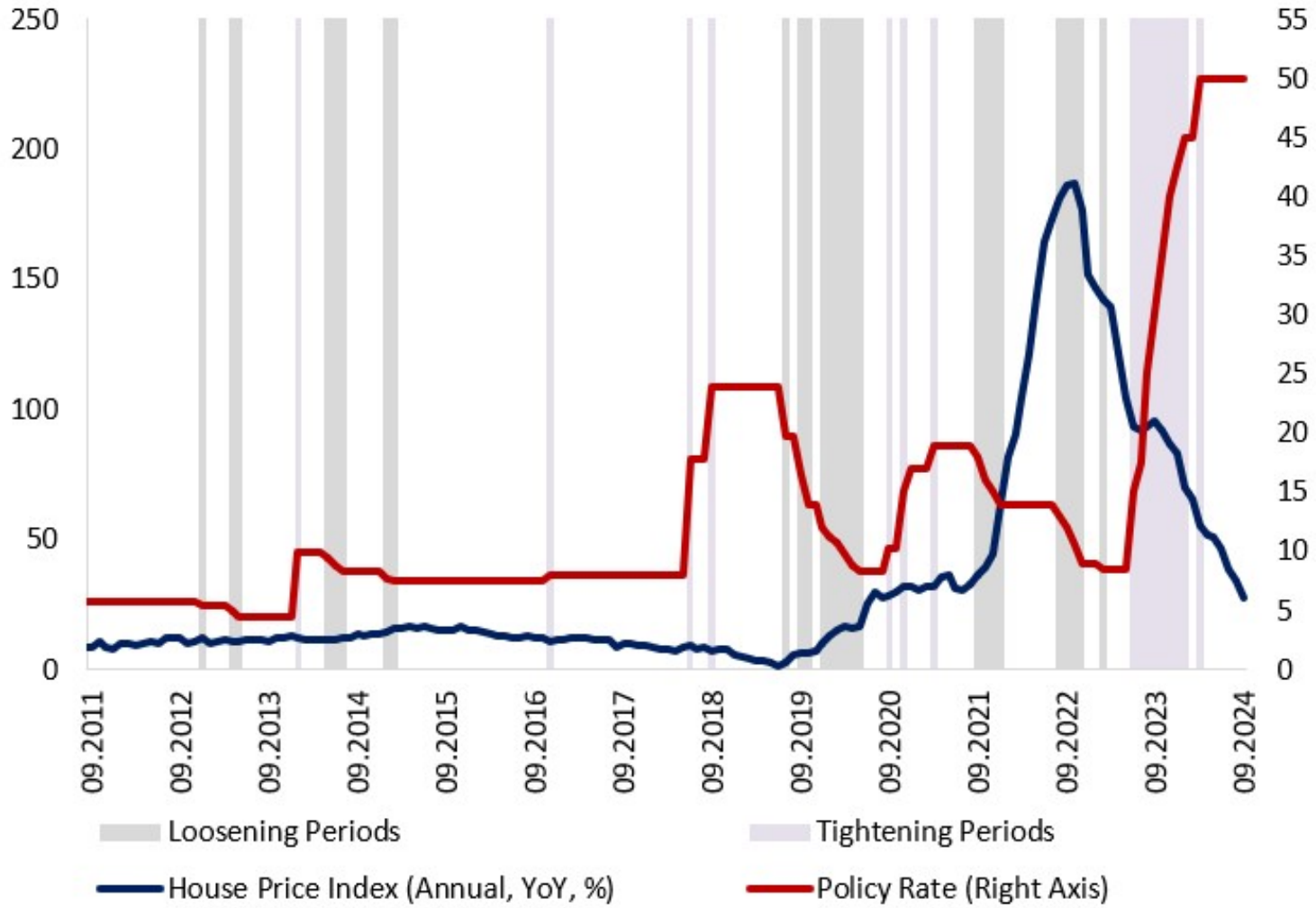


Figure 2: House Price Index and the CBRT Policy Rate

- A possible co-movement?

Research Questions

What is the impact of the...

- ... monetary policy shocks on the house prices?
- ... housing demand/housing supply on housing sector?

- To what extent are the fluctuations in the house prices stemming from the **monetary policy** stance as well as the **aggregate supply** and **demand** conditions?

- Aiming at decomposing the house prices into the impact of the monetary policy, housing demand and housing supply in the **extended model**.

Transmission Mechanism

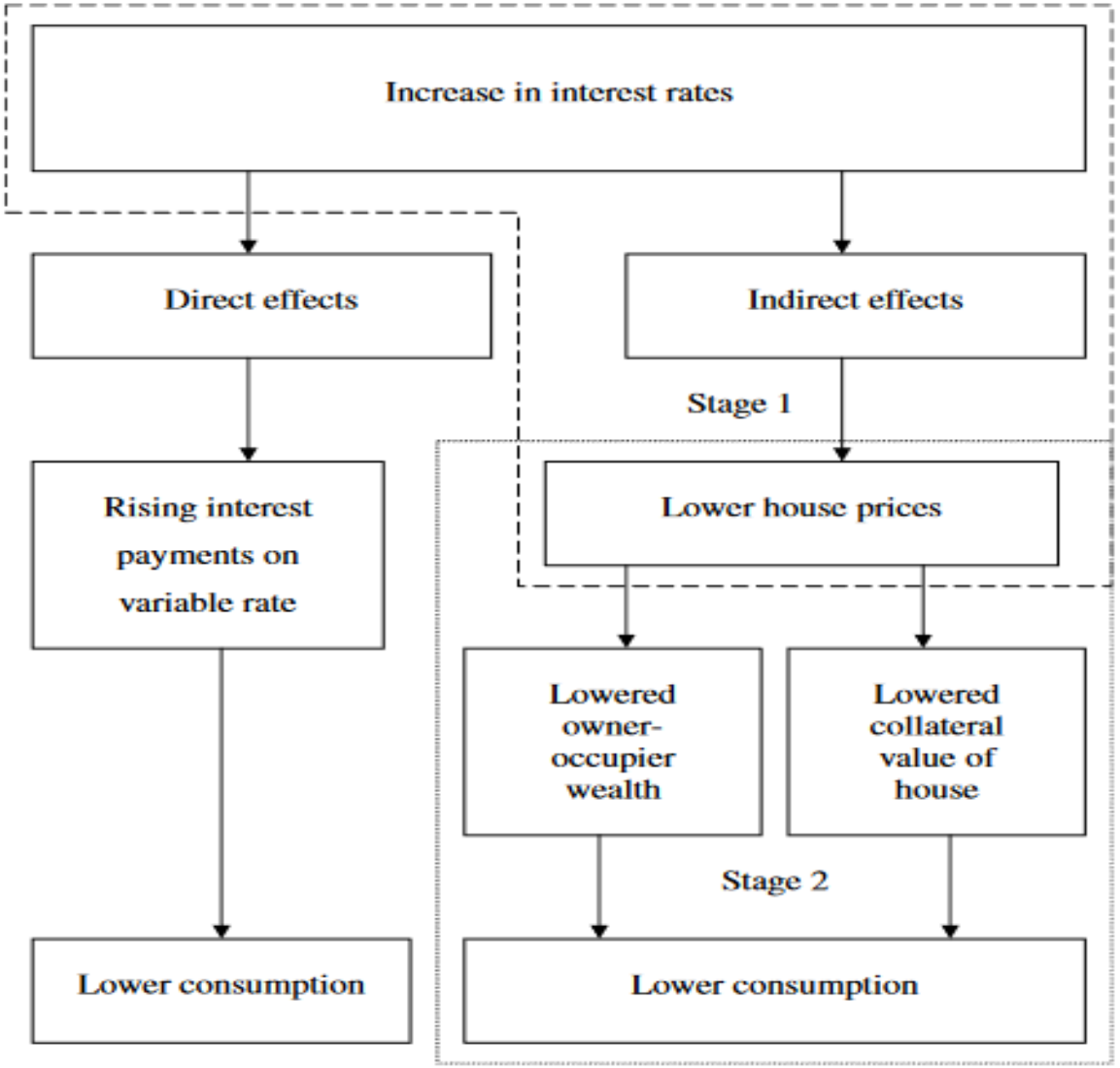


Figure 3: Monetary Transmission Mechanism Through Housing Market à la Elbourne (2008)

Foreign & Domestic Studies

- **For advanced economies:** Ahearne et al., 2005; Bjørnland and Jacobsen, 2010; Giuliodori, 2005; Iacoviello and Neri, 2010; Jarocinski and Smets, 2008; Lecat and Mesonnier, 2005; Musso et al., 2011; Nocera and Roma, 2017
- **For emerging market economies:** Fifield et al., 2000; Ncube and Ndou, 2011; Nguyen and Le, 2023; Singh and Nadkarni, 2020; Tunc and Gunes, 2023
- **For Turkish economy:**
  - Sari et al., 2007 → that housing market being subject to credit channel of the transmission mechanism,
  - Bingul, 2019; Erdoğan et al., 2017; Yıldırım and İvrendi, 2017 → significant impact of the monetary policy shock on house prices
  - Yıldırım and Yağcibaşi, 2019 → significant impact of the government expenditures as the aggregate demand on house prices
  - Akça, 2023 → housing prices are mostly affected by housing interest rates, housing volume, real exchange rate and total housing loans in the short run.

Methodology: Structural VAR

The starting point: Use of SVARs

- Recursive identification strategy fails for small-open economies
- Emergence of common empirical puzzles: exchange rate, liquidity, and price puzzles
- Cushman and Zha (1997) and Kim and Roubini (2000) highlighted the use of **structural modelling** for the monetary policy transmission in an open economy setting

Methodology: Structural VAR (cont.)

The reduced form VAR(p) model:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + ... + A_p y_{t-p} + \varepsilon_t \tag{1}$$

with $\varepsilon_t \sim \mathcal{N}(0, \Sigma)$.

Consider the structural form of the above VAR model.

$$B_0 y_t = B_1 y_{t-1} + B_2 y_{t-2} + ... + B_p y_{t-p} + \eta_t \tag{2}$$

with $\eta_t \sim \mathcal{N}(0, \Gamma)$ is the vector of structural disturbances with an orthogonal Γ matrix.

Pre-multiplying both sides of the Eq.2 yields the following:

$$\varepsilon_t = B_0^{-1} \eta_t \tag{3}$$

where the B_0 denotes the structural impact matrix.

The Eq. 3 implies by simple algebra that:

$$\Sigma = \mathrm{E}(\varepsilon_t \varepsilon_t') = \mathrm{E}(B\eta_t \eta_t' B') = B\mathrm{E}(\eta_t \eta_t')B' \tag{4}$$

$$\Sigma = B\Gamma B' \tag{5}$$

- The aim is to recover B
- Infinitely many ways to decompose Σ
- Most common ways to recover structural shocks from reduced-form residuals are:
  i. Recursive (Cholesky Decomposition) identification, where a lower triangular matrix of B is assumed
  ii. Sign and zero restrictions

  "'Orthogonalization' of the reduced-form residuals by applying a Cholesky decomposition is appropriate only if the recursive structure . . . be justified on economic grounds." -Kilian (2011)

Data & Methodology

Data[1]

- CBRT policy interest rate, consumer price level, real output level, house prices, total house sales, real housing credit
- 2010:1-2021:7 period with monthly data

Methodology

- Identifying structural shocks with sign and zero restrictions as proposed by the Arias et al. (2014)
- Benefitting the BEAR Toolbox of the ECB by the Dieppe et al. (2016)

Robustness Check

- An alternative identification for the response of house prices to a monetary policy shock

[1] The data sources are CBRT, TurkSTAT

Recursive Identification

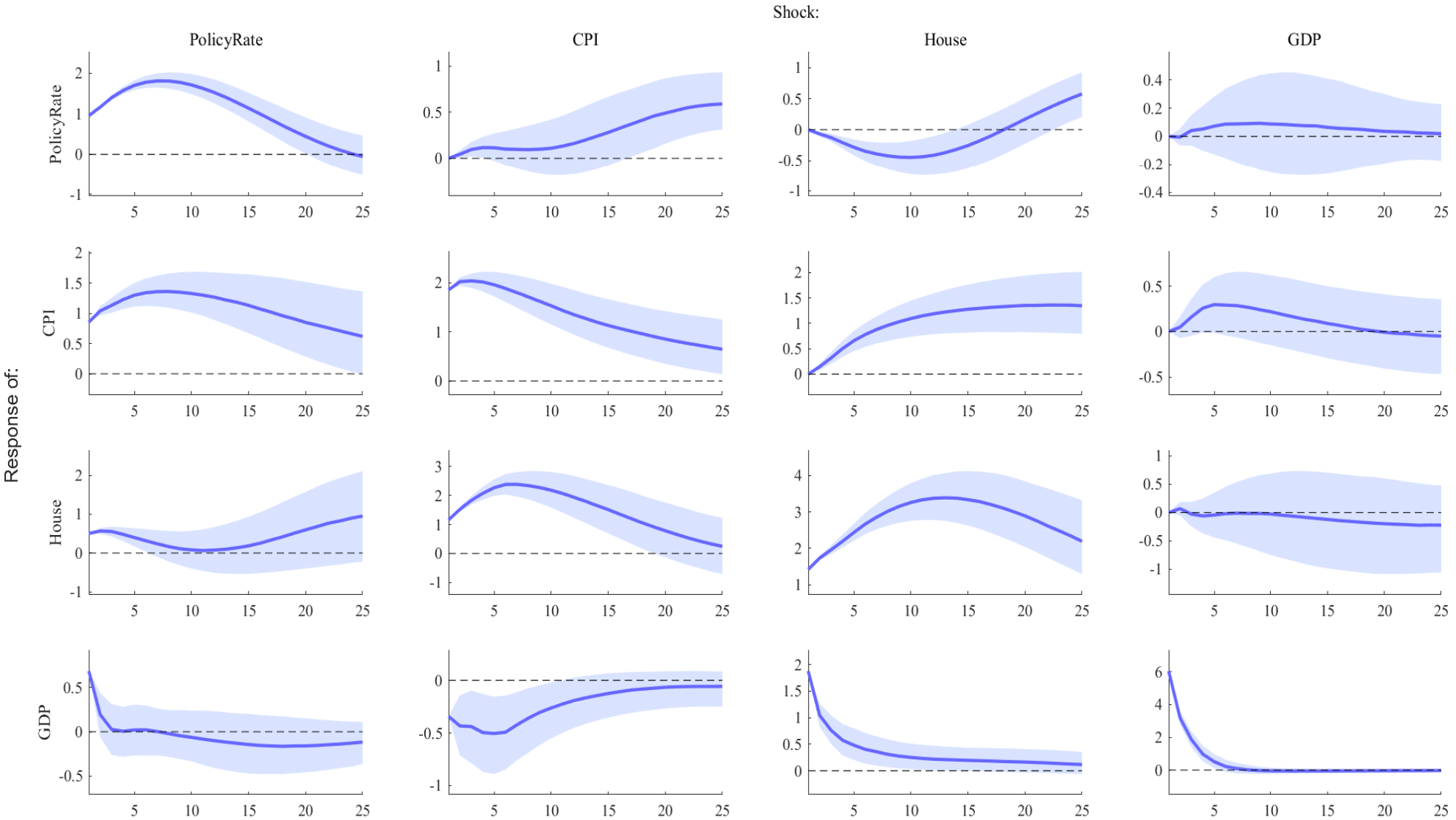
Table 1: **Cholesky Identification Scheme**

Shock/ variable	CBRT Policy Rate	Consumer Prices	House Prices	Output Level
CBRT Policy Rate	+	0	0	0
Consumer Prices	•	+	0	0
House Prices	•	•	+	0
Output Level	•	•	•	+

Table 2: **Cholesky Identification Scheme**

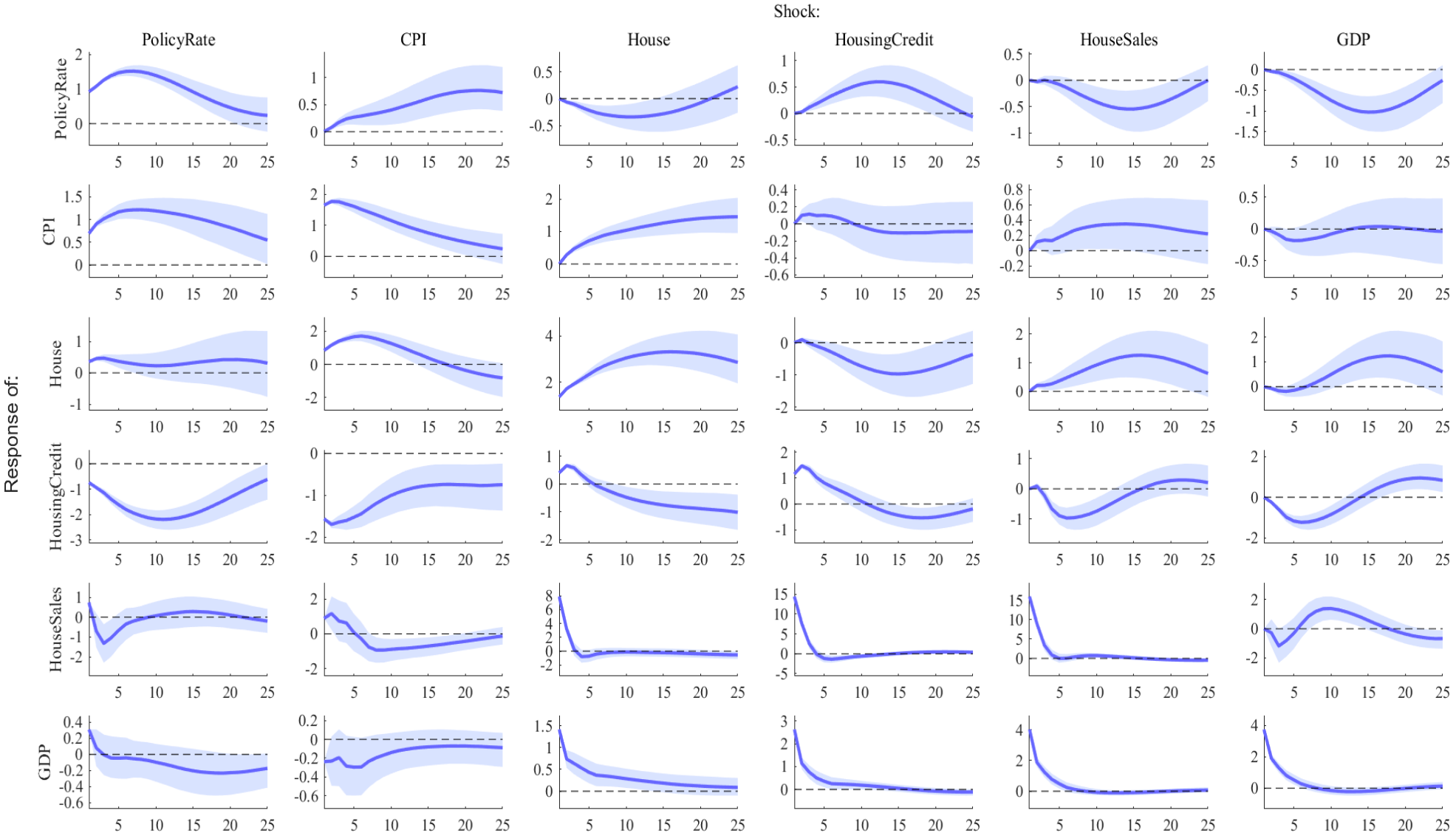
Shock/ variable	CBRT Policy Rate	Consumer Prices	House Prices	Housing Credit	House Sales	Output Level
CBRT Policy Rate	+	0	0	0	0	0
Consumer Prices	•	+	0	0	0	0
House Prices	•	•	+	0	0	0
Housing Credit	•	•	•	+	0	0
House Sales	•	•	•	•	+	0
Output Level	•	•	•	•	•	+

Recursive Identification



Puzzling results appear.

Recursive Identification



Puzzling results appear.

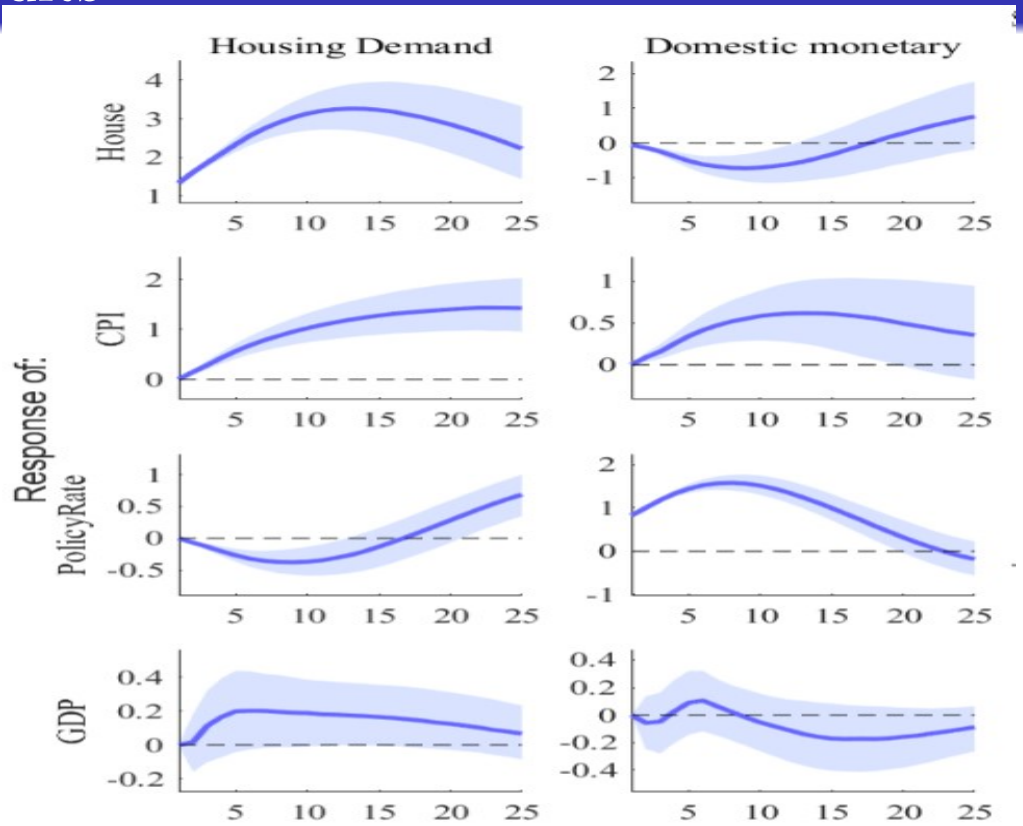
Initial Model Identification

Table 3: **Model Identification-I**

Shock/Variable	Monetary Policy	Housing Demand
Policy Rate	+	0
Consumer Prices	0	0
House Prices	-	+
Real Output	0	0

- With monthly data, impact of monetary policy on consumer prices and real output is set to **zero** on the first period.
- And **restricting the impact of the central bank** to a housing demand/price shock to zero following the Jarocinski and Smets (2008), Nocera and Roma (2017).

Initial Model Results



- Price puzzle still exists; after a CBRT policy rate shock, price level increases following periods, while house prices respond the opposite
- i. whether the CBRT responds to an aggregate demand (due to either domestic or a global economy originated) or an aggregate supply shock (such as a persistent TFP shock),
- ii. it responds to an exogenous house price shock stemming from some unknown reason

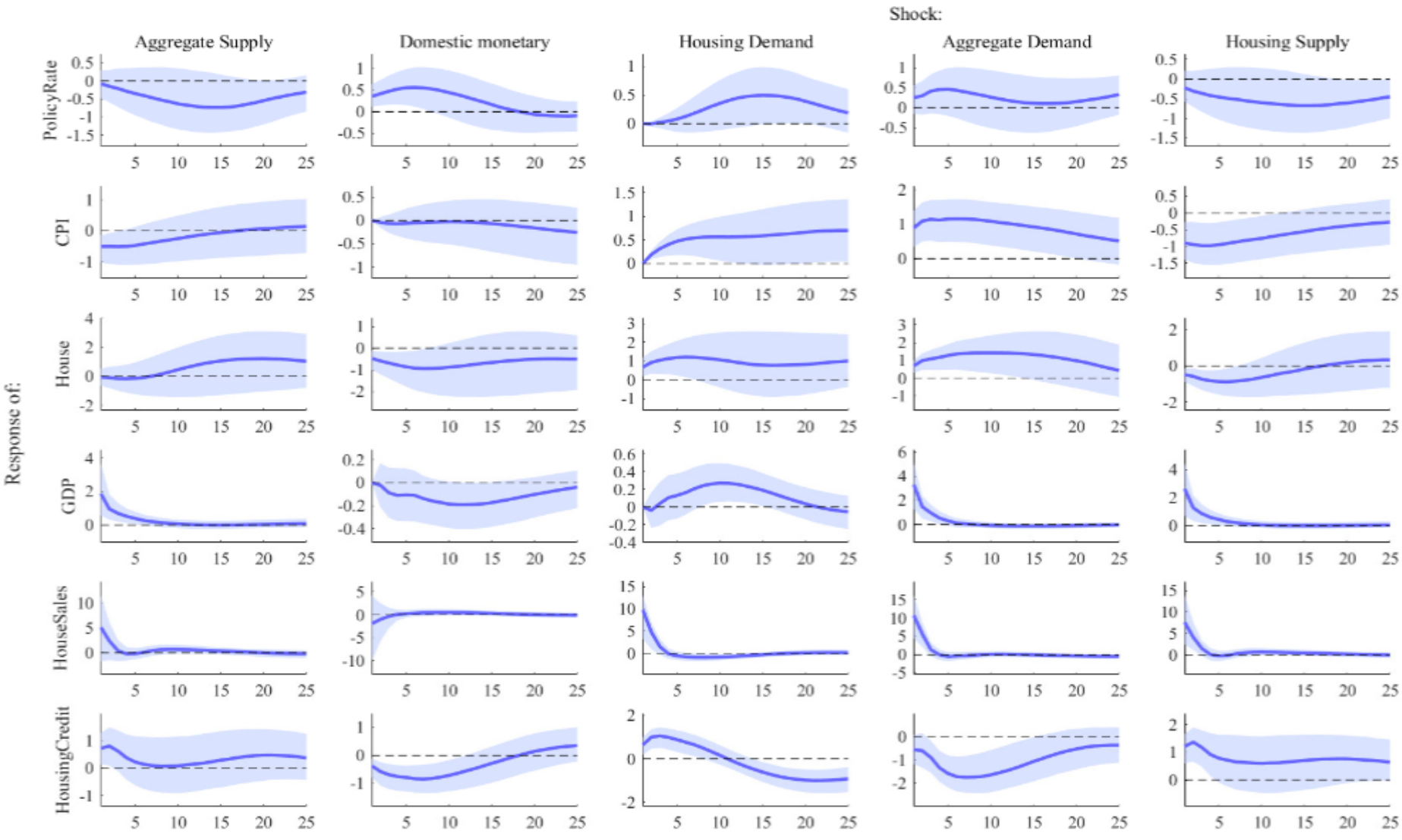
Baseline Model

Table 4: **Baseline Model Identification**

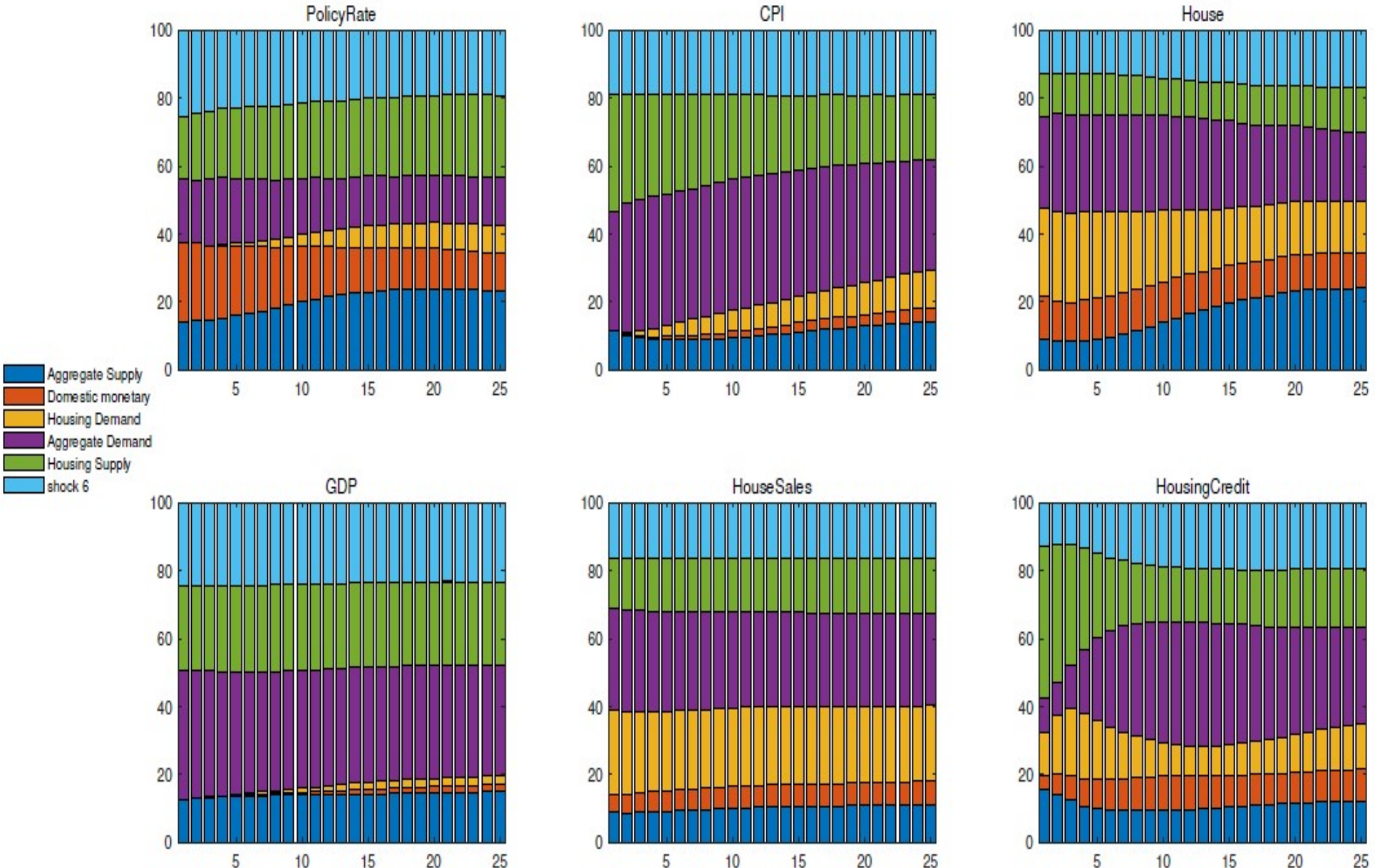
Shock /Variable	Housing Demand	Monetary Policy	Aggregate Supply	Aggregate Demand	Housing Supply
House Prices	+	-	•	•	-
Consumer Prices	0	0	-	+	•
Policy Rate	0	+	•	•	•
Real Output	0	0	+	+	•
House Sales	+	•	•	•	+
Housing Credit	+	-	•	•	+

- The real output level also contains the demand for the real estate for the consumption purposes (as by Borio, Kennedy and Prowse (1994))
- Usual AS and AD shocks with additional **housing supply** shock identified with **house sales** and **housing credit**
- Housing demand and aggregate demand shocks are disentangled by zero restrictions on the former on the CPI, CBRT policy rate and GDP.
- Building mainly on Borio et al. (1994) and Nocera and Roma (2017)

Baseline Model



Forecast Error Variance Decomposition



Concluding Remarks

- Imposing sign and zero restrictions on the first period,
- Including housing supply block's improvement,
- Common empirical puzzles exists both for Initial and Baseline model with Cholesky ordering, **structural** identification solves
- Further research: panel VAR or time varying parameter VAR model (TVP-VAR)

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Sign Restrictions Algorithm à la Arias et al. (2014)

- Drawing from the posterior distribution of the structural parameters conditional on sign and zero restrictions
- Critising the penalty function approach of **mountford2009effects**

The Algorithm:

1. Draw a vector β (set of reduced form coefficients of A_i), Σ of the reduced form model and impulse-response functions (Ψ_i's)
2. Define a preliminary lower triangular Cholesky matrix ($h(\Sigma)$) and set of structural impulse-response functions ($\tilde{\Psi}_i$'s), where $\tilde{\Psi}_i = \Psi_i h(\Sigma)$ and where $h(\Sigma)h(\Sigma) = \Sigma$
3. To ensure orthogonalisation, draw an orthonormal matrix Q from the QR decomposition of an $n \times n$ matrix.
4. Then with a candidate structural impact matrix $B = h(\Sigma)Q$ at hand, check if the restrictions are satisfied; keep or repeat the Steps **2-4**.
5. Finally having the structural B. matrix satisfying all the restrictions imposed, last thing to do is to draw the IRF's based on this structural impact matrix B.

Bayesian Approach

The Aim:

- The curse of dimensionality issue; N^2p variables to estimate in the VAR
- Using Bayesian shrinkage via Minnesota prior (Litterman (1986)) to restrict the estimation and impose *a-priori* knowledge on the parameter β matrix and the Σ
- The best predictor of a variable, its previous value ("random walk" assumption):
  - Variable's own lag/more recent lags are more informative
  - All other parameters are pushed towards zero
  - In case of a unit root containing variable, setting first lag's prior mean of an endogenous variable 1 and other lags to zero.
  - In case of a combination of unit root and no-unit root cases, the routine for determining the λ: Giannone et al. (2015) advised for hyperparameters and the AR coefficient of each VAR equation