Econometrics 3b - Time Series: Term Paper

Policy Rates, Mortgage Rates, and Swedish House Prices: Evidence from a quarterly VAR in levels

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1 Introduction

Housing is widely viewed as a core transmission channel of monetary policy: policy-rate moves shift short-term borrowing costs, pass through to mortgage pricing, change user costs of housing and, and then feed back into the real economy. A large empirical literature studies these links with VARs; evidence typically finds that policy shocks move mortgage rates quickly and house prices with a delay.

This paper asks: **How do Riksbank policy shocks transmit to Swedish mortgage rates and, in turn, to real house prices?** I estimate a VAR in levels for (r_t, m_t, gdp_t, h_t): the policy rate r_t; a short market rate STIBOR 3M used as a mortgage-rate proxy m_t; real GDP growth gdp_t; and real log house prices h_t. An Engle–Granger test suggests h_t and m_t are co-integrated, making the specification is appropriate. Identification is recursive with the ordering $r_t \to m_t \to gdp_t \to h_t$. I then analyse Impulse Response Functions to a -25bp policy surprise and use Forecast error variance decomposition to gauge the size of the shocks.

2 Data

2.1 Sample and frequency:

All series are either quarterly in origin, or have been converted from monthly using the quarterly aggregation method. After aligning sources, the estimation sample runs from the 1994Q3 to 2024Q4. I transform only what is necessary for economic interpretation and stationarity: house prices are deflated and logged; GDP is used in quarter-on-quarter growth (QoQ); rates are in percentage points.

2.2 Policy rate (r_t):

I start with the Riksbank's policy instrument (quarterly average, %). The data exists already at quarterly frequency. I keep the series in levels for the VAR. The only additional handling is mechanical: tweaking the European decimal format in the source and aligning the calendar with the other variables. **See Figure (1a)**.

2.3 Mortgage-rate proxy (m_t):

Swedish households predominantly choose short-fixation (*rörlig*) mortgages according to FI. Banks then hedge those at the 3-month STIBOR; movements in STIBOR therefore pass through to the new variable mortgage pricing. Riksbank attribute much of the variation in variable mortgage rates to short-rate factors. That makes STIBOR 3M a practical proxy for the mortgage rate relevant to housing demand, given that limited time-span of mortgage rates data offered by the Riksbank. Data is taken from the ECB. **See Figure (1b)**.

2.4 Real house prices (h_t):

Finally, I use the RPPI, quarterly and indexed to 2010=100. To obtain real housing prices. I deflate the nominal RPPI by CPIF, then take logs. CPIF is standard for Sweden since deflating housing by CPI would bake a mortgage-rate component directly into the price deflator. **See Figure (1c)**.

2.5 Real GDP growth (gdp_t):

Real GDP growth is the QoQ percent change, with constant prices and seasonally adjusted from the SCB. It enters the system in growth rates. **See Figure (1d)**.

3 Estimation strategy

3.1 VAR specification, lag selection and inference:

I estimate a quarterly VAR in levels to trace how a monetary policy change propagates to money-market/mortgage rates and on to real house prices. The specification is

$$y_t = c + A_1 y_{t-1} + \cdots + A_p y_{t-p} + u_t, \qquad u_t \sim \mathcal{N}(0, \Sigma).$$

Identification rests on two linked choices: keep the variables in economically interpretable units and estimate a VAR in levels rather than a full VECM, as per the scope of the course. The policy rate r_t and STIBOR-3M m_t enter in percentage points; house prices h_t are the log of the BIS RPPI deflated by CPIF; and gdp_t is quarter-on-quarter real GDP growth. At $\alpha = 5\%$, ADF tests indicate $r_t,\ m_t,\ h_t$ are $I(1)$ while gdp_t is $I(0)$; an Engle–Granger residual test suggests co-integration between h_t and m_t. Given this pre-testing, the modest quarterly sample, and course guidance, I estimate a VAR in levels: it preserves the long-run signal needed for impulse analysis while remaining adequate for tracing policy transmission. More details on the relevant statistical tests in the next subsection.

Lag choice. I search $p = 1, \ldots, 8$ and pick the smallest p that clears a multivariate Ljung–Box test for residual autocorrelation at horizon $h = 14$ (≈ 3.5 years) and $\alpha = 5\%$. In the aligned sample this yields $p = 5$ with a p-value ≈ 0.078 (i.e., I fail to reject no residual autocorrelation). This rule is a guardrail, not a proof. The test is sensitive to the chosen horizon (e.g., at $h = 12$ the same model would reject). I therefore adopt $p = 5$ as the most parsimonious choice that keeps residual serial correlation in check. I re-estimated the VAR at $p - 1$ and $p + 1$; the IRF and FEVD patterns remain unchanged, the detailed diagnostics are however omitted from the paper due to limited space.

Identification and scaling. Structural shocks are obtained by a recursive Cholesky decomposition using the ordering

$$r_t \to m_t \to gdp_t \to h_t.$$

For policy-relevant magnitudes, I rescale the orthogonalised impulse responses so that the initial innovation in the r_t equation corresponds to a -25 bp shock. Here, "innovation" means the unexpected part of a variable at time t; the difference between the observed value and its one-step-ahead forecast from the estimated VAR.

Diagnostics and inference. At the chosen lag p, residual autocorrelation is acceptable by the Ljung–Box check. A multivariate Jarque–Bera test rejects normality at $\alpha = 5\%$ (typical in macro VARs). A multivariate ARCH–LM test (12 lags; null: no conditional heteroskedasticity) fails to reject at $\alpha = 5\%$, providing no evidence of strong ARCH effects.

For interpretation I report the IRFs (a -25 bp policy shock) for m_t and h_t, and FEVDs for h_t at horizons $4, 8, 12, 20$ quarters. Two light robustness checks accompany the baseline: (i) an ordering swap that places gdp_t before m_t while keeping r_t first and h_t last; and (ii) a shock-size sensitivity that scales the policy innovation to $-25/-50/-100$ bp. Results from these checks are reported in the sensitivity analysis section.

Why a VAR in levels, and why it is "good enough" here? Pre-tests indicate r_t, m_t, h_t are $I(1)$ while gdp_t is $I(0)$. An Engle–Granger test suggests co-integration between h_t and m_t. In a small quarterly sample, a VAR in levels is a standard given that it preserves the long-run signal needed for IRFs.

3.2 Statistical tests:

Before estimating the VAR, I check the time-series properties. Augmented Dickey–Fuller (ADF) tests (null: unit root) were run at $\alpha = 5\%$ on levels and first differences, with lags chosen by aIC and capped at 12 quarterly lags (3 years, a standard rule of thumb). In levels, I fail to reject the null for the policy rate r_t, STIBOR-3M m_t, and the (log) real house-price index h_t; I reject the null for gdp_t, which is stationary ($I(0)$). In first differences I reject the null for Δr_t, Δm_t and Δh_t, confirming they are $I(1)$ in levels.

As a co-integration check, an Engle–Granger residual test between h_t and m_t (ADF on OLS residuals; null: residual has a unit root) rejects the null at $\alpha = 5\%$, supporting co-integration between house prices and mortgage rates. This entails that the two variables share a common long-run equilibrium.

After estimating the VAR in levels, a Ljung–Box test on residuals (null: no residual autocorrelation up to horizon h) at $\alpha = 5\%$ with $h = 14$ yields $p \approx 0.078$. I fail to reject the null, meaning there is no detectable residual autocorrelation up to about 3.5 years. The choice of this time span is not random, but rather a result of the test failing at 3 years. For distributional diagnostics, a multivariate Jarque–Bera test (null: multivariate normality) is rejected at $\alpha = 5\%$, which is common in macro data. A multivariate ARCH–LM test (12 lags; null: no conditional heteroskedasticity) fails to reject at $\alpha = 5\%$, indicating no strong ARCH effects either.

ACF plots (**See Figure 2**). of Δr_t, Δm_t, and Δh_t show no pronounced seasonal spikes at lags 4, 8, 12. As for gdp_t, data has been seasonally adjusted from the source.

4 Results

4.1 Impulse Response Functions (IRFS):

Figure 3 plots responses to a $-25\,\text{bp}$ policy-rate shock (shock scaled from the r_t-equation innovation). Two panels are shown: mortgage rates (m_t, pp) and real house prices (h_t, log level). All responses show 95% bootstrap bands (2000 replications, instead of the default 10) and yearly ticks on the horizon axis (multiplication of 4, instead of the default 5).

Statistical reading: Mortgage rates m_t fall on impact and typically trough within the first few quarters; the response mean-reverts toward zero by roughly two to three years. Real house prices h_t rise more gradually: the response only becomes statistically distinct from zero after several quarters, typically peaks after about four to five years, and then decays slowly. Confidence bands widen at long horizons, so statistical inference is strongest over the first two to three years.

Economic interpretation: The pattern is consistent with textbook transmission: a policy cut quickly loosens money-market conditions and passes through to mortgage rates; housing responds with a lag as lower financing costs stimulate demand, pushing up real house prices gradually and persistently.

4.2 Forecast error variance decomposition (FEVD):

Figure 4 shows stacked shares for the variance of h_t at horizons 4, 8, 12 and 20 quarters. Early horizons are dominated by *own shocks* (idiosyncratic movements in house prices). The mortgage-rate channel accounts for a non-trivial and rising portion of h_t's variance from year 1 to years 3–5, while direct policy-rate shocks explain a smaller but noticeable share. gdp_t innovations contribute little to house-price variance in this set-up.

Takeaway: For housing over this sample, most short-run volatility is specific to the housing block; the monetary channel operates primarily through mortgage rates, meaning that those effects accumulate with time, rather than immediately.

4.3 Robustness and sensitivity:

Two checks to test whether the headline message depends on modelling choices:

1. **Ordering swap.** Re-estimating the VAR with gdp_t ordered before m_t (keeping r_t first and h_t last) leaves the IRF shapes intact: m_t still falls quickly after a policy cut and h_t still rises gradually. This suggests the housing response is not driven by the particular ordering between activity and the mortgage rate.
2. **Shock-size proportionality.** Sensitivity plots scale the policy innovation to $-25/-50/-100$ bp display with different line types. The h_t responses scale approximately proportionally across sizes (larger cuts yield naturally larger effects with similar timing) indicating the results are independent of the specific -25 bp choice.

Results from these checks are summarised alongside the main IRF/FEVD plots; **see Figures 5 and 6**.

5 Conclusion

A simple VAR in levels delivers a clear story: a -25 bp policy-rate cut passes through to mortgage rates almost immediately and lifts real house prices gradually, with peak effects after several years. FEVDs indicate the mortgage channel accounts for most of the variation in house-price dynamics attributable to the system's shocks.

The main limitation is, as to be expected from the scope of the paper and course, methodological. Because h_t and m_t are co-integrated, a VECM would be the ideal specification in finite samples: it can estimate an error-correction term and potentially provide better long-run inference. I adopt a VAR in levels in a quarterly sample to observe the course guidelines.

There are also standard risks of misspecification and misidentification. Ff within-quarter transmission differs from our assumed ordering, the Cholesky restriction can assign effects to the wrong variable, although swapping the ordering did not change the main results. Lag choice, on the other hand, is guided by a Ljung-Box guardrail, yet that test has limited power and depends on the horizon inspected (which was imposed by the author). Residuals are non-normal (common in macro/financial data), the sample spans multiple regimes, and STIBOR-3M is an imperfect proxy for household mortgage rates.

Overall, the results should arguably be read as average historical responses conditional on the model and sample rather than precise forecasts, which is the reason this paper did not extend its scope to forecasting . A natural next step is to estimate a VECM, allow for time-varying parameters, and use richer mortgage data (as explained, data exists but to a limited time-frame) to verify the robustness of the monetary-to-housing transmission.

6 References

Sveriges Riksbank (2025) *Interest rates and exchange rates*. Available at: Riksbank statistics page

Finansinspektionen (FI) (2025) *The Swedish mortgage market: households need to have margins for an uncertain future*. Available at: FI report

European Central Bank (ECB) (2025) *SIBOR 3M series*. Available at: ECB data series (SIBOR 3M)

Federal Reserve Bank of St. Louis (FRED) (2025) *QSEN628BIS: BIS Residential Property Price Index (RPPI), Sweden*. Available at: FRED series QSEN628BIS (RPPI)

Statistics Sweden (SCB) (2025). Available at: SCB . Business cycle indicators (GDP)

7 Annex

7.1 Summary statistics:

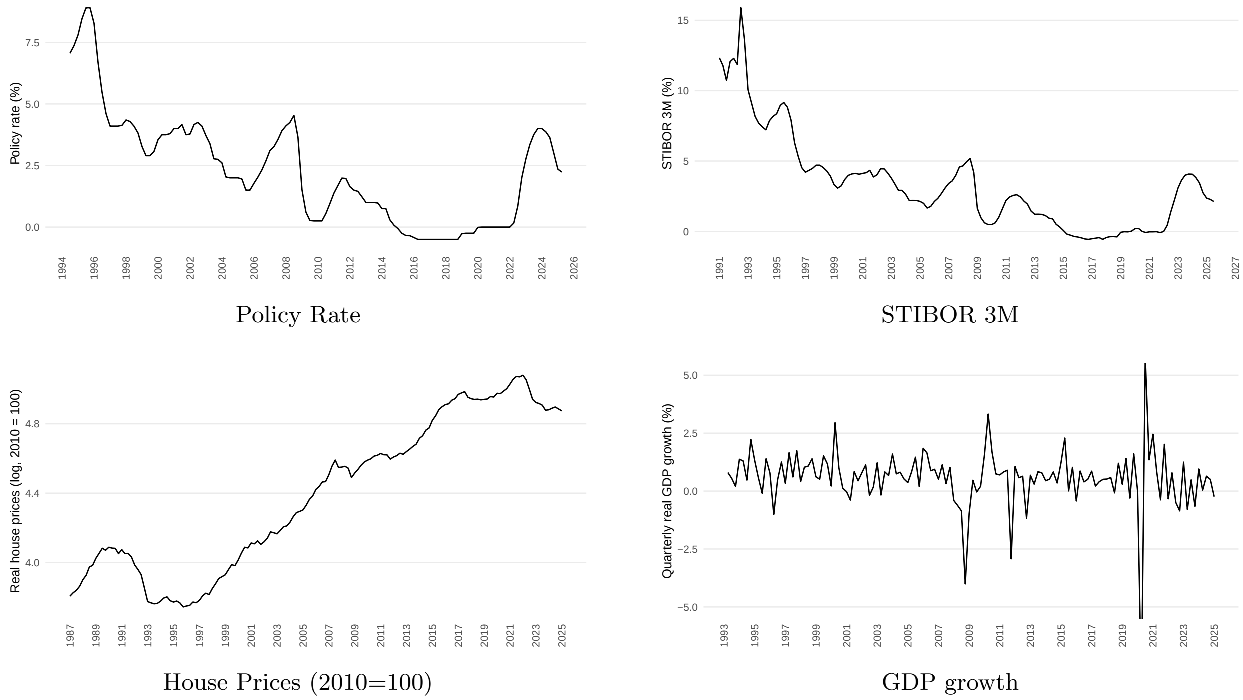

Figure 1: Four-panel overview of the series.

7.2 ACF Plots:

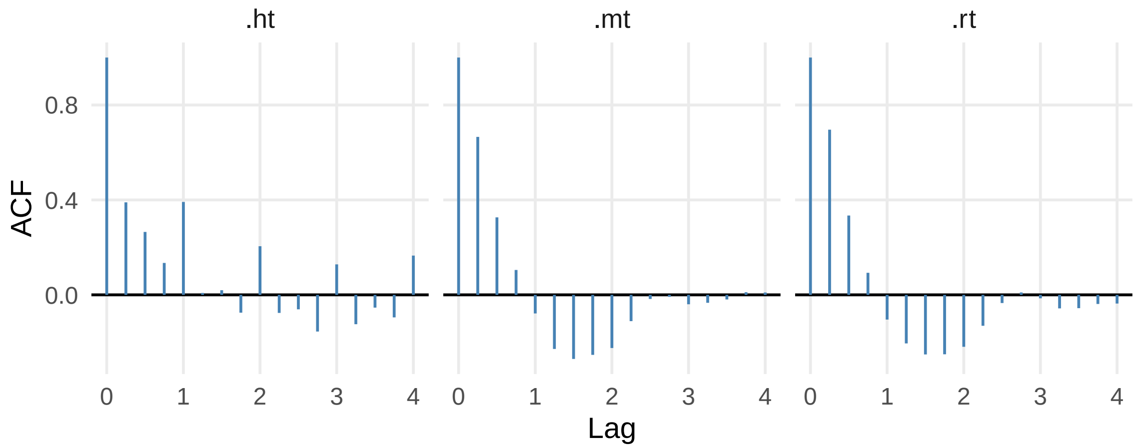

Figure 2: ACF plots for the first differences of the series (panels for Δm_t, Δh_t, Δr_t).

7.3 Impulse Response Functions:

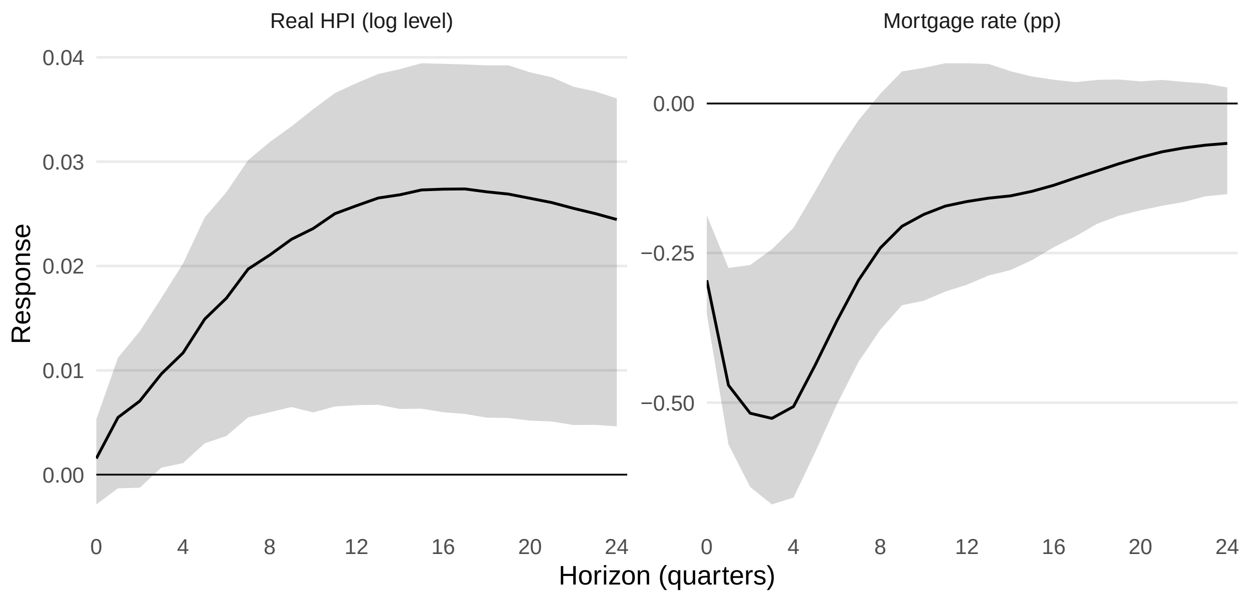

Figure 3: IRFs to a -25 policy rate shock

7.4 Forecast Error Variance Decomposition:

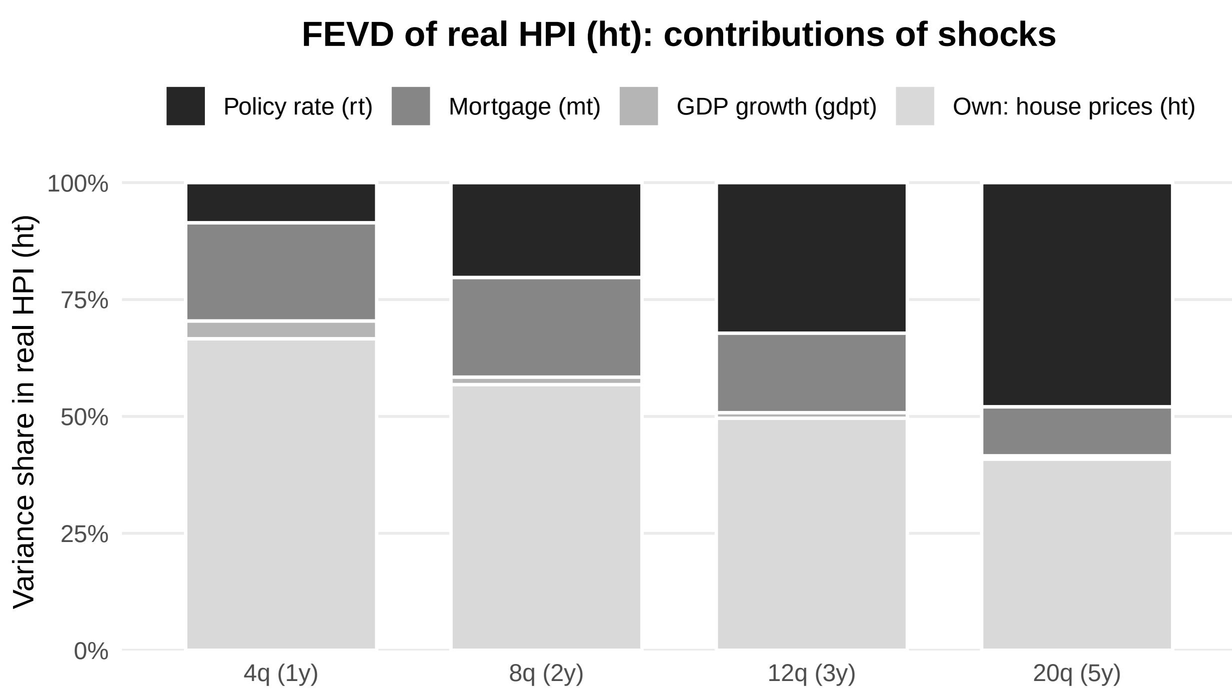

Figure 4: FEVD of real HPI - h_t

7.5 IRF Robustness:

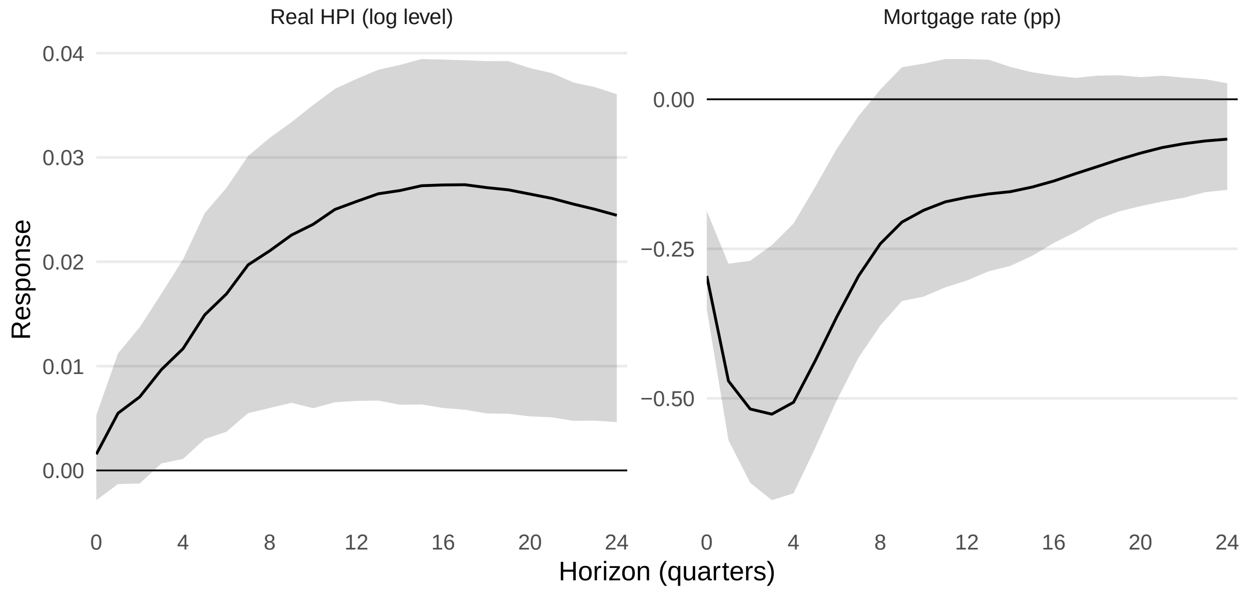

Figure 5: IRF robustness with updated ordering

7.6 IRF Sensitivity to different shocks:

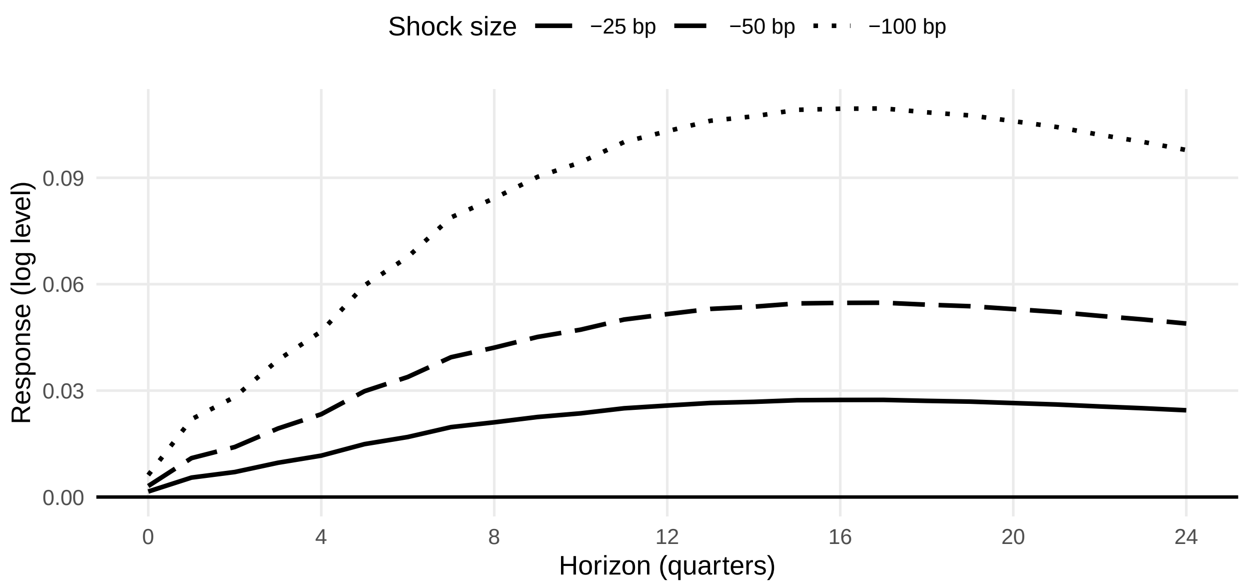

Figure 6: Sensitivity - real HPI IRFs to different shock sizes