Journal of Central Banking Theory and Practice, 2026, 3, pp. 289-309 *UDC: 336.74:332.622(510)*

Received: 25 February 2026; accepted: 16 June 2026 *DOI: 10.2478/jcbtp-2026-0029*

Time-Varying Effects of Monetary Policy on House Prices in China: Evidence from 2008 to 2025 with the TVP-VAR Approach

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Abstract: This paper investigates the dynamic and nonlinear effects of monetary policy on house prices in China from 2008 to 2025. Utilizing a Bayesian Time-Varying Parameter Vector Autoregression (TVP-VAR) model with stochastic volatility, we estimate the evolution of policy transmission in terms of shock magnitude and time-lag. By conducting 20,000 MCMC simulations, the study identifies significant structural shifts in the transmission mechanism. The results show that while the stimulative effect of targeted housing credit expansion was dominant during the 2009 and 2016 cycles, its marginal effectiveness has diminished toward historical lows in the 2023–2025 period. Simultaneously, the inhibitory effect of interest rate hikes has become increasingly shallow, suggesting severe balance sheet constraints and weak expectations in the current housing market rather than a classic "liquidity trap." The inclusion of stochastic volatility underscores the role of market uncertainty in dampening the efficiency of traditional policy instruments.

Keywords: Monetary policy; House prices; Time-varying; TVP-VAR model.

JEL Classification: E52, E58, R31.

1. Introduction

1.1. Background: The Real Estate-Monetary Nexus

China’s real estate market has served as a pivotal engine for economic growth over the past two decades, undergoing a drastic transformation from an era of rapid credit-driven expansion to a new phase characterized by deleveraging and structural adjustment (Glaeser et al., 2017). Since the commercialization of housing, the sector has been intrinsically linked to macro-financial stability (Schularick & Taylor, 2012; Deng et al., 2015; Wu et al., 2016). Over the same period, the People’s Bank of China (PBoC) has gradually transitioned its monetary policy framework from a strictly quantity-based targeting system, relying primarily on broad aggregates, toward a more targeted credit and price-based interest rate mechanism. This evolution reflects the central bank's effort to modernize macroeconomic management. However, the transmission of these policy instruments to housing prices has not been uniform. The interaction between monetary tools and asset prices is subject to evolving regulatory environments and exogenous shocks, creating a complex dynamic that challenges policy efficacy in the current cycle.

1.2. Problem Statement: The Lucas Critique and Structural Instability

Understanding these dynamics is complicated by the fact that traditional Vector Autoregression (VAR) models with constant parameters are inherently incapable of capturing such structural evolutions. By assuming a fixed economic relationship over the long term, static models ignore the "Lucas Critique," which posits that economic agents alter their behavior in response to policy regime changes. For instance, the sensitivity of housing prices to interest rate cuts in a booming market differs fundamentally from that in a market facing a liquidity crisis. Consequently, relying on average estimates risks masking the critical heterogeneity of policy effects. The necessity of this study lies in employing a Time-Varying Parameter Vector Autoregression (TVP-VAR) framework with stochastic volatility, which allows for the quantification of the evolving intensity and duration of policy shocks without imposing artificial linearity.

1.3. Research Questions and Objectives

Despite the rich literature on monetary transmission, a critical gap remains regarding the post-pandemic period, specifically the "policy effectiveness decay" observed between 2023 and 2025. To bridge this gap, this study is designed to answer two fundamental inquiries that are currently absent from the discourse. The first question investigates how the impulse response of house prices to targeted real estate credit and interest rates has structurally evolved across different historical cycles. By resolving these questions, the primary objective of this research is to provide granular identification of the "diminishing marginal effectiveness" in the contemporary Chinese housing market, thereby offering empirical evidence to policymakers that traditional transmission channels are facing significant friction due to household deleveraging.

2. Literature Review

2.1. Theoretical Framework: Transmission Channels

The transmission mechanism of monetary policy to asset prices is a foundational subject in macroeconomics (Mishkin, 2007). Theoretically, central banks influence housing markets primarily through two channels: the Interest Rate Channel and the Credit Availability Channel (Kiyotaki & Moore, 1997). The former operates by altering the user cost of capital; a reduction in policy rates lowers mortgage payments and increases the present value of future housing services, thereby stimulating demand. However, the strength of this transmission is not uniform across economies. As Calza et al. (2013) demonstrated, the responsiveness of house prices to monetary shocks is structurally dependent on the flexibility of the mortgage market. In economies with rigid credit constraints, the interest rate channel is often dampened, necessitating a greater reliance on quantitative instruments. This theoretical distinction is critical for analyzing China's market, which has historically operated under a dual-track system of quantitative targeting and interest rate regulation.

2.2. Policy Evolution in China: From Quantity to Price

The distinctiveness of China's monetary framework lies in its gradual transition from a quantity-based regime (targeting M2) to a price-based regime (targeting interest rates). This structural evolution presents a challenge for empirical modeling, a constraint widely acknowledged in Chinese macroeconomic research (Higgins & Zha, 2015). Chen et al. (2024) reconstructed China’s quarterly macroeconomic time series and identified a significant shift in policy rules. They argue that while the People's Bank of China (PBoC) has increasingly utilized interest rate corridors, the transmission to the real economy remains heavily influenced by "window guidance" and quantitative restrictions. This implies that relying solely on one broad instrument like M2 in an empirical model may fail to capture the full spectrum of policy interventions, justifying the inclusion of both targeted housing credit and interest rates in our variable set.

2.3. Macroprudential Regulation and Monetary Policy Interaction

In the Chinese context, the transmission of targeted credit is heavily constrained by these overlapping regulatory cycles. In recent years, the People's Bank of China has introduced a macroprudential assessment (MPA) system, particularly targeting the "three red lines" policy introduced in 2020 for the real estate sector (PBoC & MOHURD, 2020), and loan concentration management (Rogoff & Yang, 2024), alongside local administrative controls such as dynamic adjustments to Loan-to-Value (LTV) ratios and purchase restrictions (Crowe et al., 2013). When macroprudential policies tighten, the stimulating effect of traditional monetary easing (such as interest rate cuts) on housing prices is significantly weakened (Farhi & Werning, 2016; Kuttner & Shim, 2016).

In the context of recent empirical literature, a critical dynamic emerges when monetary policy attempts to ease macroeconomic conditions while macroprudential regulations remain in a tightening cycle, thereby constraining traditional transmission channels (e.g., Kuttner & Shim, 2016; Lu et al., 2023). While extensive research has documented monetary effectiveness during China's pre-2020 housing booms, there is relatively less empirical work dynamically quantifying this policy offset during periods of structural adjustment. This paper aims to

address this gap. By employing the TVP-VAR framework, we provide a macro-level quantification of how the strict macroprudential environment post-2020 has systematically attenuated the transmission efficacy of traditional monetary easing.

2.4. Nonlinearity and Time-Varying Dynamics

While earlier studies have successfully employed structural or factor-augmented VARs to evaluate Chinese monetary policy effectiveness (He et al., 2013; Liu et al., 2013; Fernald et al., 2014), traditional vector autoregression (VAR) models with constant parameters are increasingly viewed as insufficient for capturing the volatility of transitional economies. The relationship between monetary policy and housing prices is not static; it fluctuates in response to external shocks and policy uncertainty. To address this, recent literature has shifted toward time-varying parameter models. For instance, Lu et al. (2023) applied a time-varying framework to investigate how monetary policy uncertainty impacts regional housing markets in China. Their findings confirm that the sensitivity of house prices to policy shocks is highly unstable, exhibiting "flight-to-safety" effects during periods of high uncertainty. This validates our methodological choice of the TVP-VAR model, which allows us to capture the drifting coefficients that static models overlook.

2.5. The Post-Crisis Diminishing Returns and Balance Sheet Constraints

A critical gap in the existing literature is the lack of empirical evidence regarding the diminishing effectiveness of monetary policy in the post-2021 period. While earlier studies documented robust transmission, recent high-impact research suggests a structural break. Rogoff and Yang (2024) provide compelling evidence that China’s real estate sector has entered a phase of sharply diminishing returns. They argue that due to massive oversupply and high local debt, traditional credit expansion is no longer generating the same growth impulses as it did in previous cycles (Jordà et al., 2015). This phenomenon strongly resembles a "balance sheet recession" (Koo, 2013), where the marginal utility of monetary easing on asset prices decays significantly as households and developers prioritize debt minimization over profit maximization (Mian et al., 2017). This asymmetry in policy effectiveness aligns with

findings that monetary easing becomes significantly less powerful during economic downturns or periods of high uncertainty (Tenreyro & Thwaites, 2016; Eichenbaum et al., 2022).

3. Data

3.1. Data Selection

This study examines the transmission of monetary policy to the housing market through the interest rate channel and the credit channel, distinguishing between price-based and quantity-based policy instruments (Iacoviello, 2005; Aoki et al., 2004; Calza et al., 2013).

For the price-based instrument, the loan rate for maturities over five years is adopted as a proxy for mortgage financing costs. Considering China's interest rate liberalization reform, the benchmark lending rate prior to August 2019 is smoothly linked to the five-year Loan Prime Rate (LPR) thereafter (PBoC, 2019, Announcement No. 15, 16, and 30), ensuring a consistent time series.

For the quantity-based instrument, the year-on-year growth of medium- to long-term household loans is employed as a proxy for real estate credit. In the Chinese context, this variable primarily corresponds to mortgage lending and provides a more direct measure of housing financing conditions.

In addition, the Consumer Price Index (CPI) and the growth rate of industrial value added are included to control for inflation and real economic activity, respectively (Clarida et al., 1999). Based on these variables, a comprehensive framework is constructed to identify the transmission of monetary policy to house prices.

3.2. Data Preprocessing

To ensure the comparability and stationarity of the variables, all series have been pre-processed prior to estimation. Specifically, housing price data contain missing January month observations, which are first interpolated using an ARIMA model to effectively mitigate potential artifacts and biases that linear interpolation might otherwise introduce, particularly

in a context characterized by structural breaks. Subsequently, both housing prices and credit series are seasonally adjusted using the X-13ARIMA-SEATS procedure. After seasonal adjustment, these two variables are transformed into year-on-year growth rates to eliminate potential non-stationarity and long-term trends.

In contrast, investment (IAV) and consumer price index (CPI) are only seasonally adjusted without further transformation, as they are already expressed in growth-related terms. The interest rate variable is kept at levels to preserve its policy interpretation.

3.3. Unit Root Tests and Stationarity

To avoid spurious regression and ensure the stability of the MCMC algorithm in the TVP-VAR framework, we first conduct Augmented Dickey-Fuller (ADF) unit root tests on all selected variables. As shown in Table 1, the year-on-year variables—House Prices (HP), Industrial Added Value (IAV), and Inflation (CPI)—are stationary at their levels (I (0)). However, the policy rate (Rate) and credit aggregates (Credit) exhibit non-stationarity in levels.

Consequently, we take the first difference of the Rate and Credit variables. Subsequent tests confirm that these transformed series ($\Delta \mathrm{R}ate$ and $\Delta Credit$) are strictly stationary at the 1% significance level. This mixed I (0) and I (1) data treatment is standard in empirical macroeconomics; it preserves the valuable long-term economic information of the stationary variables while ensuring that all inputs fed into the model meet the strict stationarity requirement for time-varying parameter estimation. Economically, taking the first difference aligns perfectly with central bank operations: $\Delta Rate$ represents active policy adjustments (i.e., rate hikes or cuts), while $\Delta Credit$ captures the marginal acceleration or deceleration of credit supply. Both explicitly reflect exogenous policy interventions rather than static levels.

Table 1: Augmented Dickey-Fuller (ADF) Unit Root Tests

Variable	Transformation	t-Statistic	P-Value	Conclusion
HP	Level	-3.346**	0.0130	Stationary
IAV	Level	-3.806***	0.0028	Stationary
CPI	Level	-3.142**	0.0236	Stationary
ΔRate	First Difference	-10.121***	0.0000	Stationary
ΔCredit	First Difference	-6.011***	0.0000	Stationary

*Note: ***, ** and * denote significance at the 1%, 5%, and 10% levels, respectively.*

3.4. Lag Length Selection

Selecting an appropriate lag length is crucial for balancing the model's explanatory power and parsimony. This is particularly important for the TVP-VAR model with stochastic volatility, which is highly parameterized and consumes a significant number of degrees of freedom. We determine the optimal lag structure based on a standard constant-parameter VAR framework before estimating the time-varying model.

Table 2 presents the results of standard information criteria. While the Akaike Information Criterion (AIC) suggests 4 lags, both the Hannan-Quinn Information Criterion (HQIC) and the Schwarz Bayesian Information Criterion (SBIC) strongly indicate an optimal lag length of 2. Following the standard practice in Bayesian VAR literature to avoid over-fitting and preserve degrees of freedom, we adopt the strictly parsimonious suggestion provided by the SBIC. Therefore, the optimal lag length is set to 2, which adequately captures short-term monthly macroeconomic dynamics without over-parameterizing the model.

Table 2: Selection of Optimal Lag Length

Lag	LogL	AIC	HQIC	SBIC
0	-2602.02	25.067	25.100	25.147
1	-1234.90	12.162	12.357	12.643
2	-1166.52	11.745	12.102*	12.627*
3	-1138.00	11.711	12.230	12.995
4	-1107.59	11.659*	12.340	13.344

*Note: * indicates the optimal lag order selected by the corresponding criterion.*

3.5. Identification Strategy

While the PBOC closely monitors asset prices, operational frictions and administrative lags generally prevent monetary policy (Credit and Rate) from reacting to housing market fluctuations within the exact same month. Therefore, placing HP last in the Cholesky ordering effectively isolates exogenous monetary policy shocks from simultaneous endogenous responses.

Thus, to extract structural shocks and control for potential endogenous policy responses, the model employs a recursive identification strategy via Cholesky decomposition (Sims, 1980). The variables are ordered based on the standard macroeconomic assumption of sluggishness in real economy adjustments: IAV → CPI → Credit → Rate → HP. This specific ordering implies that real output and inflation respond to monetary policy with a lag, whereas the housing market, as an active asset market, reacts contemporaneously to all macroeconomic and policy shocks.

While alternative identification approaches, such as sign restrictions (Vargas-Silva, 2008) or external instruments, offer robust means to isolate policy shocks, applying them within a highly parameterized Bayesian TVP-VAR framework with stochastic volatility poses significant computational intractability and convergence challenges. Therefore, building on standard macroeconomic literature, our carefully theoretically grounded recursive ordering remains the most reliable and feasible baseline for identifying structural shocks in this time-varying setting.

4. Empirical Results (TVP-VAR Model)

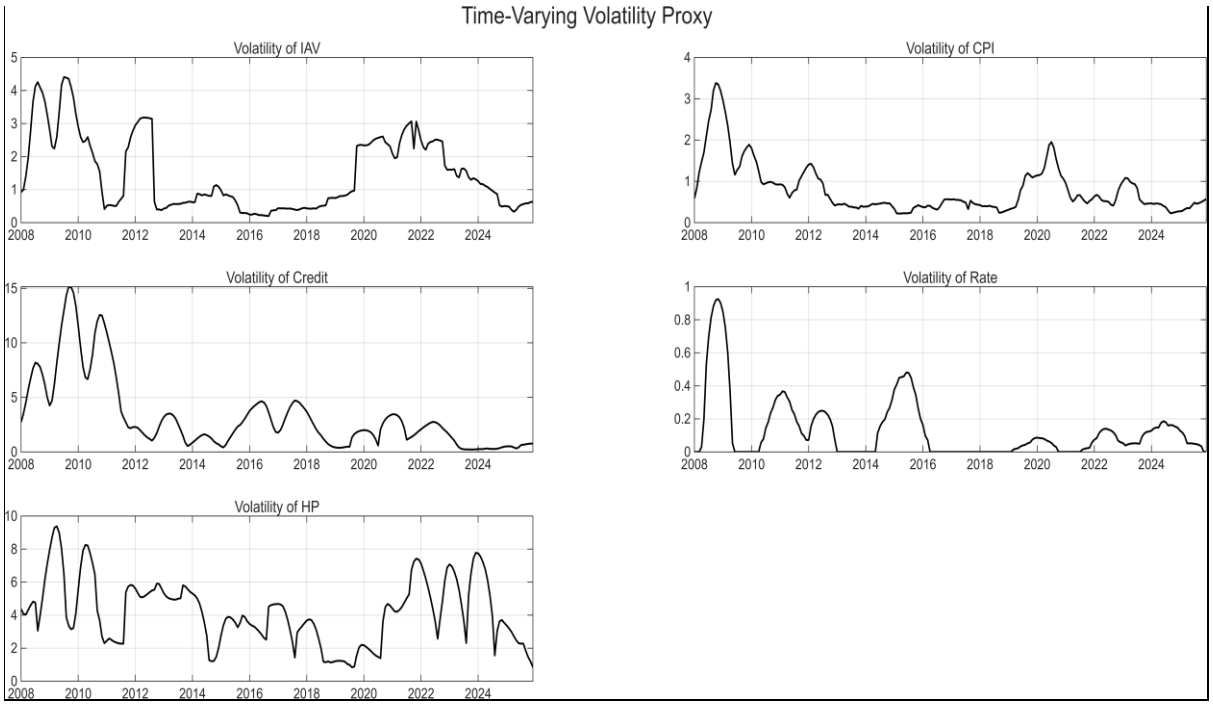
The following analysis is based on the Bayesian TVP-VAR estimation using the MATLAB package by Nakajima (2011), with 20,000 MCMC simulations.

4.1. Posterior Estimates of Stochastic Volatility

Before analyzing the impulse responses, we examine the stochastic volatility to verify the necessity of the TVP-VAR framework. Figure 1 displays the posterior estimates for the structural shocks.

Notably, the stochastic volatility of house prices (SV of HP, bottom panel) exhibits two distinct peaks. The first peak occurs around 2008, corresponding to the Global Financial Crisis. The second and more prolonged period of high volatility spans from 2020 to 2025. This period aligns with the liquidity crisis in the real estate sector and the "Three Red Lines" policy. The elevated volatility underscores the structural instability of the market and validates the use of a time-varying model.

Figure 1: Posterior Estimates of Stochastic Volatility



4.2. Time-Varying Impulse Responses: The 3D Landscape

Figure 2 and Figure 3 illustrate the three-dimensional evolution of policy effectiveness over the sample period (2008–2025). As shown in Figure 2, the response of house prices to

a housing credit shock (Credit) was most robust during the 2009 stimulus and 2016 destocking phases, characterized by sharp positive peaks. However, the response surface flattens and becomes highly volatile approaching 2024–2025, suggesting a diminishing marginal effect of credit expansion. Similarly, Figure 3 shows that the inhibitory effect of interest rate hikes (Rate) was strong in earlier cycles (deep negative valleys around 2014 and 2016) but has become notably shallower in the post-pandemic era.

Figure 2: 3D Time-Varying Impulse Response of HP to Credit Shock (Quantity Tool)

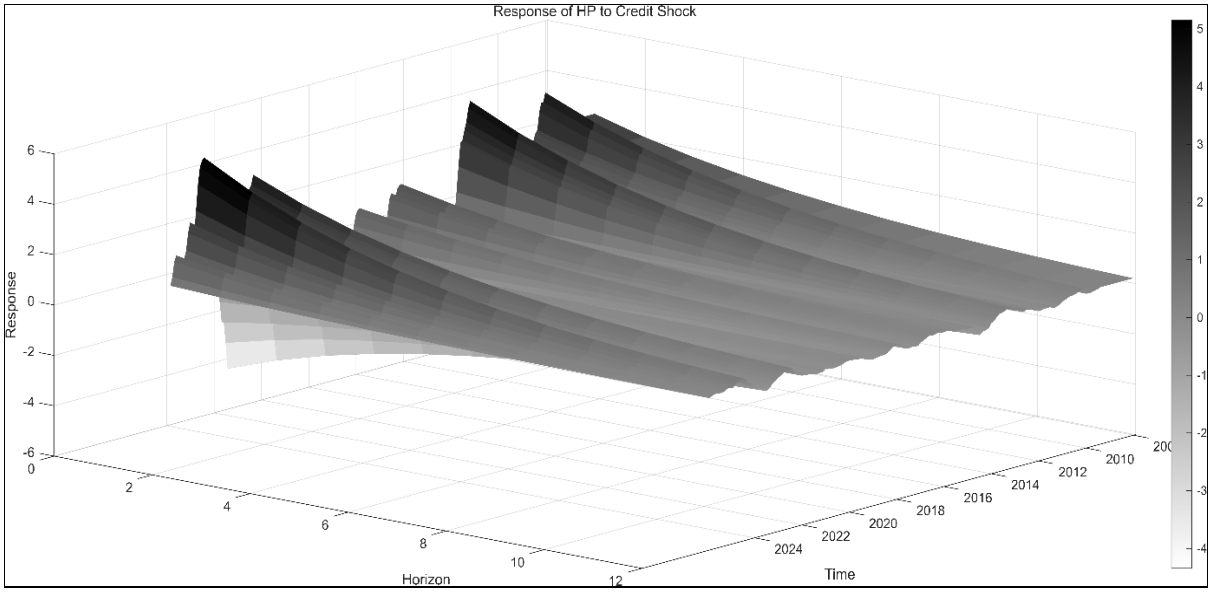
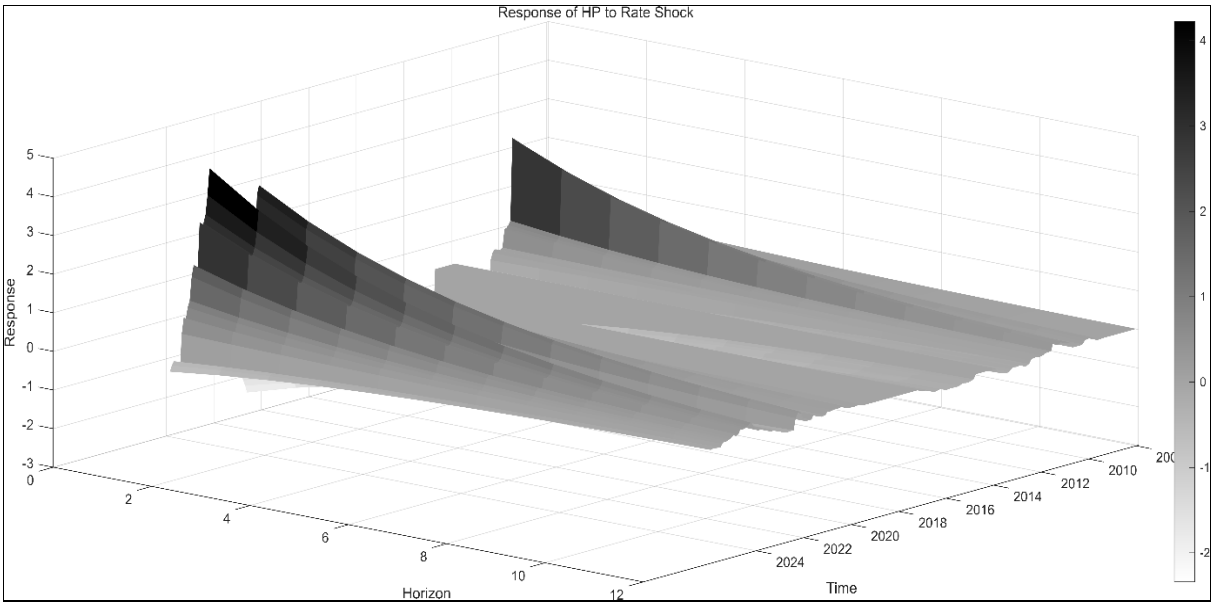


Figure 3: 3D Time-Varying Impulse Response of HP to Rate Shock (Price Tool)



4.3. Structural Evolution: Why Policies Lost Power in 2025? (Key Finding)

To provide a more granular analysis, we compare the impulse responses at specific historical points. Figure 4 reveals a striking structural shift. In the Left Panel (Credit to HP), the response in earlier easing cycles was sharp and positive. In contrast, the recent responses (2023-2024) hover closer to zero or exhibit rapid decay. This provides empirical evidence of severe balance sheet constraints in the current housing market—targeted credit expansion is failing to drive up asset prices steadily due to weak expectations. A similar dampening effect is observed in the Right Panel (Rate to HP), where market sensitivity to interest rate changes has significantly decreased in the 2023–2025 period.

The statistical robustness of this observed decay is supported by the stochastic volatility (SV) estimates in Figure 1, where the elevated volatility post-2020 aligns with a structural shift rather than a boundary artifact. Economically, the transmission friction in the post-2021 era appears largely driven by a severe contraction in credit demand alongside weakened expectations. As developers face macroprudential caps and households confront adjusted property valuations, their primary behavioral objective leans toward balance sheet repair (Koo, 2013). Consequently, conventional monetary easing—such as marginal LPR cuts—encounters a "pushing on a string" phenomenon (Tenreyro & Thwaites, 2016). Targeted credit exhibits limited transmission into actual housing transactions due to elevated risk premiums, rendering the market less sensitive to standard easing signals.

Notably, the robust magnitude of policy transmission observed in our pre-2020 cycles aligns well with recent empirical benchmarks derived from micro-level datasets (Holm et al., 2021). For instance, Fang et al. (2016) utilized extensive mortgage data to demystify the Chinese housing boom, while Chaney et al. (2012) used firm-level microdata to demonstrate how real estate booms heavily influenced capital allocation and credit demand in earlier cycles. Both confirm that historical policy stimuli significantly drove up asset valuations. However, our TVP-VAR framework uniquely captures the severe decay of this magnitude in the post-pandemic phase (where the peak response dropped to near zero), representing a distinct macro-level structural shift that earlier static models could not anticipate.

Figure 4: Impulse Responses at Specific Time Points (2013, 2018, 2024)

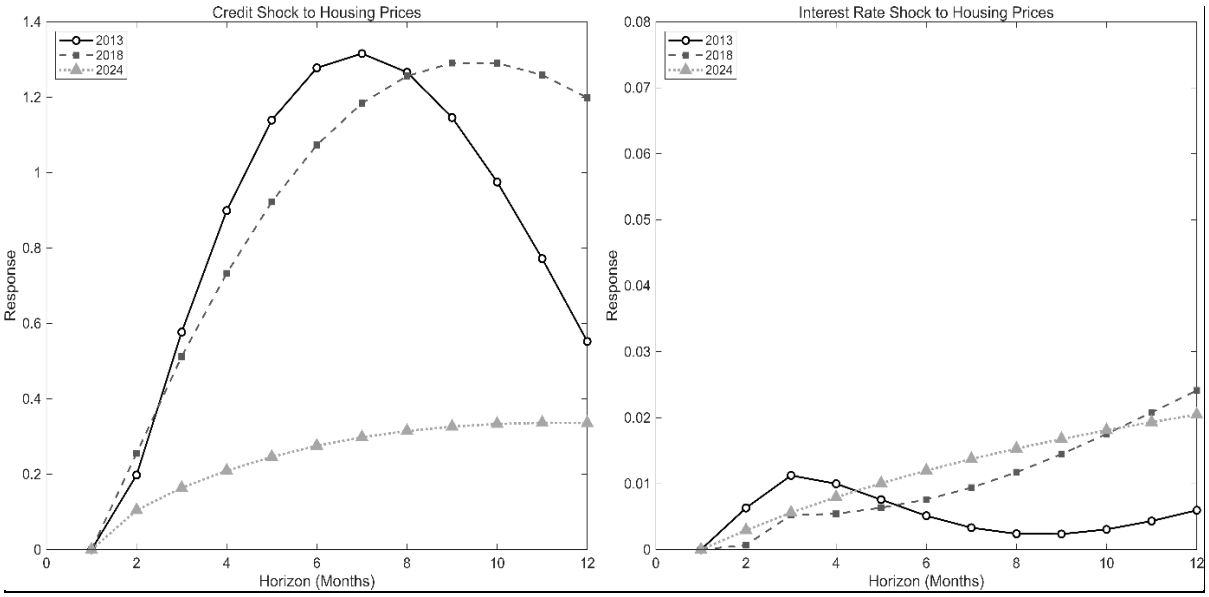


Figure 5: Time-Varying Impulse Responses at Different Lags (h=1, 4, 8)

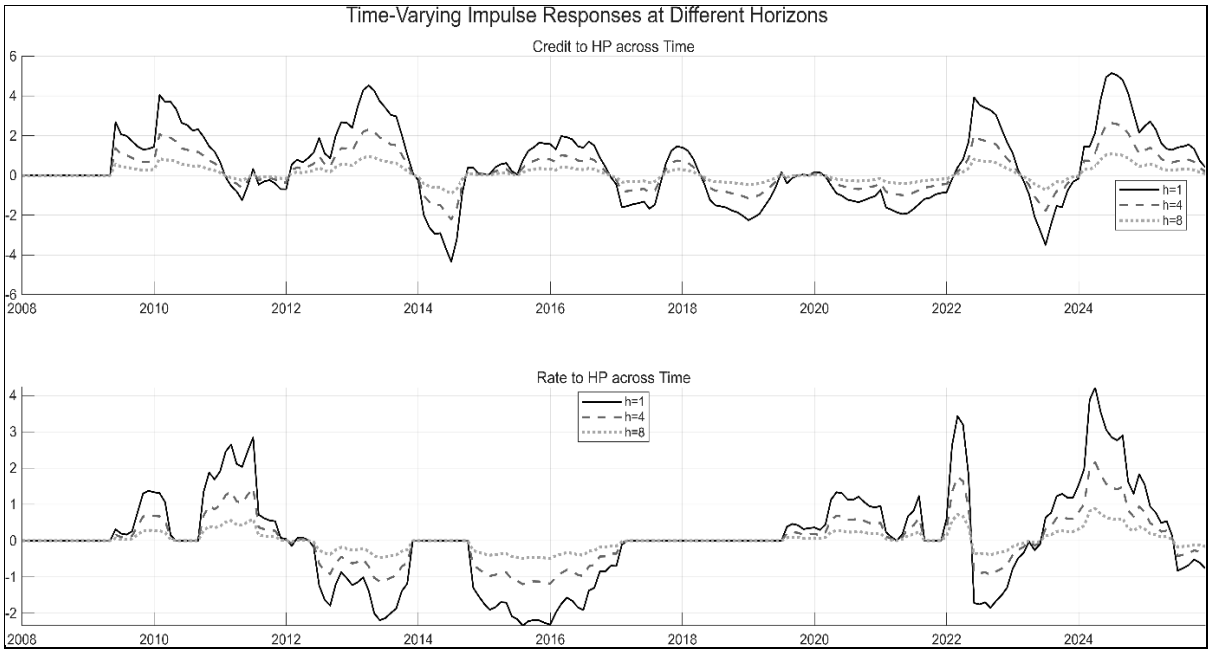
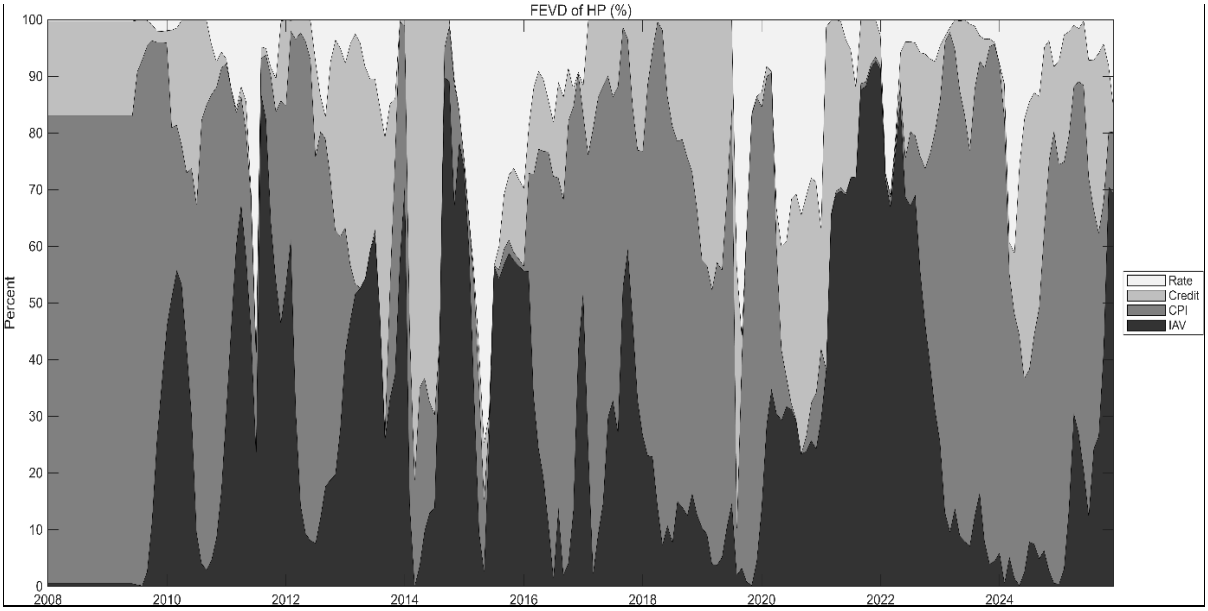


Figure 5 further confirms this trend by plotting the impulse responses at specific lags (h=1, 4, 8) over time. Both the stimulative effect of Credit and the inhibitory effect of Rate show a clear convergence toward zero after 2021, reaching historical lows in policy efficacy.

4.4. Variance Decomposition and Control Variable Analysis

Figure 6 presents the time-varying forecast error variance decomposition (FEVD) of house prices. The results show a regime shift: from 2008 to 2014, the market was dominated by quantity-based tools (Credit, Orange area). After 2015, the contribution of price-based tools (Rate, purple area) expanded significantly following interest rate liberalization.

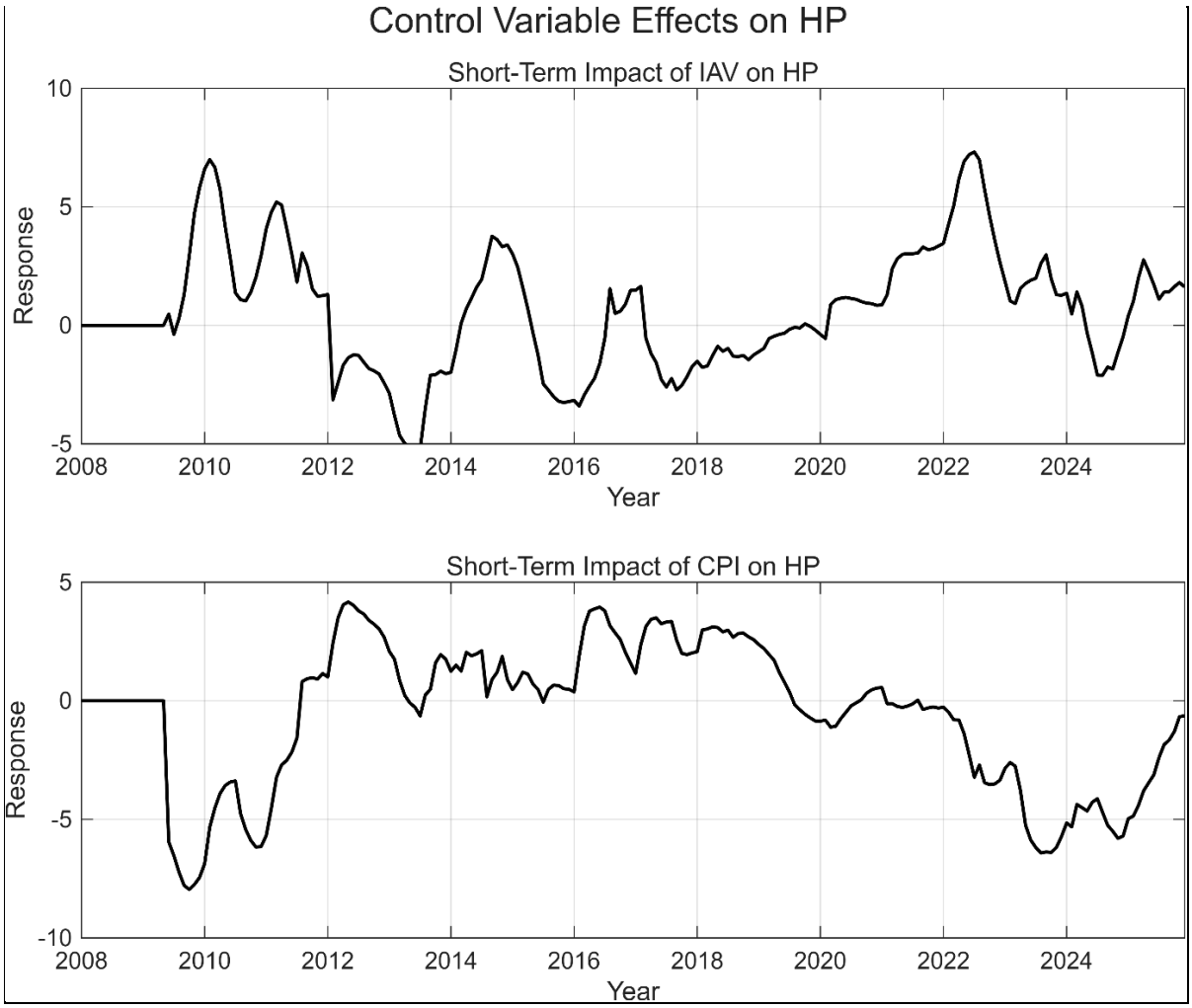
Figure 6: Time-Varying Forecast Error Variance Decomposition of House Price



Furthermore, Figure 7 illustrates the impact of the real economy (IAV) on house prices. The response fluctuates aligned with business cycles, confirming that fundamental economic growth remains a driver of housing value. Including IAV as a control variable ensures that the monetary policy effects identified above are exogenous.

Similarly, the lower panel of Figure 7 shows the short-term impact of inflation (CPI). House prices exhibit a positive response to CPI shocks in most periods, reflecting the hedging property of real estate against inflation. Including both IAV and CPI correctly isolates the exogenous monetary policy shocks.

Figure 7: Time-Varying Impulse Response of HP to IAV Shock (Control Variable)



5. Conclusion and Policy Implications

This study employed a Time-Varying Parameter Vector Autoregression (TVP-VAR) model to investigate the dynamic relationship between monetary policy and housing prices in China from 2008 to 2025. The empirical results yield three main conclusions:

First, policy heterogeneity is significant. The impact of both quantity-based (Credit) and price-based (Rate) instruments on house prices is not constant but varies considerably over time, justifying the use of the TVP framework.

Second, a structural break occurred post-2021. A crucial finding of this paper is the diminishing marginal effectiveness of monetary policy in the most recent period (2023–2025). As evidenced by the flattened and volatile impulse responses, the real estate market is constrained by a combination of long-term structural factors, including demographic shifts (aging population and slower urbanization), excess inventory, and severe household deleveraging. Despite continued monetary easing and targeted credit injection, the transmission mechanism to asset prices is impeded.

Third, the dominance of policy tools has evolved. The variance decomposition indicates a transition from a quantity-dominated regime in the early 2010s to a mixed regime involving interest rate channels in recent years.

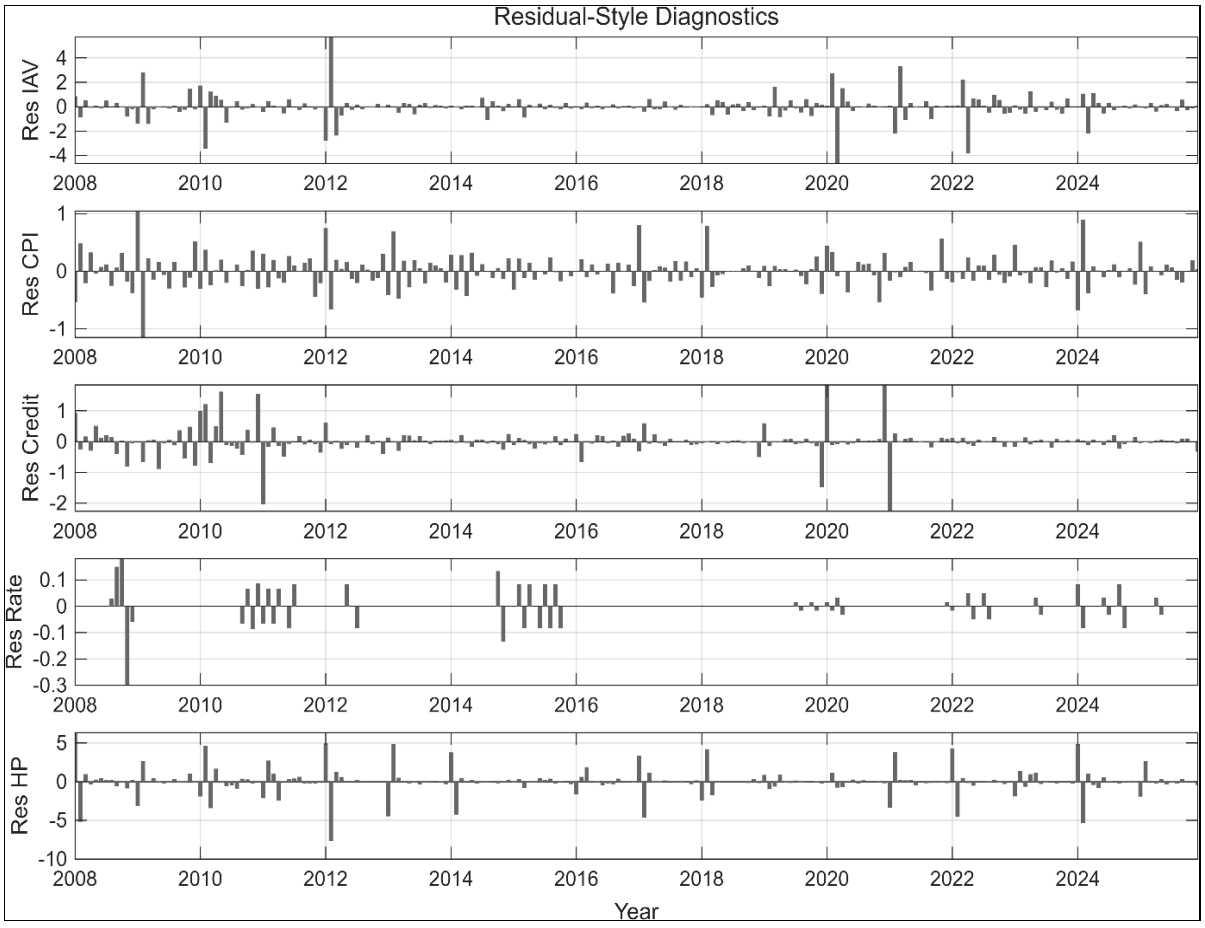
These empirical findings provide a data-driven rationale for optimizing policy strategies. First, given the attenuation of the credit channel—demonstrated by the flattened impulse responses in Figure 2—relying solely on broad credit expansion may not fully offset current balance sheet constraints. Therefore, structural monetary tools are necessary. Rather than broad-based easing, the People's Bank of China (PBoC) could continue deploying targeted instruments, such as Pledged Supplemental Lending (PSL), to provide precise funding that supports the delivery of unfinished housing projects and affordable housing initiatives, thereby bypassing the weakened credit demand of households and directly injecting liquidity into the real economy. Second, as evidenced by the historically shallow response of house prices to interest rate changes (Figure 3 and Figure 5), price-based tools are currently facing frictions. To improve this transmission channel, policy adjustments could involve dynamically calibrating macroprudential constraints to align with current market conditions, such as optimizing down-payment requirements in Tier-1 cities. Shifting toward precise structural interventions can help navigate current frictions in monetary transmission and facilitate the gradual repair of market participants' balance sheets.

Appendix: Robustness Checks

A.1. Model Diagnostics

The sample autocorrelation function of the residuals indicates no significant serial correlation, confirming the validity of the TVP-VAR model specification.

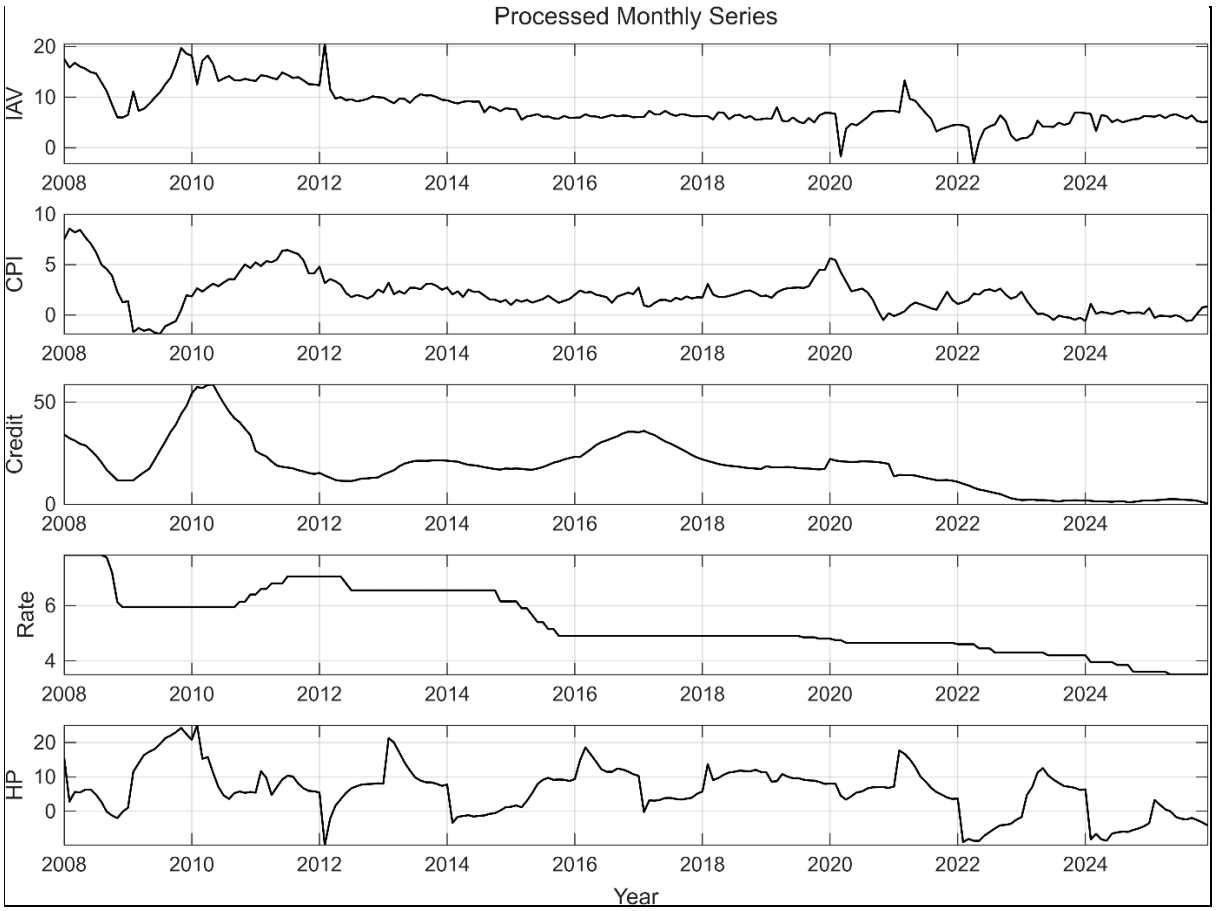
Figure A1: Sample Autocorrelation Function of Residuals



A.2. Data Overview

The processed time series used for estimation are shown below, exhibiting stationarity following the transformations described in Section 3.2.

Figure A2: Transformed Data Series (IAV, CPI, Credit, Rate, HP)



Declaration of AI Use

During the preparation of this manuscript, the authors used ChatGPT-4 for language editing. All AI-generated outputs were critically reviewed, edited, and approved by the authors, who take full responsibility for the final content of the manuscript.

Acknowledgements

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article. The authors would like to express their sincere gratitude to Dr. Elya Nabila Abdul Bahri for her valuable guidance and constructive discussions during the earlier stages of this project. This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

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