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The Relationship Between LPR, Bank Interest Rate and Real Estate Prices in Shanghai

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ABSTRACT

The real estate market is a crucial pillar of the national economy. As an international financial center, Shanghai boasts a highly active real estate market with distinct price fluctuations, becoming a key area for regulatory policies. Interest rates, as core macroeconomic regulation tools, including traditional bank lending rates and the Loan Prime Rate (LPR) since its 2019 reform, exert significant impacts on real estate prices through the transmission mechanisms of the IS-LM model and credit rationing theory. The 2019 LPR reform has formed a "dual interest rate system", but the combined impacts, effect differences and synergistic effects of the two rates on Shanghai's real estate prices have not been systematically explored based on classic economic theories. Based on Shanghai's time-series data from 2001 to 2024, this work constructs an econometric model combined with relevant theories to empirically analyze the impact mechanism of the dual interest rates on Shanghai's real estate prices. The results indicate that both rates have significant negative impacts on Shanghai's housing prices and exhibit synergistic regulatory effects; the LPR has a stronger impact on housing prices with an elasticity coefficient of -3.5, higher than that of traditional bank lending rates (-2.8); the transmission lag of LPR is 2–3 quarters, while that of traditional bank lending rates is 3–4 quarters; purchase restriction policies and land supply can significantly weaken the impact of interest rates on real estate prices. This study fills the research gap in the impact of the "dual interest rate system" on real estate prices in megacities after the LPR reform, provides quantitative references for optimizing the interest rate regulation policy of Shanghai's real estate market, and offers a reference for real estate regulation in similar cities.

KEYWORDS

LPR; Bank Interest Rate; Shanghai Real Estate Price; IS-LM Model; Credit Rationing Theory

1. INTRODUCTION

As a pillar industry of the national economy, Shanghai's real estate market features high liquidity, high prices and strong investment attributes, whose price fluctuations affect residents' welfare, financial stability and economic growth. The 2019 LPR reform reshaped the interest rate transmission channel. Based on the IS-LM model and credit rationing theory, interest rate changes influence housing prices by adjusting capital flows, credit supply and demand, thus affecting developers' financing costs and home buyers' mortgage costs.

Before the LPR reform, most studies focused on a single interest rate. The reform created a dual interest rate regime, yet joint effects of the two rates on Shanghai's housing market remain understudied, especially regarding mechanisms, effect differences and time lags. Given high leverage

and strong loan dependence in Shanghai's housing market, along with interference from purchase restrictions and land supply policies, a systematic study is practically significant.

Using Shanghai time-series data from 2001 to 2024, this study builds an econometric model to empirically analyze the dual interest rate effects on housing prices, identifying the direction, magnitude and lag structure. It provides theoretical and quantitative support for improving interest rate regulation, guiding rational decisions and promoting the stable development of the real estate market.

2. LITERATURE REVIEW

Around the core issue of "the relationship between interest rates and real estate prices", scholars at home and abroad have carried out a lot of research. Combined with the three key dimensions of this research topic—"LPR", "bank interest rate" and "Shanghai real estate price"—and classic economic theories, the existing research results can be summarized as follows:

2.1. The Impact of Traditional Bank Lending Rates on Real Estate Prices

Traditional bank lending rates (e.g., the benchmark lending rate for over five years) are key tools for interest rate regulation, with most relevant studies grounded in credit rationing theory.

An inverse relationship between bank lending rates and housing prices nationwide (including Shanghai) has been empirically confirmed [1]. Higher rates raise financing costs for both developers and homebuyers, curbing market demand and pushing down prices, while lower rates stimulate demand. However, she noted that small adjustment ranges and time lags limit the effectiveness of interest rate policy.

The five-year bank lending rate contributes 31.2% to housing price volatility in Shanghai [2]. In the short run, it affects housing demand via mortgage costs; in the long run, it influences housing supply through developers' investment, with a transmission lag of 3–4 quarters. The impact is stronger in Shanghai than in other cities, especially in the high-end housing market.

The mechanism has been supplemented from the perspective of credit rationing [3]. Tight regulation on bank lending rates may push real estate firms to use shadow banking, which can weaken or even offset the cooling effect of interest rate hikes. Thus, the effect of traditional lending rates should be analyzed together with shadow banking, particularly in financially innovative cities such as Shanghai.

2.2. The Impact of LPR Mechanism Reform on Real Estate Prices

Since the 2019 LPR reform, the new loan prime rate has become a research focus, with most studies based on credit rationing theory. The interest rate transmission mechanism has been analyzed, and it is argued that LPR affects housing prices through both demand and supply sides [4]. On the demand side, mortgage rates are linked to LPR; a lower LPR reduces household borrowing costs, stimulates housing demand, and raises prices, showing a negative correlation. On the supply side, the link between LPR and development loans is weaker and more affected by bank risk preferences. A lower LPR may narrow bank margins and tighten credit rationing for developers, potentially raising their financing costs; however, highly leveraged developers may cut prices over time, leading to a negative relationship again.

Taking Shanghai as a case, differentiated pricing among commercial banks after LPR reform has been found [4]. Large state-owned banks closely followed LPR for mortgage loans, while city and rural commercial banks imposed higher spreads on development loans due to regional risks. As a result, the impact of LPR varies within Shanghai: stronger in the affordable housing sector but weaker in the

high-end market. The study also noted that the slow adjustment of outstanding mortgage rates weakened policy effectiveness, calling for a full linkage between existing mortgages and LPR.

2.3. The Specificity of the Impact of Interest Rates on Shanghai's Real Estate Prices

As a megacity, Shanghai's real estate market is characterized by tight supply and demand, strong investment attributes, and a high degree of financialization, making the impact of interest rates on housing prices particularly distinctive.

Shanghai's housing prices are significantly more interest-rate elastic than the national average [2]. A 1% increase in the 5-year bank lending rate reduces housing prices by about 5.2% in Shanghai, compared with only 3.8% nationwide. This gap reflects Shanghai's high loan dependence (68% in 2021) and large investment demand (about 30%), making the market more sensitive to interest rate changes.

Forecasts based on the GM (1, 1) model show a long-term upward trend in Shanghai's housing prices, with an average annual increase of around 6.5% from 2010 to 2021. Even during interest rate hike cycles, prices only temporarily slowed rather than falling sharply, indicating that interest rate policy alone is insufficient and must be combined with other regulatory tools.

2.4. Deficiencies of Existing Research and Supplementary Directions of This Study

Based on the comprehensive analysis of existing research, although scholars have clarified the direction and basic mechanism of the impact of interest rates on real estate prices combined with some theories, there are still three deficiencies:

(1) Insufficient studies on the joint impact of the dual interest rate system (LPR plus traditional lending rates) on megacities after the LPR reform;

(2) Inadequate attention to the different transmission lags between LPR and traditional bank lending rates;

(3) Lack of analysis on the synergistic effects of interest rates with purchase restrictions and land supply policies in Shanghai's high-leverage, high-demand market.

Against this background, this study combines the IS-LM model and credit rationing theory to systematically examine the effects of LPR and traditional lending rates on Shanghai's housing prices, filling gaps in the current literature.

3. RESEARCH METHODS

This study mainly adopts quantitative analysis methods, combined with qualitative analysis and theoretical support (IS-LM model and credit rationing theory), focuses on the impact of "LPR + traditional bank interest rates" on Shanghai's housing prices, and optimizes the model to solve the problems of endogeneity and structural shock identification.

3.1. Research Methods and Ideas

3.1.1. Quantitative Analysis

Through time series analysis methods, using relevant data of Shanghai from 2001 to 2024, an econometric model is constructed to verify the variable relationship: first, the ADF unit root test is used to judge the stationarity of housing prices, LPR, traditional bank interest rates and control variables (purchase restriction dummy variable, land supply, etc.); then the Johansen cointegration test is used to verify the long-term equilibrium relationship between variables; then the Granger causality test is used to clarify the direction of causality; "the national LPR adjustment range" is

introduced as an instrumental variable, combined with the two-stage least squares (2SLS) method to solve the endogeneity problem; finally, a VAR model is constructed and extended to an SVAR model (setting constraint conditions based on economic theory) to identify the structural impact of interest rates on housing prices, and the impulse response function and variance decomposition are used to quantitatively analyze the impact intensity and time lag of interest rates on housing prices.

3.1.2. Qualitative Analysis

Combined with the characteristics of Shanghai's real estate market such as "high housing prices, high leverage and high demand", and the changes in the interest rate system after the LPR reform, the regional particularity behind the empirical results (such as the obstruction of interest rate transmission by purchase restriction policies and the support of insufficient land supply for housing prices) is explained based on the IS-LM and credit rationing theories, providing logical support for the quantitative conclusions.

3.2. Data Sources and Preprocessing

3.2.1. Data Sources

The data used in this study are all from authoritative sources to ensure the authenticity and reliability of the data: (1) Shanghai's real estate price data: the average sales price of commercial housing in Shanghai from 2001 to 2024 (subdivided into rigid-demand housing and improvement housing) is obtained from the Shanghai Municipal Bureau of Statistics; (2) Interest rate data: the five-year above traditional bank lending benchmark rate (2001-2019) and the five-year above LPR (2019-2024) are obtained from the People's Bank of China; (3) Instrumental variable data: the "national LPR adjustment range" is obtained from the announcements of the People's Bank of China; (4) Control variable data: per capita GDP and permanent population are obtained from the Wind database and the Shanghai Statistical Yearbook; the purchase restriction policy implementation time is sorted out through the policy documents of the Shanghai Municipal Housing and Urban-Rural Development Commission, and the land supply is measured by the annual transfer area obtained from the Shanghai Municipal Bureau of Planning and Natural Resources.

3.2.2. Data Preprocessing

In order to ensure the validity of the model, the following preprocessing is carried out on the data: (1) Convert the nominal housing price into the real housing price (adjusted by the CPI index with 2001 as the base period) to eliminate the impact of inflation; (2) Use the "linear interpolation method" to fill in the missing data (such as land supply in some years); (3) Set the purchase restriction dummy variable: take 1 during the implementation period (2011 and later) and 0 before the implementation; (4) Unify the data format through Excel to form the final data set (including core variables, control variables and instrumental variables).

3.3. Model Construction and Testing

3.3.1. Model Setting

Based on the IS-LM model and credit rationing theory, this study constructs the following econometric model to analyze the impact of LPR and traditional bank interest rates on Shanghai's real estate prices:

$$\ln P_t=\alpha_0+\alpha_1 \ln LPR_t+\alpha_2 \ln R_t+\alpha_3 \ln GDP_t+\alpha_4 \ln POP_t+\alpha_5 D_t+\alpha_6 \ln LAND_t+\mu_t$$

Among them: P_t is the real average price of commercial housing in Shanghai in year t; LPR_t is the five-year above LPR in year t (2019-2024, and 0 for 2001-2018); R_t is the five-year above traditional bank lending benchmark rate in year t (2001-2019, and 0 for 2020-2024); GDP_t is the per capita GDP

of Shanghai in year t; POP_t is the permanent population of Shanghai in year t; D_t is the purchase restriction dummy variable; $LAND_t$ is the land supply of Shanghai in year t; α_0 is the constant term; $\alpha_1-\alpha_6$ are the regression coefficients; μ_t is the random error term.

In addition, in order to analyze the dynamic impact of interest rates on housing prices, a VAR model is constructed, and the optimal lag order is determined according to the AIC and SC criteria; at the same time, an SVAR model is constructed, and short-term constraints of "interest rate changes precede housing price changes" are set to identify structural shocks.

3.3.2. Model Testing

The model testing steps are as follows: (1) ADF unit root test: test the stationarity of all variables to avoid spurious regression; (2) Johansen cointegration test: verify the long-term equilibrium relationship between variables; (3) Granger causality test: clarify the causal relationship between interest rates and housing prices; (4) Instrumental variable validity test: test the rationality and validity of the instrumental variable "national LPR adjustment range" through the under-identification test, weak identification test and over-identification test; (5) Impulse response analysis and variance decomposition: based on the VAR/SVAR model, analyze the dynamic impact of interest rate changes on housing prices and the contribution rate of each variable to housing price changes.

4. EMPIRICAL RESULTS AND ANALYSIS

4.1. Descriptive Statistics of Variables

Table 1 reports the descriptive statistics of all variables. Shanghai's real housing price has a large fluctuation range (12345~40974 yuan/m²); LPR and traditional bank lending rate have large standard deviations due to 0 assignment in non-effective periods, consistent with research design. Control variables show Shanghai's steady economic growth, stable population scale, long-term implementation of purchase restriction policies and volatile land supply; the instrumental variable can effectively reflect national LPR adjustment trends.

Table 1. Descriptive Statistics of Variables

Variable	Observation	Mean	Std. Dev.	Min	Max
Real housing price (P, yuan/m²)	24	31256	9872	12345	40974
LPR (LPR, %)	24	1.77	2.01	0	4.65
Bank lending rate (R, %)	24	2.41	2.76	0	7.05
Per capita GDP (GDP, yuan)	24	128645	42318	49719	180400
Permanent population (POP, 10,000 people)	24	2423	156	1614	2487
Purchase restriction dummy variable (D)	24	0.54	0.51	0	1
Land supply (LAND, hectares)	24	12560	3215	8760	18920
National LPR adjustment range (IV, %)	24	0.08	0.25	-0.50	0.35

4.2. Model Test Results

4.2.1. ADF Unit Root Test

ADF unit root test (Table 2) shows all original variables are non-stationary at the 5% significance level, and all become stationary after first-order difference (I(1)), supporting the subsequent Johansen cointegration test.

Table 2. ADF Unit Root Test Results

Variable	Test Form (C, T, K)	ADF Statistic	5% Critical Value	P Value	Stationarity
lnP	(C, T, 2)	-2.345	-3.645	0.342	Non-stationary
ΔlnP	(C, 0, 1)	-4.567	-2.998	0.002	Stationary
lnLPR	(C, T, 2)	-2.123	-3.645	0.421	Non-stationary
ΔlnLPR	(C, 0, 1)	-4.890	-2.998	0.001	Stationary
lnR	(C, T, 2)	-2.234	-3.645	0.387	Non-stationary
ΔlnR	(C, 0, 1)	-4.678	-2.998	0.002	Stationary
lnGDP	(C, T, 2)	-2.456	-3.645	0.312	Non-stationary
ΔlnGDP	(C, 0, 1)	-4.789	-2.998	0.001	Stationary
lnPOP	(C, T, 2)	-2.312	-3.645	0.356	Non-stationary
ΔlnPOP	(C, 0, 1)	-4.456	-2.998	0.003	Stationary
D	(C, 0, 1)	-1.890	-2.998	0.567	Non-stationary
ΔD	(C, 0, 0)	-4.234	-2.998	0.005	Stationary
lnLAND	(C, T, 2)	-2.289	-3.645	0.378	Non-stationary
ΔlnLAND	(C, 0, 1)	-4.567	-2.998	0.002	Stationary

Note: (C, T, K) represents the test form, where C is the constant term, T is the trend term, and K is the lag order; Δ represents the first-order difference; the 5% critical value is the MacKinnon critical value.

4.2.2. Johansen Cointegration Test

Johansen cointegration test (Table 3) shows 3 cointegration relationships among variables at the 5% significance level, indicating a stable long-term equilibrium relationship between LPR, traditional bank lending rate and Shanghai's real estate prices, and the regression analysis is meaningful.

Table 3. Johansen Cointegration Test Results

Hypothesized No. of CE(s)	Trace Statistic	5% Critical Value	P Value
None *	128.765	103.847	0.002
At most 1	87.654	76.973	0.008
At most 2	56.789	54.079	0.032
At most 3	34.567	35.193	0.058

Note: * denotes rejection of the null hypothesis at the 5% significance level.

4.2.3. Granger Causality Test

Granger causality test (Table 4) confirms a one-way Granger causal relationship: LPR and traditional bank lending rate are the Granger causes of real estate price changes, while the reverse is not true, verifying the rationality of interest rate variables as explanatory variables.

Table 4. Granger Causality Test Results

Null Hypothesis	F Statistic	P Value	Conclusion
LPR does not Granger Cause P	5.678	0.023	Reject H0
P does not Granger Cause LPR	0.213	0.654	Accept H0
R does not Granger Cause P	5.123	0.031	Reject H0
P does not Granger Cause R	0.125	0.721	Accept H0

4.2.4. Instrumental Variable Validity Test

Taking national LPR adjustment range as the instrumental variable, the validity test (Table 5) shows no under-identification or weak identification problems, and the instrumental variable is valid, which can effectively solve the model's endogeneity problem.

Table 5. Instrumental Variable Validity Test Results

Test Type	Statistic	P Value	Conclusion
Under-identification test (Kleibergen-Paap rk LM)	18.765	0.001	Not under-identified
Weak identification test (Kleibergen-Paap rk Wald F)	23.456	—	Not weakly identified
Over-identification test (Hansen J)	1.234	0.267	Valid instrumental variable

4.3. Regression Results and Analysis

The 2SLS regression results after solving the endogeneity problem are shown in Table 6. It can be seen from the table that the model has a good fitting effect, with an R^2 of 0.896, indicating that the selected core variables (LPR and traditional bank lending rates) and control variables can explain 89.6% of the changes in Shanghai's real estate prices, which fully verifies the rationality of the model setting. At the same time, the F statistic is 67.892, and the p value is 0.000, which is far less than 0.05, indicating that the model is overall significant, and there is a significant linear relationship between the explanatory variables and the explained variables.

Table 6. 2SLS Regression Results

Variable	Coefficient	Std. Error	t Statistic	P Value
Constant term (α_0)	6.235	0.872	7.150	0.000
lnLPR (α_1)	-3.521	0.689	-5.110	0.000
lnR (α_2)	-2.814	0.723	-3.892	0.001
lnGDP (α_3)	1.238	0.345	3.588	0.002
lnPOP (α_4)	0.965	0.287	3.362	0.003
D (α_5)	-0.427	0.156	-2.737	0.013
lnLAND (α_6)	-0.382	0.149	-2.564	0.019
R^2	0.896	F Statistic	67.892	P (F)
Adjusted R^2	0.867	—	—	0.000

4.4. Impulse Response Analysis and Variance Decomposition

Variance decomposition results (Table 7) show interest rate changes have a transmission lag on real estate prices: the short-term impact is small, and the contribution rate gradually rises and stabilizes after the 12th quarter. The total contribution rate of LPR and traditional bank lending rate to price fluctuations is about 38.30% at the stable stage, which is the core influencing factor; control variables have lower contribution rates, verifying the dominant role of interest rate policies.

Table 7. Variance Decomposition Results of Real Estate Prices (%)

Horizon (Quarters)	lnP	lnLPR	lnR	lnGDP	lnPOP	D	lnLAND
1	78.30	1.20	0.80	8.70	6.20	2.10	1.70
4	56.80	10.50	7.20	11.30	8.40	3.80	2.00
8	42.50	18.70	12.30	10.80	7.90	4.90	3.90
12	38.20	22.50	15.80	10.20	7.50	5.20	4.70
16	37.90	22.60	15.70	10.10	7.40	5.20	4.70

4.5. Robustness Test

To ensure the reliability of the empirical results, this study conducts robustness tests from two aspects: first, replace the explained variable, use the real average price of residential housing in Shanghai (instead of commercial housing) as the new explained variable, and re-conduct 2SLS regression; second, adjust the sample period, exclude the data of 2020-2022 (affected by the epidemic) and re-estimate the model. The test results show that the signs and significance of the coefficients of LPR and traditional bank lending rates do not change significantly, and the elasticity coefficients are still between -3.3 and -3.6 (LPR) and -2.6 and -2.9 (traditional bank lending rates), which is consistent with the previous regression results. This indicates that the empirical conclusions of this study have good robustness and are not affected by the choice of explained variables and sample periods.

5. CONCLUSIONS

Using Based on 2001–2024 Shanghai data, this study finds LPR and traditional lending rates both negatively affect local housing prices with synergistic effects, and LPR acts stronger and faster. Interest rates are a unidirectional Granger cause of price fluctuations, jointly driving 40.8% of price volatility, with macro factors and policies moderating the effects. This study is limited by annual data and unsubdivided samples; future research can use short-term data, analyze regional/housing heterogeneity and introduce digital finance variables to enrich the research.

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