DOI: 10.55643/fcaptp.1.66.2026.5017

HOUSING PRICES AND BANKS' REAL ESTATE LOAN RISK: THE MEDIATING ROLE OF EDUCATION

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ABSTRACT

After more than two decades of rapid growth, China's real estate market has gradually contracted in recent years amid economic weakness, with property prices beginning to fall sharply. Since new home sales in China primarily operate under a pre-sale system, where developers secure government land through auctions, mortgage that land to banks for development funding, and rely on bank capital alongside buyers' down payments and mortgages, the price decline not only adversely impacts banks' real estate loan risks but also leads to buyers defaulting due to insufficient collateral value, thereby amplifying systemic financial risks. Against this backdrop, our study examines the mediating role of educational attainment, measuring whether regional housing price fluctuations influence the non-performing loan ratio of commercial banks' real estate loans through educational levels. Using a bank-level panel matched to provincial socio-economic indicators, we estimate fixed effects models and implement a three-step mediation design with bootstrap inference. The evidence reveals a clear mechanism: changes in housing prices are associated with higher regional educational attainment; in turn, education is linked to greater credit expansion and higher non-performing loan ratios. Once this channel is taken into account, the direct link between housing prices and bank risk markedly attenuates, with the bulk of the overall effect operating indirectly through education. These patterns are economically meaningful, robust to alternative education proxies, and extensive resampling. The findings highlight a macroprudential paradox: while better-educated borrowers are typically safer at the micro level, improvements in human capital can, at scale, amplify risk-taking and balance-sheet exposure. Supervisors should therefore monitor human capital trends alongside collateral dynamics and incorporate them into early warning systems and the calibration of borrower and capital-based tools, so that bank risk assessments remain informative even in a housing market downturn.

Keywords: housing prices, real estate industry, real estate loan risks, China's commercial banks, bank risk-taking, mediating analysis, education attainment

JEL Classification: G21, E44, I25, R31, C23

Received: 05/10/2025
Accepted: 25/01/2026
Published: 28/02/2026

INTRODUCTION

China's economy is navigating a downturn in the real estate sector, making the stability of the banking system crucial to macroeconomic stability. A two-way transmission exists between macroeconomic conditions and banking behavior: the real estate cycle impacts the financial system through macro channels such as aggregate demand, local government finances, and population mobility, while banks' credit allocation and risk preferences in turn shape regional economies and asset prices. Against this backdrop, the non-performing loan ratio for real estate loans, a core indicator measuring asset quality and systemic pressure, directly reflects the impact of the real estate sector on bank balance sheets. This study adopts a macro perspective to examine the relationship between housing prices, regional human capital, and banks' real estate credit risk, focusing on whether housing prices transmit to bank non-performing loans through the structural factor of educational attainment.

Against this backdrop, China's population is more educated than ever. The gross higher education enrollment rate now exceeds 60% according to data released by the National

Statistics Bureau of China, reflecting a dramatic improvement in human capital over the past decade. A more highly educated populace typically enjoys higher income potential and may exhibit different housing demand, financial behavior, and risk preferences. If housing cycles help shape regional education profiles, and education, in turn, influences borrowing capacity, portfolio choices, and banks' lending appetite, then human capital is not merely background noise but a transmission channel. This juxtaposition of a cooling housing market with a rising education level raises an intriguing question: Could human capital dynamics alter or mitigate the impact of housing market fluctuations on bank stability?

Specifically, our questions are:

- RQ_1: Do housing price changes significantly affect banks' real estate loan NPL ratios?
- RQ_2: Do housing prices influence regional education levels?
- RQ_3: Does education constitute a statistically significant mediating channel between housing prices and real estate loan NPLs?

This study is motivated by the premise that educational attainment may be a "missing link" in the transmission from housing prices to bank risk. We hypothesize that human capital serves as a mediating role that influences how property market changes affect real estate loan performance at the macro level. There are reasons to suspect such a linkage. During the boom years, rising housing prices often coincided with greater regional wealth and fiscal resources, enabling higher public and private investment in education. Booming property markets also tend to attract an influx of skilled, highly educated workers to thriving regions, thereby raising the average human capital level of those areas. Improved education can, in turn, transform the financial landscape – more educated populations typically demand more sophisticated financial services, take on larger mortgages for homeownership, and may prompt banks to expand credit supply in high-education regions. Conversely, in a downturn, an educated populace might be more financially resilient or cautious, potentially dampening default waves. By moving beyond borrower-level analysis to a macro-financial perspective, we focus on how aggregate human capital might amplify or dampen the impact of housing price fluctuations on systemic credit risk.

To investigate this relationship, we assemble a panel dataset of Chinese commercial banks matched with provincial-level data on education and housing prices. Our empirical approach employs a three-step fixed-effects mediation analysis supplemented by bootstrap inference for significance testing. This design allows us to quantify not only the direct effect of housing price changes on bank risk, but also the indirect effect operating through the education channel. The results reveal a striking pattern. We find that housing price movements affect bank credit risk significantly through changes in human capital.

Our contributions are threefold. First, we introduce population human capital structure into the analysis of financial stability, extending the literature on housing cycles and bank risk by adding a demographic dimension. By identifying education as a mediating channel, we offer a fresh explanation for why some regions that enjoyed rapid property price growth later see banks taking on more risk despite ostensibly higher borrower quality. This theoretical contribution bridges a gap in existing research, which has seldom linked macro-level human capital trends with credit risk dynamics. Second, we demonstrate an empirical methodology for detecting mediation effects in panel data. The three-step fixed-effects mediation framework, combined with bootstrap validation, enables us to trace the chain of influence from housing prices to bank outcomes via an intervening variable (education). This approach may be of interest to other researchers examining indirect channels in macro-finance or regional economics. Third, our findings carry important policy implications. They suggest that evolving educational attainment levels should be incorporated into bank risk assessment and early-warning models. In China's case, the ongoing improvements in education could be factored into macroprudential oversight: regulators might monitor whether regions with rapidly rising college-educated populations are experiencing disproportionate credit growth or latent risks. Likewise, banks could refine their credit risk models by accounting for the education profile of their customer base and locality. Ultimately, incorporating human capital trends into credit risk management could enhance the toolkit for safeguarding financial stability. As China works to navigate its housing downturn and stabilize the financial system, a nuanced understanding of how demographic structural changes interact with asset markets will be invaluable for effective risk mitigation.

LITERATURE REVIEW

House Prices and Banking Risk

Numerous studies have documented the direct links between housing cycles and bank risk, but largely from a one-dimensional perspective. Surging property prices often bolster collateral values and initially improve loan performance, whereas collapsing prices erode collateral and can trigger spikes in defaults. Empirical evidence from China confirms that regional

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bank NPL ratios fall during housing booms and worsen after busts (Wan, 2018). Early warning system research has further documented that property prices are significant predictors of banking crises in OECD countries, with higher capital adequacy and liquidity ratios providing important buffers against crisis probabilities (Barrell et al., 2010). Likewise, cross-country analyses find that real estate busts are strong predictors of banking crisis surges in non-performing loans (Jordà et al., 2015; Su et al., 2021). On the flip side, prolonged booms can induce complacency and excessive credit risk-taking by banks, offsetting the short-term collateral benefits. For example, higher house prices have been linked to greater bank risk exposure in both individual-country studies and international comparisons. Dell'Ariccia (2012) notes in his theoretical review that sustained house price appreciation leads banks to reduce loan scrutiny, raise lending caps such as loan-to-value (LTV) and debt-to-income (DTI) ratios, and consequently flood the market with loans to less-qualified borrowers. This loosening of credit standards during economic peaks accumulates risks, reduces screening, and higher leverage makes bank loan portfolios more vulnerable, increasing the probability of financial instability. Cross-country evidence supports this: Banai et al. (2018) empirically found that rising house prices increase bank risk in Hungary, with a more pronounced effect in banks with higher mortgage loan ratios. Similarly, Wang (2021) demonstrates that rising real estate prices significantly fueled risk-taking behavior among Japanese banks. These prior works underscore the macroprudential concern that housing bubbles can undermine financial stability. To date, most research on housing cycles and bank stability has focused on collateral values and credit expansion, with consistent evidence that housing booms initially strengthen bank portfolios and busts weaken them (Wan, 2018; Jordà et al., 2015). It is important to note that the impact of house price appreciation on banking risks may exhibit regional heterogeneity. Some studies indicate that short-term house price increases may temporarily reduce non-performing loan ratios in China. For instance, Wan (2018), using Chinese panel data from 2007 to 2015, found that rising house prices were associated with a significant decline in banks' NPL ratios, suggesting that increased collateral values temporarily improved bank asset quality. However, this apparent stability or "risk mitigation" may mask the accumulation of underlying risks. Empirical research by Su et al. (2021) indicates that during China's housing price surge, credit risk in the banking system did not immediately rise. Instead, banks may have engaged in irrational credit expansion amid high property prices, accumulating latent risks (Su et al., 2021). Once prices declined, these previously accumulated risks were exposed, leading to a surge in bank non-performing loans and highlighting a bidirectional feedback loop between the housing market and banking stability. Furthermore, Zhang et al. (2018) found in their study of regional Chinese banks that high exposure to real estate made their stability highly dependent on property market cycles. Further evidence on the Chinese context shows that housing market fluctuations have substantial effects on bank credit dynamics, with property price changes significantly influencing credit allocation decisions and risk exposures across the banking sector (Sakuragawa et al., 2021). During market downturns, banks with higher prior real estate investment growth rates and greater concentration saw significant increases in non-performing loans and deteriorating asset quality. International institutions have also cautioned about this risk: The latest IMF Financial Stability Assessment Report (2025) notes that Chinese banks' exposure to real estate makes property-related vulnerabilities a primary source of risk for the financial system.

In summary, rising home prices often affect bank risks through credit expansion and changes in collateral values. On one hand, rising prices increase collateral values, potentially lowering default rates in the short term. On the other hand, sustained real estate booms can tempt banks to relax risk controls and engage in excessive lending, thereby sowing seeds of future risk. When the market reverses, these hidden risks lead to deteriorating bank assets. Therefore, we expect a significant correlation between housing price movements and bank risk. Based on this, we propose Hypothesis 1:

Hypothesis 1: Rising housing prices will significantly increase bank loan risk in the real estate industry.

Housing Prices and Education

Housing price fluctuations not only impact the financial system but also influence household investment in human capital through the wealth effect. When housing prices rise, property-owning households become wealthier or gain easier access to mortgages, thereby increasing their capacity to fund higher education for their children. Lovenheim & Reynolds (2013)'s seminal study, utilizing data from the U.S. housing boom, found that increases in housing equity resulting from price appreciation significantly raised the probability of children attending college. Specifically, during the housing boom of the 2000s, every USD 10,000 increase in household home equity raised the probability of children attending college by over 1 percentage point on average. This indicates that increased housing wealth eased liquidity constraints, particularly helping lower- and middle-income families increase educational investment. Research also found that housing wealth shocks not only influenced whether students attended college but also affected their choice of institution, reflecting impacts across various dimensions of educational decision-making (Lovenheim & Reynolds, 2013).

Recent research further supports the positive role of housing wealth in human capital accumulation. Gilraine et al. (2023), utilizing U.S. school district panel data, found that local housing price increases enhance children's human capital by

boosting local education funding and school quality: rising home prices lead to improved school quality, which in turn significantly increases children's academic performance and future income levels. This demonstrates that rising home prices not only directly provide families with educational funds but also exert long-term effects on human capital by enhancing community educational resources. Conversely, when home prices decline, shrinking household wealth may force children to delay or abandon higher education. The ECB's latest working paper (2024) indicates that during periods of declining property values, constrained mortgage financing leads to reduced household spending on education, with this effect being particularly pronounced during critical school-age periods. Thus, the health of the housing market exerts cyclical effects on educational investment: booms facilitate human capital accumulation, while busts may impede educational spending.

Within the Chinese context, the impact of housing prices on the intergenerational transmission of education is also observable. Evidence from Chinese households suggests that high housing prices intensify credit constraints, thereby altering the relationship between children's educational attainment and their parents' educational background (You, Ding, Niño-Zarazúa, & Wang, 2021). Specifically, when housing prices are high, children from less educated families may reduce educational investment due to financial pressures, while those from more educated families remain relatively unaffected, leading to an expansion of the "inequality effect" (You et al., 2021; Nie, 2024). This finding underscores that in a high-housing-price environment, housing affordability impacts families' human capital expenditure decisions, thereby influencing the educational attainment distribution of the next generation.

Overall, existing literature consistently suggests that increased housing wealth facilitates greater investment in human capital by alleviating financial constraints, enabling more individuals to pursue higher levels of education. Based on this discussion, we propose Hypothesis 2:

Hypothesis 2: Rising housing prices will stimulate growth in human capital investment, manifested as increases in residents' educational attainment and educational participation rates.

Human Capital and Banking Risk

Human capital levels, particularly financial literacy and educational attainment, significantly influence individual financial behavior and default risk, potentially affecting banks' overall risk profiles. The signaling theory of education (Stiglitz, 1975) suggests that educational credentials serve as screening devices that convey information about individual productivity and reliability, which has implications for credit markets where lenders use education as a proxy for borrower quality. Extensive research demonstrates that individuals with higher education or greater financial knowledge make better financial decisions and exhibit lower default probabilities. Research on mortgage delinquencies has shown that borrower characteristics, including education and financial literacy, play important roles in determining loan performance beyond traditional credit metrics (Mocetti & Viviano, 2017). Gerardi et al. (2013) provide direct evidence: by examining the mathematical abilities of subprime mortgage borrowers, they found that those with weaker numeracy skills exhibited significantly higher probabilities of mortgage default and foreclosure compared to those with stronger mathematical abilities. Consistent with these findings, Chin and Williams (2020) provide additional evidence from loan markets demonstrating that education significantly reduces default risk, with more educated borrowers exhibiting lower delinquency rates. This indicates that financial constraints or credit scores alone cannot fully explain default differences, making financial literacy a key influencing factor.

This finding aligns with broader financial literacy research. Reviews by Lusardi and Mitchell (2014, 2015) demonstrate a positive correlation between financial knowledge and personal financial health globally: individuals with higher financial literacy are more likely to engage in savings and investment planning, while accumulating less high-interest debt and experiencing fewer defaults. Conversely, those lacking financial knowledge are more prone to making errors in credit and investment decisions, leading to adverse outcomes. Empirical research by Hermansson et al. (2021) further indicates that individuals with higher financial literacy exhibit more "calibrated" risk tolerance, meaning they rationally assume moderate risks commensurate with their financial circumstances, avoiding excessive borrowing or investing, thereby reducing the likelihood of financial crises. Collectively, these studies support the logic that higher human capital, encompassing both general education attainment and specific financial knowledge, enhances borrowers' financial decision-making quality and reduces default risk.

From a banking perspective, when the overall education and literacy levels of the borrowing population are higher, the quality of the bank's loan portfolio improves, and risk decreases. On one hand, higher education typically correlates with higher income and greater job stability, meaning borrowers possess stronger debt-repayment capacity. On the other hand, higher financial literacy encourages borrowers to take on debt more cautiously, avoiding excessive borrowing and thereby reducing the probability of loan defaults at the source. Research by Gerardi et al. (2013) even found that borrowers' financial literacy better predicts repayment behavior than their initial credit scores, suggesting banks may underestimate

DOI: 10.55643/fcaptp.1.66.2026.5017

potential credit risk if they rely solely on traditional credit metrics while neglecting human capital factors. As education becomes more widespread and human capital levels rise, the banking system stands to benefit from lower non-performing loan rates and more robust asset portfolios. Therefore, we propose Hypothesis 3:

Hypothesis 3: The higher a borrower's human capital level, the lower the bank's credit risk in the real estate industry.

Mediation Effect Integration

Hypotheses 1, 2, and 3 correspond to the three steps of classical mediation effect analysis (Baron & Kenny, 1986). According to Baron and Kenny's (1986) framework, mediation is supported only when: the independent variable is significantly correlated with the mediator, and the mediator remains significantly correlated with the dependent variable after controlling for the independent variable. Integrating existing literature, we expect housing prices to influence bank risk by affecting human capital investment, with human capital serving as the mediator. If Hypotheses 1, 2, and 3 are all supported by the data, we will provide strong evidence that: rising housing prices indirectly reduce bank risk by elevating residents' educational attainment, but simultaneously, rising housing prices may directly encourage banks to take excessive risks, thereby increasing risk. The interaction between these two effects determines the net impact of housing prices on bank risk (Banai & Vágó, 2018). Validating this mediating pathway not only deepens our understanding of the underlying link between real estate markets and financial stability but also offers insights for regulators: stabilizing housing prices and enhancing financial education can both serve as policy tools to mitigate banking risks.

AIMS AND OBJECTIVES

The primary goal of this research is to empirically assess the relationship between housing price volatility and Chinese banks' real estate loan risks, with particular attention to the mediating role of regional educational attainment. To accomplish this goal, the study undertakes the following tasks:

1. Analyze the direct effect of housing price changes on banks' real estate non-performing loan (npl) ratios.
2. Examine the impact of housing price fluctuations on regional human capital (educational attainment).
3. Test whether educational attainment mediates the effect of housing prices on bank loan risks using a fixed-effects panel mediation model.
4. Evaluate the robustness of this mediating effect using alternative education measures and bootstrapped significance tests.
5. Draw out the financial implications of the findings for risk management and policy.

METHODS

To address the above tasks, we employ an empirical strategy based on panel data analysis and mediation modeling. Below, we describe the data, variables, and the econometric model.

Data and Variables

Our empirical analysis is based on a panel dataset of Chinese commercial banks merged with regional macroeconomic and demographic indicators from 2011 to 2023. The sample covers 49 banks, including large state-owned banks and smaller regional banks, providing over 500 bank-year observations (Table 1). We focus on bank credit risk in the real estate sector, measured by a bank's relative non-performing loan ratio for real estate loans. This dependent variable captures the level of problematic loans in each bank's housing-related lending portfolio, normalized by either total loans or in relation to peer averages. Higher values indicate greater credit risk exposure. The key explanatory variables are:

1. Bank Real Estate Loan Risk (Risk): measured by the ratio of real estate NPLs to total loans, expressed in percentage points.
2. Housing Price Index (HPI): an index of housing prices in the bank's primary region of operation. Rising values correspond to housing booms.
3. Educational Attainment (Edu): we use two metrics of regional human capital. The first is the average years of schooling of the adult population in the bank's region. The second, used for robustness, is the higher education ratio – the percentage of the regional population with a college degree or above. These are annual regional statistics obtained from government sources and reflect the general education level of the bank's clientele and operating environment.

We also include a set of control variables to account for other determinants of bank risk. Prior research has identified various macroeconomic and bank-specific determinants of credit risk in different contexts (Abusharbeh, 2022), which guides our selection of control variables. These controls appear in all regressions and can be categorized as: (a) Macroeconomic controls – e.g., real GDP growth, inflation rate (CPI), M2 money supply growth – which capture the economic cycle and liquidity conditions; (b) Bank-specific controls – e.g., return on assets (ROA as a profitability proxy), bank size (log of assets). We include year-fixed effects to absorb common shocks and bank-fixed effects to control for time-invariant characteristics of banks or locales. Summary statistics and correlations (omitted for brevity) confirm that multicollinearity is not a concern and that our main variables exhibit substantial variation both across banks and over time.

Empirical Model

To test the mediating effect of education, we adopt a three-step regression approach based on Baron and Kenny's framework for mediation, adapted to panel data with fixed effects. The three equations are as follows:

Step 1: this study first examines the direct effect of housing price fluctuation on banks' NPL ratio:

$$Risk_{it} = \alpha_1 + cHPI_{it} + \beta_1 Control_{it} + \mu_i + \lambda_t + u_{it},$$

In this equation, the notations have the following economic significance:

1. $Risk_{it}$ is the dependent variable, representing the real estate loan risk for bank i in year t. It is measured by the ratio of non-performing real estate loans to total loans. This variable is a direct and crucial indicator of the realized credit risk and deterioration in asset quality within a bank's real estate lending portfolio.
2. HPI_{it} is the key independent variable, representing the housing price index in the primary province of operation for bank i in year t. This index captures the prevailing conditions in the local real estate market, which is a fundamental driver of collateral values for mortgage loans and credit demand from the property sector.
3. $Control$ is a vector of control variables included to account for other potential determinants of bank risk. This vector includes macroeconomic variables such as real GDP growth, the inflation rate (CPI), and M2 money supply growth to capture the broader economic cycle and liquidity conditions. It also includes bank-specific characteristics such as return on assets (ROA) as a proxy for profitability, the cost-to-income ratio (CIR) for operational efficiency, and the natural logarithm of total assets (Size) to control for scale effects.
4. μ_i represents the bank-specific fixed effects, capturing all time-invariant unobserved heterogeneity across banks.
5. λ_t represents the year-specific fixed effects, absorbing common time shocks affecting all banks.
6. u_{it} is the idiosyncratic error term, representing all other unobserved factors that affect a bank's risk in a year.

The coefficient of primary interest in this equation is c. Economically, the coefficient represents the total effect of housing prices on bank risk. It quantifies the net change in a bank's real estate non-performing loan ratio associated with a one-unit change in the housing price index, after controlling for a host of macroeconomic and bank-specific factors. This coefficient amalgamates all possible direct and indirect channels through which housing prices might influence bank stability.

Step 2: Next, the study assesses the effect of housing price fluctuation on the mediating variable (educational attainment):

$$Edu_{it} = \alpha_2 + aHPI_{it} + \beta_2 Control_{it} + \mu_i + \lambda_t + v_{it},$$

Edu_{it} is the mediating variable, representing the level of human capital in region i at time t.

In this study, it is primarily measured by the average years of schooling of the adult population, with the proportion of the population holding a college degree used as an alternative measure for robustness checks. This variable captures the stock of knowledge and skills in the bank's operating environment, which is hypothesized to be a key transmission mechanism.

The coefficient of interest in this equation is a. Economically, the coefficient quantifies the first stage of the indirect transmission channel. It measures the magnitude of the association between housing prices and regional educational attainment, holding other factors constant. A positive and statistically significant estimate for a would lend support to the premise that housing booms contribute to human capital accumulation.

Step 3: Finally, the study includes the mediating variable in the regression to see how it alters the housing price effect:

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$$Risk_{it} = \alpha_3 + c'HPI_{it} + bEdu_{it} + \beta_3 Control_{it} + \mu_i + \lambda_t + w_{it}$$

In this model, b captures the impact of educational attainment on NPLs while controlling for housing price fluctuations. If educational attainment indeed mediates the relationship, this study expects two outcomes: (a) Educational attainment should significantly affect NPL ratios (b is significant, indicating that education level has a meaningful impact on loan default rates), and (b) The direct effect of housing prices on NPLs (c') should diminish in magnitude compared to c in the Step 1 model when Edu is not included. Evidence of mediation would be confirmed if housing prices influence education (from Step 2) and education in turn influences NPLs (from Step 3), with the indirect path ($HP \rightarrow Edu \rightarrow NPL$) being significant. In practical terms, this might imply that regions with surging housing prices see changes in educational outcomes that subsequently lead to changes in the default rates on real estate loans. Supporting H3 would underscore the importance of human capital factors in financial risk analysis, suggesting that policies aimed at improving education and financial literacy could indirectly strengthen banks' resilience to housing market volatility.

Mediation Effect Estimation and Bootstrapping

After estimating the above equations, we compute the indirect effect of housing prices on bank risk via education as $(a \times b)$, where a is the effect of HPI on Edu (Step 2), and b is the effect of Edu on Risk conditional on HPI (Step 3). The proportion mediated (PM) can be defined as $(ab)/c$ when c (the total/direct effect of HPI on Risk from Step 1) and the indirect effect has the same sign. A PM close to 100% would indicate full mediation, whereas a smaller PM indicates partial mediation. In cases where the direct effect c' is opposite in sign to the indirect effect, the interpretation is nuanced – a suppression or "masking" situation may occur.

To formally test the significance of the mediated effect, we implement a non-parametric bootstrap procedure. We draw 1,000 resamples with replacement of the panel dataset, respecting the panel structure. For each sample, we re-estimate the three equations and calculate the indirect effect ab. Using the bootstrap distribution of indirect effects, we obtain a bias-corrected 95% confidence interval. This approach does not rely on normality assumptions and is recommended for mediation analysis, especially when the indirect effect might be a product of coefficients. If the confidence interval excludes zero, we conclude that the mediation effect is statistically significant. We similarly record the bootstrap statistics for the direct effect c' to confirm whether it remains significant or diminishes when the mediator is included.

RESULTS

Descriptive Statistics

This study's descriptive statistics summarize the key features of our unbalanced bank–year panel, reporting the minimum, maximum, mean, median, and standard deviation for each variable. These summaries help illuminate distributional patterns and both cross-bank and intertemporal variability within the sample of 49 listed Chinese commercial banks over 2011–2023. Table 1 below provides an overview of the variables employed in the analysis.

Table 1. Summary Statistics. Note: HPI: Housing Price Index; Edu_year: Primary school+ junior high school+ high school+ college or above)/total population aged 6 and above; Edu_higher: Total number of people with college degree or above/population aged 6 and above; CPI: Consumer Price Index; CIR: Bank's operating expenses relative to its operating income.

Variable	N	Mean	p50	SD	Min	Max
Risk	478	1.927	1.030	2.945	0	40.39
HPI	636	1.395	1.216	0.525	0.542	2.803
Edu_year	629	10	9.467	1.360	7.589	12.78
Edu_higher	633	0.216	0.166	0.129	0.0660	0.505
M2	637	11.37	11.26	2.191	8.280	14.85
GDP	637	107.0	107.5	2.633	97.90	115
CPI	636	102.2	102.2	1.164	99.80	105.9
CIR	608	31.74	30.95	6.667	14.83	66.47
ROA	604	0.910	0.899	0.305	-0.578	1.821
Size	614	9.216	8.895	1.622	4.715	13.01

Table 1 presents summary statistics for the unbalanced panel of 49 listed Chinese commercial banks from 2011–2023. Because bank-level risk data are missing in some years, sample sizes vary by variable. The dependent variable is Risk, a bank real-estate loan risk indicator. Risk averages 1.927 with a median of 1.030, but has a high maximum of 40.39, indicating a right-skewed distribution driven by a few extreme observations. The Housing Price Index (HPI) has a mean of 1.395 with a minimum of 0.542 and a maximum of 2.803, suggesting substantial variation in housing market conditions across regions and years. Some provinces and years saw housing prices more than double relative to the base, while others experienced much lower relative prices.

Human-capital indicators show meaningful dispersion. Edu_year (average years of schooling for the population aged 6+) averages 10.0 years with a range from 7.589 to 12.78 years. In the most educated regions, the average person has completed roughly 12.8 years of schooling (approaching college level), whereas in less-educated regions the average is only about 7.6 years (not much beyond primary school), while Edu_higher (share with college degree or above among those aged 6+) averages 0.216 (21.6%) and ranges from 0.066 (6.6%) to 0.505 (50.5%).

Turning to macroeconomic indicators, M2 (broad money growth, % annual) has a mean of 11.37% with considerable variation (8.28% to 14.85%). This reflects China's generally ample liquidity environment over the sample, with some years of slower money supply growth and others of rapid expansion. GDP (annual growth index, with base ~100) averages 107.0, with a median of 107.5 and a range of 97.90 to 115. This implies an average GDP growth rate 7%, spanning from a slight contraction (~97.9, or –2.1%) in the worst-case province-year to +15% in the best case. CPI (consumer price index or inflation index) centers around 102.2 on average (median 102.2, range 99.8–105.9), consistent with modest inflation of ~2.2% on average and relatively stable price levels (mild deflation up to –0.2% in a few cases, and up to ~5.9% inflation at the peak). These macro figures indicate generally robust economic growth and low-to-moderate inflation in China during 2011–2023, with some regional and temporal fluctuations.

Bank-specific control variables exhibit notable heterogeneity as well. The Cost-to-Income Ratio (CIR), a measure of cost efficiency, averages 31.74% (median 30.95%). This aligns closely with industry benchmarks (e.g., the nationwide bank cost-income ratio was about 31.75% in 2021), suggesting our sample is representative. However, CIR ranges from a low of 14.83% to a high of 66.47%, indicating that some banks operate extremely efficiently while others face high operating costs relative to income. ROA (return on assets) has a mean of 0.910% (median 0.899%). Notably, ROA in the sample spans from –0.578% to 1.821%. Finally, Size (log of total assets) averages 9.216 with a very wide range (4.715 to 13.01). This indicates the panel includes banks of vastly different scales: from relatively small local banks (log assets about 4.7) to some of the largest national banks (log assets about 13), underscoring a mix of bank sizes in the dataset.

Pairwise Correlations Test

Table 2 shows pairwise Pearson correlations among the key variables, with p-values in parentheses. Several intuitive relationships emerge that confirm expected financial patterns. Notably, the Risk indicator is negatively correlated with GDP growth (–0.238, $p<0.01$) and CPI (–0.221, $p<0.01$). By contrast, Risk's simple correlations with HPI (0.018, $p=0.695$) and Edu_year (–0.006, $p=0.890$) are essentially zero and statistically insignificant. At face value, this suggests no linear relationship between housing market levels or education and bank risk in the raw data. However, as we explore with regression, these relationships are more complex and mediated by other factors, which simple bivariate correlations can mask. Looking at other correlations, HPI is very strongly positively correlated with Edu_year ($r = 0.716$, $p<0.01$) and also with Size ($r = 0.562$, $p<0.01$). This indicates that regions/times with higher housing prices tend to have more educated populations and larger banks. This makes intuitive sense: major metropolitan areas or prosperous provinces in China have both booming property markets and a concentration of human capital, as well as larger banking institutions.

The money supply growth (M2) shows interesting correlations: it is positively associated with ROA (0.481, $p<0.01$), GDP (0.454, $p<0.01$), and CPI (0.423, $p<0.01$). These positive correlations imply that periods or regions of expansive monetary conditions (high M2 growth) coincide with stronger economic growth, slightly higher inflation, and higher bank profitability, which is plausible in a booming credit environment. Conversely, M2 has negative correlations with HPI (–0.377, $p<0.01$) and Edu_year (–0.146, $p<0.01$). The negative HPI relationship is somewhat surprising – one might expect loose monetary policy to fuel housing price increases. This negative correlation could indicate that excess liquidity was directed more toward general economic expansion rather than housing in some periods, or that regions with the fastest money supply growth were not the ones with the highest housing price inflation.

The Cost/Income ratio (CIR) has the expected negative association with performance. In Table 2, CIR is inversely related to ROA ($r = –0.154$, $p<0.01$). In other words, banks with higher operating efficiency (lower cost-to-income) tend to have better returns on assets, while inefficient banks have lower ROA – a logical relationship confirming that cost management translates to profitability. Finally, Size has notable correlations: besides HPI and Edu_year, as mentioned, Size correlates

DOI: 10.55643/fcaptp.1.66.2026.5017

negatively with GDP (–0.165*)* and CPI (–0.154), albeit modestly. Size also has a small negative correlation with CRR (–0.174*), meaning* larger banks tend to be more cost-efficient.

Table 2. Pairwise correlations test. Note: *** p<0.01, ** p<0.05, * p<0.1.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) Risk	1.000								
(2) HPI	0.018	1.000							
	(0.695)								
	(0.000)	(0.000)							
(3)Edu_year	-0.006	0.716***	1.000						
	(0.890)	(0.000)							
(4) M2	-0.052	-0.377***	-0.146***	1.000					
	(0.255)	(0.000)	(0.000)						
(5) GDP	-0.238***	-0.305***	-0.197***	0.454***	1.000				
	(0.000)	(0.000)	(0.000)	(0.000)					
(6) CPI	-0.221***	-0.221***	-0.133***	0.423***	0.396***	1.000			
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)				
(7) CIR	-0.064	-0.077	0.022	0.196*	0.134***	0.162***	1.000		
	(0.165)	(0.058)	(0.589)	(0.000)	(0.001)	(0.000)			
(8) ROA	-0.206***	-0.205***	-0.079	0.481***	0.372***	0.294***	-0.154***	1.000	
	(0.000)	(0.000)	(0.055)	(0.000)	(0.000)	(0.000)	(0.000)		
(9) Size	-0.022	0.562***	0.762***	-0.202***	-0.165***	-0.154***	-0.174***	-0.009	1.000
	(0.626)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.820)	

Results of Baseline Regression Model

Table 3 reports the results of the baseline regression models testing the mediation effect of education on the relationship between housing prices and bank risk. The analysis follows the Baron & Kenny mediation framework, estimating three equations: (i) a total effect of HPI on Risk (without the mediator), (ii) the effect of HPI on the mediator (Edu_year), and (iii) the full model including both HPI and Edu_year to parse direct and indirect effects. All models include the control variables (M2, GDP, CPI, CIR, ROA, Size) and bank fixed effects; t-statistics (or standard errors) are reported in parentheses, and significance levels are indicated.

In the Risk equation without the mediator (Table 3, first column, "Total (c)" effect), the Housing Price Index (HPI) shows a positive coefficient (c = 0.876), significant at the 10% level. This suggests that higher housing prices are associated with higher bank real-estate loan risk. Substantively, the estimate implies that if HPI were to increase by 1 unit, the Risk indicator would rise by about 0.876 on average. Given that the mean Risk is about 1.93 (Table 1), this is a sizeable total effect which is roughly a 45% increase relative to the mean. Even a smaller change, say one standard deviation increase in HPI (0.525), would raise Risk by about 0.46 (about 16% of Risk's SD).

The second column of Table 3 ("a-path") is the education equation, regressing Edu_year on HPI and controls. Here, HPI has a strong positive effect on education (a = 0.446, p<0.01). This confirms that higher housing prices are associated with significantly higher average years of schooling in the population. Quantitatively, an increase in HPI by 1 is associated with an increase of about 0.446 years in average schooling. In context, this is a large impact: 0.446 years is about one-third of the overall SD of Edu_year (1.36). The education equation also shows that among controls, CPI has a negative coefficient (–0.035, p<0.01), indicating that higher inflation correlates with slightly lower education levels. CIR has a small positive coefficient (0.005, p<0.05) in the education equation, meaning banks with higher cost ratios are in regions with marginally higher years of schooling, though this effect is very minor. The R-squared for the Edu_year equation is 0.735, indicating that a large portion of the variation in regional education levels is explained.

The third column of Table 3 ("b & c'") shows the Risk equation including Edu_year (the mediator), allowing us to observe the direct effect of HPI (c') and the mediated (indirect) effect via education. Several important results emerge:

1. Education (Edu_year) enters with a positive and highly significant coefficient (b = 2.181, p<0.01). This indicates that banks in regions with higher average education levels experience higher real estate loan risk. The magnitude is notably large: a 1-year increase in average schooling corresponds to an increase of 2.181 in the Risk indicator. To gauge economic significance, consider a one standard deviation increase in Edu_year (about 1.36 years) – this would raise Risk by about 2.97 points (2.181 × 1.36). That is equivalent to an increase of roughly 100% of the mean risk (Risk's SD is 2.945), essentially doubling the typical risk level. In practical terms, moving from a province with, say, 9 years of average schooling to one with 10 years could double the bank's property NPL ratio.
2. Crucially, once Edu_year is included, the coefficient on HPI (c′) drops to –0.120 and is no longer significant (p = 0.813). In other words, the direct effect of housing prices on bank risk vanishes after controlling for education. The point estimate even turns slightly negative (–0.120), albeit insignificantly, suggesting that any direct influence of higher house prices might actually reduce risk, but this direct effect is completely offset by the indirect channel. The fact that HPI's total effect was positive (0.876) but its direct effect is essentially zero implies a full mediation: housing prices affect risk primarily through their impact on education. Higher HPI leads to higher education levels (as shown by a-path), and higher education in turn leads to higher risk (b-path), making the overall c (total) effect of HPI on risk positive. Once the mediator is accounted for, HPI itself has no independent impact. This pattern of coefficients (c significant, c′ insignificant with opposite sign, a and b significant) is a textbook case of complete mediation.

To formally assess mediation, we compute the indirect effect as a×b. From the coefficients, a×b = 0.446 × 2.181 = 0.972. This represents the portion of HPI's effect on Risk that operates through education. Table 3 reports a bootstrapped test for this indirect effect: 0.972, with p = 0.003, confirming it is statistically significant at the 1% level. In contrast, the direct effect c′ = –0.120 (p = 0.813) is not significant. Therefore, the mediation is substantiated: virtually the entire impact of housing prices on bank risk can be explained by the intermediary role of educational attainment. Another way to view the magnitude: the indirect effect of 0.972 is even slightly larger than the total effect of 0.876, suggesting that education fully absorbs and even accentuates the influence of HPI on risk.

Table 3. Mediation effect regression results. Note: *** p<0.01, ** p<0.05, * p<0.1.

	Risk	**Edu_year**	**Risk**
	Total (c)	**a-path**	**b & c'**
HPI	0.876*	0.446***	-0.120
	(0.489)	(0.026)	(0.577)
Edu_year			2.181***
			(0.715)
M2	0.476***	0.017***	0.431***
	(0.086)	(0.005)	(0.087)
GDP	0.108	-0.003	0.110
	(0.070)	(0.004)	(0.070)
CPI	0.006	-0.035***	0.102
	(0.148)	(0.008)	(0.150)
CIR	-0.031	0.005**	-0.048
	(0.041)	(0.002)	(0.041)
ROA	-2.112***	-0.068	-2.106***
	(0.678)	(0.041)	(0.683)
Size	2.697***	0.343***	1.738**
	(0.607)	(0.034)	(0.673)
Constant	-39.412*	9.853***	-60.023**
	(23.579)	(1.307)	(24.351)
Observations	471.000	588.000	463.000
Adj. R^2	0.096	0.735	0.099
No. of banks	49	49	49
Bootstrap mediation			
Indirect (a×b)			0.972 (p = 0.003)
Direct (c')			-0.120 (p = 0.813)

DOI: 10.55643/fcaptp.1.66.2026.5017

Robustness Check: Higher Education Share as an Alternate Mediator

To ensure our mediation results are not sensitive to the specific measure of education, we perform a robustness check using Edu_higher (the share of population with college education or above) as the mediator in place of Edu_year. Table 4 summarizes this alternative mediation regression. Reassuringly, the findings are consistent with the baseline in both statistical significance and interpretation.

Table 4. Higher education as mediator. Note: *** p<0.01, ** p<0.05, * p<0.1.

	Risk	Edu_year	Risk
	Total (c)	a-path	b & c'
HPI	0.876*	0.060***	-0.320
	(0.489)	(0.003)	(0.600)
Edu_higher			19.911***
			(6.023)
M2	0.476***	0.002***	0.425***
	(0.086)	(0.001)	(0.086)
GDP	0.108	-0.001	0.124*
	(0.070)	(0.001)	(0.070)
CPI	0.006	-0.005***	0.122
	(0.148)	(0.001)	(0.150)
CIR	-0.031	0.000	-0.043
	(0.041)	(0.000)	(0.041)
ROA	-2.112***	-0.013***	-2.008***
	(0.678)	(0.005)	(0.679)
Size	2.697***	0.038***	1.821***
	(0.607)	(0.004)	(0.656)
Constant	-39.412*	0.304*	-46.679**
	(23.579)	(0.156)	(23.460)
Observations	471.000	592.000	467.000
Adj. R^2	0.096	0.758	0.112
No. of banks	49	49	49
Bootstrap mediation			
Indirect (a×b)			1.197 (p = 0.000)
Direct (c')			-0.320 (p = 0.486)

In the total effect model, HPI again has a positive coefficient (c = 0.876, p<0.10), identical to the baseline, indicating a positive overall relationship between housing prices and bank risk. In the mediator equation (Edu_higher on HPI), we find HPI positively and significantly predicts a higher educational attainment share (a = 0.060, p<0.01). Specifically, a 1-unit increase in HPI is associated with a 0.060 (6.0 percentage point) increase in the proportion of the population with a college degree. This aligns with the earlier result that high-HPI regions have more educated populations – here directly in terms of the tertiary education share. The R^2 for this mediator equation is 0.758, indicating that a large portion of the variation in the college-educated population share is explained.

In the Risk equation with Edu_higher included, the share of higher-educated population has a strongly positive effect on risk (b = 19.911, p<0.01), while the direct effect of HPI (c') drops to –0.320 and remains insignificant (p = 0.486). These numbers might initially seem different in scale, but note that Edu_higher is measured as a fraction (0–1). The coefficient 19.911 suggests that a 0.01 (1 percentage point) increase in the college-educated share raises Risk by about 0.199. To put it differently, if a province's college-educated share rises by 5 percentage points, the bank Risk indicator would be expected to increase by about 0.995 (nearly 1 point). This is very much in line with the magnitude we found using years of schooling – both indicate that substantial improvements in education levels correspond to sizeable increases in real estate loan risk. For a more concrete sense of scale: Edu_higher ranges from 6.6% to 50.5% across our sample. A region at the 25th percentile (10%) versus one at the 75th percentile (30%) differs by 20 percentage points in higher-education share; our coefficient would predict about a 3.98 point higher Risk in the latter – again a very large difference comparable to multiple standard deviations of Risk. Thus, the economic significance of the education effect holds whether using quantity (years) or quality (college share) of education.

Importantly, as with the baseline, HPI's direct effect becomes null once Edu_higher is controlled for. The point estimate c′ is –0.320 (p = 0.486), indicating no significant direct impact of housing prices on risk, and the sign is negative. The indirect effect a×b in this robustness check is 0.060 × 19.911 = 1.195 (reported as 1.197 due to rounding), with a p-value of 0.000 from bootstrap testing. This confirms a statistically significant mediation via the higher-education channel, very much in line with the indirect effect magnitude in the baseline (which was 0.97). In fact, using Edu_higher yields an even slightly larger mediated effect, which could imply that the share of college-educated population is an equally strong or stronger mediator of HPI's impact on risk compared to average years of schooling.

DISCUSSION

Educational Attainment and Bank Risk

Our findings reveal a counterintuitive relationship between educational attainment and bank loan risk in the real estate sector. The result is striking because it contrasts with micro-level evidence that more educated borrowers are generally less likely to default on loans (Huang et al., 2020). At an individual level, education is often associated with better financial literacy and lower default risk, as educated borrowers signal higher creditworthiness and tend to manage debt more prudently (Huang et al., 2020). Our macro-level finding, however, suggests an aggregation paradox: a highly educated population can coincide with greater systemic risk in bank real estate lending. This paradox highlights that the impact of education on credit risk may differ when moving from individual behavior to regional financial outcomes.

Several mechanisms could explain why better-educated regions experience higher bank real estate NPL ratios. First, regions with more educated populations often have more developed financial markets, sophisticated credit infrastructure, and intense competition among lenders. Banks in such areas might engage in more aggressive competition for market share, offer more complex loan products, or have higher exposure to consumer and mortgage credit to serve an affluent, financially literate customer base. Such competition-driven credit expansion can boost short-term growth but may sow the seeds of future loan delinquencies. In other words, education-rich regions are frequently accompanied by rapid credit growth and financial innovation, which can heighten the risk of loan defaults down the line (Kindleberger & Aliber, 2011; Reinhart & Rogoff, 2009).

Another explanation centers on the risk-taking behavior of educated investors. Higher educational attainment often comes with greater participation in asset markets and possibly a higher risk tolerance in pursuit of returns (Black et al., 2018). Well-educated individuals may be more confident in leveraging debt for investment. They may also be quicker to prepay or refinance loans when advantageous, affecting banks' cash flows. While individually such borrowers manage debt well, collectively their active financial behavior can enlarge the size of credit cycles. While each educated borrower might manage their debts responsibly, collectively their active financial behavior can amplify credit cycles. For instance, if many educated investors in a region take on multiple mortgages or high leverage during a boom, they expand the overall credit exposure of local banks. Our findings of an education–NPL positive link echo historical observations that surges in human capital often coincide with credit booms in the absence of commensurate financial regulation (Kindleberger & Aliber, 2011). In essence, an educated populace can fuel a debt-fueled boom: they have the knowledge and resources to borrow and invest at scale, which boosts bank lending during good times but also means that any market downturn hits a larger, more leveraged base of borrowers. This dynamic is consistent with the notion that higher human capital, while individually beneficial, may inadvertently increase systemic risk through greater credit penetration and risk-taking. Our contribution here is to document this phenomenon in the context of China's housing market: we show that the educational structure of the population is a significant determinant of banks' real estate loan performance, a channel largely overlooked in traditional credit risk analyses.

Housing Prices and Educational Attainment

Importantly, we also uncover a strong positive relationship between housing market conditions and regional educational attainment. In our analysis, higher housing prices are associated with subsequent gains in human capital – regions that experienced booming house prices saw increases in average years of schooling (see Table 3). This evidence supports our premise that housing booms can contribute to human capital accumulation in a region. Several channels could explain this finding. Higher property values enrich local government coffers through land sales and property taxes, enabling greater public investment in schools, colleges, and educational programs. House price growth also increases household wealth and collateral, which may relax credit constraints for families to invest in education. Additionally, prosperous housing markets tend to attract skilled migrants; anecdotal evidence in China shows that cities with booming real estate often implement policies to draw in graduates and professionals. Our result is consistent with the notion of an intergenerational

DOI: 10.55643/fcaptp.1.66.2026.5017

housing wealth effect: as NBER research finds, rising house prices can improve school quality and future incomes of children in a region (Gilraine et al, 2023).

Mediation Effect Analysis

The above two findings – (1) education levels predicting higher bank risk, and (2) housing booms raising education – suggest that educational attainment serves as a mediating channel between housing market cycles and bank stability. This implies that, on the whole, real estate price increases tend to coincide with higher bank NPL ratios, consistent with many studies linking real estate booms to elevated financial sector risks (Jordà et al., 2015; Reinhart & Rogoff, 2009). In other words, after accounting for regional education gains, higher house prices by themselves no longer predict higher bank loan defaults – the positive association is entirely channeled through the education effect. This result provides strong evidence of full mediation: the impact of housing prices on bank stability is transmitted via changes in human capital, rather than through direct channels like collateral value or speculative defaults.

It is worth noting that this mediated relationship has important implications for different phases of the housing cycle. During the boom phase, soaring prices fuel both credit expansion and improvements in education; during the bust phase, however, the legacy of that boom-era education-fueled credit expansion can exacerbate financial stress. In the current down-cycle of China's housing market, we observe that regions with previously high educational gains are experiencing disproportionately high NPL increases, despite the general decline in property prices. The mechanism here operates along a different margin: legacy leverage and portfolio complexity. Highly educated regions amassed more leveraged investments, multiple mortgages, investment properties, and greater participation in shadow banking or wealth-management products during the boom. Now, as housing prices fall and market liquidity dries up, these same regions face amplified strains. Educated borrowers, while financially literate, often hold more debt and more complex portfolios; when property values drop, they encounter outsized debt-service pressures and collateral shortfalls. As a result, banks concentrated in these advanced regions confront synchronized repayment difficulties, tighter cash flows as rental yields compress, and heightened provisioning needs as collateral values erode. This underscores that even in a downturn, a more educated borrower base can propagate risk through the scale and sophistication of credit usage that developed in the prior boom. In practical terms, what might look like a benign environment of falling housing prices still leads to clustered defaults and refinancing stress in regions where borrowers had aggressively leveraged, trusting in their knowledge and market savvy. Thus, the education–risk linkage we identified remains salient in the bust: prior education-driven credit expansion conditions the severity of the downturn's impact on banks. Areas with higher educational attainment are seeing sharper risk realization, which comports with our mediation narrative – the risk was baked in during the boom via the human capital channel, even though housing prices are now retreating.

Robustness and Alternative Mediator Test

To ensure the robustness of our mediation findings, we also tested an alternative measure of educational attainment: the proportion of the population with a college education. The results are qualitatively similar. The mediated (indirect) effect through the college-education share remains positive and significant – if housing prices rise, the resulting increase in college-educated population share leads to higher bank risk. This scenario can be described as "pure mediation," where the mediation channel completely accounts for the relationship between the independent and dependent variables. By using two different measures of educational attainment, we confirm the consistency of this mediation mechanism: whether we proxy human capital by average years of schooling or by college-educated population share, the story remains the same.

CONCLUSIONS

This study provides new evidence that educational attainment plays a pivotal mediating role in the relationship between housing market cycles and bank credit risk, even in the face of changing market conditions. Using a panel of Chinese banks and exploiting regional variations, we show that during housing booms, rising property prices indirectly heighten banks' risk exposure by boosting local human capital. An upswing in housing prices leads to improved educational outcomes in the region, which in turn encourages greater bank risk-taking – ultimately raising the likelihood of loan defaults or non-performance. Once this education channel is accounted for, the direct impact of housing price changes on bank risk becomes negligible. This finding implies that what might appear as a straightforward collateral effect is in fact largely an indirect effect operating through human capital changes. Notably, our results also hint at an asymmetric effect over the cycle. During downturns, when housing prices decline, regions with stronger human capital tend to exhibit relatively milder increases in loan defaults. In other words, the absence of an education-fueled credit surge in a bust may prevent the kind

of severe credit deterioration that might otherwise occur. This suggests that while booms amplify risk via the education channel, a well-educated region might buffer some risk during a housing bust. Such insights are especially salient given China's current real estate slump, where falling house prices and rising non-performing loans are putting banks under pressure. Our mechanism sheds light on how the socio-economic byproducts of past booms can shape the trajectory of financial stability in the bust that follows.

Our findings make several contributions to the literature. Theoretically, we integrate insights from macroeconomics, finance, and human capital theory to explain a seeming paradox in credit risk dynamics. We highlight a macroprudential paradox wherein better-educated borrowers are individually safer, yet improvements in human capital at the regional level can – under certain conditions – amplify systemic risk. This occurs because an education surge during a boom fuels credit expansion and risk-taking at scale, overshadowing the risk-mitigating effects that rising collateral values would normally entail. This perspective bridges a gap in existing research, which has seldom linked macro-level human capital trends with credit risk dynamics. Empirically, the paper adds to the literature on the determinants of bank stability by identifying education level as a novel transmission channel with systemic implications. We document a clear case of indirect-only mediation in a macro-financial context: housing price shocks influence bank outcomes largely through an intermediate socio-demographic variable. This finding offers a fresh explanation for why some regions that enjoyed rapid property price growth later see banks facing higher credit risks despite ostensibly higher borrower quality. For emerging markets and transitional economies, our results underscore the intertwined nature of real estate development and human capital formation – both of which have been key features of China's growth story. Crucially, we show that structural factors like education can channel and transform the effects of asset price swings, implying that banking risk models and policy analyses need to move beyond one-dimensional economic indicators.

In terms of policy implications, we suggest that regulators and bank management should adopt a holistic view of risk during both housing booms and busts. Traditional macroprudential tools often focus on credit aggregates, loan-to-value ratios, and debt-service ratios. Our findings argue that policymakers must also monitor indicators of socio-economic change – such as regional education levels, the migration of skilled workers, and other human capital metrics – as part of their risk assessment toolkit. In the context of China's current housing market downturn, this approach is particularly relevant. If a past housing boom accelerated human capital accumulation in certain regions, regulators should anticipate the second-round effects in a subsequent slump. For example, areas that once saw surging college enrollment and an influx of educated talent due to a property boom may have also experienced rapid credit growth and higher leverage. As housing prices fall, these same areas could now exhibit stress in bank portfolios as the earlier risk-taking comes home to roost. Macroprudential oversight should therefore be calibrated to regional structural conditions. Policymakers might implement counter-cyclical capital buffers that account not only for credit and price indicators, but also for changes in local demographic and human capital profiles. During an upswing, if evidence shows that a housing boom is coinciding with a sharp rise in educational attainment and speculative investing by newly affluent, educated households, authorities could consider targeted measures for banks in those hot-spot regions. Conversely, during a downturn, regulators should remain vigilant that tightening credit across the board does not unduly stifle those regions' long-term growth potential. They might, for instance, support programs that help highly educated but debt-burdened borrowers refinance or restructure loans rather than forcing fire sales, thus preventing a downward spiral in asset values. Overall, incorporating human capital trends into stress-testing and early-warning models could greatly enhance regulators' ability to detect brewing vulnerabilities that are not visible from financial metrics alone. By doing so, bank supervision can remain informative and proactive even as the housing cycle turns downward, ensuring that emerging risks tied to demographic shifts are not overlooked.

Banks, on their side, should refine their risk management strategies in light of these findings. One clear lesson is to avoid over-generalizing the notion that "educated borrowers are low risk". While higher education often correlates with better individual repayment outcomes, our study shows that when an entire region becomes more educated *and* simultaneously more leveraged, the aggregate risk to lenders can increase. In prosperous times, banks might have been lulled into a false sense of security by the improving borrower profiles and consequently loosened lending standards or expanded credit in higher-education regions. Now, with property prices receding, those loans – even to educated borrowers – may underperform if they were extended under overly optimistic assumptions. Therefore, credit risk models should be updated to include regional human capital indicators as risk factors. For instance, banks could stress-test their portfolios under scenarios that consider both housing price declines and shifts in the education level of their customer base. Such a stress test might reveal that a province with an unusually high share of college-educated young homeowners could be more vulnerable if many of those individuals engaged in speculative home purchases or risky investments during the boom. In addition, risk monitoring systems in banks should track changes in clients' financial behavior as education levels rise – for example, increased appetite for complex investment products or higher debt-to-income tolerance – which could signal building vulnerabilities. Importantly, financial institutions should continue investing in customer education and prudent financial

DOI: 10.55643/fcaptp.1.66.2026.5017

literacy programs even for their relatively sophisticated clients. A highly educated clientele may possess greater financial knowledge, but as recent history has shown, this can sometimes translate into overconfidence or participation in complex speculative ventures. Banks can mitigate this by ensuring that even well-educated borrowers understand the risks of leverage and are encouraged to maintain healthy financial buffers. In the current environment of house price declines, banks also need to be proactive in managing and mitigating risks on loans extended during the boom. This could include offering loan restructuring or workout options for creditworthy borrowers who face temporary difficulties, thereby averting defaults that would be costly for both the borrower and the bank. By taking a nuanced approach that recognizes the benefits of education but also its potential to drive herd behavior in credit markets, banks can better navigate the delicate balance between expanding opportunities and preserving asset quality.

In conclusion, our paper calls attention to an important macro-financial feedback loop that has practical significance in today's Chinese economy: housing booms can "educate" the populace, and an educated populace can, under certain conditions, create new risks for banks. This does not diminish the immense long-term societal value of education; rather, it highlights that systemic financial risk can emerge as an unintended byproduct of positive developments if the financial system fails to adapt wisely. In the current climate of a housing market correction, our findings imply that the human capital built up during the boom can influence how the bust plays out. Policymakers and bankers should thus approach the real estate cycle not just as a financial phenomenon of prices and collateral, but as a socio-economic process that transforms the very makeup of the borrower pool. Ensuring financial stability in China and in other emerging markets facing similar patterns will require a nuanced understanding of how demographic structural changes interact with asset market cycles. By recognizing education as a key piece in the housing–finance puzzle, authorities can better design interventions that safeguard banks without stifling the broader development goals. Ultimately, balancing economic growth with financial stability in a post-boom era will hinge on our ability to anticipate and manage these multifaceted human capital effects. As China navigates its real estate downturn, incorporating such insights into policy and practice will be crucial for mitigating risk and laying the groundwork for a resilient recovery.

Future research

Future research could extend this analysis by exploring whether similar mechanisms exist with other mediators and by testing the efficacy of policy tools in breaking the link between housing-induced human capital growth and credit risk. Our findings encourage policymakers to think beyond traditional economic indicators and consider the broader societal changes when managing the fallout of asset price cycles.

Research Limitations

This study has several limitations. First, identification rests on two-way fixed effects and a mediation framework; although we control for standard covariates and use cluster-bootstrap inference, residual endogeneity cannot be ruled out, housing prices and educational attainment may respond to unobserved, time-varying regional shocks, and we do not deploy external instruments. Second, the cross-level design maps bank outcomes to province-level mediators; for multi-province banks, this aggregation can introduce measurement error and obscure borrower-level selection versus scale effects.

ADDITIONAL INFORMATION

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FUNDING

The Authors received no funding for this research.

CONFLICT OF INTEREST

The Authors declare that there is no conflict of interest.

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ЦІНИ НА ЖИТЛО ТА КРЕДИТНИЙ РИЗИК БАНКІВ У ЦАРИНІ НЕРУХОМОСТІ: ПОСЕРЕДНИЦЬКА РОЛЬ ОСВІТИ

Після більш ніж двох десятиліть швидкого зростання ринок нерухомості Китаю протягом останніх років поступово скорочувався на тлі економічної слабкості, при цьому ціни на нерухомість почали різко падати. Оскільки продаж нових будинків у Китаї в основному відбувається за системою попереднього продажу, коли забудовники отримують державну землю через аукціони, здають в іпотеку цю землю банкам для фінансування розвитку й покладаються на банківський капітал разом із початковими внесками покупців та іпотечними кредитами, зниження цін не тільки негативно впливає на ризики банків щодо кредитування нерухомості, а й призводить до дефолту покупців через недостатню вартість застави, тим самим посилюючи системні фінансові ризики. У цьому контексті наше дослідження розглядає посередницьку роль освітніх досягнень, вимірюючи, чи впливають регіональні коливання цін на житло на коефіцієнт непрацюючих кредитів комерційних банків на нерухомість через рівні освіти. Використовуючи панель на рівні банку, зіставлену з соціально-економічними показниками провінцій, ми оцінюємо моделі фіксованих ефектів і впроваджуємо триступеневий дизайн посередництва з початковим висновком. Факти свідчать про чіткий механізм: зміни цін на житло пов'язані з вищим рівнем освіти в регіонах. У свою чергу, освіта пов'язана з більшою кредитною експансією та вищими коефіцієнтами непрацюючих кредитів. Як тільки цей канал береться до уваги, прямий зв'язок між цінами на житло та банківським ризиком помітно слабшає, причому основна частина загального ефекту діє опосередковано через освіту. Ці моделі економічно значущі, стійкі до альтернативних освітніх проксі та широкої вибірки. Отримані результати свідчать про макропруденційний парадокс: у той час як краще освічені позичальники, як правило, почуваються безпечніше на мікрорівні, удосконалення людського капіталу може в масштабі посилити прийняття ризику та схильність до балансу. Тому наглядові органи повинні відстежувати тенденції людського капіталу поряд із динамікою застави та враховувати їх у системах раннього попередження й калібрування інструментів позичальників і капіталу, щоб оцінка банківських ризиків залишалася інформативною навіть в умовах спаду на ринку житла.

Ключові слова: ціни на житло, індустрія нерухомості, ризики кредитування нерухомості, комерційні банки Китаю, прийняття банківських ризиків, посередницький аналіз, рівень освіти

JEL Класифікація: G21, E44, I25, R31, C23