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The Role of Digital Inclusive Finance in Weakening Real Estate Market Speculation

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Abstract: A multitude of studies have extensively examined strategies for achieving sustainable development in the real estate market. As the pivotal component of land economy, the real estate market plays a crucial role in ensuring its sound operation. However, it is currently undergoing significant adjustments and grappling with rampant speculative activities, resulting in an alarming bubble. By scrutinizing the speculative motivations of different entities, we present a novel perspective on mitigating speculation. Our analysis reveals that digital inclusive finance effectively curbs residents' and enterprises' speculative behavior, as evidenced by diminished prevention motivation and investment substitution motivation. Utilizing data from 280 cities, this study measures real estate market speculation by establishing a model that the volatility of the housing market turnover, as a proportion of GDP, deviates from the actual housing demand transactions based on economic fundamentals. Furthermore, it investigates the relationship between digital inclusive finance and real estate market speculation, along with its spatial effects. The findings indicate that digital inclusive finance significantly curbs real estate market speculation and has a negative spatial spillover effect. This research provides a novel model and perspective for exploring real estate market speculation while positively impacting sustainable development within the real estate market.

Keywords: real estate market; sustainable development; speculation; digital inclusive finance; spatial correlation; SDM model

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1. Introduction

China always applies a people-centered development philosophy and makes efforts to improve education, employment, medical care, elderly care, housing, and poverty alleviation. With the projected influx of 100 million new residents in the city, housing remains a crucial livelihood concern, yet it continues to grapple with challenges such as inadequate supply, soaring property prices, and an unregulated rental market. In the past decade, there has been a rapid growth in the volume of personal housing loans, constituting over 45% of the total personal loans. Furthermore, the annual growth rate of the outstanding balance for personal housing loans exceeds 15%, reaching as high as 38.1% in 2016. The rapid rise in housing prices has inhibited national consumption, resulting in a significant number of 'House slaves' [1]. They have been forced to reduce their consumption because of down payments and loans [2]. The Chinese government requires that houses are for living in, not for speculating with. The paradigm of housing consumption needs to shift from speculation to habitation. Addressing the abnormal behavior in the real estate market is imperative for resolving this issue.

Since the reform and opening up, the real estate industry has always been the pillar industry of the national economy. Due to the scarcity of land, housing, being an essential requirement for human life, generates a substantial market demand and evolves into a lucrative investment opportunity [3]. The inflationary environment often leads to an increase in the cost of rebuilding a house, making real estate investment a viable option for mitigating the risk of property damage caused by currency depreciation. As a virtual

economic system, the real estate speculation market only needs to transfer the ownership certificate to complete the transaction. Buyers make trading decisions by anticipating housing price trends to earn price spreads. At present, due to the rapid development of urbanization in China, people believe that housing prices will continue to rise, leading a large number of people to invest in real estate instead of the real economy.

In 2005, the International Year of Microcredit, the United Nations first proposed inclusive finance. The G20 High-Level Principles on Digital Financial Inclusion, published in September 2016, defines digital inclusive finance as the achievement of inclusive finance through the application of digital technology. In the face of the new wave of scientific and technological revolution and industrial transformation, the digital economy, as an emerging economic paradigm, has profoundly reshaped social organization and redefined inter-subjective dynamics. The G20 Advanced Principles for Digital Financial Inclusion specify that they encompass a wide range of financial transactions, including but not limited to payments, transfers, savings, credit, insurance, and securities, as well as financial planning and bank statements. These transactions may be conducted through various channels, such as online or mobile phone platforms using e-money or payment cards, as well as traditional bank accounts. The growth momentum of China's e-commerce and electronic payment technology industry is unparalleled globally, playing a pivotal role in digitally empowering the country's real economy, facilitating social and economic transformation, laying the groundwork for industrial digital upgrading, and contributing to the establishment of a digitalized China. The 14th Five-Year Plan for Digital Economy Development issued by The State Council in 2022 requires that data be taken as a key element, digital infrastructure be strengthened, digital economic governance system be improved, traditional industrial transformation and upgrading be vigorously promoted, digital industrialization be accelerated, and new industries, new forms, and new models be cultivated.

The economic impacts of digital inclusive finance have been extensively studied, revealing its potential to alleviate corporate financing constraints [4], foster innovation [5], encourage entrepreneurial activities among households with limited material or social capital [6,7], reduce the income disparity between urban and rural residents and mitigate poverty-related issues [8]. Regarding the impact of digital inclusive finance on the real estate market, a previous study used five sampling data from 2012 to 2020 in the CFPS database and found that digital inclusive finance facilitated household debt expansion through its intermediary role in influencing real estate prices [9]. A previous study discovered that digital inclusive finance holds economic significance for the real estate sector, exerting a robust leverage effect on over 30 distinct sub-industries, such as construction materials and transportation, thereby enhancing the profitability of the real estate industry [10]. In general, existing research primarily focuses on the economic promotion effects of digital inclusive finance, with limited empirical analysis conducted on the relationship between digital inclusive finance and the real estate market. Particularly lacking is a corresponding discussion on speculative behavior in the real estate market.

The emergence of digital inclusive finance offers a new perspective for mitigating the issue of real estate market speculation. Does digital inclusive finance exert a restraining influence on real estate market speculation? Is this restraining influence characterized by regional heterogeneity? Will this restraining influence extend to other regions? Through our analysis, we discover that digital inclusive finance successfully curbs speculative behavior among residents by reducing precautionary motives and enhancing their financial literacy to optimize household asset allocation structures. Additionally, it weakens investment substitution motivations among corporate investors. Utilizing panel data from 280 prefecture-level cities in China spanning from 2015 to 2019, we construct a measure of speculative transaction activity in the real estate market, the volatility of the housing market turnover, as a proportion of GDP, deviating from the actual housing demand transactions based on economic fundamentals for each city. We then regress this measure against the digital inclusive finance index to examine its inhibitory effect. Furthermore, we explore

spatial spillover effects using the spatial Durbin model. Our findings indicate that while digital inclusive finance has an inhibitory effect on real estate market speculation within a given city, it promotes such speculation in surrounding cities. Moreover, regional heterogeneity analysis reveals that digital inclusive finance exerts an inhibitory effect on real estate market speculation in eastern and central regions but lacks significance in the western region. The paper employs three robustness test methods. Firstly, this paper introduces a lag of one period for the explanatory variables and control variables. Secondly, we construct an interaction term between the number of fixed telephones per ten thousand people in 1984 (representing individual changes) and the number of national Internet broadband access ports in the previous year (representing time) of cities as an instrumental variable for digital inclusive finance. Thirdly, another model of real estate market speculation is employed to replace the dependent variable.

The main contributions of this paper are manifested in the following three aspects. First, this paper aims to contribute to the existing research on real estate market speculation by examining it from the new perspective of digital inclusive finance. Digital inclusive finance, an emerging financial sector, is fundamentally reshaping the traditional financial landscape with its attributes of convenience, efficiency, and low cost. By incorporating the perspective of digital inclusive finance, we investigate the motivation behind real estate market speculation. This study demonstrates that digital inclusive finance effectively curbs speculative activities, thereby contributing to the existing literature on the economic implications of digital inclusive finance. Secondly, in the actual economy, there exists a certain level of interconnection and interaction among neighboring economic entities. To investigate the spatial correlation between digital inclusive finance and speculation in the real estate market, this study employs a spatial econometric model for further exploration. Additionally, this research categorizes prefecture-level urban areas into eastern, central, and western regions for analyzing regional heterogeneity. These investigations hold significant theoretical implications for examining the spatiotemporal relationship between digital inclusive finance and speculation in the real estate market. Thirdly, China, as an emerging economy with a unique institutional background in transition, exhibits a general lack of rationality among market participants and fosters a strong speculative atmosphere. The prevalence of serious speculation poses a significant threat to the stability of the real estate market, and the subsequent accumulation and bursting of the real estate bubble has had detrimental effects on the overall economy. Therefore, it is crucial to examine speculation in the real estate market from the perspective of digital inclusive finance in order to generate innovative ideas for government policy formulation aimed at fostering healthy and sustainable development within this sector.

2. Theoretical Analysis and Research Hypothesis

2.1. Direct Impact of Digital Inclusive Finance on Real Estate Market Speculation

The field of digital finance encompasses the integration of contemporary Internet technology with traditional financial practices. As the reform in Internet technology deepens, information technology continues to permeate the modern economy, leading to an expanded service scope for inclusive digital finance and exerting a profound impact on all levels of society. The key stakeholders engaged in speculation within the real estate market primarily encompass residents, enterprises, and commercial banks, with the influence of digital inclusive finance varying across these entities. The reconstruction cost of real estate increases during periods of inflation, thereby making real estate investment an effective means to mitigate the risk of property loss resulting from currency depreciation. One reason why residents engage in speculation within the real estate market is to safeguard against potential income reductions or increased expenditures caused by periodic fluctuations or unemployment stemming from financial crises, thus reflecting a precautionary motive. However, social security and commercial insurance, represented by endowment insurance, medical insurance, unemployment insurance, maternity insurance, and industrial injury insurance, can also be effective measures to reduce future risks [11].

Under the development of digital inclusive finance, major insurance companies use digital technology to improve the coverage efficiency and communication efficiency of branches and improve the reachability of insurance services through the advantages of convenience and disintermediation so that the service provider and the serviced party break the time and space limits and deepen the inclusive degree of insurance business customer groups. Digitization also reduces the accessibility barrier of financial services [12]. Faced with information asymmetry, insurance institutions tend to offer insurance services more readily to households with substantial assets and low risk, resulting in limited access for low-income vulnerable groups. The utilization of digital technology in inclusive finance has significantly enhanced the coverage and penetration rate of commercial insurance by reducing costs for service and labor [13]. Consequently, this reduction mitigates the adverse effects of future uncertainty and preventive motivation, thereby influencing residents' behavior towards real estate speculation.

According to the theory of household finance, household asset allocation primarily encompasses savings, real estate, financial assets, insurance, and other components. Housing represents the most familiar investment for residents. The scarcity and immobility of land resources, coupled with the perpetual demand for housing, determine its investment value. Real estate investment can effectively mitigate the erosion of personal wealth caused by currency depreciation [3]. Participation in the financial market necessitates individuals to possess a certain level of financial literacy and knowledge. Financial literacy encompasses the proficiency to effectively manage and utilize funds, enabling astute judgments and informed decision-making. By leveraging their own financial acumen, investors can reasonably assess anticipated future cash flows and select the most suitable credit range from an array of financial risk products based on existing information. The greater the level of financial literacy, the more proficient they become in making rational decisions and managing their own financial assets effectively [14]. In the realm of digital inclusive finance development, financial institutions establish online platforms for financial education in collaboration with Internet platforms, thereby disseminating financial knowledge to residents [12]. The rapid dissemination of Internet information significantly enhances the potential for families to access financial education knowledge, enhance their own financial literacy, augment their wealth management awareness, and digital inclusive finance amplifies the efficacy of disseminating financial knowledge [15]. Investors enhance their understanding of the financial market through the accumulation of financial knowledge, enabling them to conduct a comprehensive analysis and gain insights into interest rates, inflation, investment risks, and other factors. Consequently, they are more inclined to engage in risk investments within the financial market and optimize the allocation of household financial assets [16]. The real estate speculation market constitutes a virtual economic system [17], with investors bearing the risk of housing price fluctuations. A "seesaw" relationship exists between housing wealth and financial risk assets, such as stocks [18,19]. As households increase their allocation ratio of risk assets, they displace housing assets, thereby inhibiting speculation in the real estate market.

The motivation behind real estate market speculation by enterprises often stems from the desire for investment substitution. The availability of investment funds constitutes a crucial determinant in enterprises' investment decision-making processes. Companies encounter financing constraints during the financing procedure, and these constraints restrict their capacity for external funding. Particularly for small and medium-sized enterprises, robust financing constraints lead them to relinquish initially profitable investment projects due to the exorbitant costs associated with external financing, thereby impeding production and operational activities. In order to sustain profitability, firms are expected to augment their short-term investments [20]. Therefore, real estate investment is considered a short-term investment. Digital inclusive finance can effectively mitigate the issue of corporate financing constraints by addressing the deficiencies in traditional financial markets, such as uneven distribution of lending relationships and information asymmetry [21]. The objective is to enhance the efficiency of financial resource allocation in the investment market by

reaching a wider range of long-tail groups, thereby alleviating funding constraints during the initial stages of enterprise development [22]. The development of digital inclusive finance has expanded the financing methods and channels available to micro-enterprise subjects, facilitating efficient information matching between diverse entities. Consequently, enterprises have gained access to stable and continuous financial support. Enterprises prioritize projects with extended duration and high returns and augment investments in innovation and other strategies to enhance their competitiveness and capacity for sustainable development [23]. Consequently, they mitigate the inclination towards investment substitution and thereby curtail real estate speculation. Based on the aforementioned analysis, digital inclusive finance facilitates an increase in the proportion of households engaging in commercial insurance purchases by expanding the coverage and penetration rate of such insurance. Additionally, it mitigates speculative motives for real estate speculation. Digital inclusive finance enhances household financial literacy and knowledge levels, improves financial accessibility, broadens information channels to reduce search costs, positively influences diversification of household investments, increases the allocation of risk assets among households [24], and diminishes real estate speculation. Digital inclusive finance mitigates corporate financing constraints, facilitating stable and sustainable financial assurance, augmenting investments in innovation and daily business operations, and actively enhancing competitiveness and capacity for sustainable development. Consequently, it weakens the motivation for investment substitution among corporations while curbing speculation in the real estate market. On this basis, we propose the first research hypothesis as follows:

Hypothesis 1: *Digital inclusive finance will reduce real estate market speculation.*

2.2. The Spatial Spillover Effect of Digital Inclusive Finance on Real Estate Market Speculation

In the real economy, there exists a certain level of interconnection and interaction among neighboring economic entities [25], exhibiting spatial correlation and agglomeration effects [26]. According to the growth pole theory in urban agglomerations, production factors tend to concentrate or disperse within a specific city [27]. The initial economic growth takes place in the central city, which subsequently influences surrounding cities through diffusion and polarization effects. This exemplary role of the central city contributes to the economic development of adjacent areas by facilitating spatial factor flows [28,29], thereby generating positive or negative spillover effects. A study discovered that digital finance exhibits a positive spatial spillover effect on the high-quality economy [30]. Another study discovered that the consumption patterns of residents were influenced by the spatial economic interdependencies with neighboring regions [31]. The development of digital inclusive finance relies heavily on robust network infrastructure. The integration of the Internet and the Internet of Things enhances industrial connectivity within regions [32], reducing spatial barriers [33]. This facilitates the cross-regional flow of resources, enabling aggregation, spillover, and dissemination between neighboring cities, ultimately increasing the potential for regional linkage and spatial diffusion in digital economic development [34]. The cross-regional flow of factors is driven by heterogeneous pricing [35]. In high-digit inclusive financial areas, the demand for capital, population, and other key factors is higher under profit-seeking motives, leading to an increase in the marginal return of these factors. Consequently, the factor flows towards central cities due to the siphon effect [36,37]. In summary, the diffusional transmission characteristics of digital inclusive finance between regions, and subsequently through the internal transmission pathway, exert an influence on the concentration of capital, population, information, and other factor resources in core cities or their dispersion from core cities to peripheral cities [29]. We propose the second research hypothesis as follows:

Hypothesis 2: *Digital inclusive finance can mitigate real estate market speculation in neighboring areas through the spatial spillover effect.*

3. Methodology

3.1. Description of Variables

This study employs the Digital Inclusive Finance Development Index as a metric for measuring local digital inclusive finance [38], with data sourced from the Peking University China Digital Inclusive Finance Development Index database. The Digital Inclusive Finance Development Index, covering all regions of China, has been compiled by the Peking University team in collaboration with Alipay Group using hundreds of millions of micro-data. It effectively portrays the developmental status and spatial arrangement of digital inclusive finance in China. It encompasses three dimensions: the breadth of coverage in digital finance, the depth of utilization in digital finance, and the degree of digitalization in inclusive finance. It encompasses various key businesses, including digital payments, digital lending, digital investments, digital currency funds, digital insurance, and digital credit investigations. Table 1 shows the Digital Inclusive Finance Development Index. The Digital Financial Inclusion Development Index is widely recognized as the primary index used in research on digital financial inclusion in China [39–41]. Nearly all articles on digital financial inclusion in China rely on this index for their analysis.

Table 1. Digital Inclusive Finance Development Index.

Primary Dimension	Secondary Dimension	Quantitative Index
Coverage width	Account coverage rate	The number of Alipay accounts per ten thousand people
		Proportion of Alipay users who have linked their cards
		Average number of bank cards bound to each Alipay account
	Payment services	Average number of payments per capita
		Average payment per person
		The proportion of high-frequency (active 50 times or more per year) users to the total number of users active at least once a year
	Monetary fund business	Average number of purchases of Yu'ebao per capita
		Average purchase amount of Yu'ebao per capita
		The number of Alipay users purchasing Yu'ebao per 10,000
Depth of utilization	Credit business	Personal consumption loan: The number of adult Alipay users with internet consumption loans per 10,000
		Personal consumption loan: Average number of loans per person
		Personal consumption loan: Average loan amount per person
		Small and micro-business operators: The number of users of internet small and micro business loans among every ten thousand adult Alipay users
		Small and micro-business operators: Average number of loans per small and micro business owner
		Small and micro-business operators: Average loan amount for small and micro businesses
	Insurance business	The number of insured users per ten thousand Alipay users
		Average number of insurance policies per person
		Per capita insurance amount
	Investment business	The number of individuals participating in Internet investment and financial management among every 10,000 users of Alipay
		Average number of investments per capita
		Average investment per capita
	Credit business	Average number of credit inquiries per natural person
		The number of users utilizing credit-based services among every 10,000 Alipay users (including finance, accommodation, transportation, social networking, etc.)
Digitization level	Mobileization	Proportion of mobile payment transactions
		Proportion of mobile payment amount
	Affordability	Average loan interest rates for small and micro businesses
		Average personal loan interest rate
	Securitization	Proportion of transactions paid with Alipay Huabei
		Proportion of Alipay Huabei payment amount
		Proportion of deposit-free credit transactions in Sesame Credit (compared to all situations requiring a deposit)
		Proportion of deposit-free amounts in Sesame Credit (compared to the overall situation requiring deposits)
	Facilitation	Proportion of transactions made through QR code payment by users
		Proportion of payments made by users using a QR code

Based on the research [42], We construct a metric for measuring speculative transaction activity in the real estate market across cities of various levels. Firstly, we calculate the ratio (SPE) of turnover in the commodity housing market to the GDP of cities for a given

year. Transaction volume refers to the number of residential houses sold in a year. A larger transaction volume in the commercial housing market of this city signifies a greater flow of funds into and out of the market. Simultaneously, it leads to shorter holding periods for investors, resulting in an increased SPE value and heightened transaction activity within the real estate market of this city. Secondly, we computed the volatility of SPE and named it SPEUD. Volatility refers to the standard deviation of the change in target values within a specific time frame. The calculation methodology is as follows:

$$SPEUD_{i,t-1} = \sqrt{\left(\frac{1}{3}\right)\sum_{t=-2}^{0}\left(SPE_{i,t} - 1 - SPE_{i,t-2}\right)^2} \quad (1)$$

If the SPEUD increases, it indicates a surge in speculative transaction activity within the real estate market, suggesting a heightened level of investor speculation in this city. Given that the resulting turnover in the commercial housing market encompasses both transactions driven by economic fundamentals and those motivated by speculative factors unrelated to actual housing demand, it is imperative to exclude the former. A study discovered that the rise in per capita disposable income among residents corresponded with an increase in demand for housing. Lower interest rates effectively reduce borrowing costs for both buyers and suppliers [43]. In the case of China's housing market, which operates under strict monetary control and supervision, interest rates lack the flexibility to accurately reflect borrowing costs. Therefore, the growth rate of year-end financial institutions' loan balances is utilized as an indicator to reflect the impact of monetary policy on housing demand [44]. In addition, inflation will have a negative impact on housing prices and thus affect the demand for housing. Hence, this study employs SPEUD as the dependent variable and utilizes the growth rate of per capita disposable income of residents (DISP), the growth rate of year-end financial institutions' loan balances (LOAN), and the rate of inflation (INF) as independent variables for conducting the subsequent regression analysis.

$$SPEUD_{i,t} = \alpha_0 + \alpha_1 DISP_{i,t} + \alpha_2 LOAN_{i,t} + \alpha_3 INF_{i,t} + \varepsilon_{i,t} \quad (2)$$

The residual term derived from the regression analysis is referred to as SPECU, representing the transactions driven by factors other than economic fundamentals. SPECU serves as an indicator for real estate market speculation.

Our sample period spans from 2014 to 2020. The survey on urban–rural integration households was initiated by the National Bureau of Statistics of China in late 2013. The official release of per capita disposable income data for all urban residents took place in 2014. Therefore, as a result of the incomparability with pre-2013 data, the data presented in this paper commence from 2014. Due to the calculation method of volatility, The final data sample used in our study spans from 2015 to 2019. It also avoids overlapping with the COVID-19 pandemic, which had major effects on global capital markets and global policy responses. After eliminating outliers and blank values, the sample for this study comprises 280 cities, including cities where the issuing entity is a municipality.

This study incorporates control variables such as urban economy, house price, population, and industrial structure to enhance the accuracy of estimating the influence of digital inclusive finance on real estate market speculation. The data are collected from the prefecture-level city Statistical Yearbook and WIND database. All data are logarithmically transformed to eliminate heteroscedasticity. Table 2 shows variable definitions. Table 3 shows descriptive statistics.

Table 2. Variable definitions.

Variables	Quantitative Index
Real estate market speculation	The volatility of the housing market turnover, as a proportion of GDP, deviates from the actual housing demand transactions based on economic fundamentals.
Digital inclusive finance	Digital Inclusive Finance Development Index
Economic development	Per GDP
loans growth	year-end financial institutions' loan balances/GDP
Industrial structure	Secondary industry production value/GDP
Economic growth	GDP
Population	Permanent population
Housing price	Mean price of commercial housing transactions/Per capita GDP
Living standard	per capita disposable income of residents

Table 3. Descriptive statistics.

Variables	N	Mean	Standard Deviation	Minimum	Maximum
Real estate market speculation	1400	−0.000	0.012	−0.219	0.159
Digital inclusive finance	1400	5.354	0.158	4.883	5.773
Economic development	1400	10.836	0.525	9.304	12.281
loans growth	1400	1.099	0.588	0.310	5.305
Industrial structure	1400	0.449	0.183	0.107	2.959
Economic growth	1400	7.489	0.935	5.033	10.549
Population	1400	5.877	0.721	3.194	8.067
Housing price	1400	0.109	0.046	0.018	0.315
Living standard	1400	10.066	0.328	9.129	12.211

3.2. Model Development

First, we built an individual fixed-effect model to test the impact of digital inclusive finance on real estate market speculation. The baseline regression model is as follows:

$$SPECU_{i,t} = \beta_0 + \beta_1 DF_{i,t} + \beta_2 X_{i,t} + \lambda_i + \varepsilon_{i,t} \quad (3)$$

where i and t represent city and year, respectively. $SPECU_{i,t}$ represents the real estate market speculation while $DF_{i,t}$ represents digital inclusive finance. $X_{i,t}$ represents control variables. λ_i represents city fixed effects. It is used to control the impact of unique features of each city that do not change over time on research results. $\varepsilon_{i,t}$ is a random error term.

Second, as the hypotheses proposed above, we suggest that digital inclusive finance can mitigate real estate market speculation in neighboring areas through the spatial spillover effect. Therefore, we construct the Spatial Durbin Model.

The weight matrix is constructed in this paper using the adjacency matrix as follows:

$$W_{i,j} = \begin{cases} 1, & (i, j \text{ adjacent}) \\ 0, & (i, j \text{ not adjacent}) \end{cases} (i \neq j) \quad (4)$$

We further built the Spatial Durbin Model as follows:

$$SPECU_{i,t} = \alpha_0 + \rho_1 \sum_{j=1}^{N} W_{i,j} \times SPECU_{i,t} + \alpha_1 DF_{i,t} + \alpha_2 Control_{i,t} + \lambda_1 \sum_{j=1}^{N} W_{i,j} \times X_{i,t} + \upsilon_i + \varepsilon_{i,t} \quad (5)$$

$W_{i,j}$ represents the weight matrix. α_0 represents the intercept term. ν_i represents city fixed effects. $W_{i,j} \times SPECU_{i,t}$ and $W_{i,j} \times X_{i,t}$ represent the spatial lag terms of the explained variable and the explanatory variable, respectively.

4. Empirical Results

4.1. Basic Results

The results of the impact of digital inclusive finance on real estate market speculation are shown in Table 4 and column (1), which displays the results of Equation (3). The coefficient of digital inclusive finance is −0.0194, $p < 0.01$, which means that digital inclusive finance can effectively mitigate real estate market speculation.

Table 4. Baseline results.

Variables	(1) Real Estate Market Speculation	(2) Eastern Regions	(3) Central Regions	(4) Western Regions
Digital inclusive finance	−0.0194 ***	−0.0378 ***	−0.0195 ***	−0.0162
	(0.00444)	(0.00975)	−0.00426	−0.0101
Economic development	−0.0124	−0.0570	−0.0104 ***	−0.00619
	(0.00769)	(0.0517)	−0.00393	−0.0059
loans growth	0.00155	0.00518	−0.000853	−0.00415
	(0.00337)	(0.00571)	−0.0024	−0.00924
Industrial structure	−0.00344	−0.00235	−0.0144	−0.0135
	(0.00407)	(0.00444)	−0.00978	−0.0142
Economic growth	0.0134 ***	0.0673	0.0132 ***	0.0000132
	(0.00492)	(0.0501)	−0.00391	−0.00949
Population	0.0385	0.102	−0.0156	0.0123
	(0.0270)	(0.0698)	−0.0134	−0.0277
Housing price	−0.0775	−0.111	−0.0303	−0.0924 **
	(0.0749)	(0.183)	−0.0226	−0.0453
Living standard	0.00722	0.0122	0.00819 *	0.000758
	(0.00541)	(0.0143)	−0.00469	−0.00168
Constant	−0.153	−0.448	0.137	0.0973
	(0.166)	(0.435)	−0.0841	−0.175
Observations	1400	500	610	290
Number of city	280	100	122	58
R-squared	0.032	0.056	0.068	0.073

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4.2. Spatial Spillover Effect Results

The spatial correlation test and the assessment of the applicability of the spatial Durbin model were conducted in this study. The results in Tables 5 and 6 show that this study is well-suited for spatial effect analysis using the SDM model. The result in Table 5 and column (3) shows that the coefficient of rho is 0.164, $p < 0.01$, which means that there is a spatial spillover effect. The spatial effect is further decomposed using the partial differential method. The result in Table 7, column (5) shows that the coefficient of direct effect is −0.0302, $p < 0.1$, which means that digital inclusive finance exerts a mitigating impact on speculative activities in the local real estate market. The result in Table 7, column (6) shows that the coefficient of indirect effect is 0.0466, $p < 0.05$, which means that digital inclusive finance is expected to stimulate speculation in the real estate market within neighboring cities. This could be attributed to the reliance of digital inclusive finance development on robust urban infrastructure and high-quality Internet technology support, thereby impeding the progress of digital inclusive finance in surrounding underdeveloped cities due to the siphon effect. Digital inclusive finance in local cities serves as a deterrent to speculation in the local real estate market, thereby mitigating the potential spillover of such funds to surrounding cities and curbing speculative activities in their respective real estate markets. Consequently, this approach can foster a reverse spillover effect on adjacent cities.

Table 5. Moran's I.

Year	Digital Inclusive Finance		Real Estate Market Speculation	
	Moran's I	Z	Moran's I	Z
2015	0.445 ***	11.262	0.091 ***	2.59
2016	0.415 ***	10.517	−0.228 ***	−6.805
2017	0.429 ***	10.897	0.035 *	1.347
2018	0.496 ***	12.576	0.136 ***	3.614
2019	0.533 ***	13.466	0.233 ***	7.388

*** $p < 0.01$, * $p < 0.1$.

Table 6. LM test, Wald test, and LR test results.

	Coefficient	*p*
LM-error	18.229 ***	0.000
LM-lag	18.804 ***	0.000
LR sdm sar	158.58 ***	0.000
LR sdm sem	154.37 ***	0.000
Wald sdm sar	19.98 **	0.0104
Wald sdm sem	23.65 ***	0.0026
LM-error	18.229 ***	0.000

*** $p < 0.01$, ** $p < 0.05$.

Table 7. Spatial Durbin model results.

Variables	(1) Main	(2) Wx	(3) Spatial	(4) Variance	(5) LR_Direct	(6) LR_Indirect	(7) LR_Total
Digital inclusive finance	−0.0324 *	0.0455 **			−0.0302 *	0.0466 **	0.0164 *
	(0.0174)	(0.0183)			(0.0174)	(0.0184)	(0.00888)
Economic development	−0.0102 **	0.0113			−0.0101 **	0.0113	0.00120
	(0.00506)	(0.00846)			(0.00483)	(0.00951)	(0.0100)
loans growth	0.0133 ***	−0.0564 ***			0.0116 ***	−0.0634 ***	−0.0518 ***
	(0.00291)	(0.00413)			(0.00277)	(0.00505)	(0.00586)
Industrial structure	0.00349	−0.0180 ***			0.00286	−0.0200 ***	−0.0172 ***
	(0.00246)	(0.00374)			(0.00236)	(0.00428)	(0.00417)
Economic growth	0.0226 ***	−0.0508 ***			0.0213 ***	−0.0555 ***	−0.0342 ***
	(0.00661)	(0.00936)			(0.00618)	(0.0102)	(0.0100)
Population	0.0196	0.0816 ***			0.0233 *	0.101 ***	0.124 ***
	(0.0139)	(0.0238)			(0.0136)	(0.0281)	(0.0293)
Housing price	−0.0892 ***	0.195 ***			−0.0832 ***	0.207 ***	0.124 **
	(0.0309)	(0.0522)			(0.0321)	(0.0597)	(0.0627)
Living standard	0.00148	0.0149 **			0.00188	0.0177 **	0.0196 ***
	(0.00452)	(0.00680)			(0.00428)	(0.00729)	(0.00732)
rho			0.164 ***				
			(0.0372)				
sigma2_e				0.000129 ***			
				(0.00000488)			
Observations	1400	1400	1400	1400	1400	1400	1400
R-squared	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Number of id	280	280	280	280	280	280	280

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5. Heterogeneity Analysis

The distribution of China's real economy exhibits a pronounced concentration in the eastern region, gradually tapering off towards the Central and Western regions, characterized by heterogeneity in terms of economic development level, industrial structure, natural geography, and other factors [45]. The eastern region boasts a comprehensive network of traditional financial institutions, facilitating the development of the financial service industry [46]. The "Western Development" strategy in 2000 and the "Rise of the Central Region" plan in 2004 facilitated substantial financial allocation to support infrastructure development in the Central and Western regions, effectively addressing the issue of imbalanced capital distribution. However, in comparison to the eastern region, the infrastructure construction, such as postal and telecommunication networks, remains imperfect, while financial services development lags behind [47]. Due to its targeted and policy-oriented nature, digital inclusive finance is influenced by factors such as the level of regional economic development and characteristics of urban locations, resulting in regional variations [48,49]. In the eastern region, digital inclusive finance has achieved extensive penetration in areas such as digital insurance and digital payment, with a primary focus on supporting the already relatively abundant financial supply [50]. In the Western region, digital inclusive finance plays a pivotal role in mitigating financial exclusion through its low threshold and cost-effective nature, thereby facilitating convenient access to financial services in underdeveloped regions and compensating for the deficiencies of traditional financial development. However, these regional disparities inevitably limit the suppressive impact of digital inclusive finance on real estate market speculation.

According to the regional division standard of China, we categorized the samples into the Eastern, Central, and Western regions for regression analysis, respectively. The result in Table 4, column (2) shows that the coefficient of digital inclusive finance is -0.0378, $p < 0.01$, which means that digital inclusive finance can effectively mitigate real estate market speculation in Eastern regions. The result in column (3) displays that the coefficient of digital inclusive finance is -0.0195, $p < 0.01$, which means that digital inclusive finance can effectively mitigate real estate market speculation in Central regions. The result in column (4) displays that $p > 0.1$, which means that the two variables exhibit no discernible correlation in western regions. The Eastern and Central regions, in comparison to the Western region, exhibit a higher economic level, possess a robust Internet infrastructure, have pioneered the development of digital inclusive finance at an early stage, and demonstrate profound integration with traditional industries. These factors contribute to the complete realization of the dividends offered by the digital economy. The Western region is characterized by its vast expanse and low population density, which are accompanied by inadequate internet infrastructure and relatively underdeveloped online networks.

6. Robustness Test

We conducted rigorous robustness tests and found that the results are still robust.

First, to mitigate endogeneity issues arising from reverse causality between digital inclusive finance and real estate market speculation, this paper introduces a lag of one period for the explanatory variables and control variables. The regression results are shown in column (1) of Table 8. We find that the prosperity of digital inclusive finance also mitigates real estate market speculation.

Second, in order to avoid the estimation bias caused by the endogeneity problem, we adopt the instrumental variable approach. We employ appropriate instrumental variables for the explanatory factors to establish the net impact of digital inclusive finance on real estate market speculation. The evolution of internet technology can be traced from its early days of telephone line dial-up access (PSTN) to the current fiber optic broadband access technology, which emerged after ISDN and ADSL access. Therefore, as an extension of the fixed-line telephone penetration, the historically high rate of fixed-line telephone adoption will impact the technical aspects and other factors influencing the development and implementation of Internet technology in the region, thereby positioning it as a region

with enhanced digital inclusive finance [51]. Furthermore, as the usage of fixed telephones continues to decline, traditional telecommunication tools have progressively lost their influence on real estate market speculation and meet the demands for exclusivity. Hence, this study employs the count of landline telephones in 1984 as an instrumental variable for measuring digital inclusive finance [52]. Because of the panel data in this paper, we construct an interaction term between the number of fixed telephones per ten thousand people in 1984 (representing individual changes) and the number of national Internet broadband access ports in the previous year (representing time) of cities [53]. This interaction term serves as an instrumental variable for digital inclusive finance. The *p*-value of the LM statistic for the Kleibergen–Paap rk test is 0.000, providing strong evidence to reject the null hypothesis of insufficient identification of instrumental variables. Additionally, the Wald F statistic for the Kleibergen–Paap rk test exceeds the critical value at a significance level of 10% in Stock–Yogo's weak identification test, confirming its validity as an instrument variable. These tests collectively demonstrate the soundness and rationality of our instrumental variable approach. The regression results are shown in column (2) of Table 8. We find that the prosperity of digital inclusive finance also mitigates real estate market speculation.

Table 8. Robustness test results.

Variables	(1) Lag of One Period	(2) Instrumental Variable	(3) Replace the Dependent Variable
Digital inclusive finance	−0.0149 ***	−0.0366 ***	−0.361 ***
	(0.00452)	(0.0102)	(0.137)
Economic development	0.0129 ***	−0.00869	0.0408
	(0.00337)	(0.00809)	(0.0320)
loans growth	−0.00238	0.00532	−0.0360 *
	(0.00585)	(0.00437)	(0.0216)
Industrial structure	−0.00249	−0.00349	0.0108
	(0.00217)	(0.00405)	(0.00750)
Economic growth	−0.00252	0.0180 ***	−0.0619
	(0.00632)	(0.00584)	(0.0498)
Population	0.0286	0.0327	−0.189
	(0.0224)	(0.0269)	(0.120)
Housing price	0.119 ***	−0.0585	0.133
	(0.0277)	(0.0775)	(0.324)
Living standard	0.0000199	0.0136 *	0.404 **
	(0.00335)	(0.00781)	(0.196)
Constant	−0.221		−0.908
	(0.138)		(0.822)
Observations	1400	1400	1400
Number of id	280	280	280
R-squared	0.034	0.026	0.269

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Third, we replace the dependent variable. A previous study believed that speculation in the real estate market depends on the degree of price deviation from the basic value, and the greater the degree of price deviation from the basic value, the more active the speculation in the real estate market [43]. Investors obtain the basic value of a house by evaluating its future cash flow, such as rental income. Since the real estate rental market in China is underdeveloped and the rental data are not accurate, this paper uses per capita disposable income to derive the basic value.

$$F_t = \frac{(1+r)C_q y_t}{r-g} = R \cdot y_t \quad (6)$$

In Equation (6), r represents the discount factor, C_q denotes a constant measure of per capita disposable income y_t, $C_q y_t$ signifies the shadow market rent, and g is assumed to be

the average rate of growth of per capita disposable income in each period. Assuming unbiased expectations, future prices are anticipated to equal future fundamental values. Here, R is considered as a constant, assuming that prices fluctuate around its fundamental value.

$$R = \text{mean}\left(\frac{F_t}{y_t}\right) \approx \text{mean}\left(\frac{P_t}{y_t}\right) \quad (7)$$

In Equation (7), P_t represents the sales price of commercial housing.

$$SPECU1_{i,t} = |\ln P_{i,t} - \ln F_{i,t}| \quad (8)$$

In Equation (8), $F_{i,t}$ denotes a given basic value. The deviation between the price and the basic value at time t is quantified as $SPECU1_{i,t}$, which serves as an indicator for speculative trading activity in the real estate market of city i at that specific time.

The result in Table 8 and column (3) shows that the coefficient of digital inclusive finance is -0.361, $p < 0.01$, which means that digital inclusive finance can effectively mitigate real estate market speculation.

7. Conclusions

As a cornerstone industry of China's national economy, the real estate sector exerts a significant impact on people's well-being and has emerged as a key policy priority. China's implementation of the dual-track system for social security housing and commercial housing will not alter the fundamental purpose of real estate, which is to provide living spaces. However, the current real estate market is undergoing a significant adjustment, with irrational speculation leading to concerning bubbles in the economy. Extensive academic research has explored various perspectives on how to mitigate speculation in the real estate market in order to promote stable and high-quality development within the industry. By examining the speculative motives of various speculators in both residents and enterprises, we present a fresh perspective on digital inclusive finance that can effectively mitigate speculation. Concurrently, the government is actively promoting the seamless integration of digital inclusive finance with the real economy across different industries. The development of digital inclusive finance offers a new lens through which to study abnormal behaviors in the real estate market. Our research reveals that digital inclusive finance successfully curbs speculative behavior among residents and enterprises by reducing precautionary motivations for residential speculators and enhancing the financial literacy of these individuals to optimize their household asset allocation structure. Additionally, it weakens investment substitution motivations for corporate investors. Utilizing panel data from 2015 to 2019 encompassing 280 cities in China, this study explores the negative effect of digital inclusive finance on real estate market speculation. We empirically examine the influence of digital inclusive finance on real estate market speculation and its spatial spillover effects using both regression analysis and the spatial Durbin model. Furthermore, regional heterogeneity is discussed. The main findings can be summarized as follows.

First, digital inclusive finance can effectively mitigate real estate market speculation. Second, digital inclusive finance will mitigate real estate market speculation within the local city while concurrently stimulating such speculation in the adjacent cities. This may be attributed to the evident siphon effect in the advancement of digital inclusive finance, as well as the spillover of housing investment funds to neighboring cities. Finally, we conducted a heterogeneity analysis. In the eastern region, digital inclusive finance exhibits the strongest inhibitory effect on real estate market speculation, followed by the central region. However, no significant inhibitory effect is observed in the western region. This discrepancy may be attributed to the comparatively higher economic level and robust Internet infrastructure of the eastern and central regions, enabling them to fully leverage the dividends of the digital economy.

According to the above findings, we propose recommendations to guard against systemic risks. Firstly, it is imperative to expedite the digital industrialization reform and

establish an information-efficient digital system that can effectively adapt to economic and social advancements. Additionally, leveraging digital inclusive finance holds the potential to address the housing predicament faced by individuals while enhancing their overall well-being. Second, it is imperative to bridge the development gap in digital inclusive finance across regions. The government should foster an enabling environment for the Western region by actively facilitating access to digital inclusive finance and reducing the cost of digital resources. Furthermore, there is a need to disseminate knowledge about digital inclusive finance among the general public. Finally, it is imperative to closely monitor and analyze the capital flow between economically interconnected cities. Particular attention should be given to the spatial spillover impact of digital inclusive finance on the real estate market. Diverse urban economies necessitate distinct housing price policies, while tailored credit measures should be implemented by the government in different cities to foster a stable and sound development of the real estate sector.

Despite the valuable benefits and contributions of this study, the study has some limitations. Due to insufficient data feasibility, there exist certain limitations in the methodology employed for real estate market speculation. In fact, it may not effectively differentiate certain transactions, such as house replacement. Therefore, how to comprehensively evaluate the impact of digital inclusive finance on real estate market speculation is still worth exploring.

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