

## Research on the Effect of Technological Progress on Urban Housing Rental Prices and Countermeasures

### -- Empirical Analysis based on Panel Data in First-Tier Cities in China

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#### Abstract

The development and progress of science and technology profoundly changing the pattern of the modern economy, since the 21st century, our country's information technology industry booming contributed to chain blocks the emergence of new technology and applications, such as block chain is decentralized, openness, anonymity, data do not tamper with the advantage, has vast application prospects in the field of house lease, It can effectively solve the problems of "difficult rent" and "expensive rent" in China's first-tier cities. Therefore, on the basis of investigation and research, this paper collected relevant data from 2006 to 2020 in four first-tier cities of Beijing, Shanghai, Guangzhou and Shenzhen, established a panel fixed effect model for regression analysis, and proposed specific application schemes of block chain technology in the field of housing rental according to the empirical analysis results. Finally, corresponding policy suggestions are put forward for the government, enterprises and consumers to facilitate the implementation and application of the program.

#### Keywords

Blockchain Technology; Housing Leasing; Empirical Research; Application Scheme.

### 1. Research Background

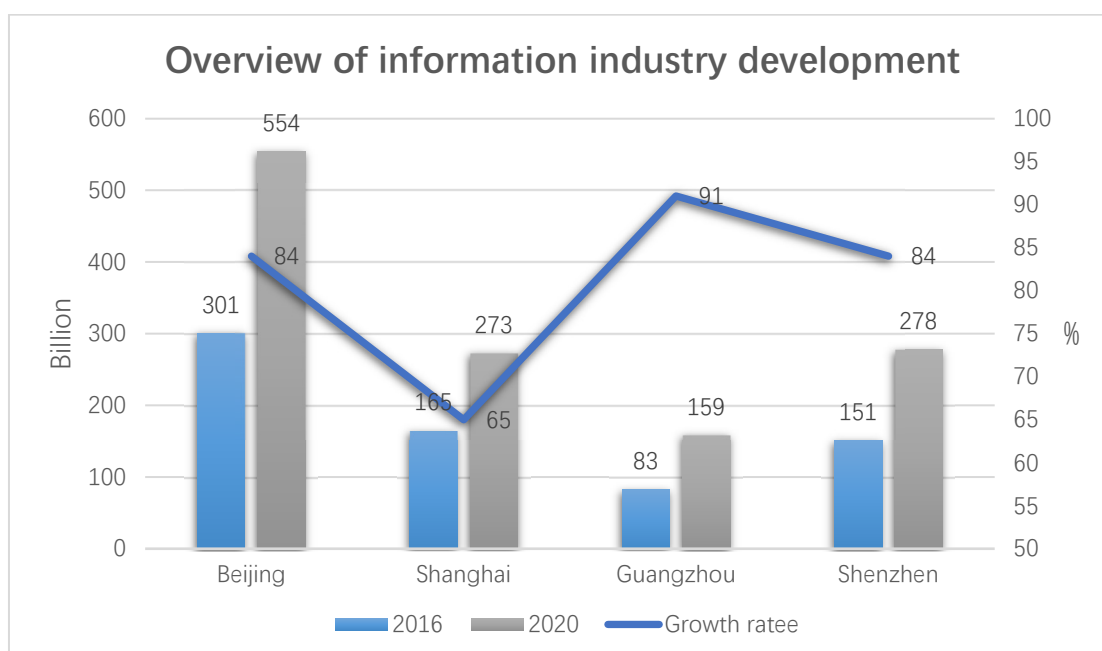


Figure 1. Overview of the development of China's information technology industry

The development of the economy is largely driven by technological progress, the emergence of new technologies and new theories has profoundly changed the pattern of modern economic development, for example, the information technology industry represented by the blockchain industry has flourished in recent years, and the promotion of its theory and application methods has not only changed people's lifestyles, but also changed the operating mode of some traditional industries, including the housing rental industry.

As shown in Figure 1, the chart shows the changes in the output value and growth rate of the information technology industry in the four first-tier cities of Beijing, Shanghai, Guangzhou and Shenzhen in 2016-2020, which shows that the information technology industry in the above cities has not only grown in output value in the past five years, but also reached 60%. Above, the emergence of this change is closely related to the application and promotion of new technologies such as blockchain. At the same time of economic development, whether the application of blockchain technology can help traditional industries get rid of development difficulties, and what attitude should be taken to face the collision and integration between new technologies and traditional economic industries, this issue has become the focus of more and more people's discussion and attention.

China's economy has continued to maintain a high-speed and healthy development trend in recent years, and more employed people tend to go to big cities to work and live, which has become an important driving force for promoting urban economic development. However, the development of China's first-tier cities are also facing many problems, affected by many factors such as large population density and scarcity of land resources, the contradiction between supply and demand of commercial housing in China's first-tier cities has been very prominent, and gradually derived from today's "difficult to rent" and "expensive to rent" and other issues. The heavy cost of living makes many employees prohibitive of big cities, so that many outstanding talents and young and strong laborers continue to flow out of the city, which has become an important hidden danger hindering the high-quality economic development of first-tier cities.

In order to properly solve such problems, it is first necessary to scientifically study the causes of the problem of high rents in China's first-tier cities and reasonably assess the impact of technological progress on the housing rental industry. Based on this, this paper collects panel data from Beijing, Shanghai, Guangzhou and Shenzhen for a total of 15 years from 2006 to 2020, and establishes a fixed-effect model for regression analysis under the premise that the data unit root test is passed, and proposes feasible measures on this basis.

## 2. The Cause of the Problem

In fact, such employed people face the social reality of "high housing prices and low income" in large cities, making it impossible for them to have the economic strength to buy high-priced commercial housing in the short term, so renting has become the only choice to meet their urgent living needs.

With the increasing demand for rental housing, the scale of China's housing rental market continues to expand, but due to the short development time, lack of relevant laws, illegal transactions of bad businesses and many other factors, China's housing rental market system is not perfect, such as untrue rental information, less choice of housing and intermediate transaction costs of the market defects, and exposed such as false publicity of bad intermediaries, arbitrary modification of housing information, sitting on the starting price, poor service attitude and other "black intermediary" problems. Due to the lack of social experience, lack of economic resources and urgent demand for rental housing, the above groups are prone to become victims of such problems, and it is difficult to effectively maintain related rights and interests, which need to be solved through the application and innovation of new technologies.

The survey found that China's solutions to the above problems are mostly concentrated at the policy level, rarely involving the technical level, and blockchain technology has the advantages of decentralization, autonomy, openness, anonymity, data immutability, etc. If blockchain technology is applied to the field of housing leasing and a new business model is developed, it will be technically effective to solve the problem, meet the needs of the good life of employees in large cities, and promote the long-term healthy development of China's economy.

### 3. Empirical Analysis

#### 3.1. Indicator Selection and Model Setting

In order to find the possible correlation between the two, this paper conducts empirical analysis by establishing a regression analysis model. Panel data from Beijing, Shanghai, Guangzhou and Shenzhen for a total of 15 years from 2006 to 2020 is collected, and the data are from the China Statistical Yearbook 2006-2020, the China Urban Construction Yearbook 2006-2020 and the website of the National Bureau of Statistics, and the individual missing data are interpolated to make up for it.

According to the results of Hausman's test, the above data are analyzed by using a fixed-effect model, and in order to effectively reduce the heteroscedasticity of the data, this paper takes a double logarithmic model for the regression equation, and according to the modern economic development theory, the following model is constructed in this paper.

$$\text{LnCPIH}_{it} = \delta_0 + \beta_1 \text{LnAIT}_{it} + \beta_2 \text{LnUHP}_{it} + \beta_3 \text{LnGDP}_{it} + \beta_4 \text{LnNEP}_{it} + \beta_5 \text{LnPCDI}_{it} + \varepsilon_{it} \quad (1)$$

In Formula (1),  $I$  is the sectional individual,  $T$  is the period,  $\text{LnCPIH}$  is the rent price index,  $\text{LnAIT}$  represents the technological progress level as the core explanatory variable of the equation.  $\delta_0$  is the constant term,  $\varepsilon_{it}$  is the random perturbation term,  $\beta$  is the parameter to be estimated,  $\beta_1$  represents the elasticity coefficient of rent price index increase in China's first-tier cities when the technological progress level increases by 1%.

Explained variables: rent price index ( $\text{LnCPIH}$ ); In this paper, the consumer price index (%) of housing rent in sample cities is selected to reflect the level of rent price. Compared with other indicators, this index is currently the internationally used reference index to measure the rise of consumer price of a certain type of goods in a region, and it can accurately reflect the actual situation of rent price in first-tier cities.

Core explanatory variables: level of technological progress ( $\text{LnAIT}$ ); With the added value of information transmission, software and information technology services industry (one hundred million yuan), the current reflects the technology level of the index, general use of Thoreau's total factor productivity (TFP) as a reference, but the indicators reflect the technical elements of the whole society's overall impact on economic growth, and the index of assumption constraints is stronger, is rough, This paper only discusses the impact of the development of information technology industry, especially blockchain technology, on the rent price, so the total factor productivity is not selected, but the total output value of the information technology industry is used to measure.

Control variables: mainly including the average housing price ( $\text{LnUHP}$ ), measured by the average selling price of urban commercial housing (yuan/square meter); Macroeconomic status ( $\text{LnGDP}$ ), measured by the total regional GDP (hundred million yuan); Urban employment status ( $\text{LnNEP}$ ), measured by urban employment number (ten thousand); People's income level ( $\text{LnPLS}$ ) is measured by the per capita disposable income of urban residents. Table 1 is the descriptive statistics of the above indicators.

**Table 1.** Descriptive statistics of panel data of first tier cities in China from 2006-2020

Type	Variable	Obs	Mean	Std.Dev	Min	Max
Explained Variable	lnCPIH	60	4.642	0.986	4.697	9.02
Explanatory Variable	lnAIT	60	6.917	1.038	10.18	15.48
Control Variable	lnUHP	60	9.820	0.333	9.226	10.85
	lnGDP	60	9.750	0.25	-1.674	0
	lnNEP	60	6.915	0.159	3.562	4.605
	lnPLS	60	10.63	0.956	5.916	9.129

### 3.2. Data Unit Root Inspection

Because the panel data is a combination of time series and cross-sectional data, a unit root test is required to verify stationarity before doing regression analysis. The more commonly used unit root test methods are LLC test, HT test, IPS test, Hadri test, Fisher-ADF test and so on. Considering that the conclusions obtained by different methods are generally different, in order to ensure the validity of the test, this paper adopts three methods of LLC, HT and Fisher-ADF test to judge the stationarity, and as long as two methods of a set of data pass the test, the data is considered to be stable. All indicators can pass the test at a confidence level of 90%, and the test results are shown in Table 2.

**Table 2.** Data unit root test results

Variable	LLC	HT	ADF	Judgment of smoothness
lnCPIH	-6.2243	0.1139	-4.5602	Smoothly
	(0.0000)	(0.0000)	(0.0000)	
lnAIT	-1.9874	0.8514	-9.4378	Smoothly
	(0.0234)	(0.0570)	(0.0000)	
lnUHP	-1.1413	0.6359	-6.6679	Smoothly
	(0.1269)	(0.0333)	(0.0000)	
lnGDP	-2.4241	0.9151	-3.8719	Smoothly
	(0.0077)	(0.8567)	(0.0000)	
lnNEP	-3.2582	0.9472	-4.8943	Smoothly
	(0.0006)	(0.5192)	(0.0000)	
lnPLS	-4.0351	0.6375	-2.9617	Smoothly
	(0.0000)	(0.0345)	(0.0015)	

Note: The unit root test statistic P values are in parentheses

### 3.3. Panel Fixed Effect Regression

In order to reasonably determine the regression analysis model, the F test and the Hausman test were performed before modeling, and the results showed that the fixed-effects model was superior to the random-effects model and the mixed-regression model. For visual comparison, this paper presents the results of the mixed regression model and the results of the random effects model together, and the regression results are shown in Table 3

**Table 3.** Regression analysis results

	(1)	(2)	(3)
	OLS	RE	FE
lnAIT	-0.023*** (0.01)	-0.023* (0.01)	-0.100*** (0.03)
lnUHP	0.011 (0.01)	0.011 (0.02)	-0.002 (0.04)
lnGDP	0.068 (0.07)	0.068 (0.05)	0.206*** (0.06)
lnNEP	-0.034 (0.07)	-0.034 (0.06)	0.022 (0.06)
lnPLS	-0.053 (0.04)	-0.053 (0.04)	-0.095** (0.04)
_cons	4.832*** (0.27)	4.832*** (0.30)	4.192*** (0.36)
adj. R <sup>2</sup>	0.562	0.592	0.643
Hausman	\	0.0345	0.0345
F	2.426	7.145	3.565
N	60	60	60

Standard errors in parentheses \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

From Table 3, it can be seen that the elasticity coefficient of the core explanatory variable technology progress level (LnAIT) is -0.1, and it is significant at the significance level of 1%, indicating that the overall improvement of the level of technological progress will have a significant negative impact on the rent price level (LnCPIH) in first-tier cities, that is, every increase in the added value of the information technology industry in first-tier cities 1%, the rent price level is reduced by 0.1%, this result theoretically verifies that technological progress can be an effective means of promoting the decline in urban rent prices.

In other explanatory variables, the macroeconomic situation and the improvement of people's income level will have a positive impact on the rise in the rent price level of first-tier cities, that is, on the basis of maintaining the development and growth trend of the urban economy, the increase in the income of residents and employees will also promote the rise in rent prices, which is in line with the general market economy law, on the other hand, the average price of housing prices and urban employment conditions have no significant impact on the rent price level of first-tier cities.

In particular, it is important to note that macroeconomic conditions have a very obvious positive effect on the level of rent prices, that is, for every 1% increase in GDP, the rent prices in cities increase by 0.206%. For government managers, how to control the rising rent prices on the basis of maintaining urban economic growth is a major problem that needs to be solved urgently. Based on the above conclusions, this paper believes that more attention should be paid to the negative impact of the level of technological progress on the level of rent prices, the government should vigorously develop the information technology industry, give preferential policies and financial subsidies to the industry, and actively use technical tools such as

blockchain to promote the reform of the rental operation model, thereby promoting the emergence of new economic formats, so as to promote the decline in rent prices, so as to achieve the reasonable rental needs of the employed and the needs of a better life.

## 4. Application Design

### 4.1. Structural Characteristics

In order to achieve the above goals, on the basis of full investigation and research, combined with the application characteristics of blockchain technology, this paper tries to design a scientific rental operation model to solve the problem of high rent in first-tier cities. Before designing the scheme, first of all, we need to understand the structural characteristics of the blockchain, the blockchain can be simply divided into a protocol layer, an extension layer and an application layer in structure, of which the protocol layer can be divided into a storage layer and a network layer, which are independent of each other but indispensable. The I/O performance capabilities of its storage layer on the data store largely determine the overall performance of the platform. The network layer uses distributed algorithms, cryptographic signatures, data storage and other operations to enable users to obtain more listing information, reduce search costs and avoid more risks, make transactions transparent and protect transaction information on both sides. The next extension layer is to design a smart contract using information obtained through blockchain technology, which is automatically executed after the two parties confirm the signing. The final application layer that plays a role obtains more listing information through blockchain technology and displays real housing scenes and cases.

### 4.2. Application Plan

Combined with the unique structural characteristics of the blockchain, the basic idea of the development and utilization of blockchain technology in the field of housing leasing is: First, the intended tenant searches for the desired house through the data of the blockchain rental application platform, the landlord ensures the authenticity and effectiveness of the information by releasing the housing information, and the two sign smart contracts through the platform, and the platform conducts private key authentication to strictly ensure the security of transaction information. Through the smart contract server, the execution of the contract is guaranteed.

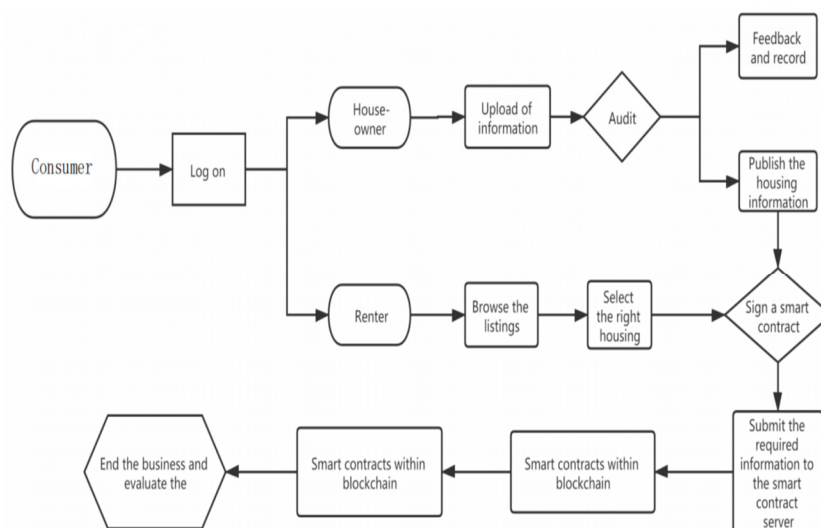


Figure 2. Schematic of the business process

It can be seen that whether in terms of structure or practical application, it provides a possibility for the development and application of blockchain technology in the field of housing leasing, and the specific development application mode is shown in the Figure 2.

As shown in Figure 4, as a new user, renters need to log in to the blockchain rental application platform to register, and then they can log in to the platform to browse the listings, choose the suitable housing according to their own situation, and contact the landlord to continue to understand when they have the intention to rent. The owner of the house rental can upload their own listing information on the blockchain application platform, which can be released on the platform after the background automatic review is passed, and the situation needs to be fed back to the homeowner after the system is not passed, when the listing information is approved, once the buyer and seller reach an agreement, they can submit the required information, sign a smart contract designed by the system, record the contract on the blockchain, and then both parties execute the contract, and finally end the business and evaluate and feedback. And because of the anonymity and immutability of the blockchain, neither the tenant nor the homeowner needs to disclose their personal information to prevent the leakage of personal privacy, and all the listing information viewed by the tenant is true and effective and cannot be tampered with in the transaction.

The application process of the scheme is simple, safe and effective, and the information is transparent, which broadens the source channels of rental housing and effectively reduces the intermediate transaction cost of renters' rentals, because the decentralized nature of the blockchain also fundamentally solves the problem of illegal intermediary transactions, and ultimately achieves the goal of improving the quality of rental housing for employees, helping to solve the current population living problems in China's first-tier cities.

## 5. Countermeasures and Suggestions

This paper first proposes the role of technological progress in promoting economic development and adjustment, combined with the causes of the problems of "difficulty in renting" and "expensive renting" in china's first-tier cities and the social status quo of the vigorous development of the information technology industry, and strives to find possible correlations between the two. By collecting panel data from Beijing, Shanghai, Guangzhou and Shenzhen from 2006 to 2020 in four first-tier cities for empirical analysis, the regression analysis of the panel fixed effect model was used to derive the relationship between the variables of rent price level, technological progress level, macroeconomic situation, people's income level, etc., and designed an application scheme of blockchain technology in housing leasing on the basis of full investigation and research based on the conclusion that technological progress will lead to the decline in rent prices. It is used to solve the current housing rental obstacles in China's first-tier cities.

All in all, the technological progress brought about by the development of the information technology industry is of great significance to promote the rental prices of China's first-tier cities to a reasonable range, especially the emerging blockchain technology has great application prospects in the housing rental business traded in the market, which should be paid attention to.

Combined with the above content, this paper puts forward the following policy suggestions (1) The government should increase policy support for the information technology industry; the Chinese government, as the manager of the whole society, should understand that the promotion and application of blockchain as a new technology is of great significance to the high-quality development of China's economy, for example, this paper proposes that the application of blockchain in housing leasing will effectively solve the problems of rental difficulties, illegal transactions, and talent outflow in China's first-tier cities if realized.

(2) The state should provide legal guarantees for the development and application of blockchain technology; the government should ensure that the administrative regulations for promoting the development of blockchain have continuity and appropriate consideration of regional differences, and at the same time make more appeals in legislation to help the legislature issue relevant laws and regulations as soon as possible to regulate the development and supervision of the industry.

(3) Enterprises should pay attention to the introduction and training of scientific and technological talents; whether it is the research and development of blockchain technology or the application in the field of housing leasing, it is inseparable from the support of professional and technical teams. Enterprises should use more strategic vision to see the problem, in the market competition, do not compete for a moment of length, to ensure the financial support for technology research and development and talent training, once the blockchain technology in the field of housing rental successful application, will bring long-term benefits to enterprises.

(4) Consumers should accelerate the acceptance of the market changes brought about by new technologies; consumption as the end of the entire social and economic operation, consumer demand will have a huge counter-effect on production, consumers should learn more about new knowledge and new technologies, and strive to accept the social changes produced by the application of new technologies, which is not only beneficial to the growth and development of individuals, but also helps to promote the improvement of the level of scientific and technological innovation in the whole society.

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