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Will Housing Prices Inhibit the Urban Scientific and Technological Innovation Efficiency? ——Analysis based on SFA model

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ABSTRACT. *Based on the panel data of 29 typical large and medium-sized cities in China from 2010 to 2017, this paper constructs a time-varying translog stochastic frontier model to explore the impact of housing prices and other factors on the efficiency of urban scientific and technological innovation (USTIE). The results show that: the internal R & D expenditure is the main driving force for the development of scientific and technological innovation activities, and the accumulation of R & D personnel will reduce the output level of urban scientific and technological innovation. Government support is the key factor to improve the USTIE, and there is a negative correlation between the level of economic development and the USTIE. Housing price itself can improve the USTIE, and weaken the negative correlation between the level of economic development and the development of scientific and technological innovation activities, but at the same time, it will also reduce the positive effect of government support on the USTIE.*

KEYWORDS: *Urban scientific and technological innovation efficiency(USTIE), housing price, economic development level, government support, stochastic frontier*

1. Introduction

In the 1980s, a number of science and technology innovation centers with world influence, such as San Francisco, Boston and Tokyo, rose rapidly. People began to focus on scientific and tech-nological innovation from the national level to the regional and even the urban level. According to statistics, the world's 20 science and technology innovation center cities, with less than 2.5% of the population, have

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steadily contributed more than a quarter of the world's high-level scientific and technological innovation[1]. In recent years, China is also aware of the huge driving force of scientific and technological innovation on urban development, and has gradually formed a basic pattern of gradient distribution of urban innovation and development in the eastern, central and western regions, with provincial capitals and cities above the provincial level as the leader. Some cities with superior geographical location, good industrial foundation and innovation environment gather various global innovation elements more and more widely. However, the housing price in these cities is also relatively high. While filtering high-quality talents, the high housing price often brings a high housing cost, which has an important impact on the innovation and development of cities that cannot be ignored. Other cities in China that have relatively low housing costs and want to improve their innovation ability and speed up transformation and upgrading begin to speed up innovation and attract talents by issuing policies, straightening out the system, creating environ-ment, and improving the affordability of housing. For a time, the differences and development paths of scientific and technological innovation among cities are more diverse. But the develop-ment of scientific and technological innovation is not only the increase of input and output, but al-so the improvement of efficiency. Although some cities invest a lot of human and material re-sources in science and technology, the output level is not satisfactory. Even the big cities with con-centrated scientific and technological innovation resources have relatively general input-output le-vel of scientific and technological innovation.

Therefore, many scholars, especially Chinese scholars, have begun to pay attention to the research and analysis of USTIE. Some scholars compare and analyze the differences in technological innovation efficiency of various cities based on a specific region or province. For example, In 2016, Zhai studied the efficiency of technological innovation in 13 cities in Jiangsu Province and believed that the allocation of technological innovation resources between cities was unreasonable[2]; In 2017, Zhu analyzed 9 cities in Fujian Province and found that most cities showed that the USTIE was ineffective, while the USTIE in economically developed cities was poor[3]. There are also many scholars who select sample cities from all over the country to study the USTIE, which can be divided into three types. The first type takes provincial or sub-provincial cities as the research object, such as Yu[4].The second type selects sample cities from the whole country as the research object

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according to the research purpose. For example, Xu selected 10 typical cities from the whole country to measure the impact of input variables on the USTIE [5]. The third type chooses all cities across the country as the research object. For example, Fan found that the efficiency of technological innovation in cities above the prefecture level is always at a low level based on empirical analysis of 286 cities in China, with repeated fluctuations and differences between cities[6]. Although different scholars have different research perspectives, most scholars have come to the conclusion that the efficiency of urban technological innovation needs to be improved, there are significant differences between cities, and the allocation of urban technological innovation resources is unreasonable.

In terms of the influencing factors of the USTIE, the government support and the level of economic development cannot be ignored, but the effect has not yet formed a final conclusion. In terms of government support, in 2016, Qi found that government subsidies have a U-shaped relationship with the USTIE of enterprises[7].In 2017, Hao thought that government support had a negative effect on the USTIE [8]. In terms of economic development, Liu found that the level of economic development promotes the USTIE after studying the provinces and cities of the Yangtze River Economic Belt in 2017[9]. However, Zhai in 2016 and Zhu in 2017 came to the opposite conclusion[2] [3]. In recent years, scholars have gradually paid attention to the impact of housing prices when studying scientific and technological innovation. In 2017, Li believed that the rise of housing prices would reverse inhibit the level of scientific and technological innovation of cities by affecting the flow of talents, the intensity of enterprise R&D and the strength of government support[10]; in 2018, Cui further pointed out that the rise in housing prices would lead to the mismatch of scientific and technological innovation resources, thus inhibiting the city's scientific and technological innovation ability[11]. However, Shao found that urban housing prices did not inhibit regional innovation, on the contrary, every 1 standard deviation increase in housing prices would promote the regional innovation level by 0.07 standard deviations[12].In 2019, Kuang also pointed out that rising housing prices will increase the mortgage effect of real estate, and indirectly increase the input and output of urban scientific and technological innovation activities by improving corporate financing capabilities[13].

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In terms of research methods, currently domestic and foreign scholars mainly use data envelopment analysis (DEA) and stochastic frontier analysis (SFA). Among them, DEA is widely favored by scholars because of its simple operation and no need to pre-set the functional relationship between input and output. The more common models in DEA include the DEA-Malmquist index model、SBM and the three-stage DEA, etc. However, DEA cannot directly analyze the influencing factors of USTIE, and generally needs to be combined with a econometric model to achieve. Compared with DEA, SFA can avoid the problem of inconsistent assumptions in efficiency measurement and influencing factor analysis, allow statistical noise and control heterogeneity, more accurately describe the real production situation[14], and keep the results consistent with DEA in the ranking of efficiency values[15]. Therefore, SFA has also been applied by scholars in the research on the USTIE and its influencing factors.

To sum up, this paper selects typical cities in China and draws on previous scholars' research points, uses SFA method to explore the USTIE after taking into account factors such as government support, economic development level and housing price. It pays special attention to whether housing price inhibits or promotes the USTIE, and whether it will affect the effect of government support and economic development level on the USTIE.

2. Hypothesis

H1: The higher the level of government support, the better the performance of USTIE.

The government plays an extremely important role in the transformation of urban science and technology innovation efficiency. First of all, the government is the leader of urban science and technology innovation activities. As scientific and technological innovation activities have the characteristics of large investment in resources, long payback periods and unpredictable investment effects, many enterprises, especially small and medium-sized enterprises, do not have the ability and willingness to resist risks. Therefore, most of the scientific research work, especially basic research, is undertaken by universities and scientific research institutions. These scientific research results not only provide a large number of

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talents with excellent knowledge base, technical ability and innovative ability for subsequent innovation, but also lay the theoretical foundation. Secondly, the government formulates favorable policies and provides financial subsidies for the development of scientific and technological innovation activities, which can effectively encourage individuals and enterprises to carry out scientific and technological innovation activities, increase the number of innovation subjects and create a good innovation environment, thereby promoting the improvement of USTIE.

H2: Cities with better levels of economic development do not perform well in terms of USTIE.

Here does not mean that the level of economic development will "hinder" the improvement of the USTIE. In general, cities with higher levels of economic development can better attract talent inflows and capital accumulation due to their complete infrastructure environment and extensive employment opportunities, thereby enhancing their scientific and technological innovation capabilities. But in terms of the efficiency of the relative degree of integration of input and output, this is not the case. Restricted by the overall R&D capability development stage and innovation resource transformation ability of Chinese cities, cities with better economic development level cannot convert high input into corresponding scale of scientific and technological innovation output, Moreover, the hysteretic effect and cumulative effect of science and technology innovation investment also lead to the fact that from an efficiency perspective, cities with better economic development level do not show better USTIE than cities with relatively general economic development level. Scholars such as Zhai[2]and Zhu[3]also pointed out this point in their research.

H3: Housing prices do not necessarily inhibit the USTIE, but instead promote the USTIE because of its "screening" effect.

Existing studies generally believe that rising housing prices will crowd out corporate innovation investment and weaken corporate innovation motivation by increasing the production and operation costs of enterprises[16]; at the same time, it will weaken the consumption ability of residents and reduce the individual risk-taking spirit, thus affecting the entrepreneurial atmosphere[17]; moreover, it will increase the life pressure of middle wage researchers, thus affecting their

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innovation motivation. In addition, it will attract most of the bank credit, which will lead to the difficulty in financing the science and technology innovation industry and increase the financing cost. Therefore, high housing prices will inhibit the development of scientific and technological innovation activities from the perspective of the overall social environment. But on the other hand, in addition to the above-mentioned "negative effects", housing prices have a certain degree of "screening" effect on the residential choice of talents and the production and development of enterprises, attracting creative and highly educated people and crowding out labor-intensive, low-tech and low innovation ability enterprises, which can effectively improve the local human capital structure and industrial structure[12], optimizes the local innovation environment, aggravate the industry competition, force enterprises to innovate, promote enterprises to speed up technological innovation and improve production efficiency, thus enhancing the USTIE of the city. In addition, higher housing prices will increase the value of the company's own real estate, which will not only help improve its repayment ability, but also alleviate its financing constraints [18]. Therefore, the screening effect of housing price will make up for the negative effect of high cost to a certain extent, and promote the USTIE.

H4: Housing prices will weaken the phenomenon of high level of urban economic development but low USTIE, and will also inhibit the promotion effect of government support.

Under the condition that other factors remain the same, the higher the housing prices in cities with the same economic development level, the greater the role of housing prices in screening the talent structure and industrial structure, forcing talents and enterprises to maintain innovative vitality and increase their innovation output to maintain their own Core competitiveness, thereby improving the city's scientific research resource transformation capacity and output level, and weakening the negative correlation between the economic development level and the USTIE. Under the same government support, housing prices will weaken the phenomenon that the level of economic development is not synchronized with the development of technological innovation, and at the same time, it will also make the screening effect of housing prices on innovative talents and companies less obvious. In this situation, rising housing prices have caused companies and talents to pay more attention to the

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impact of the increased burden of housing prices, forcing the existing excellent talents and enterprises to transfer to other cities with the same degree of government support but lower housing prices, reducing the probability of excellent talents and enterprises flowing into the city, and reducing the city's scientific and technological innovation resources and innovation subjects, These indirectly reduces the USTIE in the city.

3. Variable and Data

3.1 Variable

Input variables: Scholars usually choose R&D expenditure, full-time equivalent of R&D personnel or the number of R&D personnel as input variables, respectively representing the capital input and labor input for innovation. Compared with the full-time equivalent of R&D personnel, the number of R&D personnel can more intuitively examine whether the increase in the number of scientific and technological personnel is helpful to improve the output level of scientific and technological innovation activities. Therefore, this paper selects the city's R&D internal expenditure as the capital input variable, and the number of R&D personnel as the labor input variable.

Output variable: This article selects the number of patent applications in the city as the output variable of scientific and technological innovation activities. The main reason is that patents are the most original and direct output of scientific and technological innovation activities and are most closely related to them. Moreover, the number of patent applications can avoid artificial likes and dislikes and time delays caused by the review process, and the data is more objective and reliable [19].

Government support: This paper selects the science and technology expenditures in the government's public financial expenditure as its proxy variable. This is because among the many aspects of government support, science and technology expenditures have the most direct and effective effect on science and technology innovation activities. The size of science and technology expenditures directly

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reflects the government's attitude to support the development of science and technology innovation.

Economic development level: per capita GDP is the most effective tool to understand the macro-economic development of a city or region, and is also the most commonly used indicator in the study of economic development by most scholars. Therefore, this study selects urban per capita GDP as the proxy variable of urban economic development level [2] [3].

Housing price: Considering the current situation of China's housing trading market, the new housing transaction data often cannot truly reflect the real housing price level of each city and the differences between cities. This paper selects the average annual transaction price of stock houses as the proxy variable of housing prices [11].

Table 1 Variable summary

Primary indicators	Secondary indicators	Code	Unit
Input variables	capital input	K	Ten thousand yuan
	labor input	L	people
Output variable	Patent output	P	item
Influencing factors	Government support	fin	Million yuan
	Economic development level	gdp	yuan
	Housing price	house	yuan

3.2 Data

This paper selects 29 large and medium-sized cities in China as actual observation cities. These 29 cities are scattered all over the country, their scientific and technological innovation activities are relatively more active. The data are from the China City Statistical Yearbook, the city statistical yearbook and the city statistical bulletin, and the Wind database. The time span is 2010-2017.

3.3 Descriptive Statistics

The descriptive statistical results of each variable are shown in Table 2. The observed 29 typical cities have significant differences in both input and output variables and influencing factors. Among the input variables, the sample standard deviation of the city's R&D internal expenditure is the largest, followed by the number of R&D personnel in the city, but the sample standard deviation of the number of patent applications in the city is far lower than that of the R&D internal expenditure and the number of R&D personnel. It also shows that there is a significant gap in the input resources of the 29 observed cities, but the gap is weakened in the innovation output.

Table 2 Descriptive statistics

Code	Number	Mean	Standard deviation	Min	Max
P	232	21055.59	35142.37	441.00	18592800.00
L	232	64663.24	75925.12	951.00	397281.00
K	232	1884578.47	2727328.00	23606.69	14845762.00
fin	232	4743.80	7542.00	192.54	40352.40
gdp	232	85622.17	39964.87	27596.00	467749.00
house	232	12090.46	8414.69	4959.86	54059.00

4. Method

This paper chooses the technical inefficiency effect model of panel data stochastic frontier production function proposed by Battese and Coelli in 1995. The basic model is as follows:

$$\begin{aligned} y_{it} &= x_{it}\beta + \left(v_{it} - u_{it}\right) \\ u_{it} &= z_{it}\delta + w_{it} \quad v_{it} \sim N\left(0, \sigma_v^2\right); u_{it} \sim N\left(m_{it}, \sigma_u^2\right) \\ m_{it} &= z_{it}\delta \end{aligned} \tag{1}$$

Among them, $i = 1,2,\ldots,N; t = 1,2,\ldots,T$; y_{it} represents the logarithm of the output of the i-th manufacturer in year t; x_{it} is the logarithm of the input of the i-th city in the t year; β and δ represent the parameters to be estimated. v_{it} represents the random error term, which obeys a normal distribution with a mean value of 0 and a variance of σ_v^2, it reflects uncontrollable random deviations such as measurement errors; u_{it} represents the technical error term, which obeys the truncated normal distribution with mean value of m_{it} and variance of σ_u^2, it

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reflects the technical inefficiency caused by human factors such as improper management; u_{it} and v_{it} are not related to each other. z_{it} represents influencing factors that may affect the efficiency of the manufacturer; w_{it} represents a random variable.

Different production function of SFA will produce different analysis results, it is necessary to select a specific production function form and test the accuracy of model setting. At present, the two most commonly used production functions of SFA are Cobb Douglas production function (C-D production function) and transcendental logarithmic production function (Translog production function). Among them, the Translog production function relaxes the assumption of constant substitution elasticity between factors on the basis of the C-D production function and takes into account non-neutral technological progress. Compared with the C-D production function, Translog production function is more general in form. Therefore, this research first constructs the SFA model of the general time-varying Translog production function as follows:

$$\begin{aligned}
&lnP_{it} = \beta_0 + \beta_K lnK_{it} + \beta_L lnL_{it} + \beta_T t + \frac{1}{2}\beta_{KK} lnK_{it}{}^2 + \frac{1}{2}\beta_{LL} lnL_{it}{}^2 \\
&+\frac{1}{2}\beta_{TT} t^2 + \beta_{KL} lnK_{it} lnL_{it} + \beta_{KT} lnK_{it} t + \beta_{LT} lnL_{it} t + \left(v_{it} - u_{it}\right) \\
&u_{it} = u_i exp\left[-\eta\left(t-T\right)\right] = z_{it}\delta + w_{it} \\
&TE_{it} = \frac{E\left(P_{it}|u_{it}, x_{it}\right)}{E\left(P_{it}|u_{it}=0, x_{it}\right)} = \exp\left(-u_{it}\right)? \quad 0 \le \exp\left(-u_{it}\right)?\le 1 \\
&\text{Gamma} = \frac{\sigma_\mu}{\sigma_\mu + \sigma_\upsilon} \qquad 0 \le \text{Gamma} \le 1
\end{aligned} \tag{2}$$

Among them, P_{it} represents the number of patent applications of the i-th observation city in year t, β_0 is the intercept item, β_K、β_L etc. represent the parameters to be estimated for the corresponding input items, K_{it} represents the city's internal R&D expenditures for the i-th observation city in year t, L_{it} represents the number of city-wide R&D personnel in the i-th observation city in year t, and t represents the time variable. z_{it} is the influencing factor of the USTIE. δ is the parameter to be estimated corresponding to the influencing factor, when δ increases, the technical error term u_{it} increases, which will lead to a decrease in the USTIE. η represents the parameter to be estimated considering the time-varying,

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when $\eta > 0$, the USTIE changes with time and the efficiency is increasing; when $\eta \leq 0$, the USTIE does not change with time or even decreases with time. TE_{it} represents the USTIE，When u_{it} is 0, TE_{it} is 1, which means that the city's scientific and technological innovation activities have reached the ideal state of maximum output; When u_{it} is greater than 0, the value of TE_{it} is between 0 and 1, it means that the city's scientific and technological innovation activities are in an inefficient state. The larger u_{it}, the smaller the value of TE_{it}, and the poorer the USTIE of the city. Gamma is used to measure the proportion of the technical error term in the inefficiency term, the larger the Gamma, the greater the proportion of the technical error term in the mixed error term, and the more suitable the stochastic frontier model is for this study.

On the basis of the SFA model of the time-varying Translog production function, the following five aspects of the model setting need to be tested in order to determine the final empirical analysis model for this study: (1) Check whether u_{it} exists or not and whether SFA is applicable to this research; (2) Check which of the C-D production function and the Translog production function is more suitable for this study; (3) Test whether there is a technological change; (4) If there is a technological change, check whether the technological change is Hicks neutral; (5) Check whether the technical efficiency is time-varying.

5. Empirical analysis

5.1 Reasonable analysis of model setting

Use Frontier4.1 to test the reasonableness of the model setting of the above-mentioned time-varying Translog production function SFA model, the results are shown in Table 3. We can find that: (1) u_{it} exists and SFA is suitable for this study; (2) The Translog production function is more suitable for this study than the C-D production function; (3) There is no technological changes in this model; (4) this stochastic frontier model is time-varying and the USTIE is increasing.

Table 3 Test results of non-efficiency frontier parameters

	Hypothesis	LLF	LR	DF(k)	$\chi^2_{1-0.05}$(k)	Result
1	$H_1: \gamma \neq 0$	-34.52				

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	$H_0: \gamma = 0$	-174.47	279.91	3	7.05	False
2	H_1: At least one of $\beta_{KK}, \beta_{LL}, \beta_{TT}$ is not 0	-34.52				
	H_0: β_{KK}=β_{LL}=β_{TT}=0	-52.70	36.36	3	7.05	False
3	$H_1: \beta_T \neq 0$	-34.52				
	$H_0: \beta_T = 0$	-37.36	5.68	3	7.05	True
4	$H_1: \eta \neq 0$	-37.36				
	$H_0: \eta = 0$	-51.76	28.81	2	5.14	False

Based on the above test results and research hypotheses, including housing prices and other influencing factors, the original model is revised as follows:

$$\begin{aligned} \ln P_{it} &= \beta_0 + \beta_K lnK_{it} + \beta_L lnL_{it} + \frac{1}{2}\beta_{KK} lnK_{it}{}^2 + \frac{1}{2}\beta_{LL} lnL_{it}{}^2 \\ &+ \beta_{KL} lnK_{it} * lnL_{it} + \left(v_{it} - u_{it}\right) \\ u_{it} &= \delta_0 + \delta_1 lnfin_{it} + \delta_2 lngdp_{it} + \delta_3 lnhouse_{it} + \delta_4 lnhouse_{it} \\ &* lngdp_{it} + \delta_5 lnhouse_{it} * lnfin_{it} + w_{it} \end{aligned} \tag{3}$$

The above-mentioned modified model is substituted into FRONTIER4.1 to calculate the values of parameters to be estimated in the modified model, The results are shown in Table 4. It can be seen that the Gamma value of the modified model is 0.99, passing the test at a significance level of 1%, indicating that the model with influencing factors has good applicability and there is an inefficiency term.

Table 4 Coefficient estimation results of stochastic frontier model

Parameters	Value	Standard deviation	Tvalue
β_0	0.78380378	6.91890480	0.11328437
β_K	5.51435950	1.72013980	3.20576250***
β_L	-6.78120190	1.20103430	-5.64613530***
β_{LL}	0.49067016	0.19849142	2.47199680***
β_{KK}	-0.11835586	0.11247771	-1.05226060
β_{KL}	-0.18620629	0.28919404	-0.64388011
δ_0	2.09186400	0.97273494	2.15049750**
δ_1	-2.10566130	0.81089402	-2.59671580***
δ_2	1.86266540	0.50152688	3.71398910***
δ_3	-0.25196433	0.06995222	-3.60194910***
δ_4	-0.19298086	0.05392686	-3.57856650***
δ_5	0.23928679	0.08776052	2.72658800***
Gamma	0.99999999	0.00479526	208.53909000***

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5.2 The Influence of Input Factors on the Output

The coefficient values of $\beta_{\mathrm{K}},\beta_{\mathrm{L}},\beta_{\mathrm{LL}}$ were 5.514, -6.781 and 0.491 respectively, and all passed the 1% significance test. This result shows that: First of all, internal R&D expenditure has a strong supporting effect on the output of scientific and technological innovation, which also confirms the statement put forward in the 2016 global innovation index that “the development of China's current scientific and technological innovation activities is mainly driven by a large number of stable R&D expenditure”. Secondly, there is a significant negative correlation between the number of R&D personnel and the output of scientific and technological innovation, this may be due to the imperfection of the current scientific research system and environment, resulting in unreasonable allocation of scientific research resources and weak average output capacity of R&D personnel, the greater the number of R&D personnel, the more dispersed R&D resources, and the worse the level of scientific and technological innovation output. However, the quadratic coefficient of R&D personnel has a certain effect on the improvement of scientific and technological innovation output， this may be because in the long run, with the improvement of scientific research and innovation system and related scientific and technological environment, the increase in the number of R&D personnel has become a help to the output of scientific and technological innovation.

5.3 The Impact of Government Support and Economic Development on the USTIE

Results 1: government support can significantly improve the USTIE, H1 is true.

The coefficient δ_1 of science and technology expenditure is -2.106, which passes the 1% significance test, indicating that government support plays a key role in promoting the USTIE. This may be because under the current background that the development of scientific and technological innovation activities mainly relies on a large amount of R&D capital investment, the greater the level of government support, the stronger the attitude and determination of the government to develop scientific and technological innovation activities, thus creating loose policy support and favorable market conditions, which can attract more innovative subjects and improve the USTIE. Take Hefei and Nanchang as an example. In 2016, the two

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cities had the same level of economic development and housing prices, but Hefei's government support level is 10 times that of Nanchang, the input and output of Hefei in that year are 2.4 times and 4.7 times that of Nanchang respectively, and its USTIE is 1.6 times that of Nanchang.

Results 2: there is a significant negative correlation between the level of economic development and the USTIE, H2 is true.

The coefficient δ_3 of per capita GDP is 1.863, passing the 1% significance test, indicating that the USTIE in cities with better economic development is relatively low. This may be because cities with better economic development level have a better attraction for scientific and technological innovation funds and talents, showing a favorable level of resource investment. However, because the development of scientific and technological innovation activities is still relatively behind the level of economic development, the current R&D capacity and resource transformation capacity are far from making full use of scientific and technological innovation resources, thus showing that the level of economic development is inversely related to the USTIE. For example, Beijing, Shanghai and Shenzhen in this study are among the top cities in terms of input or output, but their actual USTIE is not high.

5.4 The Impact of Housing Price and Its Interaction on the USTIE

Result 3: Housing prices have a slight promotion effect on the USTIE. H3 is true.

The coefficient δ_3 of housing price is 0.252, which passes the 1% significance test, showing that housing price has a certain effect on improving the USTIE. This is verified by the panel data: Taking Kunming and Shijiazhuang as an example, the two cities have roughly the same level of economic development and government support, but the housing price of Kunming is 1.4 times that of Shijiazhuang. The screening effect of high housing prices makes the number of R&D personnel in Kunming only 60% of that of Shijiazhuang, but its USTIE is higher than that of Shijiazhuang by 60%. This study believes that this may be due to the fact that the high housing price level inhibits individual innovation and entrepreneurship motivation, increases individual housing pressure, and affects individual

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consumption level and life well-being. But at the macro level, it has a beneficial "screening" effect on the city's industrial institutions and human capital, leaving high-educated, high-quality and innovative talents, and crowding out labor-intensive, low-tech and low-innovative talent Industrial enterprises. The highly competitive market environment and the government's strong funding and talent subsidy policies have forced industrial enterprises to carry out scientific and technological innovation and improve the USTIE. In addition, the appreciation of property rights brought about by rising housing prices has reduced the credit pressure on individuals and companies holding real estate, and improved their financing capabilities, which indirectly promoted the USTIE from the perspective of promoting scientific and technological innovation capital investment.

Result 4: housing price can reduce the reverse correlation between economic development level and the USTIE, but at the same time, it will also inhibit the role of government support in improving the USTIE. H4 is true.

The coefficient δ_4 of the interaction between housing price and per capita GDP and the coefficient δ_5 of the interaction between housing price and science and technology expenditure are -0.193 and 0.239 respectively, both passing the significance test of 1%. Housing price will reduce the negative correlation between the level of economic development and the USTIE. This may be because at the current level, the level of economic development has a certain degree of attractiveness to resources. When housing prices rise, it will have a "screening" effect on the city's enterprises and talents by increasing innovation costs and individual life pressures. This allows limited resources to be concentratedly allocated to higher-output groups, reducing personnel redundancy and communication costs, thereby indirectly improving the USTIE.

6. Conclusions

Based on the panel data of 29 typical large and medium-sized cities from 2010 to 2017, this paper applies the Translog production function to construct an SFA model, and studies the influence of factors such as housing prices on the USTIE. The empirical results show that internal R&D expenditure is the main driving force for the development of scientific and technological innovation activities, and the accumulation of R&D personnel will reduce the output level of urban scientific and technological innovation. Government support is a key factor to improve the USTIE. There is a reverse correlation between the level of economic development and the USTIE due to the different stages of development. More importantly, from the results of the research, housing prices is not a factor that restricts the USTIE, but instead promote the USTIE due to the screening of innovative groups. At the same time, housing prices weaken the negative correlation between the level of economic development and the USTIE, but excessive housing prices will also reduce the positive effect of government support on the USTIE. Therefore, for the USTIE, housing prices are a double-edged sword and should be valued and used rationally.

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