High-Speed Rail, Housing Prices and Regional Disparities - Evidence from China

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Abstract: This paper used the panel data regression method to estimate the impact of high-speed rail on city-level housing prices. I collected the high-speed rail operation and housing price data of more than 280 cities in China from 2009 to 2017, and analyzed the disparities between cities and different regions by constructing regional dummy. There are two main findings in my paper: (1) high-speed rail operation leads to the increase of city-level housing prices by about 7.2%, and the increase of housing prices in national central cities and regional central cities are 28.4% and 13.8%; (2) with the development of high-speed rail, regional imbalance is alleviated and the housing price growth of central cities in less developed areas has been promoted.
Keywords: High-speed Rail; Housing Price; Regional Disparity

1 Introduction

1.1 Background and Significance of the Research

With the rapid growth of Chinese economy since the implementation of the reform and opening-up policy, the regional economic gap has become a great challenge to Chinese people. During 1978 and 1988, real GDP in China's coastal provinces grew at about twice the annual rate of that in the interior. In the past decade, the economic gap between different regions in China has been widening. The growing regional inequality has raised concerns about social stability and sustainable economic development.

To address these challenges, the central government has issued a series of policies to promote coordinate development of regional economies. Premier Li Keqiang said that further development is not only the key to China's economic success, but also the fundamental way to narrow the regional gap. China's high-speed rail corridor is designed to narrow the regional economic gap by strengthening links between the inland regions and the developed southern and eastern coastal provinces. Therefore, it is of practical significance to evaluate the effect of high-speed rail network construction on city and regional economic development.

The difference in housing price growth between different cities and regions will further affect their economic growth rate, thus leading to social inequality. Meanwhile, the construction of transportation infrastructure has a similar impact on regional economic growth. The curves in figure 1 and figure 2 show that the total mileage of China's high-speed rail operation and the housing prices of the provinces along the line all showed obvious fluctuations from 2012 to 2014 and rapid growth after 2016.In previous literature studies, Zheng and Saiz (2016) estimated that the average annual appreciation rate of background housing price was as high as 27.4%, while between 2006 and 2013, the average annual appreciation rate of housing price in 35 cities along the high-speed rail was about 14.3%.Thanks to the rapid development of China's high-speed rail construction, more and more Chinese people can enjoy the convenience and accessibility improvement brought by high-speed rail lines. Data from China's national bureau of statistics show that by the end of 2017, China had 127,000 km of railways in operation, including 25,000 km of high-speed rail lines, accounting for about 66.3 percent of the total.

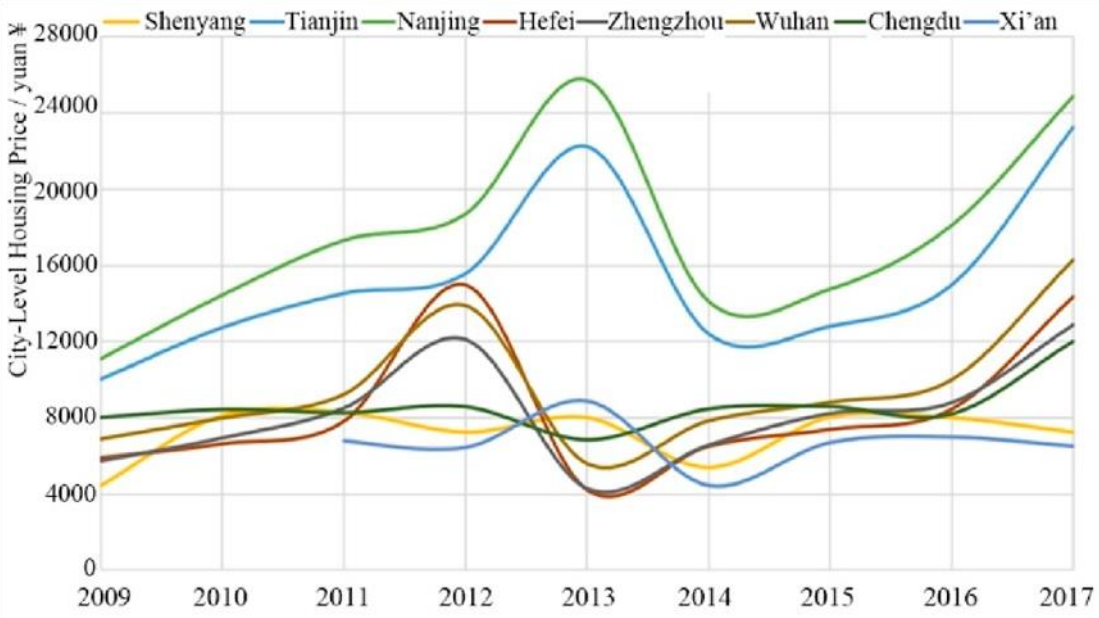

Figure 1. Housing Price Growth Trend of China's High-Speed Rail Hub Cities from 2009 to 2017

Note: 8 Chinese high-speed rail hub cities are selected as reference objects in the figure (data from Beijing are not used). The city-level housing price data are calculated by using the housing price information provided by anjuke.com in RMB (yuan/square meter).

Figure 2. China's (Expected) High-Speed Rail Operating Mileage and (Expected) Year-on-Year Growth from 2009 to 2025

Note: the data in the figure from 2009 to 2016 are from the state railway administration of the People's Republic of China (http://www.nra.gov.cn).The figures for 2020 and 2025 are based on estimates of high-speed rail construction plans for the next few years released by the state railway administration of the People's Republic of China.

Figure 3 briefly describes the current China's high-speed rail corridor and city distribution, which indicates that

China's high-speed rail network succeeded in central China, south China, north China and the southeast coastal areas, provides us with high-speed rail can be used to research policy and administrative causal effect between house prices and the representation of the regional economic differences between cases.

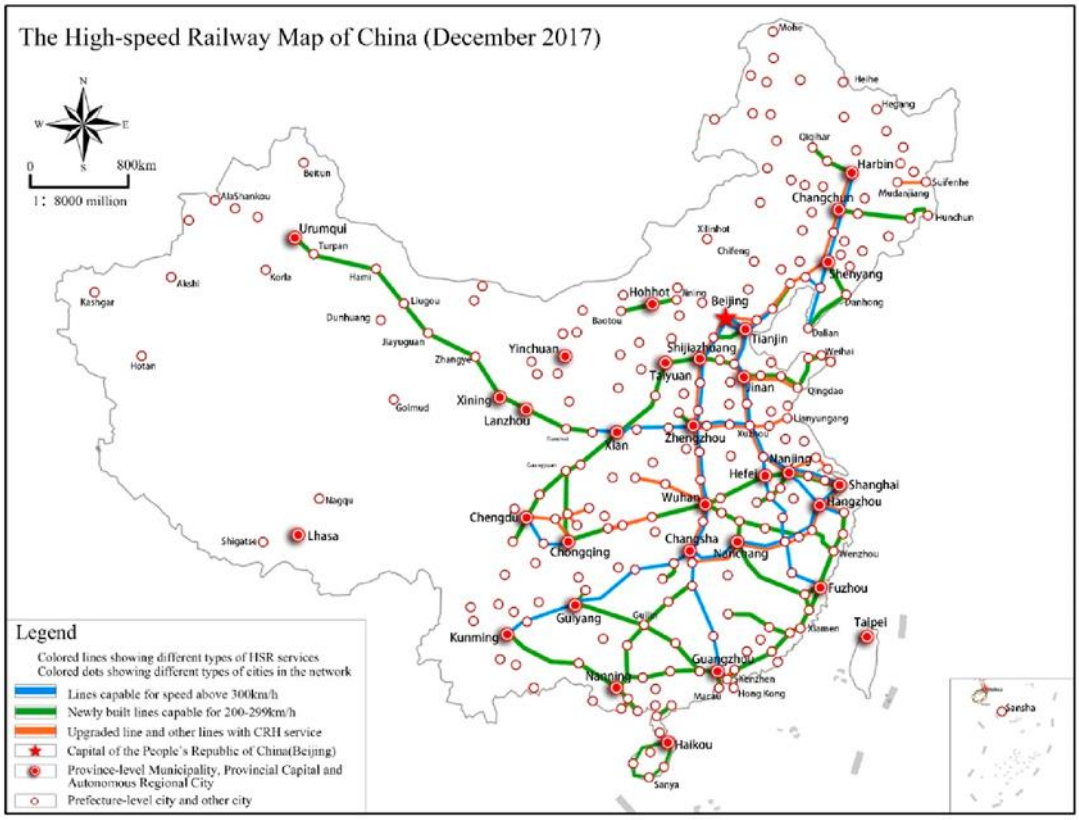

Figure 3. Distribution of China's High-Speed Rail Lines and Major Cities (up to December 2017)

Source: state railway administration of the People's Republic of China (http://www.nra.gov.cn/).

Whether China's high-speed rail construction is beneficial to economic development depends not only on the growth of national income, but also on consumers' expectations and confidence in economic growth. House prices can not only reflect the current economic situation to some extent, but also reflect consumers' confidence in future economic growth. In addition, the city-level housing price is an important factor affecting urban competition, especially the competition between big cities and their surrounding small cities. Therefore, city-level housing prices can often provide potential insights into the city's future development potential.

Although there has been a large number of literature on the impact of railway infrastructure construction on housing prices have been estimated, but the results vary.In general, due to the differences and limitations of the current empirical research data and methods, there is no sufficient evidence to show whether there is a link between China's high-speed rail development and the prosperity of the national prefecture-level real estate market.The main contributions and shortcomings of previous studies will be briefly summarized in the literature review section.

Based on the above background, this paper establishes a theoretical framework to describe the supply and demand of the real estate market, and USES the panel data regression model to estimate the impact of China's high-speed rail construction on the housing price of prefecture-level cities, and emphasizes the differences in housing price growth between different regions.

1.2 Structure of the Paper

This paper is divided into six chapters. Firstly, this paper briefly expounds the current situation of China's high-speed rail construction and the economic development gap between different regions. Combining with the housing price change trend in high-speed rail hub cities in recent years, this paper introduces the writing background and research significance of this paper, and introduces the main work content of this paper.Then the paper reviews the relevant work of previous literature and explains the position of the research in this paper in the research field of high-speed rail-housing price.The theoretical model based on supply and demand is established, and the empirical analysis is carried out by using panel data regression, and the regression results are explained and evaluated.

The paper is arranged as follows. Chapter 1 briefly introduces the status quo of China's high-speed railway construction and the economic development gap between different regions, and proposes the background, objectives and research significance of this paper. Chapter 2 summarizes the domestic and foreign development status of research related to high-speed rail, housing price and economic growth. Chapter 3 applies the supply-demand analysis method to frame the model of the relationship between high-speed rail construction and urban housing price. Chapter 4 introduces the sources of the data sets used in this article, the definitions of related variables, and the handling of potential problems. In Chapter 5, the fixed effect and dynamic panel data model are used to establish the regression model of high-speed railway construction and prefecture-level city housing price, and the reasonable interpretation and evaluation of the estimation results are given. Chapter 6 concludes with a summary of the work done, the novelty and importance of this study, and the potential problems in the study and the next improvement plan.

2 Literature Review

The development of HSR serves as an important influencing factor, or a vital intermediate variable of decision-making of real estate investment. One fundamental question is: will development of HSRs exert a positive effect on housing prices growth? For a long period of time, researchers have had very different views on this. For example, David E. A, et al. (2010) studied the effect of the western HSR line in Taiwan on housing values in cities along it. Their results indicated that the HSR accessibility has at most a minor effect on house prices, while negative price effect associated to this issue was also found, probably due to higher levels of noise or crimes (Merton Miller, 1998; Armstrong and Rodriguez, 2006). Amid such disagreements, the literature on HSR and changes in housing prices continues to expand with both theoretical models and advanced empirical methods.

A variety of theoretical models have been proposed to analyze the connection between rail system and housing price growth. Zheng and Kahn (2013) noted that the efficient markets theory of asset pricing posits that housing price reflect the expected present discounted value of future rents. The theory suggests that changes in city real estate price dynamics should reflect the expected impact of major infrastructure investments. Moreover, a housing unit can be seen as a complex good composed of an array of individual attributes. Given such consideration, the hedonic theory suggests that the scale price of such complex good can be expressed as a function of the specific combination of its characteristics (Rosen, 1974). In theory, public transport infrastructure generates two opposite effects: positive externalities based on improved accessibility to urban amenities and negative, proximity externalities linked to nuisance due to noise, increased traffic and criminality.

However, there is a vast empirical literature on the issue. Regardless of whether the research perspective was macro or micro, the majority of the existing studies observed positive results. Most previous studies, although limited in a single region, a certain city or a typical HSR line, found positive property value impacts of rail transit systems and many of them relied on the OLS method (Billings, 2011; BoIs and Ihlanfeldt, 2001; Cervero and

Duncan, 2002b; Duncan, 2008; Hess and Almeida, 2007; Pan, 2013; Pan et al., 2014; Yan et al., 2012). A handful of studies conducted in Asian cities, such as Bangkok, Thailand (Chalermpong, 2007), Seoul, Korea (Cervero and Kang, 2011), Beijing, China (Zhang et al., 2014) and Shanghai, China (Pan et al., 2014), found positive impacts on property values. National scale study also showed similar results even though studies with similar dimension were very few (Zheng and Matthew, 2013).

Nevertheless, Zhang and Li (2016) have suggested that the OLS regression estimates were likely biased due to the lack of control for the spatial dependence effect, which reveals a complex and intertwined relationship among housing transactions. Wang and Nian (2014) analyzed the economic impact of HSR in China by DID. They found that HSR construction tend to choose the higher economic growth city, and the HSR station the economic growth to some extent, but it has a positive effect on the city scale expansion. Mi Diao (2018) investigated the impact of HSR on the economic geography of China. By using a DID analysis and an instrumental variable strategy to address the non-random placement of HSR stations, they also found that on average, HSR cities have experienced a significant increase in fixed asset investment after the inauguration of HSR service, which could stimulate future economic growth.

There are also, a variety of literatures focused on why the impact HSR have on housing price observed disparities both within and between cities. Wardrip (2011) has pointed out that there may be many factors playing a crucial role in estimating the impact. From an intra-city perspective, some authors suggest that the effect varies according to the characteristics of the stations their location (Celik and Yankaya, 2006), types of rail mode (Zhang et al., 2014), development stages (Yan et al., 2012;), housing markets and land-use characteristics (Zhang et al., 2014). From an inter-city perspective, the impact may considerably vary among cities (Ryan, 2005), depending on the actual ridership level (Cervero and Duncan, 2004), the type of clientele (BoIs and Ihlanfeldt, 2001) and the global quality of the service (Landis et al., 1994). In addition, the estimated impact of rail proximity on property values may also be influenced by other external factors, such as potential substitute to public transport. Voith (1993) shows that proximity to highways affects the premium associated with rail proximity, and his conclusions are also corroborated by Ryan (1999, 2005). In contrast, some studies suggest that a good combination of transportation modes and the feasibility of multimodal trips raise house prices (BoIs and Ihlanfeldt, 2001).

In sum, the linkage between HSR development and city-level housing price involve complicated mechanisms, which require a careful consideration in the process of impact assessment. Although a positive link between rail system (or HSR) and housing price increase were observed in most micro or macro cases, and a great number of literatures partially studied the reason why disparities of the impact are significant both regionally and locally, the causal relationship between them has not been clearly addressed. Besides, studies of national scale were very few and their dataset were limited in the length of time. Moreover, the cities group for most of the historical studies were classified according to their geographic location (the east, the middle, the west), which is not reasonable for the rapid development of the China s HSR network. Hence, there are two problems to be solved: 1) What role does HSR play in the transmission mechanism from gathered factors to changes in housing price? 2) how and to what extent does the HSR network in China affects city-level house prices?

For the first problem, this study develops a theoretical framework (details in Part3), based on a great deal of historical literatures relevant to this issue. To answer the second question, I do an empirical study from a national research scale using data from 285 cities in china (details in Part 4-6), throughout 2009-2017, with just one HSR line at the beginning and the existing national network, known as the Four-horizontal and four-vertical HSR corridors, which covers almost all the prefecture-level cities in China.

3 Theoretical Framework of High-Speed Rail and Housing Price Mechanism

Figure 4 describes the basic mechanism of the impact of high-speed rail construction on the housing price of prefecture-level cities. In this paper, the supply-demand analysis method is adopted to establish this analytical framework.

From the perspective of demand, high-speed railway is an important part of urban infrastructure system, and has the subsidy function of typical public goods. Past studies have found that high-speed rail construction has a short-term impact on accessibility and interconnectivity, and inevitably a long-term impact on the migration, concentration and diffusion of economic activity. Changes in the connectivity of high-speed rail lines are playing a much bigger role in economic development than just saving time. High-speed railway strengthens the interconnection between cities, expands the market scope of most cities, and greatly reduces the cost for production and transportation of products from the cities around high-speed railway hubs to the hub cities. High-speed rail may increase labor wages and consumption capacity by promoting employment and economic activities of urban population, thus expanding the housing demand of residential households and eventually leading to the rise of housing prices in prefecture-level cities.

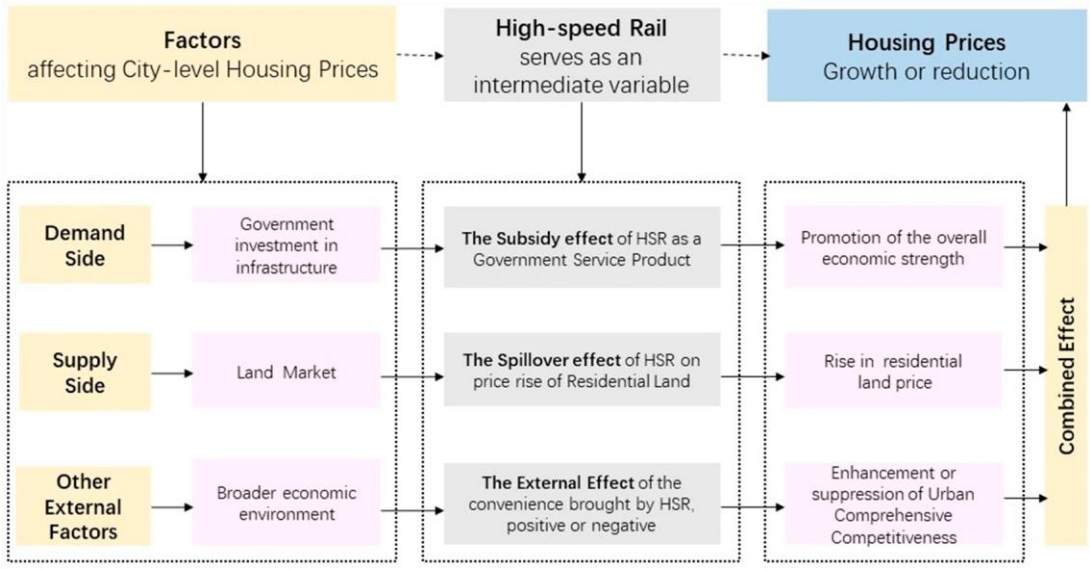

Figure 4. A Theoretical Framework Based on the Demand-Supply Analysis

From the perspective of supply, there is a direct and indirect transmission mechanism between land price and housing price. On the other hand, after the completion of the high-speed railway, the city will further attract more investment to promote the construction of business, education, medical and other infrastructure, which will lead to the rising demand for infrastructure land and further squeeze out the supply of residential land. Therefore, the intensification of land market competition caused by high-speed rail construction may have a spillover effect on housing prices.

In addition, there are other external reasons that lead to the variation of housing prices in different cities. For example, high-speed rail improves efficiency and reduces transaction costs by competing with other modes of transportation. Second, the high-speed rail network strengthens the connection between large cities and surrounding small cities, which is conducive to the professional division of labor of urban clusters, thus making inter-regional and intra-regional resource allocation more efficient. In addition, high-speed railway has been proved to be able to extend the travel time of residents and increase the travel demand of residential households to a certain extent, thus

supporting the housing price of some tourism cities, Xiamen, Sanya and other cities are typical examples.

4 Data and Variables

This section describes the resources and statistical characteristics of the data sets used in the study. This paper uses municipal data to estimate the impact of China's high-speed rail construction on housing price growth. To measure the value of a home, it uses financial variables and economic indicators.

4.1 Data Resource and Constructing Methods

The data set used in this paper is a panel data of 285 prefecture-level cities and municipalities in China from 2009 to 2017, including data on housing prices, railway and high-speed rail operations, population, GDP, savings, and other transportation facilities. The housing price data is from anjuke.com. The average housing price is calculated in accordance with prefectural cities (yuan/m2). The data of railway and high-speed rail operation are from the "national railway passenger train schedule (2009-2017)" provided by China railway customer service center, which includes passenger trains starting from g-c; Population data were obtained from China urban statistical yearbook (2009-2017) with a unit of 10,000 people. Macroeconomic data such as GDP, investment and savings data from the "China urban statistical yearbook"; Other transportation infrastructure data, such as airport operation data, came from the statistical bulletin on the development of civil aviation industry issued by the civil aviation administration of China (2009-2017).

4.2 Statistical Characteristics of Variables

Using the above data, the variables shown in **Table 1** below are constructed and their statistical characteristics are given.

Table 1. Statistical Characteristics of Data Set Variables

Variable Name	Explanation	Sample Size	Mean	Standard Deviation	Minimum	Maximum
$price$	The logarithm of the city-level housing price (yuan/m2)	1042	8.8197	0.4893	7.4697	10.9642
hsr	Whether to open the high-speed rail (yes 1, no 0)	2565	0.2760	0.4471	0	1
pop	The logarithm	2565	4.6103	0.7722	2.7147	7.8043

	of the population					
air	Has the flight been opened? (yes, it is 1, no, it is 0)	2565	0.4596	0.4985	0	1
$rail$	Whether the railway has been opened (1, 0)	2565	0.9341	0.2481	0	1
$save$	The ratio of savings to GDP	2515	0.8454	0.3962	0.0430	4.1361
$loan$	The ratio of loans to GDP	2516	1.5597	0.2602	0.0623	84.6609

Note: the unit of GDP, savings and loans is million yuan, and the unit of population is ten thousand.hsr,air,rail are all dummy variables that only take 0 or 1, if any, take 1, if none, take 2.

5 Empirical Methods and Results

This study takes China's high-speed rail operation as a natural experiment to examine the impact of high-speed rail network on housing prices at the urban level. I used GMM estimates from both the fixed effects model (FE) and the dynamic panel data model to obtain baseline regression. In order to prove the robustness of the estimation, the urban classification model and the regional classification model are added into the econometric model.

5.1 Baseline Regression

The panel data analysis used data from 285 cities between 2009 and 2017. In order to study the relationship between high-speed rail and housing price, my baseline regression model is as follows:

$$price_{i,t} = \beta_0 + \beta_1 hsr_{i,t} + \beta_2 pop_{i,t} + \beta_3 air_{i,t} + \beta_4 rail_{i,t} + \beta_5 save_{i,t} + \beta_6 loan_{i,t} + u_i + vt + \epsilon_{i,t} \quad \text{.....(1)}$$

Where i indexes one of the 285 cities and t indexes one of years; The dependent variable, $price_{i,t}$, is the logarithm of urban average housing price. My key variable, $hsr_{i,t}$, is the dummy variable, which represents whether the ith city has HSR in the panel data. HSR operates in city, $hsr_{i,t}$=1, otherwise, $hsr_{i,t}$=0. The lag term, $hsr_{i,t-1}$, has been include in the regression result to investigate the dynamic impact of HSR on housing price. $pop_{i,t}$, $air_{i,t}$, $rail_{i,t}$, $save_{i,t}$ and $loan_{i,t}$ are controlled variables. $popi,t$ represent the level of population. $air_{i,t}$ represent whether this city owns an airport or not. $rail_{i,t}$ represent whether this city owns ordinary railway or not. $save_{i,t}$ and $loan_{i,t}$ represent financial development of city. u_i are unobserved city-specific fixed effects, v_t are unobserved time fixed effects, and $\varepsilon_{i,t}$ is an idiosyncratic error term.

Baseline regression was estimated using a fixed-effect model. It was assumed that the sample population was normally distributed and had a common variance. OLS analysis often violated the additive error structure (Sakia, 1992). Through Hausman's specification test, the orthogonality between common effect and regression quantity is tested, and the fixed effect model is judged to be superior to the random effect model. The least square dummy variable (LSDV) method was used to estimate the baseline regression, including all the city dummy variables based on Beijing. In order to solve the time lag effect of high-speed rail on housing price, the first lag value of the dummy variable $hsr_{i,t-1}$ was introduced into baseline regression as the substitution variable of current value.

5.2 Dynamic Panel Data Model

The efficient market theory of asset pricing holds that real estate prices reflect the expected present value of future rents. According to this theory, the change of urban real estate price dynamics should reflect the expected impact of major infrastructure investment (Zheng and Kahn, 2013). Taking into consideration the dynamic process of housing price, I develop a dynamic panel data model:

$$price_{i,t} = \beta_0 + \beta_1 price_{i,t-1} + \beta_2 hsr_{i,t-1} + \beta_3 hsr_{i,t} + \beta_4 pop_{i,t} + \beta_5 air_{i,t} + \beta_6 rail_{i,t} + \beta_7 save_{i,t} +$$

$$\beta_8 loan_{i,t} + u_i + vt + \epsilon_{i,t} \quad \text{.....(2)}$$

Where the set of right hand side variables includes the lagged dependent variable $price_{i,t-1}$, which include the entire history of the right hand side variables in the equation, so that any measured influence is conditioned on this history. In the dynamic panel data model, the correlation between the lagged dependent variable $price_{i,t-1}$ and the compound disturbance $u_i + \varepsilon_{i,t}$ makes the LSDV estimators for panel data inconsistent even if $\varepsilon_{i,t}$ is not serially correlated, since the same u_i enters the equation for observation in group *i*. I then estimate Eq. (2) using the difference-GMM approach (Arellano and Bond, 1991) as Ill as the system-GMM approach (Arellano and Bover, 1995; Blundell and Bond, 1998). The advantage of the GMM approach is that it helps reduce the problems of multicollinearity among the explanatory variables and endogeneity between the dependent and explanatory variables.

Two normative tests proposed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) :Under the null hypothesis of effective tools, the asymptotic distribution of test statistics is chi square distribution, and the degree of freedom is equal to the number of tools minus the number of estimated parameters.(2) second-order sequence correlation test, test the hypothesis error item i,t is not sequence correlation. In the case of no correlation zero of the second order sequence, the test statistic is regarded as the asymptotic distribution of the standard normal distribution.

The results from baseline estimations are summarized in **Table 2,** which suggest that HSR exerts a significant positive impact on housing price, and the extent of the impact for hsr_t is larger than that for $hsr_{t-1,}$ which can be explained for the following two major reasons. Firstly, it is probably the psychological expectation that put up housing price before announcing an HSR line to be constructed in the city. Besides, the sale of China's commercial residential housing generally adopts the pre-sale system, stimulating housing price before the operation of HSR. We have also investigated the results of $hsr_{t-n,}$ the impact of this group is not significant than $hsr_{t.}$ One of the underlying reasons is considered to be the inconvenient public services, facilities and infrastructures, which are not available when the HSR line is newly put into service, plus another reason is that the limited time of the real estate presale system is approximately one year.

Table 2. Housing Price and HSR: Baseline and GMM Regressions.

			Dynamic Panel Data Model	
	Baseline Regression: Fixed Effect Model		**Difference GMM**	**System GMM**
$hsr_{i,t-1}$	0.072***		0.048*	0.073***
	(0.204)		(0.025)	(0.024)
$hsr_{i,t}$		0.185***	0.072**	0.086**
		(0.022)	(0.036)	(0.036)
$price_{i,t-1}$			0.670***	0.805***
			(0.056)	(0.036)
$pop_{i,t}$	0.382***	0.491***	0.361***	0.185***
	(0.051)	(0.053)	(0.070)	(0.053)
$air_{i,t}$	-0.018	-0.021	0.065	-0.038
	(0.060)	(0.066)	(0.053)	(0.119)
$rail_{i,t}$	0.033	0.027	-0.171**	-0.220***
	(0.140)	(0.154)	(0.070)	(0.083)
$save_{i,t}$	-0.058	-0.064	0.234***	0.238***
	(0.053)	(0.056)	(0.076)	(0.079)
$loan_{i,t}$	0.049***	0.070***	0.016**	-0.003
	(0.010)	(0.010)	(0.009)	(0.011)
constant	6.803***	6.189***	1.027**	0.864**
	(0.301)	(0.320)	(0.478)	(0.341)
Observations	1000	1031	532	779
Diagnosis	R^2=0.3397	R^2=0.3260	Sargan test (p=0.00)	Sargan test (p=0.00)
	Hausman test (p=0.00)	Hausman test (p=0.00)	First-order (p=0.00)	First-order (p=0.00)
			Second-order (p=0.38)	Second-order (p=0.28)

Note：Cities in Tibet are excluded from the sample due to missing data. The standard errors are in parentheses. ***The significance levels at the 1%. **The significance levels at the 5%. *The significance levels at the 10%.

Considering the dynamic process of housing price, the dynamic GMM techniques has been used in my empirical research as a robustness check. The results of First-differenced GMM and the system GMM estimations are displayed in **Table 2**, comparatively. Our results are robust when including both the lagged dependent variable $y_{i,t-1}$ and the lagged independent variable $hsr_{i,t-1}$ in Dynamic Panel Data Model. The Sargan test and the second-order serial correlation test show the dynamic panel data model setting is suitable.

In the baseline regression analysis, high-speed rail, population and financial development have a significant positive impact on housing prices, which indicates that housing prices in my sample cities of high-speed rail network are mainly driven by demand and infrastructure improvement. First-order differential GMM estimation and systematic GMM estimation have significant similar and positive effects on high-speed railway, population and financial development to different degrees. With the construction of high-speed railway, China's traditional railway system has gradually withdrawn from passenger transport. Therefore, the estimation results of the coefficient of common railway variables in the fixed-effect model and the dynamic panel data model are not robust, and the common railway operation has no positive impact on the housing price. In general, high-speed rail is the leading

variable of intercity transportation in the evaluation of housing price changes, accounting for at least 7.2% of economic growth.

5.3 Regression Model with City Classification and Regional Dummy Variables

China's cities are divided into three categories according to the country's official classification standards for cities. There are nine central cities, 27 regional central cities and 249 prefecture-level cities. I introduce city classification model variables and cross terms to study the heterogeneity of different classification cities. The regression model using the city classification model is:

$$price_{i,t} = \beta_0 + \beta_1 hsr_{i,t} + \beta_2 hsr_{i,t} \times N_i + \beta_3 hsr_{i,t} \times R_i + \beta_4 N_i + \beta_5 R_i + \boldsymbol{\alpha}\mathbf{x}_{i,t} + u_i + v_t + \epsilon_{i,t} \quad \ldots\ldots(3)$$

Where the N_i and R_i are city classification dummy variables. When the city is a national central city, N_i=1, otherwise, Ni =0. When the city is a regional central city, R_i=1, otherwise, Ri =0. The vector $x_{i,t}$ is a set of control variables used in equation (1).

The effects distribution results of different urban hierarchies are shown in **Table 3**. We compared the pool data with the panel data. On the impact of high-speed rail on the housing price at the urban level, there are differences between cities of different levels, which is consistent with some previous studies (David Emanuel Andersson et al., 2010;Zheng and Kahn, 2013).The study found that the average effect of national central cities (N, large cities) was significantly stronger than that of regional central cities (R, medium cities) and other prefecture-level cities (O, small cities).In terms of statistics, the impact of high-speed railway on housing price is significant in national central cities and regional central cities, while there is no obvious relationship in small cities.

Table 3. Housing Price and HSR with City Classification Dummy Variables

	Pooled Data		**Panel Data: Fixed Effect Model**	
	Beta	standard errors	Beta	standard errors
hsr	-0.003	0.028	0.049	0.033
*hsr*N*	0.600***	0.078	0.284***	0.056
*hsr*R*	0.349***	0.061	0.138***	0.048
N	0.087*	0.077		
R	0.102**	0.048		
pop	0.122***	0.021	0.482***	0.052
air	0.083***	0.027	-0.017	0.065
rail	0.040	0.082	0.023	0.150
save	-0.171***	0.033	-0.043	0.055
loan	0.086***	0.014	0.061***	0.010
constant	8.049***	0.129	6.256***	0.313
Observations	1031		1031	
Diagnosis	R^2=0.4632		R^2=0.3735	
			Hausman test (p=0.00)	

Note：Cities in Tibet are excluded from the sample due to missing data. ***The significance levels at the 1%. **The significance

levels at the 5%.*The significance levels at the 10%.

To sum up, high-speed rail generally contributes no less than 7.2% to the rise of urban housing prices. However, the influence of national central cities and regional central cities is much larger than that of small cities, accounting for 28.4% and 13.8% respectively. In other attributes, the coefficient of population and financial development is also statistically significant, while the coefficient of railway and airport is not.

6 Conclusion

China's housing prices have risen too fast in the past decade, attracting intense public and government scrutiny. In addition to rising demand and the speculative mentality that accompanied the housing bubble, improvements in transport infrastructure, such as high-speed rail, could also play a role. The purpose of this study is to estimate whether and to what extent high-speed rail development contributed to the rise in housing prices in China's cities.

This paper analyzes the causal effect of high-speed rail network construction on the housing price of 285 prefecture-level cities in China from 2009 to 2017 by using data sets containing information on high-speed rail and housing price, as Ill as financial, population and transportation facilities, using fixed effect and dynamic panel data model, and tries to demonstrate the economic gap between different regions. The results showed that the construction of high-speed rail network led to the increase of housing prices in prefecture-level cities by about 7.2%, 28.4% in national central cities and 13.8% in regional central cities. At the same time, with the development of high-speed rail, the regional imbalance has been alleviated, and the housing price in some central cities in less developed areas has accelerated.

It is worth mentioning that the research in this paper is based on the selected data set. It only examines the g-beginning and c-beginning high-speed railway lines opened between 2009 and 2017.In addition, more variables can be constructed according to the characteristics of the data set to make the model fitting more accurate. At the same time, other factors that may affect housing prices, such as urban greening rate, education and medical level, are also worth studying.

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