The Role of Land Prices in the Rise of Housing Prices in Beijing, Shanghai, Tianjin, and Chongqing since 2000

By

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Abstract

In this paper I study aggregate house-price trends and the role that land prices have played in the increase in house prices over the period 2000-2017 for 4 municipalities in China: Beijing, Shanghai, Tianjin, and Chongqing. First, I analyse the aggregate house-price, construction cost, and land-price trends for these four cities. I find that house prices, construction cost, and land prices for these four cities have increased since 2000. The increase of land prices is faster than the increase of construction cost and the increase of house prices for these four cities. Then, I decompose house price into construction cost and land cost to determine what percentage of the increase in house prices can be attributed to the increase in land prices for these cities. My results demonstrate that most of the increase in house prices can be attributed to the increase in land prices for these four cities over the period 2000-2017.

Keywords: decomposition, house price, construction cost, land price

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1. Introduction

In this paper I describe aggregate house-price trends and measure how land prices have affected the increase in house prices over the period 2000-2017 for 4 municipalities in China: Beijing, Shanghai, Tianjin, and Chongqing. Many factors can cause house prices to rise, for example price increases of building materials, wage increases, demand being high relative to supply, and price increases of land. In this paper I focus on the effects of land prices and construction cost on house prices.

House prices in China have increased rapidly since the year 2000. Better understanding the reasons for this is important to both the Chinese government and to economists. The Chinese central government wants to keep house prices stable because real estate is an important industry and urbanisation is an engine of economic growth. Unstable house prices could threaten the economic growth of China. In 2017 the total value of the Chinese real estate industry was 430 trillion Chinese Yuan (CNY), the Gross Domestic Product (GDP) of China was 82 trillion CNY, and the total value of all A-share (Chinese stock market) stocks was 60 trillion CNY. Thus, the value of the Chinese real estate industry in 2017 was 5 times the value of GDP and 7 times the value of A-share stocks. By comparison, the total value of the US real estate industry in 2017 was 200 trillion CNY, and US GDP was 122 trillion CNY. Thus, the value of the US real estate industry was just 1.6 times of the value of GDP. These numbers illustrate the importance of the real estate industry in China, and the vulnerability of the Chinese economy to the real estate sector.

The real estate market is also very important to the lives of Chinese individuals and families. According to Knoll *et al.* (2017): "Houses are typically the largest component of household wealth, the key collateral for bank lending and play a central role in wealth-to-income ratios". There could be social problems if house prices are unstable. Therefore, the Chinese central government is highly concerned about real estate market health in China. I argue that the Chinese central government could stabilize land prices in order to stable house prices.

Much research has shown that land prices have a significant positive effect on house prices worldwide. Davis and Heathcote (2007) develop a model to explain the relationship between house prices, land prices, and construction costs in the United States. They use the Bureau of Economic Analysis's price index for gross investment in new residential structures to represent structure prices. They use the repeat-sales-based index from the Office of Federal Housing Enterprise Oversight for house (plus land) price data. They use their model to estimate land prices and land's share of house value. They find that land prices rise faster than structure prices. They show that land's share of house value has increased since 1950. They state: "Between 1975 and 2006, land accounted 36% of the value of the aggregate housing stock. In 2006, land accounted for 46% of aggregate home value". They also explain the effect of improvement in house quality on overall house prices. They suggest the improvement of house quality increases house prices by 0.3% per year.

Knoll *et al.* (2017) perform a decomposition of house price into the construction cost component and the land cost component for 14 advanced countries. They collect their data from 60 different sources which include existing data and unpublished data.

The data covers 14 advanced countries' house price index, land price index, and construction cost from 1870 to 2012. Their long-term house price index shows a hockey-stick pattern. House prices are stable from 1870 to 1950 but then increase quickly after 1950. They base their decomposition on a Cobb-Douglas production function. They state that: "84 percent of the increase of house price can be attributed to increase of land price for these 14 advanced countries during 1950 to 2012". They also perform a sensitivity analysis for α, the share of land in housing value. They use a lower bound estimate for α which is 0.25 and an upper bound estimate for α which is 0.75. They find 76 to 92 percent of the increase in house price can be attributed to increase in land price.

Feng *et al.* (2016) develop a structural equation model to estimate the effect of land prices on house prices in Beijing. They use 2014 Beijing land prices as their explanatory variable and house prices as the dependent variable. They include five independent variables (shopping center, road, public transportation, prosperity, and facility) in the model. They obtain their data from a real estate developer in Beijing. Their results show that the coefficient on land price is around 0.2 to 0.4 and is statistically significant at the 1 percent level.

In this paper, I show that most of the increase in house prices from 2000-2017 in Beijing, Shanghai, Tianjin, and Chongqing can be attributed to an increase in land prices. I use the same method as Knoll *et al.* (2017) to decompose changes in house prices into changes in construction cost versus land cost for these 4 municipalities in China. Shanghai and Beijing are Tier-1 cities, Tianjin, and Chongqing are Tier-2 cities. These four cities have very different GDP, population, size and house prices. Therefore, land prices may have different effects on house prices in these cities.

I obtain the construction cost of houses and house price data from the National Bureau of Statistics of China. I obtain land price data from the Chinese Land Price Information Platform which is a government website and the China Real Estate Index System (CREIS) which is a website of the China Index Academy. I use these data to analyse aggregate trends of house prices for Beijing, Shanghai, Tianjin, and Chongqing. Then I perform a decomposition of house prices to determine what percentage of the increase in house prices can be attributed to the increase in land prices for these cities. I further compare and analyse the differing contributions of land prices to house price increases for these four cities. Finally, I discuss economic applications and provide suggestions for real estate policy making. My results demonstrate that most of the increase in house prices can be attributed to the increase in land prices for these four cities.

2. Data Sources

I decompose changes in house prices into changes in construction cost versus land cost for 4 Chinese cities. My data contains house prices, construction cost, and land prices at the individual city level.

I obtain house price data from the China Statistical Yearbook which is compiled by the National Bureau of Statistics of China (NBSC). The house price data is available from 2000 to 2017. The NBSC collects monthly house price data from 70 large- and medium-size cities in China to obtain a yearly average house price for each city. The NBSC collects price data of both newly built houses and existing houses. The NBSC divides houses into three strata, which are houses under 90 square meters, houses between 90 to 144 square meters, and houses over 144 square meters. For the price data of new houses, the NBSC obtains all prices of new houses from local government records. The NBSC collects samples for existing houses. Each observation in a

given month should have similar structural characteristics and similar locations compared with the previous month's observation in order to make observations comparable across months. The price data of existing houses is obtained from the real estate agency with the largest market share in China.

Failure to correct for quality improvements in the housing stock could make house price indices misleading. According to Knoll *et al.* (2017): "the quality of homes has risen continuously over the past 140 years. Indices that do not control for quality improvements will overstate the price increase over time". By comparing house prices of countries which quality-adjust their data with house prices of countries which do not quality-adjust their data they find aggregate trends are similar. Davis and Heathcote (2007) suggest the improvement of house quality increases house prices by 0.3% per year which is small compared with the annual house price growth rate in China. My data spans just 18 years. Therefore, I assume I do not need to make quality adjustments to my house prices data.

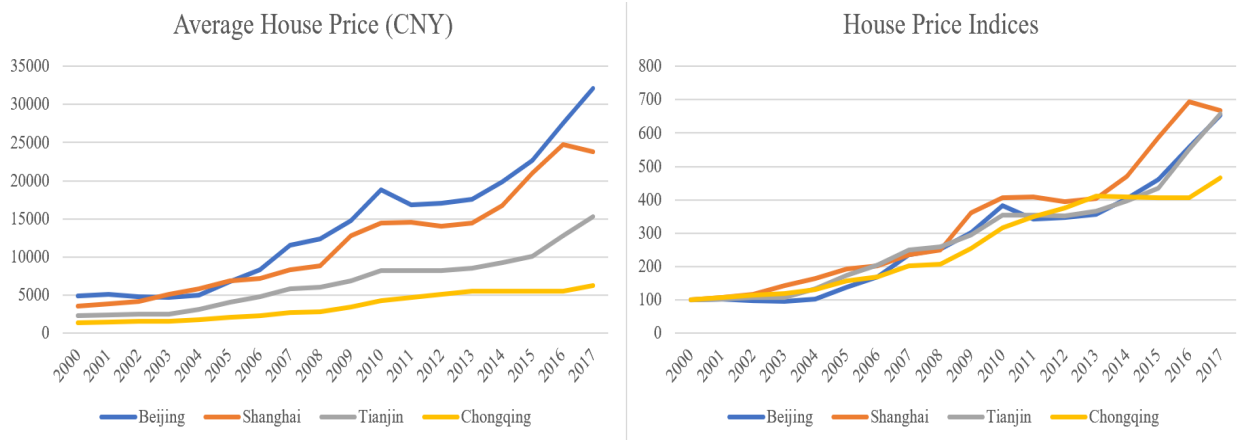
I obtain residential land price data from the Chinese Land Price Information Platform which is a website of the Ministry of Natural Resources of China and the CREIS which is a website of the China Index Academy. They have collected data from all land auctions in 105 cities in China since 2000. The Ministry of Natural Resources divides total area of land by total transaction price to get land price per square meter. I can only obtain the land price data for newly auctioned land. The data does not include prices of already developed land. Xu *et al.* (2018) state that: "Although Chinese land prices are available only for new land parcels, they are a reasonably good proxy of the price for adjacent residential land that has already been developed".

For construction cost, I use the cost of buildings from the China Statistical Yearbook. Every Chinese real estate developer needs to complete a survey which is provided by the NBSC. The NBSC collects each real estate developer's employment status, financial status, and production status which includes construction cost per square meter. Furthermore, I obtain the price indices of construction and installment from the China Statistical Yearbook. I divide the construction cost by price indices of construction and installment to eliminate the effect of inflation.

3. Aggregate Trends

In this section, I describe the changes in construction cost, land prices, and house prices for Beijing, Shanghai, Tianjin, and Chongqing from 2000 to 2017. I also compare differences and similarities of aggregate trends of construction cost, land prices, and house prices of these four cities.

Figure 1: Historical average house prices and indices for 4 cities. (Note: Index, 2000=100.)



Source: National Bureau of Statistics of China

Figure 2: Residential land supply

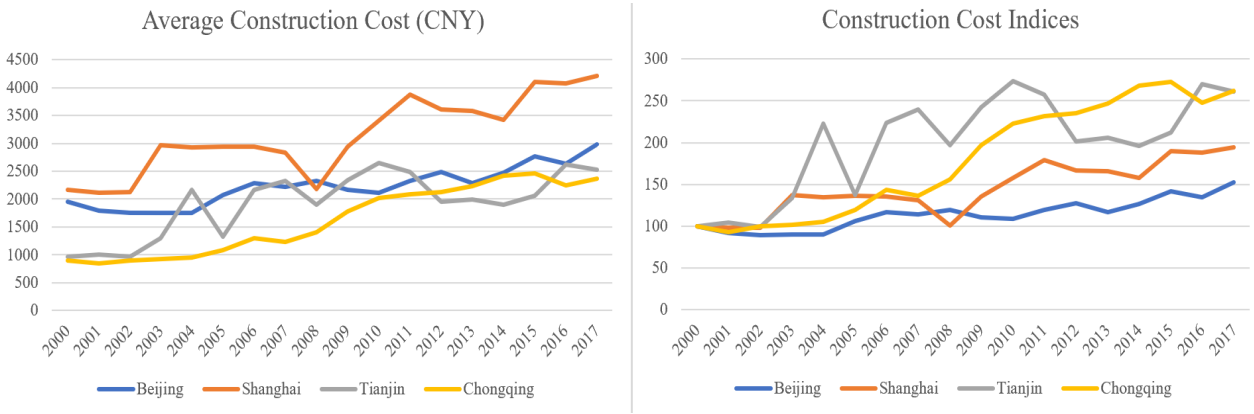
Source: Chinese Land Price Information Platform

Figure 1 shows historical house prices and house indices for these four cities from 2000 to 2017. The Tier-1 cities in my sample, Beijing and Shanghai, always have higher house prices than the Tier-2 cities, Tianjin and Chongqing. The growth trends of house prices of these cities are very similar except for Chongqing. House prices for Beijing, Shanghai, and Tianjin increased by more than 5 times from 2000 to 2017. Chongqing house prices have grown more slowly, increasing by just 4 times from 2000 to 2017. One can break the price series in Figure 1 into four major growth periods from 2000-2017. During the first period, from 2000-2003, house prices remained fairly stable. During the second period, from 2004-2010, the growth of house prices sped up. During the third period, from 2010-2014, house prices remained mostly stable again. The main reason for this cooling of the housing market was the implementation of property-purchasing restrictions by the local governments of Beijing, Shanghai, and Tianjin. For example, under these restrictions, migrant buyers could not purchase a house in Beijing unless they had already paid income tax in the last five years. Under the restrictions, Beijing local buyers could only purchase a second house with higher down payments and higher mortgage rates. The property-purchasing restrictions policy aimed to reduce pressure on house prices by reducing

speculation. During the fourth period of house price growth, from 2014-2017, growth increased again because some local governments eased or canceled the property-purchasing restrictions.

Chongqing is different than the other three cities. Chongqing has the lowest GDP per capita and the highest land supply among these four cities. The supply of land is determined by the Chinese local government. Figure 2 shows residential land supply for Beijing, Shanghai, Tianjin, and Chongqing in 2017. The land supply of Chongqing is 2 times that of the other cities. This is one reason that house price of Chongqing is lower than other three. The local government of Chongqing did not implement property-purchasing restrictions policy. As a result, house prices in Chongqing continued rising from 2010 to 2013.

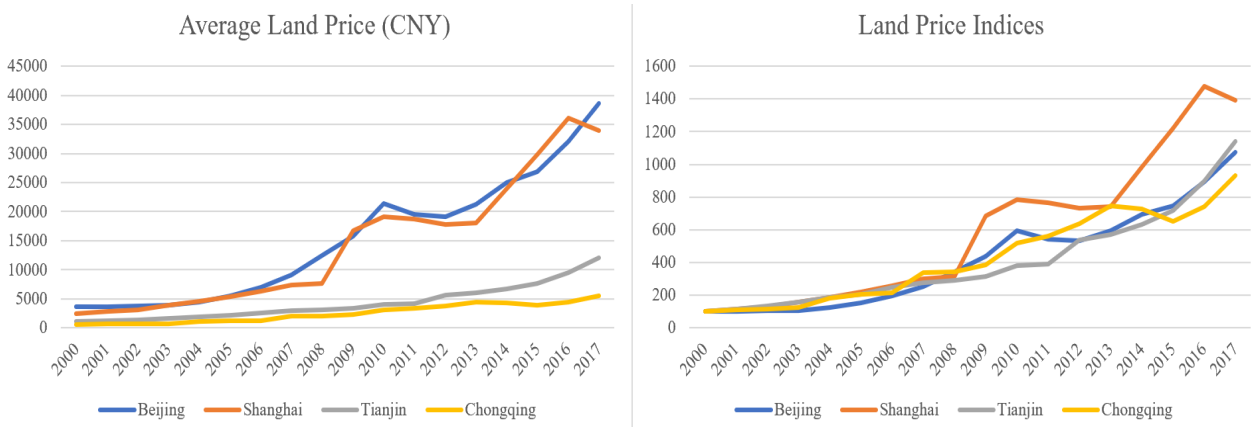
Figure 3: Historical construction cost and indices for 4 cities. (Note: Index, 2000=100.)



Source: National Bureau of Statistics of China

Figure 3 shows historical construction cost per square meter and construction cost indices for these four cities from 2000 to 2017. Tier-1 cities have higher construction cost than Tier-2 cities. One reason is higher labour costs in Tier-1 cities. Construction costs of these four cities more than doubled over the period from 2000 to 2017. A comparison of Figure 2 and Figure 3 shows that house prices have risen faster than construction cost for the period 2000-2017.

Figure 4: Historical land prices and indices for 4 cities. (Note: Index, 2000=100.)



Source: Chinese Land Price Information Platform

Figure 4 shows historical land prices and land price indices for these four cities from 2000 to 2017. Tier-1 cities always have higher land prices than Tier-2 cities. Chongqing has the largest land area and the highest land supply in these four cities. Therefore, Chongqing has the lowest land price. Land prices for Tianjin and Beijing, increased by over 10 times from 2000 to 2017. Land prices for Chongqing increased by over 8 times from 2000 to 2017. The land price for Shanghai increased by 14 times from 2000 to 2016. A comparison of Figure 2 and Figure 4 shows that land prices have risen faster than construction cost for the period 2000-2017. This suggests that most of the increase in house prices can be attributed to the increase in land prices.

4. Methodology

A house is a bundle with a structure component and a land component. Decomposing house prices into structure prices and land prices can help us understand house prices better (Davis and Heathcote, 2007). I use construction cost to represent residential structure price. We

can analyse structure price and land price to find which of them is the main cause of increase in house price.

I assume that the housing market is perfectly competitive. There are many identical real estate developers who produce houses in the market. In this situation, real estate developers are price takers and house price equals to the cost of building a house. Real estate developers need two inputs, land and residential structures to build houses. I assume the following Cobb-Douglas production function for houses:

$$H_t = L_t^{\alpha} * S_t^{1-\alpha} \qquad 0 < \alpha < 1 \qquad (1)$$

H_t: Houses at period t

L_t: Land at period t

S_t: Structures at period t

α: Land share parameter.

The cost of houses is:

$$P_t^H H_t = P_t^L L_t + P_t^S S_t \qquad (2)$$

P_t^H: House prices at period t.

P_t^L: Land prices at period t

P_t^S: Structure prices at period t

Profit maximization yields:

$$P_t^H = B(P_t^L)^{\alpha}(P_t^S)^{1-\alpha} \qquad (3)$$

$$Where\ B = (\alpha)^{-\alpha}(1-\alpha)^{-(1-\alpha)}$$

$$\frac{P_{t+1}^H}{P_t^H} = \left(\frac{P_{t+1}^L}{P_t^L}\right)^{\alpha}\left(\frac{P_{t+1}^S}{P_t^S}\right)^{1-\alpha} \qquad (4)$$

Taking logs of equation (4), I get:

$$\alpha \frac{\ln\left(\frac{P_{t+1}^{L}}{P_{t}^{L}}\right)}{\ln\left(\frac{P_{t+1}^{H}}{P_{t}^{H}}\right)} + (1-\alpha)\frac{\ln\left(\frac{P_{t+1}^{S}}{P_{t}^{L}}\right)}{\ln\left(\frac{P_{t+1}^{H}}{P_{t}^{H}}\right)} = 1$$

Equation (3) decomposes house prices into land prices and construction cost. Equation (4) shows how house price changes depend on changes in land prices and changes in construction cost. The share of the rise in total house price attributable to the rise in construction cost is *1-α*. The share of the rise in total house price attributable to the rise in land cost is *α*.

There is some variation of share of land price in house value across time. I use the average of every years' share of land price in house value to estimate *α*. Table 1 lists *α* values for these four cities for the period 2000-2017. Table 1 shows that Chongqing has the lowest land price share in house value. This may be due to the fact that Chongqing has the largest land area and the highest land supply of these four cities. Therefore, Chongqing has the lowest land price share in house value. Just half of the cost of a house in Chongqing is the land cost.

Table 1: The share of land value in housing value

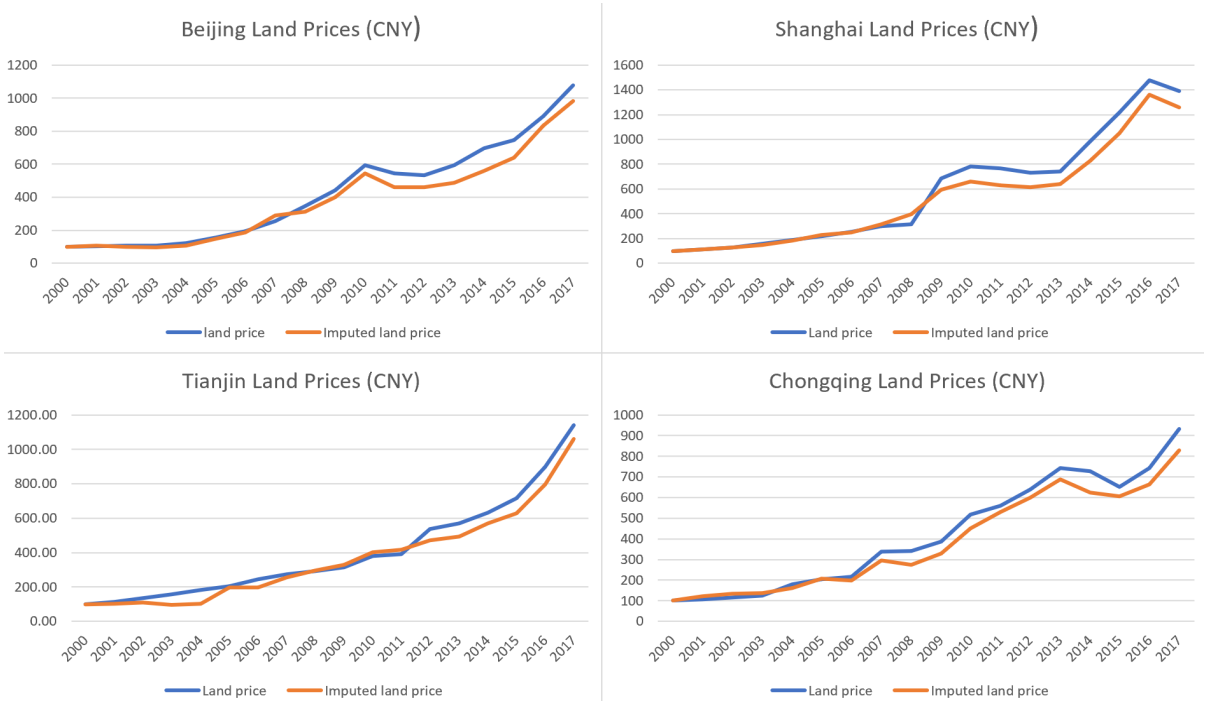
	Beijing	Shanghai	Tianjin	Chongqing
Land price shares of house value	0.78	0.66	0.66	0.50

With the data on construction cost and house prices, I can use equation (5) to calculate the imputed land prices.

$$\frac{P_{t+1}^{L}}{P_{t}^{L}} = \left(\frac{P_{t+1}^{H}}{P_{t}^{H}}\right)^{\frac{1}{\alpha}} \left(\frac{P_{t+1}^{S}}{P_{t}^{S}}\right)^{\frac{\alpha-1}{\alpha}} \quad (5)$$

Figure 5 shows graphs of observed land prices and imputed land prices for these four cities. By comparing them, I find that these two land prices are close to each other, and that their aggregate trends are very similar. Therefore, imputed land prices appear to reflect the true land prices.

Figure 5: Actual vs. Imputed land prices



Source: Chinese Land Price Information Platform

5. Result

In this section, I use the decomposition model which I introduced in the previous section to demonstrate that most of the increase in house prices from 2000 to 2017 can be attributed to the increase in land prices in the four Chinese cities that I examine. Using equation (6) and data on house prices, construction cost, and imputed land prices, I can determine what percentage of the increase in house prices can be attributed to the increase in land prices for these cities from 2000 to 2017.

$$\alpha \frac{\ln\left(\frac{P_{2017}^{L}}{P_{2000}^{L}}\right)}{\ln\left(\frac{P_{2017}^{H}}{P_{2000}^{H}}\right)} + (1-\alpha)\frac{\ln\left(\frac{P_{2017}^{S}}{P_{2000}^{L}}\right)}{\ln\left(\frac{P_{2017}^{H}}{P_{2000}^{H}}\right)} = 1 \qquad (6)$$

From 2000 to 2017, Beijing's house prices increased by 6.53 times, construction cost increased by 1.52 times, and imputed land price increased by 9.84 times. Therefore, 95.02 percent of the increase in Beijing's house prices can be attributed to the increase in land price from 2000 to 2017.

From 2000 to 2017, Shanghai's house price increased by 6.67 times, construction cost increased by 1.94 times, and imputed land price increased by 12.59 times. Therefore, 88.07 percent of the increase in Shanghai's house prices can be attributed to the increase in land price from 2000 to 2017.

From 2000 to 2017, Tianjin's house price increased by 6.58 times, construction cost increased by 2.61 times, and imputed land price increased by 10.60 times. Therefore, 82.67 percent of the increase in Tianjin's house prices can be attributed to the increase in land price from 2000 to 2017.

From 2000 to 2017, Chongqing's house price increased by 4.66 times, construction cost increased by 2.62 times, and imputed land price increased by 8.28 times. Therefore, 68.72 percent of the increase in Chongqing's house prices can be attributed to the increase in land price from 2000 to 2017. Table 2 lists key price changes, shares, and my results.

Table 2: Results

	Beijing	Shanghai	Tianjin	Chongqing
House price increases	6.53	6.67	6.58	4.66
Construction cost increases	1.52	1.94	2.61	2.62
Imputed land price increases	9.84	12.59	10.60	8.28
Land price shares (α)	0.78	0.66	0.66	0.50
Attribution of land	95.02	88.07	82.67	68.72

My results show that higher percentage of the increase in house prices can be attributed to the increase in land price for the Tier-1 cities in my study, Beijing and Shanghai. Chongqing has the lowest attribution of housing price increase to land price because land supply in Chongqing is high.

There may be bias in my result. Because the NBSC do not quality-adjust the house price data, the increase in house prices may be overstated. This could affect the value of α which is the land share parameter, and, as a result, the land prices that I impute. If I overstate the increase in house price, my attribution of house price increases to land price increases will be overstated. However, the house price increase which is caused by quality improvement is smaller than the house price increase. Therefore, the bias in my result should be very small. Davis and Heathcote (2007) suggest the improvement of house quality increases house prices by 0.3% per year. I use their result to quality-adjust my house price data. Table 3 shows the result of my sensitivity analysis. By comparing Table 2 and Table 3, I find that there is no significant change in my results. Overall, my results demonstrate that most of the increase in house prices can be attributed to increase in land prices for these four cities.

Table 3: Results of Sensitivity Analysis

	Beijing	Shanghai	Tianjin	Chongqing
House price increases	6.51	6.65	6.56	4.64
Construction cost increases	1.52	1.94	2.61	2.62
Imputed land price increases	9.80	12.54	10.55	8.23
Land price shares (α)	0.78	0.66	0.66	0.50
Attribution of land	95.01	88.05	82.64	68.66

6. Implications

In this section, I discuss economic and political implications of my findings. Knoll *et al.* (2017) note the historical debate about the relationship between land and house prices. The classical view is that house prices and land prices will keep increasing with population because of land scarcity (Ricardo 1817). The opposite view is that there is adequate land resource so that increases in house prices will drive land supply increases. This increase in land supply will keep house prices in check (Shiller 2007; Grebler, Blank, and Winnick 1956). My research provides a Chinese urban real estate dimension to the debate. My finding supports the classical view. Land prices of the four cities I study have increased since 2000. Despite the land supply of Chongqing being very high, land prices and house prices of Chongqing continue to increase.

My findings show that the majority of the increase in house prices in these four Chinese cities can be attributed to an increase in land prices. This suggests that the Chinese central government could control land prices in order to stabilize house prices. The Chinese land market is different from other countries' land markets. In China, land is owned by the Chinese government. The Chinese government has the power to price land in order to control land prices.

Land in China is traded in a system of local government land auctions. Real estate developers can purchase a 70-year lease on a parcel of land at local government auctions.

Some Chinese real estate developers complain about the land auction system. They claim that the increase in land prices is due to the land auction system. They argue that some Chinese local governments attempt to limit the supply of land in order to keep land prices high and raise more revenue at auction. My finding shows that land cost is the major cost of house building; hence real estate developers need to increase the house sale price to cover the land cost. To deal with this problem, the Chinese central government should reform the old land auction system. The new land trading system should insure that real estate developers can acquire land at reasonable prices. However, in secondary housing market, houses can still be traded in high prices. Therefore, the Chinese government also needs to publish new policy to keep the Chinese housing market healthy. Some local Chinese governments are doing this. They sell land to real estate developers with low price. Real estate developers are not allowed to resell the land. They need to build houses and rent out these houses. The rent of these houses should be reasonable low. Only low-income people and people without residential property can rent these houses. Real estate developers are not allowed to sell these houses, they can only get revenue from rent to cover their cost. If land prices keep in high level, the low rent cannot cover the cost of house building. Therefore, the local government needs to sell land to real estate developers with lower prices than before. This is an instrument that the local Chinese government can use to stable house prices.

7. Conclusion

In this paper I study the long-run growth of house prices for 4 municipalities in China Beijing, Shanghai, Tianjin, and Chongqing. I first analyse aggregate trends of houses prices for these four cities. I find that house prices of the tier-1 cities, Beijing and Shanghai, are higher than house prices of the tier-2 cities, Tianjin and Chongqing. Aggregate trends of house prices of Beijing, Shanghai, and Tianjin for 2000-2017 are similar. In addition, I find that land prices and house prices rise faster than construction cost. This suggests that most of the increase in house prices can be attributed to the increase in land prices. To measure the relative impact of land and construction price increases on house price increases, I use a decomposition developed by Knoll *et al.* (2017) to decompose house prices into land prices and construction cost. I find that most of the increase in house prices from 2000 to 2017 can be attributed to the increase in land prices for these four cities. My finding suggests that the increase of land prices is the main cause of house price increases and controlling land prices is a good way to control house prices.

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