Impact of urban economic openness on real estate prices: Evidence from thirty-five cities in China

Songtao WANG *, Zan YANG, Hongyu LIU

Hang Lung Center for Real Estate, Tsinghua University, Beijing, PR China
Department of Construction Management, Tsinghua University, Beijing, PR China

ARTICLE INFO

Article history:
Received 10 December 2009
Received in revised form 25 August 2010
Accepted 26 August 2010
Available online 8 September 2010

Keywords:
Urban economic openness
Real estate price
Quality of life
Balassa–Samuelson effect
Panel data
China

ABSTRACT

Over the past decade, China’s major cities have experienced significant real estate price increase which has been fueled by the sustained growth of the economic fundamentals. It is well believed that deeper integration with the world market is one of the major reasons for such high speed macroeconomic growth. In this paper, we examined the linkage between urban economic openness, the ratio of trade volume as a percentage of GDP, and urban real estate prices basing on the quality of life theory as well as Balassa–Samuelson (B–S) effects. Using panel data of 35 large Chinese cities from the year 1998 to 2006, we empirically find that for every 1% increase in urban economic openness, urban real estate prices will increase significantly by 0.282%, after controlling for other traditional demand–supply factors. Urban economic openness alone accounted for about 15.90% appreciations of Chinese real estate prices during the sample period, which is not neglectable. This result implies that urban real estate price fluctuations are potentially affected by international economic factors. The economic distance to the international market could be deemed as productive and consumption amenity for a city as well. This study enriches the perception of quality of life factors, and furthermore provides a new perspective for understanding the real estate price dynamics in the globalized economic development today.

© 2010 Elsevier Inc. All rights reserved.

1. Introduction

Extensive studies have been placed on the determinants of regional real estate price in the field of urban economics. One strand of research explained regional real estate prices basing on the national and regional macroeconomic factors (Green et al., 2005; Gyourko et al., 2006; Jud and Winkler, 2002). Another strand focused on regional price determinants by considering the spatial heterogeneity and interregional linkage of real estate submarkets (Alexander and Barrow, 1994; Blomquist et al., 1988; Gyourko and Tracy 1991; Meen, 1999; Roback, 1982, 1988).

Despite contributions to understanding real estate price dynamics at the regional level, none of the above studies have extended their conceptual framework to take into account the impact of international trade on the urban real estate prices. This contrasts with the fast paces of globalization in the 20th century. Actually, in the first decade of the 21st century, many scholars have begun to study the real estate market from an open economy perspective (Aizenman and Jinjarak, 2009; Bardhan et al.,...
Since the market-oriented housing reform in 1998, urban real estate prices in China have risen quite rapidly in general. According to the Statistics of China, the average real estate price in 35 major cities (the geographical locations of these 35 large cities are presented in Fig. A1 of Appendix A) went up from 3516 yuan/m² to 5748 yuan/m², with an average annual appreciation rate of 4.6% from 1998 to 2008. During the same period, China’s macro-economy enjoyed a stable and sustained growth. With the entry into the WTO (World Trade Organization) in 2001, China played an even more significant role in the international markets. These could be reflected in the indicator of urban economic openness. As defined by the National Bureau of Economic Research (NBER), economic openness is the ratio between total trade volume (imports plus exports) and GDP (Bardhan et al., 2004). The same definition on urban economic openness is used in this paper at the city level. As exhibited in Fig. 1, for the past decade, there is a lot of variation in the time series of openness and real estate prices both at the regional and aggregated level. On average, urban economic openness increased by 26.2 percentage points from 49.8% in 1998 to 76.0% in 2006. But generally speaking, cities located on the east coast have higher urban economic openness value (such as Shenzhen was 288.7% in 1998), while cities in the interior are mostly not that dependent on international trade (such as Chongqing was 5.8% in 1998).

This unique background of China’s transitional economy provides us a good opportunity to examine the urban real estate price dynamics in the context of international economics and regional economics. This paper will take a preliminary step to extend current research on real estate price determinants to the cities that have experienced substantial changes in urban economic openness. It is the first paper, as far as we know, to identify the impact of urban economic openness on regional real estate prices.

Our research hypothesis is that if a city is economically more ‘open’, reflected in higher level of urban economic openness, it should have a larger positive real estate price premium. We proposed a conceptual framework including two different channels through which urban economic openness impact on the real estate prices. The first channel is the quality of life channel and the second is the so-called Balassa–Samuelson channel.

According to the quality of life literature started from Roback (1982), workers are mobile across the cities that differ in consumption and production amenities. Wage as well as rents adjusts to the difference so that workers obtain the same utility and firms earn zero profits everywhere. That is, in equilibrium, wages and rents are higher in the location with higher productivity, while rents are also higher in more pleasant locations (Roback, 1982). We thus can expect that the higher the urban economic openness is, the higher the rent and price of real estate in a city, because urban economic openness can be regarded as a special type of amenity, both productive and consumption amenities to be exact. Such amenity could not only enhance the urban productivity directly but also create a pleasant ‘open’ environment for its citizens.

The other channel is based on the Balassa–Samuelson (B–S) hypothesis in the international economics textbook. B–S hypothesis explains how prices of non-tradable goods are related to productivity growth in the tradable good sector. Balassa (1964) and Samuelson (1964) pointed out that, if labour is mobile within a country but immobile across countries, a faster growth in labour productivity in the tradable goods sector of an economy would raise the relative prices of non-tradable goods, and would finally trigger variations in real exchange rates. Since real estate is fixed in location and the construction work and management services are not easily outsourced, the real estate industry is usually considered a non-tradable sector (Lu, 2004). If a city has a higher urban economic openness compared with other cities, it will firstly lead to a higher productivity of the tradable good sector, and then higher wage levels in both sectors, and finally a higher non-tradable good price or real estate price compared with other cities.

Theoretically speaking, both channels indicate a positive relationship between the urban economic openness and real estate prices. The relative effectiveness of the two channels should base on the real mobility of labour across the cities. We could expect that if workers are free to move and cities are rather ‘open’, the urban quality of life channel will play an important role since it is based on the assumption of free labour mobility across cities. If workers are restricted to move and cities are essentially ‘closed’, the Balassa–Samuelson channel could have a larger effect. The real situation in China, however, seems to fall between the two extremes.

In China, Hukou system has long been regarded as a restriction to labour mobility across cities. All the new immigrants have to be adopted by a local work unit to register the local Hukou that is associated with social welfare. Even it is still the barrier for the labour mobility among cities, the mobility of labour in China significantly increased along with the deepening of market-

---

Footnote 1: We categorized our 35 cities into East, Middle and West group. Wulumuqi, Xining, Lanzhou, Yinchuan, Xi’an, Chengdu, Chongqing, Guiyang, Kunming and Nanning are the 10 cities within the West group. Huhhot, Taiyuan, Zhengzhou, Hefei, Wuhan, Nanchang and Changsha are the 7 cities within the Middle group. The rest of the 18 cities are within the East group. Fig. 1 shows that the East group has a higher average urban economic openness as well as higher real estate prices while the Middle and West group have similar levels of openness and real estate prices.
oriented economic reform. From 1998 to 2008, new immigrants to Chinese cities add up to more than 100 million and the urbanization rate increased from 30.42% to 45.68% during the same period (China City Statistical Yearbook, 2009). Among all the new immigrants to cities in 2008, 26% moved among cities (China City Statistical Yearbook, 2009). We would expect with the reform on Hukou system and the sustained investment in the inter-city infrastructure that labour mobility across Chinese cities will increase gradually in the near future and quality of life channel will play a more and more important role compared to the B–S channel.

In this paper, using the panel data of 35 large Chinese cities from 1998 to 2006, we find that for every 1% increase in urban economic openness, urban real estate prices will increase significantly by 0.282%, after controlling for other traditional demand–supply factors. Urban economic openness alone accounted for about 15.90% of the appreciation of Chinese real estate prices during the sample period, which is not negligible. Because of the potential endogeneity issue, we apply instrumental variable method to estimate the regression.

The remaining of the paper is organized as follows. Section 2 theoretically explains and models how urban economic openness impacts on real estate prices through the quality of life channel and the Balassa–Samuelson channel. Section 3 describes the data and carries out empirical analysis. Section 4 is the concluding remarks.

2. Theoretical framework

The essential objective of this study is to examine the effect of urban economic openness on real estate prices in the Chinese context. In this section we provide two theoretical channels through which urban economic openness may impact on real estate prices. This lays the foundation for the empirical tests in the paper.

2.1. The quality of life channel

There has long been a widespread interest and popular debate surrounding regional variations in the quality of life. In an economic sense, the location-specific amenities are important to company production cost and household utility as well as their separate location decisions. The standard approach used in the academic literature is based on the work of Roback (1982, 1988). More recent applications of this compensating differential approach to estimating the quality of life include Hoehn et al. (1987), Blomquist et al. (1988), Greenwood et al. (1991), Gyourko and Tracy (1991), Gabriel et al. (2003) and Shapiro (2006).

Roback (1982) and Hoehn et al. (1987) extended the literature by developing models that consider the global compensation mechanism in both the labour and housing market with respect to the location-specific amenities. They proposed a method to explicitly measure the value of such amenities and provided quality of life rankings among U.S. metropolitan areas. Meanwhile,
they also found significant impact of these amenities on housing prices. Roback (1988) extended the previous model by considering two types of workers instead of a homogeneous work force and found that the wages of one type of worker are dependent on the preferences of the other. Blomquist et al. (1988) also extended the previous models by allowing for amenity variation both within and across urban areas. The authors firstly computed the county level price of amenities and then transformed those prices to metropolitan area quality of life indices. The advantage of this enhanced model lies in its ability to capture the agglomeration effects due to the productivity effects of city size. Greenwood et al. (1991) highlighted the issue of disequilibrium of the regional markets. Basing on the empirical estimation, they argued that there are some states in America that are not constantly in equilibrium within the sample period. The overlook of disequilibrium will lead to misclassiﬁcation of areas as amenity-poor or amenity-rich. The compensating differentials are however only slightly inﬂuenced quantitatively and qualitatively. Győrko and Tracy (1991) calculated the compensating differentials of the local

In our study, we would use similar model as in Shapiro (2006). We assume that there is a set of locations endowed with location-speciﬁc productivity and quality of life, denoted $A_i$ and $Q_i$ respectively. Firms produce a homogeneous good at the numeraire price of 1 using a constant-returns-to-scale production function $Y = AL(R, L)^{s_R}$, where $L$ denotes the quantity of labour and $R$ the quantity of land used in production. We further assume that input markets are competitive and firms face a constant per-unit marginal cost given by $C(W_i, P_i) = A_i$, where $W_i$ and $P_i$ are the price of labour and land in location $i$. Since there is no spatial arbitrage in equilibrium, the marginal cost is equal to unity at all locations, which is given by Eq. (1) for all $i$.

$$C(W_i, P_i) = A_i$$ (1)

Consumer’s utility function is given by $U = U(Q, X, R')$, where $X$ and $R'$ are the quantity of goods consumed and land consumed respectively. This utility function implies an indirect utility function $V(Q_i, W_i, P_i)$ which must be constant across locations in equilibrium as shown in Eq. (2) for all $i$ and a constant $\bar{U}$.

$$V(Q_i, W_i, P_i) = \bar{U}$$ (2)

Allowing $A_i$ and $Q_i$ to change exogenously over time. We can totally differentiate the equilibrium conditions (1) and (2) using the chain rule as Eq. (3).

$$C_W \frac{dW_i}{dt} + C_P \frac{dP_i}{dt} = \frac{dA_i}{dt},$$

$$V_Q \frac{dQ_i}{dt} + V_W \frac{dW_i}{dt} + V_P \frac{dP_i}{dt} = \frac{d\bar{U}}{dt}.$$ (3)

Let $k_R$ and $k_L$ be the share of land and labour in the ﬁrm’s cost function, let $s_R$ be the share of land in the household’s budget, and let lowercase letters denote natural logarithms of variables. Since $d\bar{U}/dt = 0$, we can rearrange the above conditions and get the expressions for the changes in wages and land rents.

$$\frac{dp_i}{dt} = \frac{1}{k_R + s_R} \left( \frac{V_Q}{V_W W} \frac{dq_i}{dt} + \frac{1}{k_L + s_R} \frac{da_i}{dt} \right),$$

$$\frac{dW_i}{dt} = \frac{1}{k_L + s_R} \frac{da_i}{dt} - \frac{k_R}{k_L + s_R} \frac{V_Q}{V_W W} \frac{dq_i}{dt}.$$ (4)

Eq. (4) gives an explicit relationship between land rents and regional productivity as well as amenity. It is reasonable to assume that urban economic openness is a special type of amenity. It is productive amenity since economic intuition suggests that with increasing openness and globalization, the urban economy would experience a greater increase in productivity because of greater market size, learning effect and technology enhancement (Bardhan et al., 2004). It is consumption amenity since if a city is more open to the international market, it would create a more pleasant ‘open’ environment for its citizens. Citizens could easily access foreign goods and services in open cities and open cities tend to have dynamic demographic and cultural backgrounds as well. If
we assume \( dq/dt = m \cdot d(open_t)/dt \) and \( da/dt = n \cdot d(open_t)/dt \), where \( open_t \) stands for the urban economic openness, then the relationship between land rents and urban economic openness can be written as Eq. (5).

\[
\frac{dp_t}{dt} = \frac{1}{k_e} + \frac{mV_Q Q}{V_W W} + \frac{n}{k_i} \cdot d(open_t) \\
\text{(5)}
\]

Since all the coefficients in Eq. (5) are positive, land rents or real estate prices would increase when there is a positive shock from urban economic openness. The impacts are conducted through both the local productivity growth and quality of life improvement. The relative importance could easily be calculated with the estimated coefficients.

2.2. The Balassa–Samuelson channel

The B–S hypothesis looks at the long-run variation in equilibrium exchange rates resulting from increased productivity in the tradable sector of an open economy. Balassa (1964) and Samuelson (1964) stated that purchasing power parity would not hold in the long run because of different rates of productivity growth in the tradable goods sector across countries, and this is due to the fact that higher productivity in the tradable sectors would raise wages and the relative prices of non-tradable goods and services. A strand of literature has done empirical research to test the applicability of B–S hypothesis (Drine and Rault, 2003; Hsieh, 1982; Ito et al., 1997; Marston, 1987), but only Bardhan et al. (2004) focused on real estate market.

Traditional B–S model assumes two types of representative enterprises in a small open economy, producing tradable goods and non-tradable goods respectively. Both products need two typical inputs of capital and labour. The model assumes that the market is fully competitive, where labour can flow freely within the domestic market and capital can flow freely both within and across countries. We further assume the production functions of the representative enterprises are Cobb–Douglas format. The price of the tradable goods can be unitized as one, while that of the non-tradable goods are assumed to be \( p_n \).

The profit maximizing optimization problem of the enterprise making tradable goods is as Eq. (6):

\[
\text{Max } A_e k_e^{1-\alpha} - w_e - \alpha \theta A_e (k_e^{1-\alpha})^{1-\alpha} = w. \\
\text{(6)}
\]

The optimization problem of the enterprise making non-tradable goods is shown as Eq. (7):

\[
\text{Max } p_n A_n k_n^{1-\beta} - w_n - \beta \theta A_n (k_n^{1-\beta})^{1-\beta} = w. \\
\text{(7)}
\]

In Eqs. (6) and (7), \( A_i (i = e, n) \) denotes total factor productivity. Since the labour market is fully competitive and cleared within the country, the wage level paid by the representative enterprises is the same (as denoted by \( w_e \)) in equilibrium and by calculating the first order condition (FOC), we obtain following Eq. (8) where \( \text{Output}_e \) stands for the average output of tradable sector and \( \text{Output}_n \) stands for the average output of non-tradable sector.

\[
\alpha A_e \left( \frac{k_e}{T_e} \right)^{1-\alpha} = \beta p_n A_n \left( \frac{k_n}{T_n} \right)^{1-\beta} = w_e \\
\text{FOC is } \frac{\alpha}{A_e} \left( \frac{k_e}{T_e} \right)^{1-\alpha} = \frac{\beta}{A_n} \left( \frac{k_n}{T_n} \right)^{1-\beta} = \theta \text{Output}_e \]

\[
\text{(8)}
\]

Since \( \alpha \) and \( \beta \) are stable and positive, the non-tradable price level, \( p_n \), will depend primarily on the average output between the tradable and non-tradable sectors, namely the relative labour productivity of the two sectors. In an open economy, the tradable sector can increase its productivity and average output easily through international cooperation, competition and technical innovation, while the enterprises in non-tradable sector have slower progress in productivity (Bardhan et al., 2004; Miller and Upadhyay, 2000; Pavcnik, 2002). Therefore, relative labour productivity of the two sectors is positively correlated with urban economic openness. If we assume that \( d \left( \frac{\text{Output}_e}{\text{Output}_n} \right) / dt = \theta \cdot d(open) / dt \), and \( \theta \) is positive, then the relationship between non-tradable prices, or real estate prices in this paper, to urban economic openness is written as Eq. (9) when differentiating Eq. (8).

\[
\frac{dp_n}{dt} = \frac{\alpha \cdot \theta \cdot d(open)}{\beta \theta} \frac{dt}{dt} \\
\text{(9)}
\]
It is known from Eq. (9) that a relatively faster increment of tradable sector labour productivity will lead to the rise of non-tradable goods prices relative to the general price of tradable goods. It can also be inferred that those economies with faster progress in urban economic openness would have a higher level of positive premium in their real estate prices.

The shock transmission mechanism of the Balassa–Samuelson channel is clear. Firstly, if there is an increase in the urban economic openness, then the labour productivity of the tradable sector should increase, which bring about positive shock to the wage level of the tradable sector. Secondly, since the labour market is in equilibrium, so the wage level of the non-tradable sector will increase accordingly to the same level, though with some time lag. Lastly, the increase in the labour cost in the non-tradable sector will push up the prices of non-tradable goods.

It is noteworthy that the Balassa–Samuelson effect is originally applied to explain cross country price difference in non-tradable goods. The feasibility to use this theory in explaining the cross-city real estate price variation lies in the low mobility of labour among cities in China as well as the non-tradable feature of real estate. As we argued before, although we believe that the labour mobility is improving all the time, yet the Hukou system has to a large extent restrained the labour mobility across urban areas. Meanwhile, real estate is fixed in location and the construction work and management services are not easily traded which make it natural to categorize real estate into non-tradable goods. These two points make the Balassa–Samuelson channel sound in our study.

In addition, Lu and Liu (2007) argue that the background of China’s economic growth suits the B–S effect. Fig. 2 demonstrates the growth path of urban economic openness, net export as percentage of GDP, per capita labour output of manufacturing industry and service industry. It is obvious that urban economic openness has a quite high correlation with per capita output of manufacturing industry and the correlation coefficient is as high as 0.866. Per capita output of manufacturing industry also leads the per capita output of service industry. Fig. 3 further illustrates the relationship of wage level between the manufacturing industry and real estate industry. Granger causality test confirm the causality flow both from the labour output of manufacturing industry to its wage level and the wage level of manufacturing industry to that of the real estate industry, as presented in Tables A1 and A2 in Appendix A.

The two conceptual channels proposed above actually originated from different theories. In addition to the different assumption on the labour mobility, the quality of life model has a regional dimension and the compensating differentials guarantee a regional equilibrium on both company and residents’ location choice. The B–S model, on the other hand, has a two-sector dimension which explicitly modelled the relative price level of tradable and non-tradable goods. The impacts of two theories on real estate prices are also different in nature. Quality of life channel highlights that higher urban economic openness will lead to productivity growth and urban environment enhancement, which can finally push up real estate prices through attracting more real estate demand from both companies and households. However, the B–S channel highlights that higher urban economic openness will lead to productivity growth and urban environment enhancement, which can finally push up real estate prices through attracting more real estate demand from both companies and households.

**Fig. 2.** Average economic openness and per capita output of manufacturing and service industries: 1989–2007. Note: urban economic openness is calculated as the ratio of total trade volume over GDP in a city and is the dependent variable in this paper. Per capita labour output of manufacturing and service industry are separately calculated from the added value of one industry over the working population within that industry. All data are from the World Development Indicators (WDI) 2008.
economic openness will lead to higher equilibrium wage level of two sectors and the increased wage level can finally push up real estate prices through the cost effect.\textsuperscript{2} Though the two channels are independent, yet they provide two potential channels through which the urban economic openness impact on real estate market in China, given the unique fact that the Chinese market are not absolutely “open” or “closed” economy entities. We will do empirical analysis to evaluate whether there is significant impact from urban economic openness to real estate prices through these two channels and the importance of this new determinant against those traditional determinants.

3. Data and empirical study

This section will make an empirical analysis of the impacts of urban economic openness on real estate prices using the macroeconomic and real estate market data of 35 large cities in China. Panel data technique is employed to examine the relationship both cross urban areas and time span. Since all the data have consistent basis, the availability of explanatory variables has improved significantly and there are similar institutional arrangements among all these Chinese cities, this study can overcome most of the limitations in the study of Bardhan et al. (2004).

3.1. Data description

The data used in this study covers macro-economic indicators as well as real estate market variables in 35 major cities in China from 1998 to 2006.\textsuperscript{3} REP stands for real estate price level which is calculated according to Real Estate Price Index\textsuperscript{4} of 35 major cities published by the National Bureau of Statistics (NBoS) and the National Development and Reform Commission (NDRC).

\textsuperscript{2} Website of China Engineering Cost (www.ccost.com) is an official source of construction cost information in China. It is authorized by the Ministry of Housing and Urban-Rural Development of the People’s Republic of China and provides the updated information about material cost, labour cost, machinery cost, etc. We have checked different typical projects and found that the ratio of labour cost in the whole construction cost varies between 10\% and 20\%. In China, the whole construction cost takes up about 40\% of a real estate development (other cost include pre-development design and consultancy, land cost, tax, sale fee, non-expected cost, etc.). Most pre-development fee (2\%) and sale fee (4\%) are labour cost as well. So we make a simple calculation about the total labour cost as a percentage of development cost. 40\% × 10\% + 2\% + 4\% = 10\% as the lower limitation, while 40\% × 20\% + 2\% + 4\% = 14\% as the upper limitation.

\textsuperscript{3} We did not update our dataset to 2007 since the power of the estimation is enough and urban real estate prices were quite volatile in late 2007 due to the global financial crisis which can bring about more ‘noise’ into the model.

\textsuperscript{4} Real Estate Price Index is a weighted index on different property type which include 4 categories: residential housing (typical residential and luxurious residential), non-residential (office, retail and other type), old stock transaction (residential and retail) and public housing. Since the real selling prices are published in the second quarter of 2005, we calculate quarterly real estate prices which are averaged to annual real estate price level.
Other macroeconomic data includes: (1) total volume of imports and exports (Trade, US $100 million) from the China Custom Statistical Yearbook, which can reflect the international trade flow of each city approximately; (2) gross domestic product (GDP, million yuan); (3) per capita disposable income of residents (INC, yuan); (4) total urban registered population (POP, 10,000 people); (5) registered urban unemployment rate (UNEMPLOY); (6) urban land lease price index (LANDRENTS) which is also from Real Estate Price Index published by NBoS and NDRC; (7) population density in urban built area (POPDENSITY, person/km²) which is obtained by dividing residential population over urban built up areas; (8) real estate development cost (RECOST, yuan/m²) as calculated by dividing the value of total completed real estate units over the number of real estate units; (9) real estate stock (RESTOCK, 10,000 m²); and (10) urban economic openness (OPEN), which is calculated by dividing total volume of imports and exports as percentage of GDP. We use the annual exchange rate published in the China Finance Yearbook for conversion of currency. The national GDP deflator is used to adjust the nominal GDP to the real values, and the municipality CPI of each city is used to convert those related variables into real value. Unless otherwise specified, the above data are all from various editions of the China City Statistical Yearbook and China Statistical Yearbook. We scatter plot the cross-section average urban openness and real estate prices as show in Fig. 4.

Table 1 shows the descriptive statistics of the major variables. To save space, the data of year 1999, 2001, 2003 and 2005 are listed only.

3.2. Estimation and results

This paper builds a logarithmic panel data model to explain the dynamics of urban real estate prices as shown in Eq. (10). REP is the dependent variable. The independent variables are categorized into four parts. XD represents the independent variables that affecting real estate demand. XS represents the supply side determinants of real estate prices. As presented in the theoretical framework, OPEN variable in Eq. (10) represent the shock from the open economy and is the primary focus in our paper. We include into the model an autoregressive term since real estate price are always auto-correlated with order one.

\[
Y = \alpha_0 + \alpha X_D + \beta X_S + \gamma X_{OPEN} + \theta Y_{t-1}
\]

\[
\ln(REP_{it}) = \alpha_{0,i} + \alpha_1 \ln(INC_{it}) + \alpha_2 \ln(POP_{it}) + \alpha_3 \ln(UNEMPLOY_{it}) + \beta_1 \ln(LANDRENTS_{it}) + \beta_2 \ln(POPDENSITY_{it})
\]

\[
+ \beta_3 \ln(RECOST_{it}) + \beta_4 \ln(RESTOCK_{it}) + \theta_1 \ln(REP_{i,t-1}) + \gamma_1 \ln(OPEN_{it}) + \epsilon_{it}
\]

where, \(i = Beijing, Shanghai, Guangzhou, Shenzhen\), \(t = 1998, 1999, \ldots, 2006\).

5 First multiply the per capita housing building area of each city in 1998 by the total registered population of that city to obtain the building area stock in 1998 for each city, and then add the real estate completion area of each year to obtain an approximate real estate stock series of that city.
The results are shown in Table 3.

We calculated the instrumental variable data on trade volume of a city through a certain harbour from public data source, we could only use the ratio of total trade, which makes it the easier an urban economy is accessible to the international market. Thus we can regard the China Custom Statistical Yearbook, we separately obtain the trade volume through each customs and the share of trade. Secondly, based on data from Guangzhou. Since Ningbo and Shanghai is quite near to each other and Shanghai’s trade volume is much larger, we do not which are among the 35 large scale cities in our sample listed as Tianjin, Shanghai, Dalian, Qingdao, Ningbo, Fuzhou and Jiangmen, Zhanjiang and Lasa.

Following the real estate price determinants literature, we control the demand-side factors like the per capita disposable income (INC), total urban registered population (POP), registered urban unemployment rate (UNEMPLOY). Supply-side factors like the urban land rent index (LANDRENTS), population density in urban built area (PDPDENRTY), development cost (RESCOST) and real estate stock (RESTOCK) are also incorporated into the model.

Similar to the time-series model, if any unit root exists in the panel data, all statistical inference will fail, because the regression results are effective only when the panel data is stable or cointegrated. For this reason, the Kao test and Pedroni test methods provided by Evieus 6.0 are used in this section for panel data co-integration analysis. The null hypothesis is that there is no cointegrated relationship. The results are shown in Table A3 of Appendix A. It revealed that the Kao test and panel-ADF statistics within and between dimensions of Pedroni all reject the null hypothesis. We can conclude that there is one cointegration relationship among the variables used in Eq. (10). This indicates regression analysis can be carried out in this study.

Since the level of economic development (productivity), urban economic openness (amenity) and real estate prices (land rents) are simultaneously determined according to previous theoretical analysis, we need to deal with the endogeneity problem when identifying Eq. (10). In this paper, we construct instrumental variable OPENDIS, defined as the average distance to the major ports weighted by flow of goods each year through these ports, to solve the problem. Theoretically speaking, the shorter OPENDIS is, the easier an urban economy is accessible to the international market. Thus we can regard OPENDIS as a special type of urban amenity, economic distance to international market, as well.

In 1984, the Chinese central government opened fourteen coastal harbour cities to support the open-door policy, seven of which are among the 35 large scale cities in our sample listed as Tianjin, Shanghai, Dalian, Qingdao, Ningbo, Fuzhou and Guangzhou. Since Ningbo and Shanghai is quite near to each other and Shanghai’s trade volume is much larger, we do not include Ningbo as the major ports. We firstly calculated the distance of these 35 cities to each of the 6 major ports. We have measured both the straight line distance and the road distance with the help of ArcGIS software. Secondly, based on data from the China Custom Statistical Yearbook, we separately obtain the trade volume through each customs and the share of trade volume through the six harbour cities as shown in Table 2. The total volume of trade through these six harbours takes a share ranging from 44.56% to 47.82%, which indicates the appropriate selection of major ports in the study. Since there is no specific data on trade volume of a city through a certain harbour from public data source, we could only use the ratio of total trade volume shown in Table 2 as the weights of distance. We calculated the instrumental variable OPENDIS$_1$ and OPENDIS$_2$ using straight distance and road distance separately. Both variables are in the panel data form. From above procedure, it is clear that OPENDIS is certainly correlated with urban economic openness, but arguably uncorrelated with productivity of a city. The larger the OPENDIS variable is, the lower the urban economic openness of a city. There is thus inverse relationship between OPEN and OPENDIS.

The panel data regression model provided by Evieus is used to estimate the parameters in Eq. (10), and the Pool Generalized Least Square (PGLS) method is selected pursuant to cross-section weights. We assume fix-effect panel data model. The results are shown in Table 3.

### Table 1
Descriptive statistics of variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Unit</th>
<th>1999</th>
<th>2001</th>
<th>2003</th>
<th>2005</th>
</tr>
</thead>
<tbody>
<tr>
<td>REP</td>
<td>Real estate price</td>
<td>RMB</td>
<td>2072</td>
<td>874</td>
<td>2291</td>
<td>845</td>
</tr>
<tr>
<td>INC</td>
<td>Per capita disposable income</td>
<td>RMB</td>
<td>7244</td>
<td>2491</td>
<td>8613</td>
<td>3100</td>
</tr>
<tr>
<td>POP</td>
<td>Total urban registered population</td>
<td></td>
<td>10,000</td>
<td>320</td>
<td>265</td>
<td>348</td>
</tr>
<tr>
<td>UNEMPLOY</td>
<td>Registered urban unemployment rate</td>
<td>(rate)</td>
<td>2.66%</td>
<td>0.87%</td>
<td>3.33%</td>
<td>1.08%</td>
</tr>
<tr>
<td>LANDRENTS</td>
<td>Urban land lease price index</td>
<td>(rate)</td>
<td>102.9%</td>
<td>5.8</td>
<td>104.8%</td>
<td>12.5</td>
</tr>
<tr>
<td>PDPDENRTY</td>
<td>Population density in urban built area</td>
<td>person/km²</td>
<td>608</td>
<td>451</td>
<td>630</td>
<td>478</td>
</tr>
<tr>
<td>RESEOST</td>
<td>Real estate development cost</td>
<td>yuan/m²</td>
<td>1036</td>
<td>356</td>
<td>1043</td>
<td>301</td>
</tr>
<tr>
<td>RESTOCK</td>
<td>Real estate stock volume</td>
<td>10,000 m²</td>
<td>4480</td>
<td>3972</td>
<td>5138</td>
<td>4534</td>
</tr>
<tr>
<td>OPEN</td>
<td>Urban economic openness</td>
<td>(rate)</td>
<td>51.0%</td>
<td>71.3%</td>
<td>58.2%</td>
<td>85.0%</td>
</tr>
</tbody>
</table>

6 There are 41 city customs including 34 of major cities in our sample but Jinan. The other seven customs are Manzhouli, Gongbei, Shantou, Huangpu, Jiangmen, Zhanjiang and Lasa.
7 We do a test regression to examine the relationship between OPEN and OPENDIS. In a panel data model, we take OPEN as dependent variable and OPENDIS$_1$ and OPENDIS$_2$, as independent variable separately. The regressed coefficients are $-0.191$ and $-0.179$ respectively, and are both significant at 1% level. This result proves the inverse relationship between OPEN and OPENDIS.
8 It is a common method in the panel data estimation. It inferred the estimation technique used in the estimating process. Commonly, we use least square method. Generalized least square method is an enhanced method that is applicable even if there are various patterns of correlation between the residuals.
9 When imposing cross section weights in Pooled GLS estimation, Evieus will estimate a feasible GLS specification assuming the presence of cross-section heteroskedasticity.
There are six regression results in Table 3. The first three columns are results when incorporating OPENDIS1 as an instrumental variable while Models IV to VI are regression results with instrumental variable OPENDIS2. In Model I and Model IV, all demand and supply side explanatory variables are introduced, and it is found that population, population density and real estate construction cost variables are insignificant. Model II and Model V are derived by excluding above insignificant variables. The results reveal that population and its density as well as construction cost have not affected China’s urban real estate prices on a large extent. On the contrary, the impact of the land market is very significant. When the land rent rises, real estate prices will rise simultaneously. In addition, Model II and Model V also show that there is a positive correlation between urban real estate stock and real estate prices, which might indicate that China’s urban real estate market is still growing rapidly in general, and the existing stock has not substitute new real estate development as well as hinder the increase of real estate prices. Besides, disposable income and macroeconomic fundamental as reflected by unemployment rate are also statistically significant demand-side determinants of real estate prices.

### Table 2
Trade through major harbour as percentage of total cross border trade.

<table>
<thead>
<tr>
<th>Year</th>
<th>Tianjin</th>
<th>Shanghai</th>
<th>Dalian</th>
<th>Qingdao</th>
<th>Guangzhou</th>
<th>Fuzhou</th>
<th>Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>1998</td>
<td>6.90%</td>
<td>19.65%</td>
<td>4.71%</td>
<td>6.06%</td>
<td>6.26%</td>
<td>1.62%</td>
<td>45.18%</td>
</tr>
<tr>
<td>1999</td>
<td>6.88%</td>
<td>21.11%</td>
<td>4.33%</td>
<td>6.04%</td>
<td>6.31%</td>
<td>1.52%</td>
<td>46.20%</td>
</tr>
<tr>
<td>2000</td>
<td>6.28%</td>
<td>23.05%</td>
<td>4.61%</td>
<td>6.54%</td>
<td>5.79%</td>
<td>1.42%</td>
<td>47.69%</td>
</tr>
<tr>
<td>2001</td>
<td>6.34%</td>
<td>23.63%</td>
<td>4.25%</td>
<td>6.82%</td>
<td>5.40%</td>
<td>1.37%</td>
<td>47.82%</td>
</tr>
<tr>
<td>2002</td>
<td>5.87%</td>
<td>22.95%</td>
<td>3.89%</td>
<td>6.37%</td>
<td>5.37%</td>
<td>1.20%</td>
<td>45.66%</td>
</tr>
<tr>
<td>2003</td>
<td>5.42%</td>
<td>23.63%</td>
<td>3.72%</td>
<td>6.06%</td>
<td>4.71%</td>
<td>1.02%</td>
<td>44.56%</td>
</tr>
<tr>
<td>2004</td>
<td>5.87%</td>
<td>24.47%</td>
<td>3.46%</td>
<td>6.28%</td>
<td>4.32%</td>
<td>0.98%</td>
<td>45.38%</td>
</tr>
<tr>
<td>2005</td>
<td>5.75%</td>
<td>24.65%</td>
<td>3.39%</td>
<td>6.59%</td>
<td>4.00%</td>
<td>0.83%</td>
<td>45.21%</td>
</tr>
<tr>
<td>2006</td>
<td>5.78%</td>
<td>24.36%</td>
<td>3.15%</td>
<td>6.60%</td>
<td>3.93%</td>
<td>0.76%</td>
<td>44.58%</td>
</tr>
</tbody>
</table>

### Table 3
Results of parameters of urban real estate price model of Eq. (10).

<table>
<thead>
<tr>
<th>Independent variables</th>
<th>Instrumental variable: OPENDIS1</th>
<th>Instrumental variable: OPENDIS2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>I</td>
<td>II</td>
</tr>
<tr>
<td>Constant</td>
<td>2.107*</td>
<td>0.890</td>
</tr>
<tr>
<td>Ln(INC)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>(1.817)</td>
<td>(1.073)</td>
</tr>
<tr>
<td>Ln(POP)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>0.311***</td>
<td>0.389***</td>
</tr>
<tr>
<td>Ln(LANDRENT)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>(3.404)</td>
<td>(4.936)</td>
</tr>
<tr>
<td>Ln(POP DENSITY)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>0.016</td>
<td>–</td>
</tr>
<tr>
<td>Ln(RECOST)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>−0.071**</td>
<td>−0.118**</td>
</tr>
<tr>
<td>Ln(OPEN)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>(−2.333)</td>
<td>(−4.230)</td>
</tr>
<tr>
<td>Ln(RESTOCK)&lt;i&gt;&lt;i&gt;t&lt;/i&gt;&lt;/i&gt;</td>
<td>0.186**</td>
<td>0.179**</td>
</tr>
<tr>
<td>Ln(RESTOCK&lt;sub&gt;&lt;i&gt;t-1&lt;/i&gt;&lt;/sub&gt;)</td>
<td>(2.360)</td>
<td>(2.563)</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-1&lt;/i&gt;&lt;/sub&gt;)</td>
<td>−0.036</td>
<td>–</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-2&lt;/i&gt;&lt;/sub&gt;)</td>
<td>(−0.656)</td>
<td>–</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-3&lt;/i&gt;&lt;/sub&gt;)</td>
<td>0.062</td>
<td>–</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-4&lt;/i&gt;&lt;/sub&gt;)</td>
<td>0.234**</td>
<td>0.312**</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-5&lt;/i&gt;&lt;/sub&gt;)</td>
<td>(2.087)</td>
<td>(3.231)</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-6&lt;/i&gt;&lt;/sub&gt;)</td>
<td>0.593**</td>
<td>0.593**</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-7&lt;/i&gt;&lt;/sub&gt;)</td>
<td>(7.589)</td>
<td>(7.589)</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-8&lt;/i&gt;&lt;/sub&gt;)</td>
<td>0.464***</td>
<td>0.431***</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-9&lt;/i&gt;&lt;/sub&gt;)</td>
<td>(3.517)</td>
<td>(3.696)</td>
</tr>
<tr>
<td>Ln(REPi,t&lt;sub&gt;&lt;i&gt;-10&lt;/i&gt;&lt;/sub&gt;)</td>
<td>0.929</td>
<td>0.934</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.929</td>
<td>0.934</td>
</tr>
<tr>
<td>D.W. statistic</td>
<td>1.429</td>
<td>1.231</td>
</tr>
<tr>
<td>F statistic</td>
<td>103.63***</td>
<td>116.00***</td>
</tr>
</tbody>
</table>

Note: the figures in brackets are t-test values of different variables; those marked with * are significant at the confidence level of 10%; those marked with ** are significant at the confidence level of 5%; and those marked with *** are significant at the confidence level of 1%.
It is inferred from the D.W. statistics of Models II and V that the annual real estate prices should have first-order autocorrelation, so we further incorporate a 1 year lagged real estate prices into the independent variables and obtain the final results of Models III and VI. The first-order autocorrelation coefficients are 0.593 and 0.575 respectively, which suggest strong positive correlation between real estate prices of consecutive years. The other variables remain statistically significant and with expected signs.

Through Models I to VI, regressed coefficients of urban economic openness are always significant and positive. These results testify our research hypothesis that if a city is economically more ‘open’, reflected in higher level of urban economic openness, or shorter distance to the international market, we would expect a larger positive real estate price premium. From Models III and VI, we find that significant impact from urban economic openness (instrumented by variables OPENDIS1 and OPENDIS2) on real estate prices and the regressed coefficient are 0.262 and 0.301 respectively. Both estimated coefficients are statistically significant at the 10% level. Thus, we use the average regressed coefficient 0.282 \[\left(=\frac{0.262+0.301}{2}\right)\] as the elasticity of real estate price with respect to urban economic openness.

According to our results, from 1998 to 2006, the average level of urban economic openness of the 35 major Chinese cities rose from 49.8% to 76.0%. It drives the real estate prices of these cities up by 14.78% \[\left(=0.282\times52.51\right)\] on average, and accounts for 15.90% of the average real estate price appreciation (92.97%) during the same period, suggesting a rather influential impact from urban economic openness on real estate prices.

4. Concluding remarks

This paper is the first paper, as far as we know, to propose a detailed quality of life and Balassa-Samuelson channels in explaining real estate price dynamics through urban economic openness, the ratio between international trade and GDP. Theoretical analysis suggests that both channels will bring about positive shocks to real estate prices if urban economic openness has a positive increase. Such analysis contributes to open the black box of regional property price disparity. While China’s economic development in recent years is boosted by international trade, this paper also takes this special opportunity to empirically analyze the impact of urban economic openness on real estate prices of 35 major Chinese cities, during a period of transitional economy.

This paper finds a statistically significant positive correlation between urban economic openness and urban real estate prices. The research indicates that economically more ‘open’ cities, or cities have shorter economic distance to the international market, have higher level of real estate price premium. The elasticity of real estate prices with respect to urban economic openness is estimated to be 0.282, which affects the long-term equilibrium and short-term dynamics of real estate price greatly. Specifically, for every 1% of positive variation in urban economic openness, urban real estate prices will be up about 0.282%. Urban economic openness growth has led to about 15.90% appreciation of real estate prices from 1998 to 2006 which is an influential marginal contribution.

The findings of this paper nurture the strand of literature on real estate prices determinants in the open economy scenario as well as the quality of life literature. Firstly, this research reveals that the real estate price dynamics is the result of a combined impact from demand–supply factors of the real estate market, urban factors as well as openness shock. Only when the real estate prices are investigated from the perspectives of international economics, urban economics and real estate economics can the mechanism of real estate price formulation be better understood in the globalized economic development today. The findings of this paper shed light on dynamics of real estate prices subject to international trade shocks. The large elasticity of real estate price to urban economic openness suggests that with the fast economic growth of developing countries, the real estate price will probably keep on growing while the economy is continuously integrated with the international market.

Secondly, this research also implies that urban economic openness could be deemed as productive and consumption amenity for a country or a city. Economically ‘open’ countries or cities are a new type of urban amenity that could be capitalized into the real estate prices through local productivity enhancement and amenity improvement. Although we did not compare these two sub-channels, the theoretical analysis has laid foundation for more specific analysis in the future.

Acknowledgements

The authors are grateful to the National Natural Science Foundation of China for providing financial support to the research. An earlier version of this paper was presented separately at the 13th and 15th Asian Real Estate Society Annual Conference in Shanghai (2008) and Kaoshing (2010). The authors would also like to acknowledge the suggestions made by Dr. Xiaochong Sun from School of Economic Management of Tsinghua University, Professor K.W. Chau, and Assistant Professor S.K. Wong from the University of Hong Kong, Associated Professor Charles K.Y. Leung from the City University of Hong Kong. Any remaining errors are the authors’ sole responsibility.

---

10 D.W. statistics will be around 2 when there is no serial correlation in the residual. Such autocorrelation in real estate prices may be triggered by the expected real estate price, the construction period and the time lag in real estate transaction.
Appendix A

Table A1
Granger causality test of productivity and wages of the manufacturing industry.

<table>
<thead>
<tr>
<th>Assumption</th>
<th>First-order lag</th>
<th>Second-order lag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Labour productivity does not Granger causes wages</td>
<td>0.0691*</td>
<td>0.0980*</td>
</tr>
<tr>
<td>of the manufacturing industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages of the manufacturing industry does not Granger</td>
<td>0.8377</td>
<td>0.4994</td>
</tr>
<tr>
<td>cause labour productivity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: the figures in the table are P-values of the Granger causality test, and those marked with * are significant at 10% level. Two series are both extracted from World Development Index 2008.

Table A2
Granger causality test of wages of manufacturing and real estate sectors.

<table>
<thead>
<tr>
<th>Assumption</th>
<th>First-order lag</th>
<th>Second-order lag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wage of the manufacturing industry dose not Granger causes</td>
<td>0.0581*</td>
<td>0.0233**</td>
</tr>
<tr>
<td>wage of the real estate industry</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wages of the real estate industry does not Granger cause</td>
<td>0.5308</td>
<td>0.1484</td>
</tr>
<tr>
<td>wage of the manufacturing industry</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: the figures in the table are P-values of the Granger causality test, those marked with * are significant at 10% level, and those marked with ** are significant at 5% level. Two wage series are both extracted from China Statistic Yearbook.

Fig. A1. Geographical location of 35 major Chinese cities.
### Table A3
Kao test and Pedroni test results of urban house price panel data model.

<table>
<thead>
<tr>
<th>Test method</th>
<th>Test statistic</th>
<th>AIC lag order</th>
<th>Statistical value</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kao test</td>
<td>ADF statistic of panel data</td>
<td>4</td>
<td>-4.830</td>
<td>0.000</td>
</tr>
<tr>
<td>Pedroni test</td>
<td>V statistic of panel data</td>
<td>2</td>
<td>4.33E + 15</td>
<td>0.000</td>
</tr>
<tr>
<td>(Trend and intercept)</td>
<td>rho statistic of panel data</td>
<td>2</td>
<td>10.515</td>
<td>1.000</td>
</tr>
<tr>
<td>(In-group statistic)</td>
<td>PP statistic of panel data</td>
<td>2</td>
<td>-16.410</td>
<td>0.000</td>
</tr>
<tr>
<td>Pedroni test</td>
<td>ADF statistic of panel data</td>
<td>2</td>
<td>-12.549</td>
<td>0.000</td>
</tr>
<tr>
<td>(Trend and intercept)</td>
<td>PP statistic of panel data</td>
<td>2</td>
<td>-42.398</td>
<td>0.000</td>
</tr>
<tr>
<td>(In-group statistic)</td>
<td>ADF statistic of panel data</td>
<td>2</td>
<td>-14.918</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Note: the null hypothesis of Kao test and Pedroni test is that there is no cointegration in the variables. Kao and Pedroni tests give eight statistics and among which six reject the null hypothesis. Thus, we believe there is at least one cointegration relationship among the variables in Eq. (10).

### References


