



Empirical study of the local government deficit, land finance and real estate markets in China [☆]



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ABSTRACT

The purpose of this study is to explore an important issue concerning the relationship among the local government deficit, land finance and real estate markets in China. This study uses a panel data of 30 provinces in China during 1999–2010 to estimate the panel smooth transition regression model. Since the estimated transition threshold value is 14.62, provinces with the ratio of fiscal deficits to GDP of greater than 14.62% are categorized as in the high fiscal difficulty (HFD) regime. Otherwise they are in the low fiscal difficulty (LFD) regime. The primary finding of this study is that the land leasing fee has a significantly positive influence on the total value of commodity buildings sold in the LFD regime. In addition, the local fiscal deficit has a significantly positive impact on the real estate market in the LFD regime, but this impact turns to be negative in the HFD regime.

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1. Introduction

With the rapid economic growth, China has attracted many foreign investors into the real estate market, and real estate has become the most popular industry (Jiang, Chen, & Isaac, 1998; Fung, Huang, Liu, & Shen, 2006). In fact, China's real estate development has become one of the major factors promoting economic growth in the country. Unlike the mature real estate markets in most western countries, the real estate market is an outcome of urban land reform in China.¹ Over the past decade, the transaction of real estate

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¹ Since the housing market reform from 1998 to 1999, commodity housing has come to China's property market, replacing and mainstreaming state-provided housing.

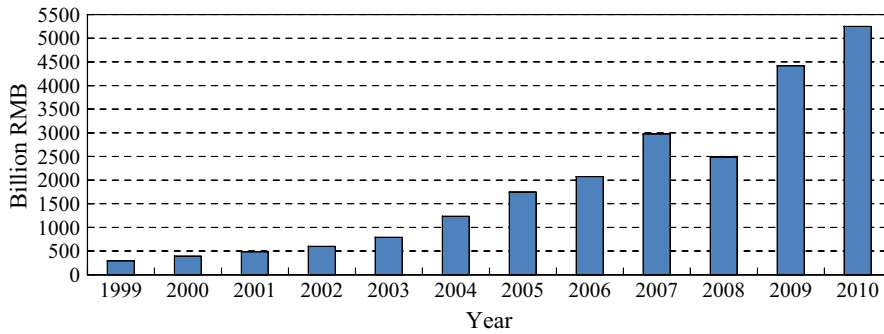


Fig. 1. The total value of commodity building sold in China, 1999–2010 (billion RMB).
Data source: CEIC China Premium Database.

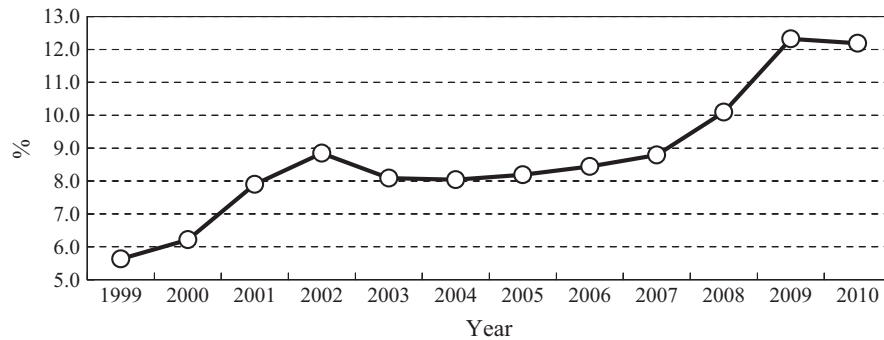


Fig. 2. The ratio of local deficits to GDP in China.
Data source: CEIC China Premium Database.

in China increased rapidly, and the growth in housing prices has outpaced the growth in income,² thereby exacerbating the affordability problem proposed by [Fung, Jeng, and Liu \(2010\)](#),³ inequality and low consumption as suggested by [Yan and Zhu \(2013\)](#), potential local government debt crisis indicated by [Fan and Lv \(2012\)](#), and lack of entrepreneurship pointed out by [Li and Wu \(2014\)](#).

According to the above description, a high housing price is the signal of an over-booming real estate market. Observing the total value of commodity buildings sold is a simple way to understand the situation of real estate markets. [Fig. 1](#) illustrates that the total value of commodity buildings sold increased from 300 billion RMB in 1999 to 5.2 trillion RMB in 2010, except that real estate market downturn due to a tightening policy of the real estate market implemented in 2008. This implies that China's real estate market will grow very fast if there are no interventions from the central government.

The overwhelming development of real estate markets, causing a high housing price, due to that real estate is a special type of asset that represents a dual role of consumption and investing goods ([Glindro, Subhanij, Szeto, & Zhu, 2011](#)). Therefore, the demand for real estate, particularly a house, increases over time once China's economic growth remains at a high level. This increasing demand for real estate provides local governments a chance to mitigate their fiscal deficits by selling the land-use right, the most important input of real estate output. This strategy is often referred to as land finance. More precisely speaking, land finance usually refers to the practice of some local governments who sustain their fiscal expenditure by selling the land-use right. Land finance suddenly becomes a panacea for local governments to cure their severe illness of fiscal deficits. The severe situation of the local government fiscal deficit is shown in [Fig. 2](#). [Fig. 2](#) shows the ratio of local fiscal deficits to GDP of China from 1999 to 2010. This ratio was greater than 8% in 2008, then showed a U-shaped pattern, and further reached a highest value in 2009 during this period. It is found that the problem of fiscal deficits has been very serious since the recent years.

After the land-use right is transferred, local governments can receive revenue of the land leasing fee from real estate developers. The land finance strategy can stimulate real estate markets, further pushing up the house price ([Cao, Feng, & Tao, 2008](#); [Fang & Zi, 2012](#); [Lu & Liu, 2012](#)). In order to finance more and more budget deficits, local governments put lots of efforts to supply land to real estate markets. According to [Cao et al. \(2008\)](#), land finance has existed for many years, meaning that local governments play a leading role in the process of "acquiring land, leasing land, imposing taxes, mortgage and then acquiring land again," and local

² Almost all studies found that China's real estate price can be pushed up by different factors, such as economic growth, acceleration of urbanization, commodity housing reform, high saving rate, limited investment vehicle, and speculative investment demand ([Ahuja, Cheung, Han, Porter, & Zhang, 2010](#)).

³ According to [Fung et al. \(2010\)](#), the ratio of housing price to household income went up from 9.79 in 1997 to 11 in 2006, suggesting that residents were actually becoming less able to afford housing.

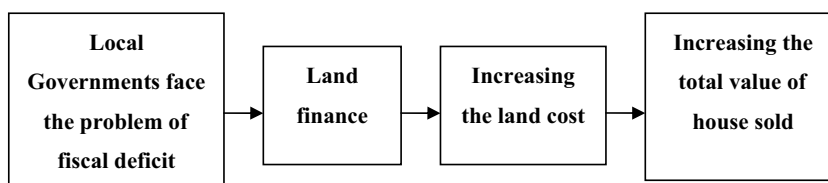


Fig. 3. The Relationship among local governments, land finance and real estate markets in China.

governments, developers and banks are the largest beneficiaries. Therefore, in the last decade, the value of the land transfers had increased rapidly and its contribution to the local governments' revenue increased as well. The official data shows that land transfers generated 1.5 trillion RMB (approximately 220 billion USD) for local governments nationwide in 2009, accounting for 46% of their overall fiscal revenue, up from 35% in 2001. As indicated by Tsao (2012), this contribution reaches 80% of fiscal revenue in some cities. Accompanied by large demand for real estate, land finance might increase the transaction of real estate. As shown in Fig. 3, to cope with the problem of fiscal deficits, local governments adopt the land finance strategy to increase the land leasing fee, further causing an increase in land cost. Finally, the total value of commodity buildings sold will increase as well.

This study further calculates each province's average ratio of fiscal deficits to GDP, average ratio of the total value of commodity buildings sold to GDP, and average ratio of the total value of the land leasing fee to GDP during 1999–2010, and simply uses the average of average ratio of fiscal deficits to GDP over 30 regions (equal to 8.73%) as a criterion to categorize 30 regions into the low fiscal difficulty (LFD) and the high fiscal difficulty (HFD) group.⁴ Each region's average ratio of the total value of commodity buildings sold to GDP and average ratio of the total value of the land leasing fee to GDP during 1999–2010 are plotted in either Fig. 4A for LFD or Fig. 4B for HFD. From Fig. 4A and B, it can be found that the relationship between these two variables in two diagrams seems to be different. This study further adopts the correlation coefficient to test the null hypothesis that the correlation between these two variables is indifferent in the HFD group and in the LFD group. The estimated correlation coefficient in the HFD group and in the LFD group is 0.56 and 0.29, respectively. In addition, this study uses Fisher r -to- z transformation proposed by Cohen and Cohen (1983) to calculate a z -score equal to 3.06, further rejecting the null hypothesis statistically. This hypothesis testing result means that the impact of local governments' land finance strategy on the total value of houses sold in the LFD group is different from that in the HFD group. However, the correlation coefficient test does not consider other factors that might affect the ratio of the total value of commodity buildings sold to GDP.

Since there are rare empirical literatures using provincial-level panel data to investigate the impact of land finance on real estate markets in China, the primary purpose of this study is to use 30 provincial-level panel data from 1999 to 2010 to examine the impact of local governments' land finance strategy on the value of commodity buildings sold. This study further explores an issue regarding the potentially different impacts of land finance on real estate markets in samples with different levels of fiscal deficits. In order to examine these issues, this study will adopt an empirical model that can divide a sample into at least two regimes to test the hypothesis of different impacts of land finance on real estate markets in regions with different levels of fiscal deficits.⁵

This study is organized as follows. Section 2 provides an overview of the land finance in China, including the retrospective of land finance and the process of land allocation in China. Section 3 introduces an empirical model for analyzing the impact of local governments' land finance strategy on the total value of commodity buildings sold under different levels of fiscal deficits. In Section 4, the estimation results of the empirical model are analyzed and some specification tests are applied to examine the correctness of the empirical model, followed by conclusions in Section 5.

2. The retrospective of land finance in China

China's public land leasing was initially conducted by Shenzhen City of Guangdong Province in the late 1980s. Almost all leased lands used for industrial, residential and commercial purposes have to go through the public land leasing process. The maximum leasehold period is 70 years for residential housing, 50 years for industrial use and 40 years for commercial housing (Cao et al., 2008; Wu, Gyourko, & Deng, 2010). The process of land allocation is conducted through an auction system that works as follows: a local government is in charge of the land and decides which lands will be available to be distributed to developers either through negotiation, tender or auction where the highest bidder obtains the award of the contract.⁶ Therefore, a local government leases lands to developers who build houses on lands, then sell these houses to private individuals.

In the 1990s and early 2000s, a lot of lands used for commercial and residential purposes were also leased out by negotiations between local governments and developers. However, the channel of land leasing has largely changed since 2003. Tender or auction for

⁴ For regions with average ratio of fiscal deficits to GDP greater than 8.73%, they are categorized as high fiscal difficulty (HFD) regions, such as Inner Mongolia, Jilin, Heilongjiang, Guangxi, Hainan, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, and Xinjiang. Otherwise, they are categorized as low fiscal difficulty (LFD) regions, such as Beijing, Tianjin, Hebei, Shanxi, Liaoning, Shanghai, Jiangsu, Zhejiang, Anhui, Fujian, Jiangxi, Shandong, Henan, Hubei, Hunan, Guangdong, and Chongqing. A more accurate criterion will be estimated in the empirical model.

⁵ Frankly speaking, it is hard to establish a causal relationship between government deficits and housing price because there are many confounding factors, and there lacks exogenous shocks. The authors thank a reviewer who pointed this out.

⁶ Land leasing through negotiation is the least transparent approach, whereas with land leasing by tender or by auction, at least two competing land users must be introduced (Cao et al., 2008).

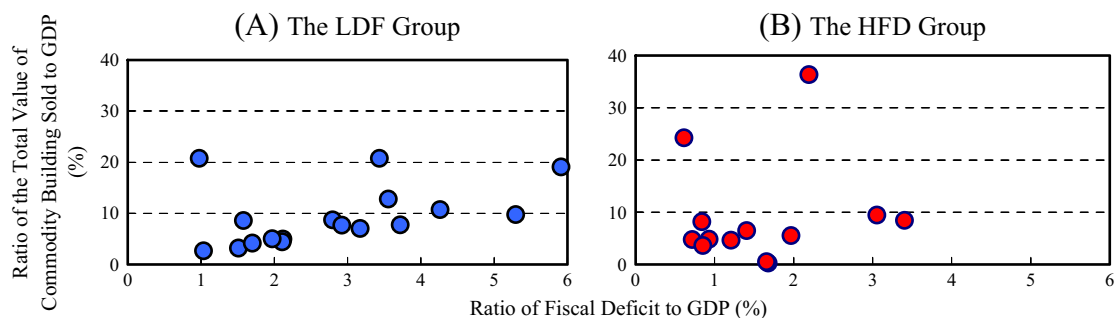


Fig. 4. The relationship between the average of ratio of total value of land leasing fee to GDP and the average of ratio of total value of commodity buildings sold to GDP in China (1999–2010).

Data source: CEIC China Premium Database.

commercial and residential purposes is now a common way for local governments to lease lands. Under the current system of land management, rural collectives can't make a private transfer of their land-use rights for nonagricultural use. Local governments have a nearly monopolistic power in the supply of land for commercial and residential use and use the monopolistic power to extract as much land revenue as possible from public land leasing.⁷

Cao et al. (2008), Tan et al. (2011) and Tsao (2012) mentioned that all of the revenue from land leasing goes to local governments' extra-budgets and that local governments have a complete control in this matter. Therefore, local governments should have a very strong incentive to lease lands out in a more competitive way so that more extra-budgetary revenue can be generated. However, offering cheap lands to attract more manufacturing investment can cause a loss of extra-budgetary revenue on the one hand, but can lead to a gain in local budgetary revenue on the other hand through value-added tax levied on manufacturing.

Table 1 illustrates the local government land leasing from 1987 to 2010. It also shows that the land leasing revenue increases very fast. In 1987, the land leasing revenue was only 0.35 billion RMB and increased to 27.1 trillion RMB in 2010. In addition, land leasing revenue as a share of local government fiscal revenue increases from 0.02% in 1987 to 66.73% in 2010. The figures in Table 1 demonstrate that land leasing activities have increased dramatically since the late 1990s, and the land finance strategy has also become the most important strategy of local governments to collect more fiscal revenue since then.

3. Methodology

Earlier analysis indicates that both land leasing activities and the total value of commodity buildings sold have increased dramatically since the late 1990s and that impacts of land finance on real estate markets might be different in samples with different levels of fiscal deficits. Therefore, this study has to adopt a proper empirical model to investigate the impact of local governments' land finance strategy on the value of commodity buildings sold and the potentially different impacts in samples with different levels of fiscal deficits.

Panel data analysis has recently been advanced and applied to many empirical studies, and the characteristic of panel data is combined time series and cross-sectional data.⁸ Therefore, this study also adopts 30 provincial-level panel data from 1999 to 2010 in China and panel data analysis. However, Hsiao (2007) pointed out that panel data could have a more complicated clustering or hierarchical structure, and structural break problems might have occurred. This study adopts the panel smooth transition regression (PSTR) model developed by González, Teräsvirta, and Dijk (2005). Since the PSTR model is in the spirit of the panel threshold regression (PTR) model developed by Hansen (1999), both models have essentially the same features and could divide the observations into a small number of homogenous regimes with different coefficients in different regimes, but allow the regression coefficients to change gradually when moving from one regime to another. In addition, as indicated by González et al. (2005), the PSTR model is better than the PTR model because the former could avoid the problem of estimation bias due to the neglect of parameter heterogeneity in the panel model. The estimating result of the PSTR model can identify the number of extreme regimes in this study. Therefore, the PSTR model is suitable to examine primary issues of this study that the China local government's land finance strategy could influence the total value of commodity buildings sold differently in different levels of fiscal deficits.

3.1. Panel smooth transition regression

According to González et al. (2005), the PSTR model could completely catch the heterogeneity in the data by individual effect and time effect. This model may be considered as a linear heterogeneous panel model with coefficients that vary across individuals and over time. Heterogeneity in regression coefficients is allowed by assuming that these coefficients are continuous functions of an

⁷ Many local governments at the city or the county level have set up "Municipal Land Management and Reserve Centers". They limit land supply for commercial and residential purposes and lease the land lots by auction or tender at higher prices (Cao et al., 2008; Tan et al., 2011).

⁸ Hsiao (1986) pointed out that panel data not only owns dynamic characteristic of time-series data but also has cross-section data in order to express different properties between samples. In addition, panel data analysis can observe the dynamic variation which cross-section data cannot.

Table 1

Local government land leasing (1987–2010).

Unit: RMB billion.

Source: Tsao (2012), pp. 129–30.

Year	Land leasing revenue	Local government fiscal revenue	Land leasing revenue as a share of local government fiscal revenue (%)
1987	0.35	1463.06	0.02
1988	4.16	1582.48	0.26
1989	4.47	1842.38	0.24
1990	12.54	1944.68	0.64
1991	101.87	2211.23	4.61
1992	500.00	2503.86	19.97
1993	511.16	3391.44	15.07
1994	649.70	2311.60	28.11
1995	388.06	2985.58	13.00
1996	349.00	37,463.92	9.30
1997	428.35	4424.22	9.68
1998	499.56	4983.95	10.02
1999	304.69	5594.87	5.45
2000	699.08	6406.06	10.91
2001	1655.29	7803.30	21.21
2002	2416.79	8515.00	28.38
2003	5421.31	9849.98	55.04
2004	6412.18	11,893.37	53.91
2005	5883.82	15,100.76	38.96
2006	8077.64	18,303.58	44.13
2007	12,216.72	23,572.62	51.83
2008	9736.96	28,649.79	33.99
2009	15,910.20	32,602.59	48.80
2010	27,100.00	40,613.04	66.73

observable variable through a bounded function of this variable, called the transition function, and fluctuate between a limited numbers of “extreme regimes”. As the transition variable is individual-specific and time-varying, regression coefficients for each of the individuals in the panel change over time.

The basic PSTR model with two extreme regimes is defined as follows:

$$y_{it} = \mu_i + \beta'_0 x_{it} + \beta'_1 x_{it} g(q_{it}; \gamma, c) + u_{it} \quad (1)$$

where $i = 1, \dots, N$, is the individual entity, $t = 1, \dots, T$, is time, y_{it} is a scalar, x_{it} is a k -dimensional vector of time-varying exogenous variables, μ_i represents the fixed individual effect, u_{it} is an error term, and $g(q_{it}; \gamma, c)$ is a continuous transition function. Among these, q_{it} is a transition variable and is normalized to be bounded between 0 and 1, γ is a transition speed, and c is a transition threshold value.

Granger and Terasvirta (1993), Terasvirta (1994) and Jansen and Terasvirta (1996) defined the transition function as follows:

$$g(q_{it}; \gamma, c) = \left(1 + \exp \left(-\gamma \prod_{j=1}^m (q_{it} - c_j) \right) \right)^{-1} \quad \text{with } \gamma > 0 \text{ and } c_1 \leq c_2 \leq \dots \leq c_m \quad (2)$$

where $c = (c_1, \dots, c_m)'$ is an m -dimensional vector of location parameters and the slope parameter γ determines the smoothness of the transitions. The restrictions $\gamma > 0$ and $c_1 \leq c_2 \leq \dots \leq c_m$ are imposed for identification purposes. In practice it is usually sufficient to consider $m = 1$ and $m = 2$, as these values allow for commonly encountered types of variation in the parameters. For $m = 1$, the type of transition function is logistic, and $m = 2$ means that the transition function is exponential.

A generalization of the PSTR model to allow for more than two different regimes is the additive model as follows:

$$y_{it} = \mu_i + \beta'_0 x_{it} + \sum_{j=1}^r \beta'_j x_{it} g_j(q_{it}^{(j)}; \gamma_j, c_j) + u_{it} \quad (3)$$

where the transition functions are $g_j(q_{it}^{(j)}; \gamma_j, c_j)$ and $j = 1, \dots, r$. Consequently, the additive PSTR model can be viewed as a generalization of the multiple regime PTR model in Hansen (1999).

3.2. Data and descriptions of variables

In order to explore the relationship between government deficit, land finance and real estate markets, this study calculates these primary variables: the ratio of fiscal deficits to GDP (*DEFICIT*), the ratio of the total value of the land leasing fee to GDP (*LEASING*), and

the ratio of the total value of commodity buildings sold to GDP (*HOUSING*), for each province in each year by using data from China Statistical Year Book (1999–2010).⁹ However, the China Land and Resources Year Book (1999–2010) and CEIC China Premium Database are also needed to supplement some related variables if necessary. Due to data limitations, the research period covered in the study is limited to the years from 1999 to 2010. The data set used in this study is a panel data of 30 provinces in China during the period of 1999–2010.¹⁰

According to literature regarding determinants of the total value of houses sold, *HOUSING* is defined as a function of *DEFICIT*, the ratio of FDI to GDP (*FDI*), the ratio of the fixed asset investment to GDP (*FAI*), the ratio of the total value of net export to GDP (*NETEX*), consumer purchasing index (*CPI*), the ratio of local commercial banks' balance of loans to GDP (*LOAN*), urban population density (*URBANPOP*), and *LEASING*. Meanwhile, the variable *LEASING* is lagged one year to avoid any potential endogeneity problem between the total value of commodity buildings sold and land leasing fee.¹¹ *DEFICIT* is used as the threshold variable in this model to examine the different impacts of each explanatory variable on *HOUSING* in different regimes of the deficit/GDP ratio. Therefore, the empirical model adopted in this study can be presented as follows:

$$\begin{aligned} HOUSING_{it} = & \mu_i + \beta_0 DEFICIT_{it} + \beta_1 FDI_{it} + \beta_2 GDP_{it} + \beta_3 FAI_{it} + \beta_4 NETEX_{it} \\ & + \beta_5 CPI_{it} + \beta_6 LOAN_{it} + \beta_7 URBANPOP_{it} + \beta_8 LEASING_{it-1} \\ & + \sum_{j=1}^r \left[\beta_{0j} DEFICIT_{it} + \beta_{1j} FDI_{it} + \beta_{2j} GDP_{it} + \beta_{3j} FAI_{it} + \beta_{4j} NETEX_{it} \right. \\ & \left. + \beta_{5j} CPI_{it} + \beta_{6j} LOAN_{it} + \beta_{7j} URBANPOP_{it} + \beta_{8j} LEASING_{it-1} \right] \times g_j(q_{it}^j; \gamma_j, c_j) + u_{it}. \end{aligned} \quad (4)$$

The main purpose of this study is to analyze the different impacts of *LEASING* on *HOUSING* in different regimes of the deficit/GDP ratio; this study assumes that the local government will increase the land leasing (*LEASING*) to solve the problem of its fiscal deficit. It is thus expected that an increase in the land leasing fee will cause an increase in the total value of houses sold. In addition, this study also expected that the government's land finance strategy could influence *HOUSING* in different levels of fiscal deficits based on the observation and hypothesis testing result from Fig. 4.

In addition, following Wang, Yang, and Liu (2011), openness is another important determinant of the total value of houses sold, and therefore net export (*NETEX*) and foreign direct investment (*FDI*) are considered in the empirical model to examine the impact of openness on *HOUSING*. It is expected that as the level of openness increases, the demand for real estate will increase as well, and further will increase *HOUSING*.

Regarding the economic performance, it will also affect *HOUSING*. The real GDP per capita (*GDP*) and consumer purchasing index (*CPI*) are adopted to examine whether *HOUSING* will be affected by the economic performance. In addition, the public expenditure is also a factor to affect *HOUSING*. The fixed asset investment (*FAI*) is employed to explain why the local government invests more in the infrastructure, how it will affect the demand for housing, and further how will it affect the total value of commodity buildings sold.

As highlighted by Herring and Wachter (1999), Hilbers, Lei, and Zacho (2001), Chen (2001) and Gerlach and Peng (2005), the linkage between property and bank lending is particularly remarkable. Therefore, this study adopts the ratio of local commercial banks' balance of loans to GDP (*LOAN*) to analyze the impact of the balance of loan on the total value of houses sold. This study expects that as the balance of loan increases, people can get more mortgages from banks, further increasing the demand for housing, and finally the total value of houses sold will increase as well. Regarding demand-side factors of house selling, this study assumes that urban population density (*URBANPOP*) will have a positive influence on the demand for housing as well as the total value of houses sold.

Finally, the definitions, descriptive statistics, and expected signs of all variables are listed and described in Table 2.

4. Estimation results

Since the characteristic of panel data is combined time series and cross-sectional data, it is necessary to test whether or not all panel variables have a unit root. After taking first a difference on variables with a unit root, a linearity test and other tests for model specification are conducted. Finally the PSTR model established in this study will be estimated and the estimation results will be analyzed.

4.1. Panel unit root test

Following González et al. (2005), the panel smooth transition model requires that the variables in the model should be stationary in order to avoid spurious regression as the PSTR model is estimated. The panel unit root test for the panel data proposed by Levin, Lin,

⁹ This study uses a composite price statistic of commodity building, including commercial and residential.

¹⁰ Tibet is excluded in the empirical model due to incomplete data.

¹¹ The authors deeply appreciate a reviewer's suggestion in this regard. A loop of causality between the independent and dependent variables of a model leads to endogeneity, and it would arise as a result of measurement error and autoregression with autocorrelated errors. Following Greene (2007), this study uses the lagged land leasing fee to prevent the potential endogeneity problem. In addition, according to "The Law of the People's Republic of China on Administration of the Urban Real Estate," developers must pay the land leasing fee in accordance with the stipulations of the grant contract to obtain the land-use right certificate. Therefore, this study's estimates from the acquisition of land use rights to housing sales at least need to be more than one year, so the assumption of the lagged land leasing fee is reasonable.

Table 2

Descriptive statistics and definitions of variables.

Sources: China Statistical Year Book (1999–2010), China Land and Resources Year Book (1999–2010) and CEIC China Premium Database.

Variables	Definitions	Mean (S.D.)	Min (Max.)	Expected sign
<i>HOUSING</i>	Ratio of total value of commodity buildings sold to GDP (%)	8.57 (8.95)	0.01 (56.70)	
<i>DEFICIT</i>	Ratio of fiscal deficits to GDP (%)	8.73 (6.57)	0.84 (46.89)	+
<i>FDI</i>	Ratio of FDI to GDP (%)	2.75 (2.54)	0.07 (11.40)	+
<i>GDP</i>	Real GDP per capita (RMB)	15,651.54 (11,878.22)	2545.0 (64,415.8)	+
<i>FAI</i>	Ratio of fixed asset investment to GDP (%)	47.54 (15.47)	24.19 (93.40)	+
<i>NETEX</i>	Ratio of total value of net export to GDP (%)	1.14 (8.15)	–29.82 (30.29)	+
<i>CPI</i>	Growth rate of consumer purchasing index (%)	9.24 (3.88)	–13.90 (28.00)	+
<i>LOAN</i>	Ratio of local commercial banks' balance of loans to GDP (%)	1.03 (0.35)	0.07 (2.25)	+
<i>URBANPOP</i>	Urban population density (people per km ²)	1851.26 (1358.98)	25.0 (6307.0)	+
<i>LEASING</i>	Ratio of total value of land leasing fee to GDP (%)	2.29 (2.71)	0.002 (28.86)	+

and Chu (2002), Im, Pesaran, and Shin (2003) and Maddala and Shaowen (1999) is employed, and the results are shown in Table 3. Table 3 indicates that the null hypothesis of the existence of a unit root for all variables is rejected, implying that all variables used in this study are stationary.

4.2. Linearity test

There are two main problems of specification in a threshold model: the choice of the threshold variable and the determination of the number of regimes. Following González et al. (2005) and Fouquau, Hurlin, and Rabaud (2008), this study adopts a three-step procedure for estimating the final PSTR model. First, this study tests the linearity against the PSTR model. If the null hypothesis of linearity is rejected, then the test of determining the type of transition function being either logistic or exponential is conducted. Finally, this study determines the number of transition functions. As explained by Fouquau et al. (2008), the transition function $g(q_{it}; \gamma, c)$ is replaced by its first-order Taylor expansion around $\gamma = 0$ to test its linearity in the PSTR model.

If the linearity of the transition function is rejected, a sequential approach is used to test the null hypothesis of no remaining non-linearity in it. The first step is to test the log-linear specification of the model. If the model is linear, there are three test statistics that can be used for this investigation: Lagrange multiplier test, Fisher test, and likelihood ratio test. The results of these linearity tests and specification tests of no remaining nonlinearity are reported in part A in Table 4. As explained by Fouquau et al. (2008), the threshold variable may have a direct effect on the dependant variable. In this case, these three test statistics prove that the model is non-linear, and it is suitable to use the PSTR model in this study.

Table 3

Panel unit root test.

Sources: China Statistical Year Book (1999–2010), China Land and Resources Year Book (1999–2010) and CEIC China Premium Database.

Variables	Levin et al. (2002)	Im et al. (2003)	Maddala and Wu (1999)
<i>HOUSING</i> (%)	–16.275***	–11.972***	347.214***
<i>DEFICIT</i> (%)	–12.096***	–7.496***	154.249***
<i>FDI</i> (%)	–6.202***	–2.544***	107.919***
<i>GDP</i> (RMB)	–12.081***	–10.085***	297.369***
<i>FAI</i> (%)	–9.434***	–4.606***	145.912***
<i>NETEX</i> (%)	–3.520***	–1.721**	80.987*
<i>CPI</i> (%)	–8.835***	–6.013***	140.134***
<i>LOAN</i> (%)	–4.644***	–1.512*	70.594*
<i>URBANPOP</i> (people per km ²)	–17.274***	–10.437***	273.938***
<i>LEASING</i> (%)	–19.892***	–12.990***	399.793***

*** 1% significance level.

** 5% significance level.

* 10% significance level.

Table 4

Tests for model specification.

Sources: China Statistical Year Book (1999–2010), China Land and Resources Year Book (1999–2010) and CEIC China Premium Database.

	Test statistic	P-value
A. Tests for linearity^a		
Wald test (LM)	97.527***	<0.0001
Fisher test (LMF)	4.170***	<0.0001
LRT test (LRT)	113.745***	<0.0001
B. Tests for choosing the PSTR model^{b,c}		
$H_{03}^* : B_3 = 0$	0.249	1.000
$H_{02}^* : B_2 = 0 B_3 = 0$	1.649**	0.025
$H_{01}^* : B_1 = 0 B_2 = B_3 = 0$	2.083***	0.002
C. Tests of no remaining heterogeneity and number of regimes^d		
Wald test (LM)	16.110*	0.065
Fisher test (LMF)	1.577	0.121
LRT test (LRT)	16.482*	0.057

^a H_0 : linear model, H_1 : the PSTR model has at least one threshold variable ($r = 1$).^b $B_i = [\beta_i^*] B_i = [\eta_i^*, \varphi_i^*, \lambda_i^*]', i = 1, 2, 3$.^c According to Granger and Terasvirta (1993) and Terasvirta (1994), we select $m = 2$ if the rejection of H_2 is the strongest one, otherwise select $m = 1$.^d The testing procedure works as follows. First, test a linear model ($r = 0$) against a model with one threshold ($r = 1$). If the null hypothesis is rejected, test the single threshold model against a double threshold model ($r = 2$). The procedure goes on until the hypothesis no additional threshold is not rejected.

4.3. Other model tests

Part B in Table 4 shows the examined results for choosing the PSTR model with $m = 1$ or $m = 2$. According to the results in Table 5, the null hypothesis $H_{02}^* : B_2 = 0 | B_3 = 0$ can be rejected at the 5% significant level but not the strongest one, suggesting that the model is the PSTR model with $m = 1$. The homogeneity test can be used for determining the appropriate order m of the logistic transition function. Part C in Table 4 also gives information about the optimal number of transition functions. The null hypothesis of $r = 2$ is

Table 5

Estimation results for the final PSTR models.

Sources: China Statistical Year Book (1999–2010), China Land and Resources Year Book (1999–2010) and CEIC China Premium Database.

Variables	Definitions	LFD regime: Ratio of fiscal deficits to GDP (%) $\leq 14.62\%$	HFD regime: Ratio of fiscal deficits to GDP (%) $> 14.62\%$
$DEFICIT_{it}$	Ratio of fiscal deficits to GDP (%)	0.4578*** (3.5654)	-0.5754** (-1.9721)
FDI_{it}	Ratio of FDI to GDP (%)	0.0611 (0.5924)	0.5969 (0.5988)
GDP_{it}	Real GDP per capita (RMB)	0.0002*** (5.0163)	0.0012*** (2.8203)
FAI_{it}	Ratio of fixed asset investment to GDP (%)	0.0454** (2.1711)	-0.1342 (-1.1244)
$NETEX_{it}$	Ratio of total value of net export to GDP (%)	0.0532 (0.8174)	-0.1144 (-0.6196)
CPI_{it}	Growth rate of consumer purchasing index (%)	0.0432 (0.8474)	-0.3148 (-1.1329)
$LOAN_{it}$	Ratio of local commercial banks' balance of loans to GDP (%)	3.0435** (2.4481)	6.7995 (1.1604)
$URBANPOP_{it}$	Urban population density (people per km ²)	-0.0001* (-0.8318)	0.0003 (0.3397)
$LEASING_{it}$	Ratio of total value of land leasing fee to GDP (%)	0.2508** (2.0650)	0.3719 (0.4922)
Observations		360	
Location parameter, c		14.62	
Slope parameter, γ		14.26	
SSR		3519.70	
AIC		2.45	
SIC		2.67	

Notes: 1. The standard errors are corrected for heteroskedasticity.

2. t -Values are in parentheses.

*** 1% significance level.

** 5% significance level.

* 10% significance level.

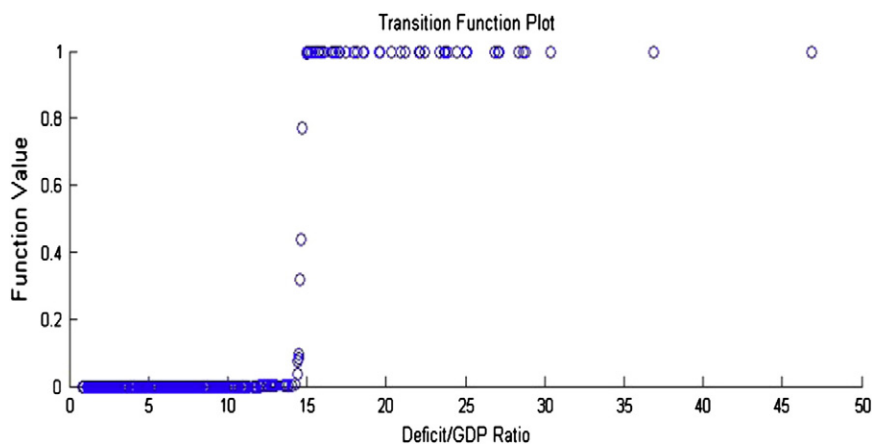


Fig. 5. Transition function plot.

Sources: China Statistical Year Book (1999–2010), China Land and Resources Year Book (1999–2010), and CEIC China Premium Database.

not rejected at the 1% significance level for $m = 1$. The specification tests of no remaining nonlinearity lead to the identification of two extreme regimes ($r = 1$).¹² Therefore, there is only one threshold, meaning two regimes, in the PSTR model.

The estimated slope parameter γ is 14.26. Therefore, this study defines the low fiscal difficulty (LFD) regime as the province's ratio of fiscal deficits to GDP $\leq 14.62\%$ and the high fiscal difficulty (HFD) regime as the province's ratio of fiscal deficits to GDP $> 14.62\%$. Since the estimated slope parameter γ is quite large, it implies that a continuum of conditions between two regimes—that is, the transition from one regime to another, is abrupt as shown in Fig. 5,¹³ meaning that the local governments are sensitive to fiscal deficit and their fiscal behaviors, and the total value of commodity buildings sold will be very different in the LFD and HFD regions.¹⁴

4.4. Estimation results

Prior to the analysis of estimation results, it is also necessary to solve the econometric problem of collinearity between two explanatory variables, if any. This study adopts the pair-wise correlation coefficients to deal with this issue. It is shown that none of the pair-wise correlation coefficients are greater than 0.8, and thus concluding that there is no collinearity between any of two explanatory variables. This result also implies that the conclusions provided by this study are reliable in this regard.

The estimation results of Eq. (4), the PSTR with instrumental variable models, for the entire samples are presented in Table 5. As shown in Table 5, the government deficit has a statistically significant and positive impact on the total value of commodity buildings sold in the LFD regions,¹⁵ implying that the total value of commodity buildings sold will increase as the government deficit increases. However, this positive impact turns to be statistically negative in the HFD regions. This study provides two reasons for this result: First, in order to get more fiscal revenue to mitigate the difficulty of fiscal deficits, a local government with more fiscal deficits tends to relax more regulations concerning the real estate market, further increasing the total value of commodity buildings sold. Second, according to Pan, Han, and Chen (2012), the supply of indemnificatory housing financed by local governments' budget will crowd out the demand of commodity housing in some west provinces,¹⁶ such as Gansu, Qinghai, Ningxia and Xinjiang, which are categorized as HFD regions in this study, and will further reduce the total value of commodity buildings sold. Therefore, the empirical result regarding the different effects of the government deficit on the total value of commodity buildings sold in the different levels of fiscal deficits is reasonable.

In addition, this study finds that the land leasing fee has a statistically significant and positive influence on the total value of commodity buildings sold in the LFD regime, but this impact becomes statistically insignificant in the HFD regime. In fact, the land finance strategy is an easy and effective way for local governments to collect more fiscal revenue. Therefore, for those local governments in the

¹² In the estimation of the PSTR model, we could decide the number of regimes from the test of no remaining heterogeneity. The testing procedure works as follows. First, test a linear model ($r = 0$) against a model with one threshold ($r = 1$). If the null hypothesis is rejected, test the single threshold model against a double threshold model ($r = 2$). The procedure goes on until the hypothesis no additional threshold is not rejected. This study rejects the null hypothesis of the linear model, and could not reject the null hypothesis of the single threshold model; therefore, there is only one threshold (two regimes) in our PSTR model.

¹³ The estimated slope parameter γ in the PSTR model measures the speed of transition from one regime to another. In fact, the PSTR model with a smooth transition function can be interpreted as a model which allows a "continuum" of regimes. This "continuum" of regimes is clearly required when measuring the threshold effect of the fiscal deficit as a share of GDP. This is the reason why we care about transition between different regimes and why we need to know whether the transition is smooth or not.

¹⁴ However, a small value for γ is indicative of a very slow and much smooth adjustment from one regime to another. It means that the change between fiscal deficits and total value of commodity buildings sold is quite slow and smooth.

¹⁵ Since both dependent and independent variables use GDP as a denominator, therefore, this study simply explains the empirical result without using ratios for both variables, hereafter.

¹⁶ Indemnificatory housing, which includes low-rent housing, affordable housing, price-fixed housing and public rental housing, is an important part of the housing supply system which has played a significant role in solving the housing problems of low-income urban families.

LFD regime, they tend to use the land finance strategy to solve the problem of fiscal difficulty and further to cause an increase in the total value of commodity buildings sold. However, for those local governments in the HFD regime, the land finance strategy is not able to statistically affect the total value of commodity buildings sold because their leasing lands are not primarily used to construct commodity buildings but used in other ways, such as scientific parks as mentioned by Tsao (2012),¹⁷ to collect more fiscal revenue, and further mitigate their fiscal deficit.

Furthermore, there is a statistically significant and positive impact of GDP per capita on the ratio of the total value of houses sold to GDP in both regimes, which is consistent with Zheng and Kahn (2008) and Ding, Zheng, and Guo (2010), suggesting that as real income rises, the ratio of the total value of commodity buildings sold to GDP will increase as well. The results also show that the government fixed asset investment has a statistically significant and positive impact on the total value of commodity buildings sold in the LFD regions. This result is consistent with our expectation that the local government investing more in the infrastructure will stimulate the demand of housing, and therefore increases the total value of houses sold. Finally, the local commercial banks' balance of loans has a statistically significant and positive impact on the total value of houses sold in the LFD regions. This result supports the hypothesis proposed by this study that as the balance of loan increases, meaning that people can get more mortgages from banks, it will increase the demand for houses and the total value of commodity buildings sold will increase as well.

5. Concluding remarks

In order to explore the relationship between government deficit, land finance and real estate markets, this study calculates three primarily variables: the ratio of the local fiscal deficit to GDP, the ratio of the land leasing fee to GDP, and the ratio of the total value of commodity buildings sold to GDP for each province in each year, by using China Statistical Year Book (1999–2010), China Land and Resources Year Book (1999–2010) and CEIC China Premium Database to supplement some related variables. Due to data limitations, this study uses a panel data of 30 out of 31 provinces in China from 1999 to 2010. The primary finding of this study is that the land leasing fee has a statistically significant and positive influence on the total value of commodity buildings sold in the LFD regime, but this impact is not statistically significant in the HFD regime. In addition, the impact of the local fiscal deficit on the total value of commodity buildings sold is statistically significant and positive in the LFD regime, but turns to be negative in the HFD regime.

As a matter of fact, an over-booming real estate market might cause inequality, low consumption as suggested by Yan and Zhu (2013), potential local government debt crisis indicated by Fan and Lv (2012), and lack of entrepreneurship pointed out by Li and Wu (2014). Therefore, how to prevent the real estate markets from over-booming is a crucial issue that the Chinese central government has to cope with.

Since China implemented the tax-sharing system in 1994, the fiscal relationship between central and local governments has continued adjusting since then. The proportion of the fiscal rights of local governments gradually declines, meaning that less tax items belong to local governments, and thus less fiscal revenue is collected by local governments. Under these circumstances, the most popular and efficient way for local governments to collect more fiscal revenue is the land finance strategy. According to our empirical results, if the Chinese central government attempts to cool down the real estate market, in addition to macro-control policies, setting restrictions on the policies of land financing adopted by local governments, especially for those in the LFD regime, is another way to fulfill the central government's goal.

In addition, this study also finds that for those in the LFD regime, as their fiscal deficit is getting higher, their total value of commodity buildings sold will be higher as well. If the Chinese central government does not favor a booming real estate market appearing mostly in the LFD regions, such as Shanghai, Beijing, and other coastal provinces, a consideration of the fiscal redistribution between the central-level and local-level governments, especially for those in the LFD regime, is needed. For those provinces in the LFD regime, once they obtain more fiscal revenue through the fiscal redistribution mechanism, they can lower their fiscal deficit, and further cool down their real estate markets.

Moreover, reducing both the fixed asset investment and the local commercial banks' balance of loans can be other alternatives for the Chinese central government to mitigate the over-booming real estate market. According to estimation results, both the fixed asset investment and the local commercial banks' balance of loans can have a statistically significant and positive influence on the real estate market in the LFD regions. This study thus suggests that the Chinese central government should prevent provinces in the LFD regime from over-investment and reduce the local commercial banks' balance of loans in LFD regions. Doing so can also cool down their real estate market effectively.

The Chinese central government plans to have a balanced tax sharing between central-level and local-level governments in "The Twelfth Five-Year Plan". It is expected that this policy will make local governments rely less on their land finance, and further cool down the overwhelming real estate market based upon the primary finding in this study. However, some additional fiscal policies to restrict speculative transactions and profitability should be included in government regulations because they could reduce real estate market volatility and might be able to make long-term sustainable economic and social development in China possible. All these issues will be left as future researches.

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¹⁷ Tsao (2012) indicated that local governments' land finance strategies include releasing the land for industrial use, such as scientific parks and industrial parks to get more fiscal revenue.

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