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Publisher: Routledge

Informa Ltd Registered in England and Wales Registered Number: 1072954 Registered office: Mortimer House, 37-41 Mortimer Street, London W1T 3JH, UK



Urban Policy and Research

Publication details, including instructions for authors and subscription information:

<http://www.tandfonline.com/loi/cupr20>

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Published online: 15 Aug 2012.

To cite this article: Christian Dreger & Yanqun Zhang (2013) Is there a Bubble in the Chinese Housing Market?, Urban Policy and Research, 31:1, 27-39, DOI: [10.1080/08111146.2012.711248](https://doi.org/10.1080/08111146.2012.711248)

To link to this article: <http://dx.doi.org/10.1080/08111146.2012.711248>

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Is there a Bubble in the Chinese Housing Market?

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(Received 2 November 2011; accepted 28 June 2012)

ABSTRACT *For many analysts, the Chinese economy is being spurred on by a bubble in the housing market, probably driven by the fiscal stimulus package and massive credit expansion, with potentially adverse effects on the real economy. The house price development is investigated by panel cointegration techniques. Evidence is based on a data-set for 35 major cities. Cointegration is detected between real house prices and a set of macroeconomic determinants. The results indicate that the bubble is less than 15 per cent of the equilibrium value implied by the fundamentals at the end of 2010. The bubble is particularly huge in the cities in the south-east coastal areas and special economic zones. While the spillovers from real house prices to consumer price index (CPI) inflation are significant at the margin, gross domestic product (GDP) growth may not be heavily affected. Thus, a decline of the bubble will likely have only modest effects on the real economy.*

许多分析家认为中国经济的动力来自房地产市场泡沫、经济刺激计划和信用贷款的膨胀,这些或对实体经济造成不利影响。本文利用板面协整技术和35个大中城市的数据,考察房价变化,以便了解泡沫的规模。我们在实际房价和一组宏观经济决定因素之间发现了协整,说明泡沫已表现出平均数复归行为。研究结果显示,2009年底,泡沫是基本面所示平衡值的百分之二十五。东南沿海和经济特区城市泡沫尤为严重。尽管实际房价溢出严重导致CPI通胀,但对GDP增长影响不大。因此,泡沫缩小对实体经济只会产生微弱影响。

KEY WORDS: Chinese economy, panel cointegration, house price bubbles

1. Introduction

For many observers, the Chinese economy is being spurred on by a bubble in the real estate market, probably driven by the fiscal stimulus package and massive credit expansion. For example, the stock of loans has increased by more than 50 per cent since the end of 2008.

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The government urged banks to increase lending to mitigate the economic slowdown (Nicolas, 2009). Home mortgage loans have played a significant role in the development, as they account for one-third of the total lending activities. Currently, house prices are at all time highs, and have been increasing at high rates especially over recent years (Wu *et al.*, 2010). Banks have provided easy credit for housing development, probably without sufficient evaluation of risks. State-owned enterprises may have stimulated the development, as they have access to low-cost capital and may believe they are too big to fail.

To slow down the development, the People's Bank of China has increased the nominal interest rate. Recently, the government has intervened and implemented measures to combat record prices. Down-payment requirements for second homes have been raised extensively. In some cities, house owners are restricted in further house purchases, and selling of apartments to non-residents has been forbidden. Many state-run mortgage lenders have started to cut mortgage discounts. Additional measures are planned, for example, higher taxes on property. As a result, housing prices in the first-tier cities stopped rising further, but are still at record levels.

The housing issue is not only a problem from an economic perspective, but also an issue of the people's livelihood that can affect social stability (Sato, 2006). Households with an average income feel that they cannot afford to buy a house. Ratios of house prices to average annual income exceed 18 in Beijing (Wu *et al.*, 2010). The government's challenge is to scrap speculative inflows, whilst not killing an engine potentially stimulating growth. However, while accelerating house prices may indicate the presence of a bubble, its existence is still controversial. In fact, urbanisation trends, rising incomes and low interest rates could have triggered the evolution. Higher house prices may be still broadly in line with the fundamental factors and could be still supported by solid demand for residential housing (World Bank, 2010).

The bursting of a house price bubble can endanger the stability of the real economy. For example, Helbling & Terrones (2003) have pointed out that house price busts are associated with output losses twice as large as equity bubbles (see also Goodhart & Hofmann, 2008). A slump in real estate prices might be more harmful than a stock market crash because real estate is the more important collateral underlying bank loans and house ownership is more widespread across the population. Shocks might transmit through a number of channels, including credit crunches and lower construction activities.

Because of the low leverage, the risk with respect to people not being able to fund their mortgage commitment might not be very high. A similar argument should hold for the risk that private households reduce their consumption spending in response to a decrease in wealth.¹ However, housing investment is an important pillar for economic growth, even in the long run (Liu *et al.*, 2002). Its share of gross domestic product (GDP) is 10 per cent, much more than in the industrialised economies. Chen & Zhu (2008) have concluded from their analysis that an increase in housing investment of 1 per cent will cause a rise in GDP of 0.2 per cent. Due to the ongoing integration of China into the world economy, a bubble might also have an international dimension. If a decline in house prices contributes to lower housing investment and output growth, negative spillovers to other countries could occur. According to many analysts, the apparent house price bubble is one of the major risks for a sound evolution of the global economy.

In this article, the house price development is investigated both at the national and regional level. The contribution is twofold. First, it is investigated whether a bubble exists.

The point of departure is a long-run equilibrium between real house prices and demographic and macroeconomic conditions. Using a regional data-set for 35 major cities, the size of the bubble is estimated relative to the fundamental level implied by the panel cointegrating relationship. Second, the impact of real house prices on consumer price index (CPI) inflation and GDP growth is investigated at the national level using an in-sample and out-of-sample framework.

The results indicate the presence of a house price bubble. At the end of 2010, real house prices were 10 per cent above their equilibrium value. However, heterogeneities are striking across the country. The bubble is especially pronounced in the cities of the south-east coastal areas and the special economic zones. While the impact of real house prices on CPI inflation seems to be significant at the margin, GDP growth may not be heavily affected. Real house prices do not cause GDP growth, and point forecasts of GDP growth are not substantially improved if the house price evolution is taken into account. These findings might reflect a limited exposure of private households' expenditure to housing wealth. The household saving rate is high and the down-payment requirement is quite stringent. Therefore, a decline of the bubble could have only modest effects on the course of the real economy.

The article is organised as follows. The next section (Section 2) reviews major changes in the Chinese housing and land market. Methods to detect bubbles and econometric issues are discussed in Section 3. Data and empirical results are presented in Section 4. Finally, Section 5 concludes.

2. The Chinese Housing and Land Market

Prior to China's housing reform, virtually no private housing existed in urban areas. All housing was owned by the state and allocated to urban dwellers by the government or state-controlled work units at very low rent. Due to lack of investment in residential property, housing conditions in the cities remained very poor. For example, the living space of urban dwellers was about four square metres per capita in the late 1970s.

Since the early 1990s, housing policies switched from the state allocation system to a market-oriented one. A series of reforms have been implemented, which have significantly reduced the role of the state as provider of housing and allowed for the emergence of a private housing sector. As a first measure, state-controlled apartments have been sold to tenants at lower-than-market price. Since then, the government has consistently promoted investment and purchases in the real estate market. Over the last decade, housing investment has grown at annual rates of 20 per cent. Housing has become the most important private property for the urban Chinese (Wang, 2003). Living conditions have improved steadily: the urban housing space per capita increased to 24 square metres. In 2009, investment in the real estate sector accounted for 16 per cent of China's total investment.

The state is still the ultimate owner of urban lands. Local governments, as the representative of central government, are empowered to allocate lands to different users. By controlling both land supply and the overall planning of land development for the city, local governments can decide what can be built in their jurisdictions, subject to state regulation (Cai *et al.*, 2009). Initially, land transactions were conducted with the price being either negotiated between the buyer and seller, or set by the local government. The land transaction price has been often lower than the market one, creating rent for

corruption. Since 2004, all transactions in urban lands have been carried out through public auction or bidding to prevent rent seeking. The successful bidder would obtain a long-term leasing contract for specified use.

Individuals are permitted to purchase urban land-use rights for up to 70 years for residential, 50 years for industrial and 40 years for commercial use (Wu *et al.*, 2010). Under this long-term contract, the land price is believed to reflect developments in the housing sector with some delay. For example, Du *et al.*, (2011) have reported Granger causality running from land to house prices, but not vice versa. According to Peng & Thibodeau (2009), residential property prices do not have an impact on land prices after 2004 (see also Zheng & Kahn, 2008). In recent years however, with soaring land prices and rapid commercialisation of the housing market, land auctions have become a major source of revenue for local governments. In Beijing, the land auction revenue currently accounts for 46 per cent of the total revenue of the municipal government.

The rapid urbanisation and the ongoing trend for smaller families have created strong housing demand. Since 1990, the number of city dwellers in Beijing has increased from 10.8 to 17.6 million, while the household size decreased from 3.2 to 1.7. The newly registered married increased by 54 per cent since 2007 (*Beijing Statistical Yearbook*). For many Chinese, especially for young couples, renting an apartment is not very popular. The regulation system does not give tenants much protection. For example, renters will lose their apartments if the homeowner decides on a different use. The preference to own a house has considerably driven up the demand in the housing market. Due to high economic growth, millions of Chinese join the middle class each year, thereby contributing to high housing demand. Because of high saving rates, many households are able to buy a house with cash and are rather independent of mortgage loans. In addition, the uneven regional development has enhanced the housing demand in the first-tier cities, as there are better living conditions, more job opportunities, and better social and public resources.

As a social housing provision system for low-income families has not been fully established yet, housing affordability therefore becomes not only an economic issue, but also an issue of social stability (Deng *et al.*, 2009; Zenou, 2010). One condition for having access to social housing is that at least one household member must have a local permanent non-agricultural *hukou* registration for longer than five years. This regulation is intended to control migration from rural areas. By allowing for temporary migration, *hukou* registration has created a group of urban residents with restricted rights. Excluded from the urban housing system, many of the rural migrants reside in the *urban villages* that are not integrated in the city administration.

3. Bubbles in Housing Markets

An asset price bubble is a price acceleration that cannot be explained in terms of the underlying fundamental conditions (Flood & Hodrick, 1990; Case & Shiller, 2003). The most important non-fundamental element driving price increases is the belief that prices will continue to rise (Shiller, 2005). Therefore, prices are high just because the market participants expect that they can sell the asset at a higher price in the future, that is, the evolution is affected by psychological components. Many houses were bought by wealthy families and individuals as investments rather than as their family homes. Houses were bought and kept empty to wait for price increases. Furthermore, the development in other asset markets might act as a trigger. The Chinese stock market index has fallen by almost

40 per cent since the end of 2007. Expected stock market losses and low real interest rates pushed people to invest more money on buying houses during recent years.

The bubble might show a high degree of persistence, as agents will not change their expectations frequently. They are uncertain with respect to the time when the market changes its perception. Nonetheless, the price evolution cannot deviate infinitely from the path defined by the macroeconomic fundamentals. A burst of a bubble might have huge negative impacts on the real economy.

Between 2001 and 2004, house prices increased by 25 per cent or more in almost every major city in China (Deng *et al.*, 2009). Prices continued to rise rapidly from 2004 to 2007 (Ye & Wu, 2008). The most recent development has been triggered by the fiscal stimulus programme launched at the end of 2008 in response to the financial crisis (Cova *et al.*, 2010).

There are some indications that the market might have overheated after 2008. In some cities, house buyers are picked up by the seller through lottery. The rapid rise nourishes exuberant expectations and speculation. Some real estate developers have started hoarding of houses by delaying their sales hoping for bigger profits when prices rise further. Due to higher price expectations, families are stretching to pay prices at the edge of their means or beyond. The speculation in the housing market might have further stimulated an already existing housing boom.

The bubble is a temporary phenomenon. It could not last forever and should show mean reverting behaviour. Hence, a cointegrating relationship between real house prices and the fundamental determinants is implied. Deviations from the equilibrium might be interpreted as an indication of a house price bubble. Fundamental factors can be either derived from the present value or structural models. The present value model ties house prices to a stream of earnings associated with housing property. In a frictionless market, the value of houses should be equal to the present value of future housing service flows that are provided to the marginal buyer (Campbell & Shiller, 1987). The latter is approximated by the rental value of the house. If the user costs of housing exceed the market rent, it would be less expensive to rent than to buy. Thus, demand to buy should fall, thereby reducing house prices. As rents are a fundamental determinant of the value of housing, they should not move too far away from prices, that is, the price rent ratio should show evidence of mean reversion. This condition is rejected in Chinese cities (see Figure 1).

While there might be indications of a slowdown or stabilisation in the huge cities like Beijing and Shanghai, the measure displays still trending behaviour in other cities, like Tianjin and Wuhan. This could reflect a bubble in house prices, but might be also explained in terms of the social and institutional environment, as renting is not very popular in China. Hence, the steep increase in the price rent ratio might not necessarily reflect speculative elements.

Structural models are based on the demand and supply side of the housing market. For example, Capozza *et al.*, (2002) and Gallin (2006) have advocated models to derive the stationarity of the price income ratio. This measure has increased tremendously, especially in Beijing, Shanghai, Shenzhen and Hangzhou (Wu *et al.*, 2010). The average price to actual per capita income of urban residents is slightly below 10, that is, almost twice as high as in the UK and 50 per cent above the Australian level. Nonetheless, economic growth in China is much higher than the rates achieved in developed countries. Moreover, non-stationary behaviour of the indicator does not inevitably imply the presence of a bubble. The structural parameters will generally depend on the elasticities governing

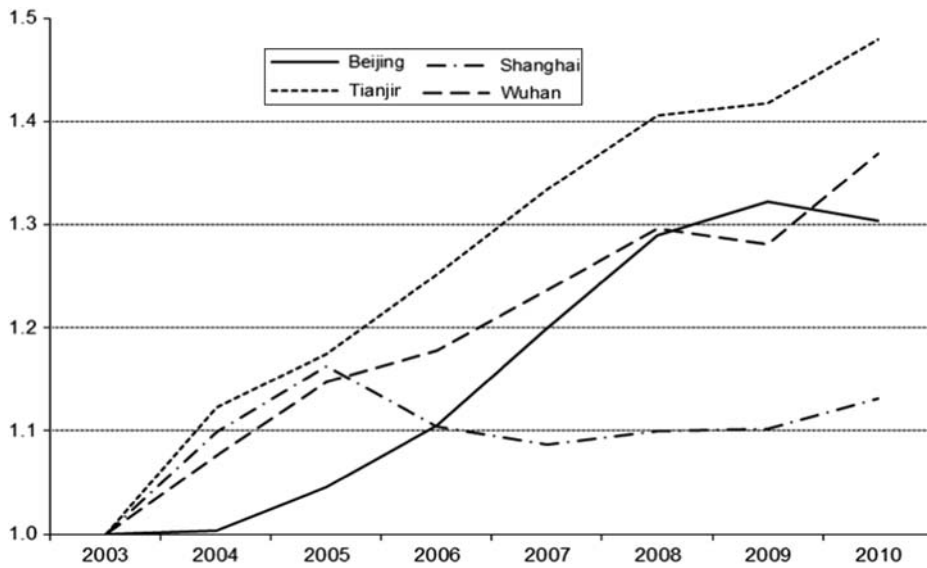


Figure 1. House price rent ratios in selected Chinese cities. *Note:* Ratio between nominal house prices and nominal rents, both obtained as an index. The figures are normalised (2003 = 1).

housing demand and supply. It is also assumed that income is the only non-stationary driver of house prices. As relevant demographic and macroeconomic determinants such as population, land prices and real interest rates might be integrated as well, the analysis should be extended by these measures.

Panel cointegration techniques are used to test for a long-run relationship between real house prices and a set of fundamental factors. This idea is based on the assumption that the actual house price evolution cannot deviate infinitely from the fundamental path. Therefore, a cointegration relationship should be detected. However, as the true fundamental model is unknown, different subsets of variables need to be considered, and the model with the most convincing cointegration evidence is selected. The panel includes information for 35 major Chinese cities over the 1998–2010 period. Because of the short time span, residual based cointegration tests are preferred, with real house prices as the left-hand side variable. On this route, however, two major problems need to be addressed. First, the tests often have low power because of an invalid common factor restriction (see Kremers *et al.*, 1992). In particular, the long-run parameters of the level variables should be equal to the short-run parameters of the differenced variables. To solve this problem, Westerlund (2007) has proposed four panel cointegration tests for the null of no cointegration that do not impose the common factor restriction. The tests are based on the residuals obtained from individual error correction models. The two panel statistics investigate the alternative that the panel is cointegrated as a whole, while the two group mean statistics check the alternative that cointegration holds at least for one cross-section unit. All tests are one sided, that is, large negative values imply that the null hypothesis should be rejected.

Second, the panel cointegration tests often rely on the assumption of independent panel members. In the presence of cross-section dependencies, large size distortions can occur

(Banerjee *et al.*, 2004). The statistics fail to achieve the normal distribution under the null. To solve the problem, Im *et al.*, (2003) have suggested to work with cross-sectionally demeaned data instead of the original series. However, this approach is valid only in the special case where shocks have the same impact on all Chinese cities. In order to circumvent size distortions, critical values are constructed using bootstrap methods; see Chang (2004) and Westerlund (2007) for details on this procedure.

Note that the panel cointegration tests do not uncover the long-run parameters. In the analysis presented below, the cointegration vector is assumed to be identical for all cities, as fundamental economic principles are involved. In fact, there is only little theoretical rationale for a wide dispersion of the cointegration parameters as the panel members are quite homogeneous. Therefore, after testing for cointegration, the pooled mean group estimator suggested by Pesaran *et al.*, (1999) is applied to reveal the common cointegration vector. It restricts the long-run coefficients to be identical across the panel members, but allows short-run coefficients and error variances to vary across cities.

In principle, deviations from the equilibrium might indicate the presence of speculative elements in the house price evolution. However, many analysts have argued that a bubble has emerged only in recent years, probably spurred on by the fiscal stimulus package (Wu *et al.*, 2010). Thus, the evidence can be misleading if the cointegration parameters are estimated to capture even the house prices at the end of the sample. As a consequence, the size of the bubble is likely biased downwards. Thus, the long run is estimated only up to some point in time. Then, the house price evolution is predicted over the rest of the sample, assuming perfect foresight with respect to the fundamentals. This approach reveals the fundamental development of house prices. It is compared to the actual development to address the size of the bubble.

The short-run implications of a house price bubble for GDP growth and CPI inflation are investigated at the national scale. The evidence is based on different methods to extract robust conclusions. In-sample results are provided by a Granger causality analysis. It is extended by an out-of-sample exercise, where the information content of real house prices is explored.

4. Data and Empirical Results

To investigate the existence of a bubble in the housing market, the evidence is built on panel data for 35 major cities in China. Annual data are available for the 1998–2010 period. Besides the panel data, quarterly series are available at the national level. The national data are used to examine the short-run consequences of a bubble decline. The relatively short time span arises from the fact that there was no real private market in either land or housing units in China until the late 1990s. Therefore, it is only possible to compare current conditions with little more than a decade of data. In fact, the data used in this study are all from a boom period. Due to the lack of sufficient data, demographic variables are only implicitly included. Shifts in these conditions are relatively moderate in a short time span. Thus, the bulk of the indicators may be captured by the city fixed effects. On the other hand, if the indicators have changed over the estimation period, the development may be erroneously interpreted as a bubble. In that case, the size of a potential bubble will likely decrease. The secular trend towards smaller families leads to additional housing demand, that is, the role of speculative factors in the price evolution would be lower.

Information on house prices, land prices, interest rates, GDP, population and the CPI (1998 = 100) are taken from the *China Statistical Yearbook*.² Nominal figures are deflated by the CPI to obtain variables in real terms. In general, the recent house price data should be interpreted with some care. This can be seen in 2009, for example, when people thought that house prices had risen very fast, probably more than 20 per cent in many cities, but according to the data of the National Statistics Bureau (NSB), the national housing price increased only by 1.5 per cent. This has cast doubts on the reliability of the statistics, and the NSB promised to improve the data collection in 2010. Except for 2009, the housing price data seem to be more or less reliable and in line with intuition. Note that the potential weak reliability of the data in 2009 does not have any impact on the size of the bubble at the end of the sample period.

Potential determinants of real house prices (*hp*) may include real land prices (*lp*), real per capita income (*y*), population (*pop*) and the real interest rate (*r*). Income per capita is the ratio between GDP and population. Nominal interest rates refer to loans with a duration of three to five years. The real interest rate is the difference between the long-run nominal interest rate and regional CPI inflation for the period ahead. Despite the real interest rates, all variables are measured in their logs.

Real per capita income, population and the real interest rate are standard to explain the development of house prices (see, e.g. Girouard *et al.*, 2006). The real interest rate is employed in the analysis instead of the user cost of housing (Poterba, 1992). The latter concept comprises expected house price inflation to proxy the repurchasing value of houses. As this might include speculative elements, the user cost variable can underestimate the size of a potential bubble. Land prices are a specific factor relevant for the Chinese economy and have been included to account for recent reforms.

To investigate the cointegration properties, the panel and group mean statistics suggested by Westerlund (2007) are employed. Parameters such as the number of lags and leads in the individual error correction models are determined by the Schwarz information criterion. As the cross sections are not independent, critical values are obtained by bootstrap methods (see Persyn & Westerlund, 2008). The evidence for certain subsets of variables is reported in Table 1.

The empirical support for a cointegrating relationship between real house prices, real per capita income and real interest rates is rather weak, as the null hypothesis of no cointegration can be rejected only at the 0.1 level. The result is even not robust, as it is only confirmed by two out of four tests. While this finding might reflect a low power problem

Table 1. Panel cointegration tests

	G_{τ}	G_{α}	P_{τ}	P_{α}
<i>hp</i> , <i>y</i> , <i>r</i>	−1.840 (0.111)	−3.134 (0.324)	−9.317 (0.088)	−3.103 (0.179)
<i>hp</i> , <i>y</i> , <i>pop</i> , <i>r</i>	−1.645 (0.478)	−1.746 (0.638)	−7.028 (0.386)	−2.289 (0.243)
<i>hp</i> , <i>y</i> , <i>lp</i> , <i>r</i>	−2.206 (0.133)	−3.450 (0.063)	−12.717 (0.030)	−3.613 (0.033)
<i>hp</i> , <i>y</i> , <i>lp</i> , <i>pop</i> , <i>r</i>	−1.704 (0.594)	−1.163 (0.338)	−10.627 (0.201)	−1.590 (0.128)

Note: Data for 35 Chinese cities, sample period 1998–2010. Real house prices (*hp*), real per capita income (*y*), population (*pop*), real land prices (*lp*) and real interest rate (*r*). Real house prices on the left-hand side. Panel cointegration tests according to Westerlund (2007). Entries denote test statistics, *p*-values in parentheses. The *p*-values are based on bootstrap methods, where 800 replications are used. See Persyn & Westerlund (2008).

due to the short time series dimension, the evidence can be improved if real land prices are added to the analysis. In the extended model, most tests indicate the presence of a long-run equilibrium at the 0.06 level. In contrast, the inclusion of population distorts the cointegration property. This could be due to the fact that the variable is an imprecise proxy of the sociodemographic trends that determine housing demand, as the presumably relevant factors such as the reduction of the family size are not included. In line with this evidence, the analysis is based on a model comprising real house prices, real per capita income, real land prices and the real interest rate. The cointegrating vector is exhibited in Table 2.

The equilibrium relationship is quite sensible, as the long-run parameters are correctly signed. While real income per capita and real land prices have a positive effect on real house prices, the real interest rate is expected to exert a negative impact. In addition, the cointegrating vector seems to be relatively stable over time. Nonetheless, there is some tendency of variation in the income and land price elasticities. While income becomes more important, if data of the more recent years are included, the land price elasticity shows a mild decline, although the change is hardly significant.

The bubble can be inferred from the cointegrating residual. However, this can underestimate the true size of the bubble, as the cointegrating parameters reflect the house price development until the end of the sample. Since the bubble is a phenomenon of the recent years, the parameter regime for the 1998–2007 period is used to predict the fundamental development over the 2008–10 period. In this exercise, the actual values of the right-hand side variables are included. As an exception, real land prices are fixed to the 2007 levels. Otherwise, a potential land price bubble could eventually blur a bubble in the housing market.

The size of the house price bubble is displayed in Figure 2. It can be seen that imbalances have emerged over the past three years. For example, real house prices in Shanghai have been 15 per cent above the long-run equilibrium in 2008, 11 per cent in 2009 and 13 per cent in 2010. The bubble is larger in Beijing, where the maximum of 20 per cent is achieved at the end of the sample. The house price bubble is even more spectacular in Qingdao. Compared to the cointegrating relationship, real house prices are persistently overvalued by 30 per cent. While the bubble was negligible in Haikou until recently, it has blown up to 40 per cent in 2010. The high demand stems from the fact that Haikou is the most beautiful beach resort in China. In general, the bubble is more

Table 2. Estimation of the cointegrating vector

	1998–2007	1998–2008	1998–2009	1998–2010
y	0.085 (0.010)	0.118 (0.008)	0.109 (0.007)	0.114 (0.007)
lp	0.281 (0.022)	0.272 (0.019)	0.259 (0.018)	0.245 (0.018)
r	–0.008 (0.001)	–0.006 (0.001)	–0.006 (0.001)	–0.006 (0.001)
R^2	0.821	0.822	0.835	0.850

Note: Data for 35 Chinese cities, varying sample periods. Real house prices (hp) on the left-hand side, real per capita income (y), real land prices (lp) and real interest rate (r) on the right-hand side of the cointegrating equation. R^2 , adjusted R -squared. Pooled mean group estimator of the cointegrating vector, according to Pesaran *et al.*, (1999). Entries denote elasticities of real house prices with respect to real per capita income and real land prices, and semi-elasticities with respect to the real interest rate, standard errors in parentheses.

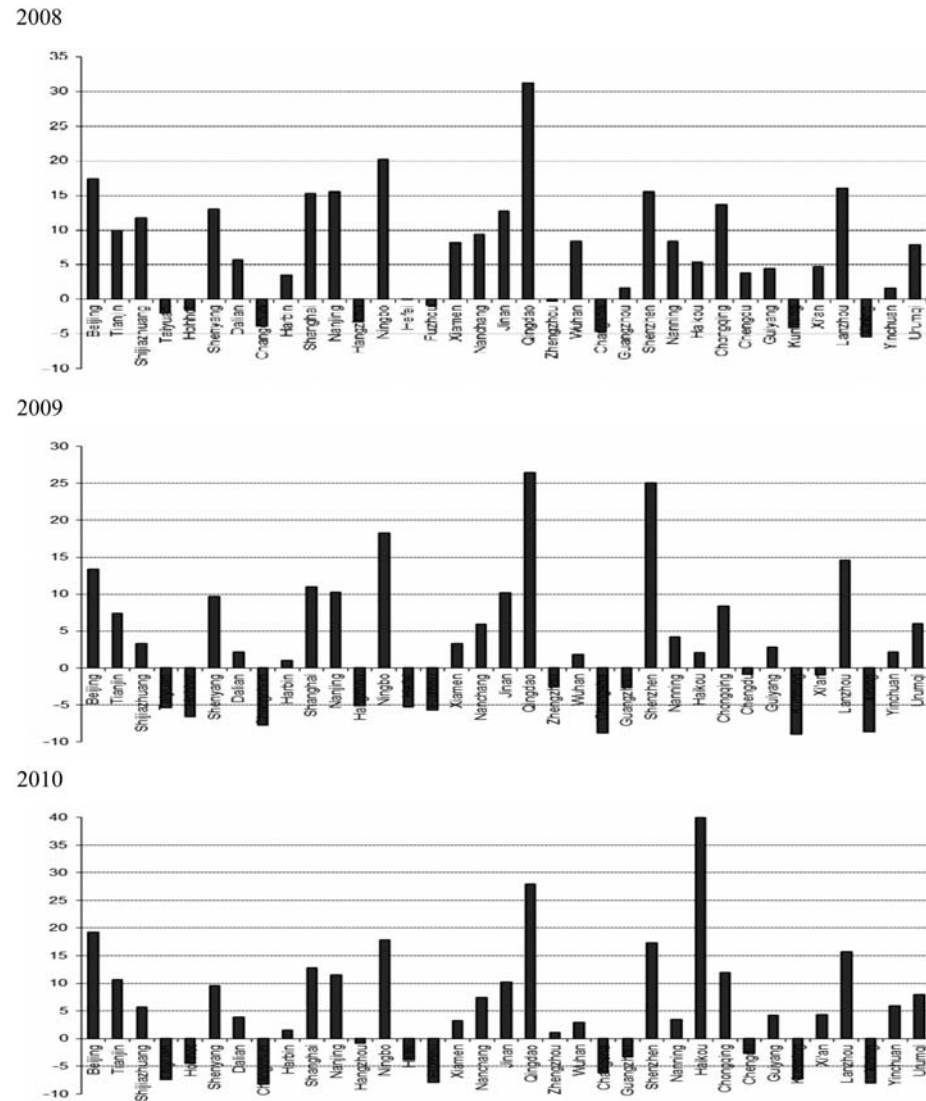


Figure 2. House price bubble in major Chinese cities. *Note:* Size of the bubble expressed in per cent of the fundamental value implied by the cointegrating relationship.

pronounced in the special economic zones and the south-eastern coastal regions. On average, the bubble exceeds the fundamental evolution by less than 15 per cent, regardless of whether GDP or population weights are applied. Therefore, a bubble exists, but it does not seem to be overwhelmingly large.

Due to the mean reverting behaviour, a decline of the bubble should be expected over the period to come. The likely effects of this event on real GDP growth and CPI inflation are explored at the national level (see Table 3 for results on Granger causality tests). While the null hypothesis that real house prices do not cause GDP growth cannot be rejected at

Table 3. Granger causality tests

$\Delta(hp)$ does not cause $\Delta(cpi)$	2.858 (0.098)
$\Delta(cpi)$ does not cause $\Delta(hp)$	0.006 (0.941)
$\Delta(hp)$ does not cause $\Delta(y)$	1.501 (0.227)
$\Delta(y)$ does not cause $\Delta(hp)$	0.085 (0.772)

Note: National data, 1998.1–2010.4. Real house prices (*hp*), real GDP (*y*) and *cpi*. Δ is the first difference operator. Lag length according to Schwarz information criterion. Entries denote *F*-values, *p*-values in parentheses.

conventional levels, it can be rejected for CPI inflation at the 0.1 level. Thus, house prices might be more related to inflation, that is, they may be one element behind the increase in CPI inflation in China over the recent years. However, the impact does not seem to be overwhelming.

Similar evidence can be obtained in an out-of-sample exercise. Here, it is examined whether the inclusion of real house prices is able to improve the forecasts of CPI inflation and GDP growth, compared to an autoregressive benchmark. The forecasts are obtained in a recursive manner. The first estimation subsample is 1998Q1–2007Q4 and the forecast subsample is 2008Q1–2010Q4. After producing the point forecast for 2008Q1, the estimation period is extended by one quarter (1998Q1–2008Q1) and the forecast for 2008Q2 is made. Hence, 12 forecasts are derived for the period of tremendous house price acceleration. The forecast accuracy is evaluated by the root mean square forecast error, expressed relative to the benchmark model. For robustness, the relative mean absolute forecast error is also reported (see Table 4). It can be seen that the forecast errors of the benchmark are quite large, implying that an autoregressive model is not well suited for the Chinese economy. The root mean square forecast error exceeds the mean absolute error because of outliers. The inclusion of house prices in the forecast equations usually worsens the prediction accuracy. Again, these findings suggest that a burst of the house price bubble will not have dramatic effects, neither for GDP growth nor for inflation.

5. Conclusions

For many analysts, the Chinese economy is spurred on by a bubble in the housing market, probably driven by the fiscal stimulus package and massive credit expansion, with possible adverse effects on the real economy. To get insights into the size of the bubble, the house price evolution is explored by panel cointegration techniques. Evidence is based on a dataset for 35 major cities. Cointegration is detected between real house prices and a set of

Table 4. Out-of-sample forecasting performance

	RMSFE	MAFE	Relative forecast accuracy
CPI inflation	2.9	2.5	1.150 0.938
GDP growth	3.5	2.6	1.057 1.109

Note: The root mean square forecast error (RMSFE) and mean absolute forecast error (MAFE) are taken from the autoregressive benchmark and expressed in per cent. The relative forecast accuracy shows the RMSFE (left entry) or MAFE (right) relative to that of the benchmark.

macroeconomic determinants. The results indicate that the bubble is below 15 per cent of the equilibrium value implied by the fundamentals at the end of 2010. The bubble is particularly huge in the cities in the south-east coastal areas and special economic zones. Moreover, the findings suggest that a burst of the house price bubble will not have dramatic effects, neither for GDP growth nor for inflation.

Notes

1. Due to the underdevelopment of the Chinese financial market, deposit saving is very important for Chinese households. According to the urban household survey conducted by the National Bureau of Statistics in 2002, house property accounts for 48 per cent of total assets, deposit saving for 35 per cent, stock shares for 10 per cent and treasury bonds for 5 per cent.
2. There are some doubts regarding the soundness of the official data for the Chinese economy. However, standard economic models receive a reasonable empirical fit; see Chow (2010) among others. In addition, the Chinese National Statistical Bureau and its provincial and city offices are obligated by law to provide accurate statistics.

Acknowledgements

The authors would like to thank two anonymous referees for their useful comments and suggestions.

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