Evaluating conditions in major Chinese housing markets ☆

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ABSTRACT

High and rising prices in Chinese housing markets have attracted global attention. Price-to-rent ratios in Beijing and seven other large markets across the country have increased by 30% to 70% since the beginning of 2007. Current price-to-rent ratios imply very low user costs of no more than 2%–3% of house value. Very high expected capital gains appear necessary to justify such low user costs of owning. Our calculations suggest that even modest declines in expected appreciation would lead to large price declines of over 40% in markets such as Beijing, absent offsetting rent increases or other countervailing factors. Price-to-income ratios also are at their highest levels ever in Beijing and select other markets, but urban income growth has outpaced price appreciation in major markets off the coast. Much of the increase in prices is occurring in land values. Using data from the local land auction market in Beijing, we are able to produce a constant quality land price index for that city. Real, constant quality land values have increased by nearly 800% since the first quarter of 2003, with half that rise occurring over the past two years. State-owned enterprises controlled by the central government have played an important role in this increase, as our analysis shows they paid 27% more than other bidders for an otherwise equivalent land parcel.

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1. Introduction

Fig. 1 depicts a more than doubling of real constant quality house prices across 35 major Chinese cities over the past decade, with about 60% of that increase occurring since the first quarter of 2007 (2007(1)). Price changes of this magnitude and speed naturally raise questions about their sustainability, with global interest high among investors, public officials and scholars both because of China's growing economic importance and the fact that a collapse in U.S. housing markets helped precipitate a worldwide financial crisis.

For example, it is not hard to find highly respected professional investors on both sides of the 'is China's housing a bubble?' question.[1] The Chinese government has indicated its own concern via a series of policy interventions over the past year.[2] Scholarly
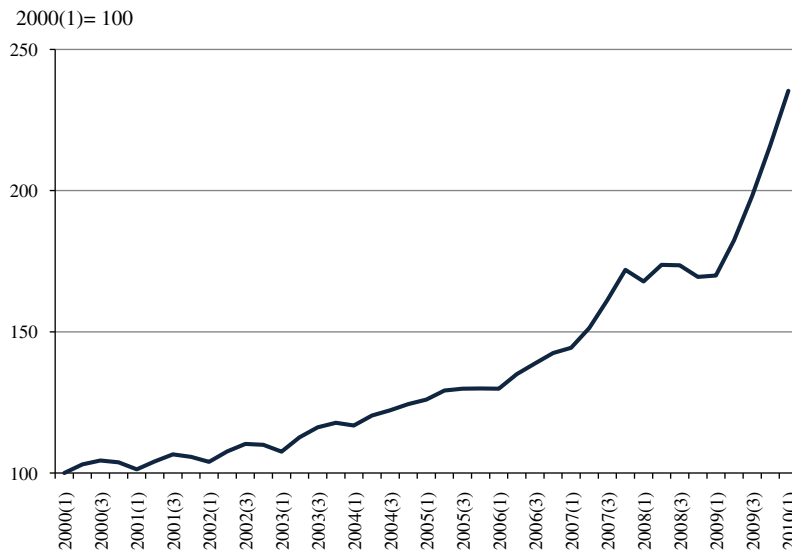
[1] See for example the January 7, 2010, New York Times article by David Barboza entitled "Contrarian Investor Sees Economic Crash in China", which contrasts the diametrically opposed views of James Chanos, a famous short seller who directs the hedge fund Kynikos Associates and believes Chinese housing is a bubble, and Jim Rogers, an equally successful investor who helped found the Quantum Fund, who believes it is not. The article is accessible at http://www.nytimes.com/2010/01/08/business/global/08chanos.html.
[2] These include the following: (a) increased equity down payment shares from 20% to 30% for first homes of more than 90 square meters in size; (b) increased equity down payment shares from 40% to 60% for second homes; (c) general discouragement of the use of any leverage on third homes or by external buyers (i.e., those not living in the market of the intended purchase); (d) new rules to prevent developers from hoarding housing units; (e) the pilot implementation of property tax levies in Shanghai and Chongqing since January 2011; this change could be very important because it would raise the cost of carry on speculative investments in owner-occupied housing; and (f) in some cities such as Beijing, new policy prohibits local households from purchasing more than one unit of housing, and suspends households from buying any homes in cities if they have not been long-time (5 years or more) residents and cannot provide tax or social insurance certificates to show their length of residence. For more details, see the "Gazette of Executive Meeting of the State Council," December 14, 2009; "Circular of the State Council on Resolutely Containing the Precipitous Rise of Housing Prices in Some Cities" (Decree No. [2010] 10), April 17, 2010; and the "Gazette of Executive Meeting of the State Council," January 26, 2011.

2000(1)= 100

Source : Institute of Real Estate Studies, Tsinghua University.

Notes: Hedonic models are used to control for quality changes in underlying samples of newly-built, private homes in 35 major markets in China. Real indices are created by deflating with the CPI series for each market. Aggregate indices are computed as the weighted average of the local market series, with transactions volume between 2000-2008 as the fixed weight.

Fig. 1. Constant quality real price index for newly-built private housing in 35 major Chinese cities, 2000(1)–2010(1).

interest in the area has expanded over the past few years, too, both in Chinese and English. Much of this effort attempts to gauge any potential mispricing by comparing actual market values with predicted fundamental prices.[3]

Chinese markets already have experienced real price appreciation on a par with or in excess of that realized in other markets that are widely agreed to have had pricing bubbles. For example, the S&P/Case–Shiller national price index for the United States shows a 144% increase in nominal home values from the start of that country's long boom in 1995 and the peak of prices in the second quarter of 2006. That implies a 7.7% average annual compounded appreciation rate over those nearly twelve years. Price growth was even higher, at 169%, in some of the fastest appreciating markets such as Las Vegas. Thus far, the bursting of the American housing bubble has seen the S&P/Case–Shiller national index decline by 53% from its peak through the latest available data for 2010(3), with the Las Vegas market down by even more at −58%.[4]

Price growth in major mainland Chinese markets tends to have been much higher since our data begin in 2003(1). For example, the Beijing, Chengdu, Hangzhou, Shanghai and Shenzhen markets have appreciated by at least 10% per year between 2003(1) and 2010(1), with Beijing's growth rate much closer to 20% per annum. The slower appreciating markets of Tianjin, Wuhan and Xian have grown from 5.9% to 8.7% annually, which is close to the rate experienced by the U.S. before its recent bust.[5]

What has happened in many mainland markets in terms of magnitudes is more akin to what happened in Hong Kong in the 1990s. From the beginning of 1990 through its pricing peak in 1997(3), Hong Kong house prices grew by 296% nominally. There was more substantial inflation during that period, but real prices still escalated by 113% for a compound average annual growth rate of nearly 15%. Prices then fell by nearly two-thirds from that peak to a trough in the middle of 2003.[6]

Of course, these simple comparisons across countries are only suggestive. To gain deeper insight into the riskiness of current Chinese house prices and whether there likely is any fundamental mispricing, we provide a new and updated analysis of conditions in Chinese housing markets in this paper. Because of very limited data due to the fact that there has only been a truly private market in land and housing units since the late 1990s, we do not follow some of the recent scholarly literature in attempting to construct or test a formal structural model of supply and demand for housing. Not only have there not been the multiple housing cycles needed for comparison purposes, but economics still does not provide a well-specified test for the presence of a bubble in any asset market.[7] Hence, our research strategy is to look at as wide a variety of data as possible to help gauge the current riskiness of Chinese housing markets.

We do so in three ways. First, we exploit one of the important strengths of the Chinese data, which is that land prices can be observed separately from the value of the housing structure. Using micro data on over 300 recent residential land auctions in the capital city of Beijing dating back to 2003, we provide the first constant quality land price series for a Chinese market. The estimated growth in land values is nothing short of extraordinary—almost an eight-fold increase since 2003. It is also clear that this is not simply a function of prices escalating prior to the Summer Olympics in 2008. Beijing's land prices nearly tripled since the end of 2008. We also are able to compare land prices to the values of finished home sales (i.e., land plus the physical unit) in nearby transactions. From 2003 through 2009, the ratio of land to house values among our matched pairs hovered between 30% and 40%. In early 2010, however, this ratio doubled to just over 60% on average.

There also is a statistically and economically strong positive correlation between land auction price in Beijing and the winning bidder being a state-owned enterprise (SOE) associated with the central government. All else constant, prices are about 27% higher when a central government-owned SOE wins a land auction, so these

[3] Research along these lines includes Shen and Liu (2004), Hui and Shen (2006), Liang and Gao (2007), Kuang (2008), Hu et al. (2008), and Chow and Niu (2010).
[4] Source: Standard & Pools, "S&P/Case–Shiller Home Price Indices".
[5] Source: Institute of Real Estate Studies, Tsinghua University.
[6] Source: Rating and Valuation Department, Hong Kong SAR.

[7] See Flood and Hodrick (1990) for an early analysis of what would be required to determine convincingly whether or not a speculative bubble exists. Their criteria clearly cannot be met in the case of China's housing markets.

entities appear to be playing a meaningful role in rising land values in Beijing. Finally, we provide suggestive evidence that investors may be backward-looking in their expectations, as the previous year's house appreciation is a powerful predictor of near-term land price growth.

The importance of expectations is emphasized in our second method of evaluating conditions in Chinese housing markets, which examines two traditional affordability metrics—price-to-rent and price-to-income ratios—in Beijing and seven other large markets: Chengdu, Hangzhou, Shanghai, Shenzhen, Tianjin, Wuhan and Xian. The data show that price-to-rent ratios not only are high in these places, but they have increased sharply in the past few years. The price-to-rent ratio in Beijing increased by almost three-quarters just in the last three years, rising from 26.4 in 2007(1) to 45.9 in 2010(1). Hangzhou, Shanghai, and Shenzhen also have seen their price-to-rent ratios rise sharply to over 40. Prices also have risen faster than rents in the other major markets of Chengdu, Tianjin, Wuhan and Xian, but they started from a lower base and their ratios remain in the 30s.

Using Poterba's (1984) asset market approach to house valuation suggests that the annual user costs of owning have to be very low—on the order of 2.5%–3.3% of house price—to justify prices that are 30–40+ times rents. Given what we think are reasonable assumptions about the other parameters determining user costs, it appears that home buyers are assuming quite large capital gains on their homes. This is not incredible on its face, of course, as real house prices have risen significantly in China in recent years. However, home prices do not always rise and certainly not consistently at the high rates recently experienced in China. Even modest declines in expected price growth would lead to large, double-digit percentage increases in user costs and similarly large declines in implied price-to-rent multiples and price levels, absent a rise in rents or some other countervailing change. It is in this sense one can conclude that house prices in major Chinese markets are quite risky, even though the data are too limited to make a blanket claim of mispricing.

It is noteworthy that the price-to-income ratio data are much less consistent in this regard. Urban income growth has been quite strong in China, and has exceeded house price appreciation in Chengdu, Tianjin, Wuhan and Xian over the past few years. However, prices in the coastal markets and in Beijing have outpaced even the high income growth enjoyed in those places. The most recent data show price-to-income ratios have reached their highest levels ever in Beijing, Hangzhou, Shanghai and Shenzhen.

Our third method of evaluating conditions in Chinese housing markets involves comparing changes in supply to demand over time. These results should be interpreted as back-of-the-envelope calculations of whether there is any evidence that demand has outpaced supply over time in these markets. The evidence is mixed here, too. In five of the eight large Chinese markets we study (Chengdu, Shanghai, Tianjin, Wuhan and Xian), the net new number of housing units provided since 1999 appears to have been at least as large as the net increase in the number of households in those markets. At the least, this suggests there has not been a systematic shortfall in supply that might justify sharply higher house prices (all else constant) in these markets. Of course, this implies that Beijing, Hangzhou and Shenzhen have experienced at least modest supply shortfalls over the past decade.

Overall, we believe the combined weight of the data raises serious questions about the sustainability of home values in many major Chinese markets. Increases in the value of land in the capital city and in house prices and price-to-rent ratios of the magnitudes experienced in most major markets over the past couple of years are sustainable only in presence of very high on-going demand growth combined with limited supply. It is difficult to gauge whether expected demand is outstripping supply because of very large internal migration flows and limited data on long-run supply conditions in these markets. However, most true fundamentals just do not change so discretely or in such magnitudes as to be able to explain the sharp changes seen in the data series examined in this paper. As already emphasized, this does not prove there is a bubble or other type of mispricing. However, it does indicate that prices have reached levels and multiples that are quite risky from either an investor's or regulator's perspective in the sense that even modest underperformance relative to expectations is likely to be associated with sharp declines in values.

The plan of the paper is as follows. The next section provides background on the history of housing reform in China, as well as the recent trend of urbanization and the nature of its land supply system. This material will be quite familiar to Chinese scholars, but we encourage others to read it before turning to the data. Section 3 then turns to the micro data on land auctions in Beijing. This is followed in Section 4 with a description and analysis of the price-to-rent and price-to-income data. Section 5 discusses our calculations of longer-run changes in supply and demand in the major markets. There is a brief summary and conclusion.

2. China's housing and land system

2.1. Housing reform

Urban residential housing units in the People's Republic of China (PRC) were nationalized and owned by the State (the central government) at the founding of the PRC in 1949. In the following three decades, the State determined the national economic plan and was the monopoly provider of housing. State-owned housing developments were financed by an annual State Budgetary Funding, with the units built then allocated to individual households at low rent through their work units (called "Danwei" in Chinese), which often were state-owned enterprises (SOEs). During this period, the private housing market was non-existent.

The State's monopoly of the residential housing system started to change in the late 1970s, when China embarked on a series of economic reforms. In 1979, a trial privatization of state-owned residential housing units was begun in several coastal cities, and was soon expanded to over 100 cities and then the entire country. This reform led to the emergence of a private housing market (called "commodity housing") in China. The first private housing developer was founded in Shenzhen in 1980. However, in this early stage, the development of the commodity housing sector mainly targeted foreigners or employees of non-state-owned enterprises. Hence, it was limited in scope and grew slowly.

An important impetus to change occurred later with the passage of the 1988 Constitutional Amendment, which provided a firmer legal foundation for development of private housing sector. The government still retained ultimate ownership of urban lands, but it permitted individuals to purchase the right of use of that land for urban residential purposes for up to 70 years. Subsequently, in the 1990s, the central government issued a series of housing reform measures and policies to accelerate the development of private housing markets. Residents were encouraged to purchase the housing units in which they resided from their state-owned work units at below-market prices. Moreover, the work units themselves were required to gradually terminate the direct housing allocation system under which they provided housing to their employees.

Finally in 1998, the State Council issued the 23rd Decree, which is regarded as a milestone in Chinese housing reform. Work units were no longer allowed to develop new residential housing units for their employees in any form. Instead, they had to integrate any implicit housing benefits into employees' salary, and the households had to buy or rent their residential housing units in the private housing market.

We take this to be the start of the modern private housing market in China. The amount of private housing built as a share of the total annual flow supply more than doubled from about 13% in 1986 to

about33% in 1993. It then stabilized for the remainder of the decade before resuming its upward march towards 72% by 2006. In terms of the quantity of space supplied by the private market, that annual amount increased almost 20-fold, from about 25 million m^2 in the mid-1980s to nearly 500 million m^2 in 2007. According to the results of the National Census for 2005, 16.3% and 12.2% of urban households in China lived in owned or rented private housing units, respectively,[8] compared to only 9.2% and 6.9% in 2000.

The public housing sector targeting low- and mid-income households also changed and developed during the process of housing reform. It is designed so that the low-income household can either rent low cost units (called "Lian Zu Fang" in Chinese) or purchase special affordable units (called "Jing Ji Shi Yong Fang" in Chinese) at highly subsidized prices from local governments. Moderate-income households can obtain subsidies to rent public rental units (called "Gong Gong Zu Lin Fang" in Chinese) or to purchase price controlled units (called "Xian Jia Fang" in Chinese). However, the construction of public housing had been very limited for most years because of financial bottlenecks at the local government level. This changed only when the State enacted a series of policies to accelerate the development of public housing in 2007.

2.2. Urbanization and migration

One of the key factors underpinning demand for housing in China's major markets is a strong urbanization trend, as depicted in Fig. 2's plot of urban population and its proportion in overall population since 1990. Between 1996 and 2005, the urban population increased by over 50% from 373 million to just over 562 million. Its proportion in national population has also been growing by about 1.4 percentage points annually since 1996. Even with a slight slowing of growth in urbanization since 2005, there are about 15 million new people entering urban areas each year.

The very large internal migration is regulated by the Household Register system (called "Hukou" in Chinese). Households migrating to a new city without "Hukou" would suffer from not being able to readily access various health, education and other public services. The constraints imposed by the "Hukou" system have lessened in recent years, although recent announcements by the State Council may signal some changes.[9] There is no doubt that many housing units are being purchased by people migrating from other areas. For example, Table 1 shows that in 2009, about one-third of the newly-built private housing units sold were purchased by migrants, up from less than one-quarter in 2005.

2.3. The urban land supply system and land market

While the government still retains ultimate ownership of urban lands, it allows individuals to purchase the right to use land for a certain number of years: 70 years for residential uses, 50 years for industrial or mixed uses, and 40 years for commercial uses. In the typical private housing project development process, local governments first lease land parcels to developers. The developers then build housing units on the parcels, and sell those units to households. Households have the right to live in, rent out or sell their housing units during the leasehold period. Precisely what will happen regarding ownership of the land and attached housing units when the leasehold expires is unclear at present.

The first land auction was held in Shenzhen in 1987, even before the 1988 Constitutional Amendment. In subsequent years, most land parcels were not sold publicly via auctions or biddings. Instead, the developer would contact the local government about a land parcel in which it was interested, and then negotiate the price. Many such deals were publicly criticized for resulting in below market prices, with the opaque process open to corruption. Consequently, in 2002 the State required that all urban land for residential and commercial use could only be transacted through public auction or bidding.[10]

Another important point about this land supply process is that land auctions are an important revenue source for local government. In fact, revenue from the land market is the local governments' most important off-budget income source. As shown in Fig. 3, the local governments' gross income from land sales grew from 542 billion yuan in 2003 to 1.6 trillion in 2009. As a benchmark, the local governments' budgetary income was 986 billion yuan in 2003, and 3.3 trillion yuan in 2009. Naturally, as the monopoly supplier in the new urban land market, local government behaviour clearly could affect the price and quantity of housing.

3. Prices in the Beijing land market

Because land is the residual claimant on value in property markets, one would like to observe its price separate from that of the structure on top of it. This is not possible in most countries, including the United States, because almost all housing market transactions involve sales of both land and building simultaneously. One of the strengths of the Chinese data is that land sales can be observed separately from housing units because the local government owns all urban land and permits leasing of its use.[11]

We were able to obtain data on all land parcels transacted in the Beijing market since the beginning of 2003 from the web site of the local land resources authority.[12] From 2003(1) through 2010(1), there were a total of 815 parcels transacted by public bidding or auction in Beijing, of which 309 parcels were for residential use.[13] The address, physical characteristics, degree of development of each residential parcel, as well as its transaction price and buyer are included in the dataset. Parcels' direct distances to the city center (D_CENTER) and nearest subway stations in use (D_SUBWAY) are also measured.

We then use the "Soufun Website-Based GIS" system[14] to match each land parcel with nearby, newly-built private housing projects. Two criteria are employed in the match. First, the housing projects must have been on sale no more than one year prior to the relevant land parcel transaction. Second, each housing project had to be no more than 5 km from the relevant land parcel. Using both constraints, we then matched up to five housing projects to each land parcel. Some land parcels have less than 5 matched projects based on these two criteria, while 13 land parcels do not match with any suitable housing projects. Ultimately, 907 housing projects were selected and matched to 296 land parcels. The average distance between matched pairs is 2.11 km. For each housing project selected, its average transaction price in the month before the

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[8] In addition to these two groups, 28.5% of urban households lived in owner-occupied self-built housing, 24.4% lived in privatized dwelling units formerly owned by the State (i.e., housing purchased from their work units during the housing reform), 14.6% lived in owner-occupied or rental public housing, and 3.9% had other housing arrangements.

[9] For example, a recent State Council announcement indicated that mortgages should be denied to buyers who cannot provide proof of local residence (*Financial Times*, April 20, 2010, "Beijing home-loans move hits shares", by Robert Cookson).

[10] See Cai et al. (2009) for more details on China's land market auctions.

[11] While the government technically retains ownership of the land, it still is sensible to view the auction values as sales prices. The sales contract typically requires the winning bidder to submit at least 50% of the total payment to the local government within one month. The rest is due within a stated period (one calendar year for most cases). Failure to complete the payment effectively cancels the contract. No further lease payments are required. We do not discount flows in the analysis below, and effectively treat the bid prices as a single lump sum payment. No conclusions are altered by this assumption.

[12] The Ministry of Land and Resources in China requires that data on all land parcels transacted be published on the web site of the local land resource authority. In the case of Beijing, the URL is www.bjtd.com.

[13] Land parcels wholly designated for public housing are excluded from the sample because their pricing mechanism is quite different.

[14] The system can be accessed at map.soufun.com.

Million
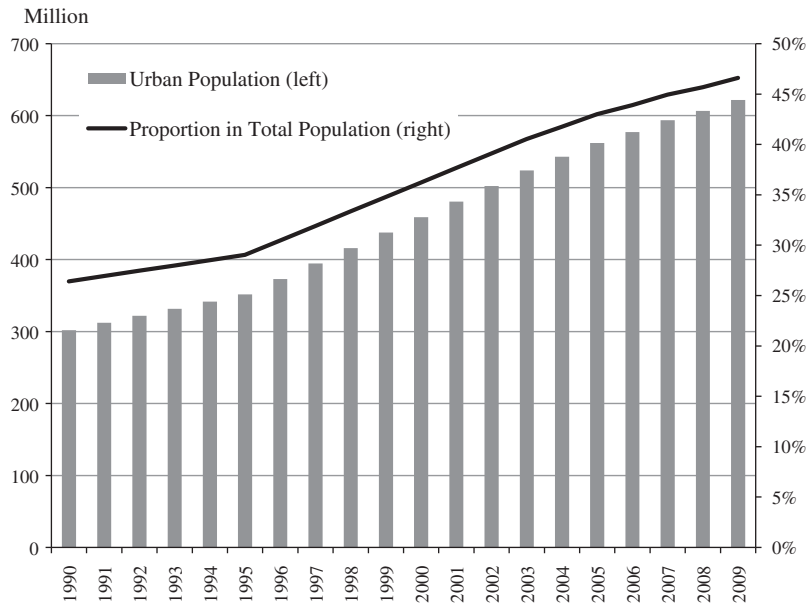
Source: National Bureau of Statistics, "Statistics Yearbook of China".

Fig. 2. Urbanization in China, 1990–2009.

matched parcel's transaction is recorded or calculated.[15] Finally the variable indicating the housing price level before the land parcel's transaction is calculated as the average of the matched housing projects' prices, weighted by the reciprocals of the projects' distances to the parcel.

We also import information on the parcel buyers (i.e., the housing developers) from the database of the municipal real estate authority in Beijing. The 309 residential parcels were purchased by a total of 199 developers who can be classified into three groups according to their type of ownership. The first two groups are state-owned enterprise (SOE) developers of one type or another. If the SOE is owned by the central government, we label it as a Central SOE developer (or C_SOE); if the SOE is owned by a subnational government, we term it a Local SOE developer (or L_SOE).[16] The last group is comprised of the non-SOE developers.

Table 2 provides a breakdown of winning developer types in the capital. Two-thirds of winning bidders are not state-owned entities (133/199≈67%), but Central SOE developers tended to win the bigger parcels and pay the highest prices. For example, the 14 winning Central SOE developers purchased 43 land parcels with an average size of 0.24 million m^2 at an average price of 8354 yuan/m^2. In contrast, the 133 non-SOE developers purchased 166 parcels with an average size of 0.11 million m^2 at an average price of 3083 yuan/m^2.

Within developer category, each entity also can be characterized along quality dimensions. We do so in two ways. One is by whether the developer is listed (LISTED) or not; the other is by the degree of qualification according to a government ranking system (GRADE1 to GRADE5).[17]

Table 1
Composition of commodity housing unit purchasers.
Source: Ministry of Housing and Urban-Rural Development.

	From local urban area (%)	From local rural area (%)	From other domestic areas (%)	From other countries/regions (%)
2005	70.1	5.8	22.7	1.5
2006	62.1	8.2	28.4	1.3
2007	62.4	10.3	26.5	0.8
2008	64.8	10.2	24.4	0.7
2009	54.1	11.8	33.5	0.6

3.1. Estimating constant quality land prices

The real average price from our Beijing land auction data increased by 587% between 2003 and 2010(1), for a 31.7% compounded average annual appreciation rate over our sample period. It is noteworthy that that mean masks a substantial acceleration over the past couple of years, with real prices more than doubling since 2008. While appreciation of this magnitude is extraordinary by any metric, variation in the quality of land prices over time could be biasing the true change in price. For example, if the highest quality sites were sold first, as seems likely to us, the change in the raw mean values would understate the constant quality rate of price appreciation. However, it also could be that pressing revenue needs in a given year lead the local government to release particularly high quality sites to the market. Because we cannot be sure which effect is dominant, we control for location quality in a simple hedonic model which is estimated via ordinary least squares (OLS). Definitions and descriptive statistics on all variables used in our empirical analysis of the Beijing land market are listed in Table 3. All monetary figures are in constant 2003 yuan.

The dependant variable is the level of the real transaction price for each parcel in logarithmic form.[18] Local traits controlled for include

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[15] If the housing project did not have a transaction in that month, the latest transaction price is chosen and a constant quality housing price index for Beijing computed by the Institute of Real Estate Studies at Tsinghua University is applied to update the price.

[16] In China, the State-owned Assets Supervision and Administration Commission (SASAC) holds shares in the SOEs from the different layers of government on behalf of the State. The SOEs whose shares are held by SASAC on behalf of the central government are defined as Central SOEs (C_SOE), while those whose shares are held by SASAC on behalf of sub-national governments (including province, city and district government) are defined as Local SOEs (L_SOE).

[17] Each developer is rated by the real estate authorities, largely based on the company's scale and experience. A grade of 1 is the highest, with a 5 being the lowest.

[18] Note that in China, land parcels for residential use are priced in terms of the floor area of housing permitted to be built on the parcel, not in terms of the land area. That convention is followed in this paper, too. While this could bias measured appreciation in land values per square meter of land in certain circumstances, that does not appear to be an issue here. First, we include a control for permitted density, as discussed immediately below in the text. Moreover, there are no trend changes (in particular, no trend decline) in permitted density during our sample period.

Billion Yuan RMB
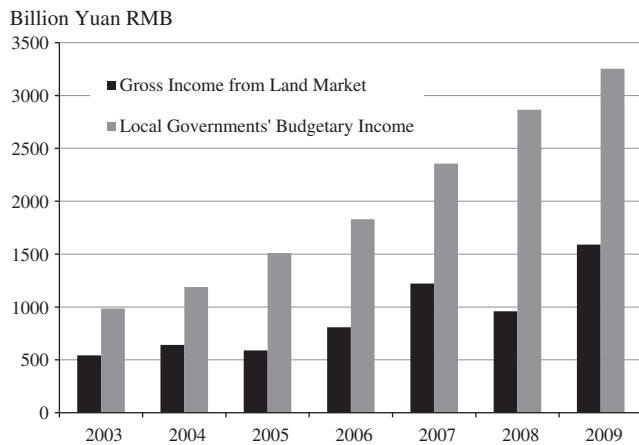
Sources: National Bureau of Statistics, "Statistics Yearbook of China";
Ministry of Land and Resources, "Yearbook of Land and Resources".

Fig. 3. Local governments' revenues, 2003–2009.

distance to the city center (D_CENTER), distance to the nearest functioning subway station (D_SUBWAY), the quality of how well the site is prepared upon delivery (LANDLEVEL), the quality of the nearby infrastructure (FULLINFRA), and the density permitted on the site when built (FAR). We also control for whether the site is encumbered with requirements to provide public rental housing units (i.e., "Lian Zu Fang"; SHARE_PR) or to have some fraction of its units subject to price ceilings (i.e., "Xian Jia Fang"; SHARE_PC). Finally the parcel's transaction form (transacted by auction or bidding) is also considered (AUCTION).

Column (1) in Table 4 reports the results of a specification that includes these variables and year dummies. In general, the results are as expected. Land parcels closer to the city center or a subway station are worth more. Better prepared parcels in terms of the site and local infrastructure also are worth more. Lower density also is associated with higher price. The point estimates on the public and price controlled housing variables are negative as expected, but they are not statistically significantly different from zero. Land parcels transacted via auction tend to achieve a higher price, but this effect is insignificant. Finally, the year dummies are quite powerful, both in economic and statistical terms.

We use the coefficients on the year dummies as a proxy for what happened to constant quality residential land prices in Beijing. These are common annual effects after controlling for differential location quality of land parcels. The dark, upper line in Fig. 4 plots these estimates starting from a base of 100 in 2003. Overall, we find a 788% rise in real constant quality prices over our full sample period,[19] with a dramatic recent rise in real land prices over the past couple of years. The nearly 330% increase from 2003 through 2009 implies an average annual compound appreciation rate of about 28%. Following that very high rate of price growth, land prices then doubled over the last year.[20]

While a number of factors could have combined to account for this extraordinary price appreciation, we next explore the potential roles of two—sharply increased bidding activity by certain state-owned enterprises and expectations of price growth—that we believe are

Table 2
Developer groups winning Beijing land auctions.

Type	Central SOE developers	Local SOE developers	Non-SOE developers
Number of developers	14	52	133
Number of parcels purchased	43	100	166
Total floor area of land purchased (million m^2)	10.11	15.94	18.25
Average price of land purchased (Yuan RMB per m^2 floor area)	8353.58	3610.66	3082.78

especially relevant in the Chinese context and most in need of deeper research if we are to better understand this market.[21]

3.2. Correlation with Central SOE developer winning bids

The past few years have seen a potentially important change in the institutional nature of land purchasers—namely, a sharp increase in the proportion of Central SOE developers buying land. During the process of fiscal decentralization in the 1980s and 1990s, the central government in China transferred ownership of most SOEs to local governments (province, city or district level), and retained control of very few enterprises (these are the "Central SOEs"). According to the latest Economic Census in 2008 by the National Bureau of Statistics, there were about 156,000 SOEs in China, representing about 3.2% of nearly 5 million total enterprises. The number of Central SOEs is much smaller—only 142 in 2008 as reported by State-owned Assets Supervision and Administration Commission (SASAC) in State Council, while a more recent SASAC report indicates that mergers reduced the number further to 129 by the end of 2009. However, these few entities are the largest and among the most important enterprises in China. As reported by SASAC in State Council, total sales revenue of the 129 remaining Central SOEs reached 12.6 trillion yuan RMB in 2009, or nearly 100 billion yuan RMB per entity.

Ninety-four of the 129 Central SOEs owned or controlled real estate developers by the end of 2009.[22] Fourteen of these developers purchased residential land parcels in Beijing during our sample period. SOE developers always have been active in Beijing, but their share of activity has been growing as depicted in Fig. 5's plot of the shares of floor area in the Beijing market purchased by different groups of developers. The combined share of Local and Central SOEs has expanded from about 37% in 2003 to nearly 71% in early 2010. Note that the share of Central SOE developers' purchases increased from negligible in 2003 and 2004 to over 50% in 2010(1).

The middle column of Table 4 adds controls to our baseline specification for the type of developer, as well as quality attributes of the developer. The coefficient on the Central SOE developer control is statistically significant and economically important. All else constant, the coefficient implies that the transactions price is 27.4% higher ($e^{0.242} - 1 = 0.274$, since the dependent variable is in log form) if the parcel is purchased by a SOE developer controlled by the central government.

How to interpret this coefficient is not entirely clear. If these particular developers are superior investors and are able to buy

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[19] Note that the numbers plotted are those implied by the raw coefficients themselves. That is, the value for 2010(1) is 888.2, which is derived from $e^{2.184} = 8.882$. Given that our beginning value is set to 100, this implies the 788% price growth mentioned in the text (i.e., [888−100]/100 = 788/100 or 788%).

[20] Note that our estimated constant quality prices are higher than the unadjusted series, which suggests that the quality of sites available for bid was higher in earlier years. The time patterns are very similar, however, with both series showing a sharp jump in prices over the past couple of years.

[21] Another possible factor underlying the land price path is the shift in the land transaction mechanism from opaque negotiation to public auction/bidding, as described in Section 2.3. This change occurred in 2002 in Beijing, so it might help explain price changes in the early years of our sample period. However, it is highly unlikely to be able to account for the surge in 2009 and early 2010. Another institutional feature is that the local government is the monopoly supplier in land market. However, there is no evidence that the recent land price surge in Beijing was fueled by the local government intentionally restricting the supply. In fact, the transaction volume of Beijing residential land sales reached its historic peak in 2009 (9.08 million m^2 in floor area), and the volume transacted in 2010(1) reached 3.09 million m^2—more than one third of that in 2009.

[22] Source: SASAC in State Council, China.

Table 3
Definition and descriptive statistics of variables.

Variable	Definition	Mean	Std dev.
LP	Transaction price of the parcel; in constant 2003 Yuan RMB per square meter of floor area.	4094.73	4035.91
D_CENTER	Distance to the city center (Tian An Men Square); in kilometers.	28.56	19.62
D_SUBWAY	Distance to the nearest subway station in use; in kilometers.	14.40	15.93
FAR	Ratio between the floor area and the land area.	2.08	0.94
LANDLEVEL	The parcel is leveled when delivered to the buyer or not; 1 = yes, 0 = o/w.	0.89	0.31
FULLINFRA	The parcel has full infrastructure when delivered to the buyer or not; 1 = yes, 0 = o/w.	0.51	0.50
SHARE_PR	Share of public rental housing required in the total floor area of the parcel.	0.002	0.02
SHARE_PC	Share of price-controlled housing required in the total floor area of the parcel.	0.02	0.16
AUCTION	The parcel is transacted by auction or not; 1 = auction, 0 = bidding.	0.77	0.42
GRADE1-GRADE5	The parcel is purchased by a developer with qualification of first (second…fifth) grade or not, 1 = yes, 0 = o/w.	–	–
C_SOE	The parcel is purchased by a SOE owned by the central government or not; 1 = yes, 0 = o/w.	0.14	0.35
L_SOE	The parcel is purchased by a SOE owned by the local government or not; 1 = yes, 0 = o/w.	0.33	0.47
LISTED	The parcel is purchased by a listed company or not; 1 = yes, 0 = o/w.	0.33	0.47
HPGROWTH	The nominal house price growth rate between the parcel's transaction month and one year before.	0.23	0.19
T2003 – T2010	The parcel is transacted in the year or not; 1 = yes, 0 = o/w.	–	–

unobserved high quality sites, then part of this effect could be a proxy for quality. We certainly do not claim that our hedonic controls are perfect. However, in other regressions not reported here, we also find that Central SOE developers pay high prices relative to the values of matched nearby housing unit sales prices. That suggests these particular buyers simply pay more and that this does not merely reflect omitted quality effects. Moral hazard arising from these entities believing they are too important to fail, combined with their access to low cost capital from state-owned banks, also could help explain their bidding behavior, as we discuss below. It remains an open question as to why central SOE developers became so much more active in housing development over the past few years. Much more research clearly is needed on this matter.[23]

Whatever the mechanism underlying this correlation, it is large enough to account for a meaningful fraction of the rapid growth of residential land prices in capital city. The middle line of Fig. 4 plots the estimated year effects after controlling for developer type and quality. Land prices certainly would be lower in Beijing if Central SOE developers did not bid differently from other buyers, but the results still indicate a very steep rise in values over the past seven years.

3.3. The possible role of backward-looking expectations on bid prices

The role of developer expectations amidst such a large trend increase in land values surely is important, if very difficult to pin down. One obvious way to help explain the trend would be if bidders had backward-looking expectations that were anchoring on recent price growth. We certainly do not claim to know how expectations are being formed, but any anchoring on the recent past necessarily is on a short boom period given that is the only history available to Chinese investors in the residential market.

The third column of Table 4 reports the results of adding a control to our baseline specification from column (1) for the accumulated nominal house price change in Beijing over the past 12 months (HPGROWTH), as a proxy for developers' expectations. While we do not believe that this admittedly naïve construction reflects precisely what developers themselves perceived, it does provide an indication of how important a role such expectations could be playing. Importantly, including this variable materially changes the pattern and magnitude of the estimated time effects. The third and lowest line in Fig. 4 plots the estimated year effects from column (3). In this case, constant quality land prices rise by only 40% of our baseline estimate,

with the vast majority of that lower amount of appreciation due to much depressed time effects over the past couple of years.[24]

While this simple exercise highlights the need to better understand the role that expectations play in housing or land markets, very little actually is known about how people form expectations about price appreciation. In the United States, Case and Shiller (2003) have surveyed small groups of home buyers in a handful of markets about their beliefs regarding price appreciation. Even in markets with flat to declining real price trends, expectations of double-digit nominal price growth over decade-long periods are common according to their results.[25] To our knowledge, there are very few surveys of price expectations in China, although the potential importance of this factor strongly suggests this should be a pressing issue both for researchers and policy markers.[26]

3.4. Land share in house value

We also calculate the ratio of the land transaction price to the weighted average price of matched housing projects. Fig. 6 plots this ratio over time. The average for all 296 matched parcels is 0.37, but land's share in house values in Beijing clearly has risen sharply since 2008. In early 2010, it constituted over 60% of house value on average. Clearly, land is becoming more expensive relative to structure in the capital city.[27]

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[23] Yet another possibility is that the SOEs see land purchases as one of the few possible inflation hedges in a country where the capital markets do not provide a securitized way to hedge.

[24] We also have estimated specifications including controls for developer type and quality, as well as this simple expectations proxy. Both sets of variables retain their statistical and economic significance (i.e., the coefficient on the Central_SOE variable falls from 0.240 to 0.206, but remains statistically significant at standard confidence levels). The year effects are slightly weaker, too. Given limited data, our intention is not to claim some precise impact for one variable versus another, but to identify at least two of the factors—changing institutional demand for land and expectations formation—that clearly are important and are in need much more study if we are to better understand the remarkably high house price appreciation experienced in Beijing (and quite probably in other major Chinese markets).

[25] For example, residents of Milwaukee, Wisconsin, a Midwestern, manufacturing-based market expected prices to grow at or above 10% per annum for at least ten years following 2003.

[26] The People's Bank of China (the central bank) has conducted a quarterly survey since 2000 of 20,000 customers of commercial bank branches in 50 cities. Beginning in 2009(3) the survey added one question about respondents' expectations of house price changes over the following quarter. To our knowledge, this is the only national survey related to house price expectations in China. Some real estate consulting companies such as Soufun (www.soufun.com) and Yiju (www.yiju.org), have conducted surveys since late 2009, but these are concentrated in select cities and the sampling procedures are not well understood.

[27] Our estimates are consistent with data provided in a recent, March 28, 2010, report of the Ministry of Land and Resources, which arrived at similar land shares in Beijing (although calculated in a very different manner; see the report itself for more details, which could be accessed at www.landvalue.com.cn/TheContent.aspx?ContentID=10690&Menu_ID=13).

Table 4
Results of the land price hedonic model.

Dependants: log (LP)	(1)	(2)	(3)
Constant	8.652 (33.43)***	8.243 (30.14)***	8.515 (34.37)***
log (D_CENTER)	−0.556 (−7.76)***	−0.475 (−6.63)***	−0.532 (−7.79)***
log (D_SUBWAY)	−0.137 (−4.16)***	−0.137 (−4.27)***	−0.151 (−4.82)***
FAR	−0.102 (−2.88)***	−0.0828 (−2.33)**	−0.100 (−2.96)***
LANDLEVEL	0.272 (2.54)**	0.276 (2.64)***	0.239 (2.34)**
FULLINFRA	0.274 (4.39)***	0.204 (3.27)***	0.255 (4.28)***
SHARE_PR	−2.528 (−1.39)	−2.982 (−1.68)*	−2.312 (−1.33)
SHARE_PC	−0.182 (−0.95)	−0.237 (−1.25)	−0.209 (−1.15)
AUCTION	0.062 (0.76)	0.133 (1.62)	0.139 (1.75)*
C_SOE		0.242 (2.27)**	
L_SOE		−0.00567 (−0.08)	
GRADE1		0.0840 (0.61)	
GRADE2		0.356 (3.41)***	
GRADE3		0.202 (1.91)*	
GRADE4		0.126 (1.27)	
LISTED		−0.0297 (−0.37)	
HPGROWTH			1.432 (5.56)***
T2004	0.251 (1.64)	0.196 (1.32)	0.221 (1.51)
T2005	0.523 (3.24)***	0.428 (2.71)***	0.429 (2.77)***
T2006	0.553 (3.61)***	0.459 (3.05)***	0.376 (2.52)**
T2007	1.143 (7.21)***	1.008 (6.46)***	0.594 (3.29)***
T2008	1.085 (6.92)***	0.919 (5.91)***	0.823 (5.26)***
T2009	1.455 (9.84)***	1.276 (8.47)***	1.216 (8.25)***
T2010	2.184 (11.76)***	1.951 (10.43)***	1.296 (5.43)***
Obs	309	309	309
Adjusted R^2	0.709	0.727	0.736

Notes: (1) t statistics are reported in parenthesis.
(2) ***: significant at the 1% level; **: significant at the 5% level;*: significant at the 10% level.

4. Housing affordability metrics for eight major Chinese markets

4.1. Eight major Chinese markets: Summary statistics

We next investigate affordability conditions in eight large markets across China, using two traditional metrics used in international studies of housing markets: the price-to-rent and price-to-income ratios. The markets themselves are Beijing, Chengdu, Hangzhou, Shanghai, Shenzhen, Tianjin, Wuhan and Xian. Each is marked on the map displayed in Fig. 7. Each market is quite large and has been growing in recent years, as documented in Table 5. None has fewer than 8 million inhabitants, and aggregate population growth since 1999 has ranged from 10% to 40%+. In terms of aggregate housing activity, the share of these eight large markets has fallen in recent years with the surge in building activity around the country, but these eight still represent over one-third of all new housing value sold in 2009 and 17% of the floor area of all new homes sold in the nation.

4.2. Price-to-rent ratios

We have detailed micro data on prices and rents of owned and rented units beginning in 2007(1) for the eight major markets noted above. While the time series is short, it is noteworthy that comparing owner-occupied housing unit prices to apartment rents is more straightforward in China than in many other countries, including the United States. Owned and rented units tend to be more similar in nature in China, as both tend to be in high rise buildings, are of similar size, and are located in many of the same neighbourhoods.[28] Even so, we are able to make further adjustments for quality by estimating simple hedonic models on the underlying samples of owner-occupied

and rental units. This allows us to create constant quality price and rent series for the same typical unit.[29] We then create the ratio of price-to-rent based on those series.

Fig. 8 plots the price-to-rent ratios in the eight major markets. Prices clearly have been rising relative to rents in each of these markets, and the changes are economically important. For example, the price-to-rent ratio in Beijing increased by almost three-quarters over the past three years, rising from 26.4 in 2007(1) to 45.9 in 2010(1).

The largest increase is in Hangzhou, where the price-to-rent ratio started off at a relatively high level of 31.8 in 2007(1), and then doubled to 65.5 in the first quarter of 2010. The Shanghai market looks much like Beijing, with the price-to-rent ratio being 45.5 in 2010(1), although its growth has been less since it started from a higher base of 32.7. Of the other major markets, Shenzhen also has a price-to-rent ratio above 40. It has reached that level for the past two quarters, increasing by about 46% since the beginning of 2007.

Chengdu, Tianjin, Wuhan and Xian have lower price-to-rent ratios than the other four big markets, but they have been increasing over time, too. Chengdu's ratio rose by 48%, Tianjin's by 78%, Wuhan's by 28%, and Xian's by 29%. Only Wuhan had a price-to-rent ratio below 30 as of 2010(1), while at the beginning of 2007, only Shanghai and Hangzhou had ratios above 30.

Rents that are no more than 2%–3% of house value require very low user costs of owning for house prices to be sustainable. User costs of owning can be computed using the standard formula pioneered by Poterba (1984) and implemented recently by Himmelberg et al. (2005) in the U.S. That is, user costs (UC) per dollar of house value equal the following:

$$UC = (1-\tau)(r + p) + m + \delta + \beta - \pi^e, \tag{1}$$

where τ is the owner's marginal income tax rate, r is the interest rate at which we implicitly presume people can both borrow and lend, p is the local property tax rate, m is maintenance, δ is depreciation, β is the required risk premium for investing in housing, and π^e is expected appreciation for the following year. Owner-occupied housing is not tax advantaged in China in the sense that one cannot deduct mortgage interest expenses. Hence, that term falls from the equation. In addition, there are no local property taxes in China (yet), so $p = 0$. We use the five-year deposit rate to proxy for the long term interest rate in China. This got as low as 2.8% in 2003 and as high as 5.6% in 2008, so this series is volatile. We follow the standard in the user cost literature in presuming that maintenance and depreciation amount to about 2.5% per year (i.e., $m + \delta = 0.025$).[30] We do the same regarding the risk premium for illiquid, owner-occupied housing, so that β equals 2%.

Given the most recent price-to-rent ratio in each market from 2010(1) and the assumptions just discussed regarding interest rates, maintenance costs and the risk premium, the first column of Table 6 reports how low expected capital gains can be for the user costs of owning not to exceed the implied costs of renting the same unit.[31]

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[28] This often is not the case in the United States, among other countries. See Glaeser and Gyourko (2009) for an analysis of the differences between owner-occupied and rental units in the U.S. and a critique of comparisons of prices to rents based on such data.

[29] The underlying data are from the Institute of Real Estate Studies, Tsinghua University. Using the transaction data provided by a leading national-wide broker in China, price and yearly rent for a typical housing unit are calculated using hedonic models each month in each city, and then the price-to-rent multiple is calculated based on these two indicators. Quality controls in the underlying hedonic model include the distance to the city center, the distance to the nearest functioning public transit stop, the age of the unit, the size of the unit, the number of rooms, the number of bathrooms, a dummy for whether the unit faces the south, and dummy for whether the unit is furnished.

[30] See Poterba and Sinai (2008) for more on this in the U.S. context. We know of no similar studies using Chinese data, making this another area in need of further research.

[31] For Beijing, the 5.9% figure is arrived at as follows. We start with the latest available five-year deposit rate, which was 3.6% in 2010(1). To this we add the 2.5% maintenance and depreciation annual cost, plus a 2% risk premium. Those three annual costs sum to 8.1%. For owning to make sense financially compared to renting given Beijing's latest price-to-rent ratio of 45.9 implies that user costs can be no higher than 2.2% (or 1/45.9). To get user costs down to that level requires expected capital gains of 5.9% for the coming year.
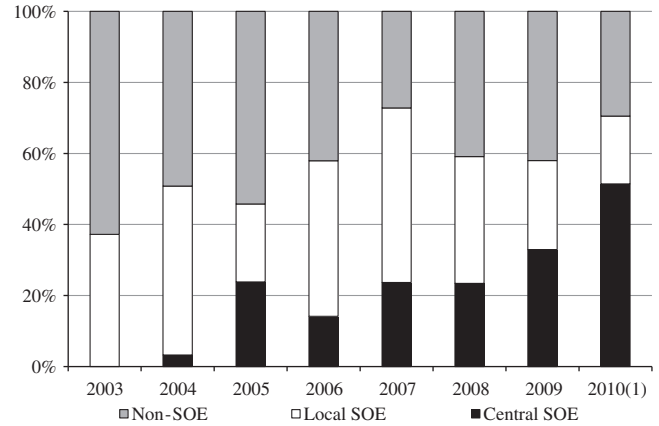
Year 2003 = 100 (in real price)
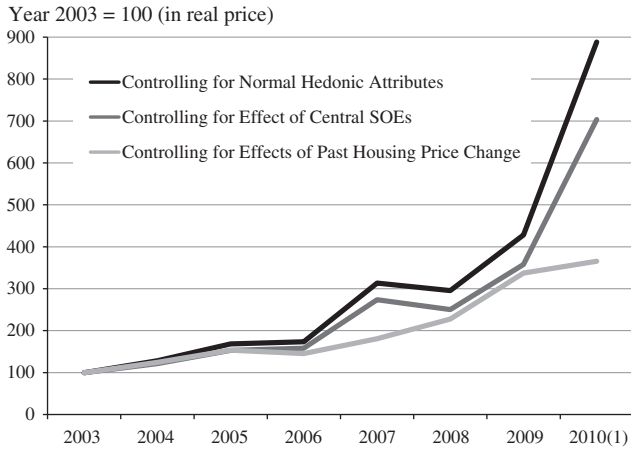
Source: Authors' calculations.

Fig. 4. Constant quality residential land real price index for Beijing, 2003–2010(1).

Source: Authors' calculations.

Fig. 5. Share of floor area of land purchased by various groups of developers in Beijing, 2003–2010(1).

Expected appreciation rates of from 4.5% to 6.6% are needed to keep the costs of ownership no higher than the costs of renting as of 2010(1). These amounts are below the average annual appreciation rates actually achieved over the 1998–2009 period, as indicated by the figures reported in column 2 of Table 6, for seven of the eight large markets (Shenzhen is the exception).

These realized average annual appreciation rates are based on highly skewed series, however, as house price growth has escalated sharply in most Chinese cities in recent years. This is indicated in the final two columns of Table 6. The third column reports the number of years, out of the eleven possible since 1998, that actual house price growth in a given year was less than the amount indicated in column 1. In each of these eight large markets, experienced appreciation was lower in at least four years. Most of those years tend to have been in the very late 1990s or early 2000s, as indicated by the results in the final column which signify the number of years in the past five during which experienced appreciation was less than the amount necessary to make it financially worthwhile to own over the coming year. House price appreciation tends to have been relatively high in recent years. In Beijing and Tianjin, there are no recent cases in which actual price growth has been less than the amount needed next year to justify owning at current price-to-rent ratios.

The riskiness of owning seems quite high at these price-to-rent ratios. Unless rents are rising commensurately, an increase in equilibrium user costs from 2% to 3% implies a dramatic decline in prices—pretty much equal to the reversal of what happened in many Chinese markets from 2007 to the present. What would it take to generate user costs above 3%? Even if interest rates were to remain at their currently low levels (3.6%), user costs in Beijing would be 4.1% if expected appreciation in that market (π^e in the formula above) were to fall only to 4%. By no means is this an inconceivable outcome, as actual annual price appreciation in Beijing was well below 4% for five consecutive years from 1999 to 2003. The implied price-to-rent ratio would be 24.4 in that case ($1/0.041\approx24.4$). Absent an offsetting increase in rents, that would imply nearly a 50% drop in prices (the drop in price-to-rent ratio from 45.9 to 24.4 is about 48%). Thus, it would only require a moderation in likely price growth to generate potentially large declines in prices, absent sharply rising rents or some other countervailing factors.[32]

Finally, it should be noted that growth rates of 4% still imply very large increases in price levels over time: 48% over ten years and 119% over twenty. So, declines in expected appreciation rates to this level do not imply stagnation in home values. This is yet another indication of how important a role that expectations of continued high price appreciation appear to be playing in Chinese housing markets. As noted above in the discussion of the Beijing land market, achieving a better understanding of what those expectations truly are and how they are formed clearly is an area in need of urgent research. The fact is that there is a very limited sample period available for people to use in informing their judgment on this matter, and it happens to have been a period of high average appreciation in the major markets, with there being a positive trend to that rate over the past decade. If people are backward-looking in some way, their anchoring on very high recent appreciation would help explain why the annual costs of ownership look very low.

4.3. Price-to-income ratios

Prices have been rising sharply relative to rents in all major markets in China, but the same is not the case with respect to income. Here we see some significant differences by region, with the markets in the interior off the coasts tending to have experienced income growth as high as or higher than their considerable house price appreciation.
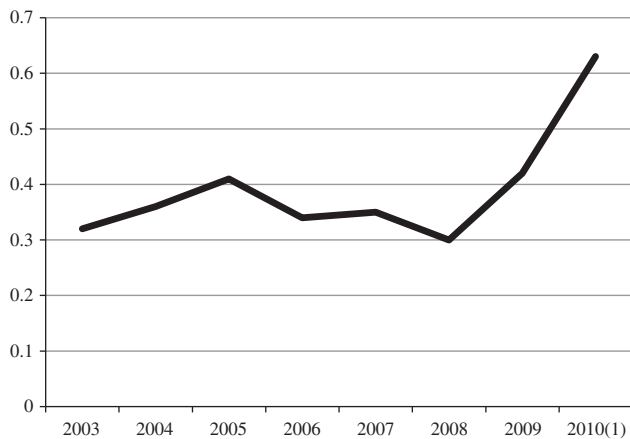
Fig. 9 plots price-to-income ratios over time for our eight major markets. These data are available further back in time, but are computed differently from traditional measures reported in the U.S. and other countries. For example, the standard formula for the price-to-income ratio in the housing literature is:

$$\text{price-to-income ratio} = \frac{\text{average total price of housing unit}}{\text{average household income}}. \quad (2)$$

However, neither the total price indicator nor the household income indicator is regularly reported in China, so we must re-write the formula as:

$$\begin{aligned}
&\text{price-to-income ratio} \\
&= \frac{\text{average housing price per sq.m floor area} \times \text{housing unit size}}{\text{average per capita income} \times \text{household size}} \\
&= \frac{\text{average housing price per sq.m floor area}}{\text{average per capita income}} \times \text{housing size per person}
\end{aligned} \quad (3)$$

Both the average unit sales prices of houses in yuan per square meter and the per capita disposable income are reported by the

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[32] For example, the pilot implementation of a property tax levy started in Shanghai and Chongqing beginning on January 28th, 2011. This type of policy is expected to expand to other cities during the next few years. The annual tax rates are 0.4%-0.6% in Shanghai, and 0.5%–1.2% in Chongqing, with both varying with house values. The implementation of property tax levy may adjust the user cost of owning properties.

Source: Authors' calculations.

Fig. 6. Average land share in house value, Beijing, 2003–2010(1).

National Bureau of Statistics in China,[33] and the unit size is presumed to be 30 square meters per person in the household in our calculations.[34]

Over the past few years, urban incomes have been rising faster than house prices in Chengdu, Tianjin, Wuhan, and Xian. In these markets, price-to-income ratios were no higher in 2009 than they were 3–5 years earlier, have not trended up since 1999, and did not experience a sharp jump in 2010(1). Prices fell relative to incomes in Shenzhen between 2007 and 2009, but the level of this ratio jumped discretely in 2010(1).

In the other markets, including the biggest coastal areas, house price appreciation has been outpacing even rapid income growth in the past few years. House prices have hovered between 14 and 15 times incomes in Beijing for the past three years, but this level is sharply higher than that experienced earlier in the decade, and it rose discretely to 18.5 in early 2010. Shanghai and Hangzhou also are experiencing rising price-to-income ratios, with their 2009 values being the highest those markets have seen since our data series begins. Unlike Beijing, they did not experience a sharp rise in prices relative to incomes in the first quarter of 2010.

These levels of the price-to-income ratios themselves will seem high to those more familiar with U.S. data, but direct comparisons are problematic. For example, gauging their appropriateness should be made at the household level, while our measure uses per capita income. The presence of multiple earners within the household would lower the reported ratios. In addition, some households may be consuming less than 30 m^2 of housing per person. In that case, our measure overestimates the share of income going to housing.

Unreported income is another reason why our measure may overstate the share of income going to housing. One recent report from an investment bank concludes that unreported income amounts to 30% of Chinese gross domestic product (Credit Suisse, 2010). While this is a very large fraction, the report does not claim that such underreporting has changed over time. This implies that one should be very wary of directly comparing price-to-income levels in China with those in the U.S. (or any other country). However, it also suggests that changes or jumps in this ratio are not due to measurement error

in income, but reflect some other changes. This is the primary reason why we believe the changes over time are more informative, with the discrete jumps in Beijing and Shenzhen in 2010(1) being especially noteworthy. Even with these caveats, it is clear that many Chinese households are spending considerable fractions of their incomes on housing.[35]

5. Has demand outpaced supply over the past decade?

Our final gauge of conditions in Chinese housing markets investigates whether there is any strong evidence that demand growth has outpaced supply growth over the past decade. Some combination of strongly growing demand with limited supply is needed to account for prices rising so dramatically and to such heights in most major Chinese housing markets. Whether the flow supply of new units is sufficient to satisfy the demand, which is strong because of the on-going rural-to-urban migration documented above, turns out the quite difficult to determine. Doing so requires a number of assumptions, and Table 7 reports back-of-the-envelope calculations of the ratio of net new housing units delivered to the local market over the past 11 years (1999–2009) to the increase in the number of households in the same market over the same time span.[36]

In five of the eight large Chinese markets, we estimate that the net new number of housing units provided since 1999 is at least as large as the net increase in the number of households. Of course, this does not necessarily mean that housing was being sufficiently supplied at the beginning of our time series or that latent demand is not higher than that indicated by actual growth in households, but it does indicate that we can find no evidence that actual population growth has been outstripping new construction on average over the past decade in Chengdu, Shanghai, Tianjin, Wuhan, or Xian.

The ratio of new supply to demand is below one in Beijing, Hangzhou, and Shenzhen. In Beijing, the number of net new households exceeded the net increase in the number of housing units (rental plus owner-occupied) by about 18% ($1/0.85 - 1 \approx 0.176$). Assuming this deficit accumulated in a linear fashion annually implies that demand exceeded supply by about 1.6% per year. The analogous figures for Hangzhou and Shenzhen are 3.4% and 4.5% per year, respectively.

In sum, local governments in the eight major Chinese markets we track have made quite a bit of land available for development over the past decade. In five of these large markets, enough new housing units (owned plus rental) appear to have been delivered to provide shelter for each net new household created in each market. In Beijing, Hangzhou and Shenzhen, there appears to be unmet demand for units. Hence, upward pressure on prices is to be expected in those places, although it is by no means clear that gaps of the type we estimate could account for the dramatic rise in home prices they experienced.

6. Conclusions and suggestions for future research

Economics does not have good predictive models of bubbles, and we could not provide a definitive test with our limited data, in any event. Even with much longer time series on prices, rents and incomes in the U.S., data series like those discussed above did not lead to any

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[33] Source: National Bureau of Statistics, "Statistics Yearbook of China".

[34] The 30 m^2 assumption is based on the following data and conclusions. First, according to the statistics published by the Ministry of Housing and Urban-Rural Development, per capita living space in urban areas increased from 20.3 m^2 in 2000 to 27.1 m^2 in 2006. Extending the positive trend yields our presumed figure of around 30 m^2 in 2010. Second, since 2006 the State requires that no less than 70% of newly-built private housing units in each market be no larger than 90 m^2. This suggests that the average size of newly-built private housing units would be around 90 m^2 in size, with the average household size in China being about 3 persons.

[35] There well could be cultural factors why Chinese households might be willing to spend more of their incomes on housing than (say) Americans. Many Chinese appear to have a strong preference for home ownership, partly because owning is viewed as an important sign of personal success and social status. Some researchers have linked this to the marriage market, where owning a home can be an important factor in achieving success in that market (Wei and Zhang, 2009). In addition, relatively undeveloped capital markets provide few alternatives for investing the large household savings that exist in China.

[36] See the notes to the table for details on the methodology used to compute these ratios.
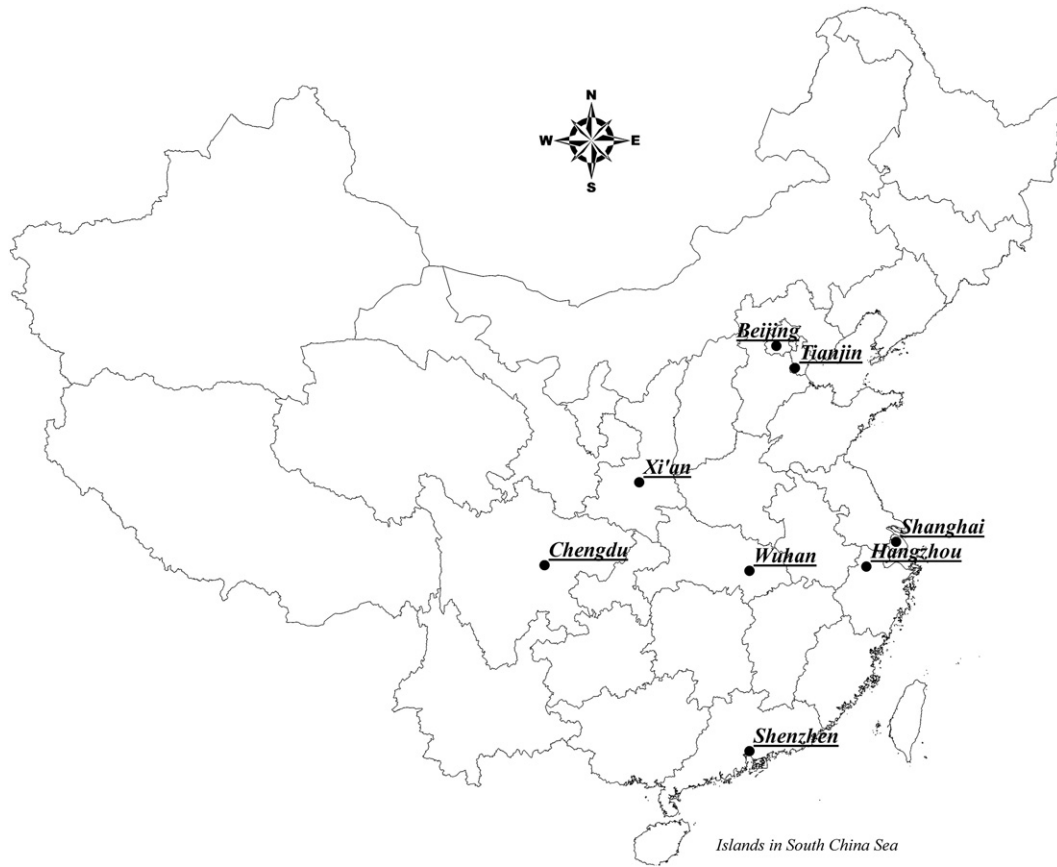
Fig. 7. Eight major Chinese housing markets.

Table 5
Population in eight major Chinese markets, 1999–2009.
Source: Statistics yearbooks in corresponding cities.

	1999 population (1000s)	2009 population (1000s)	% Change, 1999–2009	Compound annual growth rate, 1999–2009 (%)
Beijing	12,572	17,550	39.6	3.4
Chengdu	11,044	12,866	16.5	1.5
Hangzhou	6753	8100	19.9	1.8
Shanghai	15,888	19,213	20.9	1.9
Shenzhen	6326	8912	40.9	3.5
Tianjin	9595	12,282	28.0	2.5
Wuhan	8259	9100	10.2	1.0
Xian	7280	8435	15.9	1.5

consensus about American housing markets being mispriced. Claims of irrational exuberance and arguments about the sustainability of historically unprecedented price-to-rent ratios by Shiller (2005, 2006, 2008) were countered by equally prestigious researchers claiming that standard house pricing models implied no such thing (e.g., Himmelberg et al. (2005); Mayer and Sinai (2005)). No single piece or line of research was viewed as definitive, and certainly no consensus developed around any model or theory of mispricing in the American property markets.

The same is likely to be the case in China for much the same reasons. We believe that the best one can do, especially with limited data, is examine as many independent data sources as possible to see if systemic patterns are evident leading to the same answer. Multiple parts of the evidence presented in this paper suggest the potential for substantial mispricing in Beijing and other Chinese housing markets. Pricing seems very risky in the sense that only modest declines in expected appreciation are needed to generate large drops in house values absent offsetting changes in rents or other factors.

Expectations could be important in another way if people have become overoptimistic relative to true market fundamentals. Recent research by Glaeser et al. (2008) suggests that any overoptimism about future appreciation by home buyers is more likely to be sustained in markets with more inelastic supply sides. Any positive demand shock, whether or not justified by fundamental forces, will lead to greater price increases the more inelastic is supply (*ceteris paribus*). And, the bigger the price increase, the more likely that overoptimism is validated, so that the optimists feel no need to adjust their expectations downward. It is in this sense that overoptimism can persist for longer in inelastically supplied markets, which those authors show is the case in the U.S. data. The data from the previous sections suggests that this could be important in Beijing, Hangzhou and Shenzhen, where supply growth does not appear to have met demand over a period of years. As such, this looks to be an important area for future research.

The magnitude of the increase in land values over the past 2–3 years in particular in Beijing is unprecedented to our knowledge. Not only do these increases post-date the Summer Olympics, but the recent price surges in early 2010 suggest a relationship to the Chinese stimulus package which itself is temporary.[37] More broadly, the sharp rises in price-to-rent and price-to-income ratios since 2008 in Beijing and many of the other large coastal markets look to be very difficult to explain fundamentally.

Demand-side fundamentals tend not to change so discretely or with such force. Moreover, urban economic history teaches us that the fortunes of big cities tend not to wax and wane so quickly or steeply—

[37] More generally, it is the case that land value is rising in most cities across China. Simple calculations using data on the growth in average land costs, physical construction costs, and sales prices of residential units from the *Chinese Real Estate Statistics Yearbooks* readily confirm that house price increases cannot be explained by rising physical production costs. These data and analysis are available upon request.
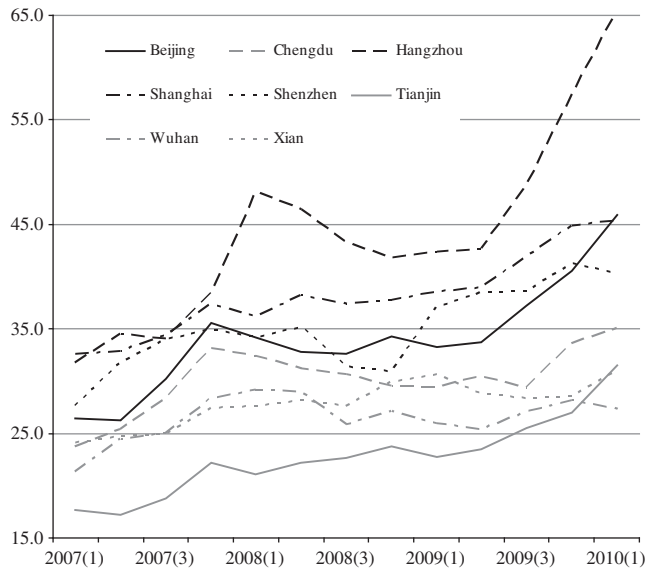
Fig. 8. Price-to-rent ratios in eight major Chinese cities, 2007(1)–2010(1).

Table 6
Breakeven expected appreciation rates equalizing implied user costs and rents.
Source: Authors' calculations.

	Π^e equalizing user cost and rent (%)	Mean annual appreciation, 1998–2009 (%)	# of years actual appreciation below Col. 1 (out of 11)	# of years below Col. 1 in last 5 years (out of 5)
Beijing	5.9	10.1	6	0
Chengdu	5.3	6.8	7	2
Hangzhou	6.6	8.5	5	1
Shanghai	5.7	9.3	4	1
Shenzhen	5.6	5.1	6	2
Tianjin	4.9	6.1	5	0
Wuhan	4.5	5.5	5	1
Xian	4.9	5.1	6	1

in peacetime, at least. We are aware of no sound estimates of supply elasticity akin to those available for U.S. cities (Saiz, 2010), so we cannot use the supply side of the market to inform us about the appropriateness of prices as in Glaeser et al. (2008). However, we do know that there is new supply being provided in all the major Chinese markets, although demand increases as reflected in the number of
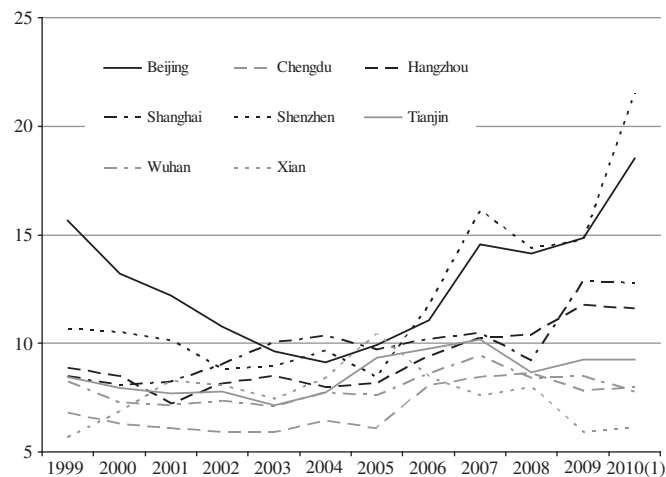

Fig. 9. Price-to-income ratios in eight major Chinese markets, 1999–2010(1).

Table 7
Ratios of new housing supply to demand, 1999–2009.

City	Ratio
Beijing	0.85
Chengdu	1.62
Hangzhou	0.73
Shanghai	1.12
Shenzhen	0.67
Tianjin	1.03
Wuhan	1.53
Xian	1.04

Notes: The numerator of the ratio reported is our estimate of the increase in households in each city between 1999 and 2009; the denominator is our estimate of the net new supply of housing units in each city over the same time period.

The number of households is estimated as follows. We begin with the reported population in each year, as provided by the statistic bureaus in corresponding Chinese cities. The number of households is determined by dividing the population number by average household size, as also reported by the statistic bureaus in corresponding cities. From this, we compute the change in urban households each year. To compile the ratio reported in the table, the numerator is the sum of the annual changes from 1999 to 2009.

The net number of housing units supplied is estimated as follows. We begin with the amount of housing delivered to the market, measured in square meters, as reported by the statistic bureaus in corresponding cities. Because each of these markets has an informal housing sector, we also try to control for its presence by subtracting the volume of housing removed each year, as reported by the construction bureaus in corresponding cities. This yields a net flow of housing measured in square meters. The number of housing units is arrived at by dividing by average unit size, which we presume to equal 100 m² in all cases. This assumption is based on data obtained on average unit size of private housing delivered by developers. Those data indicate unit sizes above 100. We use the lower number to reflect the fact that public housing is smaller on average. While this is an *ad hoc* assumption, experimentation showed that it did not affect the results reported in a material sense.

new households has systematically exceeded new supply of housing units over the last decade in the Chinese capital. So, not all the data point in the same direction even for the Beijing market.

One can readily appreciate the Chinese government's worries about its markets in the context of these data. The recent intervention policies, including higher mortgage down payment requirements, pilot implementations of property tax, prohibitions on purchasing multiple housing units, and the suspension of non-local purchasing, concentrate on the demand-side. How effective these policies will be in the broader economic environment in which the real rate of return on traditional savings accounts remains negative is unclear. We suspect they will help control speculative investments in owner-occupied housing to some extent. However, a truly broad-ranging policy would encourage more production on the supply side, too. In addition, the many demand-side constraints may bring unintended consequences to the welfare of non-speculators, and discourage intra-regional migration which may hurt regional economic growth. Finally, the conflict of interest between central and local governments can also cause policy incoherence, given the local governments' high dependency on land revenue as depicted in Fig. 3.

The complexity of the underlying economic environment makes it very difficult to predict how effective these different policy responses will be. However, the willingness of the Chinese government to intervene in response to possible mispricing is quite different from the announced policy of the leadership of the American Federal Reserve in this respect. As such, economists interested in both regulatory and monetary policy should be prepared to carefully monitor the behaviour and effectiveness of the Chinese State Council's interventions. At the least, there will be international comparison data for analysis.

We also need to better understand how a major correction in Chinese house prices, should it occur, would impact the Chinese economy. While that issue obviously is well beyond the scope of this paper, there are a few obvious questions for researchers. Given the U.S. financial crisis, which was driven by the subprime market, one naturally thinks about the potential for a broad banking crisis that

generates systemic risk. Chinese home buyers appear to have much more equity than the typical subprime borrower in the U.S. After all, the recent announcements by the Chinese State Council increased the down payment requirements for first home buyers from 20% to 30%. That still begs the question of whether that rule actually has been enforced in recent years. And, a large enough price drop can wipe out any amount of equity. However, it appears as if there is much more of an equity cushion among Chinese owners that would shield the banking system from considerable risk.

What is less clear is how the recent spike in lending associated with the national stimulus has affected the risk position and capital structures of the banks. Even less is known about the capital structure of developers, especially the central government-owned SOEs. The strong correlation of central government-owned SOE winning bids with land prices in Beijing suggests that moral hazard could be a real concern. These entities may be operating with subsidized costs of capital and believe that they are 'too big to fail'. At the very least, we need to begin calculating the exposure of these entities to the different land markets across China as a first step towards measuring their risk from a fall in house prices.

Beyond financial contagion matters is the issue of how a decline in the housing market might directly affect the real economy in China. During the last decade, investment has been a key driver of China's economic growth. In 2009, gross capital formation contributed over 90% of China's GDP growth,[38] greatly offsetting the negative impacts of the decrease in net exports that occurred during the global recession. Private housing investment accounted for 15.1% of total investment volume in urban areas in 2008, and 13.2% in 2009. The private housing sector currently accounts for over 40% (40.8% in 2008 and 42.6% in 2009) of the buildings under construction by the construction industry, and that industry is one of the most important industries in China. Its output constitutes 5.7% of Chinese GDP; it employs 14.3% of all workers in urban areas; and it consumes about 40% of all steel and lumber produced in China.[39] Estimating the impacts of a decline in housing production is well beyond the scope of this paper, but these data suggest they could be economically meaningful. Perhaps as important would be the impact of a significant price decline on the household sector. Both are yet more issues in need of further research.

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[38] Numbers in this paragraph are reported by National Bureau of Statistics, unless otherwise specified.
[39] Source: Minister of Housing and Urban-Rural Development, 2008.