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A Real Estate Boom with Chinese Characteristics

Edward Glaeser, Wei Huang, Yueran Ma, and Andrei Shleifer

Between 2000 and 2010, American housing went through a spectacular boom/bust cycle, which made and broke fortunes and left financial wreckage in its wake. Real prices of US homes grew by 5 percent per year between 1996 and 2006, and then declined by 6.4 percent per year between 2007 and 2012, according to Federal Housing Finance Agency data. Annual construction exceeded 1.9 million housing units in 2005 and 2006, and then dropped to an average of 688,000 units per year between 2009 and 2013.

Yet this US housing cycle looks stable and dull relative to the great Chinese real estate boom. In China's top cities, real prices grew by 13.1 percent annually from 2003 to 2013 (Fang, Gu, Xiong, and Zhou 2015). Real land prices in 35 large Chinese cities increased almost five-fold between 2004 and 2015 (Wu, Gyourko, and Deng 2015). As prices rose, so did construction. Between 2003 and 2014, Chinese builders added 100 billion square feet of floor space, or 74 square feet for every person in China (National Bureau of Statistics of China 2014; Chivakul et al. 2015). During this time, China built an average of 5.5 million apartments per year. In 2014, 29 million people worked in China's construction industry, or 16 percent of urban employment. By comparison, construction industry accounted for 8 percent of total

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employment in the United States and 13 percent of that in Spain at the peak of their most recent housing booms.

We begin by reviewing these facts and two other striking differences between the housing booms in the United States and China. Unlike in the United States, high vacancy rates are a distinct feature of Chinese housing markets. Vacancies include both completed units unsold by developers, and purchased units that remain unoccupied. We estimate that this stock of empty housing now adds up to at least 20 billion square feet. The other profound difference is the much greater and quite distinctive public sector engagement with real estate in China compared to the United States. For example, all urban land in China is owned by the government, and private individuals only buy and sell "use rights," which were originally bought from local governments and run for a maximum of 70 years. It is unclear what the government will do when those use rights expire. While many US local governments, especially on the coasts, fight against new development, Chinese local governments encourage building to boost local output and employment, as well as to raise revenue from land sales. The US government subsidizes home purchases through tax and credit policies, but does not have nearly as aggressive a home-building promotion program as its Chinese counterpart.

The dramatic size of the Chinese housing boom has left the world wondering whether Chinese real estate is a bubble waiting to burst. We approach this question by analyzing the determinants of demand and supply of housing in China. On the demand side, we examine the economic, demographic, cultural, and speculative factors shaping demand. We also consider valuations of apartment prices in China as a gauge of frothiness. Fang et al. (2015) find that price-to-income ratios range from 6 to 10 in their sample of Chinese cities—high but not unusually so. They also show that Chinese housing price growth is not faster than income growth, but their data stop in 2012 and rely on mortgage applicants who tend to have relatively high incomes. Since then, prices continued to rise dramatically in some cities. As of 2016, a 90-square-meter apartment in Beijing or Shanghai fetches more than 25 times average household income. Even so, conclusions on the valuation of Chinese housing based on demand factors turn critically on difficult-to-forecast national growth rates. If China continues to grow very fast, the existing high prices can be justified.

The supply-side approach to housing fundamentals is to compare housing prices to the physical costs of construction and an assessment of the long-run price of land. Building costs can be estimated with reasonable precision, but land values are hard to predict in markets where supply is constrained by geography and regulation. The supply approach to Chinese housing suggests that prices are far too high, especially outside the few top cities. Construction costs are typically less than one-third of the selling price of finished space in these cities. Absent regulation, land is not scarce in the country as a whole, especially away from the coast. The rapid pace of construction and the vast number of vacant units support the view that supply is currently elastic.

To put our empirical results together, we simulate possible prices in 20 years. We assume that speculative demand for housing cannot be sustained in the long run

and home prices stabilize at about 10 times income, a high but not implausible level by global standards. If income growth is robust and housing supply growth is effectively muted, then equilibrium prices in 20 years for apartments in top tier cities could exceed 2 million RMB. But even if income growth stays high, real returns on housing will be negative if future supply is as ample as it has been in the past.

We conclude that a housing crash is not inevitable, but that the outcome depends on decisions made by the Chinese government. Only if new construction is sufficiently restricted can prices remain high. Yet the social costs of restricting new housing supply could be significant, because of both the lower employment and reduced growth of China's hyper-productive cities. This is indeed a real estate boom with Chinese characteristics: like much of modern China, its fate rests ultimately with government decisions.

Four Differences between the Housing Booms in China and the United States

In this section, we compare four aspects of the great housing booms of China and the United States: housing prices, construction, vacancies, and the roles of respective governments. While the United States may offer a less natural comparison for China than other middle-income countries (like Brazil), the US housing boom is well measured and particularly well studied. It offers a benchmark that helps to put the Chinese boom into perspective and highlight its unique features.

Housing Price Growth in China and the United States

Housing price growth and decline between 1996 and 2012 in the United States are well documented, typically using repeat sales indices prepared both by private industry, such as the Case-Shiller index, and by the Federal Housing Finance Agency. Two facts about the US housing prices are largely uncontroversial: First, housing prices grew dramatically after 1996 and then fell dramatically after 2007. Second, there was considerable heterogeneity in price growth across metropolitan areas, which is typically related to supply elasticities (Saiz 2010; Glaeser 2013).

Official statistics in China show a "mere" doubling of housing prices between 2007 and 2014 (Chivakul et al. 2015) and some degree of moderation in housing price rises more recently. These statistics are often questioned as understating actual price growth. Fang et al. (2015) present the most compelling work to date on quality-adjusted housing price growth in China. Their data for new homes uses development project fixed effects to control for changing quality. They thus estimate price changes by comparing sales prices of units of comparable size in the same development project sold in different years. While this approach is only likely to yield price estimates for the newer housing stock, it seems far more reliable than the alternatives.

China's cities are typically divided into four categories or tiers, based on the level of economic development. Tier 1 includes only the four most developed

metropolitan areas: Beijing, Shanghai, Shenzhen, and Guangzhou. In these areas, demand is most robust and supply is most likely to be restricted. Tier 2 includes most provincial capitals and some very developed prefecture cities. These are typically large, industrialized, and have relatively strong local economies. Tier 3 includes prefecture cities that have medium to high levels of income, which are smaller but still large by western standards. Tier 4 cities are further down in economic development and size, but still very populous compared to the average western city. As these categories are the norm in Chinese real estate analysis, for the comparison with the United States we create corresponding tiers of US cities. We first rank US cities according to income per capita in 1990, prior to the start of the US housing boom. We then draw tiers based on income and require that each tier has the same population share as its Chinese counterpart.

Fang et al. (2015) report real annual price growth of 13.1 percent in Tier 1 Chinese cities between 2003 and 2013, despite a slowdown during 2008 and 2009. Even the Tier 3 Chinese cities have seen an average of 7.9 percent real annual price growth between 2003 and 2013. Figure 1 shows the real price growth in the top three tiers of cities in China between 2003 and 2013. It compares this growth with real housing price growth in the top three tiers of US cities between 1996 and 2006. For each line, the start year is given a value of one. The Chinese growth in housing prices is far more dramatic. Housing price growth in US Tier 1 cities was impressive from 1996 to 2006, but it was slower than the growth of Tier 3 cities in China over their boom period and only 40 percent of the growth of top tier cities in China during their boom.

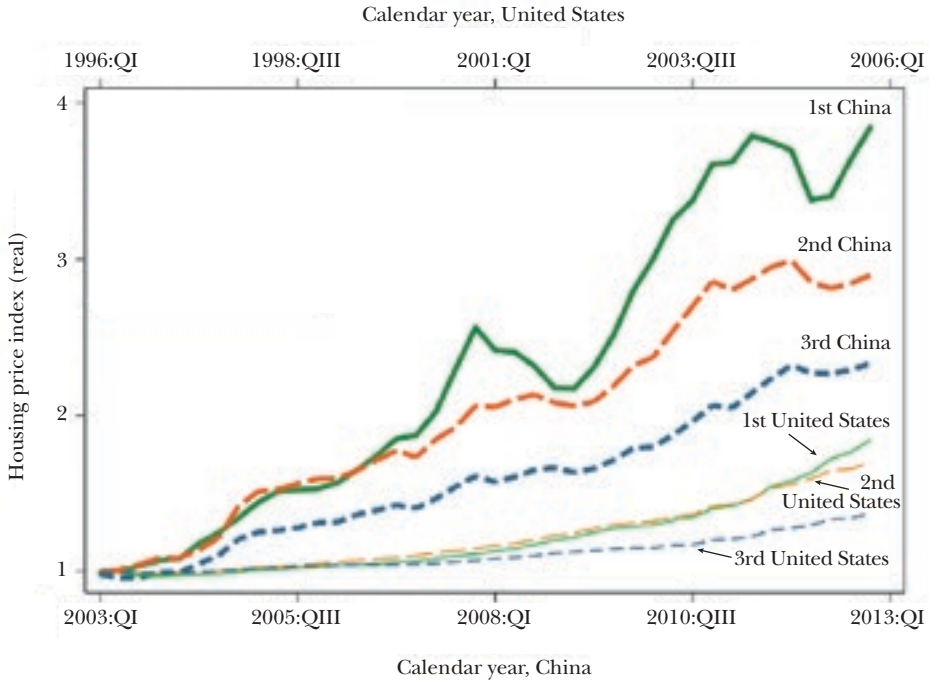
With such dramatic price growth in the past 15 years, apartments in the top Chinese cities are currently not much cheaper than in major American cities. According to Soufun data, the average price per square foot has risen to $550 in Beijing and Shanghai and $770 in Shenzhen. Zillow data currently shows San Francisco apartments costing $1,000 per square foot, and Boston units costing $600 per square foot. This similarity in prices is remarkable given that annual per capita income in Beijing, Shanghai, and Shenzhen is about $7,500, compared with more than $50,000 in San Francisco and $40,000 in Boston. The price levels in China's second and third tier cities are about one-half and one-quarter of those in the first tier cities, respectively, but average incomes are also lower by a similar magnitude.

The Size of the Building Boom in China and the United States

A construction boom of epic proportions has accompanied the price boom in China. Across China as a whole, construction value added came to 6.9 percent of GDP in 2013. Sixteen percent of China's urban employment, or 29 million people, worked in the construction sector in 2014.

We compare the construction of physical, typically residential, real estate in China and the United States. In the United States, household surveys provide estimates of the total housing stock on an annual or quarterly basis. In addition, the US Bureau of the Census provides measures of the flow of new housing construction, such as the flow of new building permits and estimates of total units completed.

Figure 1
Price Growth by Tier: China and the United States

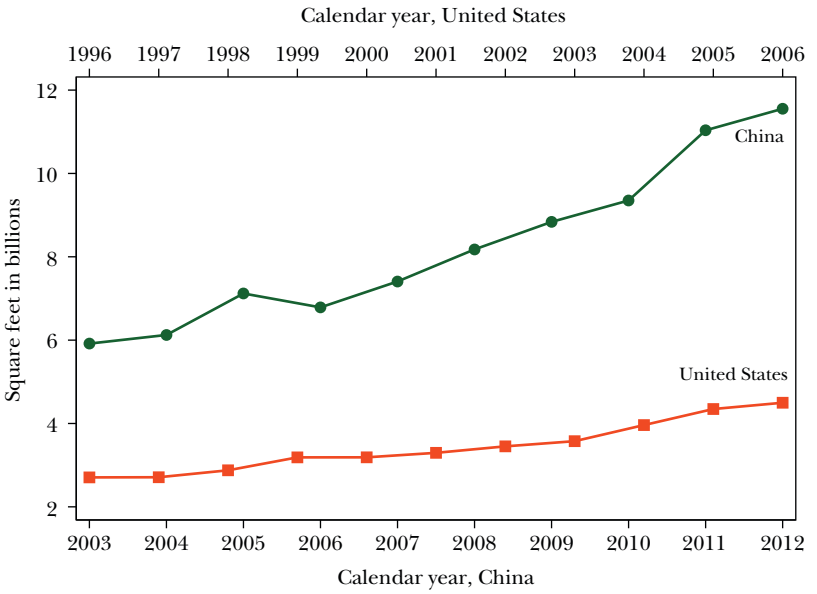


Source and Note: Housing price index data for China are from Fang et al. (2015). Housing price index data for metropolitan statistical areas (MSAs) in the US are from the Federal Housing Finance Agency. We construct tiers in the US by ranking US MSAs based on 1990 income per capita and assign tiers so that each tier has the same population share as that in China; the richest MSAs are assigned to 1st tier and so on and so forth. We calculate the real price index using the nominal price index adjusted for inflation. Price indices in each tier are weighted averages of city-level price indices.

Chinese census data provide snapshots of the housing stock at points in time but provide less-comprehensive information than their US equivalents. There are also estimates of China's new construction activity at the country and provincial levels on an annual basis.

Figure 2 shows the growth in floor-space in China and the United States. For China, we use the official statistics on housing area completed nationally. For the United States, we multiply the number of completed single-family homes by the average size of new single-family homes in that year. We then add the number of multi-family homes multiplied by the average size of new multi-family homes in that year. Figure 2 shows a large difference in total construction, which translates into similar scales on a per capita basis. For instance, between 2011 and 2014, China built 45.9 billion square feet of residential floor space, or 33.8 square feet per person. We estimate that the United States produced 16 billion square feet between 2003 and 2006, or about 55 square feet per person. In other words, although China is much

Figure 2
Construction (Square Footage) in China and the United States



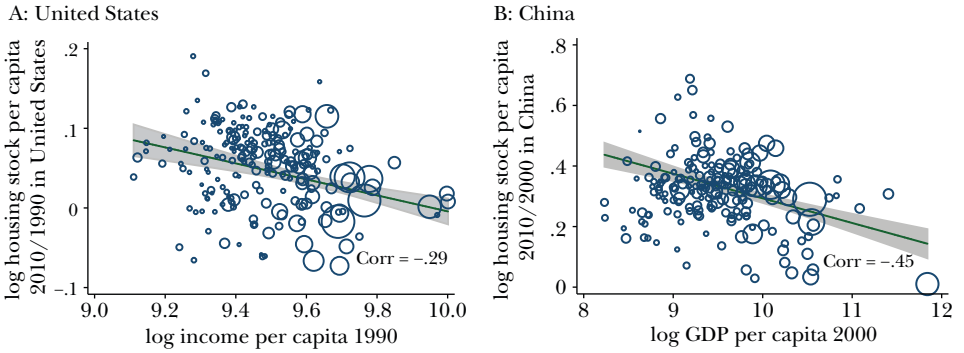
Source and Note: Annual completed residential space for China is from *China Statistical Yearbook*. Annual completed residential space for the US is calculated as units of single family homes completed multiplied by average square footage of new single family homes, plus units of multi-family homes completed multiplied by average square footage of new multi-family homes

poorer and its housing units are much smaller, it is producing about as much floorspace per person as the United States.

One striking fact about US construction growth is that more housing was built in less-productive areas, which creates a mismatch between productivity and employment discussed by Hsieh and Moretti (2015). Figure 3A shows a −0.29 correlation between per capita income in 1990 and housing supply growth between 1990 and 2010. A major reason for this misallocation of construction is supply restrictions in the most productive cities, such as zoning regulations (Glaeser, Gyourko, and Saiz 2008). Figure 3B shows the same striking negative relationship across Chinese cities between 2000 and 2010, with a slope coefficient of −0.45. The Chinese story here may be similar to the American one: local governments with the weakest economies have been the most aggressive in promoting new housing supply, perhaps as a means of generating economic growth, while local governments in the richest cities have been slowing down construction.

We have also used data provided by Matthew Khan and Siqi Zheng to examine whether air quality is correlated with urban growth and house price growth over the past decade. There is no correlation between initial air quality and subsequent price growth. There is a positive correlation between initial air quality and population growth among Tier 1 and Tier 2 cities, but not across the full sample of cities.

Figure 3
Construction and Income across US and Chinese Cities



Source and Note: In panel A, housing stock per capita and income per capita for US metropolitan statistical areas (MSAs) are from the decennial census. In panel B, housing stock per capita for Chinese prefecture level cities is from 2000 and 2010 censuses and is restricted to counties that are designated as urban in the 2000 census. Log GDP per capita in 2000 is from *China City Statistical Yearbook 2000* for city proper. The correlations are weighted by initial population.

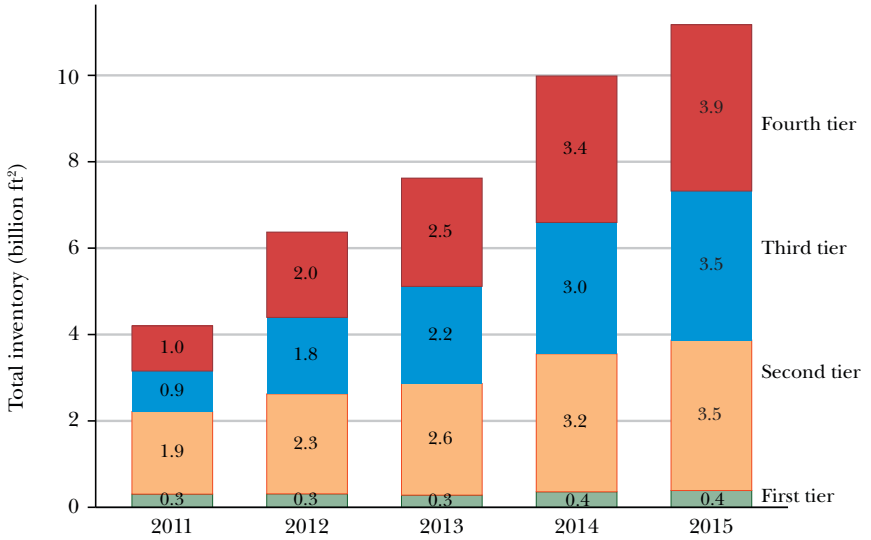
Housing Inventories and Vacancies in China and the United States

The death knell of the US housing boom was sounded by large inventories in Las Vegas that were brought swiftly to market in 2007. When developers offered the many units they owned for quick sale, prices quickly moved downwards and perhaps found a new equilibrium. Compared to the United States, inventories held by developers and unoccupied housing held by households are much larger in the Chinese boom. Unsurprisingly, this raised concerns about the viability of the boom.

At the height of the US boom, developers owned 573,000 unsold and unoccupied homes, according to the National Association of Home Builders. The vacancy rate among owner-occupied homes reached a high of 3 percent in 2008, and this statistic does not include "temporarily" vacant units. But, overall, relative to the stock of 130 million American homes as of 2010, the United States has relatively few vacant homes.

For China, our primary source for developers' inventory is Soufun, which compiles data from local housing bureaus (Fangguanju). The data covers developers' inventories for 32 major Chinese cities. We combine this data with statistics on vacant homes held by households, which is based on the Chinese Urban Household Survey (UHS). Figure 4 shows estimates of inventory by tier over time. We estimate inventories for each tier using the tier's inventory per capita in the Soufun data multiplied by the tier's urban population. The total inventory numbers show an increase from just over 4 billion square feet in 2011 to over 10 billion square feet in 2015. The bulk of this growth occurred in the lower-tier cities. For example, inventories in Tier 1 cities grew from 310 million square feet in 2011 to 390 million square feet in 2014, followed by a slight decline in 2015. Total estimated inventory in

Figure 4
Developer Inventory Estimates by Tier



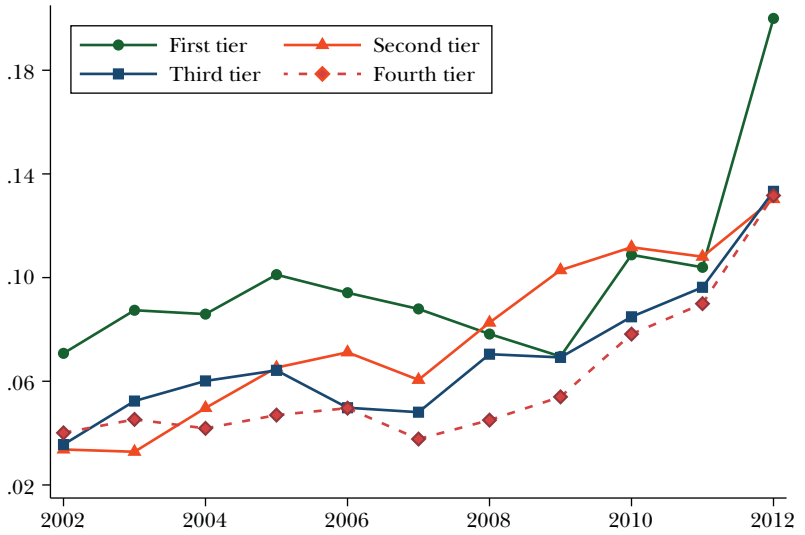
Source and Note: Developer inventory data is from local housing bureau (Fangguanju), and compiled by Soufun. Because the data does not cover all the cities, our estimates of inventory in each tier are based on inventory per capita by tier multiplied by urban population in each tier. Because the data do not have many Tier 4 cities, we also assume the Tier 4 cities have the same inventory per capita as the Tier 3 cities. In total, the estimates cover 262 prefecture level cities: 4 cities in the first tier, 34 in the second tier, 84 in the third, and 140 in the fourth.

Tier 3 cities increased from 940 million square feet to 3.9 billion square feet from 2011 to 2015.

To put these quantities into perspective, China's occupied housing space in urban areas is 111 billion square feet based on the 2010 census, with 7.7, 32.1, 32.2, and 39.5 billion square feet in the first to fourth tier cities respectively. We can also compare developer inventory in China and the United States on a per capita basis. The average new US home in 2006 was 2,500 square feet, and the US population was almost 300 million. The 527,000 new housing units in the developers' inventory in the United States in 2006 thus translate to about 4.5 square feet per capita. By 2015, developer inventory reached about 6 square feet per capita in China's Tier 1 cities, and 20 square feet per capita in Tier 2 and Tier 3 cities. The developers' stock is much higher in China than in the United States, and is concentrated not in the most successful cities, but in the less-developed ones.

Visitors to Chinese cities are sometimes struck by the number of vacant apartments. Many of these units are owned by household investors who just leave their properties empty. We can get some sense of this stock of purchased but vacant units by looking at the Urban Household Survey. We compute a vacancy rate across 36 cities by calculating the total number of vacant units owned by the residents of each city in the sample, and then dividing by the total number of housing units owned

Figure 5
Household Vacancy Rates 2001–2012



Source: Data from China Urban Household Survey.
Note: We compute a vacancy rate across 36 cities by calculating the total number of vacant units owned by the residents of each city in the sample, and then dividing by the total number of housing units owned or occupied by the city's residents in the sample. We keep the 36 cities with observations throughout 2002–2012.

or occupied by the city's residents in the sample. Anecdotal evidence suggests that owning properties outside one's own metropolitan area is rare.

Figure 5 shows these sold-but-vacant figures from 2002 to 2012 for a sample of 36 cities. The vacancy rates look relatively flat from 2002 to 2008 and then rise sharply after 2009. In 2012, the vacancy rate drew close to 20 percent in Tier 1 cities. The rates for lower-tier cities were about 13 percent.

In Table 1, we combine estimates of total developer inventories with estimates of total household vacancies. To ensure representativeness, we use vacancy estimates based on the 2009 Urban Household Survey.[1] We take the average vacant space per capita in each tier and estimate total vacant space in that tier by multiplying by its urban population. This estimate is conservative, as vacancy rates have increased since then. We pair the vacancy estimates with inventory estimates for 2014 to provide an up-to-date picture, as total developer inventories almost doubled from 2011 to 2014. Data for 2014 also cover the largest set of cities in our developer inventory dataset.

The estimates imply that there are about 16 square feet per capita of vacant real estate in Tier 1 cities, of which 5.5 square feet is owned by developers, and 10 square

[1] Up to 2009, China's Urban Household Survey provides data on household vacancies for up to 120 cities (but data are only available for 36 cities from 2010 to 2012).

Table 1
Estimates of Inventory and Vacancies

Tier of city (1)	*Developer inventory per capita (ft^2) (2)*	*Household vacancy per capita (ft^2 per capita) (3)*	*Urban population (million) (4)*	*Predicted developer inventory (billion ft^2) (5)*	*Predicted vacancy (billion ft^2) (6)*	*Developer inventory + vacancy (billion ft^2) (7)*
1	5.5	10.4	57.7	0.32	0.60	0.92
2	17.1	19.9	166.9	2.85	3.33	6.17
3	14.5	16.0	185.1	2.69	2.97	5.66
4	-	12.9	206.5	3.00	2.67	5.67
Total	**13.2**	**15.4**	**616.2**	**8.86**	**9.56**	**18.42**

Source: Inventory area per capita is calculated from local housing bureau (Fangguanju) data for 2014 compiled by Soufun, and vacant area per capita is calculated based on 2009 Urban Household Survey.
Notes: Urban population is from the 2010 census. Column 5 is column 2 multiplied by column 4, and column 6 is column 3 multiplied by column 4. Column 7 is the sum of columns 5 and 6. We assume 4th tier cities have the same inventory per capita as 3rd tier cities.

feet is owned by household investors. The total would be 20 square feet per capita if we instead used the Urban Household Survey from 2012. In Tier 2 cities, there is 37 square feet per capita of vacant real estate, split more or less evenly between developers and household investors. There are 30 square feet per capita in Tier 3 cities. In the cross section of cities, both developer inventories and household vacancies on a per capita basis are highly positively correlated with past price growth.

These data provide a picture of an enormous stock of unoccupied new housing in China, which dwarfs the US equivalent in 2006 (4.5 square feet per capita). The combination of crowded cities and empty housing stock is a highly distinctive feature of Chinese housing today.

A Regulated Bubble? The Greater Role of the Public Sector in China

The American real estate sector is hardly a bastion of laissez-faire capitalism. A web of local land use controls regulate the industry and restricts supply, while national policies, including the Low Income Housing Tax Credit, the home mortgage interest deduction, and the government-sponsored enterprises like Fannie Mae and Freddie Mac subsidize home purchases. Still, the shifting dynamics of the US housing industry are only modestly shaped by the national and local governments.

In China, the public sector retains far more control over future prices and construction. Most importantly and dramatically, all land in China is owned by the state, and the central government decides which land can be auctioned to private developers. Land auctions do not confer permanent ownership, but rather the right to use the land for several decades (up to 70 years). Article 70 of the Chinese Property Rights Law of 2007 does grant the ability to own the structures on the land but not the land itself. Article 149 suggests that use rights will be automatically renewed, and so far, China's government has not extracted additional fees for the relatively unconstrained rights to use the land after the first land sale, but it is unclear what compensation local governments will require for use right renewals in the future.

Anyone buying real estate for the long haul must trust the Chinese government to roll over their land leases at a reasonable cost.

Back in 2000, 70 percent of Chinese floor space was built by state-owned enterprises and housing collectives. In 2013, such public entities only built 13 percent of China's floor space. But the decline of formal public construction activity does not mean that the private construction operates without public guidance. Both the central and local governments are deeply involved in the housing market, and government incentives play a key role in shaping market outcomes.

Since Deng Xiaoping declared that "to get rich is glorious," China's leaders have promoted economic growth with remarkable success, with construction playing a pivotal role in these efforts. Leaders of local governments are promoted or penalized depending upon their ability to attain national growth objectives (Li and Zhou 2005). With ample credit and low construction costs, developers build towers that add to the GDP. The construction activity itself is measurable economic output, and ideally the buildings will then attract commercial and residential tenants who further boost local growth.

Another important incentive that pushes Chinese governments, particularly the local governments, towards real estate development comes from the Chinese tax system. The tax system in China leaves local governments with a limited stream of ongoing fiscal revenues. A key source of fiscal income is land sales revenue, which is collected in the transfer of state-owned land to developers. Taxation of real estate development and apartment sales also contributes to local fiscal revenue. In some years, revenues from land sales accounted for as much as 40 percent of local government fiscal revenue (Wu 2015). This revenue system helps explain why Chinese local governments are very enthusiastic about new construction.

Since the late 2000s, China's central government has increasingly shifted focus to housing market stability, and has held the local governments accountable for price stability targets. Under the central government's guidance, local governments have sought to stabilize housing prices, using restrictions or subsidies on home purchases and tightening or loosening controls on new development. The goals of economic growth and price stability, however, are often in conflict: maintaining high prices by restricting supply undermines the growth coming from construction.

Government interventions impact all players in the Chinese housing market. When it comes to developers, the Chinese local governments, like their US counterparts, regularly impose land use restrictions such as maximum floor-area ratios, although developers sometimes manage to exceed the originally mandated limit (Cai, Wang, and Zhang forthcoming). Unlike in the United States, the Chinese central government also frequently intervenes to regulate local land development. Such interventions restrict the conversion of land from agricultural to urban uses, limit the use of land for golf courses and luxury housing, and mandate development of apartments with certain sizes.

When it comes to homebuyers, American and Chinese governments have pursued very different policies. Despite some local land regulations, the US promotes homeownership through tax and credit policies. China is much more

cautious. Interest rates on mortgages, as well as minimum down payments, tend to be high. To curtail speculation, Chinese governments have also tried to directly restrict second and third home purchases, and to limit the resale of homes in less than five years. Property taxation on homeowners is also strikingly different. US governments tax real estate on an annual basis, which creates a sizable cost to holding real estate. Chinese real estate taxes are imposed only on transactions, creating an incentive to buy-and-hold.

When it comes to banks, state-owned institutions have historically dominated China's banking system, and at every level, banks' policies towards the housing market follow the government's lead. The financing for developers by government-controlled banks is critical for understanding housing in China. Historically, China had very favorable credit policies toward developers, and banks are pushed to lend. Developers are highly leveraged, and to some extent enjoy the "heads I win, tails the bank loses" situation. On the mortgage side, banks are also under government direction to adjust mortgage rates to discourage (or occasionally to subsidize) home purchases, as part of housing market stability management. But banks have not been required to systematically support home ownership, as they have been required to support construction. Although China's government has become increasingly careful of risks in development loans and tightened them in recent years, the stockpile of debt is still enormous. According to official statistics, Chinese developers had $6.2 trillion of debt by 2014, whereas households had $3.8 trillion.

In sum, the main US housing market policies encourage mortgage borrowing and restrict new development with local land use regulations. The most important Chinese housing market interventions boost construction and restrict mortgage borrowing. With these policies, it is unsurprising that China builds much more than the United States. It is perhaps more surprising that Chinese housing price growth has been so much greater, given the discouragement of home borrowing and the encouragement of new supply. This strong demand for housing, as we discuss below, is mostly coming from Chinese households who flood the real estate market with their savings and investment demand, as opposed to a levered play on a "house of debt."

Does China Have a Real Estate Bubble?

Will China's real estate boom end in a bust? We discuss two approaches to assessing whether housing is in a bubble. The demand-side approach focuses on the motivations and the behavior of buyers, but also considers whether prices seem reasonable given proxies for the demand for housing services, such as income. The supply-side approach asks whether prices seem reasonable given the cost of delivering new real estate. Here we present some facts bearing on these two ways of thinking about China's housing boom, as before, frequently comparing China and the United States.

The Demand-Side Approach to Assessing Bubbles

In the United States, many homebuyers during the boom were young and highly leveraged. Mian and Sufi (2008) document the role of subprime lending fueling the US housing boom. Glaeser, Gottlieb, and Gyourko (2010) use DataQuick loan data and find that the median US homebuyer in 2006 had a loan-to-value ratio of 90 percent. Over one-quarter of the buyers put no money down, often by using multiple mortgages.[2] The US boom featured a huge rise in the share of single homebuyers, and in 2006, almost 60 percent of loan applications came from one-person households. The National Association of Realtors data show that in 2005 and 2007 in the United States, 67 percent of new homes and 40 percent of all homes were bought by people under the age of 35.

In China, housing investment is fueled by middle-aged households saving for retirement or for their children's marriage. Home ownership has always played a prominent role in the Chinese society, and is remarkably high, standing at roughly 90 percent compared to about 65 percent in the United States.

Chinese households are well known for high saving rates, motivated by many factors from economics to culture (Chamon and Prasad 2010). Chinese savers have been pushed towards housing as a crucial form of investment, not because it is easy to borrow but because it is difficult to invest. Chinese mortgage rates have often been much higher than in the United States, and down payment requirements have rarely fallen below 20 percent. For Chinese savers buying real estate as investment assets, however, the more relevant cost of capital is not the mortgage rate but the opportunity cost of putting their funds elsewhere. The average real interest rate on Chinese bank deposits has been about zero over the past decade. The Shanghai Stock Exchange Index has had average annual real returns of zero from 2001 to 2016, which are anemic relative to more than 10 percent annual real returns to Shanghai real estate over the same period. Tight capital controls also restrict investing abroad. Moreover, traditional agrarian culture in China cultivates a strong preference for owning land and real estate. Painter, Yang, and Yu (2003) find that home ownership is 18 percentage points higher among Chinese than among white households in the United States, after controlling for household characteristics.

In addition to investing for wealth preservation, many Chinese households find it important to purchase real estate for their children, as home ownership is considered close to a necessity for marriage (and required especially for successful marriage of young men). This tradition is reflected in a high home ownership rate among young Chinese households, most of whom bought their properties with funds that to a significant extent came from their parents. The homeownership rate for Chinese households below 35 in 2013 is around 55 percent, based on data from the China Household Finance Survey, compared to 37 percent in the United States. Wei and Zhang (2011) provide detailed evidence of a competitive savings motive for

[2] From 1998 to 2007, the 75th percentile of the loan-to-value distribution for new buyers never fell below 95 percent in the United States. The mean loan-to-value level was 74 percent in 2006 (over the first three mortgages on the home), reflecting the significant number of US buyers who borrowed far less.

children's marriage in China, and the China Household Finance Survey also indicates that ownership of multiple residences and vacant residences is higher among families with unmarried young men.

Both the investment motive and the marriage motive contribute to Chinese households buying second homes if they can afford them, even without occupying them. The Chinese Urban Household Survey for 2009 contains data on ownership of second homes. The data show that these owners are richer and better-educated than the average survey respondent. Owners of vacant homes have 34 percent higher earnings than average, and 0.9 more years of education. Chinese investors are mature and prosperous. The average age of the investors is 49, and 95 percent of them are married. Estimates from several sources suggest that housing accounts for 70 to 85 percent of urban households' total assets in China (Huang 2013; Xie and Jin 2015). Despite the heaving investment in real estate, the ratio of total Chinese household debt to GDP was still under 40 percent by the end of 2015, according to data from the Bank of International Settlements (BIS Statistics Explorer, Table F3.1, Q1 2016, http://stats.bis.org/statx/srs/table/f3.1). In comparison, in the first quarter of 2008, US household debt reached 99 percent of GDP, according to data from the International Monetary Fund (reported at FRED Economic Data, https://research.stlouisfed.org/fred2/series/HDTGPDUSQ163N).

Are these Chinese real estate investors overly optimistic? In the US context, Case, Shiller, and Thompson (2012) use survey evidence to document the extremely strong overoptimism of home buyers. Simple extrapolative models do seem to fit the stylized facts of the US real estate market, such as the strong positive serial correlation in price changes, remarkably well (Glaeser and Nathanson forthcoming). There is also a robust correlation between past price growth and stated expectations about future price growth in the United States (Williams 2013). On the other hand, US optimism about real estate prices during the housing price boom had little justification other than past price growth. Chinese investors in their 50s have lived through a national economic growth miracle. Their optimism about future price growth is surely understandable, although not necessarily correct. Whether or not their buying decisions are based on overoptimism, the portfolios of the Chinese middle class are highly skewed towards real estate. Significant changes in housing values will have a considerable impact on their future well-being.

An alternative way to ask whether demand for housing is speculative and excessive is to assess whether the price of the asset is roughly equal to the value of the flow of services that the asset will deliver. In finance, this approach compares prices with flows of earnings or dividends (Shiller 2000). High prices compared to earnings are a possible candidate for bubbles.

In the case of housing, the approach typically compares housing prices to rents, assuming that rents capture the flow of services from owning the house. When interest rates are low, small differences in expectations about future growth rates can generate wild swings in the predicted price to rent ratio. As a result, some concluded that US prices in 2005 were compatible with current rents and rationality

(in this journal, Himmelberg, Mayer, and Sinai 2005). In the Chinese case, renting is so rare that rental data is unavailable for units comparable to new properties.

An alternative to rent is to compare prices to income, which *The Economist* (2016) has referred to as "a gauge of frothiness." Fang et al. (2015) use this approach in their balanced discussion of whether China has "a housing bubble that is about to burst." They note both that "housing prices are indeed expensive to the income of many households," and that "price appreciation has been mostly accompanied by equally impressive income growth." They report "price-to-income ratios of around eight in second- and third-tier cities and, in some years, even over ten in first-tier cities." These ratios are quite high by global standards, but the parallel trends of income and price growth remind us that optimistic Chinese buyers look far more sensible than their American counterparts who paid sky-high prices during the US housing price boom despite only moderate US economic growth during those years.

But a constant price-to-income ratio is neither necessary nor sufficient to establish the existence of a bubble. If houses, or any product, can be built for a fixed cost of $100,000, then even if house prices temporarily rise above $100,000 and keep pace with rapid income growth, they may still ultimately fall down to the cost of supply. Alternatively, prices can rise faster than income growth in places with restricted supply, perhaps because amenities are increasing, and there is no reason for these high prices to later crash.

In China, educational and medical resources are heavily concentrated in major cities, and the *hukou* system restricts access to many resources to local residents. Home purchases and permanent residence in top tier cities is one step towards becoming a local resident. Consequently, high housing prices could in part reflect a premium on urban amenities and expectations about future demand for urban amenities.

Overall, price-to-rent or price-to-income ratios offer remarkably little precision about whether housing prices are too high or too low. Slight changes in projected growth or interest rates (Chinese mortgages are typically variable rate) cause the implied price to rent ratio (or price to income ratio) to change substantially. Because we do not know the future value of urban amenities, it seems hard to have much confidence about what the demand should be for urban space.

The Supply-Side Approach to Assessing Real Estate Bubbles

The demand-side calculations, taken alone, ignore the power of supply over housing prices. Glaeser (2013) argues that in the history of US real estate bubbles, the most common mistake for investors is to ignore the role that supply plays in determining prices of housing and land. Investors buying in London's Belgravia or Paris' Ile St. Louis can probably rest secure that these areas will not be flooded with new housing supply. But we have already documented the enormous amount of new construction and massive quantities of vacant homes in Chinese cities. Supply seems still elastic in many Chinese cities, especially outside the first tier, although that could change quickly with a shift in public policy.

The physical cost of construction in China appears to be quite low, and fairly similar across different cities. We use construction cost estimates from two standard

sources. The first source is the China Engineering Cost Network, directed by the Ministry of Housing and Urban-Rural Development. The second source is the *China Real Estate Yearbook*. As of 2014, the China Engineering Cost Network provides a cost of 1,362 RMB per square meter for multistory housing and 1,817 RMB per square meter for high-rise housing. This would represent a cost of between $19 and $26 per square foot for building, which is astonishingly low by US standards. The total physical cost at completion from the *China Real Estate Yearbook* is somewhat higher, at 2,730 RMB per square meter, about $38 per square foot. Their estimates appear to include some softer cost and additional expenses. Developers typically report that 1,800 RMB per square meter is a reasonable industry standard for hard costs in recent years. Total cost has gone up substantially since the early 2000s, based on the *Yearbook* data. These rising costs may reflect increasing labor costs or improving quality of construction, but they remain low relative to prices. Moreover, technological progress in construction is likely to keep future construction costs low. Modular skyscraper design seems to have enabled one developer to build a 57-story apartment building in 19 days (as reported by Baer 2015).

Construction costs in China are typically given on a gross square footage basis (that is, including halls, stairwells, and the like), while sales prices refer to net square footage. As gross square footage can readily be 40 percent higher than net, construction costs range from 2,000 RMB per square meter to 3,800 RMB per square meter of usable space. These costs should be compared with the current prices of over 35,000 RMB per square meter in Shanghai and Beijing, 18,000 RMB per square meter in Guanzhou, and 10,000 RMB per square meter in Wuhan. Soufun's 100 city index shows an average sale price of 12,000 RMB per square meter by mid-2016. Construction costs appear to be less than 30 percent of sale prices in typical Chinese cities, and perhaps as little as 15 percent in the top tier cities.

The large gap between construction costs and prices does not necessarily imply that developers are earning huge profits. Land is expensive and taxes are high. Wu, Gyourko, and Deng (2015) have built a remarkable index of land prices in China based on repeat land sales (available at http://real.wharton.upenn.edu/~gyourko/chineselandpriceindex.html). They find that real land prices in 35 Chinese cities increased five-fold between 2005 and 2015. For 2014, Wu, Gyourko, and Deng (2015) data show an average land price of 23,385 RMB per square meter of floor area in Beijing (based on 31 parcel sales) and 20,620 RMB per square meter in Shanghai (based on 41 sales). Lower-tier cities have lower land prices. In a relatively well-off provincial capital like Wuhan, land prices average 4,839 RMB per square meter (based on 40 sales). Most Tier 2 and Tier 3 have land prices of around 1,000 RMB per square meter (Deng, Gyourko, and Wu 2012) and average sales price of around 5,000 to 10,000 RMB per square meter.

There are two ways in which the land cost contribution to building costs could decline and bring prices closer in line with construction costs. First, Chinese cities could permit higher floor-to-area ratios, which determine the ratio of built floor space to land in an entire parcel, and thus reflect both building height and vacant land left around buildings. Despite the height of many Chinese buildings, actual

floor-to-area ratios are relatively low. Cai, Wang, and Zhang (forthcoming) show average floor-to-area limits for new residential construction of two in many cities (for example, 2.12 in Beijing and 1.65 in Shanghai). Assume that in the long run China's total population rises to 1.5 billion with an urbanization rate of 70 percent. At a floor-to-area ratio of 2, assuming that urban Chinese consume 40 square meters of net living space or 56 square meters of gross living space per capita, in the long run an urban population of 1.05 billion will require 29.4 billion square meters of urban residential land. This is still less than China's 40 billion square meters of urban residential land.[3] Cities eager for more development and for less sprawl could ratchet floor-to-area ratios upward. At a floor-to-area ratio of 10 as opposed to 2, accommodating 1.05 billion urban Chinese will require only seven billion square meters of urban land.

An alternative path to lower land costs is to expand urban space in new cities. Shenzhen was a small town in 1980. Now it is a thriving megalopolis of 11 million. China's urban space could expand substantially, and the land constraint could be relaxed by freeing land up for urban purposes.

It is well within the power of the Chinese government to allow either enough new cities or higher floor-to-area ratios, either of which could create an ocean of new housing supply. In the next section, we will explore the effect that new supply could have on housing prices in 20 years.

China's Housing Prices in 20 Years

The Chinese investors who buy and hold empty properties are investing for the long run. In this section, we assess whether today's prices in Chinese cities will look reasonable in 20 years. We consider a range of possible scenarios and compare price estimates both with the price today, and the price today plus 3 percent annual growth. If investors require a return of 1 percent per year over and above maintenance and depreciation costs (which we assume are roughly 2 percent), then housing prices need to rise by 80.6 percent in total over 20 years. Our estimation of future price derives from estimates of demand for and supply of housing in the long run. We produce estimates separately for Tier 1, Tier 2, and Tier 3 cities. While Chinese cities have significant heterogeneity, each tier groups cities that are relatively similar in economic development.

Our demand calculations begin by assuming that the willingness to pay for housing will eventually settle on 10 times income, high by US standards but not unusual in Europe.[4] In other words, we assume that all individuals with local incomes

[3] This estimate for China's urban residential land is from Karen C. Seto and is available in slides titled "Urban Growth in China: Challenges and Prospects," https://web.stanford.edu/class/cee320/CEE320B/Seto.pdf.

[4] To justify this with a spatial equilibrium, assume that income for individual i in a city is denoted y_i, and income in the reservation locale (rural China) is $\theta y_i + (1 - \theta)\underline{y}$. If the rural price is fixed by construction

above one-tenth of the price (P) are willing to live in the location. The buyers are assumed to be the richest potential urbanites. Consequently, if the income distribution is characterized by a cumulative distribution $F(Y)$, then total demand for housing is $N(1 - F(Y^*))$ where N is the size of the "potential" urban population in this locale and $1 - F(Y^*)$ denotes the share with incomes above the cutoff value Y^*, who will be homeowners. The equilibrium price P^* will equal ten times Y^* by assumption.

Hence, we predict prices by using the equilibrium condition:

$$\text{Housing Supply} = N(1 - F(P^*/10)).$$

This equation requires us to estimate the future distribution of income, growth in the potential urban population, and growth in the housing stock. Low housing supply and high population growth will both lower the fraction of households served. High income growth means that the willingness to pay for the same marginal buyer will be higher.

For the distribution of future household income, we start with the current distribution of income in each tier, based on data from China's Urban Household Survey. We assume that the distribution is log-normal, which is consistent with the data. We then estimate the income distribution in 2030 based on assumptions of income growth rates. In the official statistics, real incomes for urban Chinese in the past ten years have grown by about 10 percent per year. Our baseline assumption is that average future growth in the next two decades will be one-half that size, but Figures 6A, B, and C will show results for a range of income projections.

We project that the growth in future potential urban population will mirror past growth in actual urban population, recognizing that past urban population reflects both changes in regional population patterns and changes in the urbanization rate. The Tier 1 cities have high and stable urbanization of 90 percent, but they have experienced much higher total population growth than the national average. The population inflow comes from these cities' advantages in creating high-paying jobs and the fact that they offer educational, medical, and many other social resources, and these advantages seem unlikely to change. For the Tier 2 cities, population growth has been at the national average, and the urbanization rate has been rising steadily. For the Tier 3 cities, total population growth has been lower than the national average, due to labor outflow, but they are experiencing very rapid urbanization of the local population.

We assume that the first tier cities will continue to be highly urbanized and that the growth in potential population will be higher than the projected national population growth rate. In second tier cities, we assume that potential population

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costs at $\underline{P}$, then the willingness to pay is $P + \frac{(1-\theta)}{r-g_i}(y_i - \underline{y})$, where g_i is the growth rate of this income gap. As long as $\underline{P} - \frac{(1-\theta)}{r-g_i}\underline{y}$ is small, then willingness to pay is $\frac{(1-\theta)}{r-g_i}$ times income. Our approach assumes that $\frac{(1-\theta)}{r-g_i}$ approximately equals 10.

will increase at above the national rate because of increasing urbanization. The third tier cities are assumed to have regional population growth below the national average but growing urbanization rate.

For supply of housing, we start with current occupied housing stock and then add inventories and vacancies. New completion of floor space nationwide has risen to about 10 billion square feet per year in the past five years, up from around 6 billion square feet in the mid- 2000s. We consider a range of supply scenarios, from a lower bound of zero to an upper bound of about 8 billion square feet per year nationally. We assume that the existing housing stock depreciates by 2 percent per year.

Will there be enough land space to accommodate that additional housing supply? While China is a very populous country, density in Chinese cities is typically lower than major American metropolitan areas. For example, the first tier cities have population density varying from 1,000 to 2,000 people per square kilometer in 2010, whereas New York City has density of 10,000 people per square kilometer and the top 100 American metropolitan statistical areas all have density above 4,000 people per square kilometer. Our most extreme high-supply scenario will less than double housing stock in the first tier cities, and the more probable range we consider will add less than 25 percent to existing housing space. It is also unlikely that population growth in the first tier cities can significantly exceed our estimate of 40 percent in the next 20 years, and this amount of population growth rate will still put top tier Chinese cities at lower density than many American cities.

Table 2A summarizes the specific parameter values we assume. Since our data and projections of housing stock are based on the urban core in each city, which has roughly 60 percent of total urban population, we also multiply by .6 to capture the core's share of total population. This potential urban population may not all be homeowners in the city. Those who cannot afford housing may rent or live outside of the urban core. Finally, we assume that per capita housing consumption in 2030 will be 40 square meters (or 430.56 square feet), up from 30 square meters in China's 2010 census.

Table 2A discusses two specific cases for each tier of cities. Here we focus on 5 percent annual income growth. We consider a conservative case where annual new supply is roughly cut in half compared to the average from 2000 to 2010, and an aggressive case where the supply is higher. These examples confirm that very high price growth seems unlikely, but as long as income growth remains robust, the downside in the eventual long-run equilibrium also appears to be modest.

Figures 6A, 6B, and 6C show long-run price estimates for each tier as a function of income growth and new supply. They present a range of possible future scenarios. Here we translate our price estimate into an average annualized house price growth from 2010 to 2030. The smallest increases in housing prices will be in the upper left corner of these figures—that is, large supply and slow income growth—while the largest increases will conversely be in the bottom right-hand corner. The horizontal line shows the average annual supply from 2000 to 2010 in each tier. The contour lines on the figures show what combination of income and supply will produce a specific rate of return: for example, what combination will produce the average

Table 2
Estimates of Housing Prices in 20 Years, by City Tier

A: Key Inputs and Assumptions

City tier:	*1st*	*2nd*	*3rd*
Total housing in urban area 2010 (billion ft^2)	8.6	37.3	36.1
Used	7.7	32.1	32.2
Developer inventory	0.3	1.9	0.9
Household vacancy	0.6	3.3	3.0
Total population growth 2000–2010	50%	26%	7%
Urbanization rate 2010	90%	70%	50%
Assumptions			
Depreciation rate of housing	2%	2%	2%
Housing per capita	403.56 square feet (or 40 square meters)		
Long-run price to income ratio	10	10	10
Total population growth 2010–2030	40%	20%	10%
Urbanization rate 2030	90%	80%	70%

B: Selected Scenarios

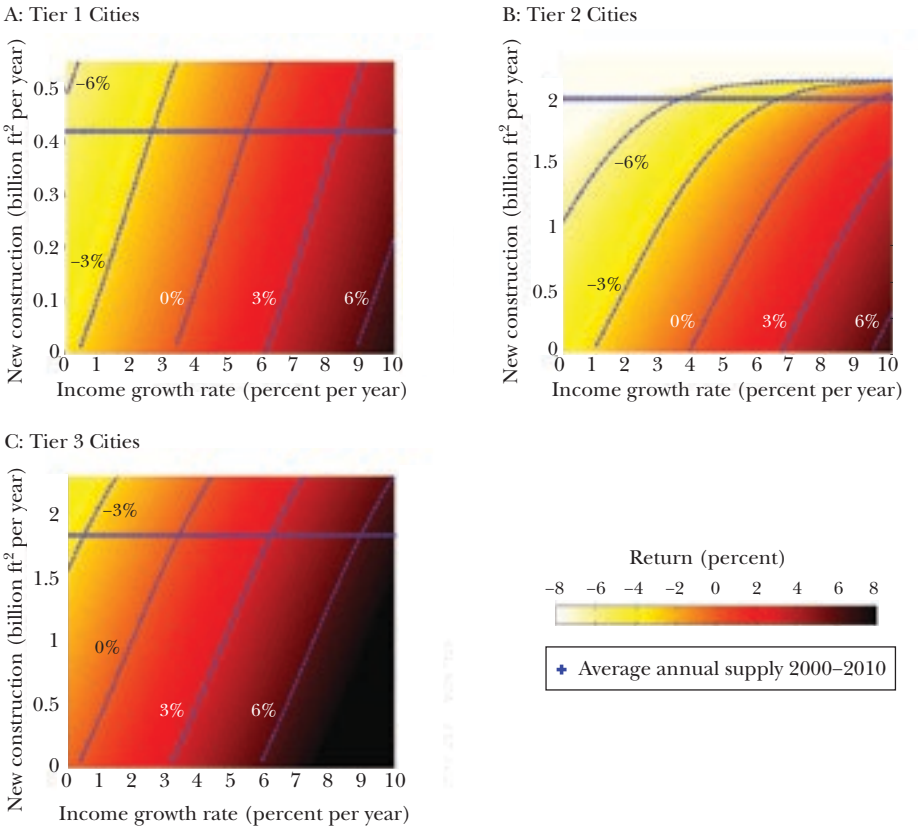
City tier	*1st*		*2nd*		*3rd*	
Scenarios	*Conservative*	*Aggressive*	*Conservative*	*Aggressive*	*Conservative*	*Aggressive*
Additional assumptions						
Annual housing supply 2010–2030 (billion ft^2)	0.17	0.48	0.72	2.00	0.90	2.83
Annual income growth	5%	5%	5%	5%	5%	5%
Price in 2030 (2014 RMB per ft^2)	2,165	1,531	1,039	410	1,017	403
Annual price growth	0.82%	−0.91%	−0.29%	−4.82%	3.37%	−1.30%
Annual housing supply 2000–2010	0.42		1.98		1.84	
Price in 2010 (2014 RMB per ft^2)	1,840		1,102		524	

Source and Notes: Housing in urban area in 2010 is from the 2010 census, covering the city proper. Inventory is estimated using Soufun data, and vacancy is estimated using Urban Household Survey data. Household income data are also drawn from Urban Household Survey. Annual housing supply in 2000–2010 is estimated as housing in city proper in the 2010 census minus that in the 2000 census times 0.82 (assuming housing stock in 2000 depreciates by 2 percent per year), then divided by 10. Based on current data, 60 percent of urban population live in the city proper area. Price estimates are in 2014 RMB. We consider a conservative case where annual new supply is roughly cut in half compared to the average from 2000 to 2010, and an aggressive case where the supply is higher.

3 percent annual real return. Different tiers can end up with different housing market outcomes, depending on economic growth and housing supply.

For both Tier 1 and Tier 2 cities, 3 percent annual real return in housing prices over the next 20 years is quite difficult to achieve. It requires annual real income of at least 6–7 percent, which is very optimistic for the average pace in the next 20 years, together with new housing supply close to zero. If the growth of housing supply persists at the average level of 2000 to 2010, returns will be minimal or negative unless income growth turns out to be spectacular. For the Tier 3 cities, our simulation provides some room for future price growth as long as supply does not overwhelm the market. The results are driven by the fact that these cities have the largest scope for increased urbanization, and their current prices are generally low.

Figure 6
Estimates of Average Annual Housing Price Growth, 2010—2030



Source and Notes: Plots of estimated average annual real housing price growth from 2010 to 2030, as a function of annual real income growth (x-axis) and annual new construction (y-axis). Darker color denotes higher returns. The solid curved line is the frontier where annual real returns are 3 percent. The dashed curve lines indicate (from left to right) returns of −6, −3, 0, and 6 percent annual returns, respectively. The horizontal line shows the level of average annual supply from 2000 to 2010. Annual housing supply in 2000–2010 is estimated as housing in urban area in the 2010 census minus that in the 2000 census times 0.82 (assuming housing stock in 2000 depreciates by 2 percent per year), then divided by 10.

Our assumptions of urban growth could have been generous for Tier 3 cities. These cities are also most likely to land in the high-supply scenario, so the outlook may not be as optimistic as Figure 6C suggests.

Overall, these simulations show a possible range of prices, depending on income growth, potential urban population growth, and housing supply growth. Of these three determinants of future prices, the Chinese government has the most capacity to shape housing supply growth. With sufficiently controlled housing supply, current prices can be maintained, but if housing supply continues to aggressively deliver new space, prices will fall.

Conclusion

In many respects, China looks like a classic housing bubble. Housing prices have soared. New construction is enormous. Vacancies are large and pervasive. It is tempting to view these events from afar and conclude that a price drop is imminent.

As we have tried to demonstrate, this scenario is far from certain. Chinese homebuyers appear to be investing for the long run and are unlikely to sell voluntarily even if home prices decline. Nor are they heavily leveraged, so repossessions and liquidations of homes are unlikely. Chinese developers are more leveraged, but are cozy with state banks, so their loans are likely to be restructured if necessary. Even if banks repossess properties from developers, they are unlikely to dump them on the market. Compared to Chinese stocks, more inertia is built into China's housing market.

In addition, there is the critical role of the Chinese government in housing markets. The demand for urbanization in China is large, so if the government acts to sharply restrict new supply, it can probably maintain prices at close to current market levels. If the government buys up excess housing inventory—perhaps to convert it to social housing as it started to do in 2015—it can further bolster softening prices. There does appear to be a feasible public path towards housing price stability.

Yet that path may create significant social costs. Construction employment would plummet. Millions of Chinese may lose the apparent productivity advantages associated with living in Chinese cities (Chauvin, Glaeser, Ma, and Tobio forthcoming). Local governments would lose the financial autonomy from land sales and taxes that has been their institutional basis.

The alternative for the Chinese government is to accommodate high levels of construction and housing supply. As we have showed, this will lead to very low or negative expected returns to investment in housing. The welfare of potential new buyers will rise, but current owners will suffer losses.

Bursting real estate bubbles have traditionally done great harm when they are associated with financial crises. Bubbles that burst without banking meltdowns, as in 1980s Los Angeles, are temporary events that seem to cause little long-run damage. Going forward, an important step is to secure China's financial system, rather than focus solely on maintaining high housing costs in Chinese cities.

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