IMF Working Paper

Understanding Residential Real Estate in China

by Mali Chivakul, W. Raphael Lam, Xiaoguang Liu, Wojciech Maliszewski, and Alfred Schipke

INTERNATIONAL MONETARY FUND

IMF Working Paper

Understanding Residential Real Estate in China

Prepared by Mali Chivakul, W. Raphael Lam, Xiaoguang Liu,
Wojciech Maliszewski, and Alfred Schipke[1]

Authorized for distribution by Steve Barnett and Alfred Schipke

April 2015

Abstract

China's residential real estate sector plays an important role in the economy and has been a key
driver of growth. Since 2014 the sector has softened visibly, reflecting overbuilding across many
cities. An orderly adjustment of the sector is welcome. The key questions are how severe the
adjustment will be and how long it will last. This paper uses various datasets, an analytical
framework to estimate demand and supply conditions, and develops a number of scenarios to
determine the oversupply both at the national level and by city tiers. It highlights that the adjustment
will be a multiyear process with adverse implications for investment and growth. Smaller cities, as
well as those in the Northeast region, face more challenging demand-supply dynamics. The key
will be to allow the adjustment to take place, while avoiding a too sharp of an economic
slowdown.

Contents   Page

I. INTRODUCTION

Real estate has been a key engine of China's rapid growth in the past decade. Real estate investment grew rapidly from about 4 percent of GDP in 1997 to 15 percent of GDP in 2014.[2] Residential investment, in particular, has been high compared with that in other countries. Today, it accounts for both about 15 percent of fixed asset investment and 15 percent of total urban employment. Bank lending to the sector accounts 20 percent of total loans. Real estate has strong linkages to several upstream and downstream industries (Liang, Gao, and He, 2006) and sales are also a key source of local public finance. Properties are extensively used as collateral for corporate borrowing.
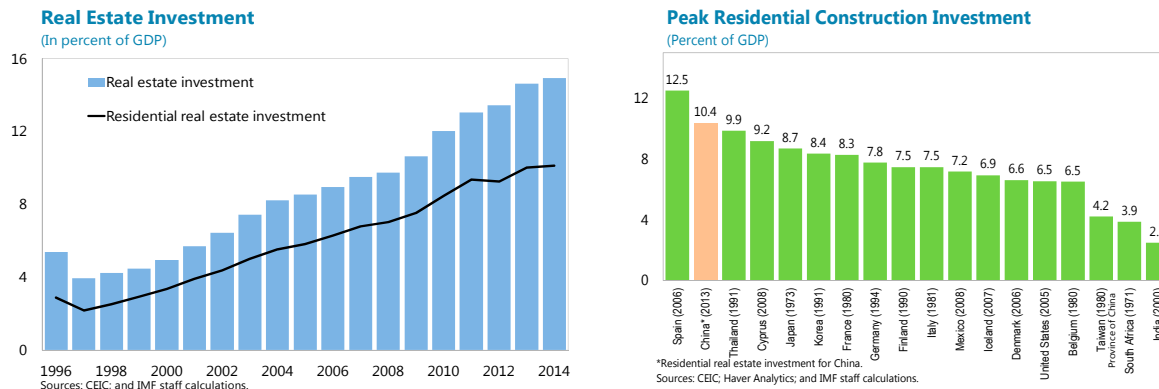
Real estate activity has softened starting in 2014. Available data suggest a nationwide slowdown in residential price growth, a contraction in transactions and new starts, and falling investment. While the previous downturn in 2012 was policy driven in response to concerns about overheating prices, the current weakness has been without any direct tightening of property market policies.

Distortions make the property market in China susceptible to both price misalignment and overbuilding. On the supply side, the market is distorted by local governments' reliance on land sales to finance spending.[3] On the demand side, the market is prone to misalignment—housing is attractive as a financial investment instrument given a history of robust capital gains, real deposit interest rates that tended to be negative, a lack of alternative financial assets, as well as capital account restrictions.[4]

This paper addresses important questions about the ongoing adjustments in the residential real estate sector in China. First, it navigates through China's numerous real estate datasets, from both official and private sources, to understand the current situation from demand and supply

[2] Real estate investment here is based on real estate investment published by the National Bureau of Statistics. See the annex for a description. Authors' estimates of real estate gross fixed capital formation (GFCF) are also described in the annex. Hung, Wu, and Du (2008) also estimate that the growth contribution of real estate investment is more than 10 percent.

[3] See Yang (2010), Zheng and Shi (2011), Wu, Gyourko, and Deng (2012), Lv and Liu (2012), and Li, Hong, and Huang (2013).

[4] See Jiang (2005), Kuang (2010), Gao, Wang, and Li (2013).

perspectives. The use of different datasets helps shed light on developments in prices, transactions, and starts at the national level as well as across city tiers and geographic areas. Most important, the paper investigates the fundamental determinants of residential real estate demand and supply and gauges the plausible size and duration of future adjustments. The paper proceeds as follows: The next section briefly explains the datasets and gives an overview of recent developments. Section III then investigates residential real estate demand and supply. The econometric results from Section III are used in Section IV to gauge plausible future scenarios of the adjustment. Section V concludes.

II. RECENT DEVELOPMENTS: WHAT ARE VARIOUS DATASETS SAYING?

A number of residential real estate datasets are available in China, from both official sources and private data providers.[5] The two main official sources—the National Bureau of Statistics (NBS) and the local housing bureaus (*FangGuanJu*)—collect data on prices (commodity building average selling prices and 70 large and medium-sized price index by NBS; and price indices for 134 cities by *FangGuanJu*), demand indicators (floor space sold), and inventory (floor space unsold). The NBS also publishes residential real estate fixed asset investment and supply indicators (floor space starts, floor space under construction, and floor space completed). The National Development Research Center (NDRC) publishes residential real estate price indices (a price index for each of 36 main cities). In addition, private entities such as *SouFun* also compile proprietary real estate indicators on prices (price indices for 100 cities).

While national level data could sketch an overall trend, city-level dynamics are key to understanding the conditions in a large country like China. In China, the four largest cities (known as Tier I cities) only account for 10 percent of floor space sold.[6] Tier II cities, usually provincial capitals, account for nearly 50 percent, and smaller cities (Tier III/IV) account for more than 40 percent of the floor

Residential Real Estate: Price, Floor Space Sold and Unsold
(In percent, YOY, SA)
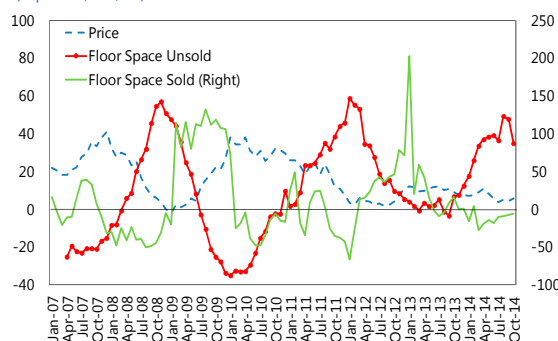
Sources: Local Housing Administrative Bureau (Fangguanju), IMF staff calculations.

House Price-to-income Ratio
(100 square meters' house price of annual disposable income per capita)
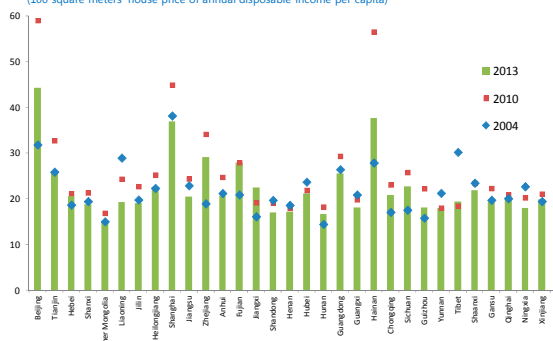
Sources: NBS, IMF staff calculations.

---

[5] See detailed data source descriptions in the annex.
[6] Chinese cities are generally grouped into four categories: Tier I cities include Beijing, Shanghai, Guangzhou, and Shenzhen; Tier II cities include Beihai, Changchun, Changsha, Chengdu, Chongqing, Dalian, Fuzhou, Guiyang, Haikou, Hangzhou, Harbin, Hefei, Huhhot, Jinan, Kunming, Lanzhou, Nanchang, Nanjing, Nanning, Ningbo, Qingdao, Sanya, Shenyang, Shijiazhuang, Suzhou, Taiyuan, Tianjin, Urumqi, Wenzhou, Wuhan, Wuxi, Xiamen, Xi'an, Yinchuan, and Zhengzhou; other small and medium cities are grouped into Tier III or IV cities.

space sold in 2013.[7] While the NBS provides national and provincial level data, there are advantages to using *FangGuanJu* data given that they are available at the city level, thus providing additional coverage, helping to depict differences, and serving as a cross check among city tiers and regions.

Based on all price indices in 2014, including the most widely used NBS and *SouFun* data, property prices have been moderating. The NBS 70-cities index (Figure 1) shows the most severe decline. Prices have been moderating at both the national level and across all city tiers. On average, Tier II and Tier III/IV cities have performed the weakest, with prices in the latter group falling on a sequential basis. Across geographical areas, the industrial Northeast and the Coast are experiencing the weakest price development. More recently, prices in large metropolitan areas have also been weak. Prices in some datasets, such as the NBS average selling price and *FangGuanJu,* have seen some signs of stabilization on a sequential basis since November 2014. Average nationwide house price has remained high at about 22 times average annual disposable income in 2013 (with Tier I cities reaching a multiple of more than 30), though the ratio has declined from its peak in 2010.
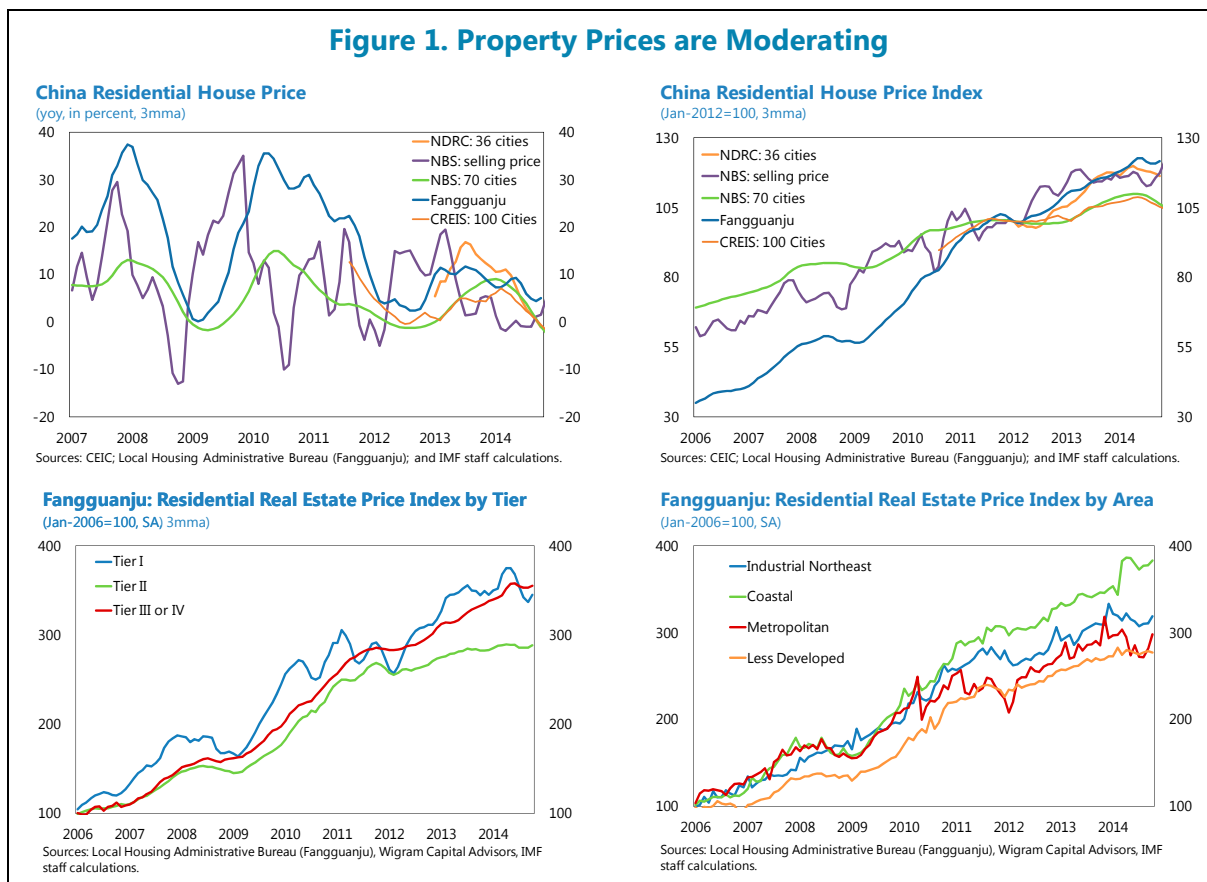
Figure 1. Property Prices are Moderating

Both NBS data and local housing bureau data show a decline in sales volume in 2014 (Figure 2). Floor space sold, a good indicator of demand for residential real estate, has declined on a year-over-year basis since mid-2013. Data on floor space sold are available from NBS and *FangGuanJu*. Transaction activity has weakened across the board, including in Tier I cities and in more well-off regions. Toward the end of 2014, sales volume picked up slightly on a sequential basis, following the relaxation of home purchase restrictions and the easing of mortgage financing conditions, though to what extent the recovery is more "one off" a unique event or more sustained remains uncertain.

Sales volume contracted most in smaller cities. These Tier III/IV cities had experienced more rapid increases of floor space sold during the boom period. The industrial Northeast region continues to face a sharp contraction in floor space sold and still has not seen any sign of the recovery that began to emerge in other regions (Figure 2).

Figure 2. Residential Real Estate Sales Have Slowed
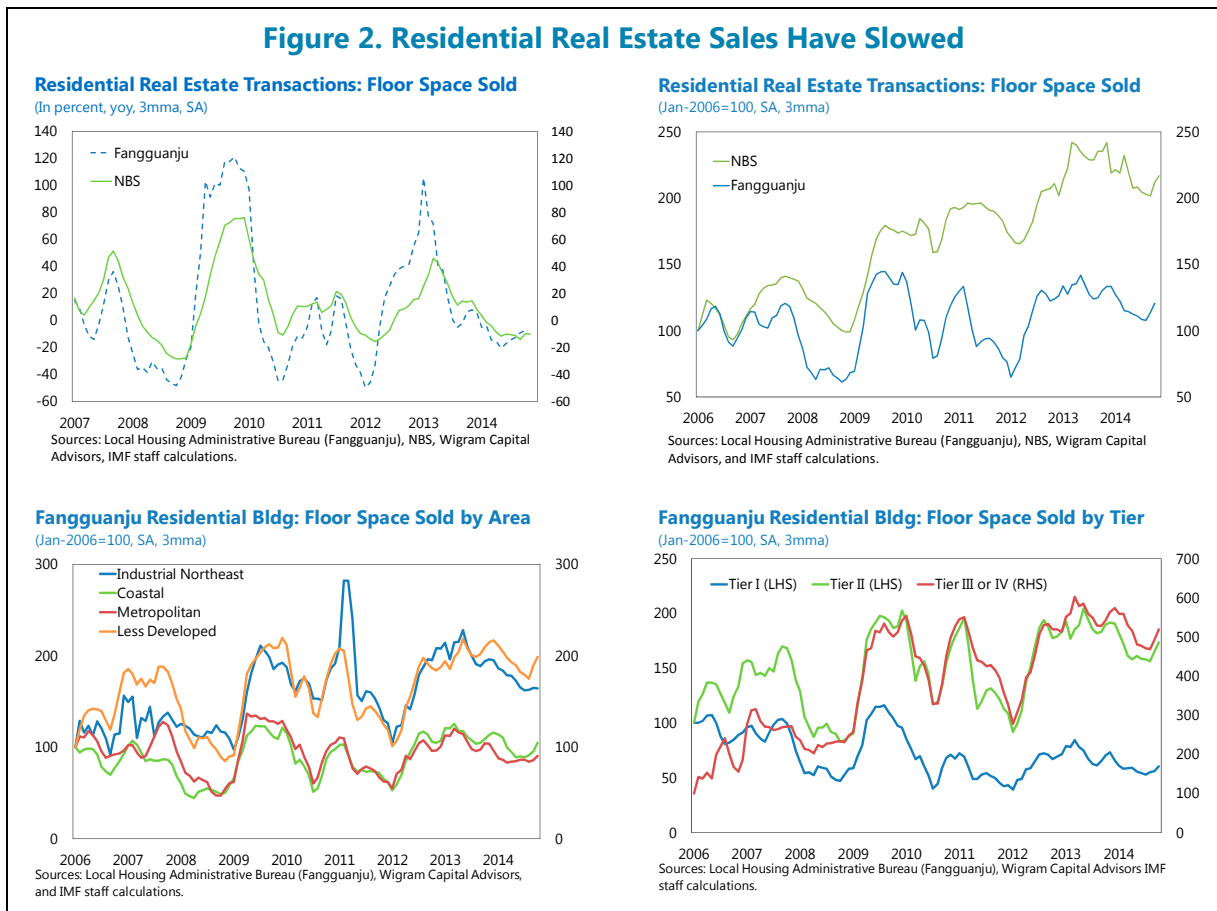
Supply-side indicators also suggest that market conditions are weak. There is a close relationship between floor space sold, floor space starts, and residential real estate fixed investment (see text chart). According to NBS data, real estate fixed asset investment has slowed from growth of about 20 percent in 2013 to 9.2 percent in 2014. In addition, housing floor space starts contracted by 14.4 percent in 2014, compared with 11.6 percent growth in 2013. Land sales revenues, another real estate market indicator, also showed a slowdown for 2014 (accounting for 6½ percent of GDP), after reaching a peak in late 2013.

Residential Real Estate Sector
(in percent, yoy)
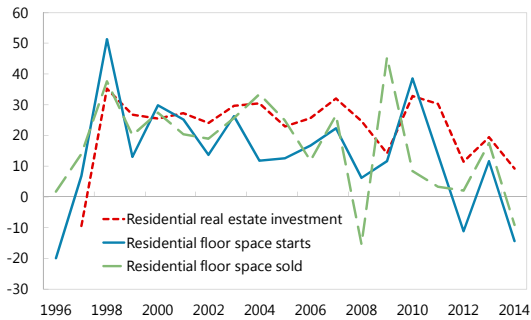
Government Land Sales Revenues
(year-one-year percentage change)

Sources: NBS.
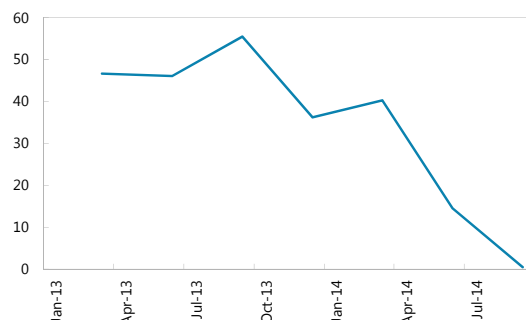
Source: CEIC.

Housing inventory indicators from the NBS and *FangGuanJu* show a buildup of inventory in 2014, the sizes of the inventory in the two datasets are significantly different (Figure 3). Inventory can be measured by the ratio of floor space unsold to floor space sold during the period. Both NBS and *FangGuanJu* data showed a rapid buildup of inventory since 2013. According to NBS data, the nationwide inventory ratio is only about four months of sales, while *FangGuanJu* data suggest that the nationwide ratio might have been as high as 24 months in mid-2014. The differences may be attributable to different data collection methodologies. The NBS data rely on developers' self-reporting and are likely subject to underreporting of unsold units and overreporting of sales; *FangGuanJu* data record all real estate registrations including buildings that have obtained permits to sell.[8]

 These inventory indicators point to a risk that construction has run ahead of demand in some regions. Overbuilding appears to be widespread across cities, though to varying degrees, leaving the adjustment challenging. Some cities have also experienced a rapid rise in the inventory ratio due to a sharp contraction in sales since the beginning of 2014.

The ratcheting up of unsold residential housing units in 2014 also appears to be more severe than in previous downturns. Based on previous episodes of real estate downturns, such as those during 2008–09 and 2011–12, the real estate downturn in 2014 appears to have started from a relatively high inventory level (text chart). Housing inventories did not normalize before ratcheting up again during 2014, particularly in Tier III/IV cites and in the industrial Northeast region, adding to an even higher buildup of inventory.

Real Estate Inventory Development Across Cycles
(Build-up of inventory (unsold floor space), index with Jan2007=100)

Peak inventory (135)

Peak inventory (145)

Peak inventory (206)

Trough inventory (84)

Trough inventory (84)

Trough inventory (140)

| 2008-09 Cycle (15 months) | 2011-12 Cycle (23 months) | 2013-14 Cycle (11 months) |
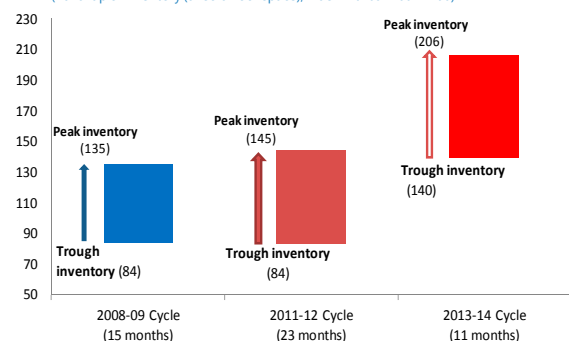
Sources: FangGuanJu; and IMF staff calculations.

---

[8] FangGuanJu data in general are better indicators but have some shortcomings as well. Developers need to register first at FangGuanJu for property sale. Developers may have incentives to arrange registrations to suggest higher sales to boost property price.

Figure 3. Real Estate: A Buildup of Inventory

Residential Real Estate Inventory: A Lower Bound Estimation
(In millions of square meters)

Sources: Local Housing Administrative Bureau (FangGuanJu), Wigram Capital Advisors, IMF staff calculations.

Residential Real Estate Inventory Ratio
(In months, 3mma)

Sources: CEIC; Local Housing Administrative Bureau (Fangguanju); and IMF staff calculations.
1/ Inventory is measured as floor space unsold; inventory ratio is measured as floor space unsold/sold.

Residential Real Estate Inventory Ratio by Tiers
(In years)

Sources: Local Housing Administrative Bureau (Fangguanju), Wigram Capital Advisors, IMF staff calculations.
1/Inventory is measured as floor space unsold; inventory ratio is measured as floor space unsold/sold.

Residential Real Estate Inventory Ratio by Areas
(In years)

Sources: Local Housing Administrative Bureau (Fangguanju), Wigram Capital Advisors, IMF staff calculations.
1/Inventory is measured as floor space unsold; inventory ratio is measured as floor space unsold/sold.

In addition to the inventory level, the stock of residential real estate (measured in per capita terms) may serve as a complementary indicator. Floor space per capita in many cities in China appears to be well above international averages.[9] Floor space per capita rose in 2009 when real estate investment accelerated as part of the stimulus measures to counter the economic pressures from the global financial crisis. Floor space per capita continued to rise for Tier III/IV cities but remained flat for large cities. Floor space now under construction could contribute further to future oversupply (text charts). International evidence suggests that per capita residential floor space is in the range of 40–50 square meters in advanced economies, with a notable exception in the United States, and between 20 and 30 square meters in emerging economies. For China, Tier I cities are close to the average levels in advanced economies, while smaller cities already see a much higher level, suggesting possible signs of oversupply.[10]
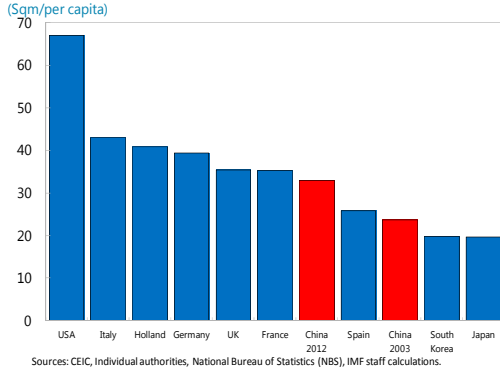
---

[9] An estimate of the per capita housing stock across cities is constructed using the stock data available from NBS and the flow of floor space sold from SouFun for the past few years after NBS data were discontinued.

[10] A caveat is in order. The denominator represents the population holding a household residency (*hukou*), such that the ratio is likely to be overestimated for larger coastal cities (that attract migrants) and underestimated for the rest (from which migrants typically originate). Therefore, the actual oversupply in some Tier III and IV cities may be even more severe than the results suggest.

Residential Real Estate Floor Space per Capita in Major Countries
(Sqm/per capita)

Residential Real Estate Floor Space Per Capita
(Sqm/per capita, 2013, prefecturel city level)

Sources: CEIC, Individual authorities, National Bureau of Statistics (NBS), IMF staff calculations.

* Figures refer to tier-average level of floor space per capita, in current and implied level, respectively.
Sources: NBS, Fangguanju, IMF staff calculations.
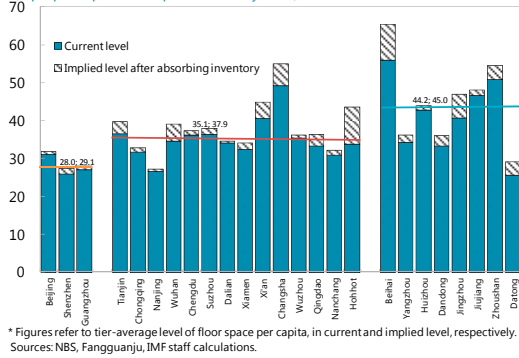
III. DEMAND AND SUPPLY DYNAMICS

Available inventory indicators in section II suggest that oversupply could be a problem. These indicators offer a snapshot of the stock of unsold properties and the approximate time it would take to run down the inventory given average annual sales. An analysis of the demand and supply dynamics will help provide a better understanding of how the oversupply comes about and how the real estate market may get back to an equilibrium level.[11] This section first estimates real estate demand conditions based on fundamentals, then derives an estimate of oversupply. The analysis begins with data starting from 1998, when China's housing market began to develop following a series of reforms that clarified property rights.

A. Real Estate Demand

On the demand side, the analysis uses the variable *floor space per capita* to capture the demand for residential real estate. The estimates start by an equilibrium (long-run) relationship between floor space per capita and fundamental determinants of demand. International evidence suggests that floor space per capita usually increases along with income as the economy grows (Berkelmans and Wang 2012), and the elasticity of floor space per capita to income is of primary interest. We estimate the following equilibrium relationship:

$$Floor\ Space\ per\ Capita_{it} = f(H_{it}, P_{it}, U_{it}, S_{it}, T_{it}) \tag{1}$$

in which $H_{it}, P_{it}, U_{it}, S_{it}, T_{it}$ represent household income per capita, residential property prices, urbanization rate, nonagricultural population scale (population density), and city tier dummy variables, respectively. The sample period in the regression spans from 2000 to 2013, where a relatively balanced panel set of data are available during 2005–12. The specification intends to illustrate the long-run relationship on the housing demand without any policy response. Policy variables such as mortgage rates and purchases restrictions are not included.[12]

---

[11] Grenadier (1996) provides a model framework for analyzing the overbuilding of real estate.
[12] Only national mortgage rates are available without city-level data. We have used it as an explanatory variable and do not find the coefficient statistically significant in the demand equation.

This relationship allows us to project the equilibrium floor space stock, by converting per capita values to absolute levels using projections for urban population growth:

$$Floor\ Space\ Stock_{it} = Floor\ Space\ per\ Capita_{it} \times Urban\ Population_{it} \qquad (2)$$

The convergence to equilibrium is assumed to be gradual and the demolition in floor space is taken into account.

$$Floor\ Space\ Sold_{it} = a(Floor\ Space\ Sold_{it-1}) + (1-a) \times (Floor\ Space\ Stock_{it} -$$
$$Floor\ Space\ Stock_{it-1} + Demolition_{i,t-1}) \qquad (3)$$

Regression results for the equilibrium demand for housing are consistent with expectations (Table 1).[13] Floor space per capita is determined by key fundamentals with expected signs, including per capita household income, residential property prices, urbanization rate, nonagricultural population in cities (reflecting the urban population density); it varies across city tiers. A 1 percentage point increase in per capita household income will increase floor space per capita by 0.2–0.3 percent (estimates are very close across specifications). Higher residential prices, urbanization rate, and nonagricultural population tend to reduce floor space per capita in cities, while the elasticity of residential prices is not as large as generally expected. This is in line with previous research that analyzes the key determinants of housing demand (Shen and Liu, 2004; Zou and Niu 2010; Gao, Wang, and Li, 2013).[14] In addition, the city-tier dummy variable also confirms the results that Tier III/IV cities tend to have more floor space per capita, mainly because land is more abundant in smaller cities than in metropolitan areas.[15]

Given the relatively strong fit of the first regression specification, the analysis projects equilibrium floor space per capita by linking it to per capita urban household income, which is assumed to grow at a gradually declining rate (beginning at 9.7 percent in 2013 and falling by ½-percentage point per year, reaching 6.2 percent in 2020).[16] This is largely in line with the growth forecast for the medium term (IMF, 2014b). The growth rate of nonagricultural population is forecast to be at levels of five-year moving average, which would imply an increase of urbanization rate by about 7–8 percentage points from now to 2020, consistent with the government's urbanization strategy. Our projection assumes no policy response, such as future changes in mortgage rate and

---

[13] Data consist of 255 prefecture-level cities with close to 2,000 observations from both Tier I and Tier III/IV cities.

[14] Potential endogeneity may arise given that property prices are included as an explanatory variable, which itself may be driven by the per capita measure of the housing stock. However, estimates will still be consistent as long as the regression represents a long-term equilibrium relationship among nonstationary series. We do not formally test for stationarity and cointegration among the series given short time series and small power of the tests.

[15] Other specifications (not shown in Table 1) include interaction terms of city-tier dummy with residential prices and urbanization rate. Relative to Tier II cities, smaller cities tend to have a greater negative impact on demand from higher residential prices, while higher prices tend to increase demand in Tier I cities, largely reflecting an expectation that future residential prices will increase. The effects of the urbanization rate on housing are less monotonic, but fall within the expectation that the effects vary across city tiers. Higher urbanization rates tend to depress demand in smaller cities, while increasing demand in larger ones.

[16] A robustness check was also performed to forecast demand using a regression with the floor space sold indicator as the dependent variable. Though the indicator is more volatile, the regression based on floor space sold directly provides a flow measure that is comparable with floor space starts. It is also a general specification. Results are fairly similar given the common use of explanatory variables such as household income.

restrictions on property purchases.[17] The adjustment parameter a in equation 3 varies by province, but is 0.5 at the national level. The demolition rate is assumed to be about 3 percent annually of the floor space stock.[18] Under these assumptions, the average annual growth rate of floor space sold is about 4.3 percent in the medium term, a continuation of the trend observed in the data.

| Table 1. Regression Estimates of Residential Real Estate Demand 1/				
	Dependent Variable: Log Floor Space Per Capita			
Explanatory Variables	(1)	(2)	(3)	(4)
Log per capita household income	0.170***	0.269***	0.296***	0.299***
	(0.0236)	(0.0353)	(0.0409)	(0.0397)
Log residential property prices		-0.0794***	-0.0603***	-0.0568***
		(0.0191)	(0.0228)	(0.0213)
Urbanization rate			-0.497***	-0.454***
			(0.0393)	(0.0389)
Log nonagricultural population				-0.0417***
				(0.0115)
Dummy_tier 1	-0.109***	-0.0804**	-0.0768*	-0.0502
	(0.0289)	(0.0319)	(0.0428)	(0.0474)
Dummy_tier 3	0.166***	0.136***	0.0746***	0.0373*
	(0.0116)	(0.0131)	(0.0166)	(0.0201)
Constant	1.366***	1.076***	0.906***	1.169***
	(0.223)	(0.242)	(0.268)	(0.266)
Year effect	Yes	Yes	Yes	Yes
Observations	1,800	1,748	1,175	1,175
R squared	0.471	0.476	0.508	0.516

1/ Robust standard errors in parentheses; "***", "**", and "*" refer to 1 percent, 5 percent, and 10 percent statistical significant levels.

B. Measuring Oversupply

Excess supply, or "oversupply," is measured by the cumulative gap between floor space starts and floor space sold (one to two years ahead). The latter is derived from NBS data for historical values and from floor space sold projections. Floor space starts instead of floor space completions is used to approximate supply. In part, this is because floor space completed tended to be much higher before 2005–06 and floor place starts are usually better indicators of future supply. The two series are

Annual Growth of Residential Investment and Floor Space Started, Completed
(yoy, in percent)

Sources: NBS; and IMF staff estimates.

---
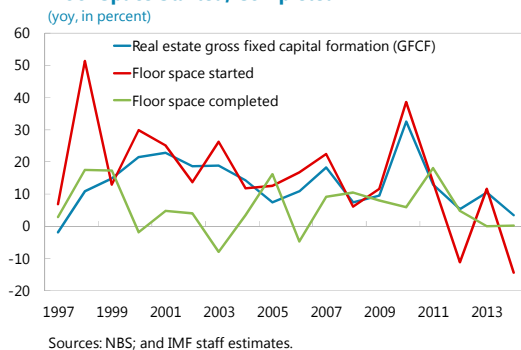
[17] The scenario analysis in the following section provides an illustrative scenario of stronger real estate demand, which could also be interpreted as more accommodative policies.

[18] The demolition rate is similar to depreciation. The forecast of excess supply is not sensitive to a moderate change in the assumption. Considering the current housing stock, the demolition pace could decelerate in the future, which will reduce the upgrading housing demand.

closely correlated in levels of floor space in square meters (text chart), but data suggest that floor space starts are strongly correlated with real estate investment, a variable of ultimate interest.[19]

 The gap is determined on the basis of floor space sold as the average flow one to two years ahead, given that it usually takes one to two years after a housing start to have the floor space ready to be sold. The calculated excess supply in 2014 was about 1.2 times annual floor space sold at the national level. The interpretation of the gap is straightforward: in equilibrium, developers should correctly anticipate demand conditions at the time when buildings will be ready for sale. Hence, the gap should be close to zero. If developers overpredict, housing starts are greater than future demand (floor space to be sold in one to two years) and the gap is positive.

There are a number of caveats to this measure of oversupply. First, not all floor space starts are listed for sale because starts include areas designated for communal facilities and infrastructure. Some developers suggest that this could be up to 15 percent of floor space starts. Second, floor space starts data likely overstate true supply because the data include projects in the planning phase or with permits even though not all floor space is built at the same time (developers may delay or stop the projects).

IV. REAL ESTATE ADJUSTMENT—A SCENARIO ANALYSIS

In the face of the current oversupply, it will be important to understand how the adjustment will take place. The analysis uses several scenarios to illustrate possible adjustment paths.

A. Scenario Analysis of Gradual Adjustments

The key assumption is how the excess supply will be eliminated over time. The floor space sold projections derived above is taken as given, implying a continuation of the historical demand trend. Floor space starts are assumed to adjust such that excess supply gradually winds down. A scenario of a stronger demand path is also considered. Various scenarios illustrate how the overbuilding gap adjusts and its impact on real estate investment (Figure 5):

- *Baseline scenario*. This scenario assumes that the excess supply gap will close gradually by 2020, broadly in a linear fashion. Excess supply will be absorbed through both a moderate contraction in floor space starts and a recovery of projected real estate demand in the medium term. The adjustment scenario yields the path of the year-over-year growth rate of floor space starts and floor space sold, providing an indication of real estate investment in the medium term, as considered below. We can also trace the effects on the inventory ratio of closing the excess supply gap considered in section II (based on *FangGuanJu* data): it would fall from 2.2 in 2013 to about 1 (a normal historical level) by 2020.

- *Gradual adjustment scenario*. This scenario assumes a more gradual reduction in the excess

---

[19] The cumulative floor space completed was higher than floor space sold before the global financial crisis, partly reflecting the opening up of residential real estate markets. Discussion with real estate developers suggest that the measure of floor space completed does not fully reflect supply conditions.

supply gap. Excess supply will be reduced by half from its 2013 level. Under a slower adjustment scenario, the inventory ratio adjusts modestly in the medium term and returns to its normal level only by 2025. While it may stabilize real estate markets as measured by floor space starts (a proxy for real estate investment), the overbuilding may persist.

- *Stronger real estate demand scenario*. This could help narrow the excess supply gap marginally, but it is unlikely to fully offset a potential contraction of floor space starts. In the scenario of stronger real estate demand, growth in floor space sold would increase to 8.6 percent (similar to levels during 2010–13 when growth was 7.8 percent) relative to 4.3 percent in the baseline (similar to levels during 2010–12 when growth was 4.6 percent). But the closure of the excess supply gap is just slightly quicker, while the year-over-year contraction in floor space starts is still inevitable.

Inventory Ratios under Adjustment Scenarios
(inventory ratio refers to cumulative floor space starts net of sold to the floor space sold; in years)
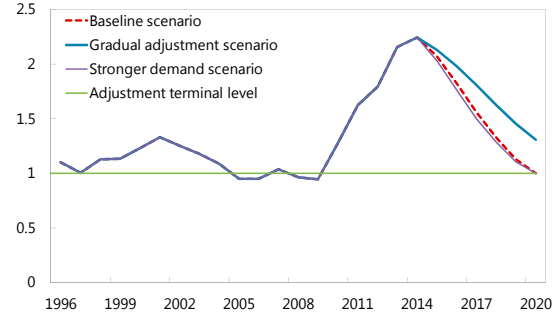
Sources: NBS, IMF staff calculations.

The projection of floor space sold (a measure of the demand side) is based on regression coefficients on floor space per capita, with projected household income per capita, residential property prices, urban population rate, and nonagricultural population share by 2020 (Table 1). Growth in national per capita urban household income is projected to decline by ½-percentage points per year, beginning at 9.7 percent in 2013 and reaching 6.2 percent in 2020, largely in line with the growth forecast for the medium term. Nationwide nonagricultural population is projected to grow at a level equal to the five-year moving average. These assumptions would suggest that the average annual growth rate of floor space sold is about 4.3 percent in the medium term, a continuation of the trend observed in the data.

B. Growth Impact across Scenarios

All scenarios indicate that growth in floor space starts would need to slow and contract in the near term (Figure 4 and Table 2). Based on data from 2001 to 2013, the relationship between growth in floor space starts and real estate gross fixed capital formation (GFCF) growth is then estimated (Table 2). The real estate GFCF series estimated using NBS data (see annex for an explanation) is used to keep the investment concept compatible with the national account (GDP) data. The growth of real estate GFCF is estimated with its own lag terms and the growth in floor space starts. Both coefficients are significant and the growth in floor space starts has the expected signs. The two coefficients are constrained to sum up to one (which is not statistically rejected). This implies that on average growth rates of the two series are the same.

$$Growth\ of\ Real\ Estate\ GFCF_t = \beta_1 \times Growth\ of\ Floor\ Space\ Starts_t + \beta_2 \times \quad (4)$$
$$Growth\ of\ Real\ Estate\ GFCF_{t-1}$$

Table 2. Regression of Real Estate Investment						
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
β_1	0.413	0.068	6.081	0.000	0.270	0.557
β_2	0.587					

Applying the estimated coefficients and the oversupply indicators in various scenarios, real estate GFCF could slow down by about 1.9–4.2 percentage points in 2015 (Table 3). In the baseline scenario in which the oversupply gap closes by 2020, the slowdown in real estate GFCF falls by nearly 4.2 percentage points in 2015. Given that residential real estate GFCF accounts for about 9 percent of GDP, that would imply a drop of GDP growth of about 0.4 percentage points for 2015 (Table 3). The growth impact over the medium term is more difficult to assess and will depend on the authorities' policy response. These different scenarios help illustrate possibility of policy actions or developments not explicitly captured in projections. This abstracts from the indirect effect arising from real estate linkages to upstream or downstream sectors. Some of these sectors suffer from an oversupply, and a slowdown in construction activity could bring losses to the surface, exposing vulnerabilities and posing risks (IMF, 2014a).

Table 3. Impact on Real Estate GFCF and Economic Growth			
Adjustment Scenario 1/	Duration of Adjustment	Floor Space Starts (y/y growth in percent)	
	Total years	2015	2020
Baseline scenario	6.0	-15.0	11.3
More gradual adjustment	10.0	-9.6	5.5
Stronger demand	6.0	-10.9	13.7
	Implied real estate GFCF growth (%) 2/	Impact on GDP (in ppt) 3/	
	2015	2015	
Baseline scenario	-4.2	-0.38	
More gradual adjustment	-1.9	-0.18	
Stronger demand	-2.5	-0.22	

Sources: NBS; FangGuanJu; and authors' estimation.

1/ Average grwoth in floor space sold is projected to be 4.3 percent per year between 2014 and 2020 in the baseline and gradual adjustment scenarios. In the stronger demand scenario, the growth increased to 8.6 percent per year, similar to average growth rates after the global financial crisis.

2/ The implied real estate GFCF growth is estimated as in Table 2. Growth of real estate GFCG(t)=0.413*Growth of floor space starts(t)+0.587*Growth of real estate GFCF(t-1).

3/ The GDP growth impact is calculated based on the fact that real estate GFCF accounts for about 9 percent of GDP.

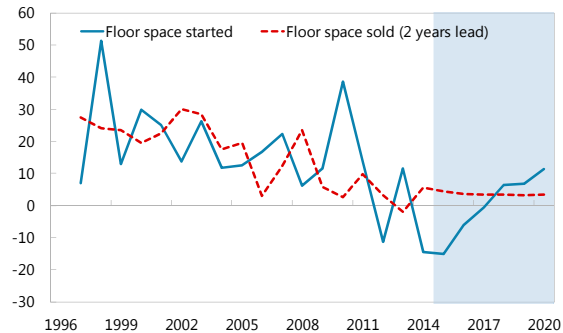# Figure 4. Scenarios Analysis on Real Estate Adjustment

Baseline Scenario—Excess Supply Gap Closes by 2020

Residential Market Overbuilding and Adjustment Scenario
(In millions of square meters)
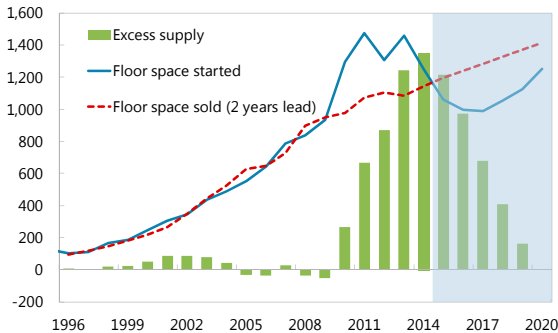
Annual Growth of Residential Floor Space Newly Started and Sold
(yoy, in percent)

Sources: NBS, IMF staff calculations.
Note: Excess supply ratio is measured as the ratio of excess supply to floor space sold (2 years lead.)

Sources: NBS, IMF staff calculations.

Gradual Adjustment Scenario—Excess Supply Gap Closes Half by 2020

Residential Market Overbuilding and Adjustment Scenarios
(In millions of square meters)

Annual Growth of Residential Floor Space Newly Started and Sold
(yoy, in percent)

Sources: NBS, IMF staff calculations.
Note: Excess supply ratio is measured as the ratio of excess supply to floor space sold (2 years lead.)

Sources: NBS, IMF staff calculations.

Stronger Demand Scenario

Residential Market Overbuilding and Adjustment Scenarios
(In millions of square meters)

Annual Growth of Residential Floor Space Newly Started and Sold
(yoy, in percent)

Sources: NBS, IMF staff calculations.
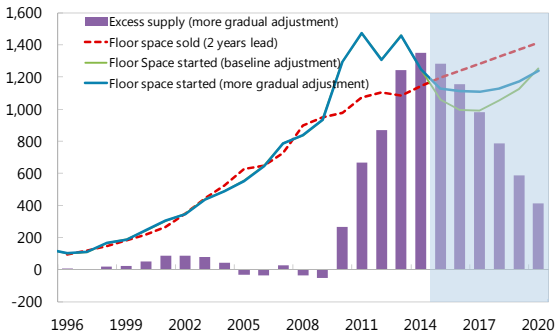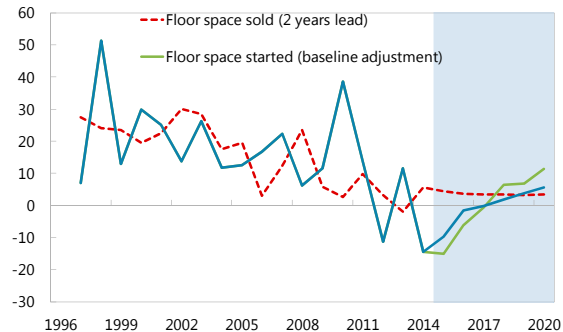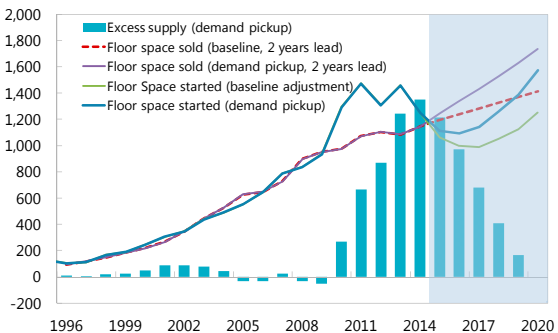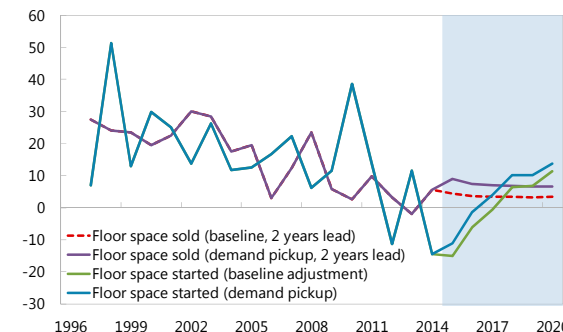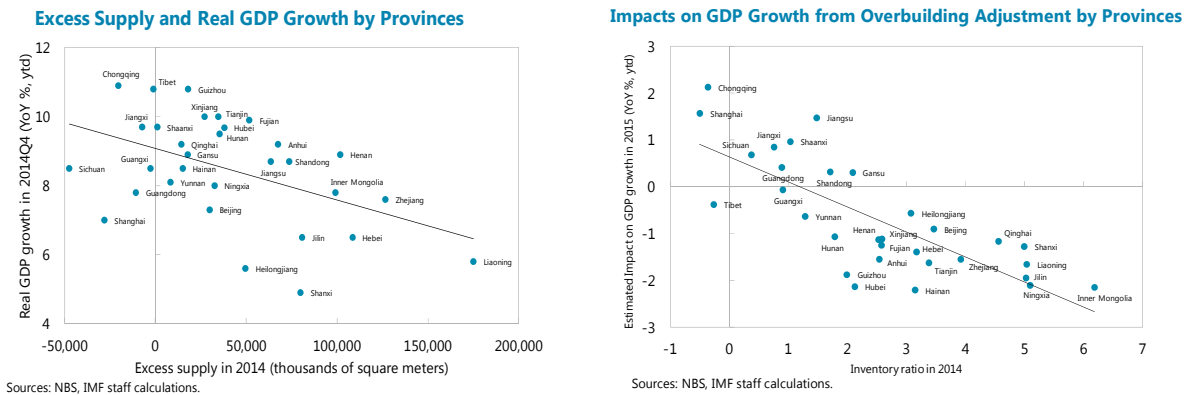Note: Excess supply ratio is measured as the ratio of excess supply to floor space sold (2 years lead.)

Sources: NBS, IMF staff calculations.

C. Scenario Analysis and Growth Impact at the Provincial Level

Based on historical data, higher excess supply is usually associated with lower real GDP growth across provinces (text charts). The transmission channel is likely through a slowdown in real estate investment, which was a key driver of growth as excess supply built up. Given sizable overbuilding of residential real estate, growth in new housing starts would need to slow (or even contract), which reduces real estate investment, and in turn, growth.

Excess Supply and Real GDP Growth by Provinces

Sources: NBS, IMF staff calculations.

Impacts on GDP Growth from Overbuilding Adjustment by Provinces

Sources: NBS, IMF staff calculations.

Applying the baseline scenario using provincial excess supply conditions helps illustrate the overbuilding problem (right text chart). Given the current excess supply gap or high inventory ratio, most provinces would see a lower new housings starts in 2015–16, before gradually recovering over the medium term. This would be even more severe and prolonged in selected provinces because of their high inventory ratios. Even as housing starts recover, the growth in floor space sold (a demand measure) is likely to slow by about 3½ percentage points from the average between 2010 and 2013, in the medium term. Fewer new housing starts would, in turn, slow real estate investment and growth. While nationwide real estate investment would decline by an average of -4.2 percent on a national level in 2015, a few provinces could see sharper contractions, weighing heavily on GDP growth. The results, however, are likely to overstate the growth impact as policy responses are not taken into account and the adjustment pace of the excess-supply gap is uniformly applied at the same horizon. In reality, some provinces with higher excess supply are likely to adjust more gradually.

V. Conclusion

China's residential real estate market plays an important role in the economy and has been an important driver of growth. Since 2014, the sector has softened visibly, driven in part by previous overbuilding across most cities. An orderly adjustment is welcome leading to an unwinding of the excess supply. It will also free resources that can be used more efficiently in other parts of the economy, hence facilitating China's goal of moving toward a new and sustainable growth model.

On the bases of an analytical framework and the usage of comprehensive real estate datasets, the paper confirms that the oversupply problem is nationwide and particularly pronounced in

smaller cities (Tier III and IV cities) and in the northeast region. Using different adjustment scenarios, the paper highlights that the adjustment is likely to be a multiyear process with implications for investment and growth. Under reasonable assumptions, real estate investment growth in 2015, could, for example, be negative. The key will be to allow the adjustment to take place, while avoiding a too sharp of an economic slowdown. Hence macroeconomic policies need to be calibrated carefully.

ANNEX: BACKGROUND ON CHINA'S RESIDENTIAL REAL ESTATE STATISTICS

China produces a wide range of data on the residential real estate sector, both from government sources—such as the NBS, the National Development Research Center (NDRC), and local housing bureaus (*FangGuanJu*)—and private entities such as *SouFun* that conduct surveys or collect data themselves.[20]

A. Price Data

There are five sources of price data. Among the five datasets, the NBS and *SouFun* data are the most widely used in analyzing the real estate markets.

- The NBS: Average Selling Prices (Commodity Building Residential Selling Price) and 70 cities (Large and Medium-sized) Price Index

- The NDRC's price index for a smaller set of cities (36 Main Cities Price)

- *FangGuanJu*'s price indices for 134 cities

- *SouFun*'s price index (CREIS: 100 Cities Price).

The common house price indices in China are based on observed selling prices, often only for new construction sales (primary market) without adjusting for property features. Most price datasets do not cover smaller cities (Tiers III/IV). The NBS's Average Selling Price is at the national and province level without city information. In some indicators, seasonal and other statistical adjustments are sometimes applied to the raw data to smooth out volatility. Because of regional differences, developers' selling strategies, and expansion of city boundaries, the NBS's price indices tend to understate the increase in house prices (Goldman Sachs, 2014).

China Residential House Price
(yoy, in percent, 3mma)
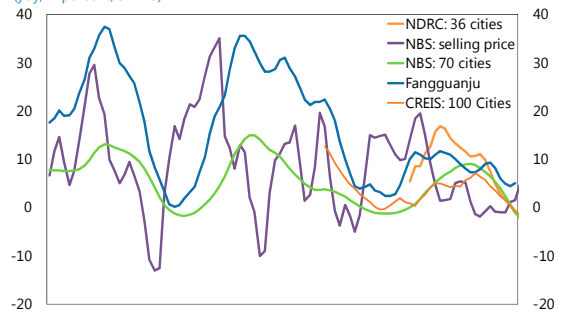
Legend: NDRC: 36 cities; NBS: selling price; NBS: 70 cities; Fangguanju; CREIS: 100 Cities

Sources: CEIC; Local Housing Administrative Bureau (Fangguanju); and IMF staff calculations.

The *FangGuanJu* dataset covers 134 cities: four Tier I cities, 36 Tier II cities, and 94 Tier III/IV cities. It covers four metropolitan cities, 25 cities in the Industrial Northeast area, 43 in coastal areas, and 62 in less-developed areas. Data from *FangGuanJu* at the city level are scattered, with missing data in some months for some cities. Given the data gap, a balanced panel on prices, sales transactions, and inventory is not directly available. The paper benefited from discussions with Wigram Capital Advisors on how to address data gaps to construct various indices. It first
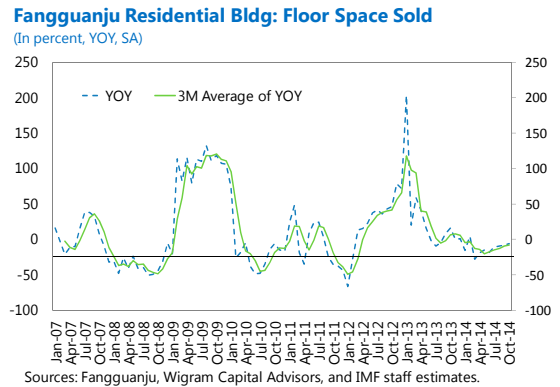
---

[20] The local housing administrative bureaus (*Fangguanju*) are city-level government agencies in charge of the real estate market in the city, under the Ministry of Housing and Urban-Rural Development. The bureaus execute and take charge of the registration of all real estate sales, leases, mortgages, and transfers.

calculates the annual and monthly growth rates for prices, sales, floor space sold, and floor space unsold for cities that have available data and then takes a weighted average (based on city size) to create a corresponding index. Inventory ratio is based on the ratio of the indices of floor space unsold to floor space sold. For the annual inventory ratio, the paper adds the floor space unsold across available cities during the year, then divides it by the sum of annual floor space sold across cities to reach the average duration (in years). This indicates the time (in years) it would take to absorb the existing unsold space.

B. Volume Data (floor space sold, starts, and completed)

Assessing real estate demand and supply conditions is often hampered by challenging data issues. China's NBS provides data on floor space sold, starts, under construction, completions, and available for sale at a national level on a monthly basis (see below).
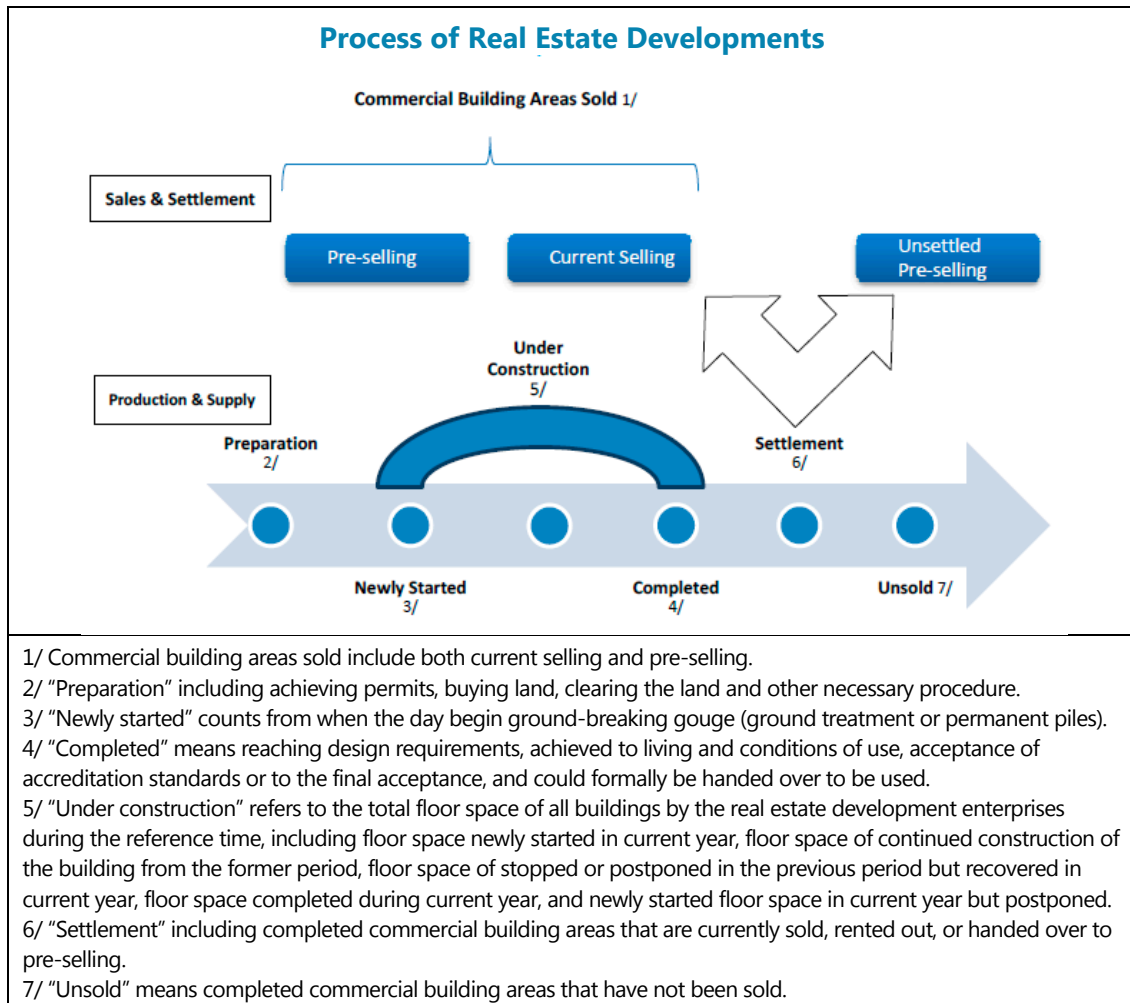
a. *Floor space sold* refers to the total floor area sold for buildings listed in the contract during any reporting period. It is the area of floor space stated in the formal contract signed by both parties. It includes both the sale of currently completed units (not yet sold) as well as presale units offered by real estate developers. The secondary market between private individuals is not included in NBS coverage.

Fangguanju Residential Bldg: Floor Space Sold
(In percent, YOY, SA)

Sources: Fangguanju, Wigram Capital Advisors, and IMF staff estimates.

b. *Commodity (Private) housing sales* refers to total sales of commodity housing (that is, private housing allowed to be resold in markets) listed in the formal contract signed by both parties during the reporting period. Again, it includes both the sale of currently completed (not yet sold) units and presale units. The secondary market between private individuals is not included in NBS coverage. The NBS released a province-level real estate price index in the Yearbook; this index is the ratio of *Commodity housing sales* to *area sold of buildings for reselling purpose*.

c. *Floor space starts* indicates residential floor space newly started by real estate development enterprises during the reference period. The accounting measure uses all construction floor space of a building. To avoid double counting, all housing construction begun in previous periods is excluded. Similarly, construction that has previously been started, but r*estarted again because of some postponement or stoppage in earlier periods* (for example, obtaining financing in the interim) is excluded. The floor space of houses newly started refers to the entire floor space of the whole building. *Newly started* counts from the day the real estate developer breaks ground (work undertaken at the foundation site). Clearing the land is not sufficient. It must be accompanied by permits, actual construction, and the like.

d. *Floor space under construction* (or floor space of buildings under construction) refers to the total floor space of all residential buildings under construction by real estate enterprises during

the reference period. It would imply that the indicator includes (1) "floor space newly started" (item *c* above) in current period; (2) floor space of continued construction carried over from previous periods; (3) floor space restarted for construction for the current period that was stopped or postponed in the previous period; (4) floor space completed during the current year, and newly started floor space in current year but postponed.

This indicator is a very broad concept by definition, referring to all buildings that are in the construction phase during the reference period (regardless of whether construction is physically taking place). As a result, it includes "floor space completed" at the current period because that remains under the construction phase at the same period. However, floor space completed in the current period will not count toward the "floor space under construction" next period because it will no longer be in the construction phase. The same applies to floor space "started but postponed" because even if construction activity is stopped, those buildings are still in the "construction phase." The NBS recognizes the difficulties in breaking these statistics down to individual components.

Process of Real Estate Developments

1/ Commercial building areas sold include both current selling and pre-selling.
2/ "Preparation" including achieving permits, buying land, clearing the land and other necessary procedure.
3/ "Newly started" counts from when the day begin ground-breaking gouge (ground treatment or permanent piles).
4/ "Completed" means reaching design requirements, achieved to living and conditions of use, acceptance of accreditation standards or to the final acceptance, and could formally be handed over to be used.
5/ "Under construction" refers to the total floor space of all buildings by the real estate development enterprises during the reference time, including floor space newly started in current year, floor space of continued construction of the building from the former period, floor space of stopped or postponed in the previous period but recovered in current year, floor space completed during current year, and newly started floor space in current year but postponed.
6/ "Settlement" including completed commercial building areas that are currently sold, rented out, or handed over to pre-selling.
7/ "Unsold" means completed commercial building areas that have not been sold.

e. *Floor space completed (Floor space of buildings completed) refers to housing construction that has been completed in accordance with the design and approval requirements, including fulfilling the conditions of use and other accreditation standards to certify the buildings can be formally handed over to buyers to use. The real estate developer needs to obtain certification from various agencies (local government, fire station, and the like). If the certification was not completed for any reason, the floor space will not be counted toward "completed" and will stay in the construction phase. Real estate developers directly report this to the NBS through an online system.*

f. *Floor space waiting for sales (vacant) refers to completed floor space of housing that is available for sale or rent but that has not yet been sold or rented. The indicator includes unsold floor space of completed buildings (in completion phase) but excludes buildings not yet built or under construction to avoid double-counting.*

C. Real Estate Investment

The NBS publishes data on *investment in real estate development*. The definition of the series (from CEIC) is investment by real estate development companies, commercialized buildings construction companies, and other real estate development units of various types of ownership in the construction of buildings, such as residential buildings, factory buildings, warehouses, hotels, guesthouses, holiday villages, office buildings, and the complementary service facilities and land development projects, such as roads, water supply, water drainage, power supply, heating supply, telecommunications, land leveling, and other infrastructural projects. It does not include activities in pure land transactions.

Residential real estate investment refers to real estate investment in residential buildings only.

IMF staff estimates its real estate gross fixed capital formation (GFCF) series based on the national account concept. It takes a share of real estate investment in total fixed asset investment (both series from NBS) and applies it to the measure of GFCF in the national accounts.

D. Inventory Data

Data on inventory consist of NBS and local housing bureau properties available for sale. The NBS data on inventory consist of *floor space unsold,* and floor space sold adjusted by the inventory ratio to measure how long it would take existing unsold units to be absorbed by average sales. The *FangGuanJu* also provides the transaction volume of floor space sold and unsold (in square meters). Data are based on transaction records for purchases and sales of newly built residential units. The sample in general covers larger cities, about 20–25 percent of China's urban landscape.

The difference between the change in housing stock and new construction can be attributed to demolitions and reclassification of rural to urban areas under the urbanization process.

E. Data Classification

Our analysis is based on five different datasets: (1) *Commodity Building Residential Selling Price* provided by the NBS, which we refer to as *NBS: Selling Price*; (2) *70 (Large and Medium-sized) Cities Price Index* provided by NBS; (3) *CREIS: 100 Cities Price* provided by *SouFun* via a survey; (4) *NDRC: 36 (Main) Cities Price*, provided by the National Development and Reform Commission; and (5) local housing bureaus (*FangGuanJu*)*: 134 Cities Residential Property Price (Floor Space Sold/Unsold)*. Different datasets have various advantages and disadvantages.

Data classification on cities consists of the division into three Tier groupings and four geographic areas. We split the cities into Tier I, Tier II, and Tier III/IV cities, based on official definitions (see footnote 6).We also split them into four geographic areas: Industrial Northeast (Liaoning, Jilin, Heilongjiang, Hebei, and Shandong provinces), Coastal (Guangdong, Fujian, Jiangsu, and Zhejiang provinces), Metropolitan (Beijing, Shanghai, Tianjin, Chongqing), and Less Developed areas (the remaining provinces) (Wigram Capital Advisors 2014).

Among the five datasets, *70 Cities Price Index* and *CREIS: 100 Cities Price* are most widely used in analyzing the evolution of China's property market. Data coverage is insufficient for analysis by city tiers. Most datasets inadequately cover the Tier III/IV cities. The coverage of *NDRC: 36 Cities Price* is the narrowest, without full coverage of Tier II, let alone Tier III/IV cities. *CREIS: 100 Cities Price* has wider coverage, but the time series is short, and the dataset is based on an unofficial survey. The *NBS: Selling Price* is provincial-level data, which provides no information at the city level.

The *FangGuanJu* dataset overcomes some of these drawbacks and has other merits. *FangGuanJu* is a city-level government division in charge of a city's real estate market. Under the administration of the Ministry of Housing and Urban-Rural Development, every city-level housing bureau executes administrative functions and takes charge of the registration of all real estate sales, leases, mortgages, and transfers. Therefore, *FangGuanJu* tends to have the most accurate data on transactions in the property market. Addressing data gaps and constructing indices benefited from inputs of Wigram Capital Advisors. The dataset covers 134 cities: 4 Tier I cities, 36 Tier II cities, and 94 Tier III/IV cities. It covers 4 Metropolitan cities, 25 cities in the Industrial Northeast, 43 in Coastal areas, and 62 in Less Developed areas.

REFERENCES

Bian, T.Y., and P. Gete, 2015, "What Drives Housing Dynamics in China? A Sign Restrictions VAR Approach', NBER Working Paper 2015 (Cambridge, Massachusetts: MIT Press).

Berkelmans, L. and H. Wang, 2012, "Chinese Urban Residential Construction to 2040," Reserve Bank of Australia, Research Discussion Paper 2012–04.

Chen K. and Y. Wen, 2014, "The Great Housing Boom of China," Federal Reserve Bank of St. Louis, Working Paper 2014-022A.

Gao, B., W. Wang, and X. Li, 2013, Expectation, Income Inequality and the Puzzle of City's Housing Price to Rent Scissors in China, *Economic Research Journal*, Vol. 6.

Goldman Sachs, 2014, "China's Housing Boom in International Context," Global Economics Paper: 225, October 16.

Grenadier, S. R., 1996, "The Strategic Exercise of Options: Development Sascades and Overbuilding in Real Estate Markets," *Journal of Finance*, Vol. 51, No. 5, pp. 1653–79.

Huang, Z., C. Wu, and X. Du, 2008, "Real Estate Investment and Economic Growth: An Analysis of National and Regional Panel Data," *Finance & Trade Economics*, Vol. 8.

International Monetary Fund, 2014a, *People's Republic of China,* IMF Staff Country Report No. 14/235 (Washington).

International Monetary Fund, 2014b, *World Economic Outlook (*Washington, October).

Jiang, C., 2005, "A Case Study of the Speculation Bubble on China's Real Estate Market," *Management World,* Vol. 12.

Kuang W., 2010, Expectation, Speculation and Urban Housing Price Volatility, *Economic Research Journal*, Vol. 9.

Li X., G. Hong, L. Huang, 2013, "The Mystery of Land Finance Growth in China: Tax-Sharing Reform, Strategic Interaction of Land Finance," *China Economic Quarterly*, Vol. 12, No. 4.

Liang, Y., T. Gao, and S. He, 2006, "An Empirical Analysis of Harmonious Development between the Real Estate Industry and the National Economy in Transitional China," *Social Sciences in China*, Vol. 3.

Lv W., and Liu C., 2012, "Fiscal Expenditure, Land Finance and Housing Price Bubble: Measurement and Empirical Study Based on Provincial Panel Data," *Finance & Trade Economics*, Vol. 12.

Moody, 2014, "A Property Downturn in China Would Exert A Marked, But Manageable Economic Impact," July 30.

Shen, Y., and H. Liu, 2004, "Housing Prices and Economic Fundamentals: A Cross City Analysis of China for 1995–2002," *Economic Research Journal*, Vol. 6.

Wigram Capital Advisors, 2014, "Chartpack on China Property Watch," unpublished.

Wu, J., J. Gyourko, and Y. Deng, 2012, "Evaluating Conditions in Major Chinese Housing Market," *Regional Science and Urban Economics*, Vol. 42, pp. 531–43.

Yang, Y., 2010, "The Scale of 'Land Finance' and Its Driving Factors," *Finance & Trade Economics*, Vol. 10.

Zheng, S., and Z. Shi, 2011, "The Land and Housing Markets in the Context of 'Land Finance': an Analysis of Local Government Behaviors," Social Sciences in Guangdong, Vol. 2.

Zou, Z., and L. Niu, 2010, "Demand and Supply for Residential Housing in Urban China," Financial Research, Vol. 1.