Stranded Property Assets in China's Resource-based Cities: implications for financial stability?

Working Paper

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Executive Summary

More than one quarter of China's housing stock is currently located in 'resource-based cities' (RBCs), where the majority of economic activity is derived from the extraction of non-renewable resources.[1] We hypothesise that residential and commercial property assets may become stranded in RBCs as China implements more stringent policies to mitigate the environmental pollution caused by extractive industries. Should this lead to a widespread fall in property prices in RBCs, it could have a profound effect on wider financial stability, as it is estimated that the majority of China's outstanding debt is in the real estate sector[2] with a material proportion of this tied to RBCs.

There are 263 RBCs (*ziyuanxing chengshi* 资源型城市). Typically such cities have at least 40% of their working population engaged in the exploitation, production, and business operations of non-renewable natural resources.[3]
Together RBCs comprise 26% of the total built-up urban area and have an average population of 2.5m – comprising 658m, or 48% of China's total.[4]

We anticipate that the RBC economies will likely stagnate and decline for variety of reasons. Industries in general tend to go through a life cycle consisting of rapid initial growth followed by a more stable mature period, and finally a period of decline.[5,6] For the past several decades China has rapidly industrialised and many of its primary industries are now entering these mature and declining phases.[7] While 'market' economies should be able to undergo a process of 'creative destruction' to reorganise and redeploy unproductive workers and capital, many RBCs are effectively locked into their dominant industries by state ownership, specialised assets, and large populations of entrenched legacy workers.[8]

At the same time, RBCs (almost all of which are land-locked) are at a disadvantage competing with more coastal cities, which have been better able to attract new industries with tax breaks and special development zones.[9] In addition to these factors, escalating environment-related risks may further compound the problem of asset stranding in RBCs. In response to increasing environmental pressure, the Chinese government has been implementing stricter policies on highly polluting industries such as coal and steel. For these reasons we think that the coal and steel industries have peaked in China, and are entering a phase of secular decline.

As a result of 'peak' coal and steel in China, RBCs that depend on these resources are likely to slow economically, reducing demand for property in these cities. One symptom of this decline has been reduced wages and unemployment in these RBCs. Over the past few years this trend has been steadily advancing, with registered coal sector employment in China estimated to drop from 5.29 million in 2013 to fewer than three

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[1] China Statistical Press 中国统计出版社, 中国城市统计年鉴 China City Statistical Yearbook, 2014.

[2] McKinsey Global Institute, 'Debt and (not Much) Deleveraging', no. February (2015): 1–136.

[3] This is regularly quoted in academic journals, newspapers and dissertations, but is not written in government documents, see: Hong Geng, Kai Zhang, and Hanwen Zhang, 'Research on Sustainable Development of Resource-Based Small Industrial and Mining Cities - A Case Study of Yangquanqu Town, Xiaoyi, Shanxi Province, China', *Procedia Engineering* 21 (2011): 633–40, doi:10.1016/j.proeng.2011.11.2059; Wu, Hong 吴洪, '发展特色旅游:阜新转型又一新思路', *Characteristic Tourism - A New Thought Of Economic Transformation in Fuxin* 8, no. 1 (2006): 9–12, doi:10.3969/j.issn.1673-2464.2006.01.003. Wei, Yuan 袁伟, '技术创新视经济转型——基于枣庄市经济转型的案例分析 Economic Transformation under High-Tech Innovation: Case Study of Zaozhuang, Shandong' (山东大学, 2007).

[4] 9,666km² of 37,162km² total. China Statistical Press 中国统计出版社, 中国城市统计年鉴 China City Statistical Yearbook, 2014.

[5] Gort, Michael, and Klepper, Stephen. 'Time Paths in the Diffusion of Product Innovations.' *Econ. J.* 92 (September 1982): 630-53.

[6] Klepper, Steven, and Graddy, Elizabeth. 'The Evolution of New Industries and the Determinants of Market Structure'. *Rand J. Econ.* 21 (Spring 1990): 24-44.

[7] IMF (2016). 'Spillovers from the Maturing of China's economy.' WP/16/212.

[8] Bray, D. *Social Space and Governance in Urban China: The Danwei System from Origins to Reform* (Stanford University Press, 2005).

[9] Rithmire, M. *Land Bargains and Chinese Capitalism: The Politics of Property Rights under Reform* (Cambridge University Press, 2015).

million people by 2020.[10] Many laid-off workers are reluctant to seek employment either in new industries or locations due to cultural factors and a lack of transferable skills.[11] Rising unemployment will translate into lower demand, negatively affecting property prices in RBCs, particularly in locations that already have oversupply.

In RBCs a surfeit of available land and perverse incentives have led to excess property development. As local governments (i) sell land for development, (ii) have ownership of the state-owned enterprises (SOEs) which buy this land, and (iii) own the platforms that finance the transactions, the system is heavily biased towards oversupply. Local governments regularly exploit this arrangement to make up for fiscal deficits, which is referred to as the 'land financing model'[12] or 'land commodification'[13]. There is also evidence to suggest that local governments coerce SOEs to pay inflated prices for this land and to 'win' the largest parcels offered for sale.[14] This system is also encouraged because it increases subsequent fiscal revenues from; (i) direct land taxes, which include urban usage, agriculture occupancy and deeds (accounting for approximately 10% of fiscal revenues), and (ii) indirect taxes such as sales and corporate income taxes from construction and real estate companies (up to 50% of fiscal revenues).[15] The resulting oversupply combined with weak demand has led to much incomplete, indefinitely postponed construction projects and empty housing.

The Chinese real estate market has been described as the single most important sector in the global economy as well as its biggest risk factor.[16] China's economy is now the world's largest in terms of purchasing-power parity, and property investment directly contributed 10% to GDP in 2016[17], and roughly 30% of China's value added originating from property.[18] Real estate is therefore a significant driver of Chinese economic growth and wealth creation. The health of China's banking system (the world's largest by assets at $33tn) is also deeply tied to the fate of the property sector.[19] Analysts estimate that more than 60% of Chinese bank loans are directly or indirectly tied to real estate.[20] Therefore, the fate of the globally important Chinese economy is closely tied to its real estate market.

However, the Chinese real estate market faces significant risks unique to its economic and political situation. Due to China's rapid economic growth rate, real estate price levels in China are dominated by expected price appreciation (as opposed to rental revenues). For example in Beijing, the ratio of average house price to rent is currently over 50[21], implying substantial expected capital gains.[22] The sensitivity of Chinese real estate prices to expected capital appreciation is compounded by the high rate of unoccupied and empty property assets because, due to the lack of tenant income, such properties can quickly lose value and are illiquid. According to the most recent data from the China Household Finance Survey, an estimated 50 million homes (or 22% of the total urban

[10] China Dialogue. (8 August, 2017). '2.3 million Chinese coal miners will need new jobs by 2020.'
https://www.chinadialogue.net/article/show/single/en/9967-2-3-million-Chinese-coal-miners-will-need-new-jobs-by-2-2-

[11] See Jane Perlez and Huang Yufan, 'Mass Layoffs in China's Coal Country Threaten Unrest', *The New York Times*, accessed 19 December, 2015, http://www.nytimes.com/2015/12/17/world/asia/china-coal-mining-economy.html?_r=1. 'Longmay Group, the biggest coal company in northeastern China, announced in September [2015] that it planned to lay off 100,000 workers'.

[12] Yuanyan, Sophia Zhang and Steven Barnett, 'Fiscal Vulnerabilities and Risks from Local Government Finance in China', *IMF Working Papers* 14 (2014): 1, doi:10.5089/9781484349953.001.

[13] Lin, G.C. and A. Y. Zhang, 'Emerging Spaces of Neoliberal Urbanism in China: Land Commodification, Municipal Finance and Local Economic Growth in Prefecture-Level Cities', *Urban Studies*, 3 April, 2014, doi:10.1177/0042098014528549.

[14] Jing Wu, Joseph Gyourko, and Yongheng Deng, 'Evaluating Conditions in Major Chinese Housing Markets', *National Bureau of Economic Research Working Paper Series* No. 16189 (2010), doi:10.3386/w16189.

[15] Lin, G.C. and A. Y. Zhang, 'Emerging Spaces of Neoliberal Urbanism in China: Land Commodification, Municipal Finance and Local Economic Growth in Prefecture-Level Cities', *Urban Studies*, 3 April, 2014, doi:10.1177/0042098014528549.

[16] Financial Times Reporters, 'Chinese property boom props up Xi's hopes for the economy', *Financial Times*, 19 October, 2017, https://www.ft.com/content/0aa534f4-acdc-11e7-aab9-abaa44b1e130

[17] Financial Times Reporters, 'Chinese property: A lofty ceiling', *Financial Times*, 13 December, 2011, https://www.ft.com/content/6b521d4e-2196-11e1-a1d8-00144feabdc0

[18] Wenlang Zhang, Gaofeng Han, and Steven Chan, 'How Strong Are the Linkages between Real Estate and Other Sectors in China?', HKIMR Working Paper 11/2014, no. 11 (2014).

[19] Financial Times Reporters, 'China overtakes eurozone as world's biggest bank system', *Financial Times*, 5 March, 2017, https://www.ft.com/content/14f929de-ffc5-11e6-96f8-3700c5664d30

[20] Financial Times Reporters, 'The Chinese chronicle of a crash foretold', *Financial Times*, 24 February, 2016, https://www.ft.com/content/65a584e2-da53-11e5-98fd-06d75973fe09

[21] Deng, Y., Gyourko, J., and Wu, J. (2015). 'Evaluating the Risk of Chinese Housing Markets: What We Know and What We Need to Know.' NBER Working Paper No. 21346.

[22] Poterba, J (1984). 'Tax subsidies to owner - occupied housing: An asset market approach.' *Quarterly Journal of Economics*, 99(4): 729-752.

housing stock) were vacant in 2013.[23] Consequently, Chinese property prices are likely to be extremely sensitive to declines in expected economic growth.[24] In the housing market, for instance, researchers have estimated that a 1% drop in expected annual house price appreciation (or a 1% increase in interest rates) would lead to price declines of about a third.[25]

The trigger for the next recession could therefore well be a value loss in real estate in RBCs associated with natural and regulatory-induced declines in the coal and steel sectors. The necessary tightening of environmental standards is causing a rapid decline in the economic prospects of coal-based RBCs, thereby undermining their real estate markets. The ensuing loss of financial solvenecy in the private and SOE sectors would be compounded by the loss of local government revenues. The combined dampening effect on the economy would have global consequences and potential implications for financial stability.

The city of Ordos is a recent example of an RBC which experienced a rapid deterioration in economic prospects due to falling prices in its key industry (coal) in 2012. As result of this economic downturn property prices in Ordos rapidly halved, falling to levels seen prior to its initial boom phase. If multiple Chinese cities were to simultaneously experience the same degree of asset stranding, due to the leveraged interlinkages of real estate with local government finances and wider financial markets, the result could be a national or even global recession. Policymakers interested in reducing the likelihood and severity of future financial crises and investors looking to better understand and hedge risks may consider further research to increase the transparency of the scale, geographies, and interlinkages of potential stranded real estate assets in these resource-based cities.

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[23] Gan, Li. (2016). 'Trend in the housing market and housing vacancy rate in urban China'. Survey and Research Centre for China Household Finance, http://www.chfsdata.org/xiangqing.aspx?id=1160
[24] Dreger, C. and Zhang, Y. (2013). 'Is there a Bubble in the Chinese Housing Market?' *Urban Policy and Research*, 31(1): 27-39.
[25] Deng, Y., Gyourko, J., and Wu, J. (2015). 'Evaluating the Risk of Chinese Housing Markets: What We Know and What We Need to Know.' NBER Working Paper No. 21346.

1. Introduction

This working paper examines stranded property assets in Chinese cities where the majority of economic output comes from the coal and steel industries. Currently some 26% of China's housing stock is located in so-called 'resource-based cities' (RBCs), where the majority of economic activity is derived from the extraction of non-renewable resources.[26] We hypothesise that some of these property assets may become stranded as China implements more stringent policies to mitigate the environmental pollution caused by these industries. Should this lead to a widespread fall in property prices in RBCs, it could have a profound effect on wider financial stability, as it is estimated that the majority of China's outstanding debt is in the real estate sector.[27]

There are 263 RBCs (*ziyuanxing chengshi* 资源型城市), defined by the State Council as cities where non-renewable resource extraction and processing are the mainstay industries.[28] Typically such cities have at least 40% of their working population engaged in the exploitation, production, and business operations of non-renewable natural resources.[29] A case study of Ordos – one of China's most prominent coal-based cities – is used to assess the possible scale and timing of asset stranding in similar RBCs.

This paper contributes to the literature on the economic geography of China, adding to work on land financing and local government finances, and the financial stability risks arising from inter-corporate loans and non-bank lending. It is distinctive in that it argues that an impact pathway affecting property could be initiated by environmental policies alone. Specifically, it delineates how the introduction of environmental policies – primarily those targeting air pollution – could catalyse the decline of highly polluting coal and steel sectors, through (i) real channels: causing closures and unemployment, filtering through to a negative demand shock on the real estate sector; and (ii) financial channels: as property is tightly interlinked with industrial production and the banking sector. Our conclusions are highly relevant to any investor or policymaker with interests in the China's property market, local governments, financial stability, and environment policy.

Section 2 of this paper continues with the history and definitions of RBCs in China and provides background on their scale, scope, and likely extent of their influence. Section 3 describes how changes in demand for natural resources are affecting the current and future development of RBCs, how this demand can affect the value of property assets, and makes the case that empty and incomplete properties are most at risk of becoming stranded property assets. Section 4 examines how and to what extent, through financial channels, these types of properties could impact financial stability. Section 5 investigates the exact lending schemes and the scale of potential asset stranding through a case study of the city of Ordos. Section 6 concludes.

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[26] China Statistical Press 中国统计出版社, 中国城市统计年鉴 China City Statistical Yearbook, 2014.

[27] McKinsey Global Institute, 'Debt and (not Much) Deleveraging', no. February (2015): 1–136.

[28] State Council, '全国资源型城市可持续发展规划（2013-2020 年）National Resource-City Sustainable Development Plan 2013-2020', 2013, http://www.gov.cn/zwgk/2013-12/03/content_2540070.htm.

[29] This is regularly quoted in academic journals, newspapers and dissertations, but is not written in government documents, see: Hong Geng, Kai Zhang, and Hanwen Zhang, 'Research on Sustainable Development of Resource-Based Small Industrial and Mining Cities - A Case Study of Yangquanqu Town, Xiaoyi, Shanxi Province, China', *Procedia Engineering* 21 (2011): 633–40, doi:10.1016/j.proeng.2011.11.2059; Wu, Hong 吴洪, '发展特色旅游:阜新转型又一新思路', *Characteristic Tourism - A New Thought Of Economic Transformation in Fuxin* 8, no. 1 (2006): 9–12, doi:10.3969/j.issn.1673-2464.2006.01.003. Wei, Yuan 袁伟, '技术创新视济转型——基于枣庄市经济转型的案例分析 Economic Transformation under High-Tech Innovation: Case Study of Zaozhuang, Shandong' (山东大学, 2007).

2. Resource-based cities

History and overview of RBCs

The first major inquiry into the resource dependency of Chinese cities was the 2001 State Council report on the need to further study measures and strategies to manage the economic transition of 'resource-exhausted' cities. This study was based on Fuxin City in northeast China, where 156,000 people lost their jobs due to closures resulting from resource-exhaustion, and a number of other cities undergoing a similar decline (in particular where mines had reached a point beyond which natural resources could not be profitably extracted).[30] In 2007 the State Council introduced a definition of resource-based cities (*ziyuanxing chengshi*, 资源型城市), as cities where non-renewable resource extraction and processing are the main sectors of the local economy,[31] and suggested targeting these areas for economic rebalancing. Typically such cities have at least 40% of the working population engaged in the exploitation, production, or business operations of non-renewable natural resources.[32] In its 2007 report the State Council recognised 32 resource-exhausted cities.[33] In its second report written two years later 118 cities were identified.[34] In the most recent report published in 2013, the State Council produced an updated list of 263 cities which it considered to be 'resource-based', and went further to designate 69 of these as also 'resource exhausted'. This compares with a total of 624 cities at the prefectural and town level in China.

Since China began liberalising its economy, RBCs have struggled to keep up with the high rates of economic growth prevalent elsewhere.[35] In an attempt to equalise growth rates, beginning in the 2000s local governments of RBCs have enacted numerous policies aimed at the promotion of tertiary industries.[36] In spite of these efforts, when sampling the 20 largest RBCs over the past ten years (depicted in Table 1 below), none have managed a successful transition to an economy where the tertiary sector accounts for more than 50% of local GDP, or have managed to extricate themselves from an RBC classfication. In fact some of these cities are now more reliant on primary and secondary economic sectors than they were when the programmes began.[37]

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[30] See《听取辽宁省阜新市资源枯竭型城市转型等有关情况的会议纪要》in Zhang Ke 章轲, '辽宁阜新：一个资源枯竭型城市的转身 Liaoning Fuxin: The Bad Turn of a Resource Exhausted City', 第一财经日报 *China Business News*, 30 October, 2012, http://finance.sina.com.cn/roll/20121030/015213515673.shtml.

[31] State Council, '全国资源型城市可持续发展规划（2013-2020 年）National Resource-City Sustainable Development Plan 2013-2020'.

[32] This is regularly quoted in academic journals, newspapers and dissertations, but is not written in government documents, see: Wu, Hong 吴洪, '发展特色旅游:阜新转型又一新思路'. Wei, Yuan 袁伟, '技术创新视角下的资源型城市经济转型——基于枣庄市经济转型的案例分析 Economic Transformation under High-Tech Innovation: Case Study of Zaozhuang, Shandong.'

[33] State Council, '国务院关于促进资源型城市可持续发展的若干意见 State Council Policy on Promoting Sustainable Development of Resource-Based Cities', accessed 18 October 2015, http://www.gov.cn/zwgk/2007-12/24/content_841978.htm.

[34] See 《资源型城市经济结构转型》in Lei, Yu 雷宇, '大冶'招商引资悬赏令' 折射资源枯竭城市转型焦渴 Encouraging Outside Investment into Daye: Transforming Resource Exhausted Cities', 中国青年报 *China Youth Daily*, 13 2009, http://news.xinhuanet.com/fortune/2009-04/13/content_11175374_3.htm.

[35] China Data Online. 2016a. 'China City Statistics.' China Data Centre, University of Michigan.

[36] State Council. 国务院关于促进资源型城市可持续发展的若干意见 State Council Policy on Promoting Sustainable Development of Resource-Based Cities'. Accessed 18 October, 2015

[37] For instance, in Nanchong (population 7.6m) the change in tertiary sector, compared to primary and secondary, as a percentage of local GDP was -9% from 2000-10.

Table 1: Largest resource-based cities by GDP

Province	Level	City	Tier	Total amount invested in real estate development in the last 10 years 2003-13 (RMB bn)	Built up area in 2013 (km²) - city statistical yearbook	Population density in 2012 (persons per km²)	GDP 2013 (RMB bn)	Population 2013 (million)
Hebei	Prefectural	Tangshan	3	247	249	782	612	7
Jiangsu	Prefectural	Xuzhou	2	174	276		444	10
Heilongjiang	Prefectural	Daqing	3	113	241		418	3
Inner Mongolia	Prefectural	Ordos	3	154	113	106	396	2
Shandong	Prefectural	Zibo	3	104	251	945	380	4
Inner Mongolia	Prefectural	Baotou	2	130	186	494	350	2
Shandong	County	Jining	3	87	176	1,081	350	9
Shandong	Prefectural	Linyi	3	98	195	1,097	334	11
Shandong	Prefectural	Dongying	3	68	113	244	325	2
Henan	Prefectural	Luoyang	2	118	192		314	7
Hebei	Prefectural	Handan	3	136	121	3,010	306	10
Shaanxi	Prefectural	Yulin	3	39	70		285	4
Shandong	County	Taian	3	49	121	765	279	6
Liaoning	Prefectural	Anshan	3	185	167	1,912	262	4
Jilin	Prefectural	Jilin	3	122	173	492	262	4
Henan	County	Nanyang	3	47	149		250	12
Hunan	County	Hengyang	3	51	159	1,344	217	8
Shaanxi	Prefectural	Xianyang	2	79	88		186	5
Shandong	County	Zaozhuang	4	68	146	739	183	4
Zhejiang	Province	Huzhou	4	136	92		180	3
Total					3,278		6,333	115
% of China					8.82%		10.89%	8.44%

Source: China Data Online 2016b

Analysis of the degree of dependence of RBCs on their main products is complicated by the fact that in official statistics China has adopted non-standard definitions for primary, secondary, and tertiary industries. In particular, whereas China follows the rest of the world in defining 'primary industries' as comprising farming, forestry, animal husbandry and fisheries, China exceptionally excludes quarrying, mining and intermediate industrial production (such as smelting) from this 'primary' category. Instead, China classifies these industries as belonging to the same category as those more customarily regarded as 'secondary', such as manufacturing. Unfortunately, more granular breakdowns by industry are not available from official statistics. Therefore, it is not possible to separate industries involved in the exploitation of non-renewable resources from the more traditionally defined secondary industries, i.e. those which create final products from raw materials. These methodological difficulties notwithstanding, 'secondary industries' (which include the quarrying, mining, and

intermediate production of non-renewable resources) are the dominant economic drivers of a number of resource-based cities, and it is understood that this dominance is primarily due to quarrying and mining. Economic breakdowns of several representative RBCs are provided in Table 1 below.

Table 2: Examples of resource-based cities by main natural resource

City, Province	Main Natural Resource	Population (million)	GDP (RMB billion) 2013	Size of Urban 'built-up area' (km²)	Economic Structure Primary: Secondary: Tertiary (%)
Xinyu, Jianxi	Steel	1.21	89	72	6:58:36
Ordos, Inner Mongolia	Coal	1.5	395	113	2:60:38
Daqing, Heilongjiang	Oil	2.8	418	241	4:79:16
Tongling, Anhui	Non-ferrous: Copper	0.74	68	69	2:72:26
Baoshan, Yunnan	Forestry	2.6	45	73	29:35:37

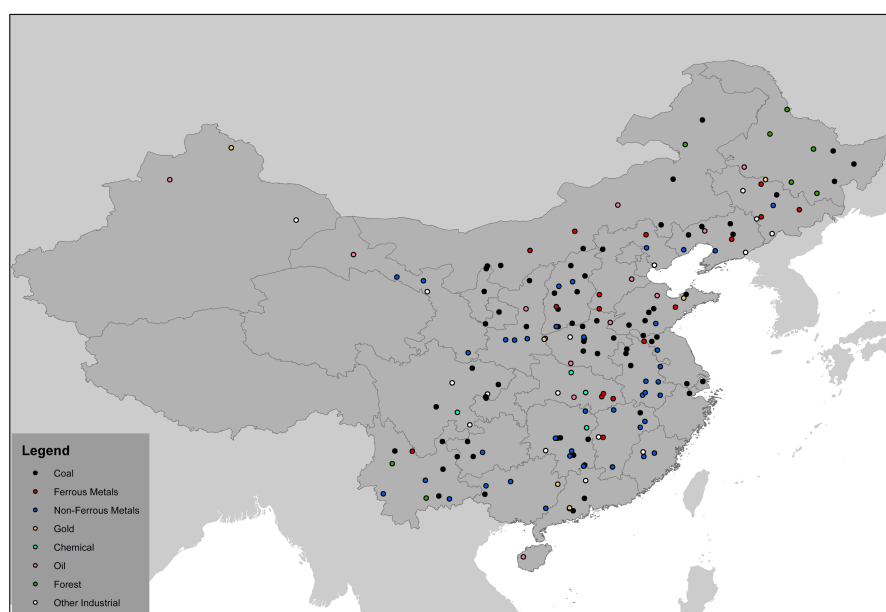Source: China Data Online 2016a; author's estimates

In addition to this definitional confusion, much of the official property data coming out of China only comprises select high-performing 'tiered' cities, which generally do not include RBCs. For example, RBCs are omitted from the regularly quoted '70 large and medium sized city housing index' for the simple reason that they are the worst performing. This systematic unrepresentativeness has hidden the fact that many RBCs are stagnating, and has cast an artificially rosy picture of the Chinese property market generally.

RBCs scale and scope

As shown in Figure 1, the 263 resource-based cities are widespread throughout China and not just located in the so-called 'rust-belt' spanning the three most northeastern provinces (Liaoning, Jilin, and Heilongjiang). Most RBCs are however located inland. Coal dependent RBCs are primarily situated in the north (e.g. Hebei), the east (e.g. Shandong), north west (e.g. Inner Mongolia) and in the south west (e.g. Sichuan and Yunnan). Cities dependent on the production of steel (termed ferrous metal cities) are located mainly in the north east (e.g. Hebei). Non-ferrous metal cities (including copper, zinc, gold, nickel, aluminium) are located in central and eastern China. Forestry cities are found in the southwestern province of Yunnan, and the northeastern province Heilongjiang. These 263 RBCs comprise 26% of the total built-up urban area and have an average population of 2.5m – comprising 658m, or 48% of China's total.[38]

Figure 1: Distribution of resource-based cities across China by industry

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[38] 9,666km² of 37,162km² total. China Statistical Press 中国统计出版社, 中国城市统计年鉴 China City Statistical Yearbook, 2014.

Source: China Data Online 2016a

Coal RBCs locations and exposure

Some 14% of China's 2013 GDP (RMB 56.9tn) came from its 80 coal resource-based cities.[39] These cities vary in size: the largest being Xuzhou in Jiangsu province (with a population of 10 million, with a built-up area of 276 km^2). The average population of these 80 coal cities was 2.5 million, and they had a five-year population CAGR (cumulative average growth rate) of 0.41%, compared with 0.59% nationally.[40]

Naturally the geographic spread of coal resource-based cities in China follows that of coal producing regions. From Figure 2 below it is clear that the impact of a decline in RBCs has the potential to stretch far beyond the northern rust belt and the coal rich Inner Mongolian boom towns like Ordos. In central China there are eight coal resources-based cities in Henan, three in Hunan, and two in Jiangxi and one in Hubei. In eastern China there are four in Anhui, and one in both Jiangsu and Zhejiang. South and southwest China have large concentrations of smaller coal resource-based cities including seven in Sichuan, and four in Yunnan.

However, most of China's total estimated coal resources of 279 billion tonnes (bnt) are located in the northern provinces of Shanxi and Inner Mongolia, accounting for 30.2% and 27.6% of the total, respectively.[41] In 2015 eight provinces were expected to contribute 79.4% of coal industry revenue: Shanxi, Henan, Shandong, Hebei, Inner Mongolia, Anhui, Shaanxi and Sichuan. The shares of revenue realised by enterprises in Shanxi, Henan and Shandong are expected to be 21%, 13.5% and 12.4% respectively.[42] However, Shandong has the highest concentration of large coal cities (by GDP) as this is where much coal processing takes place, followed by Inner Mongolia, where reserves are most easily accessible. Shandong contains the large cities of Zibo, Jining, Taian and Zaozhuang which have a cumulative GDP of RMB 1.19tn and total built-up urban area of 694km^2. Shandong also has the largest, and most concentrated, low quality government debt of all regions.[43]

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[39] State Council, '全国资源型城市可持续发展规划（2013-2020 年）National Resource-City Sustainable Development Plan 2013-2020'.

[40] China Statistical Press 中国统计出版社, 中国城市统计年鉴 China City Statistical Yearbook, 2014.

[41] Business Monitor International, 'China: Mining Report'.

[42] IBISWorld Industry Report, 'Coal Mining in China', 2015.

[43] *China Economic Weekly*, '银行不良率连涨 14 季度 山东等 15 省有了坏账银行 Non-Performing Loans Increase Successively for 14 Quarters: Shandong and 15 Provinces Have "Bad" Banks', 中国经济周刊, 24 August, 2015, http://finance.caijing.com.cn/20150824/3953476.shtml.

Figure 2: Geographic distribution of coal dependent resource-based cities

Source: China Data Online 2016a

Steel RBCs locations and exposure

About 5% of China's 2013 GDP (RMB 56.9tn) came from its 17 steel resource–based cities.[44] These cities vary in size: the largest being Handan in Hebei province (population 10 million, and built-up area of 136km²). The average steel city has a population of approximately 2.8 million and a five-year population CAGR of 0.01%.

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[44] State Council, '全国资源型城市可持续发展规划（2013-2020 年）National Resource-City Sustainable Development Plan 2013-2020'.

Figure 3: Geographic distribution of steel towns

Source: China Data Online 2016a

Hebei province in the north east is the largest producer of iron ore, and is expected to account for 27.3% of industry revenue and 24.7% of industry employment in 2016.[45] Liaoning Province also in the north east is the second-largest producer, accounting for 18.9% of industry revenues in 2016.[46] The largest iron ore district in China is the Anshan-Beixi Iron Ore District, whereas the Shandong Luzhong District is the largest in east China. Other major iron ore mining provinces include Sichuan in southwest China, Anhui and Henan in central southern China, and Fujian and Jiangxi in east China. The largest steel cities by built up area are Tangshan, Baotou, Anshan and Handan with a combined population of 23m, comprising 723km² and with a GDP of RMB 1.5tn.

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[45] Ibisworld Industry Report, 'Iron Ore Mining in China', Report 0810, May 2016.
[46] Ibid.

3. Drivers of RBC decline

In our view, the RBC economies will likely continue to stagnate and decline for variety of reasons. Industries in general tend to go through a life cycle consisting of rapid initial growth followed by a more stable mature period, and finally a period of decline.[47,48] For the past several decades China has rapidly industrialised and many of its primary industries are now entering these mature and declining phases.[49] While 'market' economies should be able to undergo a process of 'creative destruction' to reorganise and redeploy unproductive workers and capital, many RBCs are effectively locked into their dominant industries by state ownership, specialised assets, and large populations of entrenched legacy workers.[50] At the same time, RBCs (almost all of which are land-locked) are at a disadvantage competing with more coastal cities, which have been better able to attract new industries with tax breaks and special development zones.[51] In addition to these factors, escalating environment-related risks may further compound the problem of asset stranding in RBCs. In response to increasing environmental pressure, the Chinese government has been implementing stricter policies on highly polluting industries such as coal and steel. For these reasons we think that the coal and steel industries have peaked in China, and are entering a phase of secular decline.

Peak coal

Coal is the most carbon-intensive fuel used in large-scale electricity generation in China.[52] Thermal coal is also widely used as a source of domestic heating, and is responsible for a significant proportion of China's air pollution problems.[53] The mining of coal can also cause considerable damage to mined areas and local water systems.[54] As China's population has become more concerned about its environment, there have been calls for policies which would require the curtailment of coal combustion and mining.[55]

For instance, China has pledged a 40-45% reduction of the 2005 carbon intensity of GDP by 2020, as well as an absolute cap on total CO_2 emissions by 2030. It is also expected that China will more strictly enforce its existing air quality limits for particulate matter (PM), which are especially stringent for areas with large amounts of coal-fired generation. The heavily industrialised north-eastern areas around Beijing, Tianjin, and Hebei, for example, will be required to improve PM10 levels by 10% and PM2.5 by 25%; whereas the southwestern provinces of Sichuan, Guizhou, and Yunnan will only be required to improve PM10 levels by 0-5%.[56] In order to meet these goals China extended its seven-city emissions trading scheme (ETS) to the entire nation in 2016, and is considering implementing a separate carbon tax in 2018.[57] Furthermore, 12 provinces, which account for 44% of Chinese coal consumption, have pledged to measure and reduce coal use. Provinces with absolute coal consumption reduction targets between 5-50% include Beijing, Tianjin, Hebei, Shandong, Shanxi, and Chongqing.[58] The Yangtze River Delta and the Pearl River Delta have also pledged 'negative growth' in coal consumption,[59] and Jilin and Liaoning provinces have agreed not to exceed 2% annual growth.[60]

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[47] Gort, Michael, and Klepper, Stephen. 'Time Paths in the Diffusion of Product Innovations.' *Econ. J.* 92 (September 1982): 630-53.

[48] Klepper, Steven, and Graddy, Elizabeth. 'The Evolution of New Industries and the Determinants of Market Structure'. *Rand J. Econ.* 21 (Spring 1990): 24-44.

[49] IMF (2016). 'Spillovers from the Maturing of China's economy.' WP/16/212.

[50] Bray, D. *Social Space and Governance in Urban China: The Danwei System from Origins to Reform* (Stanford University Press, 2005).

[51] Rithmire, M. *Land Bargains and Chinese Capitalism: The Politics of Property Rights under Reform* (Cambridge University Press, 2015).

[52] Guan, D., et al. (2012). 'The gigatonne gap in China's carbon dioxide inventories.' *Nature Climate Change*, 2 (Sept): 672-676.

[53] Cornot-Gandolphe, S. 'China's Coal Market: Can Beijing Tame King Coal?' Oxford Institute for Energy Studies, 2014.

[54] Haibin, L. and Zhenling, L. (2010). 'Recycling utilization patterns of coal mining waste in China'. *Resources, Conservation and Recycling,* 54(12): 1331-1340.

[55] Economy, E. (2007). 'The Great Leap Backward? The costs of China's environmental crisis'. *Foreign Affairs*, 86(5): 38-59.

[56] Clean Air Alliance of China (2013). 'Can Beijing, Tianjin and Hebei achieve their PM2.5 targets by 2017?'

[57] Caldecott, Ben, Gerard Dericks, and James Mitchell, *Stranded Assets and Subcritical Coal. The Risk to Companies and Investors*, March, 2015.

[58] China Coal Cap Project (2015). 'China Coal Consumption Cap Plan and Research Report'

[59] Ibid.

[60] TShuo, L. and L. Myllyvirta (April 2014). 'The End of China's Coal Boom - 6 Facts You Should Know', Greenpeace.

These air pollution and coal consumption policies will almost certainly have their most concentrated economic effect in cities dependent on coal mining – particularly from small mines containing low-grade coal. In addition, policies are turning against coal mining directly. The 2010-15 five-year plan increased tax burdens on coal mining by introducing an environmental tax.[61] Furthermore, in its plan to develop its ethnically diverse western regions, China is planning on expanding the coal output in these areas. The westernmost province of Xinjiang holds 40% of China's coal resources, and it is intended that this region will become a strategic energy base for the rest of the country.[62] This change will be to the detriment of the traditional eastern coal mining areas of Shanxi, Shandong and Inner Mongolia, all of which contain many coal RBCs. The planned increase in western coal supply is particularly worrying for existing RBCs given that China has also recently decided to cap total domestic coal production at 3.9bnt.[63] With Chinese coal prices having fallen nearly 60% since 2011,[64] this situation represents a significant threat to the continued viability of coal RBCs.

Peak steel

China produced a record 822.7 million tonnes (mnt) of steel in 2014, roughly half of global output.[65] However the industry itself is in secular decline.[66] In 2015 while GDP grew by 6.9%, China produced only 0.9% more steel, its slowest annual growth rate in 33 years. A significant problem faced by the industry is extreme over-capacity. In the coming years both industry and government are expecting continued hardship in the steel sector, with Zhang Guangning, chairman of the China Iron and Steel Association, publicly stating that the steel sector has entered a 'period of peaking and flattening out',[67] and Morgan Stanley for instance forecasting that China's steel production will slip under 800mnt from 2017 to 2020.[68]

In response, between 2016 and 2020 the government is aiming to reduce the country's annual capacity for steel by 100-150mnt, nearly 20% of its output in 2016.[69] Capacity cuts in 2016 progressed as planned: a total of 65mnt of iron and steel production capacity were closed, going beyond the annual target of 45mnt,[70] and up to September this capacity has been reduced by a further 42mnt.[71]

Peak urbanisation

In addition to structural declines in the coal and steel industries, there is evidence that future housing demand in resource-based cities will further weaken due to changing urban migration patterns and the recent modernisation of the building stock – making property in resource-based cities more vulnerable to asset stranding. As countries develop, urbanisation rates generally increase rapidly and then level-out in an S-shaped curve.[72] According to World Bank estimations, China's urbanisation rate peaked in 2008 and has since been slowing down.[73] This reported decline in the speed of urbanisation is echoed by the Economist Intelligence Unit which projects that China's current urban population of 691 million, now growing by 20 million a year, will grow by only 7.5 million a year by 2030, and by just 1 million a year by 2040.[74]

[61] Cornot-Gandolphe, S. 'China's Coal Market: Can Beijing Tame King Coal?' Oxford Institute for Energy Studies, 2014.
[62] Ibid.
[63] Tu, Kevin Jianjun, 'China's Plan to Cap Coal Consumption and Production Needs Political Accountability and Accurate Statistical Reporting to Succeed', China Oil Trader, accessed 16 July, 2016, http://www.chinaoiltrader.com/?p=364.
[64] Perlez and Yufan Huang, 'Mass Layoffs in China's Coal Country Threaten Unrest'. *The New York Times*, 16 December, 2015, http://www.nytimes.com/2015/12/17/world/asia/china-coal-mining-economy.html
[65] Reuters (4 February, 2015). 'China reaching "peak steel" isn't all bad news: Russell.' https://www.reuters.com/article/column-russell-china-steel/column-china-reaching-peak-steel-isnt-all-bad-news-russell-idUSL4N0VE18W20150204
[66] Ibid.
[67] Ibid.
[68] Ibid.
[69] *The Economist* (7 September, 2017). 'Capacity cuts in China fuel a commodity rally and a debate.' http://www.economist.com/news/finance-and-economics/21728623-one-biggest-and-more-controversial-trends-global-economy-capacity
[70] Peterson Institute for International Economics. (29 June, 2017). 'China's excess capacity in steel: A fresh look'. https://piie.com/blogs/china-economic-watch/chinas-excess-capacity-steel-fresh-look
[71] *Nikkei Asian Review*. (27 September, 2017). 'Global steel industry strengthens as China cuts capacity.' https://asia.nikkei.com/Spotlight/China-s-annual-congress/Global-steel-industry-strengthens-as-China-cuts-capacity?page=1
[72] Mulligan, G. (2013). 'Revisting the urbanization curve.' *Cities*, 32: 113-122.
[73] 'World Bank - 2014 - WB Part II Supporting Reports Urbanization and Economic Growth', n.d., 112.
[74] Berkelmans and Wang, 'Discussion Paper Chinese Urban Residential Construction to 2040', 8.

A primary source of new property demand in China has been the replacement of socialist-style properties. As their wealth has increased, the Chinese have demanded larger and more modern accommodation. This demand has led to a rapid rebuilding of the existing building stock and has had a significant effect on the construction market. For instance, it is estimated that roughly half of new construction between 2006-10 went to replace obsolete socialist buildings.[75] However, it is believed that the demand for this redevelopment has now peaked, and that the rates of obsolescence for recently constructed modern buildings will be significantly lower than their predecessors.[76]

Weakened demand, abundant supply, and empty properties

As a result of the peak coal, steel, and urbanisation phenomena now affecting China, RBCs that depend on coal and steel are likely to slow economically, reducing demand for property in these cities. One symptom of this decline has been reduced wages and unemployment in these RBCs. At the end of 2015, the biggest coal company in northeastern China, Longmay Group, announced that it would lay off some 100,000 workers in four cities – or 40% of its workforce.[77] Over the past few years this trend has been steadily advancing, with registered coal sector employment in China estimated to drop from 5.29 million in 2013 to fewer than three million people by 2020.[78] Many laid-off workers are reluctant to seek employment either in new industries or locations due to cultural factors and a lack of transferable skills.[79] Rising unemployment will translate into lower demand, negatively affecting property prices in RBCs, particularly in locations that already have oversupply.

In RBCs a surfeit of available land and perverse incentives have led to excess property development. As local governments (i) sell land for development, (ii) have ownership of the state-owned enterprises (SOEs) which buy this land, and (iii) own the platforms that finance the transactions, the system is heavily biased towards oversupply. Local governments regularly exploit this arrangement to make up for fiscal deficits, which is referred to as the 'land financing model' [80] or 'land commodification' [81] (see appendix 'Primer on China's land market'). There is also evidence to suggest that local governments coerce SOEs to pay inflated prices for this land and to 'win' the largest parcels offered for sale.[82] This system is also encouraged because it increases subsequent fiscal revenues from; (i) direct land taxes, which include urban usage, agriculture occupancy and deeds (accounting for approximately 10% of fiscal revenues), and (ii) indirect taxes such as sales and corporate income taxes from construction and real estate companies (up to 50% of fiscal revenues).[83]

The resulting oversupply combined with weak demand has led to much incomplete, indefinitely postponed construction projects and empty housing. Beginning in 2009 the proportion of floor space under construction compared to floor space of completed buildings has rapidly increased (see Figure 4 below).[84]

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[75] Yao, Rosalea. 'Tearing Down Mountains, Building Up Castles', GK Dragonomics, 2013.

[76] Financial Times Reporters, 'Beijing Accuses Banks and Developers over Property Market', *Financial Times*, 23 June, 2014, http://www.ft.com/cms/s/0/dba1bee4-fa9a-11e3-8959-00144feab7de.html#axzz4Bb0PYE29.

[77] See Jane Perlez and Huang Yufan, 'Mass Layoffs in China's Coal Country Threaten Unrest', *The New York Times*, accessed 19 December, 2015, http://www.nytimes.com/2015/12/17/world/asia/china-coal-mining-economy.html?_r=1. 'Longmay Group, the biggest coal company in northeastern China, announced in September [2015] that it planned to lay off 100,000 workers'.

[78] China Dialogue. (8 August, 2017). '2.3 million Chinese coal miners will need new jobs by 2020.' https://www.chinadialogue.net/article/show/single/en/9967-2-3-million-Chinese-coal-miners-will-need-new-jobs-by-2-2-

[79] See Jane Perlez and Huang Yufan, 'Mass Layoffs in China's Coal Country Threaten Unrest', *The New York Times*, accessed 19 December, 2015, http://www.nytimes.com/2015/12/17/world/asia/china-coal-mining-economy.html?_r=1. 'Longmay Group, the biggest coal company in northeastern China, announced in September [2015] that it planned to lay off 100,000 workers'.

[80] Yuanyan, Sophia Zhang and Steven Barnett, 'Fiscal Vulnerabilities and Risks from Local Government Finance in China', *IMF Working Papers* 14 (2014): 1, doi:10.5089/9781484349953.001.

[81] Lin, G.C. and A. Y. Zhang, 'Emerging Spaces of Neoliberal Urbanism in China: Land Commodification, Municipal Finance and Local Economic Growth in Prefecture-Level Cities', *Urban Studies*, 3 April, 2014, doi:10.1177/0042098014528549.

[82] Jing Wu, Joseph Gyourko, and Yongheng Deng, 'Evaluating Conditions in Major Chinese Housing Markets', *National Bureau of Economic Research Working Paper Series* No. 16189 (2010), doi:10.3386/w16189.
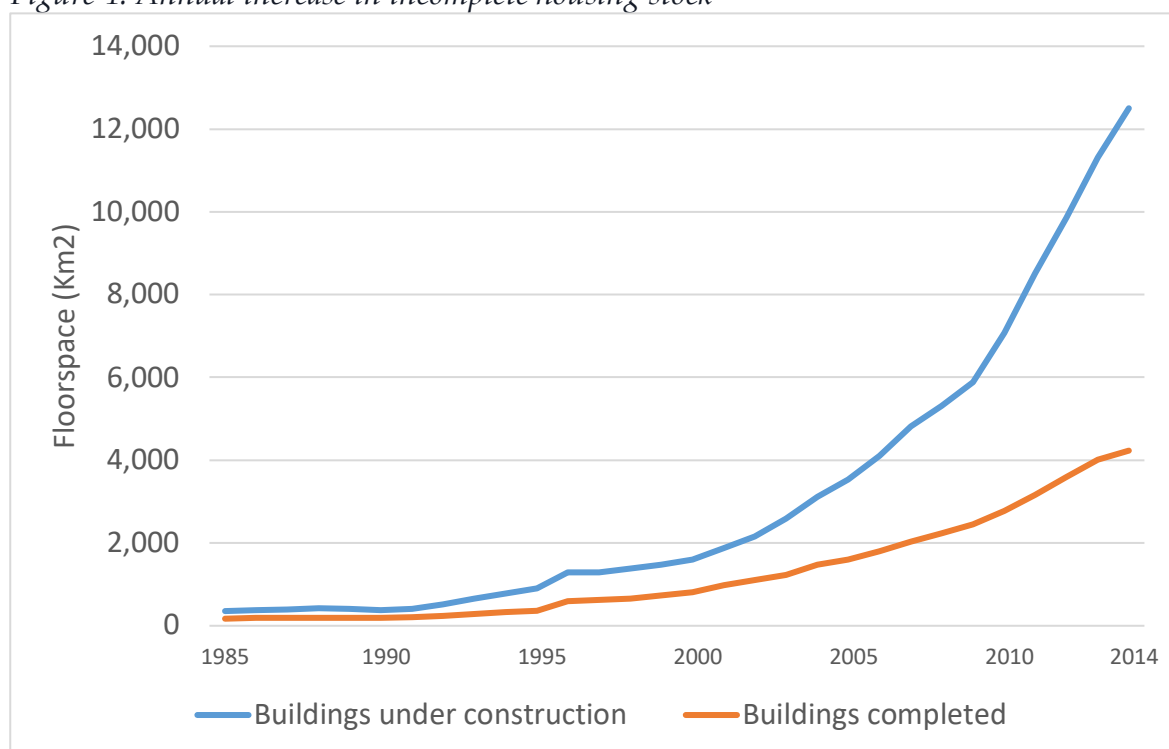
[83] Lin, G.C. and A. Y. Zhang, 'Emerging Spaces of Neoliberal Urbanism in China: Land Commodification, Municipal Finance and Local Economic Growth in Prefecture-Level Cities', *Urban Studies*, 3 April, 2014, doi:10.1177/0042098014528549.

[84] Definition: refers to the floor space of buildings that are completed in the reference period in accordance with the requirements of the design, and building regulations.

Figure 4: Annual increase in incomplete housing stock

Source: China Data Online 2016c

This widening gap has led to a significant rise in the inventory of unsold homes. For instance, when examining the inventories of a balanced panel of 119 listed property developers in Shanghai and Shenzhen, researchers have shown that since 2004 normalised inventories have nearly doubled from 24% to 45%, while turnover ratios have halved from 44% to 25% (see Figure 5).[85] Similarly, it was estimated that in July 2015 that construction starts would have to decline for three to four years for inventories to return to their 2011 level.[86]

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[85] Yonhheng Deng, Joe Gyourko, and Jing Wu, 'Evaluating the Risk of Chinese Housing Markets: What We Know and What We Need to Know'.
[86] Ibid.

Figure 5: Property developers have built-up large inventories[87]

	Average Turnover Ratio	Aggregated Inventory (in billion yuan)	Average Normalized Inventory
2004	44.30%	76.00	23.70%
2005	40.54%	87.63	24.69%
2006	42.71%	136.45	28.32%
2007	45.20%	226.93	30.54%
2008	33.08%	356.92	44.65%
2009	30.01%	377.54	37.83%
2010	28.97%	517.44	41.92%
2011	24.90%	707.81	45.74%
2012	24.22%	815.20	44.41%
2013	25.26%	1039.71	44.80%

Due to monetary and financial controls, alternative investments to property in China are often unavailable.[88] Consequently, property is frequently used simultaneously as store of wealth, an investment asset, and as collateral for further loans – including second homes. Therefore, homes are regularly built and purchased with little prospect of occupancy.[89] Estimates for empty housing and vacancy rates in urban areas vary greatly. In May 2015 it was estimated by the previous deputy governor of the PBOC and the IMF deputy managing director that there was 1 billion m[2] of empty property in China, or 1,000km[2] of space. However, in 2016 academic researchers estimated that there are 50 million empty flats in China,[90] implying that the true amount of empty residential space is closer to 5,700km[2]: or 22% of the total urban housing stock and valued at some 11.8% of total household wealth, or RMB 4.2 tn.[91,92]

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[87] Ibid. The first column reports average turnover rate as reflected by the mean sales-to-asset ratio for these firms. Under Chinese accounting rules, inventory includes all land parcels purchased and housing units under construction, including those pre-sold to households. Deng Gyourko and Wu adjust that number to exclude all advance payments from pre-sold units and report it in the second column. Normalised inventory, which standardises by the level of assets, is reported in the final column. Absolute and relative inventory levels clearly have risen over time, with a higher plateau being reached following the stimulus period.
[88] Ahuja, A, Cheung, L, Han, G, et al (2010). 'Are House Prices Rising too Fast in China?', IMF Working Paper WP/10/274.
[89] Sender, Henny, 'Currency Risk Matters for China's Property Sector', *Financial Times*, accessed 16 July, 2016, http://www.ft.com/cms/s/0/385cb206-c358-11e5-b3b1-7b2481276e45.html#axzz4BgsKZl00.
Chatterjee, Sumeet and Murugaboopathy, Patturaja, 'Property Loans, the Glass Chin of China Banks' Reuters, accessed 16 July, 2016, http://www.reuters.com/article/us-china-banks-realestate-idUSKCN0YG05Z
[90] *Xinhua*, '中国楼市空置率到底有多高? How Far Will China's Real Estate Occupancy Rate Fall?', 新华网, accessed 4 August, 2015, http://news.xinhuanet.com/fortune/2015-05/01/c_1115153720.htm.
[91] Gan, Li. (2016). 'Trend in the housing market and housing vacancy rate in urban China'. Survey and Research Centre for China Household Finance, http://www.chfsdata.org/xiangqing.aspx?id=1160
[92] Gan Li 甘犁, '城镇住房空置率及住房市场发展趋势 Chinese Urban Property Occupancy Rate and Market Development Trends' (South Western University of Finance and Economics, 2014), http://chfs.swufe.edu.cn/.

4. Potential risks to financial stability

China's financial system

China is heavily indebted. Although estimates for the level of indebtedness vary, it is believed that total debt across corporate, household, and government sectors runs to about 250% of GDP.[93] In China the majority of this debt is owed by the corporate sector. However the divide between corporate and government debt is clouded, as many corporate entities are either state-owned or have an implicit government guarantee in the event of financial distress. Although this level of indebtedness is comparable to that of developed nations such as the US and UK, other emerging economies typically have total debt levels of 175% of GDP or less. China's debt has expanded rapidly, growing to present levels from around 150% of GDP prior to the stimulus package of 2009.[94] Direct exposure of the banking sector to RBCs specifically increased greatly after the 2009 stimulus package and took two principle forms: mortgage loans and loans to real estate developers, totalling RMB 7.1tn (13% of total domestic loans) and RMB 3.5tn (6%) respectively in 2011.[95]

Lending in China is dominated by its 'big four' banks: Bank of China, China Construction Bank, Industrial and Commercial Bank of China, and Agricultural Bank of China. At the municipal level smaller city commercial banks (whose main shareholder is local government) also provide financing and are an important source of funding for property. However, a key characteristic of financing in Chinese property markets is the prominent role of local government financing vehicles (LGFVs). In contrast to state and municipal governments in the US, most local governments in China are forbidden from borrowing money directly. Land sales have historically been a significant revenue source for local governments in China, but since the global financial crisis these LGFVs have also been raising funds through taking bank loans, issuing bonds, selling equity, and re-lending so called 'trust loans'. The intimate linkage between Chinese property markets and local government finances (see Appendix 'Primer on China's land market') means that a substantial drop in real estate prices would increase the riskiness (and cost) of local government debt, and thereby jeopardise the continued provision of local government services. According to the latest available statistics published by the National Audit Office, the size of this local government debt is substantial. As of June 2017 the total volume of outstanding local government debt was RMB 5.6 tn , equivalent to 7.3% of China's 2016 GDP.[96] The worry now is that much of the infrastructure funded by LGFVs in the wake of the 2008 and 2011 stimuli was invested in Keynesian make-work projects which will not yield sufficient returns.[97]

Although the CBRC claims that in 2015 commercial banks had RMB 1.09tn of non-performing loans or NPLs (accounting for 1.5% of commercial bank outstanding loans),[98] it is widely believed that the true figure is many multiples of this.[99] Following the 1998 Asian financial crisis, Chinese banks faced NPLs amounting to RMB 1.4tn, or 20% of GDP. Rather than write down these bad loans, the government created special asset management companies which bought them from the 'big four' state banks at full value, paying with 10-year bonds. When these bonds came due in 2009, after a decade of rapid economic growth, the NPLs purchased ten years earlier then amounted to less than 5% of GDP, in theory making them politically and practicably easier to write down. Fast-forward to today and the Chinese government may use a similar strategy to shrink the current cycle's

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[93] 'China debt load reaches record high as risk to economy mounts, *Financial Times*, 24 April, 2016. http://www.ft.com/cms/s/0/acd3f2fc-084a-11e6-876d-b823056b209b.html#axzz46p4Z9Y1W

[94] Ibid.

[95] Iorgova, Silvia and Yinqiu Lu, 'Structure of the Banking Sector and Implications for Financial Stability', in *China's Road to Greater Financial Stability: Some Policy Perspectives*, 2013.

[96] Bloomberg. (27 June, 2017). 'China debt squeeze has Moody's awaiting first local default.' https://www.bloomberg.com/news/articles/2017-06-26/china-debt-squeeze-has-moody-s-awaiting-first-ever-local-default

[97] Ibid.

[98] *China Economic Weekly*, '银行不良率连涨 14 季度 山东等 15 省有了坏账银行 Non-Performing Loans Increase Successively for 14 Quarters: Shandong and 15 Provinces Have "Bad" Banks', 中国经济周刊, 24 August, 2015, http://finance.caijing.com.cn/20150824/3953476.shtml.

[99] *The Economist*, 'Small Is Ugly', 4 July, 2015, http://www.economist.com/news/finance-and-economics/21656711-bad-loans-pile-up-chinas-small-unlisted-banks-small-ugly.

cluster of NPLs. Of course, this strategy can only continue to work in an environment where economic growth exceeds the growth of NPLs. In a recent report, the Chinese central bank singled out property, PV solar, steel, shipbuilding and plate glass as overcapacity sectors where NPLs could rise rapidly.[100]

The shadow banking sector in China is also significant. Shadow banking is defined as 'the system of credit intermediation that involves entities and activities (fully or partly) outside the regular banking system'. By definition shadow banking is difficult to measure, and estimates of its scale can vary widely. For instance, according to a recent paper from the Brookings Institution credible estimates can range from 5tn to 46tn RMB, or 8% to 80% of GDP.[101] Because shadow banking is subject to fewer controls and less oversight than formal banking, it is a relative wild card in the financial system. One of the key issues is that shadow banking financing often flows into sectors already in overcapacity, such as property and steel, as it is expensive financing, only wanted by those who have exhausted other channels.[102] Shadow banking therefore encourages and increases the size of non-performing property assets, via financing and refinancing. In 2014 the Hong Kong Monetary Authority found that the most widespread shadow banking product (real estate trusts), accounted for 30% of all trust products[103], and a 2012 survey by Morgan Stanley of 64 small-scale credit intermediaries (including pawn shops) suggested that close to 20% of credit was extended to real estate developers.[104]

Financial stability and real estate

There is considerable evidence that the collapse of real estate bubbles are the primary cause of many if not most financial crises.[105,106,107] For instance, in a recent study examining 46 systemic banking crises it was found that more than two-thirds were preceded by a boom-bust cycle in property.[108]. Other research has shown that greater real estate price growth prior to financial crises increases the severity of ensuing downturns.[109] That academic researchers[110] and market commentators[111] alike are pointing to the rapidly growing Chinese real estate sector (over 10% annual real price growth between 2003 and 2014[112]) as a possible flashpoint for the next global financial crisis is therefore hardly surprising.

The Chinese real estate market has been described as the single most important sector in the global economy as well as its biggest risk factor.[113] China's economy is now the world's largest in terms of purchasing-power parity, and property investment directly contributed 10% to GDP in 2016[114], and roughly 30% of China's value

[100] PBOC, 'China Financial Stability Report (中国金融稳定报告）' (China Financial Press, 2014).
[101] Elliott, D., A. Kroeber, and Y. Qiao (2015) 'Shadow Banking in China: A primer', Brookings Institution, April 2015.
[102] RIETI, 'Shadow Banking in China: Current Situation and Challenges'.
[103] Wenlang Zhang, Gaofeng Han, and Steven Chan, 'How Strong Are the Linkages between Real Estate and Other Sectors in China?', HKIMR Working Paper 11/2014, no. 11 (2014).
[104] Asia Insight: 'Informal Lending Low Risk to the Financial Sector: Limited Impact on the Real Economy', 11 January, 2012, Morgan Stanley Research.
[105] Allen, F., and Carletti, E. (2013). 'Systemic risk from real estate and macro-prudential regulation.' International *Journal of Banking, Accounting and Finance*, 5(1-2): DOI: 10.1504/IJBAAF.2013.058091
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added originating from property.[115] Real estate is therefore a significant driver of Chinese economic growth and wealth creation. The health of China's banking system (the world's largest by assets at $33tn) is also deeply tied to the fate of the property sector.[116] Analysts estimate that more than 60% of Chinese bank loans are directly or indirectly tied to real estate.[117] Therefore, the fate of the globally important Chinese economy is closely tied to its real estate market.

However, the Chinese real estate market faces significant risks unique to its economic and political situation. Due to China's rapid economic growth rate, real estate price levels in China are dominated by expected price appreciation (as opposed to rental revenues). For example in Beijing, the ratio of average house price to rent is currently over 50[118], implying substantial expected capital gains.[119] The sensitivity of Chinese real estate prices to expected capital appreciation is compounded by the high rate of unoccupied and empty property assets because, due to the lack of tenant income, such properties can quickly lose value and are illiquid. According to the most recent data from the China Household Finance Survey, an estimated 50 million homes (or 22% of the total urban housing stock) were vacant in 2013.[120] Consequently, Chinese property prices are likely to be extremely sensitive to declines in expected economic growth.[121] In the housing market, for instance, researchers have estimated that a 1% drop in expected annual house price appreciation (or a 1% increase in interest rates) would lead to price declines of about a third.[122]

The trigger for the next recession could therefore well be a value loss in real estate in RBCs associated with natural and regulatory-induced declines in the coal and steel sectors. The necessary tightening of environmental standards is causing a rapid decline in the economic prospects of coal-based RBCs, thereby undermining their real estate markets. The ensuing loss of financial solvenecy in the private and SOE sectors would be compounded by the loss of local government revenues. The combined dampening effect on the economy would have global consequences and potential implications for financial stability.

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5. Ordos city case study

To provide insights into the possible scale, timing, and likelihood of asset stranding for RBCs which may now be entering a period of decline, this section provides a case study of Ordos, a coal resource-based city located in Inner Mongolia that is now resource exhausted. Ordos was chosen because it is a widely documented case of debt-led, resource-based, urban expansion, and because it has seen a complete cycle of resource boom and urban expansion, followed by a resource collapse and property decline.

Overview

As can be seen from Table 3 below, coal sales represented 82% of GDP in Ordos city in 2011, indicating the heavy dependency of the Ordos economy on coal. Exploiting this resource, Ordos experienced three periods of urban development spanning roughly the two decades between the late 90s and the present: 1) government-led coal industry development combined with growth in lending; 2) industrial decline and the rise of private investment and shadow bank lending; and 3) loan default and asset stranding. During the first phase, the built-up area in Ordos grew rapidly from 16km² in 2000 to 250km² in 2012.[123] The urban infrastructure development and extraction of coal was first carried out by the local government via LGFVs, land reserve loans and loans from commercial banks. Later private enterprises entered the market, which then used a greater proportion of shadow banking finance.

Table 3: Ordos city 2011 economic data

		RMB (bn)	As % of 2011 GDP
Basic economic data	GDP[124]	321.85	
	Fiscal budget revenue[125]	34.61	11%
	Land sales[126]	24.23	8%
	Coal sales[127]	265.16	82%
Housing built 2000-11	Total sales value of constructed property[128]	612.99	190%
	Total investment in residential buildings[129]	101.31	31%
	Total constructed property cost[130]	205.44	64%
	Total land sales [131]	57.02	18%
Debt	Shadow banking sector[132]	200.00	62%
	Industrial and Commercial Bank of China loans to LGFVs[133]	15.00	5%

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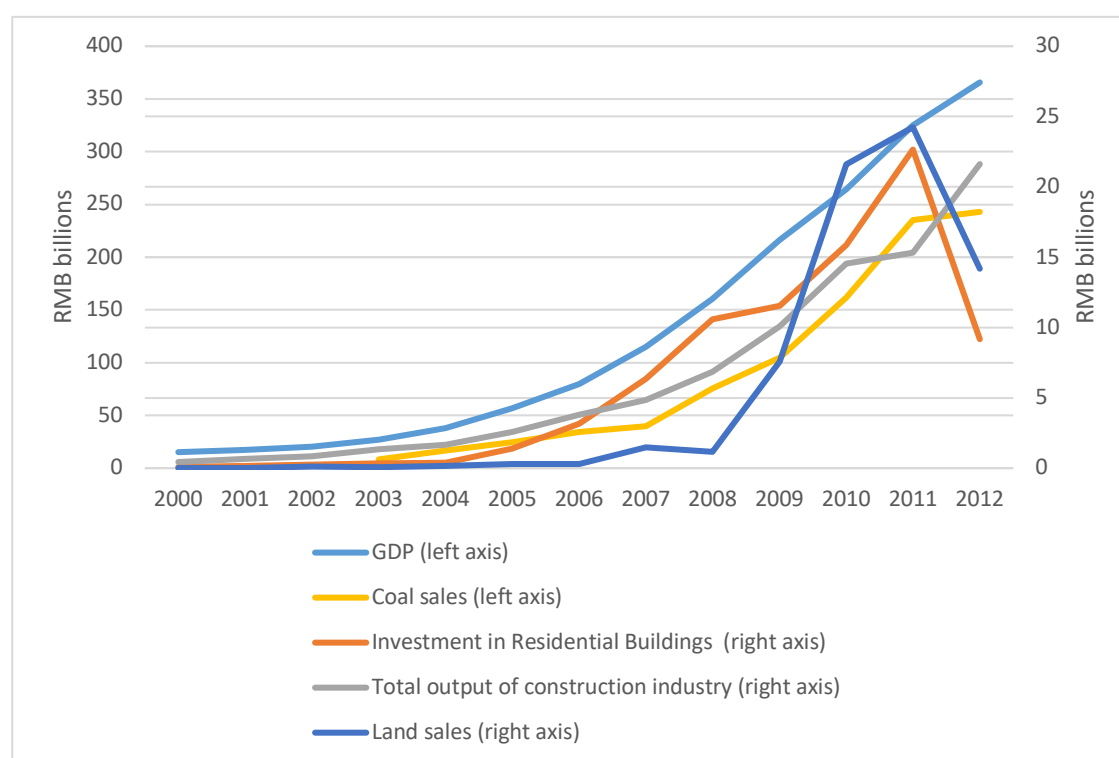
	Folk financing[134]	30.10	9%

Property was central to the local economy of Ordos, as it was first a store of value, secondly it brought in revenues to the local governments and property developers, and thirdly was used as collateral to take out further loans. The primary purpose of construction in Ordos appeared to be to satisfy these three criteria, and not because of any great demand for housing by the population. This is evidenced by the fact that from 2011 coal production, investment in residential buildings, and land sales steeply declined, yet output from the construction industry continued to increase (see Figure 6 below). Shadow banking circulated household wealth and much of it reached the property sector and was stranded in properties that would never be completed. By 2011-12 (the peak of the bubble in Ordos) the scale of the traditional banking sector debt was around RMB 40bn, but as much as RMB 200bn of financing existed in the shadow banking sector.[135] In 2012, along with the coal price decline, the coal industry contracted, the previous period's speculative investments led to an oversupply in commercial property, and property sale prices fell by half.[136] Ordos' economy declined and so did investment in property (see Figure 6 below).[137] The result was a complex and growing web of outstanding debt and non-performing assets.

Coal decline and stranded assets

Figure 6: Growth and Decline of Ordos' Economy

Sources: Statistical Yearbooks and author estimates

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The halving in property prices that occurred in Ordos in 2012 destroyed roughly as much economic value as had been created there in the previous decade.[138] The severity of this decline is perhaps an extreme case due to the city's heavy dependence (even by RBC standards) on coal. However, such declines are not out of the question in other cities, especially if such a downturn were to spread to national or international levels. For instance, as a result of the 2008 global real estate crash, average real housing prices in America in 2012 were similarly no higher than they were in 2000.[139] Moreover, relatively small initial losses in national real estate markets can balloon into wider capital markets. In the same 2008 recession, the loss of a 'mere' $250 billion in the value of US subprime loans and securities mushroomed into world GDP and stock market losses of, respectively, $4,700 billion and $26,400 billion.[140] If many Chinese cities were to experience the same degree of asset stranding as Ordos simultaneously, due to the leveraged interlinkages of real estate with financial markets and local government finances, the result could be a nationwide or even global recession similar to the 2008 financial crisis.

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6. Conclusion

Real estate is an important pillar of the Chinese economy, which itself is critical for sustaining global economic growth. A characteristic of the Chinese economy is the heavy dependence of many cities on the exploitation of non-renewable and environmentally questionable resources, so-called Resource-Based Cities (RBCs): whose industries are often run by inflexible state-owned enterprises. By official counts, China currently has 263 such cities where at least 40% of municipal GDP is derived from these unsustainable industries. These RBC cities currently account for 48% of China's population and 26% of its built-up urban area. The coal and steel industries (the primary industries associated with RBCs) in these cities account for some 13.5% and 4.6% of China's total 2012 GDP, respectively. [141] However, the Chinese coal industry is currently grappling with low coal prices and mounting regulations limiting its use, while the steel industry is desperately trying to shed significant excess capacity. Given the scale of these industries and their importance to many local economies and fiscal revenues, this paper argues that, as China's rate of urbanisation naturally slows, and as it continues to (i) rebalance its economy from primary production to manufacturing and services, and (ii) tighten environmental regulation and transition to a low-carbon economy, much of the real estate in these 263 resource-based cities (RBCs) may become stranded assets, particularly their growing stock of incomplete and empty properties.

Furthermore, there are looming questions regarding the indebtedness and solvency of the Chinese financial system, particularly with respect to LGFVs, 'shadow banking' practices, and the prevalence of non-performing loans. Historically, it has been shown that real estate crises frequently cause, and can magnify, wider financial panics. Against this backdrop, there is growing concern that even small declines in expected real estate price growth caused by, for instance, stranded assets could cascade into the broader economy.

The city of Ordos is a recent example of an RBC which experienced a rapid deterioration in economic prospects due to falling prices in its key industry (coal) in 2012. As result of this economic downturn property prices in Ordos rapidly halved, falling to levels seen prior to its initial boom phase. If multiple Chinese cities were to simultaneously experience the same degree of asset stranding, due to the leveraged interlinkages of real estate with local government finances and wider financial markets, the result could be a national or even global recession. Policymakers interested in reducing the likelihood and severity of future financial crises and investors looking to better understand and hedge risks may consider further research to increase the transparency of the scale, geographies, and interlinkages of potential stranded real estate assets in these resource-based cities.

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Appendix

Primer on China's land market

Rural land in China is officially collectively owned (*jituan* 集体)[142] whereas urban land is owned by the state. In practice, however, governments expand urban boundaries to take ownership of surrounding agricultural land. After doing this, the allocation of urban land is made by the state 'in the interest of the people'. This 'public interest' can be defined broadly, such as the need to build a highway or shopping mall.[143] Increasingly, urban land usage rights are sold (*churang* 出让) at market rates with strict land use restrictions for a specific numbers of years[144] and zoned as commercial (*shangye* 商业), industrial (*gongye* 工业), or residential (*zhuzhai* 住宅) land. China is moving towards a land market in line with market principles, and although land is *sold*, most land has weak private property rights and may be subject to requisition at below market rates.[145] For instance, 'between 1990 and 2010 local governments expropriated rural land at RMB 2tn below market value'.[146]

As local governments are not allowed to directly participate in municipal bond markets to secure financing, many are reliant on revenues from selling leasing rights to land.[147] The fiscal reforms of 1994, which included the Tax Sharing System (*fenshuishi* 分税制), fundamentally changed the tax system, crucially with the central government receiving a much higher 75% rate of VAT.[148] Despite this, following the large-scale restructuring of state-owned enterprises in the mid-1990s, local governments had to pay for an increasing social welfare burden with lower revenues.[149] Currently local governments are responsible for infrastructure investment, service delivery and social spending, which accounts for 85% of total expenditure.[150] As a result of this local governments – which cannot borrow directly via bond issuance according to the Budget Law[151] - created companies that could borrow from banks, trust companies, and on bond markets. These were called local government financing vehicles (LGFVs), which explicitly fund infrastructure investment.[152]

Data collection

The list of 263 resource based cities was taken from the 2012 State Council report on resource-based cities.[153] This does not divide the cities into groups of cities based on resource, however a report published by the Chinese Association of Mayors contains a breakdown of 178 cities.[154] Searching online we were able to group the remainder, and identify a city based on what was described as its main, dominant or leading industry. As this paper focuses on the value at risk in urban construction, regions and districts were excluded, except for urban districts located within larger resource-based cities. For example, Yangjia county-level district economic high-

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[142] Rithmire, Meg, 'Land Politics and Local State Capacities: The Political Economy of Urban Change in China', *The China Quarterly* 216 (2013): 872–95.

[143] Hongbin Cai, J. Vernon Henderson, and Qinghua Zhang, 'China's Land Market Auctions: Evidence of Corruption?', *RAND Journal of Economics* 44, no. 3 (2013): 488–521, doi:10.1111/1756-2171.12028.

[144] Usually 40 years for commercial, 50 years for industrial, 70 years for residential.

[145] Guangzhong Cao, Changchun Feng, and Ran Tao, 'Local "Land Finance" in China's Urban Expansion: Challenges and Solutions', *China & World Economy* 16, no. 2 (March 2008): 19–30, doi:10.1111/j.1749-124X.2008.00104.x.

[146] World Bank, 'WB Part II Supporting Reports: Urbanization and Economic Growth', 2014.

[147] Ambrose, B., Deng, Y., and Wu, J. (2015). 'Understanding the risk of China's local government debts and its linkage with property markets.' Available at SSRN: http://dx.doi.org/10.2139/ssrn.2557031

[148] Justin Yifu Lin, Ran Tao, and Mingxing Liu, 'Decentralization and Local Governance in China's Economic Transition', no. May (2003): 1–33.

[149] Wong, Christine P.W. *Financing Local Government in the People's Republic of China* (Oxford University Press, 1997).

[150] Yuanyan Sophia Zhang and Steven Barnett, 'Fiscal Vulnerabilities and Risks from Local Government Finance in China', *IMF Working Papers* 14, no. 4 (2014): 1, doi:10.5089/9781484349953.001.

[151] Although this might be changing, see Bloomberg News, 'China Mulls Using Muni Bonds for Local Projects From 2016 - Bloomberg Business', 2014, http://www.bloomberg.com/news/articles/2014-10-22/china-mulls-using-muni-bonds-for-local-projects-from-2016.

[152] These bodies are actually more similar to public private partnerships

[153] State Council, '全国资源型城市可持续发展规划（2013-2020 年）National Resource-City Sustainable Development Plan 2013-2020'.

[154] China Association of Mayors 中国市长协会, '第 22 章 资源型城市问题与转型研究', 中国城市发展报告 (中国城市出版社, n.d.).

tech development zone（*yangjiazhuang jinjikaifaqu* 杨家杖子经济开发区）is listed as a resource-based district, within the resource-based city of Huludao （葫芦岛）. From the China City Statistical Yearbook we extracted urban built-up area and population data for resource-based cities.[155] From China Data Online, a database in the University of Michigan which compiles numerous national, provincial and city level statistics, we extracted GDP, population and other data, both as a panel of cities, and time series data – from which we calculated CAGR for population and GDP.

We have extensively used Chinese and English newspaper articles, subscription-based and freely available industrial reports and surveys. To build a map of local-level lending patterns between local financing institutions, we used Chinese masters and doctoral dissertations, especially in the case study of Ordos.

Longitude and latitude coordinates were taken from GeoNames,[156] and details about current credit ratings of local government debt can be found on Licai.[157]

Notes on Chinese property data

Despite their importance to the Chinese economy and its future trajectory, resource-based cities receive low tier ranking, and are also are under-represented in Chinese property data. In the regularly quoted '70 large and medium-sized city housing index', many large resource-based cities are omitted because they are 'worst performing' (all cities in the housing index are tier 1-3). Similarly, cities with smaller economies are included in the index because they are modern and competitive.[158]

The two main official sources of residential housing data in China are the National Bureau of Statistics (NBS), which collects data on 70 large and medium-sized cities, and the local housing bureau (*fangguangju* 房管局), which collects data on 134.[159] The regularly quoted 70 city index of small and medium-sized cities was deemed not credible[160] and was abandoned in 2011, with the Chinese statistical agency publishing price changes in individual cities without reference to a national average.[161]

When it is reported, for example, in December 2014 that new home prices fell in 67 of 70 cities,[162] this should be interpreted as the new home price fell in 67 of the 70 '*best performing cities*'. The index, includes the 'best performing cities' in each tier – for example there are large 'worst performing' second tier cities that are not included in the index and small 'best performing' third tier cities that are. Because of weak coverage of quoted housing data in China, and the cherry-picked nature of the index, it is reasonable for investors and policymakers to interpret a fall in the index – such as the one in December 2014 – as '*the new home price fell in all of China's 642 cities at prefectural and county level except for three.*'

[155] China Statistical Press 中国统计出版社, *中国城市统计年鉴 China City Statistical Yearbook*.

[156] 'GeoNames', accessed 31 August, 2015, http://www.geonames.org/.

[157] Licai '格上理财网_中国领先的金融理财机构', accessed 31 August, 2015, http://www.licai.com/.

[158] The 70 city real estate indexes include resource cities: Jilin, Luoyang, Luzhou, Xuzhou and Baotou, but exclude large resource-based cities with populations of over 7 million: Tangshan, Nanyang, Linyi, Xuzhou, Handan, Ganzhou, Jining, Shaoyang, Hengyang, Xingtai, and Nanchong. At the same time small 'tiered cities' are included in the real estate indexes: including 25 of the 70 with populations of less than five million and 20 with GDP of less than RMB 200bn in 2013 (i.e. these smaller tiered cities would not make it onto Table 2).

[159] This data covers all tier 1 cities, most tier 2 cities but only 50 to 60 tier 3. Chivakul et al., 'Understanding Residential Real Estate in China'.

[160] 'Popping the Question', *The Economist*, 16 June, 2011, http://www.economist.com/node/18836400.

[161] Rabinovitch, Simon, 'Index of 100 Cities Gains Ground', *Financial Times*, 1 June, 2011, http://www.ft.com/cms/s/0/1bba8cde-8c69-11e0-883f-00144feab49a.html#axzz3hk7s23J0.

[162] Bloomberg, 'China Home Prices Fall in Fewer Cities as Market Stabilizes', accessed 4 August, 2015, http://www.bloomberg.com/news/articles/2014-12-18/china-home-prices-fall-in-fewer-cities-as-market-stabilizes-1-.

Figure 7 Macroeconomic data for Ordos

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
GDP (RMB bn)	15.20	17.18	20.48	27.14	38.04	56.48	80.00	115.09	160.30	216.10	264.32	324.86	365.68
y-o-y change in GDP		13%	19%	33%	40%	48%	42%	44%	39%	35%	22%	23%	13%
Investment in Residential Buildings (RMB bn)	0.09	0.16	0.27	0.36	0.38	1.40	3.18	6.33	10.60	11.54	15.86	22.65	9.19
Investment in Residential Buildings as % of GDP	0.01	1%	1%	1%	1%	2%	4%	5%	7%	5%	6%	7%	3%
y-o-y % in residential buildings		89%	69%	34%	5%	268%	126%	99%	67%	9%	37%	43%	-59%
Total output of construction industry (RMB bn)	0.44	0.65	0.83	1.34	1.66	2.57	3.81	4.83	6.85	10.07	14.55	15.34	21.62
Total output of construction industry as % of GDP	0.03	4%	4%	5%	4%	5%	5%	4%	4%	5%	6%	5%	6%
y-o-y % change in total output for construction industry		47%	28%	62%	24%	55%	48%	27%	42%	47%	45%	5%	41%
Coal production (RMB bn)				8.35	16.50	24.51	34.38	39.80	75.57	104.90	161.75	235.16	242.97
Coal production as % of GDP				31%	43%	43%	43%	35%	47%	49%	61%	72%	66%
y-o-y % change in coal production					98%	49%	40%	16%	90%	39%	54%	45%	3%
Land sales (RMB bn)	0.01	0.01	0.10	0.08	0.15	0.30	0.30	1.47	1.18	7.59	21.59	24.24	14.17
Land sales as % of GDP	0%	0%	0%	0%	0%	1%	0%	1%	1%	4%	8%	7%	4%
y-o-y % change in land sales			605%	-19%	88%	101%	0%	389%	-20%	543%	185%	12%	-42%
Property price (RMB)					2100	2900	3600	5250	6250	7600	6220	6254	7650
y-o-y % change in property price						38%	24%	46%	19%	22%	-18%	1%	22%