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Skyscrapers and Skylines: The Case of China

摩天大楼与城市天际线：以中国为例

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Abstract | 摘要

Since 1978, when China instituted economic reforms, cities have embraced skyscraper construction. Despite the importance of these structures, little is understood about what has been driving their heights and frequencies. This work explores to what degree skyscraper construction patterns represent rational responses to the demand for tall buildings versus political or sociological factors, such as to call attention to respective cities or raise revenue for municipal governments. The findings suggest that economic fundamentals (population and gross city products) are key drivers of skyscrapers. Evidence for political factors is mixed. Municipal fiscal situations do not seem to matter, but there is a negative correlation between the ages of municipal leaders and skyscraper construction, suggesting that younger leaders promote skyscrapers as a way to advance their careers. No evidence is found to support that cities engage in inter-city competition in the skyscraper market, but smaller cities build taller than predicted.

Keywords: Building Height, China, Economics, Urban Growth

1978年，中国迎来了改革开放。伴随着全面的经济改革和城市化进程，中国各大城市也开始投入到摩天大楼的兴建中。虽然中国的摩天大楼已经得到了广泛关注，却很少有人探索是什么力量在不断推动中国摩天大楼的高度和建设速度。这篇文章旨在探索中国摩天大楼的兴建动力，究竟是城市发展对高层建筑的合理需求，还是其他社会或政治原因。研究发现表明，基本经济要素例如人口和城市生产总值仍是影响摩天大楼兴建的主要因素。政治因素的作用是复杂的。地方财政收支和摩天大楼修建之间没有有明显的关系，但地方政府主要官员（市长和市委书记）的年龄与摩天大楼的修建负相关系，这意味着年轻的地方官员更希望借助摩天大楼的修建推动他们政治生涯的发展。此外，这篇文章没有发现系统性的证据支持摩天大楼市场中存在城市之间的竞争，但发现小城市比预期建设了更高的摩天大楼。

关键词：建筑高度、中国、经济学、城市发展

Introduction

Since 1978, when the Chinese government instituted its economic reforms, China has seen rapid economic development. Along with this change has been the growth of China's cities, where new skylines have risen. While China's investment in skyscrapers has been nothing short of spectacular, little, in fact, is known about what is driving their construction. Unlike many other developed or developing nations across the world, such as Europe or Latin America, Chinese cities have dramatically embraced the skyscraper as a key part of its real estate stock. Table 1 shows that the Asian continent has more skyscrapers (100 meter or taller buildings) than the rest of the continents combined (Figure 1). Table 2 shows that east Asian cities comprise six of the top 10 cities with the most skyscrapers (www.emporis.com, 2016) (Figure 2).

Likely, one key role is the major economic and demographic transitions taking place. In China, the massive movement of agricultural workers to cities seeking employment in the

简介

从1978年起，中国政府开始大刀阔斧地进行经济改革，伴随着迅速的经济发展和产业升级， 中国的城市化进程也不断加速。在新兴的中国城市中，新的城市天际线正逐步形成。中国摩天大楼的投资和兴建一直备受关注，但摩天大楼修建背后的动力却鲜有人探索。不同于世界其它地区很多并不热衷于摩天大楼的发达或发展中国家例如诸多欧洲和拉丁美洲国家，中国城市正狂热的修建高楼，累积摩天大楼的数量。图一是各大洲摩天大楼数量的统计，由表一可知，亚洲大陆拥有的摩天大楼数量（高度不低于100米的建筑）要多于其他各大洲摩天大楼数量的总和（图1）。图二是世界拥有最多摩天大楼的摩天城市排行榜。位居排行榜前十的城市有六个都在东亚地区（www.emporis.com，2016）（图2）。

东亚国家狂热建造摩天大楼的时期，也正是其经历经济转型和人口转型的时期。在中国，大量的农业人口迁徙至城市，进入制造业和服务业，这可能是世界史上最大规模的内部迁徙（Ren，2013）1979年，

Rank	Continent	Number of skyscrapers	Percentage
1	Asia	6,651	59%
2	North America	3,050	27%
3	Europe	708	6%
4	South America	456	4%
5	Oceania	319	3%
6	Africa	93	1%

Figure 1. Number of skyscrapers (100 meters or greater) in each continent, 2015 (Source: www.emporis.com)
图1. 2015年世界各大陆拥有的100米及以上摩天大楼数量（来源：www.emporis.com）

manufacturing and service sectors represents perhaps the largest internal migration within any a country in world history (Ren, 2013). In 1979, 18.6 percent of residents lived in urban areas; by 2014 that figure was 54.4 percent (World Bank Indicators, 2015). As a result, China has gone on a rapid building spree.

But, what makes Chinese skyscraper construction all the more interesting is that, unlike most Western countries, China does not have a free market in urban land. Urban land is generally owned by the respective municipal governments, and development rights are sold by the government. That is to say, the Chinese municipal governments offer ground leases for extended periods of time, such as 70 years, in exchange for ground rents. Municipal governments use the money collected to fund government operations and infrastructure investments. As such, they have a direct incentive to generate as much income as possible from ground leases.

It is within this context that this paper explores skyscraper construction in China, with the goal of testing several hypotheses. This paper seeks to investigate how much of tall building frequencies and heights are driven by the underlying economic fundamentals versus other sociological and/or political factors.

On the one hand, skyscrapers, because of their size and the quantity of resources needed to create them, can be used for additional purposes beyond simply housing economic activity. Skyscrapers can advertise to the world that a city is "open for business." In addition, in China, the incentives for skyscraper building seem more dramatic given that municipal officials appear to have several motivations to promote them. First, as mentioned above, in order to have ample funds for public goods and infrastructure, Chinese municipal governments rely heavily on the sale of land use rights. Second, since rapid economic development is a priority for the Chinese government, the production of large-scale projects is a major focus for local officials (Yu, et al., 2016).

Within this context, however, is the supply issue. Building space across cities is, presumably, substitutable; as a result, if one city goes on a buildings spree, it will lower the price of building space and can potentially draw economic activity away from other cities, as it reduces the incentives to construct elsewhere.

One aim of this paper is to test whether skyscrapers in China are "strategic complements" or "strategic substitutes." A strategic complement is a good where one provider increases the amount produced as a response to a rival's production of the good. A strategic substitute is where a producer reduces production as the response to a rival's increased production (Barr, 2013). If skyscrapers in China are strategic complements, it suggests market players are trying to outdo each other to draw attention or resources to their respective cities. If they are strategic substitutes, then it suggests that the net effect of skyscraper construction is more firmly rooted in the fundamentals of supply and demand, since the market "punishes" those who overbuild for non-purely profit maximization purposes.

To test these theories, data was collected on skyscraper construction in 74 cities throughout China from 1970 to 2014. Nearly all 100 meter buildings completed in mainland China (including Hong Kong) are included in the data set.[1] As controls, data was collected on economic and political variables. Using this data set, several regressions were run to test for the degree to which skyscraper construction patterns are based on economic fundamentals versus the competitive desire to stand out or due to political reasons.

The dependent variables of interest are the annual number of skyscraper completions

中国只有大约18.6%的人口居住在城市地区，而2014年底这一数据已达到了54.4%（世界银行，2015）。因此， 中国房地产业开始迅猛发展。

中国摩天大楼问题更为独特有趣的一点是，不同于很多西方国家，中国没有公开售卖城市用地的市场。城市用地归属于国家，由地方政府管理。只有土地使用权可以被地方政府出售。也就是说，地方政府将城市用地按一定期限，如70年，租给土地的开发商以换取土地出让金。当地政府可以利用土地出让金支持政府运作和城市基础设施建设。因此，地方政府总是有足够动力最大化土地带来的收入。

这篇文章就是在这个大背景下研究中国摩天大楼的建造的。具体来说，这篇文章旨在检验可能推动中国摩天大楼修建的若干假设，检验推动中国修建新摩天大楼和修建更高的摩天大楼的究竟是基础经济要素还是其他社会和政治因素。

一方面，摩天大楼因其巨大的空间容量和修建所耗费的资源，已远超为经济活动提供场所这一价值。摩天大楼可以作为城市的名片，在世界范围内为城市做广告宣传以及招商引资。另一方面，中国地方官员

Rank	City	Number of skyscrapers
1	Hong Kong	1294
2	New York City	690
3	Tokyo	418
4	Chicago	302
5	Dubai	268
6	Shanghai	254
7	Toronto	239
8	Guangzhou	229
9	Shenzhen	217
10	Chongqing	198
11	Singapore	179
12	Seoul	163
13	Bangkok	157
14	Osaka	151
15	Moscow	146
16	Kuala Lumpur	131
17	Wuhan	126
18	Istanbul	119
19	Busan	118
20	Mumbai	115

Figure 2. Number of skyscrapers (100 meter or greater) in leading cities, 2015 (Source: www.emporis.com)
图2. 2015年拥有100米及以上摩天大楼城市排行榜（来源：www.emporis.com）

1: The skyscraper data was collected from several sources: http://www.skyscrapercenter.com/, http://www.skyscraperpage.com, http://www.emporis.com, http://top.gaoloumi.com/motian.php, and http://www.motiancity.com/2012/. Unfortunately, the sources do not provide year of completion for about 10 percent of the buildings, and thus they are omitted from inclusion here. Also, if a building is not reported on one of these websites, it is not included. The authors have no sense of the number of 100 meter or taller buildings that are not recorded.

each year for each city; the height of the tallest building completed in each city, each year; the reigning tallest building in each city, each year; and finally, a variable that takes on the value of one if a building completed in a city each year is greater than 183 meters (600 feet) and a zero otherwise. 183 meters or above is a measure of what qualifies as a very tall structure.

Skyscraper Construction Patterns in China

Figures 1 to 4 demonstrate skyscraper construction patterns across China from 1970 to 2014. Figure 1 shows the total number of skyscraper completions (100 meters or taller) including and excluding Hong Kong (Figure 3). The graph shows that, first, the market for skyscrapers in mainland China began in earnest in the mid-1980s, but then saw a rapid take-off period starting in about 1994. The number of skyscraper completions rose rapidly for about a decade, before peaking in the mid-2000s, followed by a steep drop between 2005 and 2010. Since then, skyscraper completions across the country have rebounded.

Figure 2 shows the height of the tallest building completed across the country each year from 1970 to 2014, both including and excluding Hong Kong (Figure 4). Here, the pattern is a bit different from the completions graph; in short, the trend of the tallest building has steadily been increasing (though there is some noise in the pattern). This trend contrasts with the US, which has not seen upward growth in its tallest buildings over the same period (Barr, et al., 2015).

Similarly, despite a drop in skyscraper completions broadly, Figure 3 shows China's continued eagerness to construct very tall

也可能有动力来推动摩天大楼的兴建。例如，地方官员希望能从土地出让金中获得更多的收入以支持地方财政开支，加强基础设施建设。

其次，在一党专政的中国，官员提拔主要由上级党政领导决定。在任期有明显成就，例如完成大型工程建设，推动地方经济发展的官员更容易获得提拔。(Yu, et al., 2016).

当然，以上提到的两点都是从摩天大楼供给的角度出发。从需求的角度来讲，各个城市的建筑容量是可替代的。也就是说，在经济活动总量有限的条件下，一个城市狂热地修建新的建筑会降低这个城市的建筑价格，吸引原属于别的城市的经济活动，从而降低竞争对手城市修建新建筑的动力。

这篇文章的一个目的就是探索是否中国各个城市的摩天大楼是“战略互补品”还是“战略替代品”。如果是“战略互补品”，商品提供者会增加生产来回应竞争者增加生产的行为。如果是“战略替代品”，商品提供者会减少生产来回应竞争者增加生产的行为(Barr, 2013)。 如果中国的摩天大楼是“战略互补品”，意味着摩天城市都想要通过修建摩天大楼来吸引更多的资源以超过竞争者。如果中国的摩天大楼是“战略互补品”，意味着摩天大楼的修建基于传统的供求需求理论。在这种情况下，市场会“惩罚”过度修建，因为摩天大楼的修建受到了多方面复杂因素的驱动，而不再是利益最大化的结果。

为了检验这些理论，这篇文章搜集了中国74个城市在1970年到2014年之间建成的摩天大楼数据。首先，这篇文章收集了中国大陆及港澳台地区所有超过100米的建筑的数据，同时也搜集了一系列经济和政治相关数据作为控制变量。基于这个新数据库的数据，这篇文章构建了一系列回归模型来检验摩天大楼的修建是基于传统经济需求还是城市竞争亦或政治因素。

这篇文章选取了多个被解释变量，包括每年每个城市的新增摩天大楼数量；每年每个城市新建成的摩天大楼的最高高度；每个城市建筑史上摩天大楼的最高高度以及一个超高层建筑虚拟变量。如果一个城市某年修建了至少一个高于183米（600英寸）的摩天大楼，这个虚拟变量为1，否则为0。183米为衡量超高层建筑的标准。

中国摩天大楼总体建造结构

基于本文的摩天大楼数据库，图1到图4展示了从1970年到2014年中国摩天大楼的建造情况。图一反映了包含香港和不包含香港的中国新建摩天大楼的总量变化（图3）。由图可知，中国的摩天大楼市场在20世纪80年代中期开始起步，在大约1994年前后开始迅速发展。在1994年到2005年左右十年间，中国新建摩天大楼数量迅速增加，在2005年左右达到顶峰。2005年到2010年间，每年新建摩天大楼的总数有所下降，2010年之后又迎来了新的摩天大楼繁荣期。

图2反映了从1970到2014年间中国每年建成的最高建筑的高度情况（包括和不包括香港两种情况）（图4）。不同于每年新建摩天大楼总量较为波动的趋势，从二十世纪80年代中期开始，虽然有一些较微弱的波动，但每年中国最高新建摩天大楼的高度都在持续增加。相较之下，在同一时期的美国，新建摩天大楼的高度并没有这一持续递增的趋势(Barr, et al., 2015).。

图3反应了1980年到2014年间中国新建的超高层建筑（高于183米）（图5），虽然每年新建摩天大楼（高于100米）的总数在近十年有下降的趋势，但中国修建超高层建筑的热情却逐年递增。

在中国，摩天大楼市场多为经济发展迅速的城市。图4是2013年有新建摩天大楼的52个中国城市的最高摩天大楼高度和城市

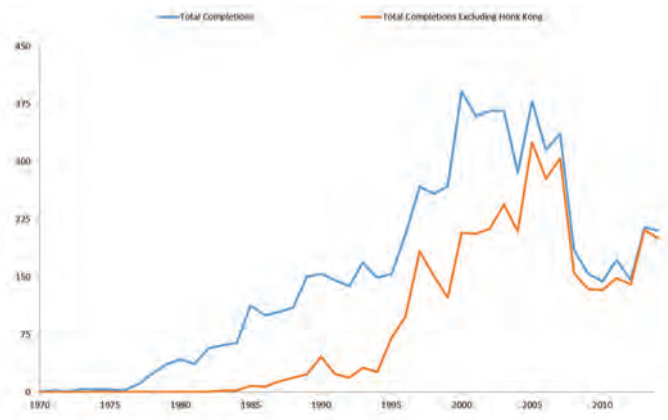

Figure 3. Number of skyscraper (100 meters or greater) completions in China from 1970 to 2014 (Source: Jason Barr)
图3. 1970–2014年间，中国每年建成的摩天大楼（100米及以上）总数（来源：Jason Barr)

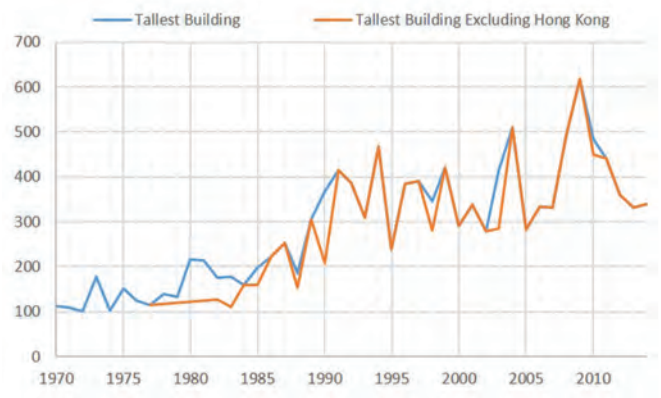

Figure 4. Height of tallest completed building (in meters) each year from 1970 to 2014 (Source: Jason Barr)
图4. 1970–2014年间，每年建成的摩天大楼的最高高度（米）（来源：Jason Barr)

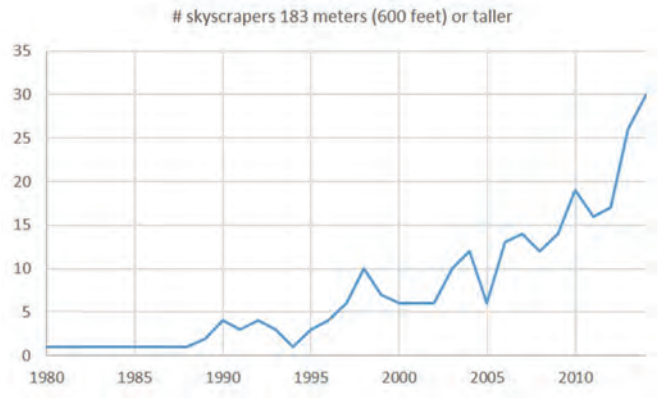

Figure 5. Number of 183-meter (600-foot) or taller skyscrapers constructed in China from 1980 to 2014 (Source: Jason Barr)
图5. 1980–2014年间，中国每年建成的超过183米(600英尺）的超高层建筑总数（来源：Jason Barr）

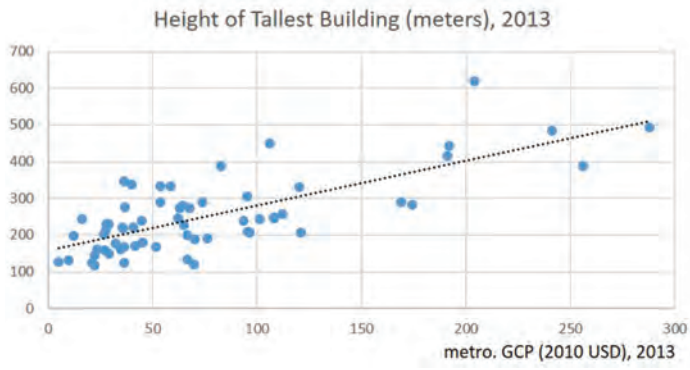

Figure 6. Height of tallest building in 52 Chinese cities versus gross city product, 2013 (Source: Jason Barr)
图6. 2013年，52个城市中建成摩天楼的最高高度与城市生产总值的关系（来源：Jason Barr）

buildings (Figure 5). The figure shows the rising number of 183-meter (600-foot) or taller buildings completed between 1980 and 2014.

Likely, a large part of the skyscraper market is driven by the rapid economic growth of China's cities. Figure 4 shows a scatter plot of the tallest building as of 2013 in each of 52 Chinese cities versus its metropolitan region's gross city product (GCP) in 2013 (Figure 6). There is clearly a strong positive relationship. To measure this relationship, a regression was run to estimate how the cumulative number of skyscrapers in each city and the height of the tallest building in each city (in levels), respectively, is determined by each city's population and GCP. The results are given in Table 3 (Figure 7). Over 50 percent of the variation in the skyscraper measures can be explained by these two variables. As is expected, population and GCP are both positively associated with skyscraper construction. Location coordinates were added as additional controls (latitude and longitude). These results suggest that more skyscrapers are built in the southern and eastern parts of the country.

Skyscraper Construction Hypotheses

As discussed above there are several possible theories that might explain skyscraper construction patterns across China. The different hypotheses are first itemized, and the next section will discuss the data and the regression results which aim to distinguish among them. Although they are not necessarily mutually exclusive, the goal is to see if the data can suggest some as being more important than others.

H1: Economic Fundamentals. The maintained or "null" hypothesis is that skyscraper construction patterns, both their frequencies and their heights, are a rational response to the underlying economic climates in cities across China. The key point is that when rapid urbanization and demand for central locations are strong, the supply and demand forces for real estate will naturally generate high-rise buildings as the most efficient means to allocate urban land (Barr, 2010). In China, as urban land becomes increasingly more valuable, Chinese officials have an incentive to increase its supply for economic development. Developers will offer high land-use rights bids, and will supply skyscrapers as the profit maximizing outcome.

H2: Municipal Finances: Since the mid-1980s, the Chinese central government has decentralized its fiscal system, devolving more responsibility from the central government to local governments for approving local investment decisions, allocating resources, and managing local economic growth (Ding and Lichtenberg 2008; He, et al., 2015; Lichtenberg and Ding 2009; Zhang 2010).

生产总值的散点图（图6）。从图4可以看到，二者有明显的正相关关系。为了衡量这个关系，这篇文章运用回归分析来估计城市摩天大楼总数和城市最高摩天大楼的高度的变化在多大程度上可以被城市生产总值和区域人口的变化解释。回归结果反映在图7中。由表3可知，这两个变量可以解释大于50%的摩天大楼变量的变化。城市的经纬度也作为附加控制变量被包括在回归中。结果显示中国南部和东部区域拥有更多的摩天大楼。

摩天大楼建筑假设

正如前面介绍中所讨论的一样，有多种可能的理论能解释中国摩天大楼的修建。这篇文章列出如下几种不同的假设并在下一章节中运用回归分析进行检验。虽然这几种假设并非完全互相排斥，但这篇文章主要讨论哪一种假设更为重要。

	ln (Total # Skyscrapers)	ln (Total # Skyscrapers)	ln (Height of Tallest Building)	ln (Height of Tallest Building)
ln(Population)	0.829	0.839	0.05	0.075
	(2.89)***	(2.09)***	-0.7	-0.72
ln(GCP)	0.85	1.03	0.306	0.327
	(3.17)***	(2.61)***	(4.57)***	(3.67)***
Latitude (degrees)		-0.043		-0.013
		(1.78)*		(2.37)**
Longitude (degrees)		-0.033		-0.003
		-1.58		-0.45
Constant	-12.54	-8.26	4.65	4.95
	(3.58)***	-1.34	(5.30)***	(2.97)***
R-Squared	0.57	0.62	0.51	0.56

Figure 7. Regression results for the total number of skyscrapers and the heights of the tallest buildings across 59 Chinese cities, 2013 (Note: statistically significant at 99 percent confidence level; statistically significant at 95 percent confidence level; statistically significant at 90 percent confidence level; robust t-stats are below coefficient estimates) (Source: Jason Barr)
图7. 用2013年59个城市每年建筑的摩天大楼总数和最高新摩天大楼的高度进行回归的结果。(来源：Jason Barr)

However, because the central government still keeps the lion's share of tax revenue, it has caused local governments to seek external forms of revenue. This has come from the land-lease system, where developers pay for the right to develop land. The revenue is then used by the city for municipal expenditures. In this case, the Municipal Finances Theory is that municipal authorities promote skyscraper construction in order to raise revenue.

H3: Involvement Degree of Public Officials: One issue frequently discussed in the media and academic literature is the tendency of municipal officials to think that they can increase local income by promoting large development projects (Zhu, 2012). Officials may feel they can support local construction by promoting real estate development and becoming more involved in the project.

H4: Reputation Building and Foreign Direct Investment: Individual municipal officials often have an incentive to engage in large-scale projects that will enhance their reputations, and in being seen as able to "get things done." For this reason, skyscraper construction, because of its visibility and large resource requirement, could be used as an assessment factor in determining eligibility for promotion (Li and Zhou, 2005). In addition, officials may also try to lure international firms to increase their foreign direct investment (FDI) (He, et al., 2015). If building skyscrapers will draw more FDI, then officials have an added incentive to encourage their construction.

H5: Urban Advertising: This theory is that skyscrapers are a means to advertise the city in general. That is, skyscrapers are used to draw attention to a city in order to advertise its success and growth in a broad sense, independent or separate from the hypotheses described above. In particular, small cities might use skyscrapers as a means to stand out and draw attention to themselves (Research Institute, 2012).

H6: Rival Cities: The Rival Cities Theory is that cities with some particular characteristics are directly competing against cities with similar characteristics in order to outshine them. For example, cities of similar sized (populations or GCP), may try to outdo each other in order to advertise their city relative to their rivals (Barr, 2013).

The Data

A data set was constructed on skyscrapers and related economic variables to test the hypotheses discussed above, using regression analysis. A brief account of the data is given here, but more details about sources and processing can be found in Barr and Luo (2016). Most of the city-level data was collected from the Chinese City Year Books, and other sources. Data was collected on all recorded skyscraper completions in 74 cities in mainland China, Hong Kong, Macau, and Taiwan to 2014. For each building, the city, the year of completion, and the height is included.[2]

From this data, several dependent variables were created. First is the number of completions in each city during each year; second is the height of the tallest building completed each year in each city; third is the current tallest building in each city during each year; and fourth is a binary variable that takes on the value of one if a 183-meter (600-foot) building was constructed in a city in a given year, otherwise it receives a zero. This last variable will allow for an estimation of the probability that a very tall building will be completed.

In order to test the theories described above, a number of other variables were collected. The first set consists of the regional population of each city during each year, the regional GCP, and the fraction of GCP in a city that comes from the service sector. These three variables are used for testing H1 (Economic Fundamentals).

Regarding testing H2 (Municipal Finances), two variables are used to measure government budgets. First is the total municipal government expenditures in a given a year, and the second variable is budget deficit "dummy" variable that takes on the value of one if expenditures exceed revenues in a given year, otherwise its receives a zero. These two variables aim to see if cities with high expenditures and/or deficits are likely to promote skyscrapers to increase development and thus increase land-rights sales, all else equal.

Regarding H3 (Intensity of Official Involvement), this paper has included data discussed in Zhu (2012), but collected by Guang Zhang of Xiamen University. Here, the aim is to see if cities with more intensive official involvement are likely to have more skyscrapers, all else equal.

假设1： 基本经济要素假设。在这个假设下，摩天大楼的建设，包括修建更多和更高的摩天大楼都是对城市经济环境的合理反应。当迅速的城市化进程和城市中心区域的需求很高时，高层建筑自然会作为最有效的城市土地配置方式来实现房地产供给和需求的均衡(Barr，2010)。 在中国，当城市土地变得越来越值钱时，地方政府有足够的动力增加土地供给，促进当地经济发展。房地产开发商也以土地利用效率最大化的方案投标，建筑摩天大楼以实现利益最大化。

假设2：地方财政假设。从1980年代中期开始，中国的中央政府开始对财政系统进行放权，给各地地方政府更多权利批准投资项目，分配资源和整合当地经济发展。然而， 因为大部分税收收入需上缴中央政府，地方政府仍需从多种途径增加地方财政收入。在土地租赁系统里，开发商支付土地出让金获得开发土地的权利，这些土地出让金就就会作为地方财政收入并用于地方财政支出。地方财政假设就是指地方政府为了增加地方收入而鼓励修建摩天大楼的假设。

假设3：政府官员腐败假设：地方政府官员利用参与大型经济建设项目来增加个人隐形收入是一个媒体和学术论文经常讨论的话题。地方官员认为他们可以从大型经济建设项目中获利并免于受罚（Zhu，2012）。尤其在房地产行业，地方官员认为他们能够通过推动房地产项目来获得非法收入。假设3就是指地方官员鼓励房地产开发商修建摩天大楼是因为他们可以从这样的大型项目中额外获益。

假设4 ：仕途提升假设。在中国的一党专政的背景下，那些渴望在政治生涯中获得提拔的官员总是参与大型项目来提升政绩，增加名声。摩天大楼因其巨大的视觉效果和所需因此可以被用来作为提升仕途的工具(Li and Zhou，2005）。此外，地方官员渴望吸引更多的海外直接投资(He，et al.，2015)。如果修建摩天大楼能够帮助吸引海外直接投资，地方官员就有更多的动力鼓励修建摩天大楼。

假设5：城市名片假设。假设5是说摩天大楼是城市的招牌广告。这个假设独立于前四个假设，假设摩天大楼的修建是为了在城市群中彰显其与众不同。在这个假设下，中小城市更希望通过修建摩天大楼来吸引世界的目光(Research Institute，2012)。

假设6:城市竞争假设：这个假设认为城市不断修建摩天大楼，增高城市天际线是为了与相似水平的城市竞争。例如，城市生产总值和人口总数相近的城市可能希望在

2: Note that in several cases different websites gave different years for completion. This paper used year of completion as the average of the two years. Using different years (e.g., the first or the last) does not alter the results. Building use data are also not available.

To test H4 (Reputation Building and Foreign Direct Investment), this paper uses data collected by Yu, Zhou, and Zhu (2016), which is the average age of city leaders (local party chiefs and mayors) in each city-year. Since local officials must retire by 65, this study hypothesizes a negative relationship between official's ages and skyscraper construction, since younger leaders must produce results if they are going to be recognized as boosting the local economy.

Regarding H5 (Urban Advertising), to advertise means to build more or taller than economic fundamentals would suggest, controlling for the other factors. In this case, this study tries to explore how city size affects skyscraper constructions patterns by looking at two variables. The first is a quadratic form of city population to see if it has a u-shape or inverted-u shape with respect to the skyscraper measures. A u-shape would suggest smaller cities seek to stand out relative to moderate-sized cities; an inverted u-shape means mid-sized cities build more or taller. The second variable investigated is what is called the city-fixed effect. In short, using regression analysis, this study looks at the differences in skyscraper patterns for each city that is constant (relative to the other cities) and controlling for the other factors mentioned above. The idea is to look at the size of the fixed effects across China to see if they suggest which cities are more likely to engage in skyscraper construction than others.

To test H6 (Rival Cities), this paper employs the statistical method known as spatial autocorrelation regression (SAR). The idea is to see if changes in building patterns in one city positively or negatively affect building patterns in other cities. The SAR method allows for "connecting" cities in different ways, such as by their geographic distances from each other or based on the relative difference in the population or GCPs. The idea is to see if cities with similar sizes or are geographically close to each other are more likely to add height when their rival cities do.

Results

Here, the results are discussed in general. Information about the statistical methods and specific regression results tables are presented in Barr and Luo (2016). A few quick words, however, about the statistical models; generally speaking, the models were implemented using ordinary least squares regression with the inclusion of city dummy variables, as well as year dummy variables. Each of the independent variables discussed

全方位的城市竞争中能够凸显自己的优势和特色(Barr，2013)。

数据

这篇文章首先构建了一个中国摩天大楼数据库，然后利用这些摩天大楼数据和中国各城市统计年鉴中的经济数据进行回归分析，测试以上六个假设。这篇文章仅对数据提供简单的介绍，更多细节可参照在Barr and Luo (2016)。这个数据库包含了中国大陆，香港，澳门和台湾地区共74个城市在2014年及以前修建并被记录的摩天大楼。这个数据库包含了每一栋摩天大楼的城市信息，修建年份和高度等信息。

基于这个数据库，这篇文章选取了几个被解释变量对摩天大楼进行回归分析。第一个被解释变量是每个城市每年新建的摩天大楼总数。第二个是每个城市每年新建的摩天大楼的最高高度。第三个是城市目前最高建筑的高度。第四个是一个超高层建筑虚拟变量。如果一个城市拥有至少一个超高层建筑（高于183米或600英尺）的建筑，这个虚拟变量为1，否则为0. 最后一个被解释变量可以用于估计一个城市建设新的超高层建筑的可能性。

为了检验以上一系列假设，这篇文章包含了代表各方面信息的自变量。这些自变量包括城市的人口，区域生产总值，第三产业产值占总产值的比重。这三个变量将用于检验假设1，经济基本要素假设。

为了检验假设2，即地方财政假设，这篇文章选取了两个变量来衡量地方政府预算，一个是地方政府每年的财政支出，一个是 财政赤字虚拟变量。如果这个城市一年的财政支出高于财政收入，这个虚拟变量为1，否则为0. 这两个变量是为了检验是否高财政支出或高财政赤字会促使地方政府鼓励摩天大楼的建设，以从土地中获取更多利润，同时也促进地方经济发展。

为了检验假设3，地方官员腐败假设，这篇文章采用了Zhu（2012）一文中厦门大学张光教授收集的数据库。这个数据库包含了每年每个城市发生的地方官员腐败案件的总数。这篇文章想要借此分析是否地方腐败越多的城市，摩天大楼建筑也越多。

为了检验假设4，仕途提升假设，这篇文章采用了Yu, Zhou and Zhu (2016)的数据库中每个城市主要地方官员（市长和市委书记）的平均年龄的数据。因为地方官员普遍在65岁前退休，我们假设因为年轻的地方官员有更强的动力来增多自己的政绩已获得提拔，在主要地方官员的平均年龄与摩天大楼的修建之间可能有负相关的关系。

在假设5，城市名片假设下，打广告就意味着，在其他控制变量相同的条件下，修建的摩天大楼可能会多于和高于经济要素假设下的摩天大楼的高度和数量。 这篇文章想要通过两个变量检验是否城市大小会影响摩天大楼的城市建设结构。一个变量是城市人口数的平方，想看它是否与摩天大楼有U型或倒U形的关系。U型的关系意味着小城市比中型城市更愿意用摩天大楼来凸显自己，一个倒U形的形状意味着中等城市在更积极的修建摩天大楼。第二个变量是城市固定效应变量。简短说，在进行回归分析时，这篇文章分析了控制其他解释变量后摩天城市之间仍然存在的固定区别，即城市固定效应。这篇文章通过分析各个城市固定效应变量的大小来检验是否有些城市比别的城市更积极的修建摩天大楼。

为了检验假设6，竞争城市假设，这篇文章对摩天大楼数据进行了空间自回归模型分析，这个模型是为了检验是否一个城市修建摩天大楼的动态会影响别的城市修建摩天大楼的决定。空间自回归模型有很多种方式反映城市之间的联系，例如城市之间的地理距离，城市GDP和人口数量的相对差别。运用空间自回归模型，这篇文章想要检验是否相同城市规模或地理区域靠近的城市会在修建摩天大楼时把竞争对手的摩天大楼数量或高度作为参照。

检验结果

文章的第5部分主要讨论检验结果。更多关于统计检验的信息和统计方法可以参考Barr and Luo (2016)。简单说，这篇文章的模型运用了含有年份虚拟变量和城市虚拟变量的最小二乘法回归。每一个自变量都滞后了两年。这是因为摩天大楼的修建决定与大楼建成之间大约有两年的时间间隔（Barr，2010)。

回归分析的结果首先支持了摩天大楼修建的理性经济行为假设，正如第二部分所阐释，一个城市摩天大楼的总数及最高摩天大楼高度与城市的人口与地方生产总值有很强的关系。更为具体的回归结果显示地方生产总值与代表摩天大楼数据的四个被解释变量之间有很强的正相关关系。人口总数与摩天大楼之间的关系因自变量选取的不同而有些波动，但总体来说大城市建造了更多更高的摩天大楼。

关于假设2，地方财政假设，这篇文章没有找到摩天大楼修建与地方财政状况之间明显的关系。地方财政支出或地方财政赤字虚拟变量在回归中并没有得到统计显著的系数。关于假设3（地方官员腐败假设）和假设4（仕途提升假设），虽然回归结果显著性因自变量选取的不同而有一些变化，但都得到了地方官员年龄与摩天大楼变量有负相关关系的结果，这支持了

above were "lagged" two years. That is to say, this study investigated how skyscraper construction patterns were influenced by things like population and GCP two years prior, since there is a long lag between when construction decisions are made and when a building is completed (Barr, 2010).

Regarding the findings, first, the data strongly support the theory that skyscraper construction patterns are largely a rational economic phenomenon. As shown in Section 2, there is a very strong relationship between the cumulative number of skyscrapers and a city's tallest building, respectively, and its population and GCP. Second, the more detailed regressions show a positive relationship between GCP, and the four dependent variables. The relationship between population and the skyscraper measures is a little more complex (discussed below), but larger cities have more skyscraper construction and taller buildings, as would be expected.

Regarding H2, this study does not find consistent evidence that skyscraper building patterns are related to the fiscal situation of cities. The measures, government expenditures, and the budget deficit dummy variable, show little to no statistical significance across regressions. Regarding H3 and H4 (Involvement Degree of Local Officials and Reputation Building / Increasing Foreign Investment), the evidence is mixed. Across all dependent variables this paper finds that there is a negative relationship between the average ages of municipal officials and skyscraper building frequencies and heights (though statistical significance varies). The results do suggest that younger officials are more active in promoting skyscraper construction, all else equal; this provides support for the Reputation Building and Foreign Direct Investment Hypothesis. Evidence is also mixed; only in one case did this study find a strong statistically significant relationship between intensity of involvement and one of skyscraper measures. Namely, this study finds a positive and statically significant relationship between intensive local official involvement in a city in a given year and the probability that a city will complete a 183-meter (600-foot) or taller skyscraper.

Regarding the Advertising and Rival Cities Hypotheses (H5 and H6), a more significant finding is what is called the Small City Effect. This paper finds that small cities tend to construct taller buildings than would be expected given their size. As Figure 5 shows, there is a strong negative correlation between a city's population in 2013 and its city-fixed effect for the height of the tallest building completed each year (Figure 8). This conforms with the findings presented in the Research Institute of Complex Engineering & Management's report (2012); the authors find that smaller and mid-sized cities are eager to use skyscrapers to draw real estate development and economic growth to their cities.

In terms of the Rival Cities hypothesis, while the paper cannot state if some specific cities are directly competing against each other in terms of skyscraper heights, there is no systematic evidence for the strategic complements hypothesis. First, the paper found evidence that across space, skyscrapers are strategic substitutes; that is, when a neighboring city goes on a building spree, on average cities tend to respond by reducing their skyscraper building activity. That is to say, in general, across China skyscrapers are strategic substitutes. Rivalries by cities of similar populations and GCP were also investigated, but no clear evidence of systematic inter-city completion was found. This conclusion is also in agreement with the findings of those in the Research Institute report (2012).

Conclusion

The objective of this paper is to investigate the economic and political determinants of skyscraper frequencies and heights across cities in China. Because China's municipalities own the land in their respective cities, this can present several political and fiscal incentives for authorities to promote their construction. This study finds a strong economic rationale for their patterns across cities; those with

仕途提升假设。也就是年轻的地方官员更希望把摩天大楼的修建作为自己的政绩之一，在争取提拔时作为筹码。关于官员腐败假设，回归结果有些波动，但腐败案件的总数与一个摩天大楼变量，即城市是否建造超高层建筑（高于184米或600英尺）有明显显著的正相关关系，这意味着腐败易出现在大型的摩天大楼建设项目上。

关于假设5，城市名片假设和假设6，城市竞争假设，这篇文章验证了小城市影响假设。从城市固定效应分析的结论来看，小城市建造了与其较小的城市规模不相称的摩天大楼，从图5可知，2013年的城市人口与对城市最高建筑高度回归分析中得到的城市固定效应因素之间有明显的负相关关系，这说明越小的城市越积极地建筑超出他们城市规模的摩天大楼（图8）。这个结论印证了同济大学复杂工程管理研究院2012年编写的《中国摩天大楼建设与发展研究报告》中的结论。《中国摩天大楼建设与发展研究报告》指出中小城市更渴望通过构建摩天大楼来促进当地房地产业等方面的经济发展。

关于城市竞争理论，虽然这篇文章无法断言是否某些城市之间在修建摩天大楼的时候有摩天大楼高度竞争关系，但这篇文章并没有得到系统性的证据支持战略互补假设。首先，这篇文章发现，在中国的摩天大楼市场之间仍然是战略替代的关系。也就是说，当城市群中一个城市建筑更高的摩天大楼时，处于相邻位置的城市平均会降低摩天大楼的高度。当把城市人口与城市生产总值的相对关系加入相邻摩天城市的分析时，这篇文章仍未发现系统的城市竞争关系。这个结论与《中国摩天大楼建设与发展研究报告》的结论一致。

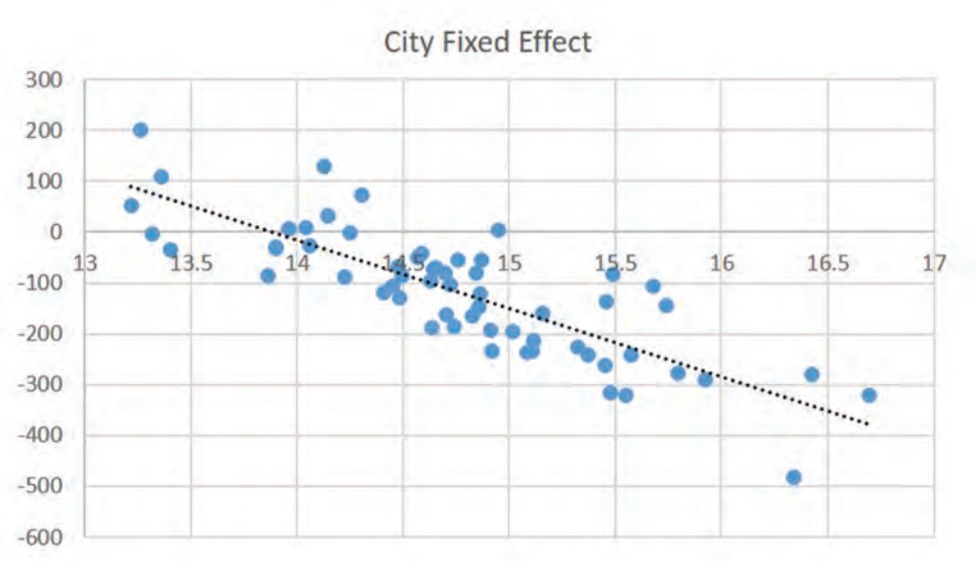

Figure 8. Scatter plot of the relative "fixed effect" of 52 Chinese cities versus the log of its population in 2013 (the black line indicates the trend) (Source: Jason Barr)
图8. 2013年，52个中国城市"固定效应"与人口自然对数的散点图，图中黑线是趋势线（来源：Jason Barr）

higher populations and GCPs have more and taller skyscrapers. No evidence is found to support that cities are building skyscrapers to improve their fiscal positions or to promote FDI. The study does find that smaller cities tend to build more skyscrapers than their size would suggest; this provides evidence for an Urban Adverting Theory, where cities use tall buildings to advertise themselves to the rest of China. A negative correlation between the ages of municipal leaders and skyscraper construction suggests that younger leaders promote skyscrapers as a way to emphasize their achievements. Lastly, the paper does not find evidence that cities engage in direct inter-city competitions in the skyscraper market, suggesting that skyscrapers are not strategic complements.

结论

这篇文章的研究目的是探索影响中国摩天大楼建筑速度和建筑高度的经济和政治等因素。中国的土地由地方政府管理， 政治和地方财政等方面的动机可能推动地方政府支持摩天大楼的修建。这篇文章发现中国各大城市修建摩天大楼仍然是理性的经济决定。人口较多，城市生产总值较高的城市建造了更多和更高的摩天大楼。没有系统性的证据表明城市修建摩天大楼是为了增加地方财政收入或者吸引海外投资。其次，这篇文章的统计结果显示，小城市热衷建造摩天大楼，比用其城市规模预测得到的摩天大楼数量更多。这也印证了城市名片理论，也就是城市希望通过超高建筑向全国乃至世界推销这座城市。 此外，这篇文章发现主要的地方官员平均年龄与摩天大楼变量之间有显著负相关关系，这说明年轻的城市领导者更热衷于把修建摩天大楼作为政绩来为自己的官职的提升增加筹码。这篇文章并没有发现中国摩天大楼市场有系统的直接的城市竞争关系，也就是说在中国的摩天大楼之间并没有战略互补的关系。

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