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Career Incentives of City Leaders and Urban Spatial Expansion in China*

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Abstract

This paper develops a theoretical framework to study the critical role that politics play in shaping the spatial dimension of China's urbanization and the related welfare implications. Utilizing a large dataset of residential land transactions matched with city leaders in 200 Chinese cities from 2000 through 2011, the empirical analysis finds that a one-standard-deviation increase in the career-incentive measure leads to nine additional kilometers of outward expansion, a 23% increase relative to the sample average. It also finds some suggestive evidence pointing to the distortionary impacts of overly strong incentives of city leaders on spatial expansion, consistent with the theory.

JEL Classification: R1; R52; H7

Keywords: Urban spatial expansion; Land use policies; City leaders; Career advancement incentives; Political economy

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1. Introduction

Rapid urbanization has occurred in many developing countries in recent decades (Glaeser, 2014). China has experienced striking urban growth: from 1990 to 2015, its urban population grew from 302 million to 771 million and real urban GDP increased at an annual rate of 10%.[1] Along with this massive urban growth, the cities have undergone substantial spatial expansion. According to data based on U.S. Landsat TM/ETM images covering 200 major Chinese cities, the total built-up urban land area of these cities expanded from 18,652 square km in 1990 to 51,891 square km in 2010, increasing at an annual rate of 5.3%, far outstripping urban population growth.[2] This rapid expansion in urban area produced profound social and economic impacts that may last for decades. While increasing city size can bring about higher productivity (Duranton and Puga, 2014), it also leads to longer commuting times and traffic jams (Newman and Kenworthy, 1999; Kahn, 2000; Harari, 2018). Furthermore, urban spatial expansion causes pollution and potential damage to the ecosystem (Glaeser and Kahn, 2004; Zheng and Kahn, 2013). Rural-to-urban land conversion in China has been notoriously characterized by under-compensation of peasants who lost their agricultural land to urban expansion (Feng, Lichtenberg, and Ding, 2015). Such under-compensation incentivizes cities to sprawl rather than undertaking brownfield redevelopment.

This paper examines a key driver of urban expansion. In addition to the standard economic causes of urban spatial expansion that have been widely studied in the literature, such as population, income, transportation costs, and agricultural rent, (e.g., Brueckner and Fansler, 1983; Glaeser and Kahn, 2004; McGrath, 2005; Burchfield, Overman, Puga, and Turner, 2006), we

[1] The calculations are based on China Statistical Yearbooks of various years.

[2] From 1990 through 2010, the total urban population of these 200 cities grew at an annual rate of 2.5%. The urban population data is obtained from the 1990 and 2010 Chinese Censuses.

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introduce a new dimension: the critical role of city leaders' career-advancement incentives in shaping the spatial pattern of China's urbanization. Our analysis is motivated by two important institutional features of China's urban planning and development. First, China's city leaders, who hold critical control over local economic activities, play a central role in planning urban land development. They set the key parameters that determine how much new land is to be developed and where (Lichtenberg and Ding, 2009). Second, these leaders are placed in tournaments in which their promotions are evaluated by upper-level governments and closely linked with local economic outcomes such as total output and fiscal revenues (e.g., Li and Zhou, 2005). The root cause of these two institutional features lies in China's intergovernmental governance structure, which combines a regionally decentralized economic system with a politically centralized hierarchy (Xu, 2011).

City leaders care about the welfare of their citizens (just as typical social planners would), but they also care about their own political careers. Given that the advancement of a city leader depends on the city's economic performance, the city leader puts certain positive weight on that performance (e.g., total output) in his objective function. This weight increases and overshadows his concern for welfare as his career-incentive intensity increases, which may cause distortion. One strategy that is frequently used to enhance economic performance is to raise fiscal revenues to finance public infrastructure. Taking land at the city edge is a key financing mechanism since it generates land sale revenues for the city treasury and the compensation fee for farm land is very low while the demolition fee for brownfield redevelopment is very high (World Bank and DRCSC, 2014).

There is a tradeoff for city leaders. On one hand, land development can enhance a city's economic performance. On the other hand, outward expansion generates social costs (e.g., pollution, lengthy commuting, etc.) and hurts social welfare. Social welfare also has a positive weight in the city leader's objective function. Land development incurs administration costs on

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the leader. Moreover, the upper-level governments impose quota restrictions on urban land expansion in order to prohibit the loss of arable land and to maintain food security. City leaders have to expend costly efforts, such as devising creative rationales for extra quotas and networking with upper-level government officials, to lobby for permission to exceed typical expansion allowances (Xie, 2015).

This paper first develops a model that captures the driving forces of urban outward expansion as discussed above. Our model predicts that the higher the career-incentive intensity of city leaders is, the more urban outward expansion occurs, which leads to higher output and larger population. Furthermore, city leaders with sufficiently strong career incentives tend to expand their cities outward beyond the socially optimal level and this excessive expansion is detrimental to social welfare. We then test the key predictions of our model utilizing a large database of over 30,000 completed residential land transactions in 200 Chinese cities from 2000 through 2011. The land transaction data contain detailed information on the use type, transaction date, sale price and geographic location of each transacted land parcel. We focus on residential land because its sales revenues accounted for nearly three quarters of the total land revenues produced through public auctions held by city governments, which are at the heart of our political economy story of urban land development. We match the land transaction data with data for 200 cities and 974 city leaders who took office during the same time period.

Our empirical analyses focus on the relationship between city leaders' career incentives and the spatial pattern of urban land development. We are able to identify the effect of city leaders' career advancement incentives because in China different city leaders face different rule-derived ex-ante chances of promotion and hence different incentives to exert effort to enhance the economic performance of their cities. A city leader's ex-ante promotion likelihood can be estimated by his age and political hierarchy level when he takes office, independent of his ex-post performance. If a given city leader has a higher ex-ante chance of promotion, then we assume

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that he has stronger career incentives to improve the city's economic performance. As such, a given city leader's career-incentive intensity is measured by his ex-ante likelihood of promotion. We construct a measure of outward expansion based on the top percentiles (e.g., 90%) in the distribution of the distances to the city center of all the land parcels sold during each leader's term of office. We find that a one-standard-deviation increase in the leader's career-incentive measure leads to nine additional kilometers of urban outward expansion, a 23% increase relative to the sample average. Furthermore, more than 60% of the city leaders in our sample spatially expanded their cities beyond what would be justified by their cities' population growth. There is also evidence that stronger career incentives are correlated with lower building intensity as measured by the floor-to-area ratio. All of these empirical results are consistent with our theory predictions.

Our paper contributes to the existing literature by providing an original political economy story about China's urban spatial expansion. To the best of our knowledge, this paper is the first to show how local politicians under an authoritarian regime play a central role in shaping urban spatial expansion. Furthermore, we investigate the welfare implications of such career-incentive-driven outward expansion. Our paper thus enriches the urban sprawl literature (e.g., Brueckner and Fansler, 1983; Glaeser and Kahn, 2004; McGrath, 2005; Burchfield et al., 2006), as well as the literature on land use policies and regulations, for which most current research is set in the context of democratic countries (Gyourko and Molloy, 2015).[3]

[3] Regarding the political economy of urban land development in democratic countries, one strand of literature emphasizes that homeowners who care about their own home values are likely to support stricter land use regulations (e.g., Brueckner, 1995; Glaeser, Gyourko, and Saks, 2005; Hilber and Robert-Nicoud, 2013; Ortalo-Magné and Prat, 2014; Duranton and Puga, 2015). In addition, some studies argue that local developers may also influence local land use regulations

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Moreover, our study contributes to a large strand of literature on the incentives of Chinese local leaders and their impacts on economic development. While some studies emphasize the role of fiscal incentives (e.g., Qian and Weignast, 1997), others focus on promotion incentives (e.g., Li and Zhou, 2005; Xu, 2011). Our study extends this line of literature by linking local leaders' career incentives to the spatial expansion of urban land development, which is arguably one of the major growth engines of Chinese cities (Henderson, 2005).

There is a small but growing body of recent literature on land development and regulations in urban China (Deng et al., 2008; Lichtenberg and Ding, 2009; Han and Kung, 2015; Brueckner et al., 2017; Cai, Wang, and Zhang, 2017). Unlike these studies, we explicitly model and empirically test the role of city leaders' career incentives in driving the outward expansion of city boundaries and its welfare implications. In addition, the urban land development of Chinese cities has involved pervasive rent-seeking and corruption, as is well documented in the literature (Cai, Henderson, and Zhang, 2013; Cai et al., 2017). However, we argue that the empirical findings in this paper are unlikely to be driven by the rent-seeking and corruption motives of local leaders. We elaborate on this in section 5.

The rest of the paper is organized as follows. Section 2 describes the institutional background of land development as well as of local leaders' career incentives in China. In Section 3, we present a simple theory that demonstrates city leaders' decision-making processes with regard to urban land development. Section 4 discusses the data and the main variables. We present our primary empirical results regarding the outward expansion of urban land in Section 5. In Section 6, we discuss welfare. Section 7 concludes.

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by lobbying for pro-growth policies (e.g., Molotch, 1976; Fischel, 2008; Glaeser et al., 2005; Hilber and Robert-Nicoud, 2013), with Solé-Ollé and Viladecans-Marsal (2012) providing some empirical evidence. .

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2. Institutional Background

2.1 Urban land development regulations in China

Land quota and urban growth control

In 1978, at the beginning of the economic reforms, the arable land per capita in China was only 1.51 mu, far lower than that in the U.S. (12.7 mu).[4] In the 1980s and early 1990s, there was an unprecedented loss of arable land in China due to large-scale industrialization and urbanization. This sizable decline fueled concerns about China's food security (Brown, 1995). In the meantime, conflicts between local governments and farmers due to insufficient compensation for rural-to-urban land conversion intensified. In order to keep urban land expansion under control, the central government amended the Land Administrative Law in 1998 and enacted a new set of arable land protection provisions in order to prohibit additional losses. In the same year, a new ministry, the Ministry of National Land and Resources of the People's Republic of China, was established to strengthen the central government's control over land development.

Since 1998, an urban land quota system has been implemented via a hierarchical, top-down planning process. The central government makes the nation's long-term land development plan. The first plan covered the period from 1997 through 2010. The plan dictates the maximum amount of newly developed urban land for each province in the long term as well as the minimum amount of arable rural land to be held in reserve. Under these two important constraints, provincial governments make their own long-term development plans. In practice, provincial governments also make short-term (five-year or annual) land development plans. According to these plans, they allocate land use quotas to cities under their administrative control. The quota constraints are primarily imposed on rural-to-urban land conversion. Within a city's boundary,

[4] The historical arable land and population data of China and the U.S. are obtained from the World Bank's website (data.worldbank.org).

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filling in vacant and waste land spots and redeveloping brownfields do not require extra land quotas.

When a provincial government allocates land quotas to cities in its jurisdiction, it must follow certain general guidelines set by the central government. For example, a city's land quota should be proportional to the city's income and predicted future population growth. The city government makes decisions regarding the size and location of land to be developed in a city. When land development involves conversion of rural land to urban land, it must be approved by the upper-level government. If the conversion is within the original quota constraints imposed by the upper-level government, it is relatively easy to obtain approval. Otherwise, the city government has to exert extra effort to lobby the upper-level government for an increase in the land quota.[5] The lobbying process involves extensive bargaining and negotiations with the upper-level government and even the central government. City leaders typically need to design and propose rationales for extra quotas, network with upper-level or central government officials, and take the risk of being scrutinized by the upper-level governments in cases where the constraints are violated. Various creative rationales for extra quotas have been developed by city governments, such as creating college towns, cultural and historic sites, or high-tech industrial parks at the city's edge. All of these involve low-density land use and justify more land allocation (Xie, 2015). In addition, sometimes city governments even tolerate some small-scale land development at a city's edge without any approval from the upper governments.

[5] China's Land Administration Law (1998) requires that any conversion of farm land to non-agricultural use must be approved by higher-level authorities and must be offset by conversion or reclamation of other land to agricultural use so that the amount of land used for agriculture, adjusted for quality, remains constant (Feng et al., 2015).

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There is intense competition for quotas among cities within the same province. Some cities may receive more land quotas from the provincial government than others. When short-term provincial quotas are used up, provincial governments may yield to pressure from city governments by allocating future land quotas in advance in order to support urban economic growth in their provinces. As a result of bargaining and concessions, the long-term land quota of rural-to-urban land conversion was exhausted several years before the completion of the first long-term plan in numerous provinces. For example, by 2004, Shandong and Zhejiang provinces had already used up 80% and 99% (respectively) of the total land quotas allotted to them by the long-term plan of 1997-2010. The zeal of local governments for urban land development placed tremendous pressure on the central government, which led to the early ending of the 1997-2010 long-term plan for land development in 2006. Not surprisingly, the drafting of the next long-term plan for 2006-2020 quickly encountered lengthy intergovernmental bargaining.

Conversion of rural to urban land vs. brownfield redevelopment

When converting rural land to urban land, the city government has to compensate the farmers who were using the land before the conversion. By China's Land Administration Law, the total compensation fees should not exceed 30 times the average annual value of products generated from agricultural land in the three years just before the conversion. There was a consensus that the compensation was generally far below the market value of the land at the city edge. In some cases, the market value was 500 times greater than the compensation (e.g., Guo, 2001; Ding, 2007). This is mainly because the calculation of the compensation fees is based only on the average returns of agricultural products grown on the farmland. At city edges, farmers often plant high-return agricultural products (e.g., organic vegetables, fruits, etc.) or run sight-seeing farms that cater to urban residents, or they build shabby lodging to rent out to migrant workers who work in the cities. Although under-compensation of farmers caused discontent and protests, in most cases the farmers had to accept the local governments' offers due to their lack of political

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power. After rural land is converted to urban land, it is at the disposal of the city government since by law, all urban land is owned by the state. All land sale revenues are turned in to the city treasury. This is why developing rural land at the city edge is lucrative to city governments: they can auction off the land at a much higher price after conversion.

By contrast, brownfield redevelopments near city centers have generally been very costly to local governments. According to World Bank and DRCSC (2014, pp.135), low-density edge growth and leapfrog growth accounted for about 95 percent of China's urban growth while infill and urban redevelopment were quite uncommon. Historically, the central city area was occupied by state-owned enterprises (SOEs) and public housing for their employees during the planning era (1949-1978). These public housing units were sold at very low prices to their residents in the 1998 housing reform. Even though the state owns all urban land, the Chinese Constitution and the Land Administration Law are ambiguous about how local governments should execute their property rights, and about which use rights apply to the current or former SOE employees living there. This gives great bargaining power to the current use right holders and sitting residents, and significantly raises the compensation fees for brownfield redevelopment (Ding and Knaap, 2005).

Land use planning and regulations

The authority in charge of general land use planning and guideline setting is the city's land reserve and allocation committee, whose members include the city's key leaders and bureau directors from relevant government agencies. Apparently, the city's top leader has a decisive voice in key urban planning and land development strategies such as setting the urban spatial boundary. After creating the urban development strategies and guidelines, the committee typically delegates the routine decisions, such as use type and detailed restrictions on floor-to-area-ratio (FAR)[6], building height, green area rate, etc. to the city's urban planning bureau for

[6] Floor-to-area-ratio (FAR) is the total floor space built on a land parcel divided by the total land

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each parcel of land to be developed. After the urban planning bureau has set the detailed use regulations for a parcel, the land is turned over to the city's land bureau for auction. Note that what is actually for sale is the leasehold of the land. The typical leasehold length for residential-use land is 70 years, and for purely commercial-use land it is 40 years. Since 1988, the use rights of vacant urban land parcels have been allocated through leaseholds by city land bureaus.

2.2 Local leaders' career incentives and land-finance policies

China's political system and local leaders' career incentives

In China, there are four hierarchical city levels: provincial, deputy-provincial, prefectural, and county. Our sample excludes all county-level cities. The hierarchical ranking of city leaders largely depends on the hierarchical level of the cities in which they take office, but there are exceptions. Specifically, the hierarchical ranking of city leaders consists of four possible levels. In descending order, these are *politburo, province*, *deputy-province*, and *prefecture*. The top city officials include the party secretary and the city mayor. The party secretary is more powerful than the city mayor due to the ruling position of the Chinese Communist Party. We therefore refer to the city's party secretary as the city leader in this paper.

China adopted a "one-level-down" appointment system in 1984. Prefectural city leaders are under the supervision and control of provincial governments, and deputy-provincial or higher-ranking officials are subject to the evaluation and appointment of the central government. The appointment of a city leader (a party secretary in our case) can be a deliberative process and many factors, such as the candidate's personality, expertise, and age, come into play. The evaluation criteria of local leaders include political loyalty, educational qualifications, age, and the economic

area. In order to regulate building density, the city government typically imposes an upper limit on FAR which specifies the maximum floor space that can be built per unit of land (Brueckner et al., 2017; Cai et al., 2017).

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performance of their regions. Since the early 1980s, regional economic performance measures (such as total output and fiscal revenues) have been key performance indicators for the career advancement of local leaders, as documented in the literature (e.g., Li and Zhou, 2005; Xu, 2011; Yao and Zhang, 2015; Tsai, 2016).

For city leaders, a term of office normally lasts five years, but this is not binding. Most city leaders stay in office fewer than five years. Some leaders may be re-appointed for second terms, but it is very rare for them to exceed 10 years in a single office. Our data show that from 2000 through 2011, the average term of office for city leaders was about 3.7 years. Moreover, since the establishment of a mandatory retirement age in the early 1980s, age has become a critical factor in career advancement. The retirement age for local officials varies with hierarchy level: it is 60 for both prefecture-level and deputy-province-level city leaders and 65 for province-level city leaders. This retirement system has been enforced rather strictly in recent decades. When a local leader approaches the retirement age, his chances for promotion decrease sharply. Typically, a city leader who is approaching the retirement age will be placed in some honorary position in the Chinese People's Political Consultative Conference (CPPCC) or the People's Congress (PC) at either the prefectural or provincial level. The move to the local CPPCC or PC is commonly regarded as semi-retirement in China since these positions carry no real power. This means that both age and hierarchy level are important determinants of the likelihood of promotion. Given a local official's age and hierarchy level upon starting office, his distance from the glass ceiling of retirement is essentially fixed. It is reasonable to argue that relatively young city leaders have relatively strong career incentives and thus will care more about the economic performance of their cities.

Local fiscal system and land-finance policies

Beginning in the late 1970s China went through several waves of fiscal reforms aimed at decentralizing its fiscal system and fiscal management. Fiscal decentralization led to a decline in

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the central government's share of fiscal income, and it acted to turn this tide by implementing a tax-sharing reform in 1994.

The fiscal revenue of local governments consists of two categories: budgetary and extra-budgetary revenue. Since the 1994 reform, the budgetary revenue has been shared between the local governments and their upper-level governments. Consequently, 75 percent of the value-added tax, the largest source of tax revenue, now goes to the central government. Corporate income tax, originally designated as a local tax in 1994, was reclassified as a shared tax between the central and local governments after 2000. Due to repeated reallocations of tax revenues in favor of the central government, local governments have felt increasing fiscal pressure. Land sale revenue is classified as "extra-budgetary revenue" and local governments are not required to share it. Before 2011, China had no property tax system. Since 2011, just two cities (Shanghai and Chengdu) have begun to levy property taxes on second houses and luxury villas. Property taxes are still in the experimental stage in China.

Against this backdrop, land sale revenues rose to prominence and became the largest source of extra-budgetary income for local governments. According to Chen and Kung (2016), while land revenue accounted for less than 10% of extra-budgetary revenue before 1998, it grew phenomenally over time. By 2008, land revenue accounted for 79% of extra-budgetary revenue and about 38% of total fiscal revenue. Fang et al., (2015) show that the average share of land revenues in city fiscal budgets further increased to 60% in 2009 and to more than 70% in 2010. Over the past two decades, city governments have increasingly relied on land-leasing revenues to finance provision of urban public goods such as infrastructure investment, which in turn can help boost local economic performance. It is worth mentioning that about three quarters of the land sale revenues created through public auctions come from the sale of residential land. City governments tend to deliberately lower the sale prices of industrial land parcels in order to attract new firms, which again may enhance economic performance.

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3. Theoretical framework

In this section, we present a theoretical framework to demonstrate how a city leader makes decisions regarding the expansion of a city's urban spatial boundary *S*. Our model assumes a mono-centric city with linear form as in Duranton and Puga (2015). All workers commute to the Central Business District (CBD) to work. The city leader sets the optimal urban boundary. We assume no migration across cities for simplicity; however, rural workers in the areas surrounding a city can move into the city under the regulation of the city government in order to attain the population that corresponds to the planned urban spatial size.[7] Let us consider a representative city.

A. Individual

An individual worker's utility comes from housing services as well as from consumption of a composite good that includes all other commodities. An individual worker's objective function is as follows:

$$\begin{aligned} &\max_{x(r),h(r)} u(x(r),h(r)) = x(r)^{\theta} h(r)^{1-\theta} \\ &s.t. \\ &w = x(r) + h(r)\,p(r) + 2tr - \kappa T(S) \end{aligned} \quad , \tag{1}$$

where *r* indicates the location where the worker lives, $h(r)$ is housing consumption, $x(r)$ is consumption of the composite good, *w* is wage income, *t* is commuting cost per unit distance, and $p(r)$ is house price per unit floor area at location *r*. And $p(S)$ is the housing price at the

[7] This assumption is based on the fact that in China while cities face a highly elastic supply of workers from surrounding rural areas due to the large urban-rural income gap, the city governments can attain their desired population by controlling the immigration of rural workers to a large extent, such as by rationing the temporary residence permits issued to them. At the same time, migration costs across Chinese cities (and especially across provinces) remain high (Tombe and Zhu, 2019; Henderson, Su, Zhang and Zheng, 2018).

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city edge and is equal to the rural rents $\underline{p}$. $T(S)$ is the social cost associated with outward urban expansion due to pollution, congestion, damage to the ecosystem, under-compensation of farmers, etc.; and we assume $T_S > 0, \quad T_{SS} > 0$. And $\kappa T(S)$ is the part of the social cost that must be borne by urban residents, $0 < \kappa < 1$. Let V denote the individual worker's indirect utility corresponding to the solution of the individual's objective function (1).

B. Firm

Assume that the city's production is conducted by a representative firm. The firm's production function is

$$Y = AGN, \tag{2}$$

where A is the city's production amenity, G is the public infrastructure provided by the city government, and N is labor which is equal to the city's population size in equilibrium. Here, public infrastructure may consist not only of road infrastructure, but also infrastructure for telecommunications and industrial or technology parks. In general, G improves the total factor productivity. We assume that the firm sells products in the national market and that there is free trade among cities. The product price is normalized to one. Prefect competition among firms gives zero profit, implying the following wage equation

$$w = AG. \tag{3}$$

C. Land sale revenues and government expenditures

The city government expands the city to boundary S. We assume that the local government conducts land development. The net revenues from land development are equal to the total housing value minus the land compensation fee and construction cost.[8] Informed by the

[8] In urban China, the city government is the monopoly supplier of city land. It holds auctions to sell long-term leaseholds of land to private developers. Through competitive bidding, these land sales can grab the developers' profits from land development.

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institutional background discussed in Section 2, we assume that the compensation fee $C(S)$ is lower than the social cost of urban outward expansion, namely, $C(S) = (1-\kappa)T(S), \quad 0 < \kappa < 1$. The remaining part of the social cost will be borne by the urban residents. The net revenue from land development is all used to finance public goods *G* and it is equal to

$$G = \int_0^S p(r)F(r)dr - \int_0^S q(F)F(r)dr - (1-\kappa)T(S), \tag{4}$$

where $F(r)$ is the total floor area per land unit at each location *r* (i.e., the floor-to-area ratio), and $q(F)$ is the construction cost per unit floor area.

Given the institutional background in urban China discussed in Section 2, we assume that the city government delegates an agent to set the floor-to-area ratio $F(r)$ for land development at each location r. In determining the ratio, the agent aims to maximize the value per unit of land; that is,

$$F(r) = \arg\max_F \; p(r)F - q(F)F .$$

The construction cost $q(F)$ increases monotonically with F. Note that the assignment of FAR by the agent is similar to what a private developer would do (DiPasquale and Wheaton, 1996), except that the agent considers the possible externality costs included in $q(F)$. Let the construction cost per unit floor area be $q(F) = 0.5 * F$. Then the optimal FAR level is $F(r) = p(r)$.

D. *Build outward: city leader sets urban boundary to maximize his own payoff*

In making a decision regarding the urban boundary of his city, a city leader considers his own payoffs, which depend not only on the urban residents' welfare, but also on his political career. The city leader's ex-post promotion likelihood increases with λY, where λ captures the intensity of a city leader's career-advancement incentives. The higher λ is, the further away the local leader is from the career glass ceiling, or the brighter his ex-ante career prospects are. Thus, improving the city's economic performance (captured by *Y*) can more effectively increase the

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likelihood of promotion of a city leader with a higher λ than of a city leader with a lower λ.[9] We henceforth assume that the payoffs of a city leader consist of a weighted average of the city's output performance and the welfare of urban residents, where the weight on output performance, denoted as μ, $0 < \mu < 1$, is positively related to the city leader's career-incentive intensity λ.

The city leader faces a tradeoff. On one hand, expanding the city outward can help his political career. On the other hand, expanding the urban boundary may create social costs that will hurt welfare. Moreover, pushing the urban boundary outward usually requires the city leader to seek extra urban land quotas from the upper-level government, which is costly. Suppose that the upper-level government initially sets the city boundary constraint at the socially optimal boundary that maximizes each urban resident's welfare, denoted as S_0 (See Appendix A for the derivation of S_0). This reflects that when upper-level governments allocate land quotas to cities, they consider the welfare and the fundamentals of the cities' economies, which is consistent with the institutional background discussed in Section 2 of this paper. If a city leader wants to expand the spatial boundary of his city beyond S_0, he needs to lobby the upper-level governments.

The lobbying efforts are reflected in the lobby cost function, denoted as $D(S)$. We assume both the lobby cost and the marginal lobby cost is zero for $S \le S_0$. When the city expansion goes beyond the boundary constraint, the marginal lobby cost increases with S for $S > S_0$. In addition to the lobby cost, there is also administration cost associated with land development that

[9] In China's political system, the likelihood of promotion of a politician hinges on the politician's career incentive when he starts office and on his ex-post performance during his office term. The two factors complement each other. This is different from what is documented in the literature on western political regimes (e.g., Besley, Persson, and Sturm, 2010; Solé-Ollé and Viladecans-Marsal, 2012).

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increases linearly with S. So the total effort cost of the city leader is expressed as $E(S) = a * S + D(S)$, where $a > 0$ is the city leader's marginal cost of administration effort in urban land expansion.

The objective function of a city leader can be described as follows:

$$\begin{aligned} &\max_{S} \quad R \equiv \mu Y + (1-\mu)V - E(S) \equiv \mu * ANG + (1-\mu) * V - E(S) \\ &s.t. \\ &(i) \quad G = \int_0^S 0.5 * p^2(r)dr - (1-\kappa)T(S) \\ &(ii) \quad \int_0^S \frac{F(r)}{h(r)}dr = \int_0^S \frac{p(r)}{h(r)}dr = N \end{aligned} \quad . \tag{5}$$

In (5), *(i)* is the city government's budget constraint incorporating the optimal FAR, and *(ii)* means that the total housing supply should accommodate the total housing demand, which effectively determines the city population corresponding to the optimal urban boundary.

E. Solution and predictions of the model

We can derive the first-order condition of (5) for *S*:

$$R_S \equiv \mu A(G_S N + N_S G) + (1-\mu)V_S - E_S = 0 . \tag{6}$$

Suppose that there exists an interior solution with $V > 0$. And suppose that the second-order derivative of the objective function with respect to *S*, denoted as R_{SS}, is negative. Then with the first-order condition, we can solve for the optimal urban boundary for (5), denoted as S^* and the corresponding *G*, *N* and *Y*. These fully characterize the equilibrium. Next, we present two predictions of our model. Note that S^* depends on the city's production amenity *A*, transportation technology associated with *t*, agricultural rents associated with $\underline{p}$ and institutional factors such as κ and a, etc. Additionally and more importantly, it depends on the weight μ that the city leader puts on total output in the objective function, which is closely associated with his career-incentive intensity.

Proposition 1. *Assume that* $R_{SS} < 0$ *and* $V_{SS} < 0$. *And assume the parameter space*

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guarantees that $\Omega \equiv \theta^{\theta}(1\text{-}\theta)^{1\text{-}\theta} / \underline{p}^{1-\theta} < 1$. [10] *Then at* S^*, $dS^*/d\lambda > 0$, $dY^*/d\lambda > 0$, *and* $dN^*/d\lambda > 0$.

Proof. See Appendix B.

Intuitively, a city leader with greater career-incentive intensity puts more weight on the total output which may enhance his promotion chances. So he is willing to exert more effort to expand the city outward, generating more total output and population.

Proposition 2. *Assume that* $R_{SS} < 0$ *and* $V_{SS} < 0$. *As long as* $Y_S(S_0) > a$, [11] *there exists a threshold career incentive level* $\bar{\lambda}(S_0)$ *that corresponds to the threshold weight* $\bar{\mu}=a/Y_S(S_0)$, *such that city leaders choose to expand urban boundary beyond the socially optimal level; that is,* $S^* > S_0$, *if and only if* $\lambda > \bar{\lambda}(S_0)$ *or* $\mu > \bar{\mu}$. *Regarding welfare, for* $\lambda > \bar{\lambda}(S_0)$, $dV^*/d\lambda < 0$; *for* $\lambda \le \bar{\lambda}(S_0)$, $dV^*/d\lambda \ge 0$.

Proof. See Appendix B.

Intuitively, at the socially optimal size S_0, the marginal welfare gain from urban expansion is zero. However, developing more land can still create additional total output. If a city leader cares enough about his own political career, it is wise for him to expand the city beyond S_0 because the benefits generated by the additional output will dominate his additional effort cost. Regarding welfare, if the city leader's career incentives are great enough that the current equilibrium urban boundary is already beyond the socially optimal level, then an increase in his incentive intensity drives more excessive expansion, which is detrimental to social welfare.

4. Data, variable construction, and summary statistics

4.1 Data

[10] This condition can easily be satisfied under reasonable parameter space.

[11] This condition can easily be satisfied under reasonable parameter space.

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The sample for our analysis of urban land expansion contains over 30,000 residential land transactions completed through public auctions in 200 Chinese cities during the period from 2000 through 2011.[12] This database is provided by the China Index Academy, which is China's largest independent think tank focused on the real estate market. Figure A1 in the online appendix maps the 200 cities, among which 196 are prefecture-level and four are provincial-level cities (Beijing, Shanghai, Tianjin, and Chongqing). They represent 70% of all prefectural cities in China and are mainly located in the eastern and central regions. For each land parcel, we have information on the use type, total area, transaction date, sale price, auction type, address, etc. By taking advantage of the micro-level land data we are able to obtain detailed geographic information on residential land developments. We first geocode each land parcel based on its address and infer the names of the streets that serve as its boundaries. Using this information, we then find the smallest polygon that contains the land parcel on Baidu Map (www.map.baidu.com). The geographic coordinates of the polygon's centroid are used as the coordinates of the land parcel and we use them to calculate the distance to the city center for each land parcel.

We manually collect biographic information on 974 city leaders who were in office during 2000-2011 in the 200 Chinese cities that our land sample covers. For each leader, the information includes date of birth, educational attainment, start time and end time of office, hierarchical level at the start of office, and power status just after leaving office (e.g., promotion, lateral move, or retirement). On average, the time span between a city leader's office start and end, which we refer to as the city leader's tenure, is 3.73 years in our sample. Among the 974 city leaders, 76% stayed

[12] For residential land sold through negotiations, the sale prices were far below the market value. This suggests that such negotiated sales are not intended to create fiscal revenues for local governments. Since local government revenues are at the heart of this paper's story, our residential land transaction data from public auctions is suitable for our research purposes.

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in office for at most five years, and 95% of the city leaders stayed in office for at most seven years. A city leader's hierarchical level typically does not change during his tenure. Of the 974 city leaders in our sample, there were 798 prefecture-level leaders, 157 deputy-province-level leaders, 10 province-level leaders, and 9 politburo-level leaders (at the time when they took office). The 19 province- and politburo-level city leaders were all from the four provincial-level cities. Panel A of Table 1 reports the summary statistics of the city leader characteristics.

We match the residential land transactions in each city with the data on city leaders during our sample period. We are then able to calculate the extent of outward development during each leader's term of office. Specifically, we collapse the land sample at the city-leader level, and measure the urban boundary by the top percentiles in the distribution of the land distance to the city center among all the land parcels sold during each leader's office span. Panel B of Table 1 shows that, among the 362 city leaders in our matched sample, the average of the 90^{th} percentile distance to the city center is around 40 km.

The outward expansion of urban land development is a typical form of urban spatial expansion. Previous studies have generally measured the expansion by the change in total urban land area (e.g., Brueckner and Fansler, 1983; McGrath, 2005; Deng et al., 2008; Lichtenberg and Ding, 2009). A clear limitation of such aggregate measures is that the growth of total urban land area may be caused either by new developments filling in open space between existing developments or by developments pushing the existing urban boundary further away from the city center. Rigorously speaking, the latter type of development is more consistent with the outward expansion of urban boundaries. And our outward measure is better able to capture it. Nonetheless, it is worth noting that our outward measure is positively correlated with the growth of urban land area based on several widely used data sources, such as the land classification data constructed every five years by the Institute of Geographic Science and Natural Resources at the

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Chinese Academy of Sciences based on the U.S. Landsat TM/ETM images[13] and the *City Statistical Yearbooks*, as shown in Table A1 of the appendix.

The data appendix provides data construction details.

4.2 Constructing career-incentive measure of city leaders

As noted in Section 3, mandatory retirement age varies with the hierarchical ranking of a city leader, so both the age and hierarchical level of the city leader at the start of his office term largely determine his *ex-ante* likelihood of promotion. We therefore estimate the effects of initial age and hierarchical rank at the start of office (*start age* and *start level* respectively hereafter) on promotion likelihood using our sample of 974 city leaders.

We define a promotion dummy variable which equals one if the city leader was promoted to a higher-level position by the end of his term. Note that the higher-level positions exclude those in the local CPPCC or PC. We observe the promotion outcomes of 735 city leaders. Among them, 258 were promoted. Figure A2 shows the percentage of leaders promoted by start age for each start level. For prefecture-level city leaders, it is clear that the likelihood of promotion strictly decreases with start age. Overall, 40% of prefecture-level city leaders successfully climbed to a higher hierarchical level. Only 6% of deputy-province-level city leaders were promoted. About 70% of the province- or politburo-level city leaders were promoted.

We then regress the promotion dummy on start age, the dummies of start levels, and the interactions of start age and dummies of start levels. Column 1 of Table 2 shows the LPM results, and column 3 reports the Probit results. The relationships between promotion, start age, and start level are consistent with the patterns shown in Figure A2. Variations in start age and hierarchical level explain about 20% of the variation in promotion. We use the estimated coefficients on start

[13] Goldblatt, You, Hanson and Khandewal (2016) develop a methodology to quantify the urban land area in India using Google Earth Engine based on imagery from the U.S. Landsat database.

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age, start level, and their interactions in column 3 to predict the prior promotion likelihood for each of the 974 city leaders. Note that we intentionally avoid including variables that are endogenous to the actual effort level of city leaders, such as tenure length and city economic performance. We assume that a leader's career incentives should increase with the predicted prior promotion likelihood. As such, we measure the intensity of each city leader's career incentives by his predicted ex-ante promotion likelihood, which is based only on his start age and start level.

We also know whether the city leader worked previously in the central government, and whether the leader had a graduate degree, both of which are considered relevant to promotion in the Chinese political economy literature (e.g., Li and Zhou, 2005; Xu, 2011). Comparing column 2 with column 1 of Table 2 (or comparing column 4 with column 3), we can see that these two variables contribute little to the variation in promotion since the adjusted R-squared remains almost unchanged when we include these two variables. Also, the estimates of the coefficients on the start age, start level, and their interactions are robust to including these two variables.

4.3 Comparison of outward expansion between earlier and later leaders in a turnover

Before doing regression analysis, we first compare the spatial patterns of urban land development between the earlier leader and the later leader when a city undergoes a turnover of leaders. To differentiate the incentive intensities of city leaders, we define a city leader to be high-incentive if his career-incentive intensity is above the sample median (0.25), and low-incentive otherwise. Then we divide all the turnovers into four types by the incentive intensities of the earlier and later leaders: high-to-low, low-to-high, high-to-high, and low-to-low. Further restricting the sample to those city leaders who sold at least one residential land parcel during their terms, we identify 30 high-to-low-type turnovers, 24 low-to-high-type turnovers, 45 high-to-high-type turnovers and 63 low-to-low-type turnovers.

For each type of turnover, Table 3 reports the mean of the 90^{th} percentile distance to the city center of all land parcels sold by the earlier leader during his term (column 1), and the mean of

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the 90th percentile distance of the later leader (column 2). Column 3 of Table 3 shows the mean difference in the 90th percentile distance between the earlier and later leaders for each turnover type. One can see that when a city experiences a turnover from a high-incentive leader to a low-incentive leader, the 90th percentile of distance decreases from 43 km to 35 km on average (the t-stat of the mean difference is -2.92 and the p-value is 0.005). By contrast, when a city experiences a low-to-high type turnover, the city expands further outward by about 11 km on average (the t-stat of the mean change is 2.83 and the p-value is 0.007). Notice that the mean difference in the outward expansion is small and insignificant for the other two turnover types where the earlier and later leaders do not exhibit large differences in incentive intensities. This exercise indicates that the outward expansion of urban development is closely related to city leaders' career incentives.

5. The effect of career incentives on urban outward development

5.1 City-leader-level analysis

We examine the relationship between a city leader's career-incentive intensity and the extent of the city's outward development during his office term. We have 362 city-leader observations for final estimation. The main regression specification is given by

$$z_{c,s}^{p} = \beta^{p}\lambda_{c,s} + \eta_{c} + X_{c,s}\phi + u_{c,s}, \quad (7)$$

where $z_{c,s}^{p}$ represents the *p*-th percentile of the distribution of the distance to the city center of land parcels sold during the office term of city leader *s* in city *c*; $\lambda_{c,s}$ is the career-incentive intensity of city leader *s* when he took office in city *c*; η_{c} are city fixed effects, capturing the time-invariant characteristics of city *c* that may affect its spatial expansion, such as geographic features, climate, and natural endowments (Burchfield et al., 2006); and $u_{c,s}$ is an error term. The parameter of interest is β^{p}. We expect β^{p} to be positive for uppermost percentiles as our model predicts that city leaders with higher career incentives are more likely to expand their cities

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outward.

In (7), $X_{c,s}$ represents a set of city-leader-level characteristics. The inclusion of $X_{c,s}$ addresses the concern that the placement of a high-incentive leader may be correlated with some omitted city-leader-level characteristics that are associated with the city's outward expansion. First, the timing of a city leader's arrival and departure may overlap with the enactment of some national or regional-level policies. In addition, when the turnover of a city leader coincides with that of his superior, the city leader may develop the city in a way that caters to the new boss. To deal with these issues, we include the fixed effect of the years when each city leader takes and leaves office (the *office-start* and *office-end* years hereafter), as well as the province-specific time trends of the office-start and office-end years, to capture the national and regional trends of urban outward expansion upon the turnover of city leaders. Second, the appointment of high-incentive city leaders may initially be systematically correlated with certain city characteristics such as higher population, greater production scale, larger built-up urban land area, or greater growth potential in these dimensions. These cities may automatically expand faster after the new leaders take office. Because of this, we control for the city's population size, GDP per capita, and built-up urban land area (all in logs) in the years just before the office-start years in all our regressions. In order to control for the pre-trends of the city's economic development, we also include in the regression the growth rates of population, GDP per capita, and built-up urban land area over the two years before a city leader takes office.

All the regressions are weighted by the number of land parcels sold during the office span of each city leader. Because the career-incentive-intensity measure is a generated regressor, the standard errors are calculated on the basis of 1,000 bootstrap replications. Also, we cluster the bootstrap replications on provinces because the outward expansion of cities in the same province may be correlated.

Columns 1-4 of Table 4 report the regression results for the 90th percentile, 80th percentile,

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median, and mean of distance to the city center. The greater the top percentile of the distance to the city center is, the farther outward the city expands. Consistent with the model's prediction, the coefficient β^p is positive and significant for both the 90th and 80th percentiles, suggesting that a city leader with greater career incentives tends to promote outward-oriented urban development. The effect of career incentives is large: a one-standard-deviation increase in the career-incentive intensity (0.236) leads to an increase in the 90th percentile distance to the city center of about 9.46 km, representing about a 23% increase over the sample mean (which is about 40 km as shown in Panel B of Table 1). Columns 3 and 4 show that the effects of career incentives on the median and mean distances to the city center are positive but relatively small in magnitude and statistically insignificant. Table A2 in the appendix presents the regression results for different percentiles of distance to the city center. The effects of career incentives on the lower percentiles turn gradually from being positive and significant to being negative and insignificant as we move from the 90th percentile to the 10th percentile of the distance distribution. This constitutes strong evidence that the positive effects of career incentives show up mainly in the expansion of urban boundaries as opposed to inner-city land development. The standard economic factors such as initial growth rates of GDP per capita and population are positively associated with urban outward expansion, which is consistent with the classic urban literature.

Urban development in the four provincial-level cities, Beijing, Shanghai, Tianjin, and Chongqing, may be heavily influenced by the will of the leaders in the central government. Also, the leaders of these four cities may have quite different career horizons as most of those in our sample eventually became central leaders of the country. Columns 5-8 of Table 4 show that the results are fairly robust to the exclusion of these four large cities.

The urban land development of Chinese cities has involved pervasive rent-seeking and corruption in land auctions (Cai et al., 2013). As such, outward expansion may create opportunities for corruption (e.g., through under-the-table deals with private developers in land

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transactions and development and/or deals with private firms during infrastructure construction). Corruption, then, might be a motive in city leaders' decisions regarding urban outward expansion. But we believe that the rent-seeking and corruption motives do not drive our key results, which show that city leaders with greater career-advancement incentives tend to expand the city further outward. Generally speaking, the opportunity cost of corruption is higher for younger city leaders with stronger career incentives (if caught and convicted). In fact, there is much talk in China about the so-called "59-year-old phenomenon," which refers to cases where city leaders become very corrupt just one year before the retirement age of 60.[14]

5.2 Identification challenges and robustness checks

5.2.1 Road infrastructure

High-incentive city leaders may be appointed to cities with better transportation infrastructure, which facilitates outward urban expansion (Burchfield, et al., 2006; Baum-Snow, 2007; Baum-Snow, Brandt, Henderson, Turner, and Zhang, 2017). In order to address this concern, we must control for the initial road infrastructure of the cities to capture the effect of existing road infrastructure on spatial expansion during each leader's office term. From the *China Urban Construction Statistical Yearbook 1998-2011*, we obtain data on each city's annual road stock as measured by its total road length. To the baseline regression specified in column 1 of Table 4 we add the logarithm of city road stock in the year just before the leader takes office. In addition, we include the interaction of the log of the leader's initial road stock with the linear trend of the

[14] For example, see the article entitled "The 59 Years Old Phenomenon" on the Epoch Times (https://www.theepochtimes.com/the-59-years-old-phenomenon_1732969.html), and "Why 59-Year-Old Officials Are Being Charged with Corruption in China" on the Vision Times (http://www.visiontimes.com/2014/03/01/why-59-year-old-officials-are-being-charged-with-corruption-in-china.html).

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leader's office-start year to allow the effect of the road infrastructure to vary by year. Column 1 of Table 5 shows that the main results are robust to inclusion of the initial road infrastructure conditions.

5.2.2 Various pre-trends of urban development

There is a concern that city leaders with differing career-incentive intensities may be systematically appointed to cities that have undergone different pre-trends of economic development. To avoid the confounding effect of such pre-trends, we control for the growth rates of various city economic characteristics in our baseline regressions. As a robustness check, we further add into our baseline regression (column 1 of Table 4) the interactions of the city characteristics in the year just before the leader takes office (i.e., population size, GDP per capita, built-up urban land area) with the linear trends of the leader's office-start year. Column 2 of Table 5 shows that the main results are very similar after controlling for the effects of pre-trends of urban development.

In addition, a given city leader may simply carry on the spatial development policies of his immediate predecessor. If career incentives are correlated among city leaders appointed to the same city, then the estimates shown in Table 4 would be biased. Column 3 of Table 5 shows that the main results are robust to including the career-incentive intensity of the immediate predecessor.

We also conduct a falsification test by regressing the extent of outward expansion during the office span of the city leader's immediate predecessor on the career-incentive intensity of the city leader. Table A3 in the appendix reports the results. The estimated coefficients on the career-incentive intensity turn out to be negative and insignificant for all four percentile outcomes, contrary to what we found in Table 4.

Moreover, changes in national industrial structure may cause the extent of urban outward expansion to differ across cities with different initial industrial compositions. Meanwhile, the

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career-incentive intensity of a city leader may be correlated with the city's initial industrial structure. To address this concern, we construct a Bartik-type variable that measures the effect of industrial structural change during each leader's office term (Bartik, 1991). For this exercise, we use the sub-sample of 299 city-leader observations covering those who took office in or after 2004, as this is the year when the variable definitions of the city-level employment data agree with those of the national-level data. The regression results reported in column 4 of Table 5 show that the effect of career incentives on outward expansion remains, although the significance level drops due to the small sample size.

5.2.3 Promotion incentives versus competence

Local leaders promoted to the prefecture level at a younger age may be more competent than other leaders. This raises the concern that the ability or competence of the leaders may be a confounding factor in the estimation. Our model helps us differentiate the effects of career incentives and the effects of ability/competence on urban outward expansion. When a city leader's career incentives drive excessive expansion, the effect on welfare is negative. In the context of our model, however, it is hard to imagine that the ability or competence of city leaders per se is distortionary in the sense of lowering welfare. Actually, if we assume that local leaders with higher ability levels can manage their cities more efficiently, then a higher ability level will enhance social welfare. People may still argue that a more competent city leader may also have better connections with the central government, which lowers his lobbying costs, all other things being equal. If this is true, given the career-incentive intensity, higher competence would indeed drive excessive urban expansion. Even in this non-typical scenario, however, our empirical results remain robust. As shown in column 5 of Table 5, when we control for the central work experience of city leaders as a proxy for central connections as well as educational attainment as a proxy for ability, the effects of both central work experience and education are insignificant, and the urban expansion effect of career incentives is very similar to our baseline effect as

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reported in column 1 of Table 4.[15]

There is also concern that the upper-level or central government may assign younger and more competent leaders to cities that are targeted for faster growth. To address this concern, we conduct a careful check to see whether there is any systematic correlation between the cities' pre-existing economic conditions and the appointed city leaders' personal characteristics (such as age, level and education). We run separate regressions of the city population, GDP per capita, and built-up urban land area just prior to the leader's office-start year (all in logs), as well as the growth rates of these variables over the two years before the office-start year, on the city leader's start age, start level and education. As shown in Table A4 in the appendix, we find no significant relationship between the pre-trends of city characteristics and a city leader's start age, start level or education.

5.2.4 More robustness checks

Our main results in Table 4 are robust to including the age of the provincial leader (and its squared term) as of the city leader's office start year, which addresses the concern that city leaders display more loyalty towards provincial leaders who are older than they are and, in turn, are more favored by those older upper-level superiors in the allocation of resources (in terms of granting land quotas). Adding the economic performance of peer cities in the same province as controls in the regression does not change the main results.

A city leader who has greater career-incentive intensity may stay in office for a longer time. Meanwhile, his tenure length may affect the number of land parcels sold during his office term and their distance from the city center, which in turn influences the outward expansion. Our main results remain robust to inclusion of the city leader's total tenure length and its squared term.

[15] Xi, Yao, and Zhang (2018) finds that career-concerned opportunism is mitigated by capabilities among city leaders in China.

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Also, it is possible for a city leader to draft a new plan upon being reappointed for an additional term after the first five years. We conduct several robustness checks regarding this reappointment issue. The results remain robust.

We also rerun the regressions in Table 4, either replacing the predicted career-incentive intensity with the city leader's start age and start level, or using the logs of the distance measures as outcome variables. Our main results still stand. Appendix D discusses the details and reports the results of all the above checks.

6. Welfare discussions

Is the career-incentive-driven urban expansion in Chinese cities distortionary? Our theory demonstrates that career incentives motivate city leaders to exert efforts to expand the city outward and build infrastructure, which in turn boosts output production and attracts more people. However, incentives that are too strong may lead to expansion beyond the socially optimal level and cause welfare loss. While we have found empirical evidence that local leaders' career incentives are positively related to cities' total industrial output and population (see Appendix E for the impacts of career incentives on various economic outcomes), empirically testing whether career incentives lead to excessive expansion is challenging. This is because ideally, "excessive" outward expansion should be measured as total outward expansion minus the benchmark outward expansion that is socially optimal or is permitted by the original land quota. Unfortunately, we can observe neither the socially optimal level nor the land quota data for each city. However, informed by the institutional background, we know that a city's original quota depends on its future population growth as predicted by the economic conditions at the start of each leader's office term. Hence we construct an alternative measure of excessive expansion, that is, the urban land expansion beyond what would be justified by a city's population growth.[16]

[16] We thank one anonymous referee for this suggestion.

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For each city leader, we calculate the built-up urban area necessary to host the population increase in the coming office term of five years, as predicted by the economic conditions that existed at the beginning of his term, under four scenarios.[17] In the first scenario, we assume that each city's population will grow at the same rate in the next five years as it did over the two years just before the start of the office term. In the second scenario, we predict the city's population growth rate using the city's total road stock, fixed asset investment, and population size in the year just prior to the office term, as well as the city fixed effects. In both the first and second scenarios, we assume that the city's population density remains unchanged at the initial level and we calculate the city's projected built-up urban area as the projected population divided by the initial population density. In the third and fourth scenarios, we predict the city's population growth in the same way we did in the first and second scenarios, respectively, but we let the population density change. Specifically, we assume that the population density changes at the same rate that it did over the two years just before the office term.

We define excessive expansion to be the gap between the actual built-up urban area at the end of a leader's term and the projected area if the gap is positive; otherwise, the excessive expansion is zero. We find that more than 60% of the city leader cases in our main regression samples have a positive gap. To shed light on the effects of career incentives on the likelihood and extent of excessive expansion, we run a Tobit regression using specification (7) with the outcome variable being the excessive expansion constructed above. The results reported in Table 6 show that career incentives are positively correlated with the excessive expansion thus measured.

Building density is another important dimension of spatial development that is relevant to

[17] In the calculation, we assume that at the beginning of each office term, the city leader expects that his term will last for five years, because an official term in China's administrative system is stipulated as five years, although this is not strictly binding.

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welfare. In China, building density is usually measured by floor-to-area ratio (FAR). Utilizing micro-level data with information on the regulatory FAR for each land parcel, we run land-parcel-level regressions of FAR on city leaders' career incentives while controlling for the effects of transaction time and the land's distance to the city center (see Appendix F for details). We find that, on average, the career incentives of local leaders are negatively associated with the regulatory residential building density in Chinese cities (see column 1 of Table A10 in the appendix). Furthermore, column 2 of Table A10 shows that the greater the career-incentive intensity of the city leader is, the smaller the magnitude of the gradient of building density against the distance to the city center becomes. The distance gradient itself is negative, which is consistent with most literature. Hence one can see that while career incentives drive outward expansion, building density flattens out at the same time, which indicates that the spatial layout of cities governed by high-incentive city leaders is less compact than that of cities under low-incentive ones. The flattening-out of a city may cause lengthier commuting times and a reduction in agglomeration forces. As shown by Harari (2018), less compact urban layouts are associated with lower welfare.[18] In this light, we interpret the result on FAR as another piece of suggestive evidence on the welfare impacts of city leaders' incentives.

In summary, we find some suggestive evidence pointing to the distortionary impacts of overly strong incentives of city leaders on spatial expansion. But, due to the limitations of the data, a rigorous welfare analysis requires further research.

7. Conclusion

[18] Harari (2008) constructs a disconnection index to measure the degree of city compactness using nighttime light imagery data that delineates the spatially contiguous footprints of cities. Based on this measure, that paper studies the welfare impacts of city shape using a Rosen-Roback framework with free migration.

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The spatial aspect of urbanization is essential to consider because it not only shapes the internal structure and the spatial distribution of economic activities within a city, but also affects biodiversity and environmental quality for decades to come. This paper studies the effect of city leaders' career-incentive intensities on urban spatial expansion under China's unique institutional background.

An intriguing question arising from our study concerns the welfare implications of the spatial pattern of urban land development led by city leaders. On one hand, the total factor productivity increases when outward expansion creates more land sale revenues and thus channels more money into public infrastructure investment. Further, the higher productivity associated with outward expansion can attract more people from rural areas into industrial and service sectors. On the other hand, commuting costs increase as the geographic footprint of a city expands. There are other social costs associated with urban spatial expansion, such as traffic jams and environmental costs, in addition to inefficiency and negative redistribution effects arising from the under-compensation of peasants for the agricultural land at the city edge. Because of the increased focus of promotion evaluation criteria on jurisdictional economic performance, Chinese city leaders generally downplay those social costs. This causes inefficiency.

Our theoretical model predicts that city leaders with higher career incentives tend to expand the urban spatial size further outward, generating higher output and population. When the incentives are strong enough, there will be excessive outward expansion at the expense of social welfare. Exploiting a large micro-level land dataset that features rich variations across cities and over time, we put the model to empirical tests and find results fairly consistent with the theory. Note that due to data limitations, we are unable to perform a comprehensive welfare assessment. We thus regard our empirical results concerning welfare as suggestive evidence.

This paper also creates possibilities for future research in several directions. For instance, it is worth further studying how the pattern of urban land development influences the spatial

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distribution of economic activities within cities. Baum-Snow et al. (2017) find that road infrastructure facilitates the decentralization of population and manufacturing production in Chinese cities. It would be interesting to examine how urban land development directed by city governments affects the provision of public infrastructure, and how this in turn shapes the internal urban structure in terms of the locations of firms, employment and population. It would also be worth investigating how residential land developments complement industrial land developments in boosting local output and how land developments enhance the formation of edge cities in suburban areas. A recent study shows that as large numbers of firms cluster in industrial parks at the city edge, they can enjoy localization economy benefits and workers can also live in nearby residential developments (Zheng et al., 2017). This implies that the downsides of the outward expansion that we have described may be mitigated by the creation of industrial parks at the edges of many cities.

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Table 1: Summary Statistics

	Mean	S.D.	Obs.
Panel A: City leader characteristics			
Dummy: Prefecture	0.819	0.385	974
Dummy: Deputy-province	0.161	0.368	974
Dummy: Province or above	0.020	0.138	974
Tenure length, year	3.729	1.889	974
Start age	49.898	3.946	974
Dummy: Promotion of city leader	0.351	0.478	735
Dummy: Central experience	0.033	0.178	974
Dummy: Graduate degree	0.616	0.487	974
Panel B: City-leader level characteristics			
90th percentile distance to city center, km	40.388	24.356	362
80th percentile distance to city center, km	31.721	21.159	362
50th percentile distance to city center, km	17.773	13.065	362
Mean distance to city center, km	20.133	12.372	362
City leader's career-incentive intensity	0.306	0.236	362

Notes: In Panel A, the hierarchical-level dummies indicate the city leaders' hierarchical ranks at the time they took office. In Panel B, the means are calculated by weighting each observation by the number of residential land parcels sold during the office time span of each city leader.

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Table 2: Start Age, Start Level and Promotion

	Dummy: Promotion of city leader			
	LPM	LPM	PROBIT	PROBIT
	(1)	(2)	(3)	(4)
Start age	-0.048***	-0.045***	-0.136***	-0.128***
	(0.005)	(0.005)	(0.015)	(0.016)
Dummy: Deputy-province	-2.690***	-2.825***	-7.935***	-8.524***
	(0.263)	(0.278)	(1.398)	(1.537)
Dummy: Province or above	-0.570	-0.773	-1.547	-1.279
	(0.758)	(0.817)	(2.386)	(3.121)
Start age * Dummy: Deputy-province	0.048***	0.050***	0.136***	0.146***
	(0.005)	(0.005)	(0.027)	(0.030)
Start age* Dummy: Province or above	0.022	0.024*	0.060	0.051
	(0.013)	(0.014)	(0.042)	(0.053)
Dummy: Central experience		0.177**		0.672***
		(0.076)		(0.260)
Dummy: Graduate degree		0.061*		0.198*
		(0.034)		(0.112)
Constant	2.749***	2.587***	6.368***	5.858***
	(0.229)	(0.249)	(0.752)	(0.802)
Observations	735	735	735	735
R-squared	0.193	0.200		
Adjusted R-squared	0.188	0.192		
Pseudo R-squared			0.162	0.168

Notes: *** p<0.01, ** p<0.05, * p<0.1. Heteroskedasticity-robust standard errors in parentheses are clustered at the city level.

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Table 3: Comparison of Outward Expansion between Earlier and Later leaders in a Turnover

Turnover type	90th percentile distance to city center of land sold by the earlier leader (km)	90th percentile distance to city center of land sold by the later leader (km)	Mean difference in 90th percentile distance to city center (km)
	(1)	(2)	(3) = (2) – (1)
High-to-low	42.820	34.889	-7.931***
	(2.224)	(1.554)	(2.713)
Low-to-high	35.206	45.736	10.530***
	(3.186)	(1.929)	(3.724)
High-to-high	47.211	49.803	2.593
	(1.840)	(1.566)	(2.416)
Low-to-low	31.609	31.989	0.380
	(1.187)	(1.070)	(1.598)

Notes: In column 3, *** indicates that $p<0.01$. Standard errors are reported in parentheses. There are 30 high-to-low-type turnovers, 24 low-to-high-type turnovers, 45 high-to-high-type turnovers, and 63 low-to-low-type turnovers.

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Table 4: Outward Development and Career Incentives of City Leaders

Dependent variable: City-leader-level outward expansion measures (km)								
	90th pct. distance to city center	80th pct. distance to city center	50th pct. distance to city center	Mean distance to city center	90th pct. distance to city center	80th pct. distance to city center	50th pct. distance to city center	Mean distance to city center
	Full sample				Drop 4 provincial-level cities			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
City leader's career-incentive intensity	40.087***	25.532**	1.473	9.731	40.131**	25.550**	1.534	9.769
	(15.221)	(10.945)	(8.967)	(7.295)	(16.334)	(11.319)	(13.645)	(7.379)
City fixed effects	Y	Y	Y	Y	Y	Y	Y	Y
Baseline city-leader-level characteristics	Y	Y	Y	Y	Y	Y	Y	Y
Observations	362	362	362	362	353	353	353	353
R-squared	0.975	0.971	0.959	0.980	0.971	0.966	0.946	0.975

Notes: *** p<0.01, ** p<0.05, * p<0.1. Standard errors (in parentheses) are calculated on the basis of 1,000 bootstrap replications clustered at the province level. Each regression is weighted by the number of residential land parcels sold during the office term of each city leader. The baseline city-leader-level characteristics include the dummies of the years when the city leader takes and leaves office; the province-specific time trends of the office-start and office-end years; the city's population, GDP per capita, and built-up urban land area (all in logs) in the year just prior to the leader's office-start year; the growth rates of population, GDP per capita, and built-up urban land area over the two years just before the city leader takes office.

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Table 5: Outward Development and Career Incentives of City Leaders: Robustness Checks

Dependent variable: City-leader-level 90th percentile distance to city center (km)					
	(1)	(2)	(3)	(4)	(5)
City leader's career-incentive intensity	43.143***	35.929*	41.794**	47.473	41.707**
	(16.398)	(20.384)	(16.948)	(39.583)	(17.181)
Log (initial road stock)	-10.672				
	(12.856)				
Log (initial road stock)* Office-start year trend	-0.011				
	(0.764)				
Log (initial population)* Office-start year trend		-3.420			
		(2.457)			
Log (initial GDP per capita)* Office-start year trend		-3.383			
		(3.014)			
Log (initial built-up land area)* Office-start year trend		2.683			
		(2.199)			
Immediate predecessor's career-incentive intensity			-4.466		
			(12.601)		
Bartik variable				169.788	
				(395.636)	
Dummy: Central experience					4.806
					(10.675)
Dummy: Graduate degree					-3.482
					(5.052)
City fixed effects	Y	Y	Y	Y	Y
Baseline city-leader-level characteristics	Y	Y	Y	Y	Y
Observations	360	362	359	299	362
R-squared	0.976	0.978	0.979	0.992	0.975

Notes: See Table 4 for notes.

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Table 6: Excessive Expansion and Career Incentives of City Leaders: Tobit Regressions

	Excessive expansion, sq. km			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	(1)	(2)	(3)	(4)
City leader's career-incentive intensity	57.271***	43.563***	77.335***	55.171***
	(0.134)	(0.067)	(0.106)	(0.060)
City fixed effects	Y	Y	Y	Y
Baseline city-leader-level characteristics	Y	Y	Y	Y
Observations	361	356	361	356
Pseudo R-squared	0.23	0.27	0.34	0.34
Number of positive excessive expansion	324	309	222	213

Notes: *** p<0.01, ** p<0.05, * p<0.1. See Table 4 for notes on controls.