Cohorts, Competition and Construction: Economic Performance, Land Expropriation and Bureaucrat Promotion in China

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Abstract

We identify the causal effect of career incentives on bureaucrat performance by exploiting the ex-ante competitiveness of promotions. Using data on the careers of bureaucrats in all Chinese prefectures, we show that bureaucrats with fewer competitors have a greater likelihood of promotion. They adopt a strategy that relies on real estate investment and rural land expropriation, resulting in faster growth in construction and GDP. The same incentives result in lower investment in education, public transport and health. Land expropriations are associated with adverse outcomes for expropriated individuals, with arrests of local officials, and with the emergence of "ghost cities".

Keywords: Personnel Management, Bureaucracy, Economic Performance, Land Expropriation

JEL Codes: D73, H11, O43, P26

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1 Introduction

Bureaucrats around the world are responsible for implementing social and economic policies. Yet it is difficult to motivate bureaucrat performance, as their chances of being demoted or fired are low and pay follows seniority-based rules. Moral hazard problems in bureaucracies can be potentially mitigated through performance-based promotion criteria.

An often cited example of a successful meritocratic bureaucracy is China, where scholars argue that yardstick competition between local government officials fosters economic development (see, for example, Maskin, Qian and Xu, 2000). An influential empirical literature shows how GDP growth over a bureaucrat's term affects his subsequent chances for promotion.[1] In this paper, we focus on a complementary question: how do ex ante promotion incentives affect bureaucrat performance and policy choices? We identify the causal effect of promotion incentives by exploiting variation in the competitiveness of promotions that is determined before a bureaucrat begins his term.

Using both administrative and online sources, we identify the top official (the Chinese Communist Party or CCP secretaries) of all prefectures in China from 1996 and 2014. We collect data on their personal characteristics, as well as their past and future career paths. We use administrative, satellite and survey data to study these officials' policy choices.

To identify the effect of promotion incentives, we use exogenous shocks to an individual bureaucrat's competitive environment. We find that a prefecture party secretary's most immediate competitors are party secretaries of other prefectures in the same province who start their term at the same time. The size of this starting cohort negatively affects a CCP secretary's likelihood of promotion at the end of their term. A prefecture party secretary who starts with four other party secretaries is 10 percentage points more likely to be promoted than a party secretary with twice as many competitors. There is also some evidence of non-linear effects: when there is very little competition, an increase in starting cohort size increases promotion likelihood. Conditional on prefecture and year fixed

[1] Examples include Chen and Kung (2016); Jia, Kudamatsu and Seim (2015); Landry, Lü and Duan (2018); Li and Zhou (2005). See Section 2 for more details.

effects, starting cohort size is unrelated to observable characteristics of the CCP secretary and their assigned prefecture.

Using a theoretical model, we show that the CCP promotion system generates incentives akin to contests between a varying number of players for a fixed number of prizes. A smaller number of competitors increases a bureaucrat's incentives to provide effort, as a given amount of effort translates into higher chances of getting promoted. When a bureaucrat is faced with multiple competing policy choices, greater promotion incentives lead the bureaucrat to choose the more easily observable promotion-relevant option.

We find evidence that bureaucrats respond to greater promotion incentives by adopting riskier growth strategies. Having fewer competitors increases GDP growth rates over a prefecture party secretary's term: a one standard deviation decrease in the size of a CCP secretary's starting cohort (or 2.4 fewer competitors) increases annual nominal GDP growth by 0.8 percentage points and real GDP growth by 0.3 percentage points. These faster growth rates are driven by higher real estate investment and faster growth in construction employment. We corroborate our findings using satellite data and find significant increases in both nightlight intensity and growth of urban areas due to stronger promotion incentives.

This type of construction-led growth strategy relies on increased expropriations of rural farm land. Bureaucrats can resell the user rights of expropriated land to private developers in order to boost government revenue, investment and GDP figures, as well as undertake large-scale infrastructure projects. We use retrospective land history data from an individual-level survey (the China Health and Retirement Longitudinal Survey - CHARLS) and find that a one standard deviation decrease in the size of a CCP secretary's cohort increases the probability of expropriation by 14 percent for individuals living under their jurisdiction.

Many of these expropriations are illegal.[2] We find that bureaucrats who expropriated more land are more likely to be subsequently investigated for corruption. Prefectures, where more rural land was expropriated, are also

[2]According to the Chinese central government, an estimated 20 percent of land was illegally expropriated by local officials. See `http://en.people.cn/90001/90778/6272123.html`.

more likely to become "ghost cities", that is underutilised urban areas. For the farmers losing their lands, we find that being expropriated is associated with adverse outcomes later in life. According to news reports, inadequate compensation and forced eviction of farmers trigger two thirds of all social protests in China.[3]

Higher-powered promotion incentives can also shift a bureaucrat's attention away from policies that are less visible. We find suggestive evidence that party secretaries with fewer competitors underinvest in education, transport and health, as measured by the number of teachers per capita, the number of buses per capita, and the number of doctors and hospital beds per capita in the prefecture.

Our paper contributes to a broad literature on understanding the impact of bureaucracies on economic performance (see, for example, Finan, Olken and Pande, 2017, for a recent review). We use the institutional context to identify exogenous variation in the intensity of promotion incentives that a bureaucrat faces. In this respect, our paper is similar to Bertrand et al. (2020) who use a bureaucrat's age at entry into the Indian civil service as a measure for career incentives and find that stronger incentives result in better performance. While our results also show that stronger career incentives lead to better headline measures, our paper qualifies this by highlighting the potential detrimental effects on less easily observable outcomes.

Our empirical findings are motivated by the theoretical literature on multitasking problems in principal-agent relationships (see, e.g. Holmstrom and Milgrom, 1991), which we incorporate in a rent-seeking game (see, e.g. Pérez-Castrillo and Verdier, 1992). Li et al. (2019) also model bureaucrat competition in China using a Tullock contest model. Their focus is on explaining the setting of GDP growth targets, while in this paper we use our theoretical framework to model promotion incentives and their effect on subsequent policy choices.

We build on the economics and political science literature on Chinese bureaucrats (see Section 2 for more details). While previous papers largely focus on the question of whether higher growth leads to promotions, in

[3] https://www.reuters.com/article/us-china-land/china-ministry-urges-end-to-forcible-land-requisition-paper-idUSBRE94E04320130515

this paper we ask the reverse, that is, how do ex ante promotion incentives affect policy choices. Our paper provides a framework for understanding the trade-offs inherent in the Chinese bureaucratic promotion system between spurring fast growth (see, e.g., Jia, Kudamatsu and Seim, 2015; Li and Zhou, 2005; Yao and Zhang, 2015) and its socially undesirable byproducts (see, e.g., Fisman and Wang, 2017). Two related papers investigate the relationship between land sales and bureaucrat promotions in China. Chen and Kung (2016) show that higher land revenue reduces the effect of economic growth on the promotions of county-level officials. Chen and Kung (2019) show that Chinese bureaucrats give land price discounts in return for better promotion prospects. Our findings suggest that this is made possible by local officials' ability to expropriate rural land.

Our paper also relates to the literature on the importance of land in development. Insecure land rights are at the core of many aspects of agricultural and economic development in China (see, e.g., De La Rupelle et al., 2009; Li, Rozelle and Huang, 2000) and elsewhere (see, e.g., de Janvry et al., 2015; Field, 2007; Goldstein and Udry, 2008). In our paper, we find that political economy considerations drive the insecurity of land rights.

Section 2 provides a brief description of the Chinese bureaucratic system and land market. Section 3 presents an overview of our theoretical model and Section 4 describes the data. In Section 5 we present our empirical measure of ex ante promotion incentives. Section 6 shows how promotion incentives affect bureaucrat's policy choices and section 7 shows the robustness of these results. Section 8 concludes.

2 Background

2.1 Chinese bureaucratic system

China is geographically divided into several administrative levels: provinces, prefectures, counties and villages. At each level, the Chinese Communist Party (CCP) secretary is the de facto highest-ranking official. In this paper, we focus on the party secretaries of China's 334 prefectures and 15 vice-provincial cities, which are ranked between a prefecture and a province.

Promotions of prefecture party secretaries are typically decided by their immediate superiors, that is, the provincial party standing committee.[4] Therefore, the main competitors for a prefecture party secretary are other prefecture party secretaries within their province. We find empirically that competition occurs mainly within the same cohort, that is, among prefecture party secretaries who start at the same time in the same province.

The criteria for bureaucrat promotions in China have been subject to debate in the literature. Chen, Li and Zhou (2005); Li and Zhou (2005) show that high GDP growth is positively correlated with subsequent promotions of provincial-level officials, while Persson and Zhuravskaya (2016) and Jia, Kudamatsu and Seim (2015) find that connections to the local elites and patrons in the central government also play an important role.[5] In contrast, Landry, Lü and Duan (2018) find no relationship between economic growth and promotions at the province and prefecture levels and a positive relationship at the county level.

2.2 Land markets in China

In China land use is strictly governed and all land is divided into rural or urban land. Most rural land is owned by village collectives and allocated to registered rural residents for their housing needs and agricultural purposes. In contrast, urban land is owned by local governments, who can auction user rights to developers for real estate or industrial use. In recent years, some urban areas of China have seen a real estate boom and as a result a large disparity in the value of rural and urban land.

This creates strong incentives for local officials to re-purpose rural farm land in order to generate local economic growth and better chances for promotion. According to Yew (2012), "local governments [...] seek to outdo each other in 'place-making', both to attract investments and to conjure up highly visible trophy projects". Many of the land conversions occur by "retaking" land from farmers collectives. Local governments are only

[4]Most of these officials spent all of their careers within one province. While there are some exchanges of officials across provinces, these are mostly short-term exchanges or lateral transfers.

[5]Other papers, such as Chu et al. (2021); Fisman et al. (2020); Shih, Adolph and Liu (2012), study political selection and connections in the Chinese bureaucracy.

obliged to compensate farmers for the agricultural productivity of the land instead of its market value. The revenue from such land conversions accrue to the local government and is exempt from the tax-sharing agreement with the centre. Chen and Kung (2016) show that higher land revenue weakens the link between economic growth and promotions for county-level officials.

These types of land seizures are often illegal, as the central government aims to preserve China's farmlands for food security. Insufficient or non-existent compensation mean these land expropriations have become a major source of social unrest in China.[6] The land market in China is reportedly highly corrupt. For instance, Chen and Kung (2019) document how local Chinese bureaucrats give preferential treatment in land sales to firms that are connected to high-ranking officials. In return these local officials are rewarded with promotions.

3 Theoretical Framework

We conceptualise our setting as a contest between multiple players, who compete for a fixed number of prizes by expending effort across potentially multiple tasks (see Appendix B for a formal model). Prefecture CCP secretaries compete against other members of their starting cohort for promotion to a limited number of higher offices. Promotions are decided by a principal (the provincial party standing committee) on the basis of measured GDP growth outcomes during an agent's (prefecture CCP secretary's) term. A prefecture CCP secretary chooses a policy over his term to increase his chances of promotion, but effort expended on implementing different policies is costly. We distinguish between two types of policies. The first is based on expropriating rural farm land, which results in higher government tax revenue and construction-led growth. The second focusses on public goods provision, which might be desirable for the local population (and the bureaucrat himself), but does not lead to higher growth outcomes over a party secretary's term. The first type of effort increases an official's

[6] See, e.g. https://www.nytimes.com/2013/09/09/world/asia/as-chinese-farmers-fight-for-homes-suicide-is-ultimate-protest.html

chances of promotion, while the second does not.[7] This set up incorporates a multi-tasking principal-agent problem (Holmstrom and Milgrom, 1991) in a rent-seeking game (Pérez-Castrillo and Verdier, 1992).

Our model generates the following predictions. The optimal amount of effort officials spend on promotion-relevant policies decreases with the number of competitors, while their effort on promotion-irrelevant policies increases. In equilibrium, the probability of promotion of any official is lower when there are more competitors.[8] The intuition is the following: when there are more competitors, officials know that their chance to be promoted is lower, therefore they spend less effort on promotion-related activities and more on other pro-social policies. In our setting, we predict that a smaller starting cohort increases prefecture party secretaries' chances of promotion, increases land expropriation, construction and GDP growth and lowers pro-social spending.

4 Data and descriptive statistics

4.1 Prefecture CCP secretaries

We identify the CCP secretaries of all 334 prefecture-level administrative units and 15 vice-provincial cities of China from 1996 to 2014 using official Provincial Yearbooks.[9]. For each CCP secretary, we collect their birth dates, other individual characteristics (such as education, gender, ethnicity) and full career history using official sources, Wikipedia and Baidu Baike (a Chinese online encyclopedia similar to Wikipedia).

We identify promotion, lateral transfer, retirement and demotion or dismissal at the end of each official's term. An official is promoted if they

[7]This is consistent with the findings of Persson and Zhuravskaya (2016) for provincial leaders in China.

[8]In the model, we characterise a symmetric equilibrium. CCP secretaries are aware of their competitors and all behave in the same way. Nitzan (1994) show that in an asymmetric equilibrium, where the highest effort wins the contest with certainty, the expectation of mixed strategies can also be a decreasing function of the number of competitors. The negative relationship between effort and competitors may no longer hold when there are sufficiently large asymmetries in candidates' cost of effort or characteristics that affect promotions.

[9]Since the precise date of nomination is not always available, we use the name of the official in office at the end of the year

attain a position with a higher official administrative rank after the end of their term. We account for the practice of moving older officials into honorary positions outside of the party and government by coding these moves as retirement, even when these positions are theoretically higher ranked.[10] Additional details on how we code bureaucrats' careers are given in Appendix C.

A prefecture party secretary in China has a 49 percent chance of being promoted at the end of their term over the period from 1996 to 2014 (Table C9),with considerable variation across prefectures and years. The average size of a starting cohort for a prefecture party secretary is 4 (with a standard deviation of 2.5) and also varies across time and space.

We identify party secretaries who were investigated or arrested under Xi Jinping's anti-corruption campaign by searching the Baidu Baike entry of each official for a set of keywords.[11] We manually check the accuracy of our coding and cross-validate our findings with data from ChinaFile.[12] Of 1310 prefecture party secretaries, 165 (13 percent) were investigated and faced disciplinary sanctions. According to Chen and Kung (2019), the campaign singled out land-related crimes as one of its main targets.

4.2 Land expropriations

We use the 2014 China Health and Retirement Survey for data on rural land expropriation. The survey is representative of the Chinese population aged 45 and above. CHARLS contains the full retrospective life history of surveyed individuals, as well as their personal characteristics. Instances of land expropriation are documented, with the corresponding date, acreage and compensation and we assign each instance to the prefecture where the

[10]This is a similar approach to Li and Zhou (2005), who consider provincial CCP secretaries.

[11]We identify these by looking through the records of a given CCP secretary for a match on any of the following keywords: 'Expulsion from public office' (开除公职), 'Expulsion from Party membership' (开除党籍), 'Corruption' (腐败), 'Bribery' (受贿), 'Legal inspection' (依法审查), 'Suspended for inspection' (停职检查), 'Double designation' (双规; this term is specific to the Chinese Communist Party and refers, as 双开, to a type of internal investigation, that is generally kept secret), 'Illegal' (违法), 'Violation of regulations' (违规), 'Violation of rules' (违纪), 'Crime' (犯罪), 'Imprisonment' (有期徒刑). We then manually check the entries that match those keywords.

[12]See `http://www.chinafile.com/infographics/visualizing-chinas-anti-corruption-campaign`.

respondent is registered at the time. Figure C4 shows that the majority of expropriation events occurred after 1996, corresponding to the start of our sample.

We construct a balanced panel of 11,184 individuals over 19 years for whom we have the complete residency history. We compute the expropriation rate of a given prefecture in a given year as the number of individuals who were expropriated in that year over the total number of rural residents in that prefecture in that year. The average annual expropriation probability is 0.6 percent. 11 percent of respondent have been expropriated at least once over their lifetime.

4.3 Macroeconomic data

We use prefecture-level macroeconomic data from the Chinese City Statistical Yearbooks compiled by the National Bureau of Statistics. We rely on the following measures, which are consistently measured throughout the period: nominal and real GDP growth, sectoral nominal GDP growth and employment and real estate investment. As proxies for public goods provision, we use the number of primary school and middle school teachers and the number of doctors and hospital beds in public hospitals and clinics.

Summary statistics are presented in Appendix Table C10. The average prefecture over the sample period has 4 million inhabitants and measures 23,000 km^2, with an average nominal GDP growth of 16 percent and average real GDP growth of 13 percent.[13] Real estate investment accounts for on average 6 percent of GDP.

The reliability of official Chinese statistics is often questioned.[14] We address these data quality concerns by studying less politically important variables, corroborating our finding using remote sensing data and analysing

[13]These values are larger than the official national GDP growth rates. This is due to the City Statistical Yearbooks' better coverage of richer and more urban prefectures and worse methodology (see Holz, 2014).

[14]A diplomatic telegram from the ambassador of the United States of America to China, addressed to the USA Secretary of State in 2007 and released by Wikileaks, states for instance: "GDP figures are 'man-made' and therefore unreliable, [then-executive vice premier] Li [Keqiang] said. [...] When evaluating Liaoning's economy, he focuses on three figures: 1) electricity consumption, which was up 10 percent in Liaoning last year [...] All other figures, especially GDP statistics, are 'for reference only,' he said smiling." `https://wikileaks.org/plusd/cables/07BEIJING1760_a.html`.

the figures for evidence of data manipulation (see Section 7.4).

4.4 Remote sensing data

Night light intensity Following Henderson, Storeygard and Weil (2012, 2011), we use the intensity of night lights in a given prefecture as a proxy for GDP growth. Between 1996 and 2014, night light intensity over China was measured by six different satellite systems, which introduces structural breaks in the raw data. To deal with this issue, we use the smoothed time series data compiled by Zhang, Pandey and Seto (2016) and focus on the percentile rank of each prefecture in the distribution of growth rates rather than absolute growth as our outcome variable. We compare how well the raw night light data and the processed data approximate aggregate Chinese GDP in Appendix D.

Urban expansion We use satellite data from Yao et al. (2018) to measure the extent to which urban areas in each prefecture expand.[15] For similar reasons as above, we use the percentile rank of urban area growth as our outcome variable.

"Ghost cities" Rapid (and at times excessive) urban expansion have led to the emergence of areas with high vacancy rates in China, so-called "ghost cities".[16] We use data on "ghost cities" provided by Jin et al. (2017), who use remote sensing data and machine learning to identify discrepancies in activity between older and newer urban settlements at a localised level.[17]

5 Identifying promotion incentives

A main contribution of our paper is to identify exogenous variation in promotion incentives for local government officials in China. We should expect this measure to affect actual promotion and to be uncorrelated with observable characteristics of the bureaucrat and their appointment.

[15] Our results are robust to using alternative data from He, Huang and Ye (2014).

[16] One of the most cited examples is Ordos (鄂尔多斯) in Inner Mongolia.

[17] Activity is measured using, for instance, data on internet usage and local points of interest.

Based on the promotion system for prefecture CCP secretaries in China, we show that the size of the starting cohort (number of other prefecture CCP secretaries starting in the same year and province) leads to plausibly exogenous variation in the competitiveness of promotions and hence the strength of ex ante promotion incentives.[18]

5.1 Competition and promotions

We show that the size of the starting cohort has an impact on the actual promotion likelihood of CCP secretaries by estimating the following equation:

$$P_{c,t} = \zeta Z_{c,t} + \alpha_c + \delta_t + \eta_{c,t} \tag{1}$$

where c denotes prefecture and t year. $P_{c,t}$ is a dummy variable that takes the value of 1 in each year t of a prefecture c's party secretary's term if he is promoted at the end of his term. $Z_{c,t}$ is the size of a prefecture party secretary's starting cohort, that is, the number of prefecture party secretaries who start their term in the same year and same province. Both $P_{c,t}$ and $Z_{c,t}$ take the same value for each year of a CCP secretary's term. α_c and δ_t are prefecture and year fixed effects, respectively.[19] As $Z_{c,t}$ is symmetric for all prefecture party secretaries who start their term in the same year in the same province, we cluster the standard errors $\eta_{c,t}$ at the province-start-year level.

Table 1 and Figure 1 show how competition, in terms of the size of the starting cohort, affects the promotion likelihood of CCP secretaries. An increase by 1 standard deviation (or 2.4) in the number of competitors in a CCP secretary's cohort decreases his likelihood of promotion by 6.5 percentage points (or 13 percent of a standard deviation), relative to a mean probability of promotion of 48 percent. This effect is statistically

[18] In Section 7, we that the results are robust to using an alternative source of variation in competitiveness based on the ages of bureaucrats' predecessors.

[19] Prefecture fixed effects account for differences in the number of prefectures across provinces, as well as other time-invariant prefecture-level characteristics. Year fixed effects allow us to rule out China-wide macroeconomic shocks, for example, changes in the central CCP leadership which generate increased turnover at lower levels and other shocks to the supply of bureaucrats.

significant at the 1 percent level. These results are consistent with our model predictions that a larger number of competitors weakens the promotion incentives facing each bureaucrat and lowers their realised chances of promotion.

Figure 1 also points to non-linearities in the relationship between promotion and the number of competitors. When the starting cohort size is very small, the average probability of promotion increases until a starting cohort size of three and then declines almost linearly until a cohort size of eight. Approximately two thirds of the observations lie in this downward sloping region and drive the empirical finding that on average promotions are inversely related to the number of competitors (see Appendix Figure C2).

5.2 Exogeneity of starting cohort size

After controlling for location and time fixed effects, the residual variation in starting cohort size is primarily driven by variation in the number of predecessor CCP party secretaries who exit each province each year. Appendix Table A1 compares the actual starting cohort size with the hypothetical starting cohort size if all bureaucrats completed their official five-year term based on the initial allocation of terms in 1996. The remaining variation in starting cohort size is driven to a similar extent by previous prefecture party secretaries retiring or being promoted (see Table A2). One important factor that drives the starting cohort size is the seniority rule for promotion. As prefecture party secretaries who are older than 55 become ineligible for promotion, there is increased turnover among officials who reach this critical age and an increase in the starting cohort size the following year.[20] This means that the size of a CCP secretary's starting cohort is determined by events *before* they enter office.

Potential identification challenges remain if the size of the starting cohort is correlated with characteristics of CCP secretaries that impact both their career path and policy choices. Or if CCP secretaries are able to precisely choose their appointments in order to start their term in well-developed prefecture with fewer competitors. We show in Table 2 that

[20]Bureaucrats who are about to turn 55 are often evaluated first for promotion.

there are no systematic correlations between the size of the starting cohort and individual CCP party secretary or pre-determined prefecture characteristics.[21]

Age at entry is not correlated with the size of an official's starting cohort (see Figure 2). This is reassuring, as according to anecdotal evidence, well-connected bureaucrats (for example, heirs of CCP leaders or "Princelings") systematically take office at a young age and are quickly promoted. This is consistent with the finding in Table 1 that younger CCP secretaries have a higher probability of being promoted. We control for age in all subsequent regressions to increase precision.

6 Promotion incentives and policy choices

Assuming that the size of the starting cohort only affects policy outcomes during a bureaucrat's term through promotion incentives, the following equation identifies the impact of promotion incentives on policy outcomes:

$$Y_{c,t} = \beta Z_{c,t} + \alpha_c + \delta_t + \epsilon_{c,t} \tag{2}$$

where $Y_{c,t}$ denotes an outcome in prefecture c in year t, such as GDP growth, construction investment, land expropriation and public goods provision. The rest of the notation is as before and standard errors are clustered at the province-start-year level.[22]

6.1 Economic growth and number of competitors

In Table 3, we show that GDP growth under a prefecture party secretary is higher when they face stronger promotion incentives, that is, when they enter office with fewer competitors. A one standard deviation (2.4 competitors) decrease in the size of the starting cohort increases nominal GDP

[21]The coefficient on the dummy variable for whether a prefecture party secretary graduated from a Top A class university is negative and significant at the 10 percent level. This is consistent with chance. We show in Section 7 that the results are robust to controlling for these individual CCP characteristics.

[22]This model implicitly assumes that β is invariant over an official's term and weights longer terms more than shorter ones. In Section 7, we show that our results are robust to relaxing both assumptions.

growth by 0.8 percentage points on average (5 percent of the sample average of 15.8 percent), or 9 percent of a standard deviation. We find a similar result for real GDP growth: a one standard deviation decrease in the number of competitors is associated with a 0.3 percentage point increase in real GDP growth or 2.5 percent of the mean growth rate of 12.7 percent. In Tables A5 and A6 we show that this growth is mainly driven by the secondary sector and accompanied by increases in employment.

We find consistent results using remote sensing data. A smaller number of competitors results in a higher percentile rank of a prefecture within a province in terms of nightlight growth (Table 3, column 3). This relationship is, however, less precisely estimated due to the measure's noisiness (see Appendix D).

6.2 Construction-led growth

How are officials able to generate this additional growth? Our model predicts that stronger promotion incentives lead to increased effort by officials on more visible and promotion-relevant activities. In Table 4 we show evidence of a shift towards construction-led growth in response to promotion concerns. A decrease of one standard deviation in a prefecture CCP secretary's starting cohort size results in an increase in the real estate investment to GDP ratio of the prefecture by 0.3 percentage points, or 5 percent of the sample average. This is in large part due to investment in residential real estate, which increases by 0.2 percentage points of GDP (or 3.5 percent of the sample mean). We also find a large and positive, but not statistically significant, effect on employment growth in the construction sector.

This strategy leads to an overall expansion of urban areas through expropriation of neighbouring farmland. Using satellite data, we show in column 5 of Table 4 that prefectures whose party secretaries face less competition experience faster growth in their urban area. A decrease in the number of competitors of a CCP secretary increases the average prefecture-level expropriation rate based on the CHARLS survey (column 4 of Table 4). This effect is large: a one standard deviation increase in a CCP secretary's starting cohort size induces a 0.1 percentage point (or 15 percent) increase in expropriations.

6.3 Consequences of land expropriations

What are the welfare implications of this strategy? We present three pieces of descriptive evidence which highlight the costs of rural land expropriation.

First, we use the CHARLS survey to analyse the consequences of expropriations on expropriated individual's life trajectories (Table 5).Individuals who have been expropriated are 3 percentage points (8 percent) less likely to move from their prefecture of residence. This is likely a result of individuals who have experienced expropriation being less confident in the security of their land usage rights. As a consequence, they may become less inclined to migrate and take advantage of employment opportunities elsewhere (see, e.g., De La Rupelle et al., 2009). Expropriated farmers are also not significantly more likely to be compensated with a urban Hukou - which is tied to many social benefits, such as healthcare and pensions. Similarly, we find that having been expropriated also reduces the probability of being employed in rural collectives or local state-owned enterprises. This results in lower access to pensions, and fewer assets, such as heating, as well as adverse health outcomes later in life, such as having suffered injuries (2 percentage points, or 22 percent of the mean) or being hospitalised (2.8 percentage points, or 22 percent of the mean). These relationships are robust to the inclusion of time-invariant individual controls and location specific fixed effects.

Second, we look at the correlation between a CCP secretary's history of expropriations and his probability of being arrested for corruption. We find a positive relationship in Table 6, which is robust to including start year and province fixed effects.[23] The effect is large, a one standard deviation in the average expropriation rate is associated with a 4.4 percentage point increase in the likelihood that an CCP secretary arrested for corruption (compared to a mean probability of 15 percent). This is in line with Chen and Kung (2019) findings of corrupt land market practices by local Chinese officials.

Third, we examine whether the urban development that is made pos-

[23]Including prefecture fixed effects reduces the size and significance of the estimated coefficient. This is a demanding specification as it uses only within prefecture-level variation. On average, a prefecture is lead by four CCP secretaries over the sample period.

sible through rural land expropriation appears efficient. The Chinese media often cites examples of so-called "ghost cities" (urban areas with high vacancy rates) as evidence of resource misallocation in the Chinese construction boom. We show in Table 7 that prefectures with higher average expropriation rates throughout this period are more likely to be categorised as "ghost cities" according to three different definitions listed in Jin et al. (2017).

6.4 Public goods provision

Our model suggests a trade-off for bureaucrats between construction-driven growth policies and other policies which are less visible and therefore matter less for promotions. In Table 8, we study the impact of promotion incentives on a range of different public goods, such as the provision of health services (as measured by the number of hospital beds per capita and the number of doctors per capita), transport services (buses per capita) and education (primary school teachers per capita and middle school teachers per capita), while controlling for confounding factors such as population size and student body size. We normalise these 5 measures and aggregate them into an average z-score.[24] An increase by one standard deviation in the number of competitors increases this measure of public good provision by 1.5 percent of a standard deviation. This effect is statistically significant at the 5 percent level. Measured separately, all coefficients on different public goods outcomes are positive and relatively large in magnitude, but none are statistically significant at conventional levels.

We interpret this as suggestive evidence that some substitution might be at play. The presence of many competitors decreases each secretary's chance of being promoted, and dilutes the incentives to provide effort towards promotion, via highly visible construction-led growth. Local officials may instead decide to foster public good provision, for instance if they derive utility from their prefecture's overall welfare or rely on the patronage of local elites (Persson and Zhuravskaya, 2016).

[24]Each variable is normalised by subtracting the annual mean of the variable from each observation and dividing by its annual standard deviation. The aggregate z-score is the average of the 5 normalised indices.

7 Robustness checks

7.1 Controlling for potential omitted variables

A potential threat to our identification strategy is the endogenous placements of bureaucrats, for instance, if local bureaucrats with connections can choose where and when they become prefecture-level CCP secretaries. We show in Section 5 that the starting cohort size is unrelated to a number of observable characteristics of both the bureaucrat and the prefecture and here we show that our results on policy outcomes remain robust to controlling for these characteristics.

Prefecture CCP secretary characteristics In column 2 of Table 9, we show that our main results on policy outcomes remain broadly robust to including individual characteristics of the prefecture CCP secretaries.[25] This reduces our sample size considerably, from 306 to 260 clusters and from 2577 to 1826 observations. The coefficient on the share of real estate investment turns marginally insignificant, but is not statistically significantly different from our main estimation result.

Prior prefecture outcomes Column 2 of Table 9 shows that our main results are robust to controlling for prefecture-level outcomes in the year before a party secretary's term begins. This alleviates, for instance, the concern that bureaucrats with higher expected promotion likelihood are placed with fewer competitors in areas where greater performance has just been observed.

Predecessors' promotion probability Column 4 of Table 9 shows that controlling for the promotion rate of prefecture party secretaries in the same province in the year before a party secretary enters office does not significantly alter the magnitude or the precision of our main estimates.[26] This

[25]For simplicity, we only show the results for nominal GDP growth, real estate investment to GDP ratio and the average public goods provision z-score.

[26]As adding the predecessors' promotion rate reduces the sample size (because of the availability of promotion data on predecessors), we do not include this variable in our main specifications.

suggests that our findings are not driven by serial correlation in promotion probabilities.

7.2 Placebo test

We perform a placebo test by replacing the starting cohort size by the value it would have taken had the bureaucrat taken office one year earlier. We present the results in Table A3. The coefficient of the placebo starting cohort size is never precisely estimated and does not show a pattern that matches our main results.

7.3 Alternative specifications

Term-level specification As the variation in promotion incentives is at the term level, we also reproduce our results by collapsing the policy outcomes from the previous section to the term level.[27]

Column 5 of Table 9 shows that overall the results are in line with those obtained with our main specification. Effects on nominal GDP growth and the share of real estate investment in GDP are of similar magnitude and statistical significance. The estimated coefficient on the average public goods z-score becomes marginally insignificant.

Weighted panel specification We also re-estimate Equation 2 using the inverse term length as a weight for each observation, to counterbalance the fact that longer terms carry more weight in our original specification than shorter ones. We display our results in column 6 of Table 9 and find that the magnitude, sign and significance of our results are largely unchanged.

[27] We estimate the following relationship between starting cohort size and promotion likelihood:

$$P_{c,t_0} = \xi Z_{c,t_0} + \alpha_c + \mu_{t_0} + \eta_{c,t_0} \tag{3}$$

and our main specification on the effect of competition on policy outcomes becomes:

$$Y_{c,t_0} = \pi Z_{c,t_0} + \alpha_c + \mu_{t_0} + \eta_{c,t_0} \tag{4}$$

where t_0 denotes the start year of each term, μ_{t_0} are start-year fixed effects and the rest of the notation is as in equation 1 and 2. The main difference to our baseline specification is the inclusion of start-year fixed effects instead of year fixed effects.

Individual-level specification for land expropriation In order to leverage all the information available in the CHARLS survey, we also estimate individual-level regressions, where the outcome variable is a dummy variable for whether an individual is expropriated in a given prefecture and year.[28] Appendix Table A4 shows that a smaller starting cohort is associated with a higher probability of being expropriated for individuals who live in that CCP secretary's prefecture during his term. The magnitude of the effect of a one standard deviation increase in the starting cohort size of a CCP secretary ranges from a 0.09 percentage points (12 percent of the mean) to a 0.11 percentage points (14 percent of the mean) increase in an individual's annual expropriation probability. These effects are robust to using different controls and fixed effects, as well as different sample definitions.[29]

7.4 Data quality concerns

Throughout the paper, we corroborate our results using data from multiple sources, such as administrative, survey and satellite data (see Appendix D for a discussion of using nightlights data as a proxy for GDP). We find consistent evidence that promotion incentives affect policy outcomes using these alternative measures.

Sectoral GDP and employment As headline GDP figures could be susceptible to manipulation, we show that competition also affects less politically sensitive measures, such as sectoral GDP growth and employment.

[28] We estimate the following equation:

$$E_{i,c,t} = \beta Z_{c,t} + \mathbf{X'_{i,t}}\gamma + \alpha_c + \delta_t + \mu_{i,c,t} \tag{5}$$

where i denotes an individual. $E_{i,c,t}$ is a dummy variable that equals to 1 if individual i was expropriated in prefecture c in year t. $\mathbf{X'_{i,t}}$ are controls for a range time-varying and time-invariant individual characteristics, such as age, age squared, gender, ethnicity and a full set of educational attainment dummies or individual fixed effects. All other notation is as before and standard errors are clustered at the province-start-year level.

[29] As the CHARLS survey is retrospective and some respondents have migrated prior to being surveyed in 2014, the average prefecture-level expropriation rates are based on a varying number of individuals. We vary our sample to either include all individuals and years where we have information, or only prefectures and years where we observe at least 20 individuals or 50 individuals.

Table A5 shows that less competition increases GDP growth across all sectors and in particular the secondary sector, consistent with a construction-led growth strategy. Employment growth also responds to promotion incentives (Table A6).

Sensitivity to outliers The raw GDP figures reported in statistical yearbooks can exhibit a very high variance and in our main specifications we trim our data to exclude the top and bottom outlying values of each variable.[30] Column 7 of Table 9 shows that our main results on GDP growth rates are all statistically indistinguishable from the ones obtained on the non-trimmed data.

Data manipulation The distribution of second decimal digits in reported real GDP growth data of Chinese prefectures does not follow Benford's law as noted by Ji (2019) and others (see Figure A1).[31] This in itself is not necessarily proof that the underlying data are manipulated.[32] We find that the absence or presence of some specific digits is associated with the size of a CCP secretary's starting cohort (Table A7). A larger starting cohort decreases the likelihood that the real GDP growth rate ends with a 2 or 5, and increases the probability that it ends with an 8, and these effects are statistically significant at the 5 percent level: the distribution of decimal digits differs more from Benford's law when the number of competitors of a CCP secretary is small.[33] We interpret these results as suggestive evidence that *in addition* to real effects, promotion incentives may also increase official data manipulation at the local level.

[30] We keep all values that satisfy:

$$\text{abs}\left(\frac{Y_{it} - \bar{Y}_t}{\sigma_{Y_t}}\right) \leq 2.15$$

where $\bar{Y}_t$ is the average of Y and σ_{Y_t} its standard deviation across prefectures in year t.

[31] Benford's law, also named 'first digit law', states that "the frequency distribution of first digits in many—but not all—real world data is not distributed uniformly, but according to the widths of gridlines on a logarithmic scale" (Holz, 2014). This also applies to further digits following the first one (Smith, 1997).

[32] Rounding errors can, for instance, explain the over-representation of zeros and fives.

[33] Adjusted for multiple hypotheses testing, the results on 2 and 8 remain significant.

8 Conclusion

In this paper we study the causal impact of promotion incentives on the policy choices of local government officials in China over 25 years. We identify promotion incentives through exogenous variation in the competitiveness of promotions based on the structure of local competition. A prefecture party secretary's main competitors in China are other prefecture party secretaries who start their term at the same time in the same province. This starting cohort size is uncorrelated with a range of observable characteristics of the individual bureaucrat and the prefecture where they are placed. We find that more competitors reduce the probability that any given party secretary is promoted to higher office at the end of his term, thus reducing promotion incentives. We build a simple theoretical model to show that less competition for promotions incentivises bureaucrats to engage in highly visible activities, such as construction investment. Using administrative, survey and satellite data, we show that less competition leads to higher GDP growth, real estate investment, land expropriation and urban growth. We also find suggestive evidence that there is a trade-off between construction-led growth and the wider provision of public goods. Finally, we document that land expropriations are linked to negative outcomes for the individuals who face them, corruption charges for the local officials who engage in them, and excess capacity for the cities where they take place.

Our paper contributes to understanding performance and policy incentives of a competitive bureaucracy. Bureaucrats see their chances of promotion increase when there is less competition. This increases the marginal return of effort, but only in the dimensions that matter for performance evaluation. This system results in better headline measures - at potentially high social costs.

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Tables

Table 1: Promotion probability and size of starting cohort

Dep. var.	Promotion likelihood
Size of starting cohort	-0.0647***
	(0.0188)
Age at entry	-0.0354***
	(0.00448)
Nb. of obs.	2679
Nb. of clusters	306
Mean of dep. var.	0.48

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest.. The dependent variable is a dummy variable for whether the CCP party secretary is promoted at the end of his term. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. All regressions include prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 2: Correlation of starting cohort size with party secretary characteristics and prefecture pre-trends

Panel A: Individual characteristics of prefecture party secretary

			Education				
	Ethnic minority	Native of the province	Top university (A) graduate	Top university (B) graduate	Top specialist university graduate	Party school graduate	Teaching college graduate
Size of starting cohort	-0.0182	0.00817	-0.0558*	-0.00389	-0.00120	-0.0315	-0.0149
	(0.0122)	(0.0314)	(0.0296)	(0.0104)	(0.0199)	(0.0332)	(0.0210)
Nb. of obs.	573	547	429	429	429	429	429
Nb. of clusters	244	235	212	212	212	212	212

Panel B: Prefecture-level characteristics before beginning of term

	GDP growth (nominal)	GDP growth (real)	GDP growth rank	Real Estate investment % GDP	Expropriation rate	Urban expansion rank	Public good provision Z-score
Size of starting cohort	0.000472	-0.00130	-0.0581	-0.00133	-0.000552	-0.0345	0.0133
	(0.00605)	(0.00193)	(0.145)	(0.00108)	(0.000740)	(0.152)	(0.0113)
Nb. of obs.	732	733	770	705	452	732	486
Nb. of clusters	300	300	306	285	237	301	209

The dependent variables are individual prefecture party secretaries' characteristics in Panel A: non-Han ethnicity dummy (column 1), an indicator for whether the prefecture party secretary was born in the same province (column 2), the prefecture party secretary's education level is characterised by a set of dummy variables for his reported alma mater (columns 3 to 7). Top universities are those named as "Double Firsts" by the Chinese Ministry of education in 2015. The dependent variables are prefecture characteristics in the year before a party secretary's term starts in Panel B: nominal GDP growth (column 1), real GDP growth (column 2), implied GDP growth from night light data, measured as within-province rank (column 3), residential investment as a share of GDP (column 4), expropriation rate from CHARLS data (column 5), urban area growth from satellite data, measured as annual national rank (column 6) and an average z-score for public good provision (column 7). Controls include the CCP secretary's age in the year he takes office, as well as prefecture and start-year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 3: GDP growth and promotion incentives

Dep. Var.	GDP growth (nominal)	GDP growth (real)	GDP growth rank
Source	NBS	NBS	Satellite
	(1)	(2)	(3)
Size of starting cohort	-0.00836***	-0.00332***	-0.0935*
	(0.00244)	(0.00122)	(0.0550)
Age at entry	0.000535	0.000236	-0.00827
	(0.000453)	(0.000227)	(0.0146)
Nb. obs	2677	2676	2677
Nb. clusters	306	306	306
Mean of dep. var.	0.158	0.127	5.161

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. The dependent variables are nominal GDP growth (column 1), real GDP growth (column 2) and implied GDP growth using night light intensity data, measured as within-province rank (column 3). All regressions include prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 4: Real estate, expropriations and promotion incentives

Dep. Var.	Employment Growth Construction sec.	Real Estate investment % GDP	Residential RE investment % GDP	Expropriation rate	Urban expansion rank
Source	NBS	NBS	NBS	CHARLS	Satellite
	(1)	(2)	(3)	(4)	(5)
Size of starting cohort	-0.0823	-0.00266*	-0.00178*	-0.00113**	-0.108**
	(0.0645)	(0.00138)	(0.000928)	(0.000551)	(0.0526)
Age at entry	0.0104	-0.000173	-0.000249	-0.0000844	-0.0119
	(0.0125)	(0.000312)	(0.000241)	(0.000123)	(0.0159)
Sample definition					
Prefectures	All	All	All	$N_{expro} > 20$	All
Nb. obs	2677	2677	2647	1321	3051
Nb. clusters	306	306	305	218	341
Mean of dep. var	1.050	0.0656	0.0518	0.00778	5.197

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. In column 4, the sample is restricted to the 120 sampling prefectures of the CHARLS survey, where the annual prefecture-level expropriation rate is estimated based on at least 20 observations. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. The dependent variables are employment growth in the construction sector (column 1), real estate investment as a percentage of GDP (column 2), residential real estate investment as a percentage of GDP (column 3), land expropriation rate (column 4) and growth of total urban area based on satellite data, measured as the prefectures annual national rank (column 5). All regressions include prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 5: Land expropriation and individual outcomes

	Mobility		Health			Job History			Social security			Assets
	Change of residence	Hukou ever converted to Urban	Ever Suffered Injury	Ever Confined to Bed	Ever Hospitalized	Job in SOE	Job in Rural Collective	No job in either	Has Any Pension	Has any Medical Coverage	Has any Access to Healthcare	Has Heating
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Ever expropriated	-0.0285**	0.0112	0.0213**	0.0255**	0.0284***	-0.0801***	-0.526***	0.559***	-0.0149*	0.000479	-0.00649	-0.0291***
	(0.0130)	(0.00887)	(0.00881)	(0.0111)	(0.0101)	(0.00689)	(0.0110)	(0.0114)	(0.00862)	(0.00951)	(0.00815)	(0.00972)
Male	0.00374	0.00179	0.0615***	0.0199**	0.0474***	0.0427***	0.00318	-0.0172**	0.0344***	0.0544***	0.00239	-0.0143**
	(0.00939)	(0.00587)	(0.00611)	(0.00799)	(0.00714)	(0.00582)	(0.00783)	(0.00787)	(0.00596)	(0.00645)	(0.00636)	(0.00706)
Ethnic minority	-0.0140	-0.0166	0.0120	0.0346*	0.0260	0.00770	0.00749	-0.0112	0.000484	0.00349	0.00905	0.0110
	(0.0243)	(0.0143)	(0.0154)	(0.0205)	(0.0179)	(0.0170)	(0.0193)	(0.0195)	(0.0151)	(0.0161)	(0.0181)	(0.0132)
Education level												
No schooling	-0.0481***	-0.0291***	0.0141*	0.00422	0.0158	-0.0433***	0.0375***	-0.0237**	-0.0374***	-0.0310***	0.0149	-0.0176*
	(0.0124)	(0.00671)	(0.00830)	(0.0113)	(0.0102)	(0.00652)	(0.0102)	(0.0100)	(0.00663)	(0.00739)	(0.00973)	(0.0101)
Middle School	0.0315***	0.0544***	-0.000696	-0.0116	-0.00629	0.0581***	-0.0749***	0.0435***	0.0581***	0.0560***	-0.00914	0.0152*
	(0.0118)	(0.00733)	(0.00749)	(0.00942)	(0.00844)	(0.00776)	(0.00997)	(0.00985)	(0.00771)	(0.00827)	(0.00737)	(0.00855)
High School	0.0540***	0.129***	-0.0346***	-0.0172	-0.00973	0.174***	-0.159***	0.0439***	0.168***	0.141***	-0.0245**	0.0361***
	(0.0193)	(0.0147)	(0.0107)	(0.0143)	(0.0132)	(0.0162)	(0.0165)	(0.0167)	(0.0159)	(0.0158)	(0.0104)	(0.0124)
More than High School	0.137***	0.422***	-0.0358***	-0.00761	0.00262	0.503***	-0.260***	-0.120***	0.548***	0.510***	-0.0123	0.0746***
	(0.0239)	(0.0224)	(0.0130)	(0.0184)	(0.0176)	(0.0229)	(0.0216)	(0.0206)	(0.0218)	(0.0218)	(0.0141)	(0.0154)
Nb. Obs	10510	10510	10502	10500	10502	10510	10510	10510	10510	10510	10510	10510
Mean dep. var.	0.34	0.11	0.09	0.17	0.13	0.13	0.54	0.38	0.19	0.20	0.11	0.73

Notes: The main regressor of interest is a dummy variable taking value of 1 if the individual has ever been expropriated. Education level is included as a set of dummy variables, with primary school as the reference level. Additional control variables include prefecture-level and year-of-birth fixed effects, as well as health status as child (5 dummy variables) and type of the first hukou. Standard errors are robust with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 6: Expropriations and arrests for corruption

Dep. Var.	P(Arrest (1)	P(Arrest (2)	P(Arrest (2)
Expropriation rate	3.330*	4.027*	1.920
	(1.987)	(2.364)	(2.231)
Age at entry	-0.00104	-0.000101	-0.00494
	(0.00401)	(0.00441)	(0.00529)
Start Year FE	No	Yes	Yes
Province FE	No	Yes	No
Prefecture FE	No	No	Yes
Nb. of obs.	378	376	370
Nb. of clusters	366	364	359
Mean of dep. var.	0.15	0.15	0.15

Observations are at the term level. The sample only includes the CHARLS survey sampling prefectures and terms that start at the earliest in 1996 and finish before 2014. The dependent variable is a dummy for whether a CCP secretary is caught in an anti-corruption campaign. The regressor of interest is the average expropriation rate in the prefectures and years where the CCP secretary was in office. Standard errors are clustered at the level of a CCP secretary, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 7: Expropriations and 'Ghost Cities'

	P(Ghost city) (1)	P(Ghost city) (2)	P(Ghost city) (3)
Panel A: Weighted regression			
Prefecture-level average expropriation rate	0.0866*	0.131**	0.112*
	(1.77)	(2.16)	(1.72)
N	121	121	121
Panel B: Unweighted regression			
Prefecture-level average expropriation rate	0.0665	0.101	0.102
	(1.36)	(1.61)	(1.60)
N	121	121	121
Panel C: Panel A + Compensation rates			
Prefecture-level average expropriation rate	0.0931*	0.135*	0.120*
	(1.69)	(1.98)	(1.67)
Prefecture-level average compensation rate	-0.00102	-0.00136	-0.00221
	(-0.91)	(-0.97)	(-1.50)
N	114	114	114

The dependent variable in column 1 is a dummy variable indicating whether (all or part of the) prefecture has been identified as a ghost city by Jin et al. (2017). The dependent variable in column 2 is a dummy variable that further includes ghost cities identified by the BiaoZhun study (cited in Jin et al. 2017). The dependent variable in column 3 is a dummy variable that further includes ghost cities identified by Chi et al. (2016). The weights used in panels A, and C are the average population of the prefecture. In all regressions, the expropriation rate for a given prefecture is computed as the number of expropriations that occured between 1996 and 2014 in the prefecture divided by the number of CHARLS survey respondents registered in said prefecture. In all regressions, the sample is restricted to the 121 endline prefectures that were sampled in the 2014 CHARLS survey. In Panel C, the compensation rate for a given prefecture is the share of expropriations that are reported to have been at least partly compensated. 7 prefectures where the expropriation rate is 0 in all years are dropped from the sample. Standard errors are robust to heteroskedasticity, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table 8: Public good provision and promotion incentives

	Average Z-score	Variables				
		# Hospital beds per capita	# Doctors per capita	# Buses per capita	# Teachers per c. (primary)	# Teachers per c. (middle)
Source	NBS	NBS	NBS	NBS	NBS	NBS
	(1)	(2)	(3)	(4)	(5)	(6)
Size of starting cohort	0.0155**	0.189	87.51	0.145**	0.172	0.112
	(0.00748)	(0.147)	(59.50)	(0.0645)	(0.162)	(0.174)
Age at entry	0.000367	0.00125	4.373	-0.0163	0.0364	0.0000151
	(0.00167)	(0.0333)	(11.81)	(0.0172)	(0.0367)	(0.0298)
Nb. obs	2486	2600	2552	2488	2643	2624
Nb. clusters	303	303	302	303	305	306
Mean of dep. var.	-0.0576	11673.7	6571.9	6.467	18261.8	15628.2

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. The dependent variables are the number of hospital beds (column 2), doctors (column 3), busses (column 4), primary school teachers (column 5) and middle school teachers (column 5), all measured per capita. In column 1, the dependent variable is the average Z-score of the 5 variables in columns 2 to 6, where each variable is normalized by its annual mean and standard deviation. All regressions include prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

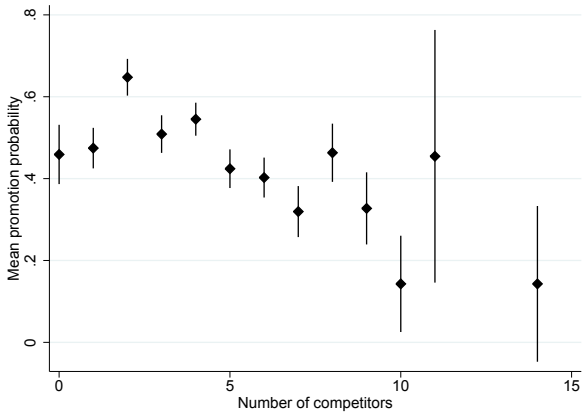
Table 9: Promotion incentives and policy outcomes: robustness checks

Specification	Main specification	CCP secretary characteristics	Lagged Dep. Var.	Predecessors' promotion	Term-level specification	Weighted Pref.-year panel	Removing outliers
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dep. Var.							
Nominal GDP growth	-0.00836***	-0.00952***	-0.00936***	-0.0109***	-0.0145**	-0.00822***	-0.00690***
	(0.00244)	(0.00225)	(0.00243)	(0.00318)	(0.00698)	(0.00232)	(0.00230)
Nb. obs	2677	1813	2583	2335	770	2677	2610
Nb. clusters	306	259	303	232	306	306	306
Mean of dep. var.	0.158	0.163	0.159	0.164	0.162	0.156	0.156
Real Estate Investment	-0.00266*	-0.00253	-0.00174*	-0.00521**	-0.00464**	-0.00274**	-0.000805
	(0.00138)	(0.00192)	(0.00105)	(0.00218)	(0.00212)	(0.00138)	(0.000880)
Nb. obs	2677	1813	2497	2335	770	2677	2558
Nb. clusters	306	259	291	232	306	306	299
Mean of dep. var.	0.0655	0.0706	0.0607	0.0678	0.0633	0.0647	0.0585
Public goods	0.0155**	0.0172**	0.0154**	0.0149	0.0225**	0.0187***	0.0225*
	(0.00748)	(0.00741)	(0.00692)	(0.00910)	(0.0102)	(0.00706)	(0.0117)
Nb. obs	2486	1709	1861	2222	751	2486	2673
Nb. clusters	303	252	216	231	304	303	306
Mean of dep. var.	-0.0575	-0.0569	-0.0843	-0.0660	-0.0357	-0.0510	0.0335

Observations are at the prefecture-year level, except column 5 where observations are at the term level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. The dependent variables are nominal GDP growth in row 1, real estate investment (% of GDP) in row 2, average public goods z-score in row 3. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. Column 1 shows the main specification, which corresponds to Tables 3, 4 and 8. Column 2 controls for individual characteristics of CCP secretaries and column 3 controls for prefecture-level outcomes in the year before the CCP secretary takes office (see also Table 2). Column 4 controls for the CCP secretary's predecessors' promotion rate. Column 5 uses observations at the term level. Column 6 weights observations by the inverse of the term length. Column 7 excludes top and bottom outliers. All regressions control for the CCP secretary's age at entry, prefecture and year (start year in column 5) fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

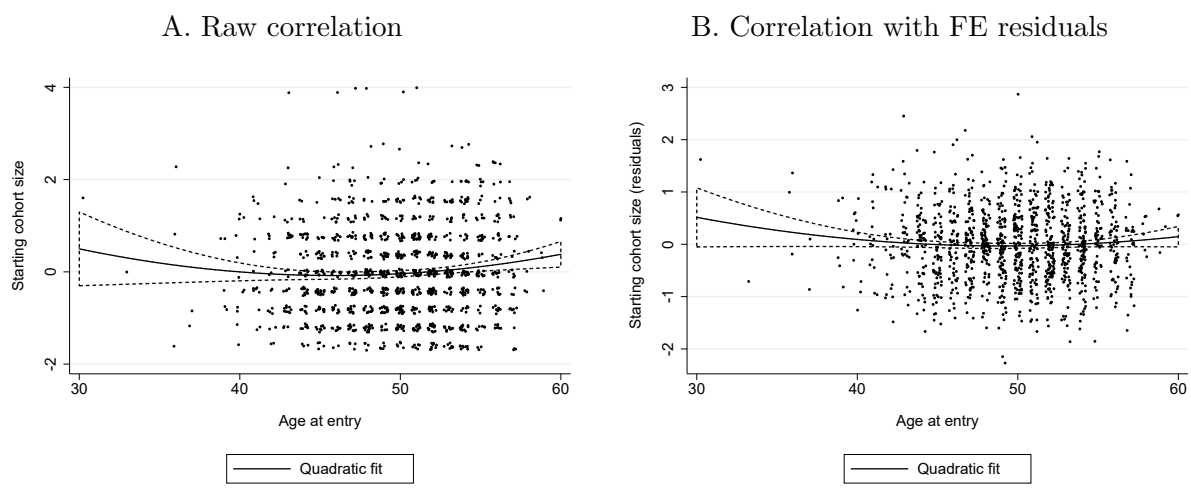
Figures

Figure 1: Promotion probability and size of starting cohort



Note: This graph shows the average probability that a prefecture party secretary is promoted at the end of his term on the y-axis (95% confidence intervals in bars) against the size of his starting cohort on the x-axis. The size of the starting cohort is defined as the number of prefecture CCP secretaries who start their term in the same year and same province.

Figure 2: Size of starting cohort and CCP secretary's age



Note: These graphs plot the size of the starting cohort against the age of the CCP secretary when he takes office. The starting cohort is the number of other prefecture-level CCP secretaries who start their term in the same year and in the same province. Panel A plots the raw correlation and a quadratic fit. Panel B plots the residuals of the starting cohort size regressed on prefecture and start-year fixed effects. The data are based on 1310 prefecture-level CCP secretaries' terms.

A Robustness Tables and Figures

Table A1: Theoretical cohort size and actual cohort size

	(1) All	(2) Before 2004	(3) Before 2000
Theoretical cohort size, initialized in 1996	0.0996	0.262***	0.488***
	(0.0861)	(0.0781)	(0.0918)
Observations	390	215	118

Observations are at the province-start year level. The dependent variable is the actual starting cohort size, defined as the number of prefecture-level party secretaries who start their term in the province in a given year. The regressor of interest is the theoretical starting cohort size as computed by extrapolating from the 1996 distribution of term lengths, and applying a fixed length of 5 years (following the theoretical length of a term). Controls include province level and start year level fixed effects. Standard errors, clustered at the provincial level, are reported in parentheses with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table A2: Starting cohort size and composition of predecessors

	(1)	(2)	(3)	(4)
Nb of t-1 cohort secretaries who are older than 55	0.116**			0.197***
	(0.0469)			(0.0449)
Nb of t-1 cohort secretaries who were promoted		0.972***		0.924***
		(0.0805)		(0.0461)
Nb of t-1 cohort secretaries who retired			0.942***	0.880***
			(0.0791)	(0.0460)
Nb. clusters	364	364	364	364

Observations are at the prefecture-year level. The sample only includes terms that start at the earliest in 1996 and finish before 2014 and for which we observe the prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. In each column, the dependent variable is the starting cohort size in a given province and year. Standard errors are clustered at the province-start-year level with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table A3: Policy outcomes and promotion incentives:
Placebo test using lagged starting cohort size

Panel A: Economic growth						
	GDP growth (nominal)	GDP growth (real)	GDP growth rank			
Lagged starting cohort size	0.000462	0.000432	-0.00284			
	(0.00242)	(0.00113)	(0.00239)			
Nb. clusters	281	281	281			
Nb. of observations	2567	2566	2567			
Mean dep. var.	0.160	0.128	0.101			
Panel B: Real estate and expropriation						
	Employment Growth Construction sec.	Real Estate investment % GDP	Residential RE investment % GDP	Expropriation rate	Urban area expansion rank	
Lagged starting cohort size	-0.0309	0.00200	0.000679	0.000385	-0.0798	
	(0.0668)	(0.00123)	(0.000836)	(0.00144)	(0.0630)	
Nb. clusters	281	281	280	226	281	
Nb. of observations	2567	2567	2541	1551	2423	
Mean dep. var.	1.082	0.0650	0.0511	0.00730	5.188	
Panel C: Public good provision						
	Average Z-score	# Hospital beds per capita	# Doctors per capita	# Buses per capita	# Teachers per c. (primary)	# Teachers per c. (middle)
Lagged starting cohort size	-0.00465	-0.0910	80.36	-0.0651	0.0295	-0.123
	(0.00551)	(0.106)	(52.95)	(0.0623)	(0.139)	(0.152)
Nb. clusters	278	279	277	278	280	281
Nb. of observations	2398	2499	2445	2400	2532	2514
Mean dep. var.	-0.0618	28.01	5821.2	6.010	43.68	37.36

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1997 and finish before 2013 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. In column 4 of Panel B, we restrict the sample to the 120 sampling prefectures of the CHARLS survey, where the annual prefecture-level expropriation rate is estimated on at least 20 observations. The regressor of interest is the 1-year lagged value of the starting cohort size (the value it would have taken had the bureaucrat started one year earlier) Controls include the CCP secretary's age in the year he takes office, as well as prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table A4: Expropriation probability and promotion incentives: individual-level results

Dep. Var.	Probability of being expropriated						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Size of starting cohort	-0.00093*	-0.00090*	-0.0010***	-0.0010***	-0.00089*	-0.00094*	-0.00100**
	(0.00051)	(0.00052)	(0.00037)	(0.00038)	(0.00050)	(0.00051)	(0.00038)
Age at entry	0.0000017	-0.0000027	-0.000010	-0.00017*	-0.00000079	-0.0000058	-0.000012
	(0.000099)	(0.00010)	(0.000095)	(0.000099)	(0.000098)	(0.00010)	(0.000098)
Control variables							
Prefectural FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Start of term FE	Yes	Yes	No	No	Yes	Yes	No
Calendar year FE	No	No	Yes	Yes	No	No	Yes
Individual FE	No	No	No	No	No	No	Yes
Age and Age, squared	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Other controls	Yes	Yes	Yes	Yes	Yes	Yes	No
Sample definition							
Prefecture - Years	$N > 20$	$N > 20$	$N > 20$	$N > 20$	All	$N > 50$	All
Individuals	All	Rur. h.	All	All	All	All	All
CPC Secretaries	All	All	All	$\text{Age}_{t_0} < 55$	All	All	All
Nb. Obs	140608	132332	140608	130035	142453	138486	142450
Nb. individuals	10203	9608	10203	10200	10333	10050	10330
Nb. clusters	256	256	256	239	323	249	323
Mean dep. var.	0.01	0.01	0.01	0.01	0.01	0.01	0.01

- Observations are at the respondent-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. Columns 1 to 4 are restricted to prefectures and years, where we observe at least 20 individuals and at least 50 individuals in column 6. In column 2, we restrict the sample to individuals who have a rural Hukou. In column 4, we restrict the sample to terms where the CCP secretary was younger than 55 at the beginning of this term. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table A5: GDP growth and promotion incentives

Dep. Var.	GDP growth Primary sector	GDP growth Secondary sector	GDP growth Tertiary sector
	(1)	(2)	(3)
Size of starting cohort	-0.00554*	-0.0119***	-0.00487**
	(0.00304)	(0.00411)	(0.00239)
Age at entry	0.000976	0.000447	0.000356
	(0.000744)	(0.000775)	(0.000501)
Nb. obs	2677	2677	2677
Nb. clusters	306	306	306
Mean of dep. var.	0.0997	0.183	0.161

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. The dependent variables are nominal GDP growth in the primary sectory (column 1), nominal GDP growth in the secondary sectory (column 2) and nominal GDP growth in the tertiary sectory (column 3). All regressions include prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table A6: Employment growth and promotion incentives

Dep. Var.	Employment growth (Total)	Employment growth (Primary sec.)	Employment growth (Secondary sec.)	Employment growth (Tertiary sec.)
Source	NBS	NBS	NBS	NBS
	(1)	(2)	(3)	(4)
Size of starting cohort	-0.0118**	-0.0696**	-0.0126***	-0.00871**
	(0.00470)	(0.0310)	(0.00453)	(0.00413)
Age at entry	-0.00263	-0.0162	-0.00195*	-0.00185
	(0.00190)	(0.0322)	(0.00112)	(0.00159)
Nb. obs	2677	2670	2677	2677
Nb. clusters	306	306	306	306
Mean of dep. var.	0.00228	0.0436	0.0122	0.00159

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. The dependent variables are total employment growth (column 1), employment growth in the primary sector (column 2), employment growth in the secondary sector (column 3) and employment growth in the tertiary sector (column 4). All regressions include prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Table A7: Promotion incentives and GDP data manipulation:
Distribution of decimal digits of reported real GDP growth rates

Panel A: First decimal digit	$D1=1$	$D1=2$	$D1=3$	$D1=4$	$D1=5$	$D1=6$	$D1=7$	$D1=8$	$D1=9$
Size of starting cohort	0.00197	-0.00254	0.00274	0.00226	-0.00267	0.00526	0.00265	-0.00484	-0.00567
	(0.00860)	(0.00848)	(0.00684)	(0.00581)	(0.00737)	(0.00748)	(0.00701)	(0.00654)	(0.00612)
	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]	[1.000]
Mean of dep. var.	0.14	0.11	0.091	0.066	0.11	0.096	0.071	0.096	0.059
Nb. of clusters	306	306	306	306	306	306	306	306	306
Nb. of observations	2676	2676	2676	2676	2676	2676	2676	2676	2676
Panel B: Second decimal digit	$D2=1$	$D2=2$	$D2=3$	$D2=4$	$D2=5$	$D2=6$	$D2=7$	$D2=8$	$D2=9$
Size of starting cohort	0.00172	-0.00809***	-0.00187	-0.00109	-0.00739**	-0.00409	0.000940	0.00851***	-0.000820
	(0.00254)	(0.00277)	(0.00285)	(0.00224)	(0.00335)	(0.00331)	(0.00264)	(0.00279)	(0.00224)
	[1.000]	[0.076]	[1.000]	[1.000]	[0.559]	[1.000]	[1.000]	[0.050]	[1.000]
Mean of dep. var.	0.013	0.012	0.012	0.012	0.016	0.015	0.0090	0.010	0.0097
Nb. of clusters	306	306	306	306	306	306	306	306	306
Nb. of observations	2676	2676	2676	2676	2676	2676	2676	2676	2676

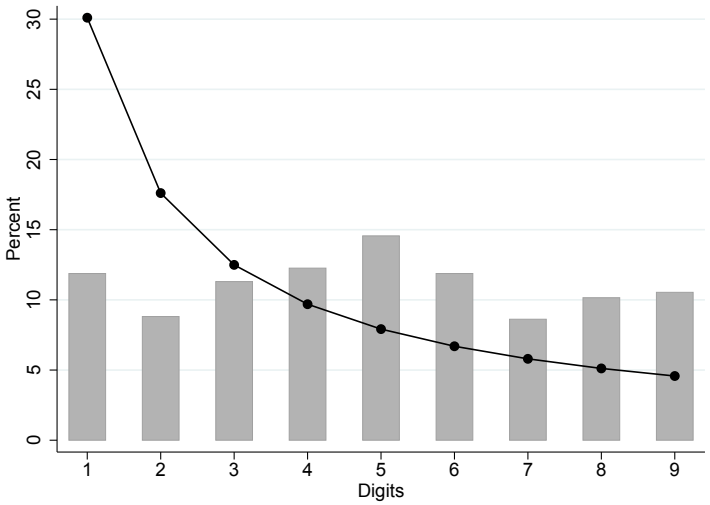
Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. In each column, the dependent variable is a dummy equal to 1 if the first (Panel A) or second (Panel B) decimal digit of the reported real growth rate of a prefecture in a given year is equal to 1, 2, ..., 9. The main regressor of interest is the size of the starting cohort, i.e. the number of prefecture-level CCP secretaries who start their terms in the same year and the same province. The size of the starting cohort is normalised to have a mean of 0 and standard deviation of 1. Controls include the CCP secretary's age in the year he takes office, as well as prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level, with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively. P-values adjusted for family-wise multiple hypothesis testing are reported in square brackets.

Table A8: Individual-level results:
Robustness to CHARLS sample definition

Variables	$\mathbb{1}_{it}\{\text{expro}\}$ (1)	$\mathbb{1}_{it}\{\text{expro}\}$ (2)	$\mathbb{1}_{it}\{\text{expro}\}$ (3)
Size of starting cohort (Normalized)	-0.00102***	-0.00107***	-0.00111***
	(0.000380)	(0.000384)	(0.000382)
Sample definition			
Prefectures	All	$N > 20$	$N > 50$
Nb. Obs	142453	140608	138486
Nb. individuals	10333	10203	10050
Nb. clusters	323	256	249

Observations are at the individual-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2014 and for which we observe the prefecture party secretary's promotion and age, as well as all macroeconomic variables of interest. The regressor of interest is the number of other prefecture-level CCP secretaries in the province who start their terms in the same year as said prefectural CCP secretary. Controls include the CCP secretary's age in the year he takes office (reported in the table), as well as prefecture and calendar year fixed effects. Standard errors are clustered at the province-start-year level with significance at the 1%, 5% and 10% denoted by ***, ** and *, respectively.

Figure A1: Second decimal digit distribution



Note: This graph plots the actual distribution (grey bars) of the second decimal digits in reported real GDP growth rates and the distribution according to Benford's law (black connected dots). The underlying data are from the NBS City Statistical Yearbooks, 1996-2013.

B Model

In this appendix we propose a simple model to show how promotion incentives can affect bureaucrats' policy choices. We combine a rent-seeking model (see, e.g. Pérez-Castrillo and Verdier, 1992; Tullock, 1980) with a multi-tasking framework following Holmstrom and Milgrom (1991).

Set up N bureaucrats compete for one position, which yields utility S. Each bureaucrat spends his total available effort e on either task 1 or two, which cost $c_1(e_{1,i})$ and $c_2(e_{2,i})$. The likelihood that bureaucrat i obtains the position is given by the following contest success function (CSF):

$$p_i = \frac{e_{1,i}}{\sum_{k\in[0,N]} e_{1,k}} \tag{6}$$

Only effort on the first task enters into the contest function, while effort on the second task yields a private benefit to the bureaucrat of $B(e_{2,i})$.

Maximisation problem Bureaucrats are risk-neutral and maximise their utility

$$\max_{e_{1,i},e_{2,i}} U_i = S * p_i(e_{1,i}, E_{1,-i}) + B(e_{2,i}) - c_1(e_{1,i}) - c_2(e_{2,i})$$

$$\text{subject to } e_{1,i} + e_{2,i} \leq e_i = e$$

$$\text{Or: } \max_{e_{1,i}} U_i = S * p_i(e_{1,i}, E_{1,-i}) + B(e - e_{1,i}) - c_1(e_{1,i}) - c_2(e - e_{1,i})$$

The first order condition is:

$$\begin{aligned}\frac{\partial p_i(e_{1,i}, E_{1,-i})}{\partial e_{1,i}} &= \frac{\partial c_1(e_{1,i})}{\partial e_{1,i}} + \frac{\partial B(e - e_{1,i})}{\partial e_{1,i}} - \frac{\partial c_2(e - e_{1,i})}{\partial e_{1,i}} \\ \frac{\partial p_i(e_{1,i}, E_{1,-i})}{\partial e_{1,i}} &= \frac{\partial \phi(e_{1,i})}{\partial e_{1,i}}\end{aligned} \tag{7}$$

where ϕ represents the costs of effort e_1 net of the opportunity cost of not providing $e_2 = e - e_1$. Equation (7) defines a "best response curve" to the vector of $N-1$ strategies by the other bureaucrats, $E_{1,-i}$.

Equilibrium A symmetric equilibrium ($e_{1,j} = e_{1,k} = e_1, \quad \forall j \neq k$) exists for this game, where:

$$\begin{aligned}\frac{\partial p_i(e_1, E_1)}{\partial e_1} &= \frac{\partial \phi(e_1)}{\partial e_1} \\ \frac{(e_1 + E_1) - e_1}{(e_{1,i} + E_1)^2} &= \frac{\phi'(e_1)}{S} \\ \frac{(N-1)e_1}{N^2 e_1^2} &= \frac{\phi'(e_1)}{S} \\ e_1 \phi'(e_1) &= \frac{N-1}{N^2} S\end{aligned} \tag{8}$$

And equilibrium promotion probabilities are equal to:

$$\begin{aligned}p_i &= \frac{e_{1,i}}{\sum_{k \in [0,N]} e_{1,k}} \\ &= \frac{1}{N}\end{aligned} \tag{9}$$

One can show (as in Pérez-Castrillo and Verdier, 1992) that non-symmetric equilibria do not exist if all agents have the same costs and valuations.

The right-hand side of equation 8 is decreasing in the number of competitors N, meaning that the equilibrium level of contest-related effort e_1

will be a decreasing or increasing function of N depending on the shape of $e_1\phi'(e_1)$.

Recall that $\phi = c_1 - (c_2 - B)$. Thus ϕ' is increasing when the marginal cost of contest-relevant effort increases faster than the marginal cost of private effort, net of marginal private benefit. This is likely to be the case when the level of contest-relevant effort is high, such as when the expected benefit of the context is large relative to the private benefit. In this case, the equilibrium level of contest-relevant effort e_1 is a decreasing function of N: when facing many competitors, bureaucrats are discouraged from providing promotion-relevant effort. Depending on the net private benefit $B - c_2$, bureaucrats may substitute towards private effort.

Equation 9 implies that promotion probabilities are also a decreasing function of the number competitors.

Discussion and model predictions We think this model is appropriate for the setting of our paper and delivers a number of testable predictions. In China's meritocratic bureaucrat promotion system, the principal (here, the provincial party standing committee) evaluates a number of agents (here, prefecture party secretaries) for promotion to higher office. In the empirical analysis, the relevant number of competitors N is the size of the starting cohort. S is large, as a prefecture party secretary who is promoted gains substantially in terms of power and compensation.[34] As the principal can observe GDP growth and infrastructure projects, effort spent on increasing growth e_1 are rewarded. Effort on other pro-social policies e_2 are less easily observable to the principal and thus do not result in greater

[34]In China, a prefecture-level official is seen as low-ranking, while the next higher rank (sub-provincial) is considered high-ranking. This distinction entails significant differences in status and compensation.

likelihood of promotion. e_2 may, nevertheless, yield private benefits to the bureaucrat. For instance, the bureaucrat may intrinsically care about the local population or local elites and these policies may benefit the bureaucrat himself after retirement.

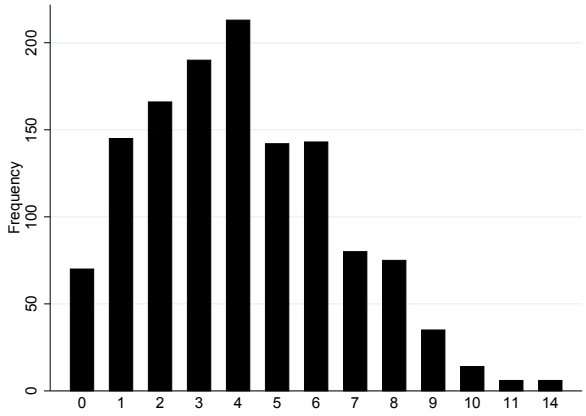
In equilibrium, a smaller number of competitors increases the likelihood that any given prefecture party secretary is promoted. Prefecture party secretaries spend more effort on promotion-related activities, such as construction and infrastructure projects, and less effort on other policies, such as public goods provision.

C Detailed sample description

C.1 Bureaucrats

Table C9 shows descriptive statistics of prefecture party secretaries in China from 1996 to 2014. The average prefecture party secretary enters office when he is 50 years old with three other prefecture party secretaries from the same province. Figure C2 shows the distribution of the size of the starting cohort. Despite an official term limit of five years, the average term is less than three years long, see Figure C3 for the distribution of term lengths.

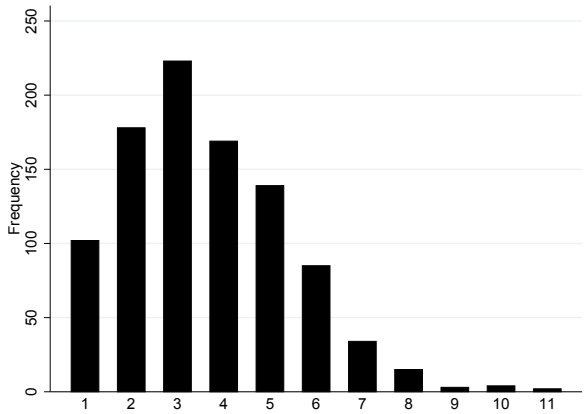
Figure C2: Size of starting cohort



Note: This graph shows the distribution of the starting cohort size, i.e., the number of other CCP secretaries who start their term in the same year and in the same province as a given CCP secretary. The data are based on 1310 prefecture CCP secretaries' terms.

For each bureaucrat, we gather data on his career path in the years following his term. We define a time window relative to the end of the term, and collect information on the positions the bureaucrat holds within this time frame. We then attribute ranks to these positions based on official administrative rules. We assign to the bureaucrat the highest rank he reaches within two years of ending his term as a prefecture CCP secretary.

Figure C3: Distribution of term lengths



Note: This graph shows the distribution of term lengths in our sample. The length of a term is equal to the number of consecutive years at the end of which a bureaucrat is observed as being in office in a given prefecture. The data are based on 1310 prefecture CCP secretaries' terms.

We distinguish between sub-provincial cities and regular prefectures. Sub-provincial cities rank one level higher than regular prefectures, so that a move from a regular prefecture to a sub-provincial city is coded as a promotion.[35]

Many of the transfers are in fact to 'retirement'positions, which are official positions that wield little political power, but are still remunerated and can be officially ranked higher than prefecture-level party secretaries. We use qualitative data from media sources to identify such positions, and re-code transfers to such positions as retirement rather than promotions.[36] This is a similar approach to Li and Zhou (2005), but at the prefecture- rather than provincial level. Prior to the anti-corruption campaign, out-

[35]For almost all secretaries where we collect career information, we are able to rank at least one position.

[36]These positions are at the national-level, provincial-level and prefectural-level, (i) positions in the Chinese People's Political Consultative Conference, often abbreviated as CPPCC, or in Chinese, 政治协商会议委员会, abbreviated 政协, and (ii) positions in to the Standing Commitee of the People's Congress, or in Chinese, 人民代表大会常务委员会, abbreviated 人大.

right dismissals and demotions were rare and were sometimes masked as early retirement.

Table C9 shows that the likelihood of a prefecture party secretary being promoted at the end of his term is around 49 percent. 26 percent of party secretaries moved into retirement after their term ended. We are able to identify the size of a party secretary's starting cohort in over 98 percent and the career path in 73 percent of all terms.

Table C9: Term-level descriptive statistics

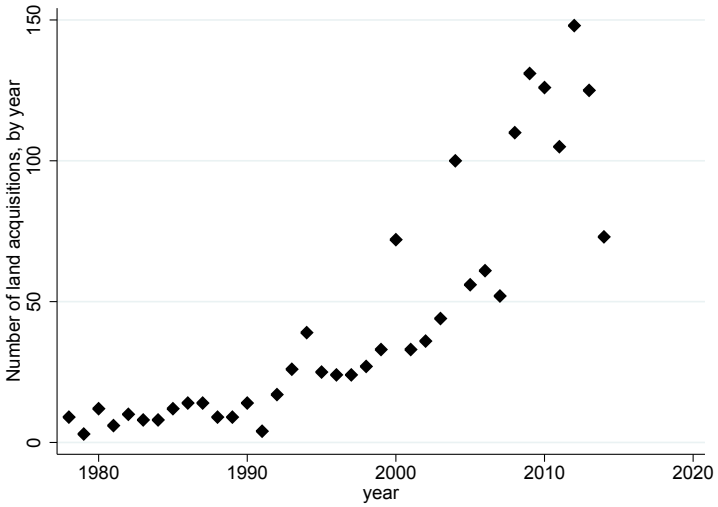
Variables	Mean	Std. deviation	Min	Max
Length of term	2.635	1.778	0	10
Age at entry	49.75	4.231	30	60
Size of starting cohort	4.072	2.524	0	14
Promotion (official rank)	0.526	0.500	0	1
Promotion (actual)	0.487	0.500	0	1
Retirement	0.263	0.440	0	1
Anti-corruption campaign arrest	0.126	0.332	0	1
Data availability				
Age data available	0.946			
Competitor data available	0.981			
Promotion data available	0.732			
All data available	0.726			

The statistics in this table are computed on the 1310 terms of prefecture-level CCP secretaries that start no earlier than 1996 and end in 2014 or before. The length of term is equal to 0 if the secretary is observed in office once at the end of a year, 1 if he is observed in office at the end of two consecutive years, etc. The age at entry of a secretary is the age of the CCP secretary when he takes office. The size of the starting cohort corresponds to the number of competitors of a given secretary, i.e., the number of secretaries in the same province who start their term in the same year as a given secretary. Promotion data are based on the positions that a given secretary occupies following his term. We consider all positions for which the starting date is between the last year at the end of which a secretary is in office and two years after. For most individuals this corresponds to a duration of less than one year, and this is by definition strictly less than 2 years. Promotion is officially defined by ranks in the hierarchical structure of the CCP. Some of these promotions are to 'retirement positions'. Some secretaries are nominated to several positions, which explains why the retirement rate and actual promotion rate do not add up to the total promotion rate. The variable 'Competitor data available' is a dummy variable equal to 1 if data on the seniority and age of all other secretaries in the province at the time a given secretary takes office are available.

C.2 Policy outcomes

Figure C4 shows the number of land expropriations recorded each year in the CHARLS survey. Expropriations increased rapidly in our sample period between 1996 and 2014.

Figure C4: Land expropriations, CHARLS survey



Note: This graph plots the absolute number of expropriation events that are recorded for each calendar year. In our analysis, we restrict the data to the 1996-2014 period, which is the period where most expropriations occur and for which we collect data on CCP secretaries. The data are from the 2014 Life History wave of the CHARLS survey.

Table C10 shows summary statistics for the prefecture-year panel used in the main analysis.

Table C10: Summary statistics - macroeconomic variables

Variables	Mean	Std. Deviation	Min	Max
Population (in millions)	4.170	2.348	0.160	12.50
Provincial capital	0.0897	0.286	0	1
Total prefecture area (thousands of km^2)	23.39	46.83	0.978	496.3
Nominal GDP (billion RMB)	75.68	110.3	0.702	1542.0
Nominal GDP growth	0.159	0.0963	-0.736	1.462
Real GDP growth	-0.999	0.00232	-1.005	-0.921
GDP growth rank (satellite)	5.186	2.867	1	10
Nominal GDP growth (Primary sector)	0.145	2.184	-0.638	125.0
Nominal GDP growth (Secondary sector)	0.188	0.205	-0.761	6.068
Nominal GDP growth (Tertiary sector)	0.172	0.270	-0.885	11.20
Employment (thousands)	446.0	537.5	40.50	6101
Employment growth	0.00167	0.532	-0.957	26.06
Employment share (Primary sector)	0.0530	0.103	0.0001000	0.740
Employment share (Secondary sector)	0.424	0.137	0.0446	0.844
Employment share (Tertiary sector)	0.523	0.134	0.0991	0.948
Employment growth (Construction sector)	1.020	4.364	-1	91.21
Real estate investment (% GDP)	6.339	5.965	0	91.22
Residential RE investment (% GDP)	5.184	4.351	0.00887	61.50
Expropriation rate	0.00708	0.0429	0	1
Urban area growth rank (satellite)	177.0	101.8	1	344
Number of hospital beds	11450.3	7946.5	860	66721
Number of doctors	6478.7	4803.5	377	63193
Number of buses per capita	6.398	6.517	0	115
Number of teachers (primary school)	17786.9	10251.6	595	57887
Number of teachers (middle school)	15082.3	8678.6	400	46287
Number of teachers (higher education)	3089.7	6128.8	0	55416

Data included in this table are from the National Bureau of Statistics City Statistical Yearbooks, except for the expropriation rate, which we compute from the CHARLS survey, and implied GDP (provincial rank) and urban area growth (national rank), which are based on satellite data. The statistics are computed on our main estimation sample, the 2899 prefecture-year observations where macroeconomic data and CCP secretary characteristics are available.

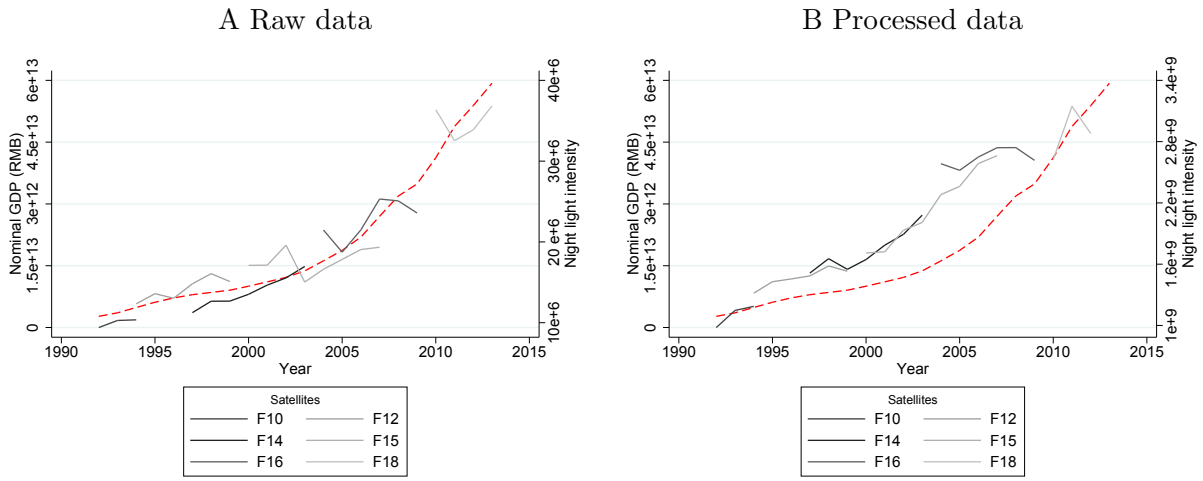
D Measurement of GDP growth using night light data

In this appendix we present a simple comparison of raw night light data from the National Oceanic and Atmospheric Administration (NOAA)'s Defense Meteorological Program Operational Line-Scan System (DMSP-OLS) and nominal GDP figures from the NBS. This reproduces the comparison in Zhang, Pandey and Seto (2016) for China. As shown in Panel A of Figure D5, the DMSP-OLS data are available in different series which partially overlap. The absolute levels of night light intensity (on the left axis) for a given year can be substantially different depending on the series. Zhang, Pandey and Seto (2016) use machine learning algorithms to smooth the global night light data and obtain the processed data in Panel B. This procedure is aimed less at improving the overall fit of the night light data to GDP than in smoothing out differences across series of satellite data.

Aside from discrepancies in the levels of night light intensities recorded by different satellite systems, the most problematic aspect of nightlight data in our context is that two satellite systems of different sensitivity yield year-on-year variations that sometimes go in opposite directions. In Panel A of Figure D6 this is the case for the F14 and F15 systems for the years 2002 and 2003 or the the F15 and F16 systems in 2005.

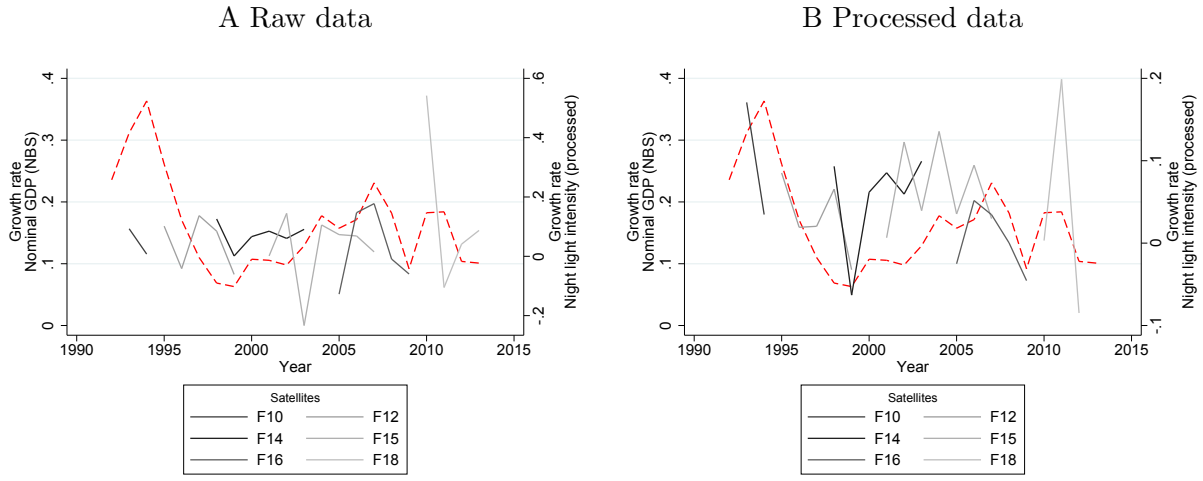
For this reason, we prefer to use the percentile rank of prefectures rather than the absolute levels of growth rates implied by the satellite data and always report estimates using prefecture and year fixed effects.

Figure D5: Night lights and GDP levels



Note: These figures show the aggregate GDP of China in nominal terms (dashed red line, left axis) and the total night time light intensity from satellite data over China's territory (grey solid lines, right axis). GDP data are from the NBS and night time light intensity data are from the DMSP-OLS (Panel A) or Zhang, Pandey and Seto (2016) (Panel B). The different solid grey lines correspond to different satellite systems.

Figure D6: Growth of Night light intensity and Growth of GDP



Note: These figures show the nominal growth of aggregate Chinese GDP (dashed red line, left axis), and the annual growth of total night time light intensity from satellite data over China's territory (grey solid lines, right axis). GDP data are from the NBS, and night time light intensity data are from the DMSP-OLS (Panel A) or Zhang, Pandey and Seto (2016) (Panel B). The different solid grey lines correspond to different satellite systems.