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

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Abstract

We study the effect of career incentives on bureaucrat performance by exploiting the ex-ante competitiveness of promotions. We combine administrative, remote sensing and survey data on all prefecture-level Chinese cities between 1996 and 2012 with detailed information on the career histories of city leaders. We find that officials with fewer rivals for promotion have a greater likelihood of advancement and face stronger promotion incentives. We show that the number of competitors is uncorrelated with characteristics of the bureaucrats and their placements. Strong career incentives lead to a growth strategy that relies on real estate investment and rural land expropriation, resulting in faster growth in construction and GDP, but lower investment in education, public transport and health.

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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. Performance-based promotions provide incentives, which can potentially mitigate moral hazard problems in bureaucracies, but might also result in excessive risk taking (see, e.g. Lazear, 2018).

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). Much less is known, however, about how the intensity of competition among otherwise similar officials shapes the policies they pursue. In this paper, we answer this question by exploiting variation in the ex-ante competitiveness of promotions among local Chinese bureaucrats. We find that stronger career incentives due to fewer competitors lead bureaucrats to adopt riskier policies, leading to better headline measures at the cost of less easily observable outcomes with potentially detrimental effects for social welfare.

We focus on the policy choices of prefecture Chinese Communist Party secretaries in China. China is subdivided into 31 provinces and 334 prefectures, the majority of which are cities. Using both administrative and online sources, we identify the CCP secretary of all prefectures in China from 1996 to 2012. We collect data on their personal characteristics, as well as their past and future career paths. We combine these data with administrative, satellite and survey data on policy outcomes.

We argue that prefecture party secretaries who enter office in the same province at the same time form a cohort and are each other's main rivals for promotion. This is due to two reasons. First, promotions of prefecture party secretaries are decided by their superiors within each province. Second, there are strict age-eligibility criteria for promotion and no fixed term length, so successful officials work to be seen and promoted from the very start of their term which usually lasts less than three years.

We first establish that bureaucrats entering office as part of larger cohorts are significantly less likely to be promoted. On average, a prefecture party secretary who starts in

a cohort of eight is 20 percentage points less likely to be promoted than a party secretary who starts in a cohort with half as many rivals. A larger cohort means more competitors and, as the number of available higher-ranking positions does not change correspondingly, a smaller likelihood of being noticed and promoted. We interpret this finding as evidence that officials facing more competitors experience weaker promotion incentives. This variation allows us to study how differences in the intensity of competition affect subsequent policy choices.[1]

We use cohort size as a predetermined proxy for competitive pressure. Our identification assumption is that cohort size affects policy outcomes only by changing the intensity of competition, conditional on prefecture and year fixed effects. We argue that this is plausible for institutional reasons. Cohort sizes are determined *before* a prefecture CCP secretary enters office and results from the history of idiosyncratic timings of moves by previous prefecture party secretaries in the province. We also think that it is unlikely that cohort size is strategically manipulated, as any high-level official who is powerful enough to do that would also be able to promote their favored bureaucrat directly. We show that starting cohort size is uncorrelated with observable characteristics of the CCP secretary and of their assigned prefecture and province. The main threat to identification is that cohort size could instead proxy for broader personnel churn in the province and we present institutional arguments and empirical evidence against this explanation.

This variation in the ex-ante competitiveness of promotions incentivizes bureaucrats to adopt different policies during their term. We show that faced with stronger promotion incentives, bureaucrats refocus their attention and effort on policies that are more likely to result in promotions, such as ones that increase headline economic growth, but do not necessarily enhance social welfare (see also the theoretical literature on multi-tasking by Holmstrom and Milgrom (1991)). A smaller starting cohort size increases GDP growth rates over a prefecture party secretary's term: a one standard deviation smaller starting cohort (or 2.5 fewer rivals for promotion) increases annual nominal GDP growth by 0.8

[1]This can be formalized as a contest game (see, e.g. Corchón and Serena, 2018; Tullock, 1980), where multiple players (the CCP officials) compete for a fixed prize (a promotion) and the equilibrium probability of winning the prize is inversely related to the number of players.

percentage points and real GDP growth by 0.3 percentage points.

To generate this additional growth and highly visible achievements over their short terms, bureaucrats rely on the construction sector. We find that promotion incentives lead to higher real estate investment and faster growth in construction employment. We corroborate our findings using satellite data and find significant increases in both night light intensity and growth of urban areas due to stronger promotion incentives.

One constraint for this type of construction-led growth is the availability of land. We find evidence for increased expropriations of rural farm land due to promotion incentives. 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 and inefficient and can have long-term adverse consequences for the expropriated farmers.[2] The distributional cost we document is therefore borne primarily by rural households, in the form of a transfer of productive assets from farmers to local governments and developers.

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 rivals under-invest in education, transport and health, as measured by the number of teachers, buses, and doctors and hospital beds per capita in the prefecture.

Our paper contributes to the literature on the effects of the bureaucracy on economic development (see, for example, Besley et al., 2022; Finan, Olken and Pande, 2017, for recent reviews of the literature). An important research agenda in development economics focuses on how to motivate bureaucrats and how a well-functioning bureaucracy contributes to various aspects of development. A recent influential literature experimentally varies incentives for specific public sector employees, such as teachers, tax collectors,

[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`.

health workers etc. (see, e.g. Duflo, Hanna and Ryan, 2012; Khan, Khwaja and Olken, 2019; Leaver et al., 2021). We also identify the effect of career incentives on bureaucrat performance, but in a country-wide study over a long time frame, focusing on bureaucrats with a broad remit for developmental policy, which lies beyond the scope of experimental approaches.

We build on earlier work in economics and political science on the Chinese bureaucracy (see also Section 2 for more details). The classic literature on the Chinese promotion tournament (see, e.g. Chen and Kung, 2016; Jia, Kudamatsu and Seim, 2015; Landry, Lü and Duan, 2018; Li and Zhou, 2005) has emphasized the growth-promoting effects of competitive promotion, by showing how GDP growth over a bureaucrat's term affects their subsequent chances for promotion. Implicitly, most of this literature conceptualizes competition as a binary institutional feature and asks whether the existence of career incentives affects bureaucrats' effort. We instead study how competitive promotions are. Within the same promotion tournament system, some officials face many rivals while others face relatively few, and we show that these differences generate meaningful variation in promotion probabilities and therefore in career incentives. The existing literature provides substantial evidence that the existence of meritocratic competition can promote economic growth; our finding that the intensity of competition can discourage effort and change policy choices is more surprising and less studied.

We develop a new measure of competitive intensity - the starting cohort size. Previous observational work has generally followed one of two approaches. The first approach uses structural features of the competitive environment, such as the number of prefectures within a province (Li et al., 2019; Yu and Shen, 2022). These measures are essentially time-invariant and are likely to be correlated with other placement characteristics. The second approach uses characteristics of the individual bureaucrat, such as age (Bertrand et al., 2020; Wang, Zhang and Zhou, 2020), political connections (Jia, 2025), or career stage (Xu et al., 2025). These characteristics are likely to be correlated with unobserved ability or may affect policy choices directly. In contrast, our cohort-based measure varies at the individual level but is generated by structural factors rather than by characteristics

of individual bureaucrats.

Standard tournament models predict that stronger incentives should increase effort, but they are silent on how this additional effort is allocated across competing policy objectives and on the distributional consequences of this allocation. By combining administrative, satellite and individual-level survey data, we document not simply an incentive effect but a distortion in the composition of development policy. Our findings help reconcile two strands of the literature on the Chinese bureaucracy. One strand emphasizes the growth-promoting effects of meritocratic promotion (Jia, Kudamatsu and Seim, 2015; Landry, Lü and Duan, 2018; Li and Zhou, 2005; Maskin, Qian and Xu, 2000). A second strand documents social costs of career incentives, including pollution (Jia, 2025), land-related corruption (Chen and Kung, 2019) and accidental deaths (Fisman and Wang, 2017). We show empirically that these are joint consequences of the same incentive structure, once one allows for multi-tasking (Holmstrom and Milgrom, 1991). Under multi-tasking, strong incentives on measurable outcomes distort effort toward visible margins and away from less-visible ones. Using a unified framework and a single source of variation in incentive intensity, we identify this distortionary effect of career incentives across headline growth, rural land expropriation, and less-visible public goods.

One major source of social tensions in China, as in many other fast developing contexts, are the inequalities resulting from rapid urban expansion. Related to our work, Chen and Kung (2019, 2016); Wang, Zhang and Zhou (2020) show how land sales and urban expansion in China are tied to the individual career incentives of bureaucrats, rather than being designed to maximize social welfare.[3] We contribute to this literature by providing direct empirical evidence on rural land expropriation at the household level - a phenomenon that is widely known about but very difficult to measure.

[3]Wang, Zhang and Zhou (2020) use a sample of residential land transactions to show that stronger career incentives of bureaucrats lead to increased outward expansion of cities. 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.

2 Background and Data

Local Chinese government officials

China is geographically subdivided into several administrative levels: provinces, prefectures, counties and townships. At each level, the Chinese Communist Party (CCP) secretary is the de facto highest-ranking official.[4] In this paper, we focus on the party secretaries of China's 334 prefectures (including 15 vice-provincial cities) from 1996 to 2012. We identify their names using official Provincial Yearbooks and 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).

Career incentives are seen as the main motivator for Chinese bureaucrats. Promotions are especially important for prefecture party secretaries, as a promotion brings them into the high ranks in the Chinese bureaucracy and comes with considerable benefits in terms of status and compensation.[5]

Prefecture party secretaries are evaluated and promoted by the provincial CCP standing committee from their own province. Only very few prefecture party secretaries leave their province at this stage in their career.[6] Even though officially prefecture party secretaries have five-year terms, in practice most last less than three years. In part due to age limits for promotions, successful bureaucrats aim to spend as little time as possible in each position. For more details, see Appendix A2.

These two factors - the in-province promotion decision and the pressure to be promoted quickly - combine to generate natural groups of rivals for promotion among prefecture party secretaries, namely, the starting cohorts, i.e. prefecture party secretaries

[4]The prefecture party secretary is responsible for setting the overall agenda, personnel decisions and resource allocation, while the mayor is responsible for implementing the agenda and the day-to-day administration of the prefecture.

[5]Bureaucrats from the prefecture-level downwards are considered low ranking, while the next level up (vice-provincial) is considered high ranking.

[6]In our sample, only 7.8% of prefecture party secretaries moved outside of their province within two years of finishing their term, to other provinces, the central government or other government organizations and SOEs. Yao and Zhang (2015) find that although 15% of prefecture party secretaries move across prefectures, only 1.6% serve in two different provinces.

who began their term at the same time in the same province. In Figure A2.4, we plot the starting cohort size over our sample period separately for each province. There is considerable variation in starting cohort size both within and across provinces. Crucially, the starting cohort size is not a proxy for the size or amount of resources within a province. Even within the same province and in the same year, there will be multiple values for the starting cohort size as prefecture party secretaries enter their terms in different years. The average size of a starting cohort for a prefecture party secretary is 4 (with a standard deviation of 2.5).

We identify promotion, lateral transfer, retirement and demotion or dismissal at the end of each official's term. An official is promoted if they 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 officially higher ranked.[7] Additional details on how we code bureaucrats' careers are given in Appendix A2. 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 2012 (Table A2.1), with considerable variation across prefectures and years.

The criteria for bureaucrat promotions in China are subject to debate in the literature. Chen, Li and Zhou (2005) and 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.[8] At the prefectural level, Chen et al. (2017); Luo and Qin (2021); Shi et al. (2018) find a positive association between GDP growth and promotion, while Landry, Lü and Duan (2018) find no relationship.

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

[8]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.

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 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 center.

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.[9]

Given the potentially illegal and politically sensitive nature of land seizures, good data over this time period are rare. We use the 2014 China Health and Retirement Longitudinal Survey (CHARLS) 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 respondent is registered at the time. Figure A2.3 shows that the majority of expropriation events occurred after 1996 - the start of our sample.

We construct a balanced panel of 11,184 individuals whom we have the complete

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

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 respondents have been expropriated at least once over their lifetime.

Macroeconomic outcomes

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 A2.2. 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.[10] Real estate investment accounts for on average 6 percent of GDP.

The reliability of official Chinese statistics is often questioned.[11] We address these data quality concerns by studying less politically important variables, corroborating our finding using remote sensing data and analyzing the figures for evidence of data manipulation (see Section 5).

[10] 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).

[11] 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`.

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. During our sample period, 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.

Urban expansion We use satellite data from Yao et al. (2018) to measure the extent to which urban areas in each prefecture expand.[12] For similar reasons as above, we use the percentile rank of urban area growth as our outcome variable.

3 Cohort competition and promotion incentives

Starting cohort size and promotion outcomes

In this section, we show that bureaucrats who happen to have more competitors (i.e., who enter office as part of a larger starting cohort, see Section 2) are less likely to be promoted and so face weaker promotion incentives.[13] We estimate the following equation:

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

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

[13] This can be formalized as a contest game (see, e.g. Corchón and Serena, 2018; Tullock, 1980), where multiple players (the CCP officials) compete for a fixed prize (a promotion) and the equilibrium probability of winning the prize is inversely related to the number of players. In practice, the number of higher-ranking positions is clearly not fixed, but the model results carry through as long as the number of higher-ranking positions does not respond endogenously to the number of competitors. This is unlikely in our context. A newly promoted prefecture party secretary can be placed in a wide range of vice-provincial positions both within the same province, but also in other provinces and central government ministries. We include prefecture and year fixed effects to capture differences in the average number of higher-ranked positions across localities, e.g. some provinces are larger and have more positions, and years, e.g. there is more turnover around the central leadership transitions every five years.

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 they are promoted at the end of their 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.[14] 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 A2.3 and Figure A2.5 show that the size of the starting cohort negatively affects the promotion likelihood of prefecture CCP secretaries. A one standard deviation (or 2.5) increase in the starting cohort size reduces the likelihood of promotion by 6.5 percentage points (or 13 percent of a standard deviation), relative to a mean of 48 percent. This effect is statistically significant at the 1 percent level.[15]

Identification

Our identification strategy uses variation in starting cohort size as a predetermined proxy for the competitive pressure officials face. To interpret the findings as the causal effect of promotion incentives on policy outcomes, the key identifying assumption is not that cohort size is randomly assigned, but that, conditional on prefecture and year fixed effects, it affects policy outcomes through variation in competitive pressure rather than through other channels. As with much of the observational literature on bureaucratic incentives, our identification strategy ultimately relies on untestable assumptions and we cannot definitively rule out all threats to identification. We take comfort in our understanding of the institutional context, the balance tests showing no correlation on observables, the

[14]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, as well as changes in the central CCP leadership which generate increased turnover at lower levels and other shocks to the supply of bureaucrats.

[15]Figure A2.5 also suggests some nonlinearities in the relationship between promotions and starting cohort size. The probability of promotions increases with the number of rivals 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 result in Table A2.3 (see Appendix Figure A2.1).

evidence that cohort size does not proxy for wider personnel churn, and the range of alternative specifications and controls (Section 5).

Institutional reasoning

We believe this assumption is plausible in our setting for institutional reasons. Cohort size is determined *before* a prefecture party secretary enters office and makes policy decisions. It is generated by the idiosyncratic timing of prior career events (promotions, retirements, demotions, and transfers) of predecessor prefecture party secretaries in the same province, in a system without fixed term lengths (Figure A2.4). We think it is unlikely that cohort size is strategically manipulated by higher-level officials, for example, if provincial leaders time prefecture appointments to place favored bureaucrats in small cohorts and fast-growing regions. To change the size of an incoming cohort, an official would need to move predecessor prefecture party secretaries and any official powerful enough to do so would be able to promote their favored bureaucrat directly.

Empirical tests

We provide several empirical tests to increase confidence in our identification strategy. For example, if cohort size were strategically manipulated, we would expect cohort size to be correlated with observable bureaucrat and placement characteristics. Table A2.4 shows no such correlations. Panel A shows that cohort size is uncorrelated with individual characteristics of the bureaucrat (ethnic minority status, province of origin, four of five measures of educational attainment).[16] Figure A2.6 also shows that age at entry is not correlated with the size of an official's starting cohort. This is reassuring, as age at entry is a likely proxy for connections or ability. 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. Similarly, especially capable CCP secretaries are able to climb the bureaucratic ladder faster and are younger when they

[16]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 5 that the results are robust to controlling for these individual CCP characteristics.

start their term. Both of these explanations are consistent with the finding in Table A2.3 that younger CCP secretaries have a higher probability of being promoted. We control for age in all subsequent regressions to increase precision.

Panels B and C of Table A2.4 show that a prefecture party secretary's starting cohort size is not correlated with pre-term characteristics of the prefecture or the province. In Panel B, we find no correlation between the starting cohort size and our main policy outcome variables measured the year before an official enters office, such as GDP growth, real estate investment as a percentage of GDP, rural land expropriation rate, urban growth and public goods provision. Panel C shows corresponding outcomes at the province level when available. These findings alleviate concerns that some officials marked for promotion might be assigned specifically to fast-growing regions and small starting cohorts.

Personnel churn

The main threat to identification is whether cohort size proxies for broader features of provincial personnel churn or promotion opportunities. In this context, it is especially reassuring to find the negative relationship between cohort size and promotion probability (see Table A2.3 and Figure A2.5). If promotion opportunities expanded proportionally with cohort size, then cohort size would not create meaningful variation in competitive intensity and would not predict promotion probability. The negative correlation we document is instead consistent with cohort size reflecting competitive pressure rather than the availability of promotion opportunities.

We present three additional pieces of evidence on this.

Provincial head turnover Table A2.4, Panel C, column 7, shows that cohort size is uncorrelated with turnover of the head of the province. Provincial head turnover is a natural summary measure of provincial-level personnel churn.[17] The provincial party secretary is personally involved in the promotion decisions of prefecture-level officials, and incoming provincial heads often install lower-level officials who are loyal to themselves.

[17]Data on provincial leader turnover are from Landry, Lü and Duan (2018).

Predecessors' promotion rates A related concern is that cohort size may be correlated with broader features of the provincial promotion environment. For example, provinces whose predecessors were recently promoted at high rates may differ systematically from provinces with less active promotion pipelines, and this could affect both cohort size and the type of bureaucrat placed in each prefecture. In Table A2.8, column 4, we show that our main results are robust to controlling for the rate at which prefecture party secretaries in the same province were promoted in the year before the focal bureaucrat's term began. This supports our interpretation that the effect of cohort size is driven by within-cohort competition rather than by province-year variation in upstream promotion activity.

Placebo test Table A1.1 shows that outcomes are not driven by the size of the previous cohort. If cohort size were serving as a proxy for persistent province-level personnel dynamics, we would expect lagged cohort size to also predict outcomes, but it does not.

4 Promotion incentives and policy choices

How do promotion incentives affect bureaucrats' policy choices? A larger cohort of prefecture party secretaries competing for promotion results in weaker promotion incentives for each bureaucrat. As their probability of being promoted declines, they can become discouraged from working to be promoted and might instead reallocate their effort to other tasks.[18] Empirically, we should thus see different policy choices and outcomes as the starting cohort size varies.

The following equation estimates the relationship between a prefecture CCP secretary's starting cohort size and subsequent prefecture-level outcomes during their term:

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

[18]Formally, this effect can be modeled by nesting a principal-agent multitasking problem (see, e.g. Holmstrom and Milgrom, 1991) within a rent-seeking contest game (see, e.g. Corchón and Serena, 2018; Pérez-Castrillo and Verdier, 1992; Tullock, 1980).

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.[19]

Economic growth

In Table A2.5, we show that GDP growth under a prefecture party secretary is higher when they face stronger promotion incentives, that is, when they enter office in a smaller cohort. A one standard deviation decrease in the size of the starting cohort (2.5 CCP secretaries) increases nominal GDP 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. As GDP growth is an important metric for official performance and promotion (see Section 2), this result is in line with our prediction that greater incentives should lead to more effort on promotion-relevant tasks.

In response to concerns about manipulation of the official GDP statistics, we show that results are consistent when using remote sensing data. A smaller cohort results in a higher percentile rank of a prefecture within a province in terms of night light growth (Table A2.5, column 3). This relationship is, however, less precisely estimated due to the measure's noisiness. We also find corresponding impacts on less politically important measures, such as sectoral GDP and employment growth (Tables A1.3 and A1.4). For more on robustness to data quality and manipulation concerns, see Section 5.

Construction-led growth

How are officials able to generate this additional growth during their short terms of less than three years? In Table A2.6 we show evidence of a shift towards construction-led

[19]This model implicitly assumes that β is invariant over an official's term and weights longer terms more than shorter ones. In Section 5, we show that our results are robust to relaxing both assumptions.

growth in response to promotion concerns. A decrease of one standard deviation in the size of a prefecture CCP secretary's starting cohort 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 entails an overall expansion of urban areas through expropriation of neighboring farmland. Using satellite data, we show in column 5 of Table A2.6 that prefectures, whose party secretaries are incentivized to expend more effort to get promoted, experience faster growth in their urban area. A smaller CCP secretary cohort increases the average prefecture-level land expropriation rate based on the CHARLS survey data (column 4 of Table A2.6). This effect is large: a one standard deviation decrease in a CCP secretary's starting cohort size leads to a 0.1 percentage point (or 15 percent) increase in expropriations.[20]

Public goods provision

When faced with stronger promotion incentives, bureaucrats reallocate their effort towards construction-led growth and away from other policies which are less visible and relevant for promotions. In Table A2.7, we study the impact of cohort size 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 normalize these 5 measures and aggregate them into an average z-score.[21] A one standard deviation increase in the cohort size increases this measure of

[20]In results not reported, we find that bureaucrats who expropriated more land are more likely to be investigated subsequently for corruption. Prefectures, where more rural land was expropriated, are also more likely to become "ghost cities", that is underutilized urban areas. For the farmers losing their lands, we find that being expropriated is associated with adverse outcomes later in life.

[21]Each variable is normalized 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 normalized

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.

We interpret these results as suggestive evidence of some substitution between upward and downward accountability. The presence of many rivals for promotion decreases each bureaucrat's chance of being promoted and dilutes the incentives to provide effort via construction-led growth which is visible to the higher-level officials deciding promotions. Knowing that their chances of being promoted and leaving the prefecture are lower, local officials may instead decide to provide more local public goods. This is optimal, if local officials derive some utility from their prefecture's overall welfare or become more reliant on the good will of the local population or the patronage of local elites (see Persson and Zhuravskaya, 2016).

5 Robustness checks

Controlling for potential omitted variables

We show in Section 3 that the starting cohort size is unrelated to observable characteristics of both the bureaucrat and their 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 A2.8, we show that our main results on policy outcomes remain broadly robust to including individual characteristics of the prefecture CCP secretaries.[22] 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.

indices.

[22]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.

Prior prefecture outcomes Column 3 of Table A2.8 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 A2.8 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.[23] This suggests that our findings are not driven by serial correlation in promotion probabilities.

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 A1.1. The coefficient on the placebo starting cohort size is never precisely estimated and does not show a pattern that matches our main results.

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.[24]

[23] 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.

[24] 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.

Column 5 of Table A2.8 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 A2.8 and find that the magnitude, sign and significance of our results are largely unchanged.

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.[25] Appendix Table **??** 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 their term. The magnitude of the effect of a one standard deviation decrease in the starting cohort size 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.[26]

[25] 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.

[26] 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.

Data quality concerns

Throughout the paper, we corroborate our results using data from multiple sources, such as administrative, survey and satellite data. 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 promotion incentives also affects less politically important measures, such as sectoral GDP growth and employment. Table A1.3 shows that having fewer rivals increases GDP growth across all sectors and in particular the secondary sector, consistent with a construction-led growth strategy. Employment growth is also affected correspondingly (Table A1.4).

Sensitivity to outliers The raw GDP figures reported in statistical yearbooks can exhibit very high variance and in our main specifications we trim our data to exclude the top and bottom outlying values of each variable.[27] Column 7 of Table A2.8 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 A1.1).[28] This in itself is not necessarily proof that the underlying data are manipulated.[29] We find that the absence or presence of some specific digits is associated with the size of a CCP secretary's starting cohort (Table A1.5). 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

[27] 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.

[28] 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 grid lines on a logarithmic scale" (Holz, 2014). This also applies to further digits following the first one (Smith, 1997).

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

significant at the 5 percent level: the distribution of decimal digits differs more from Benford's law when a CCP secretary has fewer rivals for promotion.[30] 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, in line with findings by Xu et al. (2025).

6 Conclusion

How do promotion incentives affect bureaucrats' performance and policy choices? We study local bureaucrats and their promotion paths and policy choices in China. We collect detailed biographical information about all prefecture leaders from 1996 to 2012 and combine it with administrative, survey and satellite data on economic outcomes during their term. We exploit plausibly exogenous variation in the ex-ante competitiveness of promotions to identify the effects of career incentives on a bureaucrat's policy choices when in office.

We proxy for the competitive pressure officials face by using the size of their cohort. We argue that a prefecture party secretary's main rivals for promotion are other prefecture party secretaries who start their term at the same time in the same province. This is because each prefecture party secretary works to be seen and promoted right from the start of their term and is evaluated for promotion by their immediate superiors in the same province. We verify empirically that being in a smaller cohort raises the probability that a given party secretary is promoted at the end of their term, thus delivering stronger career incentives. Cohort sizes vary due to the idiosyncratic timings of career moves by previous prefecture party secretaries, so they are predetermined with respect to the official's actions during their term. We verify that the starting cohort size is indeed uncorrelated with a range of observable characteristics of the individual bureaucrat and the prefecture and province where they are placed. We also show evidence against the main alternative interpretation of the results, namely that cohort size proxies for broader personnel churn in the province.

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

We find that stronger promotion incentives, due to a smaller starting cohort, leads to a shift towards highly visible construction-led growth at the expense of the wider provision of public goods. Furthermore, this additional growth is often only made possible through increased expropriation of rural land. Our results suggest that the high-powered career incentives embedded in the Chinese bureaucracy are successful in delivering better headline measures - but at potentially high social costs.

A1 Robustness Tables and Figures

Table A1.1: 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

Source: Authors' analysis based on Provincial Yearbooks, Wikipedia, Baidu Baike, National Bureau of Statistics City Statistical Yearbooks, China Health and Retirement Longitudinal Survey, Zhang, Pandey and Seto (2016) and Yao et al. (2018).
Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1997 and finish before 2011 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 A1.2: 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	-0.00095*	-0.00093*	-0.0011***	-0.0011***	-0.00091*	-0.00096*	-0.0010**
	(0.00052)	(0.00053)	(0.00038)	(0.00039)	(0.00051)	(0.00052)	(0.00039)
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

Source: Authors' analysis based on Provincial Yearbooks, Wikipedia, Baidu Baike and China Health and Retirement Longitudinal Survey.
Observations are at the respondent-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012. 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 normalized 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 A1.3: 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

Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Provincial Yearbooks, Wikipedia and Baidu Baike.
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 normalized 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 A1.4: 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

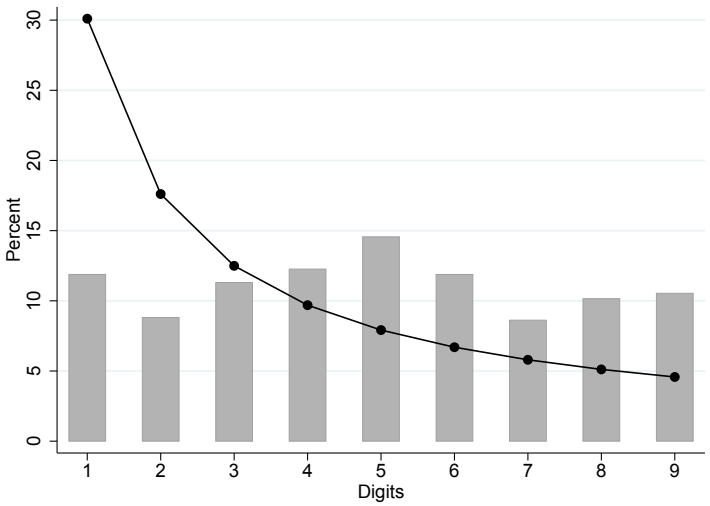
Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Provincial Yearbooks, Wikipedia and Baidu Baike.
Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012 and 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 normalized 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 A1.5: 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

Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Provincial Yearbooks, Wikipedia and Baidu Baike. Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012 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 normalized 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.

Figure A1.1: Second decimal digit distribution



Source: National Bureau of Statistics City Statistical Yearbooks.

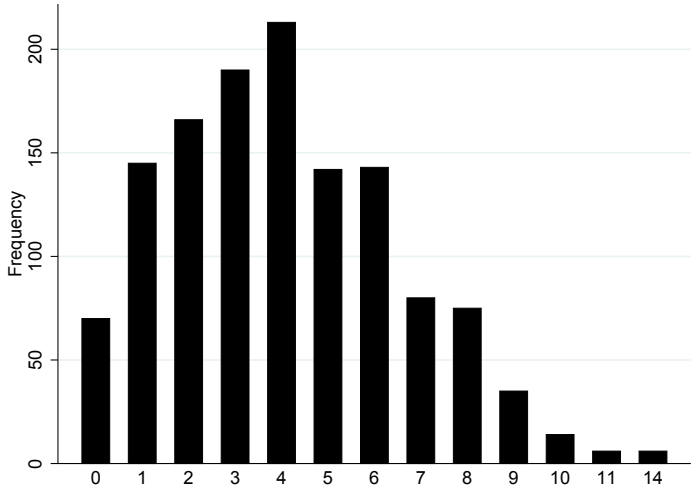
Note: This graph plots the actual distribution (gray bars) of the second decimal digits in reported real GDP growth rates and the distribution according to Benford's law (black connected dots). The underlying data are from the NBS City Statistical Yearbooks, 1996-2013.

A2 Detailed sample description

Bureaucrats

Table A2.1 shows descriptive statistics for prefecture party secretaries in China from 1996 to 2012. The average prefecture party secretary enters office when he is 50 years old with three other prefecture party secretaries from the same province. Figure A2.1 shows the distribution of the size of the starting cohort. Despite an official term length of five years, the average term is less than three years long, see Figure A2.2.

Figure A2.1: Size of starting cohort

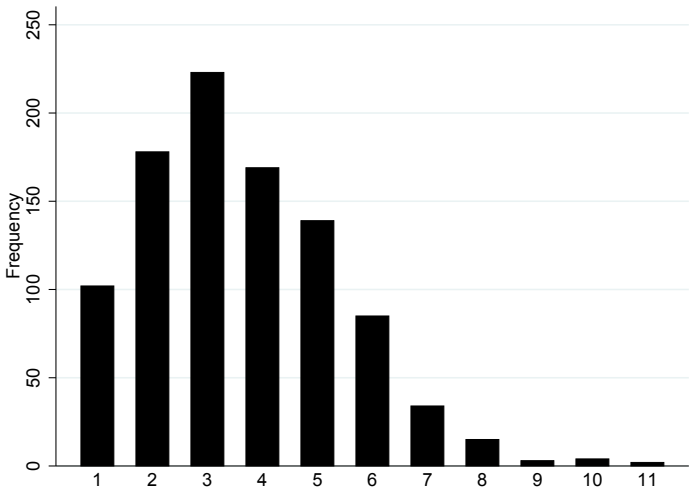


Source: Authors' compilation based on Provincial Yearbooks.

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 their career path in the years following their 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 they reach within two years of ending their term as a prefecture CCP secretary. We distinguish between vice-provincial cities and regular prefectures. Vice-provincial cities rank one level higher than regular prefectures, so that a move from a

Figure A2.2: Distribution of term lengths



Source: Authors' compilation based on Provincial Yearbooks.

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.

regular prefecture to a vice-provincial city is coded as a promotion.[31]

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.[32] This is a similar approach to Li and Zhou (2005), but at the prefecture- rather than provincial level. Prior to the anti-corruption campaign, outright dismissals and demotions were rare and were sometimes masked as early retirement.

Table A2.1 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.

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

[32]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.

Table A2.1: Term-level descriptive statistics

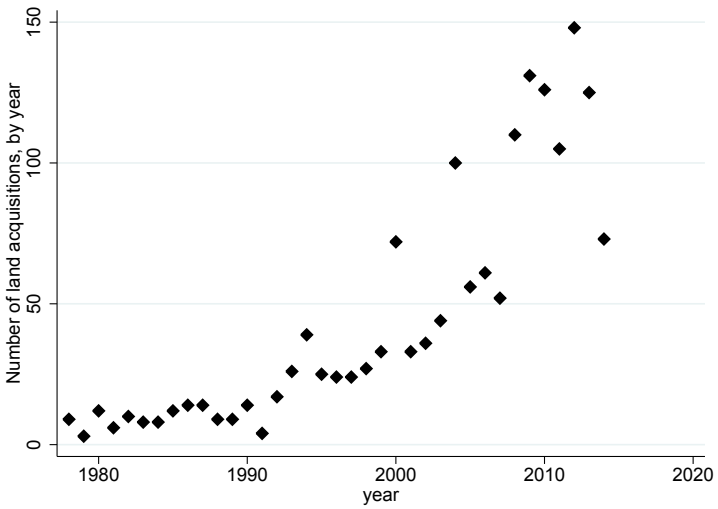
Variables	Mean	Std. deviation	Min	Max
Length of term	2.635	1.778	0	10
Age at entry	49.75	4.231	30	60
Size of starting cohort	4.072	2.524	0	14
Promotion (official rank)	0.526	0.500	0	1
Promotion (actual)	0.487	0.500	0	1
Retirement	0.263	0.440	0	1
Anti-corruption campaign arrest	0.126	0.332	0	1
Data availability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

Source: Authors' analysis based on Provincial Yearbooks, Wikipedia and Baidu Baike.
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.

Policy outcomes

Figure A2.3 shows the number of land expropriations recorded each year in the CHARLS survey. Expropriations increased rapidly in our sample period between 1996 and 2012.

Figure A2.3: Land expropriations, CHARLS survey



Source: China Health and Retirement Longitudinal 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 A2.2 shows summary statistics for the prefecture-year panel used in the main analysis.

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Table A2.2: 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	0.135	0.232	-0.488	7.908
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

Source: National Bureau of Statistics City Statistical Yearbooks, China Health and Retirement Longitudinal Survey, Zhang, Pandey and Seto (2016) and Yao et al. (2018).
The statistics are computed on our main estimation sample, the 2899 prefecture-year observations where macroeconomic data and CCP secretary characteristics are available.

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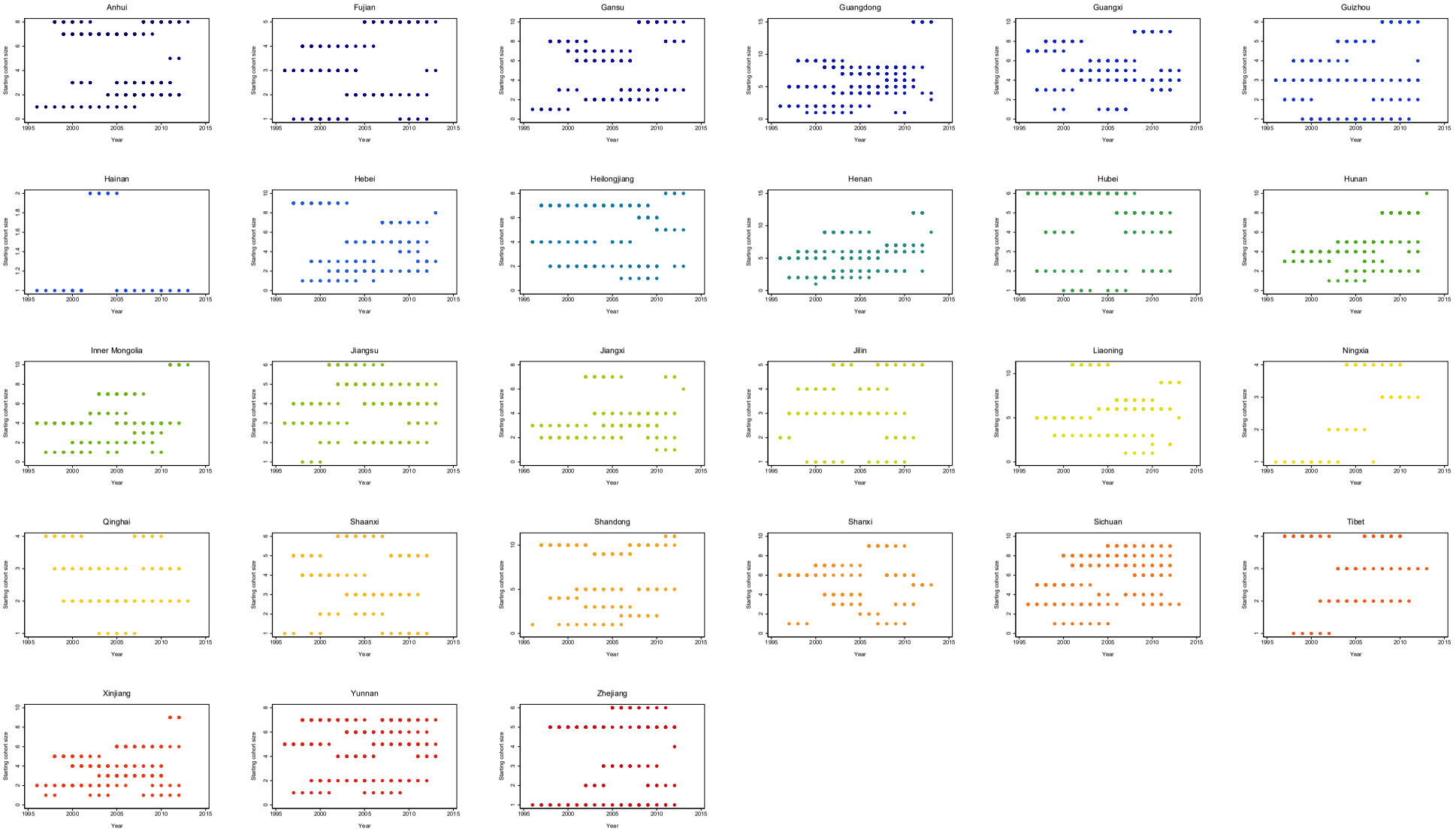
Figures

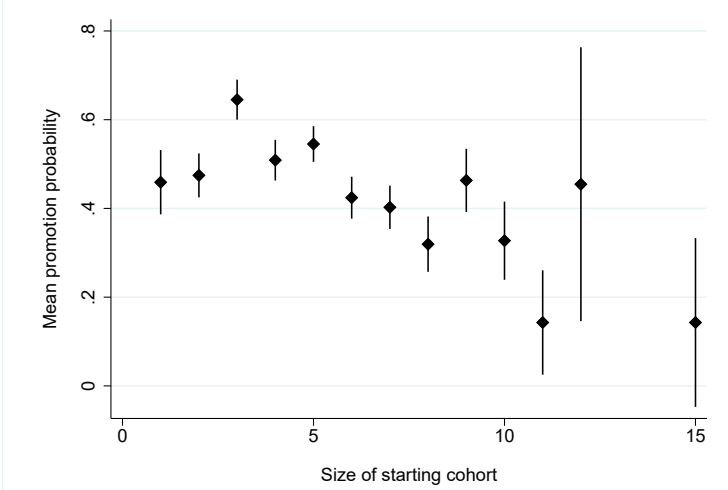
Figure A2.4: Size of starting cohort across provinces



Source: Authors' compilation based on Provincial Yearbooks.

Note: These graphs plot the sizes of the starting cohorts of prefecture-level party secretaries per year in each province.

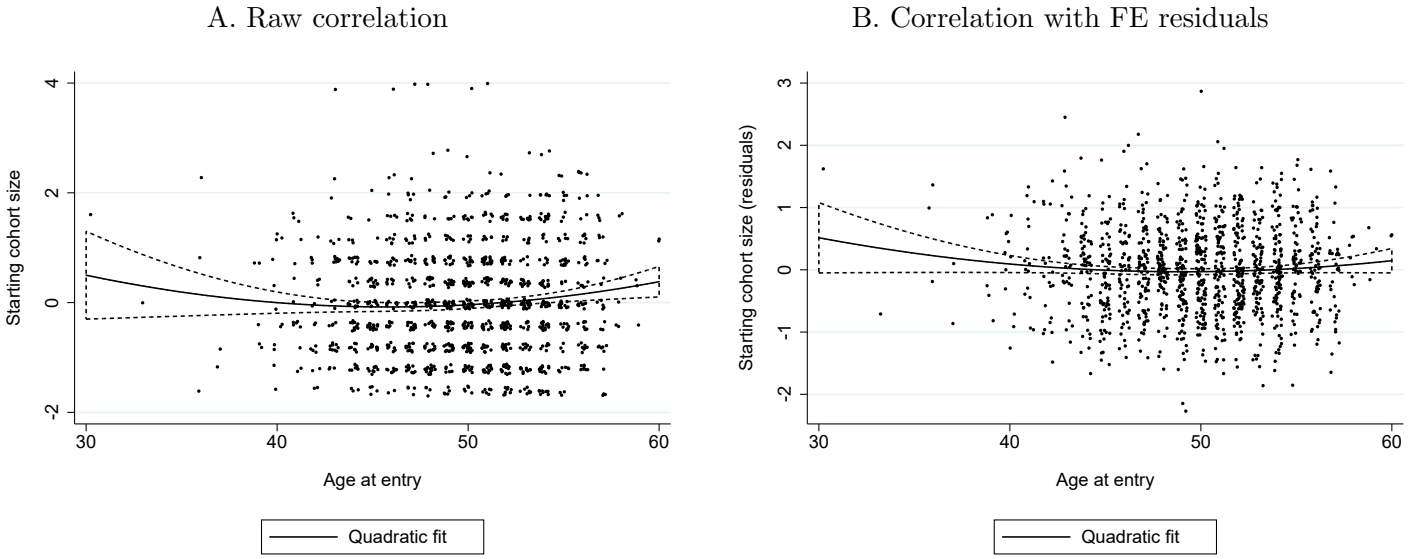
Figure A2.5: Promotion probability and size of starting cohort



Source: Authors' analysis based on Provincial Yearbooks, Wikipedia and Baidu Baike.

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 A2.6: Size of starting cohort and CCP secretary's age



Source: Authors' analysis based on Provincial Yearbooks, Wikipedia and Baidu Baike.

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.

Tables

Table A2.3: 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

Source: Authors' analysis based on Provincial Yearbooks, Wikipedia and Baidu Baike.
Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012 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 normalized 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 A2.4: 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
Panel C: Province-level characteristics before beginning of term							
	GDP growth (nominal)	GDP growth secondary (nominal)	GDP growth Construction (nominal)	Real Estate investment % GDP	#Teachers per cap.	#Doctors per cap.	Province head turnover
Size of starting cohort	-0.000433	-0.00220	-0.00122	-0.000495	-0.0881	-0.195	-0.00662
	(0.000905)	(0.00146)	(0.00237)	(0.000657)	(0.0971)	(0.162)	(0.00988)
Nb. of obs.	628	628	628	465	422	422	628
Nb. of clusters	261	261	261	191	173	173	261

Source: Authors' analysis based on Provincial Yearbooks, Wikipedia, Baidu Baike, National Bureau of Statistics City Statistical Yearbooks, China Health and Retirement Longitudinal Survey, Zhang, Pandey and Seto (2016) and Yao et al. (2018).
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 characterized 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), real estate 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). The dependent variables are provincial level characteristics in the year before a party secretary's term starts in Panel C: nominal GDP growth (column 1), nominal GDP growth in the secondary sector (column 2), construction-sector GDP growth (column 3), real estate investment as a share of GDP (column 4), number of primary school teachers per capita (column 5), number of doctors per capita (column 6) and an indicator for whether the party secretary of the province leaves office (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 A2.5: 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

Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Zhang, Pandey and Seto (2016), Provincial Yearbooks, Wikipedia and Baidu Baike.
Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012 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 normalized 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 A2.6: 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

Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Yao et al. (2018), China Health and Retirement Longitudinal Survey (CHARLS), Provincial Yearbooks, Wikipedia and Baidu Baike.
Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012 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 normalized 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 A2.7: 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

Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Provincial Yearbooks, Wikipedia and Baidu Baike.

Observations are at the prefecture-year level. The sample only includes observations during terms that start at the earliest in 1996 and finish before 2012 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 normalized 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 A2.8: 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

Source: Authors' analysis based on National Bureau of Statistics City Statistical Yearbooks, Provincial Yearbooks, Wikipedia and Baidu Baike.
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 2012 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 normalized to have a mean of 0 and standard deviation of 1. Column 1 shows the main specification, which corresponds to Tables A2.5, A2.6 and A2.7. 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 A2.4). 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.