

# Career Incentives and GDP Falsification

Shengqi Ni<sup>1</sup> and Junyan Jiang<sup>2</sup>

<sup>1</sup>Department of Economics, Boston University

<sup>2</sup>Department of Political Science, Columbia University

**This Version: January, 2024**

## Abstract

Evaluating politicians' competence often hinges on economic performance, giving them incentives to manipulate statistics. In this paper, we construct a tournament-style political competition model where politicians decide effort and falsification levels. The degree of manipulation depends on politicians' career lengths and relative costs to deliver actual growth. Applying this model to analyze 287 Chinese prefecture cities' GDP growth data reveals the following empirical patterns: younger politicians have lower development costs, yield higher real economic growth and engage in less falsification. Additionally, within individuals, falsification decreases over a politician's career.

**Keywords:** Political Selection, Career Incentive, Data Manipulation

# 1 Introduction

Understanding how politicians' career incentives shape their behaviors is one of the most important questions in political economy. Politicians employ various strategies to enhance their chances of winning the elections (if they are selected by people) or being promoted (if they are selected by superiors). When evaluating politicians' competence, economic development during their term is usually a primary concern. However, to deliver higher GDP growth, politicians can choose to either work harder or manipulate statistics more. Notably, data manipulation is prevalent in non-democratic nations, where information asymmetry is more pronounced. A recent study by [Martinez \(2022\)](#) found that autocracies tend to overstate yearly GDP growth by approximately 35%. In this paper, I exploit the variation in GDP falsification at the sub-national level within a country and study how local politicians' characteristics affect their manipulation behaviors.

China provides an ideal institutional setting for investigating the relationship between career incentives and GDP falsification. First, local officials are mainly evaluated by superiors based on economic metrics like GDP growth rate and fiscal revenue, which fosters a competitive environment (tournament) among officials to drive economic development ( [Li and Zhou \(2005\)](#), [Xu \(2011\)](#), [Cheung \(2014\)](#) [Jia, Kudamatsu, and Seim \(2015\)](#)). Under such an evaluation system, local officials are motivated to manipulate the local statistics to boost their performance. Second, regional GDP statistics are collected and reported by regional statistics bureaus, which are under the direct control of the local governments. For example, county-level GDP is calculated by county-level statistics bureau, and prefectural-level GDP is calculated by prefecture-level statistics bureau, and so on. This setting gives local government a huge scope to manipulate economic statistics. Anecdotal evidence suggests that before submitting the economic statistics to the central bureau, local bureau of statistics is required to send the statistics to the local government for review and these statistics are subject to adjustments by local governments. In February 2012, the national bureau of statistics launched an Online Reporting System (ORS), all above-scale enterprises were required to submit their raw data directly to NBS annually. However, this did not stop the data fabrication by local governments. For example, Henglan county in Guangdong Province reported 8.51 billion RMB in industrial output in 2012. After being audited by NBS, the real industrial output turned out to be 2.22 billion RMB, which is less than one-third of the reported value<sup>1</sup>. [Figure 1](#) presents the weighted average GDP growth rates reported at the national-, provincial-, and prefectural-level. There is a substantial discrepancy between national statistics and provincial statistics; and between provincial statistics and prefectural

---

<sup>1</sup>[http://cn.chinagate.cn/economics/2013-06/17/content\\_29140815.htm](http://cn.chinagate.cn/economics/2013-06/17/content_29140815.htm)

statistics. From 1999 to 2016, the weighted average GDP growth rate at the prefectural level is 11.73%, while this number is 11.06% at the provincial level and 9.33% at the national level. The widening gap along the jurisdiction levels can be explained by lower-level officials having stronger incentives to manipulate and it is harder for the central authority to monitor the behaviors of lower-level officials.

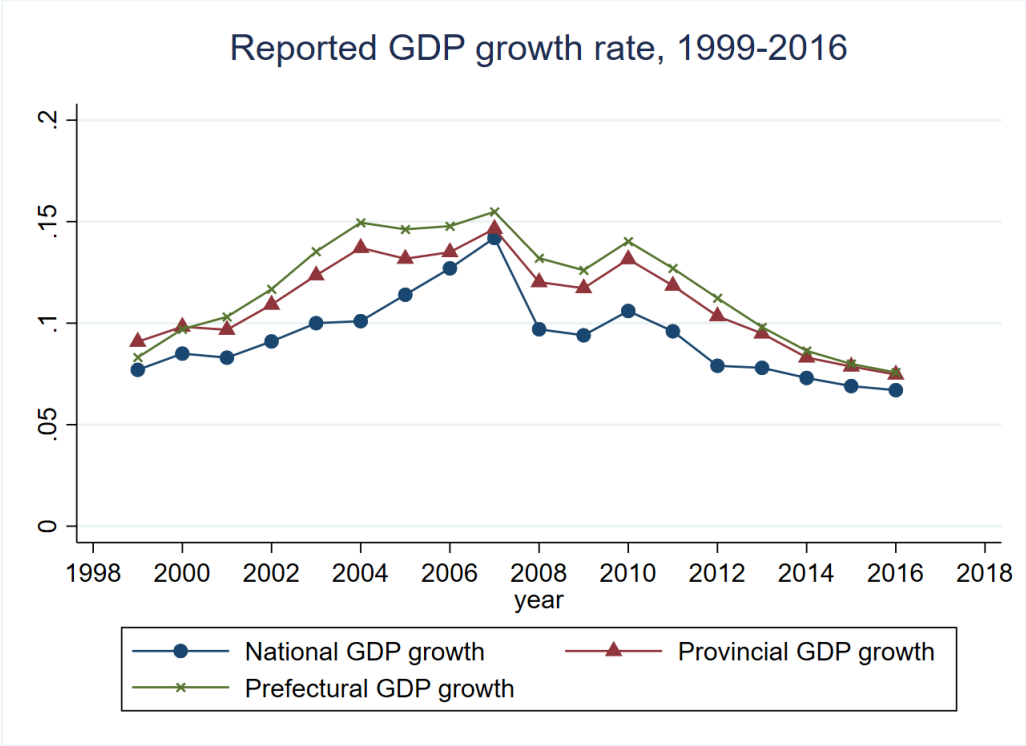


Figure 1: AVERAGE GDP GROWTH RATE REPORTED BY DIFFERENT LEVELS OF GOVERNMENTS IN CHINA. This figure shows the average GDP growth rate reported by different levels of government in China, weighted by regional GDP. National-level and provincial-level data come from the National Bureau of Statistics. City-level data come from City Statistical Yearbooks.

In this paper, we construct a tournament-style model wherein low-level politicians strive for promotion based on their performance. These officials have the autonomy to determine their effort levels and engage in risky behavior to enhance their performance. Variability among officials lies in their remaining career length and the cost of delivering genuine growth relative to fabricated performance. In this context, younger politicians will exert more effort and engage in more manipulation, capitalizing on the prospect of a more extended period of high utility upon promotion. Conversely, politicians with lower costs for achieving actual growth are inclined to manipulate less, recognizing the substitutability of effort and manipulation in overall performance production. Our empirical findings align with this model, suggesting that younger politicians indeed have lower costs for delivering growth.

In this paper, we build a tournament-style model wherein low-level politicians strive for promotion based on their performance. These officials determine their effort levels and may

engage in risky behavior like statistical manipulation to enhance their performance. Officials are different in their remaining career length and cost of delivering real performance relative to fabricated performance. When politicians only differ in the remaining career length, younger politicians will exert more effort and engage in more manipulation since they can enjoy a more extended period of high utility upon promotion. When politicians only differ in the relative costs for achieving actual growth, politicians with lower costs will manipulate less since effort and manipulation are substitutable in overall performance production.

To estimate the extent of GDP falsification in different periods and cities, we employ various alternative economic indicators, which are not likely to be manipulated by local governments. Following [Pinkovskiy and Sala-i-Martin \(2016\)](#)'s framework and with some additional assumptions, we decompose reported GDP growth into realized and falsified components. Subsequently, we examine the relationship between city leaders' characteristics and falsification level. We find across individuals, young politicians deliver higher actual economic growth, and engage in less falsification. Within an individual, the falsification decreases along a politician's career. Our empirical findings align with the predictions of the theoretical model, suggesting that younger politicians have lower relative costs for delivering growth.

The rest of the paper is organized as follows. [Section 2](#) reviews the related literature. [Section 3](#) introduces the theoretical framework. [Section 4](#) describes the data and our empirical methodology. [Section 5](#) tests multiple predictions of our model regarding the falsification behaviors of different politicians. [Section 6](#) concludes.

## 2 Literature Review

Our paper is related to the extensive literature examining how career concerns influence politicians' behavior. In democratic regimes, politicians' behaviors are often driven by the motivation to win elections. For instance, numerous literature has found politicians adopt expansionary fiscal and monetary policies in election years to enhance their chances of reelection ([Nordhaus \(1975\)](#), [Alesina and Roubini \(1992\)](#), [Drazen \(2000\)](#) ). [Levitt \(1997\)](#) shows that the size of police forces increases disproportionately in mayoral and gubernatorial election years. Conversely, lame-duck politicians, ineligible for reelection, tend to prioritize their own preferences over voters' preferences ([Besley and Case \(1995\)](#), [Ferraz and Finan \(2011\)](#), [De Janvry, Finan, and Sadoulet \(2012\)](#)). For example, [Aruoba, Drazen, and Vlaicu \(2019\)](#) find that the possibility of reelection leads to a 13 percentage point increase in the fraction of US governors who exert high effort in their first term in office, as measured by voters' job approval. Under nondemocratic regimes, such as China, where politicians still care about

getting ahead along the political hierarchy. They are incentivized to deliver better performance defined by their superiors, who have authority in promotion decisions. The promotion incentive affects various public policies. [Piotroski and Zhang \(2014\)](#) find that the rate of exchange eligible firms engaging in an IPO temporarily increases in advance of impending political promotion events. [Lü and Landry \(2014\)](#) find strong evidence for an inverse U-shaped relationship between the intensity of political competition (proxied by the number of county-level jurisdictions within a prefecture) and fiscal revenues. [Xi, Yao, and Zhang \(2018\)](#) show that there is a significant boost in the growth rate preceding the Communist Party’s national congress. [Wang, Zhang, and Zhou \(2020\)](#) finds that city leaders with higher career incentives (measured by start age, and start position level) exhibit significant outward city expansion. Our study extends this literature by showing that the promotion incentive not only motivates politicians to exert more effort but also encourages risky behaviors such as statistical fabrication. We provide a new piece of evidence that the degree of this behavior depends on politicians’ types and career concerns.

Our paper also contributes to the literature on the reliability of government statistics<sup>2</sup>. Previous studies have questioned the credibility of the official statistics produced by authoritarian regimes like China ([Cai \(2000\)](#), [Rawski \(2001\)](#), [Fernald, Hsu, and Spiegel \(2015\)](#)). [Rawski \(2001\)](#) presents a detailed critique of GDP statistics in China over the period 1997–2001 and speculates that cumulative GDP growth was no more than one-third of official claims. [Ma et al. \(2014\)](#) find there are big discrepancies between China’s national aggregate statistical values and the sum of provincial figures, and the industrial sector contributes the most to the gap. By adjusting national GDP by the difference between value-added growth reported by NBS and value-added tax revenue growth reported by the State Administration of Taxation, [Chen et al. \(2019\)](#) estimate that the GDP growth from 2010 to 2016 is 1.8 percentage points lower than the official growth rate. On the contrary, a lot of studies claim that national statistics in China are generally accurate. [Mehrotra and Pääkkönen \(2011\)](#) use factor analysis to summarize information from 83 macroeconomic indicators, and compare the dynamics of the estimated factors with GDP. Their factors closely match the GDP dynamics and the discrepancies between them are small. [Holz \(2014\)](#) evaluates the quality of

---

<sup>2</sup>There is a strand of literature using innovative data sources to assess and complement the development statistics provided by governments ([Deaton \(2005\)](#); [Chen and Nordhaus \(2011\)](#); [Henderson, Storeygard, and Weil \(2012\)](#); [Young \(2012\)](#); [Pinkovskiy and Sala-i-Martin \(2016\)](#) provides a framework on how to calculate the relative weights on alternative measures when predicting economic growth. Their key identification assumption is that the measurement error of one indicator (satellite-recorded data on nighttime lights) is independent of the measurement errors of other indicators. A limitation of their framework is that they can only identify the ratios of optimal weights, not the absolute value of optimal weights. I add an extra assumption to make the whole system identifiable: the expected true GDP growth rate across cities should equal the national GDP growth rate.

China's GDP statistics from various perspectives and concludes that there is no compelling evidence for GDP falsification at the national level. [Nakamura, Steinsson, and Liu \(2016\)](#) use systematic discrepancies between cross-sectional and time-series Engel curves to construct alternative estimates of Chinese growth and inflation. They find official national-level statistics present a smoothed version of reality, but there is no evidence that the growth rate (of urban consumption) was systematically overstated. Apply the methodology of [Pinkovskiy and Sala-i-Martin \(2016\)](#) on Chinese data, [Clark, Pinkovskiy, Sala-i-Martin, et al. \(2020\)](#) find that the Chinese true growth rate is considerably higher than is reported in the official statistics during 2003-2012. Besides economic statistics, other statistics are subject to manipulation once they are related to the promotion incentive of officials (see [Fisman and Wang \(2017\)](#) on accidental deaths, [Chen et al. \(2012\)](#), [Ghanem and Zhang \(2014\)](#) on Air Pollution Index, [Greenstone et al. \(2022\)](#) on PM10 concentrations.) Our research advances this debate by introducing a method to estimate true economic growth using alternative indicators and identify the GDP falsification at the sub-national level. The variation of falsification levels across time and locations enables us to study how career incentives affect politicians' cheating behaviors

Some studies try to explore the factors influencing falsification behaviors. [Tsai \(2008\)](#) finds that village cadres were less likely to inflate village income per capita when they were cadre-entrepreneurs, when they were located in villages with well-implemented elections, when they were embedded in village-wide solidary groups such as temples and lineages, when they experienced less direct supervision from township officials, and when they relied less on revenue from village levies. [Wallace \(2016\)](#) observes an increased gap between provincial GDP and electricity growth rates during leadership turnover. He argues that with promotions on the line, sub-national leaders tend to overestimate GDP growth during political turnovers as a signal of competence and success. [Lyu et al. \(2018\)](#) find strong evidence of discontinuities around zero in the distribution of actual minus target GDP growth rates. The frequencies of just meeting or beating GDP growth targets are about five (four) times the frequencies of just missing targets at the prefecture (province) level. The results are stronger for governors with longer tenures and those without political connections to higher-level officials as well as for local governments with more resources under their control. In a closely related paper, [Chen, Qiao, and Zhu \(2021\)](#) construct a two-period model. In each period, there are many officials who choose the level of "chasing" effort and "cheating" effort. Since the marginal benefit of making an additional effort decreases with tenure, they predict that officials choose to reduce both kinds of effort in the second period. They find that county officials, who are in the first term expect a higher chance of being promoted, undertake more cheating efforts to manipulate GDP than those in the second term. [Zhou and Zeng \(2018\)](#) find that compared

to mayors who are ineligible for promotion due to age restriction, reported GDP is 2% to 3% higher for eligible mayors, while the night-time light growth is merely 0.5% higher. Our research looks at another important dimension: politicians' age and offers a comprehensive perspective on the falsification behaviors along a politician's career.

### 3 Career Concern with Heterogeneous Agents

#### 3.1 Basic Setting

To simplify the analysis, we posit a system with two hierarchical positions: low-level and high-level, and the difference in their values to agents is denoted as  $V = V_H - V_L$ . All officials start their careers at the low-level position and face decisions regarding the level of effort  $e$  and risky behavior  $f$ , Effort  $e$  represents works like spending time to attract entrepreneurs and making strategic investments through local government financing vehicles, which affects real GDP growth. The risky behavior  $f$  is the GDP falsification level. In a broad sense, risky behavior can be understood as any action that positively influences the chances of promotion while risking inspection and punitive measures by the Party. Taking GDP falsification as an example, on the one hand, more falsification leads to higher reported economic growth, which can increase official's promotion prospects. On the other hand, more falsification also increases the probability of being caught and punished by the Party. Other examples include exempt regulations for firms or corruption for greasing the wheels. By striking special deals for connected businessmen, officials may be able to deliver better performance but also face the risk of being sanctioned. We assume the realized GDP growth rate is  $g(e)$  and the reported GDP growth rate is  $g(e) + f$ . It is natural to assume  $g'(e) > 0$  and  $g''(e) < 0$ . The cost function, denoted as  $C(e, f)$ , adheres to conditions where  $\frac{\partial C}{\partial e} > 0$ ,  $\frac{\partial C}{\partial f} > 0$ ,  $\frac{\partial^2 C}{\partial e^2} > 0$ ,  $\frac{\partial^2 C}{\partial f^2} > 0$ . We also assume additive separability in costs, for example:  $c(e, f) = \frac{1}{2}c_e e^2 + \frac{1}{2}c_f f^2$ .

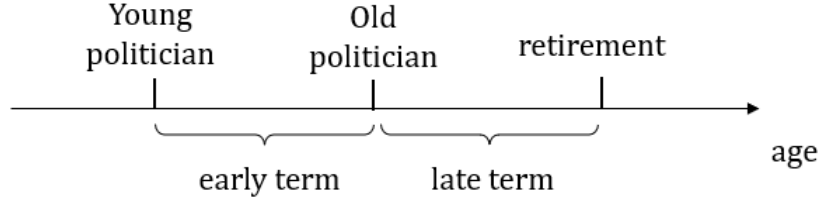
Local officials engage in a Tullock contest for promotion, basing their success on reported economic growth. The contest success function (hereafter referred to as CSF) takes the following ratio form  $p(e_i, f_i) = \frac{\phi(e_i, f_i)}{\sum_{i=1}^{i=2} \phi(e_i, f_i)}$ . There are various choices of the function  $\phi$ . For example, the simple linear case is:  $p(e_i, f_i) = \frac{g(e_i) + f_i}{\sum_{i=1}^{i=2} g(e_i) + f_i}$ .

The "exponential" form is:  $p(e_i, f_i) = \frac{e^{g(e_i) + f_i}}{\sum_{i=1}^{i=2} e^{g(e_i) + f_i}}$ .

The "power" form is:  $p(e_i, f_i) = \frac{(g(e_i) + f_i)^\epsilon}{\sum_{i=1}^{i=2} (g(e_i) + f_i)^\epsilon}$ .

#### 3.2 Career Concern only

Consider two identical politicians except for ages. A young politician has two terms left before retirement, and an old politician has only one term left before retirement.



The optimization problem for the old politician is:

$$\max_{e_i, f_i} \underbrace{p(e_i, f_i)}_{\text{prob of being promoted}} * \underbrace{V}_{\text{reward if promoted}} - C(e_i, f_i) \quad (1)$$

Given the opponent's strategy  $(\hat{e}_{early}, \hat{f}_{early})$ , the optimal levels  $e_{late}^*$  and  $f_{late}^*$  satisfy the following first-order conditions:

$$\frac{\partial p(e_{late}, f_{late}, \hat{e}_{early}, \hat{f}_{early})}{\partial e_{late}^*} * V = \frac{\partial C(e_{late}, f_{late})}{\partial e_{late}^*} \quad (2)$$

$$\frac{\partial p(e_{late}, f_{late}, \hat{e}_{early}, \hat{f}_{early})}{\partial f_{late}^*} * V = \frac{\partial C(e_{late}, f_{late})}{\partial f_{late}^*} \quad (3)$$

The young politician's optimization problem is as follows:

$$\begin{aligned} \max_{e_{early}, f_{early}} & \underbrace{p(e_{early}, f_{early})}_{\text{prob of being promoted in early term}} * \underbrace{2V}_{\text{reward if promoted in early term}} + \underbrace{(1 - p(e_{early}, f_{early}))}_{\text{prob of not being promoted in early term}} * \underbrace{p(e_{late}, f_{late})}_{\text{prob of being promoted in late term}} * V \\ & - C(e_{early}, f_{early}) - C(e_{late}, f_{late}) \end{aligned} \quad (4)$$

With probability  $p(e_{early}, f_{early})$ , the young politician is promoted to the high-level position at the end of the first period, so he can enjoy the reward  $V$  for two periods. With probability  $1 - p(e_{early}, f_{early})$  the young politician does not get promoted in the first period. In the second period he faces a similar maximization problem as the old politician. Here we assume that when he becomes old, he will compete with a new young or old politician with some random probabilities. Using backward induction, he will choose  $e'_{late}$  and  $f'_{late}$  in the second period. Given opponent's strategy  $(\hat{e}_{late}, \hat{f}_{late})$  the optimal level of  $e_{early}^*$  and  $f_{early}^*$  satisfy the following first-order conditions:

$$\frac{\partial p(e_{early}, f_{early}, \hat{e}_{late}, \hat{f}_{late})}{\partial e_{early}^*} * (2 - p(e'_{late}, f'_{late}))V = \frac{\partial C(e_{early}, f_{early})}{\partial e_{early}^*} \quad (5)$$

$$\frac{\partial p(e_{early}, f_{early}, \hat{e}_{late}, \hat{f}_{late})}{\partial f_{early}^*} * (2 - p(e'_{late}, f'_{late}))V = \frac{\partial C(e_{early}, f_{early})}{\partial f_{early}^*} \quad (6)$$

**Proposition 1.** (comparing across individuals) If the function  $p$  and  $C$  are symmetric across politicians, then  $e_{early}^* > e_{late}^*$ , and  $f_{early}^* > f_{late}^*$ .

*Proof.* Comparing the FOC (2) by FOC (5), since  $2 - p(e'_{late}, f'_{late}) > 1$ , the LHS of FOC (5) is larger, therefore  $\frac{\partial C(e_{early}, \cdot)}{\partial e_{early}^*} > \frac{\partial C(e_{late}, \cdot)}{\partial e_{late}^*}$ . Since  $C$  is strictly convex,  $e_{early}^* > e_{late}^*$ . Similarly, Comparing the FOC (3) by FOC (4), we have  $\frac{\partial C(\cdot, f_{early})}{\partial e_{early}^*} > \frac{\partial C(\cdot, f_{late})}{\partial e_{late}^*}$ , therefore  $f_{early}^* > f_{late}^*$   $\square$

Intuitively, young officials have longer future careers. The marginal benefit of performing well is larger since they can enjoy a longer period of high utility if they get promoted. Compared to the old official, he exerts higher effort and falsifies more.

**Proposition 2.** (comparing within individual) If the function  $p$  and  $C$  are symmetric across politicians, then  $e_{early}^* > e'_{late}$  and  $f_{early}^* > f'_{late}$ .

*Proof.* In the second period, suppose the old politician will compete with a young opponent with probability  $\alpha$ , or compete with an old opponent with probability  $1 - \alpha$ . The FOC of the politician in the second period is:

$$\alpha \frac{\partial p(e_{late}, f_{late}, e_{early}^*, f_{early}^*)}{\partial e'_{late}} * V + (1 - \alpha) * \frac{\partial p(e_{late}, f_{late}, e_{late}^*, f_{late}^*)}{\partial e'_{late}} * V = \frac{\partial C(e_{late}, f_{late})}{\partial e'_{late}} \quad (7)$$

Note that  $p(e_i, f_i) = \frac{\phi(e_i, f_i)}{\phi(e_i, \cdot) + \phi(e_{opponent}, f_{opponent})}$

$$\frac{\partial p(e_i, \cdot)}{\partial e_i} = \frac{\frac{\partial \phi(e_i, \cdot)}{\partial e_i} * \phi(e_{opponent}, \cdot)}{(\phi(e_i, \cdot) + \phi(e_{opponent}, \cdot))^2}$$

Taking the derivative with respect to  $e_{opponent}$ , we obtain:

$$\frac{\partial^2 p(e_i, \cdot)}{\partial e_i \partial e_{opponent}} = \frac{\partial \phi(e_i, \cdot)}{\partial e_i} \frac{\frac{\partial \phi(e_{opponent}, \cdot)}{\partial e_{opponent}} * [(\phi(e_i, \cdot) + \phi(e_{opponent}, \cdot))^2 - \phi(e_{opponent}, \cdot) * 2(\phi(e_i, \cdot) + \phi(e_{opponent}, \cdot))]}{(\phi(e_i, \cdot) + \phi(e_{opponent}, \cdot))^4}$$

$$\frac{\partial^2 p(e_i, \cdot)}{\partial e_i \partial e_{opponent}} = \frac{\partial \phi(e_i, \cdot)}{\partial e_i} \frac{\frac{\partial \phi(e_{opponent}, \cdot)}{\partial e_{opponent}} * (\phi(e_i, \cdot) - \phi(e_{opponent}, \cdot))}{(\phi(e_i, \cdot) + \phi(e_{opponent}, \cdot))^3}$$

Therefore:  $\frac{\partial^2 p(e_i, \cdot)}{\partial e_i \partial e_{opponent}} < 0$  iff  $e_i < e_{opponent}$ .

We have shown  $e_{early}^* > e_{late}^*$ , then

$$\alpha \frac{\partial p(e_{late}, f_{late}, e_{early}^*, f_{early}^*)}{\partial e'_{late}} + (1 - \alpha) * \frac{\partial p(e_{late}, f_{late}, e_{late}^*, f_{late}^*)}{\partial e'_{late}} < \frac{\partial p(e_{late}, f_{late}, e_{late}^*, f_{late}^*)}{\partial e'_{late}}$$

Comparing FOC (5) and (7), the LHS of FOC (5) is larger, since  $C$  is strictly convex,  $e_{early}^* > e'_{late}$ . Similarly,  $f_{early}^* > f'_{late}$ .  $\square$

Intuitively, there are two reasons why a politician will exert higher effort in the early stage of his career. First, he can enjoy the reward longer if he gets promoted earlier. Second, a young politician is competing with an old politician in period 1, but may compete with a young politician in period 2 if he does not get promoted and stays in his current position. Competing with a more motivated opponent leads to a lower marginal benefit of exerting effort. To summarize, under the career concern-only setting, we have the following results:

	young politician	old politician
effort	high	low
falsification	high	low

Table 1: PREDICTION OF THE CAREER CONCERN-ONLY MODEL.

### 3.3 Heterogeneous costs only

We will show later that the above predictions are not enough to explain all the empirical findings. Therefore, we introduce another dimension: heterogeneous costs to deliver real growth. Specifically, low-cost politicians have a lower marginal cost of effort:  $\frac{\partial C^{low}}{\partial e} < \frac{\partial C^{high}}{\partial e}, \forall e \geq 0$ . Simply comparing two identical politicians except for costs of effort, assuming they both have 1 term left. The FOC of

$$\frac{\partial p(e_i, f_i, e_{-i}, f_{-i})}{\partial e_i^*} * V = \frac{\partial C(e_i, f_i)}{\partial e_i^*} \quad (8)$$

$$\frac{\partial p(e_i, f_i, e_{-i}, f_{-i})}{\partial f_{*i}} * V = \frac{\partial C(e_i, f_i)}{\partial f_{*i}} \quad (9)$$

**Proposition 3.** (*Heterogeneous costs*) If  $\frac{\partial C^{low}}{\partial e} < \frac{\partial C^{high}}{\partial e}, \forall e \geq 0$  and  $g(e)$  and  $f$  are perfect substitutes (i.e., the success probability depends on  $g(e) + f$ ), then  $e_{low}^* > e_{high}^*$ , and  $f_{low}^* < f_{high}^*$ .

*Proof.* (We present a simple case here and the complete proof is in the appendix) Assume  $P(e_i, f_i, e_{-i}, f_{-i}) = \frac{e_i + f_i}{e_i + f_i + e_{-i} + f_{-i}}$ ,  $c(e_i, f_i) = \frac{1}{2}c_e e^2 + \frac{1}{2}c_f f^2$ , low-cost official has a lower marginal cost to develop real economy:  $c_e^{low} < c_e^{high}$ . The FOCs for the low-cost official are:

$$\frac{\hat{e}_{high} + \hat{f}_{high}}{(e_{low} + f_{low} + \hat{e}_{high} + \hat{f}_{high})^2} * V = c_e^{low} e_{low}^* \quad (10)$$

$$\frac{\hat{e}_{high} + \hat{f}_{high}}{(e_{low} + f_{low} + \hat{e}_{high} + \hat{f}_{high})^2} * V = c_f f_{low}^* \quad (11)$$

The FOCs for the high-cost official are:

$$\frac{\hat{e}_{low} + \hat{f}_{low}}{(e_{high} + f_{high} + \hat{e}_{low} + \hat{f}_{low})^2} * V = c_e^{high} e_{high}^* \quad (12)$$

$$\frac{\hat{e}_{low} + \hat{f}_{low}}{(e_{high} + f_{high} + \hat{e}_{low} + \hat{f}_{low})^2} * V = c_f f_{high}^* \quad (13)$$

In equilibrium,  $\hat{e}_{high} = e_{high}^*$ ,  $\hat{f}_{high} = f_{high}^*$ ,  $\hat{e}_{low} = e_{low}^*$ ,  $\hat{f}_{low} = f_{low}^*$ .  
Divide (10) by (11), we obtain:

$$c_e^{low} e_{low}^* = c_f f_{low}^* \quad (14)$$

Divide (12) by (13), we obtain:

$$c_e^{high} e_{high}^* = c_f f_{high}^* \quad (15)$$

Divide (10) by (12), we obtain:

$$\frac{e_{high}^* + f_{high}^*}{e_{low}^* + f_{low}^*} = \frac{c_e^{low} e_{low}^*}{c_e^{high} e_{high}^*} \quad (16)$$

Substituting  $f_{low}^*$  and  $f_{high}^*$ , we obtain

$$\frac{e_{high}^* + \frac{c_e^{high}}{c_f} e_{high}^*}{e_{low}^* + \frac{c_e^{low}}{c_f} e_{low}^*} = \frac{c_e^{low} e_{low}^*}{c_e^{high} e_{high}^*} \quad (17)$$

which is:

$$\frac{(1 + c_e^{high})c_e^{high}}{(1 + c_e^{low})c_e^{low}} = \frac{e_{low}^{*2}}{e_{high}^{*2}} \quad (18)$$

Since  $c_e^{low} < c_e^{high}$ ,  $e_{low}^* > e_{high}^*$ , so the low-cost official will exert higher effort since his cost of effort is smaller.

Divide (11) by (13), we obtain:

$$\frac{e_{high}^* + f_{high}^*}{e_{low}^* + f_{low}^*} = \frac{f_{low}^*}{f_{high}^*}$$

Substituting  $e_{low}^*$  and  $e_{high}^*$ , we have:

$$\frac{\frac{c_f}{c_e^{high}} f_{high}^* + f_{high}^*}{\frac{c_f}{c_e^{low}} f_{low}^* + f_{low}^*} = \frac{f_{low}^*}{f_{high}^*}$$

which is:

$$\frac{\frac{c_f}{c_e^{high}} + 1}{\frac{c_f}{c_e^{low}} + 1} = \frac{f_{low}^{*2}}{f_{high}^{*2}}$$

Since  $c_e^{high} < c_e^{low}$ ,  $f_{high}^* < f_{low}^*$ , so the low-cost official will falsify less since realized growth and falsified growth are substitutes.  $\square$

To summarize, under the heterogeneous costs setting, we have the following results:

	low-cost politician	high-cost politician
effort	high	low
falsification	low	high

Table 2: PREDICTION OF THE HETEROGENEOUS COMPETENCIES MODEL.

Incorporating both career concerns and heterogeneous costs, with the assumption that **young politicians have significantly lower relative costs than old politicians**, our model generates the following predictions:

1. Across individuals, falsification is increasing with politicians' age.
2. Within individuals, falsification is decreasing with a politician's age.
3. Lower realized GDP growth is associated with higher GDP falsification.
4. Young politicians deliver higher realized growth and are more likely to be promoted.

## 4 Data and Empirical Strategy

### 4.1 Econometric Specification

In this section, we explore how politicians' characteristics influence manipulation behavior. Our baseline model is specified as follows:

$$falsification_{p,c,i,t} = \beta_0 + \sum \beta_j * 1(age_{i,t}) + \beta' X_{c,t-1} + \beta' X_{i,t} + \eta_c + \gamma_{p,t} + (\zeta_i) + \epsilon_{p,c,t}$$

where p, c, i, t index the province, the city, the politician, and the year, respectively. The main independent variable is a set of dummy variables indicating politician i's age at year t. X is a set of time-varying economic and leadership covariates. Economic covariates include GDP, population, fiscal revenue, fiscal expenditure, first industry's share, and second industry's share. Leadership covariates include gender, education, tenure, ethnicity, and whether connected to provincial leaders for both the city secretary and the mayor. City fixed effects  $\eta_i$  capture the time-invariant heterogeneity across cities, such as geographical location and traditional culture. Province-year fixed effects  $\gamma_{p,t}$  capture the common variation for all cities within the same province across different years, for example, leadership change and regional policy changes at the provincial level. In some specifications, we control for the individual fixed effects  $\zeta_i$ .

## 4.2 Data

The main sample includes all prefecture-level cities in mainland China, excluding districts under centrally administered municipalities. After dropping cities with missing data, the resulting panel includes observations from 277 cities from 2003 to 2013.

Data on provincial and city-level leaders are drawn from the China Political Elite Database (CPED), which contains the biographical information of municipal, provincial, and national leaders in China since the late 1990s. For each leader, the database provides information on gender, age, education, ethnicity and detailed work experience. I include the two most important positions, namely, city secretary and mayor in the analysis. In case there are multiple leaders for one position in one year, the official who served the longest in that year is chosen as the leader. In the main analysis, I followed Jiang (2018)'s definition of political connection between city leaders and provincial leaders.

*Definition: A city leader  $C$  is defined as connected to a provincial leader  $P$  if and only if  $C$  was first promoted to a city leadership position (as city secretary or mayor) from within the province when  $P$  was serving as the provincial leader of that province.*

Economic variables are collected from the China City Statistical Yearbooks.

## 4.3 Estimating the GDP falsification level

Details of the framework can be found in the appendix. The following results are obtained using four indicators: growth rate of bank loan disbursement, electricity consumption, total freight<sup>3</sup>, and nighttime light. City-level statistics are extracted from the China City Statistical Yearbooks. Nighttime light data is obtained from the Chinese Research Data Services Platform (CNRDS). Loan disbursement growth rates are adjusted for regional inflation rates. We set the sample period from 2002 to 2013 given the availability of data. Figure 2 illustrates the growth rates of these variables.

Table 3 reports the observable moment conditions. Table 4 reports the estimated parameter values. Based on these parameters, the optimal weights assigned to four indicators are calculated as follows:

$$\hat{g}_{gdp} = 0.4828 * g_{loan} + 0.1469 * g_{electricity} + 0.1388 * g_{freight} + 0.2744 * g_{light}$$

Figure 3 shows the time series of the average reported GDP and real GDP growth rate estimated by our approach. Note that the estimated GDP exceeded the reported GDP in

---

<sup>3</sup>The original Keqiang index uses railway freight, but due to measurement inaccuracies and volatility at the city level, total freight (highway+railway+airway) is used.

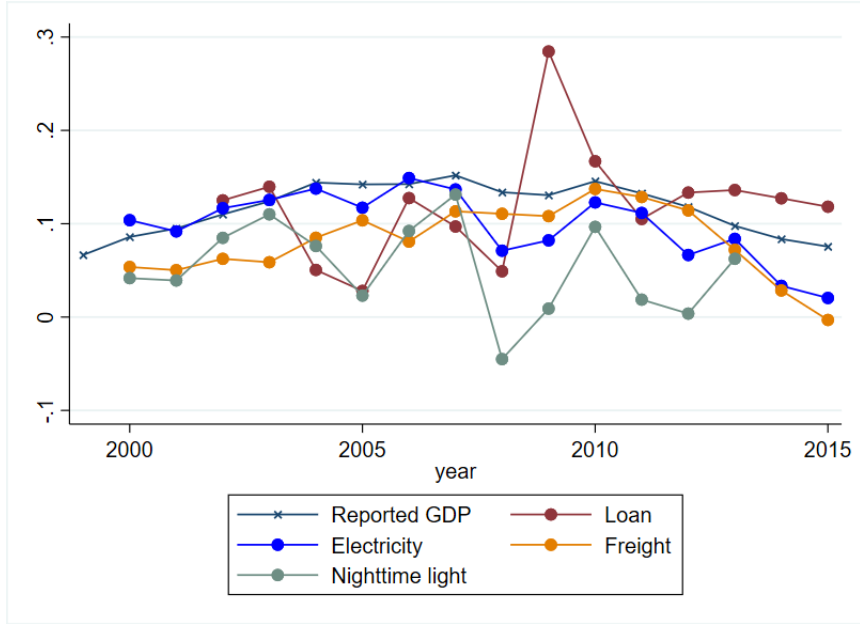


Figure 2: AVERAGE GROWTH RATE OF ECONOMIC GROWTH INDICATORS. This figure shows the average growth rate of various economic growth indicators at the city level, weighted by regional GDP. Data sourced from City statistical yearbooks.

$E(X_{loan})$	0.119	$Cov(X_{loan}, X_{electricity})$	0.0004
$E(X_{electricity})$	0.110	$Cov(X_{loan}, X_{freight})$	0.0010
$E(X_{freight})$	0.096	$Cov(X_{loan}, X_{light})$	0.0008
$E(X_{light})$	0.055	$Cov(X_{electricity}, X_{freight})$	0.0008
$Var(X_{loan})$	0.009	$E(Y_{national})$	0.102
$Var(X_{electricity})$	0.027		
$Var(X_{freight})$	0.022		
$Var(X_{light})$	0.006		

Table 3: OBSERVABLE MOMENT CONDITIONS FROM DATA. The table reports the observable moments from data. They include the average growth rate of indicators, the variance of the growth rate of indicators, the covariance of the growth rate of indicators, and the average national GDP growth rate.

$\beta_{loan}$	1.165	$\sigma_{loan,electricity}$	-0.0001
$\beta_{electricity}$	1.074	$\sigma_{loan,freight}$	-0.0002
$\beta_{freight}$	0.941	$\sigma_{electricity,freight}$	-0.0003
$\beta_{light}$	0.544	$\sigma_y$	0.033
$\sigma_{loan}$	0.088	$E(Y_{national})$	0.102
$\sigma_{electricity}$	0.162		
$\sigma_{freight}$	0.148		
$\sigma_{light}$	0.078		

Table 4: ESTIMATED PARAMETERS.

2009 due to the fiscal expansionary policy launched by the Chinese government to deal with the global financial crisis, leading to a surge in debt since 2009. The growth rates of loan disbursement were 10.5%, 29.5%, 20% in 2008, 2009, 2010 respectively. To address this problem, we conduct robustness tests by dropping the bank loan indicator or excluding all observations in 2009.

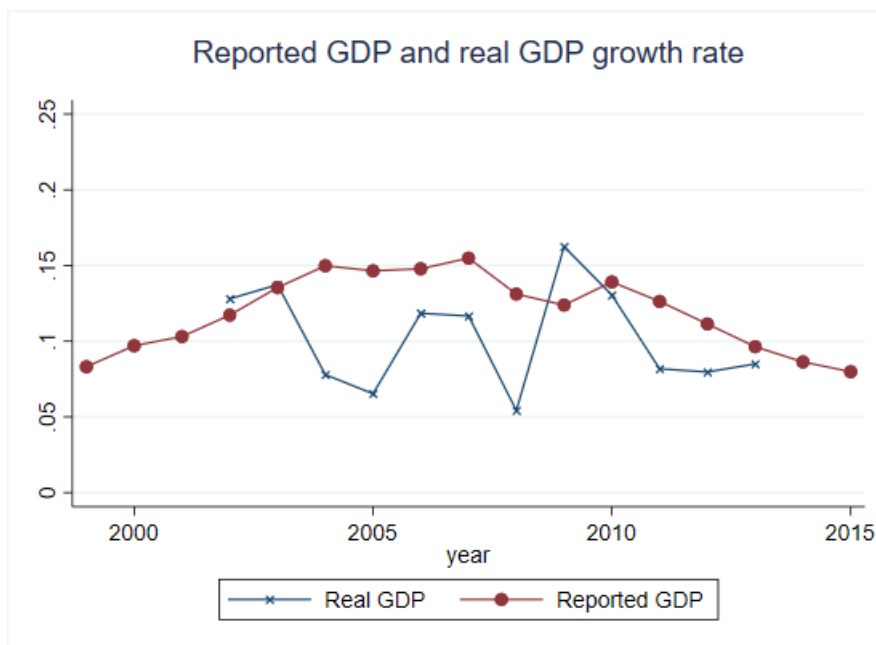


Figure 3: AVERAGE REPORTED GROWTH RATE AND ESTIMATED GROWTH RATE AT CITY-LEVEL. This figure shows the average growth rate reported in the city statistical yearbooks and estimated growth rates using bank loan disbursement, electricity consumption, total freight, and nighttime light.

### 4.3.1 Validation Exercises

Table 5 displays the average falsification levels for three types of city-year spells: (1) directly reported cases of growth falsification, (2) cities located in provinces with reported falsification activities not directly tied to specific cases, and (3) cities in provinces without any exposed falsification cases. The gradation of falsification indices across these three groups aligns with expectations: Cities directly implicated in falsification reports exhibit the highest average falsification level—approximately 21

#### 1. Validation based on News Report

Does our measure accurately capture variations in economic falsification over time and space? Given the hidden nature of falsification, direct verification can be difficult, but several validation checks make us confident in the measure. First, we conduct an extensive internet search to collect news reports exposing instances of growth falsification in China. The news reports that we found cover a total of 17 provinces and mention the names of

41 specific prefectures. While these cases obviously do not exhaust all falsification activities that took place in China, it is safe to assume that exposed localities have higher-than-average falsification levels. Therefore, if our falsification measure is valid, it should exhibit a more positive value in those exposed cities compared to those where such activities have not been revealed. Table 5 displays the average falsification levels for three types of city-year spells: (1) those that were directly reported to be committing growth falsification, (2) those located in provinces where falsification activities have been reported, but not directly tied to any specific cases, and (3) those located in provinces without any exposed falsification cases. The gradation of falsification indices across these three groups aligns with our expectation: Cities whose names are directly mentioned in falsification reports indeed have the highest average falsification level—about 21% of a standard deviation above the mean. The average falsification level for not publicly implicated cities in provinces with exposed falsification is somewhat lower, but still positive and much higher than provinces without reported cases.

<b>Locality</b>	<b>Average Falsification Level</b>
Exposed cities (n=41)	4.34 [3.67, 5.01]
Non-exposed cities in exposed provinces (n=148)	3.25 [2.91, 3.59]
Other provinces (n=95)	1.70 [1.27, 2.12]

Table 5: FALSIFICATION LEVEL IN DIFFERENT LOCALITIES. The table reports the average falsification level in GDP growth rate in cities that were directly reported to be committing growth falsification, cities located in provinces where falsification activities have been reported, but not directly tied to any specific cases, and cities located in province without any exposed falsification cases. 95% confidence interval in brackets.

## 2. Falsification Within a Term

Second, we examine how falsification varies with city leaders' time in office. Our interviews with local officials suggest that the incentive to exaggerate growth is usually the weakest during an official's first year in office for several reasons. First, leaders may come into power during the middle of the year, limiting their influence on policies set by predecessors. Second, the credit for good performance in the initial year typically goes to predecessors. Lastly, a lower starting point makes it easier for the newcomer to show accomplishments later. Figure 4 depicts the relationship between the average level of falsification and tenure length of the city party secretary, who is the DE FACTO leader of a city. Consistent with our hypothesis, the level of falsification is significantly lower in the year when a party secretary first assumes office. The level of falsification is the lowest during the first year of city leaders' tenure and gradually increases thereafter, peaking around the fourth year, one year before

the end of their formal term<sup>4</sup>.

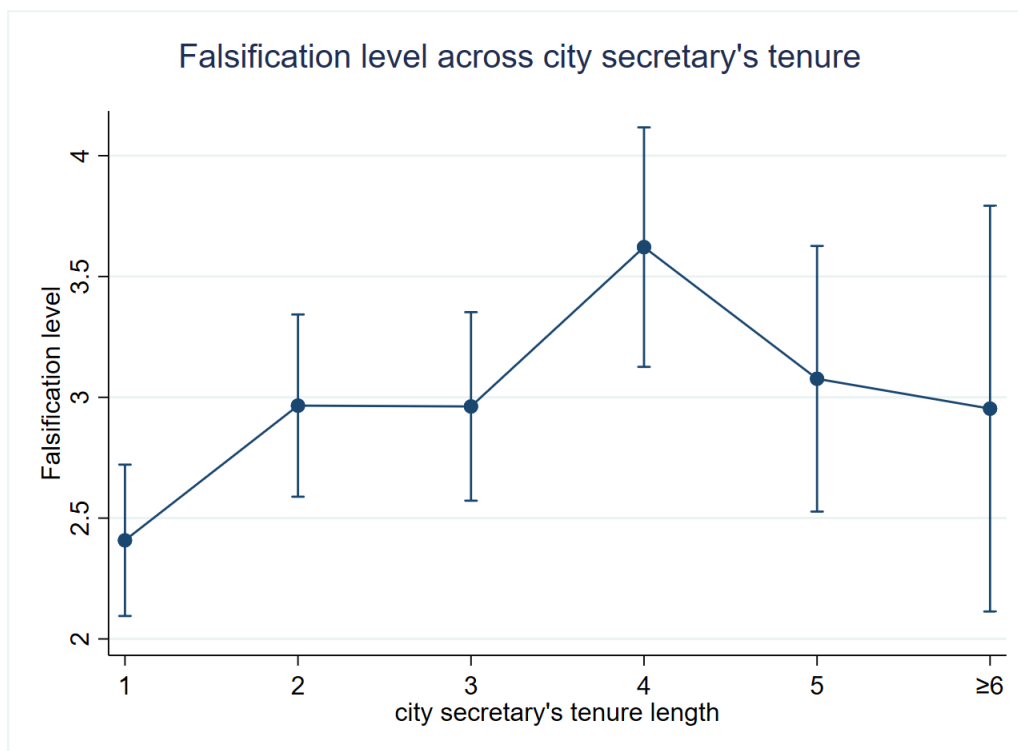


Figure 4: FALSIFICATION LEVEL ALONG CITY SECRETARY’S TENURE. This Figure illustrates how falsification level varies across city secretaries’ tenure after controlling for city and province-year fixed effects. The circles indicate the point estimates and the vertical bars indicate the 90% confidence intervals.

### 3. Geographic Variations

We further analyze geographic variations of the intensity of statistical fabrication. Figure 5 illustrates the average value of the falsification index for Chinese cities between 2002 and 2013, with darker colors representing more severe over-reporting. The geographic distribution of falsification is largely consistent with the received wisdom: In particular, falsification tends to be more severe in provinces located in the northeast (Liaoning, Jilin, and Inner Mongolia). In January 2017, Qiufa Chen, the provincial governor of Liaoning province, said “Liaoning was involved in large-scale statistical deception at city and county levels that lasted a long time and involved many people. The fiscal revenues in the province were inflated by at least 20 % from 2011 to 2014.”<sup>5</sup> According to Liaoning’s statistical report, the reported fiscal revenue in 2013 is 319.07 billion RMB, while this figure fell dramatically to 212.56 billion RMB in the next year. Similarly, the Inner Mongolia autonomous region government admitted falsities in its economic and budgetary data in 2018. The industrial

<sup>4</sup>Officially, the party secretary and mayor’s term is five years and with the possibility of re-electing. In practice, most party secretaries finish their tenure in 3-5 years. The average length of tenure of city secretaries is 3.8 years in our sample.

<sup>5</sup><https://www.ft.com/content/b25d1b32-dd37-11e6-9d7c-be108f1c1dce>

added value in 2016 was padded by 40% <sup>6</sup>. In contrast, coastal provinces in the southeast, such as Zhejiang and Fujian, exhibit comparatively less over-reporting, even under-reporting, potentially driven by high fiscal surplus and the incentive to transfer less fiscal revenue to the central government.

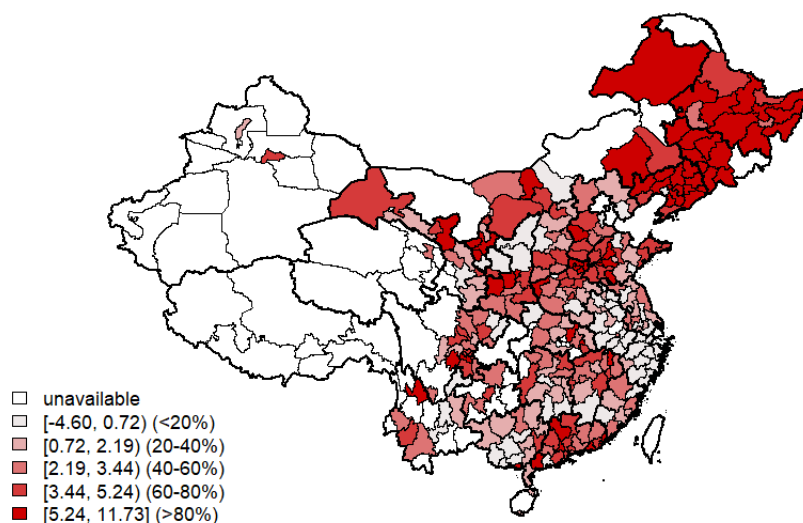


Figure 5: GDP GROWTH RATE FALSIFICATION AT CITY-LEVEL . This Figure illustrates how falsification level varies across cities. Falsification is measured by the gap between the reported and estimated real GDP growth rate in section ??.

## 5 Results

### 5.1 Falsification and politicians' age (across individuals)

In this section, we explore the relationship between politicians' age and the level of falsification. Table ?? summarizes our main findings. The dependent variable is the disparity between reported and actual GDP growth rates. In Column (1), the independent variables include secretaries' characteristics, economics covariates, and city-fixed effects. In column (2), we add province-by-year fixed effects. We find there is a strong positive association between the city secretary's age and falsification level. In Column (3), we focus solely on city secretaries under 58 years old, the coefficient is larger and more significant. Results in Column (4) show there is an inverse U relationship between the falsification level and the secretary's age, though this pattern becomes linear when restricted to politicians below 58

<sup>6</sup><https://www.chinadaily.com.cn/a/201801/13/WS5a5975caa3102c394518efc6.html>

years old. We also find city secretaries connected to provincial secretaries and with higher education falsify significantly less. In Column (6), we include mayors’ characteristics as independent variables and do not find any no significant relationship between the falsification level and the mayor’s characteristics. Therefore, we will focus on city secretaries henceforth.

To better illustrate the dynamics of falsification across different ages, we employ a more flexible specification with age-fixed effects for both city secretary and mayor. The dynamic effects are visualized in Figure 6. The pattern suggests that the falsification level remains at a low level before secretaries reach 47 years old, and is relatively high for secretaries between 47 to 57, and finally drops dramatically afterward. On the contrary, such a pattern does not exist for mayors. The drop in falsification level among older secretaries can be explained by the promotion age restrictions imposed by the Communist Party. Typically, city secretary and mayor positions in prefectural-level cities correspond to the Bureau level (Zheng Ting). Advancement to the Deputy Minister level (Fu bu) – deputy provincial Secretary, governor, deputy Ministers of the State Council, etc. – represents the next career step. Officials aged 58 or above become ineligible for promotion to Deputy Minister level positions (Kou and Tsai (2014)). This restriction diminishes or eradicates the promotion incentive for secretaries aged 58 and above, consistent with findings in Zhou and Zeng (2018), albeit employing a different method for estimating true GDP growth.

## 5.2 Falsification and politicians’ age (within an individual)

In this section, we investigate how the level of falsification evolves throughout a politician’s career. The career-concern model predicts that politicians will falsify more when they are younger. Table below reports the effect of age on falsification after controlling for secretary-fixed effects. Column (1)-(3) uses the Keqiang index and nighttime lightness as alternative indicators to estimate actual GDP growth. To ensure the robustness of our findings, we introduce land revenue as an extra indicator and follow the same procedure to calculate the optimal weights. The realized GDP growth now can be calculated by:

$$\hat{g}_{gdp} = 0.46 * g_{loan} + 0.16 * g_{electricity} + 0.15 * g_{freight} + 0.27 * g_{light} + 0.02 * g_{landsales}$$

The results based on this estimate are presented in Column (4). Second, the optimal weights may depend on province-specific economic and geographic structures. Therefore, we apply the statistical framework to each province so that the optimal weights are now province-specific. We assume the average true GDP growth rate of cities within a province equals the reported GDP growth rate by the province government. Results are reported in Column (5). Lastly, to address anomalies arising from the exceptional growth of bank loans in 2009, we

Table 6: Politician's characteristics and GDP falsification

	Y: Falsification Index					
	(1)	(2)	(3)	(4)	(5)	(6)
Secretary's age	0.095** (0.048)	0.071* (0.038)	0.107** (0.041)	1.947*** (0.660)	1.376* (0.799)	0.068* (0.039)
Secretary's age <sup>2</sup>				-0.018*** (0.006)	-0.013 (0.008)	
Connected city secretary	-0.541* (0.307)	-0.705** (0.324)	-0.651** (0.331)	-0.698** (0.324)	-0.641* (0.330)	-0.769** (0.329)
Secretary's education	-0.274 (0.320)	-0.514* (0.268)	-0.522* (0.273)	-0.473* (0.267)	-0.498* (0.273)	-0.500* (0.269)
Secretary's tenure	-0.040 (0.085)	0.048 (0.078)	0.064 (0.081)	0.068 (0.078)	0.071 (0.082)	0.048 (0.081)
Female Secretary	-1.101 (0.746)	-1.188 (0.738)	-1.192 (0.765)	-1.282* (0.734)	-1.264* (0.762)	-1.163 (0.772)
Minority Secretary	1.353 (0.933)	1.163* (0.668)	1.182* (0.685)	1.095* (0.661)	1.141* (0.681)	1.128 (0.730)
Mayor's age						-0.033 (0.033)
Connected Mayor						0.121 (0.346)
Mayor's education						-0.004 (0.289)
Minority Mayor						0.044 (0.084)
Female Mayor						-0.263 (0.513)
Minority Mayor						-0.164 (0.648)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Prov*Year FE	No	Yes	Yes	Yes	Yes	Yes
Economics Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	<58	All	<58	All
N	2879	2861	2723	2861	2723	2848
Adjusted R <sup>2</sup>	0.085	0.494	0.488	0.495	0.489	0.492

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

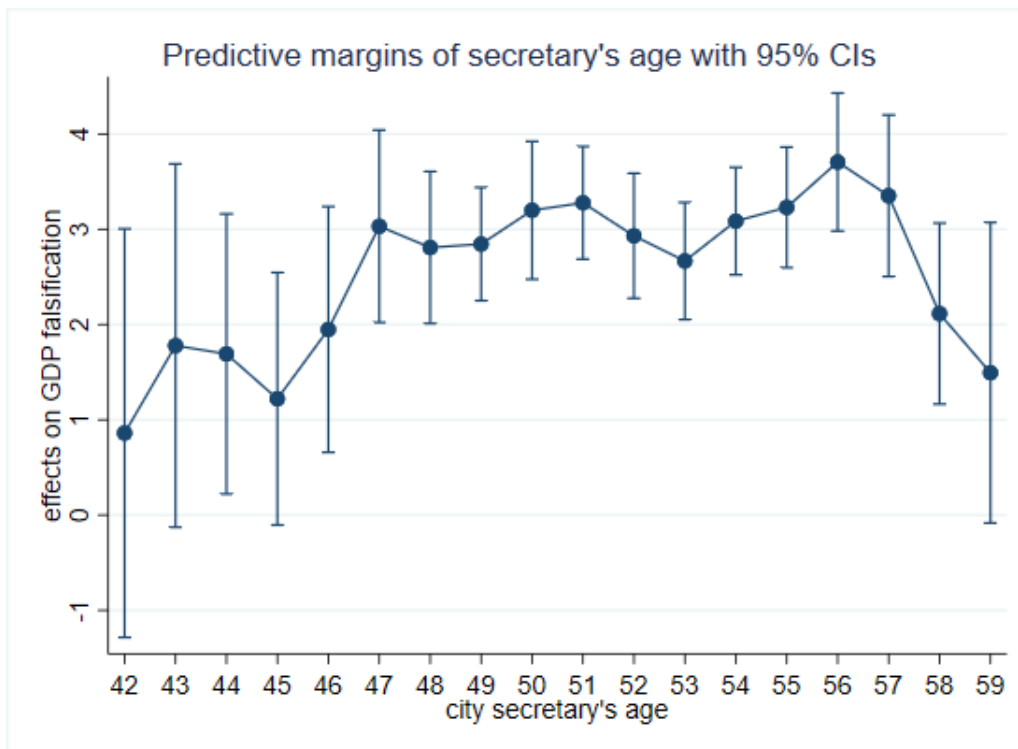


Figure 6: CITY SECRETARY’S AGE AND FALSIFICATION LEVEL. This Figure plots the secretary’s age fixed effects. We control for economic covariates, city-fixed effects, and province-by-year fixed effects. The vertical bars indicate the 95% confidence intervals.

omit all observations from that year and re-run the regressions, as detailed in Column (6). The findings consistently demonstrate a decreasing trend in falsification with age within an individual. This robust pattern remains stable across all columns.

### 5.3 Realized Growth and Falsified Growth

In this section, we evaluate the predictions of the heterogeneous-costs model: politicians with low costs can achieve higher actual growth and engage in less falsification. Table below presents the correlation between falsification and real GDP growth. The independent variable is various measures of falsification same as Table 7. In Column (1), we control for province-by-year fixed effects so we are comparing different cities within a province. In Column (2) we control for city-fixed effects to capture time-invariant city characteristics. In column (3), we further control for city secretary fixed effects. Across all specifications, realized GDP growth is negatively correlated with falsification. Ceteris paribus, a 1 percentage point decrease in realized GDP growth corresponds to a 0.95 percentage point increase in falsified GDP growth. This consistent negative relationship underscores the notion that politicians with lower costs tend to achieve higher actual growth while falsifying less.

Table 7: Politician's age and GDP falsification

	Y: Falsification Index					
	Keqiang index+lightness			Include land revenue	province-specific	drop 2009
	(1)	(2)	(3)	(4)	(5)	(6)
Secretary's age	-1.947*** (0.411)	-1.436*** (0.512)	-1.355* (0.782)	-3.631*** (0.645)	-1.621*** (0.556)	-1.143** (0.524)
Mayor's age	0.024 (0.095)	0.038 (0.092)	0.074 (0.097)	-0.051 (0.097)	0.022 (0.114)	0.040 (0.097)
City FE	Yes	Yes	Yes	Yes	Yes	Yes
Secretary FE	Yes	Yes	Yes	Yes	Yes	Yes
Economics Covariates	No	Yes	Yes	Yes	Yes	Yes
Individual Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	<58	All	All	All
N	2670	2661	2522	2085	2661	2437
Adjusted R <sup>2</sup>	0.009	0.029	0.012	0.040	-0.050	0.063

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ 

Table 8: Realized Growth and Falsified Growth

	Y: Falsification Index					
	Keqiang index+lightness			Include land revenue	province-specific	drop 2009
	(1)	(2)	(3)	(4)	(5)	(6)
real GDP growth	-0.902*** (0.014)	-0.945*** (0.013)	-0.978*** (0.010)	-0.952*** (0.015)	-0.960*** (0.011)	-0.954*** (0.012)
City FE	No	Yes	Yes	Yes	Yes	Yes
Prov*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Secretary FE	No	No	Yes	No	No	No
Economics Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Individual Covariates	Yes	Yes	Yes	Yes	Yes	Yes
N	2850	2849	2662	2254	2849	2438
Adjusted R <sup>2</sup>	0.878	0.900	0.859	0.904	0.922	0.842

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 5.4 Politician's age and real GDP Growth

In this section, we explore the implications of the heterogeneous-costs model, which posits that politicians with lower costs can achieve higher actual growth. Before doing that, we first show suggestive evidence that young politicians have lower costs to deliver actual growth. We divide politician into two groups depending on whether their age is below or above the median age of 52 and report summary statistics of these two groups. The comparison reveals intriguing differences between these groups: the younger cohort tends to have higher education levels, stronger political connections, and operates in economically backward regions. These findings suggest that younger politicians, on average, have lower costs associated with delivering actual growth.

Table 9: Summary Statistics of Politicians' Characteristics

	Young ( $\leq 52$ )	Old ( $> 52$ )	Difference	
	Mean	Mean	young-old	p-value
Age	48.88	54.94	-6.05***	(0.00)
College degree	0.64	0.48	0.17***	(0.00)
Female	0.06	0.02	0.03**	(0.00)
Minority	0.07	0.06	0.01	(0.50)
Years since join the CCP	22.55	24.18	-1.63***	(0.00)
University Management	0.02	0.00	0.01*	(0.01)
County leadership	0.51	0.50	0.01	(0.82)
SOE Management	0.16	0.20	-0.04*	(0.04)
Public finance experience	0.13	0.10	0.04*	(0.04)
worked in the provincial government	0.49	0.45	0.03	(0.19)
worked in the central government	0.08	0.06	0.02	(0.11)
Youth league experience	0.26	0.10	0.16***	(0.00)
Connected provincial leader	0.42	0.34	0.08***	(0.00)
Corrupted	0.10	0.10	-0.00	(0.98)
Initial GDP per Capita	23954.51	29299.19	-5344.68***	(0.00)
Initial Population	385.10	428.46	-43.35***	(0.00)
Initial fiscal revenue	757406.14	1102600.32	-345194.18**	(0.00)
Initial fiscal expenditure	1410692.62	1837489.32	-426796.70**	(0.00)
Initial 1 <sup>st</sup> industry share	9.29	7.60	1.69***	(0.00)
Initial 2 <sup>nd</sup> industry share	49.24	51.24	-2.00**	(0.00)
Initial 3 <sup>rd</sup> industry share	-57.53	-57.84	0.31	(0.57)
Observations	726	703	1429	

Therefore, both career-concern-only and heterogeneous-costs model predicts young politicians can deliver higher actual growth. To test this, we regress actual GDP growth on politicians' age. All regressions control the same economic covariates and individual covariates as

before. In Column (1) we control for province-by-year fixed effects. The coefficient of secretaries' age is negative but not significant. In Column (2), after controlling city fixed effects, a significant positive relationship is observed, indicating that younger politicians deliver higher actual growth. This pattern is stronger if we restrict our sample to politicians younger than 58 in Column (3). In Column (4), we include a set of dummy variables indicating whether the city secretary is below 45, between 45 to 50, between 50 to 55, or above 55. We find the youngest group of politicians delivers substantially higher real GDP growth. These results align with the predictions of the our model, supporting the notion that younger politicians are more motivated and better positioned to deliver higher actual growth.

Table 10: Politician's age and real GDP Growth

	Y: Realized GDP Growth			
	(1)	(2)	(3)	(4)
Secretary's age	-0.055 (0.035)	-0.076* (0.040)	-0.108** (0.044)	
Mayor's age	0.006 (0.036)	0.041 (0.036)	0.052 (0.037)	0.040 (0.035)
age_below45				1.592** (0.633)
age_45to50				0.191 (0.384)
age_50to55				0.067 (0.326)
City FE	No	Yes	Yes	Yes
Prov*Year FE	Yes	Yes	Yes	Yes
Economics Covariates	Yes	Yes	Yes	Yes
Individual Covariates	Yes	Yes	Yes	Yes
Sample	All	All	<58	All
N	2857	2848	2711	2859
Adjusted R <sup>2</sup>	0.439	0.484	0.483	0.485

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## 5.5 Politician's age and Promotion Probability

Lastly, we delve into the relationship between a politician's age and the probability of promotion. Both the career-concern-only and heterogeneous-costs model predicts young politicians are more likely to be promoted. In our main analysis, Promotion is defined as

a binary variable equal to 1 if there is a rise in official’s rank<sup>7</sup>. Figure 7 illustrates the unconditional promotion probability of city secretaries across ages, revealing a non-linear pattern with two peaks. The first is for politicians whose age is between 43-44, coinciding with the conclusion of the youngest politicians’ initial term. The second peak is between ages 55-58, which is the last possible term for older city secretaries. However, some higher-rank positions do not necessarily have real power. For example, politicians who work in People’s Congress and People’s and Political Consultative Conference are toothless and have little influence on government policies. As a robustness test, we redefine promotion based on a politician being transferred to positions with higher rank positions with real power, including roles in provincial government, party committee, central State-owned enterprises, Communist Youth League, People’s Court, and People’s Procuratorate. Figure 8 shows the unconditional promotion probability of city secretaries across ages. We find there is a clear decreasing pattern of politicians’ promotion probability.

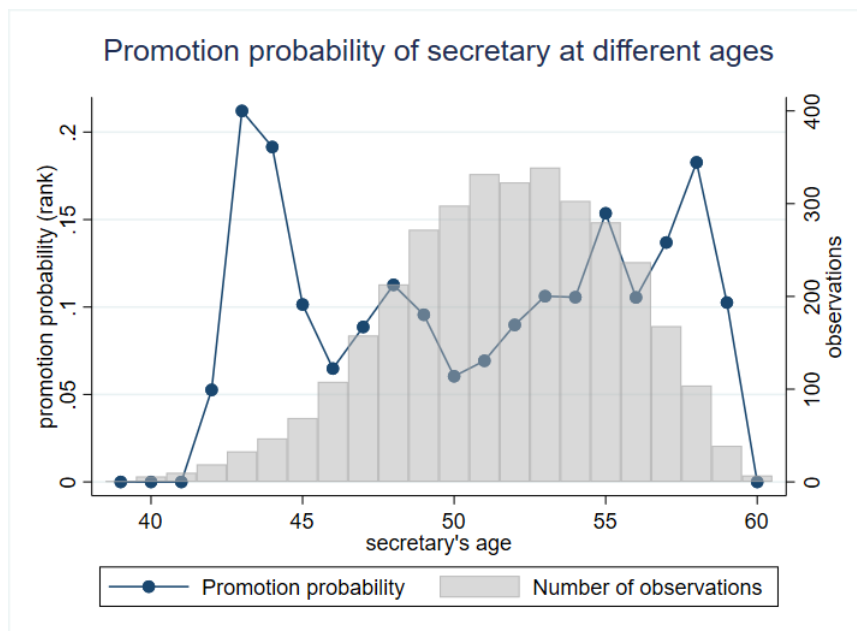


Figure 7: PROMOTION PROBABILITY OF CITY SECRETARIES. This Figure plots the secretary’s probability of being promoted at different ages. Promotion is defined based on a rise in ranks.

Table ? reports the results of regressing promotion dummy on politician’s age. The dependent variable from Column (1) to (5) is whether a politician gets promoted based on a rise in ranks. The dependent variable in Column (6) is whether a politician gets promoted to a higher rank position with real power. Column (1), (2), (3) reports the results of the linear

<sup>7</sup>The ranking system of civil servants in China are as follows: National leader, Sub-national leader, Provincial/Ministerial level, Sub-Provincial/Ministerial level, Bureau/Director level, Deputy-Bureau/Director level, Division/Head level, Deputy-Division/Head level, Section-Head level, Deputy-Section-Head level. Most party secretaries and mayors of prefecture-level cities are at the Bureau-Director level.

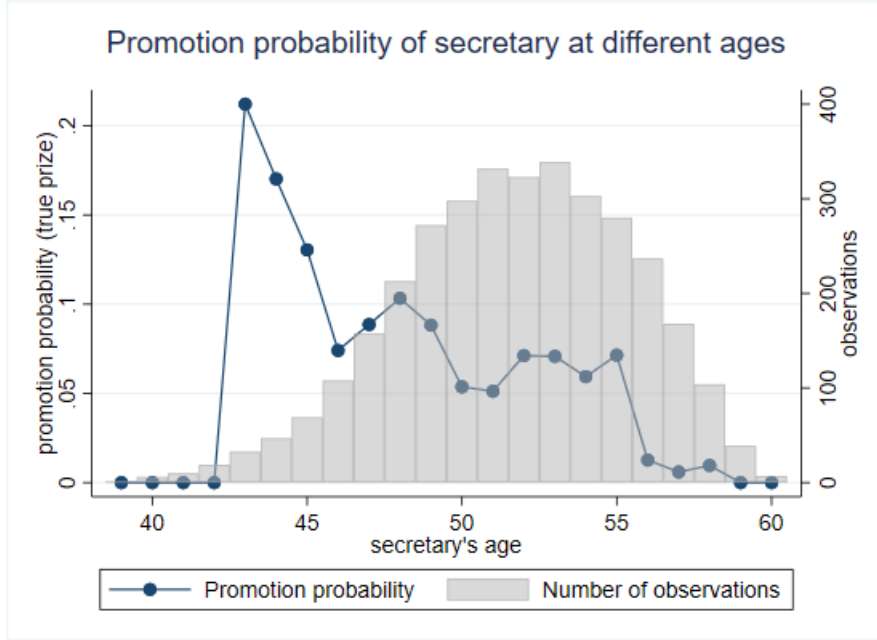


Figure 8: PROMOTION PROBABILITY OF CITY SECRETARIES. This Figure plots the secretary’s probability of being promoted at different ages. Promotion is defined based on a rise in ranks and transferred to positions with real powers.

probability model, Logit model, and Probit model, respectively. A consistent and significant relationship indicating that younger politicians are more likely to be promoted. *Ceteris paribus*, for every year a politician ages, their probability of promotion decreases by 0.4 percentage points. Columns (5) and (6) compare the promotion probability across different age groups. The results affirm that politicians in the youngest age group are significantly more likely to be promoted. These findings support our theory’s predictions, implying young politicians possess stronger motivation and lower costs associated with delivering actual growth.

## 6 Conclusion

In conclusion, this paper presents a tournament model wherein politicians compete for better performance, allowing for the choice between working harder or manipulating data to enhance their standings. The model predicts that politicians with stronger motivations and higher costs to develop the economy tend to engage in more manipulation. By employing a statistical framework to estimate true regional GDP growth rates, we measure manipulation through the gap between reported and realized growth rates. To test the prediction of our model, we study how local leaders’ attributes affect the manipulation level. Relying on different career lengths and heterogeneous costs, we find our model can explain the following empirical patterns: young officials deliver higher real economic growth, falsify less, and are

Table 11: Politician’s age and Promotion Probability

	Y: whether being promoted (=1 if promoted based on rank)				real power	
	(1)	(2)	(3)	(4)	(5)	(6)
	Linear	Logit	Probit	age<58	by groups	by groups
Secretary’s age	-0.004**	-0.066***	-0.039***	-0.005**		
	(0.002)	(0.025)	(0.013)	(0.002)		
age_below45					0.102***	0.169***
					(0.029)	(0.024)
age_45to50					0.030	0.107***
					(0.018)	(0.014)
age_50to55					0.021	0.081***
					(0.016)	(0.011)
City FE	No	No	No	No	No	No
Prov*Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Economics Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Individual Covariates	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	<58	All	All
N	3078	1831	1831	2915	3067	3067
Adjusted R <sup>2</sup>	0.114			0.112	0.114	0.058

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$ 

more likely to get promoted. Additionally, we can also explain the decreasing trend in falsification within a politician’s career.

Our findings shed light on understanding how career incentives affect politicians’ opportunistic behaviors. First, when the upper-level principals rely on self-reported statistics to evaluate lower-level agents’ performance, agents may take the risk of fabricating their performance, jeopardizing the accuracy and reliability of reported performance metrics. Second, the extent of such behaviors depends on politicians’ ability and motivation. Politicians with poor performance and face longer career have a stronger temptation to lie. This problem could be rampant in an imperfect information principal-agent setting.

The results of this study have critical policy implications. First of all, upper-level principals should actively seek alternatives to relying solely on self-reported statistics for performance evaluations. One solution is to set up independent Statistics Bureaus that are not subject to the influence of local governments. Another solution is to use alternative indicators that are less susceptible to manipulation to measure agents’ performance.

## References

- [1] Alberto Alesina and Nouriel Roubini. “Political cycles in OECD economies”. In: *The Review of Economic Studies* 59.4 (1992), pp. 663–688.
- [2] S Borağan Aruoba, Allan Drazen, and Razvan Vlaicu. “A structural model of electoral accountability”. In: *International Economic Review* 60.2 (2019), pp. 517–545.
- [3] Timothy Besley and Anne Case. “Does electoral accountability affect economic policy choices? Evidence from gubernatorial term limits”. In: *The Quarterly Journal of Economics* 110.3 (1995), pp. 769–798.
- [4] Yongshun Cai. “Between state and peasant: local cadres and statistical reporting in rural China”. In: *The China Quarterly* 163 (2000), pp. 783–805.
- [5] Shuo Chen, Xue Qiao, and Zhitao Zhu. “Chasing or cheating? Theory and evidence on China’s GDP manipulation”. In: *Journal of Economic Behavior & Organization* 189 (2021), pp. 657–671.
- [6] Wei Chen et al. *A forensic examination of China’s national accounts*. Tech. rep. National Bureau of Economic Research, 2019.
- [7] Xi Chen and William D Nordhaus. “Using luminosity data as a proxy for economic statistics”. In: *Proceedings of the National Academy of Sciences* 108.21 (2011), pp. 8589–8594.
- [8] Yuyu Chen et al. “Gaming in air pollution data? Lessons from China”. In: *The BE Journal of Economic Analysis & Policy* 13.3 (2012).
- [9] Steven NS Cheung. “The economic system of China”. In: *Man and the Economy* 1.1 (2014), pp. 1–49.
- [10] Hunter Clark, Maxim Pinkovskiy, and Xavier Sala-i-Martin. *China’s GDP growth may be understated*. Tech. rep. National Bureau of Economic Research, 2017.
- [11] Hunter Clark, Maxim Pinkovskiy, Xavier Sala-i-Martin, et al. “China’s GDP growth may be understated”. In: *China Economic Review* 62.C (2020).
- [12] Alain De Janvry, Frederico Finan, and Elisabeth Sadoulet. “Local electoral incentives and decentralized program performance”. In: *Review of Economics and Statistics* 94.3 (2012), pp. 672–685.
- [13] Angus Deaton. “Measuring poverty in a growing world (or measuring growth in a poor world)”. In: *Review of Economics and statistics* 87.1 (2005), pp. 1–19.
- [14] Allan Drazen. “The political business cycle after 25 years”. In: *NBER macroeconomics annual* 15 (2000), pp. 75–117.
- [15] John G Fernald, Eric Hsu, and Mark M Spiegel. “Is China fudging its figures? Evidence from trading partner data”. In: Federal Reserve Bank of San Francisco. 2015.
- [16] Claudio Ferraz and Frederico Finan. “Electoral accountability and corruption: Evidence from the audits of local governments”. In: *American Economic Review* 101.4 (2011), pp. 1274–1311.

- [17] Raymond Fisman and Yongxiang Wang. “The distortionary effects of incentives in government: Evidence from China’s “death ceiling” program”. In: *American Economic Journal: Applied Economics* 9.2 (2017), pp. 202–18.
- [18] Jie Gao. ““Bypass the lying mouths”: How does the CCP tackle information distortion at local levels?” In: *The China Quarterly* 228 (2016), pp. 950–969.
- [19] Dalia Ghanem and Junjie Zhang. “Effortless Perfection: Do Chinese cities manipulate air pollution data?” In: *Journal of Environmental Economics and Management* 68.2 (2014), pp. 203–225.
- [20] Robert Gibbons and Kevin J Murphy. “Optimal incentive contracts in the presence of career concerns: Theory and evidence”. In: *Journal of political Economy* 100.3 (1992), pp. 468–505.
- [21] Michael Greenstone et al. “Can Technology Solve the Principal-Agent Problem? Evidence from China’s War on Air Pollution”. In: *American Economic Review: Insights* 4.1 (2022), pp. 54–70.
- [22] J Vernon Henderson, Adam Storeygard, and David N Weil. “Measuring economic growth from outer space”. In: *American economic review* 102.2 (2012), pp. 994–1028.
- [23] Bengt Holmstrom. “Moral hazard in teams”. In: *The Bell journal of economics* (1982), pp. 324–340.
- [24] Bengt Holmström. “Managerial incentive problems: A dynamic perspective”. In: *The review of Economic studies* 66.1 (1999), pp. 169–182.
- [25] Carsten A Holz. “The quality of China’s GDP statistics”. In: *China Economic Review* 30 (2014), pp. 309–338.
- [26] Ruixue Jia, Masayuki Kudamatsu, and David Seim. “Political selection in China: The complementary roles of connections and performance”. In: *Journal of the European Economic Association* 13.4 (2015), pp. 631–668.
- [27] Junyan Jiang. “Making bureaucracy work: Patronage networks, performance incentives, and economic development in China”. In: *American Journal of Political Science* 62.4 (2018), pp. 982–999.
- [28] Chien-wen Kou and Wen-Hsuan Tsai. ““Sprinting with small steps” towards promotion: solutions for the age dilemma in the CCP cadre appointment system”. In: *The China Journal* 71 (2014), pp. 153–171.
- [29] Steven D Levitt. “Using Electoral Cycles in Police Hiring to Estimate the Effect of Police on Crime”. In: *The American Economic Review* 87.3 (1997), pp. 270–290.
- [30] Hongbin Li and Li-An Zhou. “Political turnover and economic performance: the incentive role of personnel control in China”. In: *Journal of public economics* 89.9-10 (2005), pp. 1743–1762.
- [31] Xing Li et al. “Target setting in tournaments: theory and evidence from China”. In: *The Economic Journal* 129.623 (2019), pp. 2888–2915.

- [32] John A List and Daniel M Sturm. “How elections matter: Theory and evidence from environmental policy”. In: *The Quarterly Journal of Economics* 121.4 (2006), pp. 1249–1281.
- [33] Xiaobo Lü and Pierre F Landry. “Show me the money: Interjurisdiction political competition and fiscal extraction in China”. In: *American political science Review* 108.3 (2014), pp. 706–722.
- [34] Changjiang Lyu et al. “GDP management to meet or beat growth targets”. In: *Journal of Accounting and Economics* 66.1 (2018), pp. 318–338.
- [35] Ben Ma et al. “Explaining sectoral discrepancies between national and provincial statistics in China”. In: *China Economic Review* 30 (2014), pp. 353–369.
- [36] Luis R Martinez. “How Much Should We Trust the Dictator’s GDP Growth Estimates?” In: *Journal of Political Economy* 130.10 (2022), pp. 000–000.
- [37] Aaron Mehrotra and Jenni Pääkkönen. “Comparing China’s GDP statistics with coincident indicators”. In: *Journal of Comparative Economics* 39.3 (2011), pp. 406–411.
- [38] Tomasz Michalski and Gilles Stoltz. “Do countries falsify economic data strategically? Some evidence that they might”. In: *Review of Economics and Statistics* 95.2 (2013), pp. 591–616.
- [39] Emi Nakamura, Jón Steinsson, and Miao Liu. “Are Chinese growth and inflation too smooth? Evidence from Engel curves”. In: *American Economic Journal: Macroeconomics* 8.3 (2016), pp. 113–44.
- [40] William D Nordhaus. “The political business cycle”. In: *The review of economic studies* 42.2 (1975), pp. 169–190.
- [41] Maxim Pinkovskiy and Xavier Sala-i-Martin. “Lights, camera... income! Illuminating the national accounts-household surveys debate”. In: *The Quarterly Journal of Economics* 131.2 (2016), pp. 579–631.
- [42] Joseph D Piotroski and Tianyu Zhang. “Politicians and the IPO decision: The impact of impending political promotions on IPO activity in China”. In: *Journal of Financial Economics* 111.1 (2014), pp. 111–136.
- [43] Thomas G Rawski. “What is happening to China’s GDP statistics?” In: *China Economic Review* 12.4 (2001), pp. 347–354.
- [44] Robert M Townsend. “Optimal contracts and competitive markets with costly state verification”. In: *Journal of Economic theory* 21.2 (1979), pp. 265–293.
- [45] Lily L Tsai. “Understanding the falsification of village income statistics”. In: *The China Quarterly* 196 (2008), pp. 805–826.
- [46] Jeremy L Wallace. “Juking the stats? Authoritarian information problems in China”. In: *British Journal of Political Science* 46.1 (2016), pp. 11–29.
- [47] Zhi Wang, Qinghua Zhang, and Li-An Zhou. “Career incentives of city leaders and urban spatial expansion in China”. In: *Review of Economics and Statistics* 102.5 (2020), pp. 897–911.

- [48] Tianyang Xi, Yang Yao, and Muyang Zhang. “Capability and opportunism: evidence from city officials in China”. In: *Journal of Comparative Economics* 46.4 (2018), pp. 1046–1061.
- [49] Wei Xiong. *The mandarin model of growth*. Tech. rep. National Bureau of Economic Research, 2018.
- [50] Chenggang Xu. “The fundamental institutions of China’s reforms and development”. In: *Journal of economic literature* 49.4 (2011), pp. 1076–1151.
- [51] Alwyn Young. “The African growth miracle”. In: *Journal of Political Economy* 120.4 (2012), pp. 696–739.
- [52] Q Albert Zhou and Jiangnan Zeng. “Promotion incentives, GDP manipulation and economic growth in China: how does sub-national officials behave when they have performance pressure?” In: *working paper* (2018).

# Online Appendix

## A The distribution of politician's ages

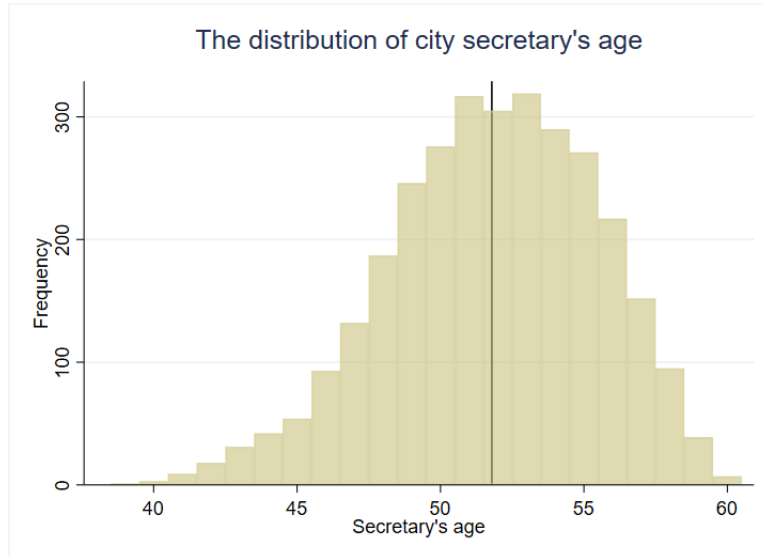


Figure 9: THE AGE DISTRIBUTION OF CITY SECRETARIES.

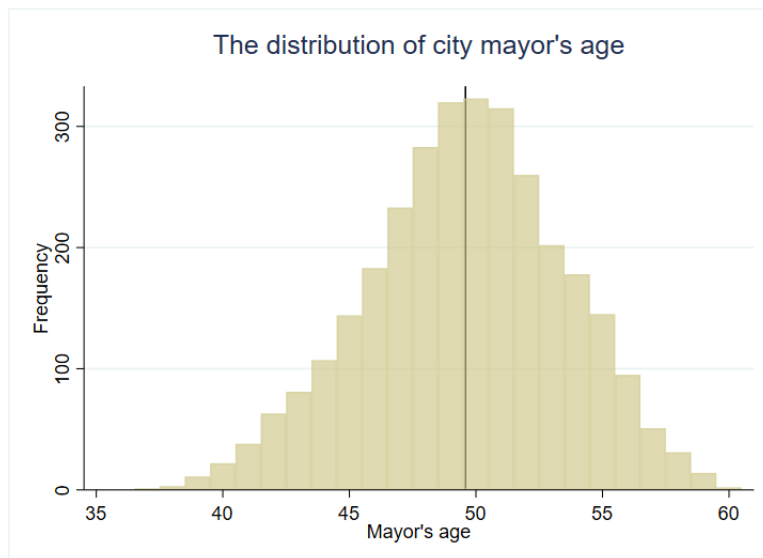


Figure 10: THE AGE DISTRIBUTION OF CITY MAYORS.

## B The distribution of politician's tenure

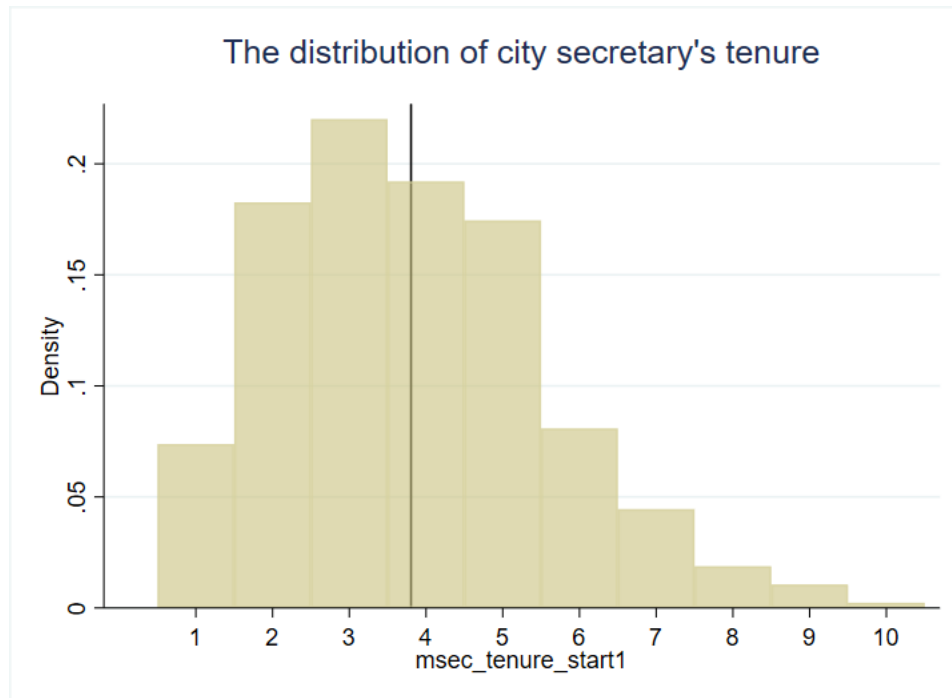


Figure 11: THE TENURE DISTRIBUTION OF CITY SECRETARIES. The sample includes 854 city secretaries who have finished their term during 2003-2015.

## C Promotion probability across politician's tenure

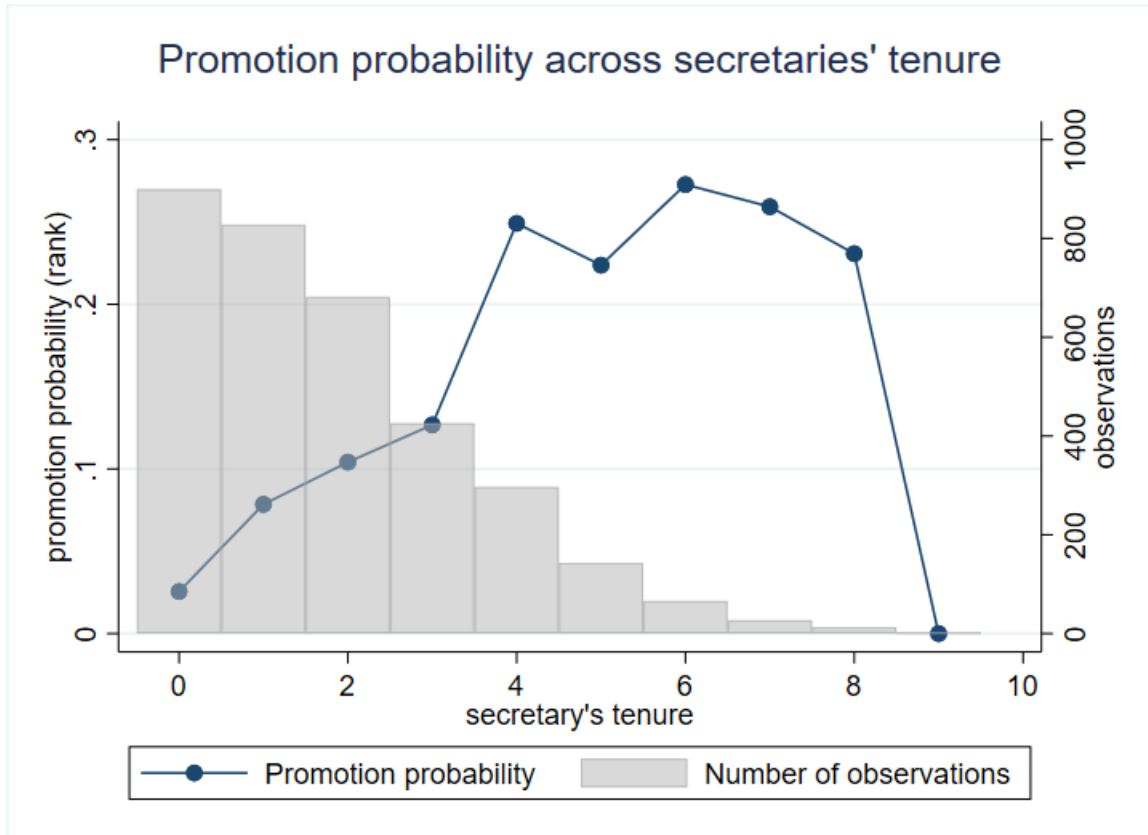


Figure 12: PROMOTION PROBABILITY OF CITY SECRETARIES. This Figure plots the secretary's probability of being promoted at different tenures. Promotion is defined based on a rise in ranks.

# D Target and Falsification

In this section, we examine the relationship between GDP growth targets and falsification. Target setting in economic plans is a top-down process: the central government sets the national plan and provincial and prefectural governments follow sequentially to establish their own economic plans (Li et al. (2019)). Prefectural annual targets are collected from the Report on the Work of the Government issued by prefectural governments. The following figure shows the GDP growth target and reported GDP growth.

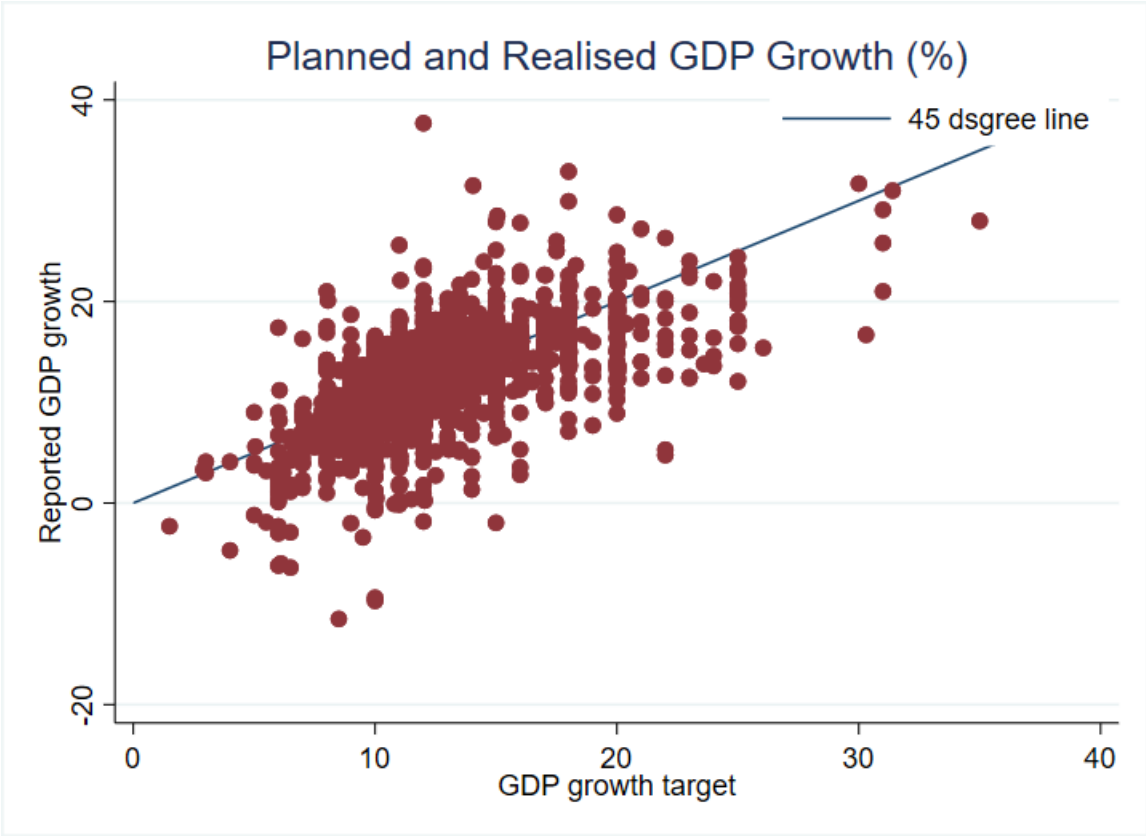


Figure 13: PLANNED AND REALIZED GDP GROWTH.

First, we find that cities meet the growth target falsify less. There is a strong linear relationship between distance to the target (=realized GDP growth-planned GDP growth) and falsification level. When realized GDP growth is below the target and the distance is 1% higher, the falsified GDP growth rate will increase by 0.91%. Moreover, we regress falsification on real GDP growth and target at the same time. We find that conditional on real GDP growth, a higher target leads to more falsification.

Table 12: Target and GDP falsification

	Y: Falsification Index		
	(1)	(2)	(3)
meet target (=1 if meets)	-6.767*** (0.256)		
distance to the target		-0.908*** (0.014)	
real GDP growth			-0.938*** (0.013)
GDP growth target			0.453*** (0.072)
Secretary's age	0.015 (0.032)	-0.009 (0.020)	-0.007 (0.021)
Secretary's education	-0.457** (0.227)	-0.247* (0.139)	-0.341** (0.133)
Female Secretary	-0.652 (0.615)	-0.165 (0.285)	-0.151 (0.297)
Secretary's tenure	0.092 (0.066)	0.099*** (0.037)	0.099*** (0.036)
Minority Secretary	0.887 (0.671)	0.016 (0.451)	-0.064 (0.380)
Connected city secretary	-0.641** (0.279)	-0.455** (0.176)	-0.411** (0.163)
City FE	Yes	Yes	Yes
Prov*Year FE	No	No	No
Economics Covariates	Yes	Yes	Yes
N	2850	2485	2485
Adjusted R <sup>2</sup>	0.619	0.894	0.903

Standard errors in parentheses

\*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.01$

## E Statistical Framework to estimating the true GDP growth rate

This section presents [Pinkovski and Sala-i-Martin \(2016\)](#)'s statistical framework to estimate the true regional GDP growth rate using weighted average growth rates of alternative indicators. Suppose we have N observable economic indicators like nighttime brightness from satellites, electricity consumption, total freight, loan disbursement, land sales, etc. Their growth rate can be approximated by a linear function of the true GDP growth rate:

$$g_{x_{ni}} = \beta_n g_{y_{ni}} + \epsilon_{ni} \quad (19)$$

where n indicates economic indicator and i indicates city. The error terms  $\epsilon_{ni}$  have zero mean but may be correlated to each other. Note that the true GDP growth rate is unobservable. We try to use the linear combination of these indicators to predict true income growth:

$$\hat{g}_{y_i} = \sum_{n=1}^N \lambda_n g_{x_{ni}} \quad (20)$$

Our goal is to find the optimal weights by minimizing the mean of squared errors:

$$\begin{aligned} \min_{\lambda_n} E(\hat{g}_{y_i} - g_{y_i})^2 \\ s.t. E(\hat{g}_{y_i}) = g_{y_i} \end{aligned} \quad (21)$$

The constrained optimization problem can be expressed as:

$$\begin{aligned} \min_{\lambda_n} var \left( \sum_{n=1}^N \lambda_n \epsilon_{ni} \right) \\ s.t. \sum_{n=1}^N \lambda_n \beta_n = 1 \end{aligned}$$

To save space, we do not show the formula of optimal weights here. The solution of optimal weights are functions of the following parameters:

$$\left\{ \begin{array}{ll} \beta_1, \beta_2, \dots, \beta_N & N \text{ unknowns} \\ \sigma_1, \sigma_2, \dots, \sigma_N & N \text{ unknowns} \\ \sigma_{ij} & N(N-1)/2 \text{ unknowns} \\ E(g_{y_i}), \sigma_{g_{y_i}} & 2 \text{ unknowns} \end{array} \right.$$

where  $\beta_n$  is the elasticity of indicator n with respect to GDP;  $\sigma_n$  is the measurement error of the indicator n;  $\sigma_{ij}$  is the correlation of the measurement errors of indicator i and j;

$E(g_{y_i})$  is the expected true GDP growth rate and  $\sigma_{g_{y_i}}$  is the standard deviation of the true GDP growth rate.

We can observe the following moment conditions:

$$\begin{cases} E(g_{n_i}) & N \text{ moments} \\ \text{Var}(g_{n_i}) & N \text{ moments} \\ \text{Cov}(g_{n_i}, g_{n_j}) & N(N-1)/2 \text{ moments} \end{cases}$$

So far, we have more numbers of unknown parameters than equations, so there are infinite solutions. To make the system identifiable, we need to make further assumptions or get more moment conditions. Our first attempt is to put restrictions on the correlation between the error terms. The correlation of measurement errors comes from several sources. First, if a region's statistical system is weak and tends to record biased statistics in the same direction, then the error terms will be positively correlated. Second, if some indicators are closely related to certain sectors of economic activity, then a common shock in these sectors will result in correlations between errors. A special feature of nighttime brightness is that it has a completely different data-generating process compared to other indicators collected by the statistical bureau. It is collected by U.S. satellites from outer space without any special statistical assumptions and methods adopted by different regions. The measurement error comes from different weather conditions, the sensitivity of satellites, and so on, which are unlikely to be correlated with measurement errors of economic indicators in different regions. Therefore, we assume that the measurement error of night light is uncorrelated with the errors in the data-generating process of economic indicators:

$$\sigma_{\text{lightness},j} = 0 \quad \textbf{(Assumption 1)}$$

This assumption has also been made in [Pinkovskiy and Sala-i-Martin \(2016\)](#), [Henderson, Storeygard, and Weil \(2012\)](#) and [Chen and Nordhaus \(2011\)](#). With this assumption, the number of unknowns drops by N-1, and the number of moment conditions drops by N-2<sup>8</sup>.

China's institutional setting gives us another opportunity to calibrate the model. The National Bureau of Statistics is well aware of this issue and has worked hard to detect data fraud and produces its own numbers for national GDP. For example, NBS reported

---

<sup>8</sup>With the assumption we made above, N-2 moment conditions become redundant since they can be expressed by other moment conditions. To see this, suppose there are three indicators and the third indicator is lightness:

$$\frac{\text{cov}(g_1, g_3)}{\text{cov}(g_2, g_3)} = \frac{\beta_1 \beta_3 \sigma_y^2}{\beta_2 \beta_3 \sigma_y^2} = \frac{\beta_1}{\beta_2} = \frac{E(x_1)}{E(x_2)}$$

Therefore, once we know the covariance between lightness and one indicator, the covariances between lightness and other indicators are pinned down by the ratio of these indicators' expectations.

89 fraud cases and 1289 officials and entrepreneurs are punished for falsification in 2019.<sup>9</sup> Chen et al. (2019) document how NBS uses micro-data from surveys, economic censuses, and administrative data to estimate the national GDP without relying on local statistics. Based on these pieces of evidence, we treat the national-level data as a more reliable source and set the expectation of true economic performance as the national reported GDP growth rate:

$$E(g_{y_i}) = E(g_{y_{national}}) \quad \text{(Assumption 2)}$$

Note that we are not trying to argue that the national-level data is entirely reliable. The national-level data per se may be overstated or understated. What we will capture from the following exercise is the difference in the degree of GDP overstatement between national- and prefectural-level governments. We can do robustness checks by adding or subtracting a constant for this moment restriction.

With two additional sets of assumptions above, we have the same number of equations and unknowns so that the whole system is identifiable. (We solve this system of nonlinear equations by the command `fsolve` in MATLAB.)

---

<sup>9</sup>[http://www.stats.gov.cn/tjgz/tzgb/201912/t20191230\\_1720560.html](http://www.stats.gov.cn/tjgz/tzgb/201912/t20191230_1720560.html)