THE UNIVERSITY OF CHICAGO

# BEHAVIOR AND INCENTIVES OF POLITICAL PLAYERS IN NON-DEMOCRATIC SYSTEMS

A DISSERTATION SUBMITTED TO
THE FACULTY OF THE IRVING B. HARRIS
GRADUATE SCHOOL OF PUBLIC POLICY STUDIES
IN CANDIDACY FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

BY
RUOCHEN YI

CHICAGO, ILLINOIS
JUNE 2024

# Contents

List of Figures . . . . . vii

List of Tables . . . . . ix

Abstract . . . . . xii

**1 Political Structure and Balance of Power**

**Evidence from Mid-level Officials' Promotion in China** **1**

1.1 Introduction . . . . . 2

1.2 Background . . . . . 7

1.2.1 Hierarchy in China . . . . . 7

1.2.2 Why prefectural level . . . . . 11

1.2.3 Unique dual-head system in China . . . . . 13

1.3 Data . . . . . 17

1.3.1 Data component . . . . . 17

1.3.2 Statistic summary . . . . . 19

1.3.3 Age constraint of promotion and retirement . . . . . 21

1.4 Reduced Form Empirical Results . . . . . 22

1.4.1 Which position need better GDP performance . . . . . 22

1.4.2 Which year of GDP performance matter . . . . . 25

1.4.3 GDP performance and promotion of mayor . . . . . 26

1.5 Model . . . 28
1.5.1 Model foundation . . . 28
1.5.2 Model setup . . . 30
1.5.3 Utility function of Secretaries . . . 32
1.5.4 Simple version of the model . . . 36
1.5.5 Decision making of Higher authority . . . 39
1.5.6 Example of mayor's choice . . . 40
1.6 Empirical Result . . . 42
1.6.1 Summary of testable predictions . . . 42
1.6.2 Last chance for secretary . . . 43
1.6.3 Heterogeneity of provinces . . . 45
1.6.4 Different standards for secretary . . . 49
1.6.5 Ambition of mayors . . . 50
1.6.6 Help or not . . . 52
1.7 Conclusion . . . 55
Bibliography . . . 57
1.8 Appendix . . . 60

**2 Endogenous Rebellion Benefits and Political Survival 92**

2.1 Introduction . . . 93
2.2 Model . . . 97
2.2.1 Discussion of Setup . . . 99
2.3 Analysis . . . 101
2.3.1 Social groups' rebellion decisions . . . 101
2.3.2 Institution paths with one transition time point . . . 107
2.3.3 Institution paths with more than one transition time points . . . 112

2.4 The Role of Commitment . . . 117
2.5 Conclusions . . . 119
Bibliography . . . 121
2.6 Appendix . . . 124

**3 Government incentives in China's land market auctions 127**

3.1 Introduction . . . 128
3.1.1 Corruption Incentives . . . 129
3.1.2 Financial Burden . . . 130
3.1.3 Development Incentives . . . 131
3.2 Background . . . 131
3.2.1 Land Auctions . . . 131
3.2.2 Central Inspection Team . . . 133
3.2.3 Local Government Finances . . . 135
3.3 Literature Review . . . 136
3.4 Theoretical Framework . . . 138
3.4.1 Corruption in auctions . . . 138
3.4.2 Deposit rate and bidder selection . . . 140
3.5 Data Description . . . 142
3.5.1 Chinese Land Auctions . . . 142
3.5.2 Local government debt and urban investment bonds . . . 145
3.6 The Effect of Central Inspection Teams on Auctions . . . 146
3.6.1 Empirical Strategy . . . 146
3.6.2 Results . . . 147
3.7 Local Government Debt and Land Market Auctions . . . 154
3.8 Real Estate Developer Selection on Land Auction . . . 154

3.8.1 Government incentives on selection of developer . . . . . 154
3.8.2 Spillover effects of successful real estate development . . . . . 156
3.8.3 Potential method of developer selection . . . . . 159
3.9 Conclusion . . . . . 162
Bibliography . . . . . 165
3.10 Appendix. Example of an Announcement of China's Land Auction . . . . . 168
3.11 Appendix. Missing Value Problem . . . . . 170

# List of Figures


1.1 Hierarchy in China . . . . . 60
1.2 Level of Party . . . . . 60
1.3 Level of Government . . . . . 61
1.4 Level of City . . . . . 61
1.5 Promotion Sequence In Modern China . . . . . 62
1.6 Promotion Trajectory of Leaders of the USSR . . . . . 63
1.7 Promotion Trajectory of Leaders of the PRC . . . . . 64
1.8 Age of Secretary first serve as Secretary . . . . . 65
1.9 Length as Secretary before real promotion . . . . . 65
1.10 Secretary age distribution . . . . . 66
1.11 Age of Mayor first serve as Mayor . . . . . 66
1.12 Mayor age distribution . . . . . 67
1.13 Age of Mayor promoted to Secretary . . . . . 67
1.14 Age of Secretary got real promotion . . . . . 68
1.15 Age of Secretary got promoted . . . . . 68
1.16 Density of reported GDP growth . . . . . 69
1.17 Average GDP growth by age of Secretary . . . . . 69
1.18 GDP growth reported by Secretaries from different provinces . . . . . 70

1.19 Average GDP growth reported by different age of Secretary . . . . . 70
1.20 Average probability of promotion at different age of Secretary . . . . . 71
1.21 Appendix: Years in office of secretaries get promoted to primary positions . 71
1.22 Appendix: Model Simulation . . . . . 72

2.1 Player $i$'s payoff and rebellion decisions. . . . . 104
2.2 Both players' payoff and rebellion decisions. . . . . 106
2.3 Player $a$'s payoff on institution paths with different transition time points. . 109
2.4 Government's transition time ($t_a^*$) and survival time ($T_a^*$) with different $\beta$ and $r$ 112
2.5 Player $a$'s share of $V$, i.e. $\frac{p_{at}}{t}$. . . . . 114

3.1 Timing of English auction and two-stage auction . . . . . 133
3.2 Simulation results . . . . . 141
3.3 Number of land bureaus that choose certain percentage of two-stage auctions 143
3.4 Deposit rate . . . . . 145
3.5 Reserve price pre-trends for land bureaus inspected in the first round . . . . 147
3.6 Event study results: number of auctions, total land area, reserve price . . . . 148
3.7 Event study results: auction choices and outcomes . . . . . 149
3.8 Missing data on announcement time and final price . . . . . 170

# List of Tables


1.1 Effect of GDP growth and Secretaries' experience on probability of promotion in general . . . 73
1.2 Effect of GDP growth and Secretaries' experience on probability of level promotion . . . 74
1.3 Effect of GDP growth and Secretaries' experience on probability of real promotion . . . 75
1.4 Effect of GDP growth on probability of promotion of Secretary . . . 76
1.5 Effect of Mayors' experience on probability of promotion . . . 77
1.6 Effect of Mayors' experience on probability of real promotion . . . 78
1.7 Effect of Secretary at Age 55 on GDP growth reported . . . 79
1.8 Balance check for Secretary at age 54 and 55 . . . 80
1.9 Effect of Secretary at Age 54 on GDP growth reported . . . 81
1.10 Effect of Secretary at different age on GDP growth reported . . . 82
1.11 Other measurement of development . . . 83
1.12 GDP growth of prefectures in different provinces . . . 84
1.13 Effect of Secretary at Age 54 and 55 on reported GDP growth . . . 85
1.14 Effect of Mayor at Age 54 and 56 on reported GDP growth . . . 86

1.15 Effect of Mayor in office for less than 3 years and Secretary at Age 55 on reported GDP growth . . . . . 87
1.16 Effect of Mayor length in office and Secretary at Age 55 on reported GDP growth . . . . . 88

3.1 When and where the central inspection team was sent during 2013-2016 . . . 134
3.2 Summary statistics for post-2013, comparable auctions . . . . . 144
3.3 How auctions are separated into different period groups, based on their overlap with CIT presence . . . . . 150
3.4 Disentangle the potential mechanisms by period dummies . . . . . 151
3.5 The effect of central inspection teams, for auctions organized by city land bureaus . . . . . 152
3.6 The effect of central inspection teams, for auctions organized by county land bureaus . . . . . 153
3.7 The effect of local government debt on auction elements and auction outcomes 155
3.8 The effect of local government debt on auction elements and auction outcomes, continued . . . . . 156
3.9 The effect of Wanda Plaza Opening on auction elements and auction outcomes, using post-2013 data, part 1 . . . . . 158
3.10 The effect of Wanda Plaza Opening on auction elements and auction outcomes, using post-2013 data, part 2 . . . . . 159
3.11 The effect of Wanda Plaza finish land transfer on auction elements and auction outcomes, using post-2013 data, part 1 . . . . . 160
3.12 The effect of Wanda Plaza finish land transfer on auction elements and auction outcomes, using post-2013 data, part 2 . . . . . 161

3.13 The effect of Wanda Plaza win the bid on auction elements and auction outcomes, using post-2013 data, part 1 . . . . . 162
3.14 The effect of Wanda Plaza win the bid on auction elements and auction outcomes, using post-2013 data, part 2 . . . . . 163
3.15 Information and Requirements for Land . . . . . 168

# Abstract

This dissertation explores the intricate dynamics of political behavior and incentive mechanisms within non-democratic systems, with a focus on China's unique governance structure. It comprises three comprehensive chapters, each addressing distinct yet interrelated aspects of political maneuvering and strategic decision-making by political players.

Chapter 1 delves into the manipulation of GDP growth by local Chinese officials, particularly mayors and prefecture Party secretaries, as a strategy for career advancement. Through an extensive analysis of career trajectories for 536 Party secretaries and 583 mayors, this chapter reveals how these officials engage in GDP manipulation at critical junctures in their careers to secure promotions. Employing a game theory model, findings demonstrate that both mayors and secretaries exploit their last opportunity for advancement to positions of real authority by artificially boosting GDP figures. However, this manipulation is met with heightened promotion criteria by higher authorities, particularly for secretaries at pivotal ages who must exceed average GDP growth rates significantly to be considered for promotion. Interestingly, the presence of mayors poised to succeed them acts as a deterrent against secretaries' short-sighted economic policies, suggesting a complex interplay that favors long-term development over immediate gains.

Chapter 2 investigates the survival strategies of governments facing threats from various actors with divergent interests. It posits that strategic institution building, which initially disadvantages and later empowers certain challengers, can delay rebellions. This nuanced approach to managing political dissent and conflict highlights the importance of timing in the transition of institutional power, providing insights into the economic and political evolution observed in China. The government's manipulation of perceived benefits to delay potential uprisings underscores the delicate balance between short-term survival and long-term stability.

Chapter 3 focuses on the non-revenue-maximizing incentives driving government actions in China's land market auctions, such as corruption, financial pressures, and long-term development goals. By analyzing the impact of anti-corruption campaigns and local government debt on auction outcomes, the study highlights a shift towards transparency and strategic financial management. The involvement of major developers in setting auction prices further illuminates the government's incentive to ensure the developmental viability of land, balancing immediate financial needs against broader economic objectives.

Overall, this dissertation sheds light on the complex behaviors and incentives of political players in non-democratic systems, offering a nuanced understanding of the strategies employed to navigate the challenges of governance, economic development, and political stability in China.

# Chapter 1

# Political Structure and Balance of Power

**Evidence from Mid-level Officials' Promotion in China**

Abstract

The purpose of this paper is to analyze the government leadership structure of China and its effect on the promotion practices for Party secretaries and government mayors by answering three questions: 1) How do local Chinese officials manipulate GDP growth for promotion according to the crucial junctures in their careers? 2) How does the central government strategically react to such manipulation in terms of promotion decisions? 3) How does the interplay between the mayor and secretary under the distinct dual-head leadership structure affect GDP growth manipulation? To address these questions, a comprehensive dataset was collected on the career trajectories of 536 prefecture Party secretaries and 583 mayors. The first outstanding characteristic was how their promotion prospects depend on age. A game theory model was designed to generate testable predictions about the

dynamic relationship between secretaries' and mayors' ages and their decisions to manipulate GDP growth. It was found that both secretaries and mayors manipulate GDP growth during the last opportunity for promotion to primary vice-provincial positions with real authority. Aware of these manipulations, higher-level authorities have set a higher promotion standard for these secretaries. secretaries at their critical age must achieve a 1.45% higher nominal GDP growth rate on average (12.5% of the average GDP growth) than secretaries at other age ranges to be promoted. Additionally, it was found that secretaries at their critical ages manipulate less when paired with mayors who were qualified to succeed them as secretaries, since short-term policy measures used by secretaries to "stimulate" economic development can hinder the mayors' prospective pursuit of high GDP growth, highlighting how the presence of mayors can act as a control on secretaries.

**Keywords:** Diarchy, Promotion Path, GDP manipulation, Career advancement

## 1.1 Introduction

As the world's second-most-populous country, the third largest country, and the country with the second highest GDP, China is an increasingly powerful state in the geopolitical landscape. At the same time, the Chinese government's approach to governance is distinct from other democratic, as well as non-democratic countries. In addition to a hierarchical central-local government structure, China adopts a dual-head, horizontal leadership structure, where each municipality is governed by both a Party leader and a government leader. What are the different incentives of these two types of leaders? How does the dual-head leadership structure affect the strategic interactions between these two heads? This paper will make an attempt to answer these questions, and fill the literary gap in the topic.

A natural context is to study the leaders' incentives of promotion given by the central gov-

ernment. Unlike the dual-head leadership structure in Russia, where officials are promoted either by the party line or the government line, the standard next step for a government head in China usually means promotion as Party leader (Party secretary). The literature has jointly studied the promotion of provincial-level officials and GDP growth, arguing that the central government adopts the "Tournament Model", where it promotes provincial officials based on their economic performance, represented by GDP growth (Li and Zhou, 2005; Jia et al., 2023). Without re-elections or supervision, such incentives lead to manipulation of GDP figures by local officials (Wallace, 2016).

Building on the literature, this paper argues that it's important to distinguish government heads from Party secretaries in the context of promotion, as they face different promotion incentives. These diverging incentives lead to optimal GDP manipulation at different stages of their careers, resulting in a scenario where one role counterbalances or checks the other, creating a unique dynamic in the political landscape. The present research paints a holistic picture of the manipulation choices of local officials under promotion incentives, the strategic responses by the central government anticipating manipulation, and the strategic interplay between two leaders under the dual head leadership structure.

In order to study these questions, a unique dataset was collected on the promotion paths of all prefecture level Party secretaries and mayors during 2010-2015. By focusing on mayors and prefecture level Party secretaries, this paper ensures a sample size large enough for the separate examination of the incentives driving these two categories of officials. Furthermore, officials' prior political and career history was measured, encompassing experiences that significantly influence their future promotions and policy directions. The highest rank these officials achieved was recorded for each of these experiences. This study also addresses a gap in previous literature regarding officials' actual educational qualifications, which is unrelated to their ranks. Additionally, these local officials occupy a lower tier in the administrative

hierarchy compared to provincial-level officials. This aspect of their position reduces their exposure to the potentially confounding influences of nepotism with central government members, offering a more unobstructed view of their career progressions and decision-making processes.

Moreover, it was investigated whether Party secretaries and mayors succeeded in advancing to vice-provincial positions and noted the timing of these promotions. For Party secretaries, promotion to primary vice-provincial positions with real authority depends on economic performance, while advancement to secondary vice-provincial positions requires a sufficiently long tenure. For mayors, promotion to the Party secretary position is more contingent on the departure of the current secretary. Both Party secretaries and mayors tend to exaggerate economic data before their last promotion opportunity to primary vice-provincial positions with real authority, typically occurring at the age of 55 for Party secretaries and between the ages of 53 and 54 for mayors, depending on the current Party secretary's departure.

In order to understand the complicated strategic interplay of this dual-head structure, a game theory model was built to test its implications. The model predicts that while both Party head and government head are motivated by promotion and may manipulate GDP, there is a trade off between the benefit of manipulation and the cost of getting caught. As a result, manipulation is higher at their last chance for promotion. In response, the higher-level authorities will reduce the GDP figures during officials' last chance of promotion, knowing manipulation will be highest there. This ensures less data manipulation, the selection of capable party secretaries and prevents otherwise qualified party secretaries of other age ranges from losing promotion opportunities. Promotion standards for 55-year-old Party secretaries, based on GDP growth, were raised on average by 1% to 1.5%, significantly higher than those of Party secretaries of other ages.

Finally, but most important, China's unique dual leadership system was analyzed, where mayors have a significant probability of being promoted to the position of Party secretary in their own city. This incentivizes mayors to reduce data manipulation to avoid negative consequences on their own future development and promotion prospects. As mayors' probability of succeeding to Party secretary increases within one term (five years), it was found that the tendency of 55-year-old Party secretaries to over report GDP growth significantly decreases as the tenure of their paired mayors increases. This demonstrates that the unique dual-head leadership system not only fosters better collaboration between Party secretaries and mayors but also encourages mutual constraint and restricts substantial manipulation, especially when these two categories of leaders have diverging goals, thus mitigating the challenges posed by limited supervision from same-level disciplinary secretaries serving as Party secretaries and mayors' subordinates.

This paper contributes to several streams of literature.

First, it contributes to the literature on the promotion of Chinese officials, showing that Party secretaries are evaluated based on their performance on economic growth, while mayors are not. By distinguishing primary promotions (promotion to positions with more authority and higher rank) from secondary promotions (promotion to positions with less authority but higher rank), demonstrating that performance on economic growth only matters for the former. If these two types of promotions are not distinguished, the estimation is susceptible to measurement error.

Second, it contributes to the literature on GDP manipulation in China. By comparing it with electricity consumption growth, a significant increase in GDP growth was found for secretaries of age 55. It also demonstrated that secretaries tend to over report GDP performance before their last opportunity for promotion to primary vice-provincial level positions. The age constraint of promotion used in this paper is inferred from actual promotions, avoid-

ing the use of "official retirement ages" or age limits that lack support from data, which has been widely used in the literature (e.g. Kou and Tsai 2014). Previous literature focusing on data manipulation concentrated on provincial-level officials, thereby giving more consideration to political cycles (Wallace, 2016). In this paper, targeting prefecture-level officials, a dynamic decision-making model was constructed to analyze how the motivation for GDP growth manipulation varies among secretaries of different ages.

Third, this paper also addresses the literature on how anticipation of future career prospects affect officials' decision-making. Literature has found that in democratic countries incumbent official making decision depended on probability of winning re-election (Biglaiser and Mezzetti, 1997). In this paper, it was found that mayors, as the likelihood of succeeding the secretary position increases, tend to reduce the secretary's behavior of over reporting GDP growth or the use of various short-term measures to inflate GDP.

Finally, this research adds to the understanding of dual-head leadership structures by examining China's unique system. While not directly comparing it with the Soviet Union, findings indirectly relate to Lane and Ross (1994) observations about the Soviet system. Lane and Ross noted the challenges the Soviet Party faced in influencing government appointments, which contributed to its eventual collapse. In contrast, this paper reveals that China's dual-head system, involving both government departments and Party systems, allows for interchangeable promotions between government officials and Party leaders. This key distinction underlines a fundamental difference in operational dynamics between China's leadership structure and what was observed within the Soviet Union. While also studying the dual-head structure in China, Li (2023) focused on the political structure in ancient China and documented how the central government set up deputy positions at the local level to divide power and prevent local tendencies towards independence. This paper contrasts Li's paper in analyzing the balancing of power under diverging promotion incentives,

and providing empirical evidence from the modern context.

The paper proceeds as follows: section 2 introduces China's political institutions, section 3 covers data collection, categorization, and statistical analysis, section 4 presents the reduced form empirical results which is the foundation of the decision making model, section 5 formalizes the decision making process of prefectural secretaries, prefectural mayors and higher-level authorities, section 6 tests and discusses how the predictions are revealed in the data, and section 7 summarizes.

## 1.2 Background

### 1.2.1 Hierarchy in China

In China, especially before the institutional reforms in 2017, nearly all state-owned institutions held administrative ranks. These ranks were standardized from top to bottom and applied across all 31 provinces, municipalities, and autonomous regions within the mainland. This administrative rank system extended beyond Party and government officials, encompassing institutions such as public schools, hospitals, research organizations, and state-owned enterprises. From primary school principals to university Party secretaries, and from township health clinics to hospital directors in Beijing, all adhered to the same administrative rank system. This system consisted of five levels, corresponding to China's administrative hierarchy: national level, provincial level, prefectural level, county-level, and township-level. Figure 1.1 provides an illustration of this hierarchical structure.

Excluding the military, administrative institutions in China primarily operated within four parallel branches: the Party, the National People's Congress (NPC), the government, and the Chinese People's Political Consultative Conference (CPPCC). Each branch had its own subordinate departments and lower-level administrative institutions. Typically, the head

of a department in a higher-level administrative institution held the same administrative rank as the chief official of the corresponding lower-level administrative institution. For example, within the government branch, the head of the Finance Department of provincial government held the same rank as the mayor of a prefecture-level city. Similarly, within a province, the Party secretary (the head of the Party branch), the chairman of the NPC (the head of the NPC branch), the governor (the head of the government branch), and the chairman of the CPPCC (the head of the CPPCC branch) all held the same rank known as the "zhengshengji", or the full provincial level. Focusing on the provincial level, vice positions within these four branches, such as vice Party secretary and vice governor, vice chairman of the NPC, and vice chairman of the CPPCC, held the rank of "fushengji", or the vice-provincial-level. Figure 1.2 and Figure 1.3 illustrate the positions within the Party branch and the government branch at various levels.

At the legal level, the heads of departments under these four branches held the same rank as the Party secretary, NPC chairman, governor, and CPPCC chairman of the lower-level administrative institution. However, it's important to note that Party leaders at the corresponding rank, while their administrative rank might match that of other administrative branch leaders, always held a higher political status. In practice, Party department heads often concurrently held the position of standing member of the Party committee, granting them a higher rank even than regular deputy officials in the government. For example, the head of the organization department of the provincial Party committee typically also served as a standing member of the provincial Party committee, which came with greater political privileges than regular vice governors.

While Party department head ranks surpassed those of their counterparts in the government, such as the head of the organization department of the provincial Party committee having a higher rank than the head of the financial department of the provincial govern-

ment, the Party secretary and the governor usually held the same rank at the provincial level. Similarly, in most cases at the prefecture-city level, the Party secretary and the mayor also held the same rank, known as the "zhengtingji", or the prefectural level. Theoretically, the Party secretary was responsible for Party affairs and cadre selection, while the mayor tended to focus more on economic activities. However, given the Party's comprehensive control, particularly over administrative institutions at the prefecture-level city or lower, this distinction might not be very pronounced in practice.

Similarly, at the provincial level, the heads of the NPC and the CPPCC also held the same rank as the Party secretary and the governor. However, their powers differed significantly. The Party and government held real decision-making authority, while the NPC and the CPPCC, especially at the provincial and lower levels, often served as preparatory institutions for retiring officials—what is often referred to as secondary organizations. While the NPC theoretically resembled parliamentary systems in democratic countries with legislative powers, in China, the NPC functioned more like a rubber stamp. The political status of the CPPCC was even lower than that of the NPC. It was a unique manifestation of China's united front with non-Communist parties and individuals, as China has eight democratic parties alongside the Communist Party. These democratic parties operated under the leadership of the Communist Party, and their leaders were also integrated into the NPC and the CPPCC. The primary role of the CPPCC was advisory, providing suggestions to the Communist Party and government, and its actual influence was smaller than that of the NPC. Consequently, for officials, transitioning from the Party or government to the NPC or the CPPCC usually signified the end of their political careers and prepared them for retirement. However, since the NPC and the CPPCC held the same rank as the corresponding Party committees and governments, vice chairmen of the NPC and the CPPCC often became ideal positions for rewarding retiring officials.

In this article, we focus on prefecture-level cities, which are below the provincial level and above the county-level. In China, prefecture-level cities hold a unique status. Legally, they don't even exist; they're designated institutions of provincial-level Party committees and governments. However, this intermediary tier between the province and county has a longstanding history and has become an established administrative level. There are four directly administered municipalities in China: Beijing, Shanghai, Tianjin, and Chongqing, each having the administrative status of a province. Aside from these four cities, there are 15 cities that hold a vice-provincial-level status. Both of their Party secretaries and mayors are vice-provincial-level officials. Additionally, all provincial capitals are special prefecture-level cities because the Party secretary of these capitals is customarily held by a standing member of the provincial Party committee, also making them vice-provincial-level officials. Many mayors of these capital cities also have experience as Party secretaries in other prefecture-level cities within the province. Unlike ordinary mayors of prefecture-level cities, these mayors of provincial capitals have opportunities for promotion to vice-provincial-level officials directly. Finally, there are some important cities. The most notable example is Suzhou in Jiangsu Province. The Party secretary of Suzhou is typically also a standing member of the provincial Party committee. In fact, most of these secretaries of provincial capital cities and important cities also serve as alternate members of the Central Committee, which distinguishes them from normal secretaries significantly. In this article, we won't discuss the promotion and economic performance of Party secretaries and mayors in these cities. Additionally, the concept of "prefecture-level city" that we're discussing doesn't include these mentioned special cities. Figure 1.4 illustrates the different administrative tiers of cities.

### 1.2.2 Why prefectural level

In China, there are a total of 333 prefecture-level administrative divisions, of which 293 are prefecture-level cities, excluding border regions and a few ethnic autonomous areas. There is a significant disparity in population among prefecture-level cities, ranging from a few hundred thousand (notably, Sansha City, with a population of only 3,000 located in the middle of South China Sea, is often not considered a real prefecture-level city) to over ten million. Typically, a prefecture-level city's population falls in the range of one to eight million. Similarly, the territorial jurisdiction of these cities varies substantially. Excluding prefectures like Sansha, the smallest prefecture-level city covers an area of 1,440 square kilometers, while the largest extends over 370,000 square kilometers (excluding ethnic minority prefectural-level autonomous districts). Economic volume and development levels also exhibit significant disparities among prefecture-level cities, even when excluding border areas, ethnic minority regions, provincial capitals, and economically important cities in various provinces.

Prefectural secretaries are usually promoted within their province, competing with their peers in the same province. After excluding the capital city and important prefectures where secretaries are customarily held by a standing member of the Provincial Party Committee, prefecture cities in the same province (excluding Xinjiang and Xizang/Tibet) are less diverse.

The primary focus of this article is on the Party secretaries and mayors of various prefecture-level cities. While they are nominally considered middle-level officials in China, they do not fit the conventional middle-class category. In China, officials at or above the vice-provincial level are regarded as senior officials. In Xi Jinping's anti-corruption campaign, corrupt officials at or above the vice-provincial level were referred to as "tigers," while officials at or below the prefectural level were called "flies." Therefore, for officials at the prefectural level, the temptation to be promoted to the vice-provincial level, particularly to influential positions, is substantial. In China, there are approximately 2,000 officials at

the vice-provincial level, including the secondary positions in the NPC and CPPCC, while there are around 10,000 officials at the full prefectural level. China's total civil service population is approximately 7 million, and about 90 million people working in institutions with administrative ranks, such as public schools or hospitals. As the most influential officials at the prefectural level, Party secretaries and mayors represent the top 0.1% of Chinese officials, making them elite members of society. Detailed data on their working experience, education background, promotion dates, and other vital information can be obtained from public report and official resume.

In China, it's a common practice for the Party secretary of a province and the provincial governor to be appointed from different regions. They cannot be officials who are native to the province or have worked in the province for an extended period, although the provincial governor can be promoted to the position of Party secretary within the same province. On the other hand, the Party secretaries and mayors of prefecture-level cities are typically officials under provincial organization department, often promoted from within the province, and rarely appointed from other provinces. Therefore, in comparison to the connections between provincial-level officials, and members of the Politburo, it's challenging for the Party secretary and governor of a province to have hometown connections or previous working relationships with Party secretaries and mayors of prefecture-level cities within the same province. As a result, the political connections between the Party secretary and governor of a province and the Party secretaries and mayors of prefecture-level cities within the province tend to be more distant. Compared to promotion of provincial Party secretaries and governors, promotion of Party secretaries and mayors of prefecture-level cities within the same province are less influenced by political connection.

### 1.2.3 Unique dual-head system in China

In the usual promotion sequence, becoming a Party secretary is often the final step before being promoted to the vice-provincial level. This promotion opportunity is particularly enticing for Party secretaries. Conversely, becoming a mayor often requires first becoming a Party secretary before having a chance to be promoted to the vice-provincial level. Therefore, if pursuing the promotion to Party secretary doesn't lead to the opportunity for a vice-provincial level promotion due to age factors, the motivation to pursue this promotion might be significantly diminished.

In the prefecture-level administrative tier, while the political status of a Party secretary is higher than that of a mayor, their administrative ranks are the same when neither holds concurrent positions in superior institutions. Both hold the position of a member of the Provincial Party Committee, which grants them the qualification to report upwards and participate in various meetings. However, a mayor also concurrently holds the position of vice Party secretary of prefecture, which means, within the Party's organizational system, the mayor is still subordinate to the Party secretary. Furthermore, a Party secretary can be directly promoted to vice-provincial level positions, whether they are influential positions like standing member of the provincial Party committee or vice governor, or rank-based promotions like vice chairman of the provincial People's Congress or vice chairman of the provincial CPPCC. In contrast, mayors of prefecture-level cities have very limited chances to be directly promoted to vice-provincial level positions. For most mayors, becoming a Party secretary is the necessary path to eventually being promoted to a vice-provincial level position.

In summary, for grassroots Chinese officials, whether they start in Party committees or government institutions, they usually need to alternate between Party and government positions to secure promotions. A typical promotion trajectory could be county mayor, county

Party secretary, vice prefecture mayor, standing member of prefectural Party committee (including vice prefectural Party secretary), prefecture mayor, prefectural Party secretary, vice governor, standing member of provincial Party committee (including vice secretary of provincial Party committee), governor, provincial Party secretary. Figure 1.5 illustrates the promotion sequence from county level to vice-provincial level.

This dual-headed political model is unique and differs from the administrative models commonly seen in other countries. For instance, in the United States, lower-level governments are not accountable to higher-level governments; they are only accountable to their own voters. Additionally, in the federal government of the United States, the Speaker of the House of Representatives usually doesn't ascend to the presidency, and retiring Vice Presidents don't typically transition to becoming Speakers of the House. There is no hierarchical promotion relationship between the executive and legislative branches. In India, although the civil servant system (IAS) and the elected official system are somewhat similar in terms of a dual-headed system, officials in these systems have limited interaction, and there is no sequential promotion relationship between them. When comparing to other non-democratic countries, a prominent example of a dual-headed system is Iran. However, to some extent, Iran shares similarities with India. The interaction between Iran's religious clergy system and government officials is not very frequent. Among other socialist countries, China's system remains highly unique. Former Soviet Union and Cuba also had similar dual-headed systems, but their dual-headed systems resemble those of India or Iran with infrequent interactions between different systems. For example, in the former Soviet Union, if an official originated from the government system, the ideal promotion trajectory would be mayor, vice governor, governor/Republic minister, vice chairman of minister conference of Republic. To provide a specific example, Leonid Brezhnev mostly worked within the Party system throughout his life, while Alexei Kosygin worked predominantly in government departments. Figure

1.6 illustrates the promotion trajectory of Leonid Brezhnev and Alexei Kosygin before join Political Bureau and Figure 1.7 illustrates the promotion trajectory of Xi Jinping and Li Qiang before join Political Bureau.

Among the existing socialist countries, Vietnam's promotion trajectory is the most similar to China's. In Vietnam, the provincial People's Committee functions as the government, and the chairman of the provincial People's Committee corresponds to China's provincial governor. Like China, it's a common phenomenon in Vietnam for governors to be promoted to provincial Party committee secretaries. However, unlike China, there's a significant difference in political status between provincial Party committee secretaries and governors in Vietnam. Among the members of the 13th Central Committee of the Communist Party of Vietnam (most recent central committee, elected at 2021), almost all the serving provincial Party committee secretaries are elected as central committee members, but there are very few governors elected as central committee members. In contrast, in China, both serving provincial Party secretaries and governors are inevitable central committee members[1]. For a province, both the prefectural Party secretary and mayor are inevitable members of the provincial Party committee. Thus, compared to Vietnam, government leaders at various levels in China have relatively greater autonomy and more comparable political rights to their counterparts in the Party.

Even when compared to ancient China, the current system has many differences. Li (2023) pointed out that the dual-head system in ancient China was effective in reducing rebellions, using officials such as Tongpan (assistant prefecture mayor specialize in justice) and Tongzhi (vice prefecture mayor) as examples. In ancient times, the gap between the Prefect and Tongzhi was much larger than the gap between the secretary and the mayor

[1]The central committee re-elect every 5 years, the incumbent provincial Party secretaries and governors are inevitable central committee members for the new central committee as long as they will not retire soon, however, provincial Party secretaries and governors are not required to select from central committee members.

today. More importantly, the possibility of Tongzhi being promoted to Prefect was very limited, and even if promoted, it was more likely to be a transfer to a different place rather than taking over as the Prefect in the same jurisdiction. In fact, in the closest example to modern times, the Qing Dynasty, the promotion path for local officials was County Magistrate, Prefectural Magistrate (mayor of vice-prefecture level administrative district), and then Prefect, in that order. It did not require passing through the positions of vice Prefect or Assistant Prefect at the prefecture level, which is quite different from the present. Furthermore, in the Qing Dynasty, the appointment of Prefect or higher civil officials was centralized in the Ministry of Personnel and need permit from Emperor. The majority of Prefects were appointed from officials who had previously served in the central government and frequently transferred across provinces, which is also very different from the modern era. Today in China, almost half of the secretaries are promoted from mayors of the same city and very limited of prefecture secretaries or mayors are from outside of province.

In summary, the dual-head system implemented in China today has two characteristics that are not present in ancient China or contemporary other countries. First, the treatment of the two heads is extremely balanced, from administrative level to political treatment to salary treatment, all very similar. Second, the promotion path is very special, secretaries likely to be succeeded by mayors after leaving office. From a political perspective, this arrangement cleverly avoids one-person rule, and from an economic perspective, it allows the secretary and the mayor to balance long-term development with immediate interests from promotion. In this article, we attempt to explain China's economic data based on this unique setup. Ultimately, this also helps us understand why higher-level authorities are able incentivizes officials to promote economic development by rewarding those who excel in economic performance.

## 1.3 Data

### 1.3.1 Data component

As mentioned earlier in this article, this paper exclusively focuses on ordinary prefecture-level cities, excluding directly-administered municipalities, vice provincial-level cities, important cities where the Party secretary concurrently holds the position of a standing member of the provincial Party committee, vice prefecture-level cities, and county-level cities. Additionally, due to data limitations and the unique characteristics of border regions, this study does not include minority autonomous prefectures or prefectures in Xinjiang, Tibet, and other similar areas. Finally, all prefecture-level cities considered in this article are from mainland China and do not include Hong Kong, Macau, and Taiwan.

The data used in this article primarily consists of four main parts:

1. The first part includes panel data for each prefecture-level city for each year. This data is sourced from official government-published statistical report for each year. It includes city population, birth rate, death rate, total GDP, GDP growth rate, GDP per capita, industrial proportion, agricultural proportion, investment amount, fiscal budget revenue, and more.

2. The second part consists of VIIRS nighttime light data used to cross-reference with GDP data from official statistical yearbooks published by prefecture governments. This study covers nighttime light data for the years from 2010 to 2013.

3. The third part includes GDP growth targets set by the central government and provincial government at the beginning of each year. These data are collected from the annual central government work report and annual government work reports of each province.

4. The fourth part includes the profiles of the prefectural Party secretaries and mayors for each year. If there are multiple Party secretaries or mayors within a year, those with a tenure exceeding 6 months are considered. If no Party secretary or mayor holds the position for

more than 6 months, the position is considered vacant. The original data for Party secretaries and mayors primarily come from officially published resumes. In cases where official resumes are incomplete, they are supplemented with information from publicly available official news reports.

The original data of resumes are presented in textual narratives, including ethnicity, official education, and tenure periods. I have compiled and organized the data, using numerical variables to record each official's political career experiences. For instance, whether they have worked in the central government, their highest administrative position held during central institution service, whether they have worked in the Communist Youth League, their highest administrative position held during Youth League service, whether they have served as a senior cadre's secretary, and their highest administrative position held during such service, and so on.

I have also recorded the officials' work experience in government positions prior to their current roles as Party secretary or mayor. Correspondingly, I have similarly recorded the officials' work experience in Party positions prior to their current roles. I have also tracked whether each Party secretary was promoted from the position of prefecture mayor and whether each mayor was subsequently promoted to the position of Party secretary. The officials' careers are tracked prior to their roles as Party secretary or mayor.

I have also documented whether they eventually received a promotion to the rank of vice-provincial-level cadre or higher and the timing of their promotion to vice-provincial-level cadre. I have also tracked whether each official faced prosecution due to corruption. The data about promotion and punishment are updated until the end of 2022.

Additionally, I have attempted to reconstruct the true education level of each Party secretary and mayor. Previous research indicates that education level significantly impacts an official's potential for promotion. However, previous studies did not differentiate between

officials' first degrees, full-time degrees, and their officially highest degrees.

In China, the first degree refers to the degree obtained after taking the national college entrance exam and entering a university. If an individual did not participate in the national college entrance exam, their first degree is the highest full-time degree they obtained. The full-time degree refers to the highest education level achieved through regular academic study. The officially highest degree, on the other hand, includes in-service/part-time degrees obtained from Party schools, as well as distance learning degrees. In reality, such degrees are relatively easy for officials to obtain. For senior officials, obtaining a part-time degree from a university in their primary jurisdiction or affiliated with their province does not necessarily involve academic study.

All the data of officials used in this paper were collected and organized by myself from published resumes and news reports.

### 1.3.2 Statistic summary

In my database, I have recorded a total of 536 Party secretaries. The average age of these Party secretaries when they first assumed the position of prefectural Party secretary was 50.8 years old. Figure 1.8 displays the age distribution of these Party secretaries at the time they took on the role of prefectural Party secretary. On average, these Party secretaries served for 3.83 years. Among them, 62% were eventually promoted to the rank of vice-provincial-level cadre, and 33% of them attained vice-provincial-level positions with real authority, or simply called primary vice-provincial-level positions, which are vice-provincial-level positions not belong to provincial or national NPC or CPPCC, such as vice governor, deputy minister and standing member of provincial Party committee. When we focus solely on those Party secretaries who achieved primary vice-provincial-level positions, we find that their average tenure was 3.37 years. For those who were promoted to vice-provincial-level positions belong

to the NPC or CPPCC, the average tenure was 4.83 years.

Figure 1.9 depicts the distribution of years of service as prefectural Party secretary for those who were promoted to primary vice-provincial-level positions. From the graph, it can be observed that Party secretaries who aspired to further promotions typically needed to serve in their roles for at least one to two years. In the database, there are a total of 586 pairs of Party secretaries and prefectures, as some Party secretaries have served in multiple prefectures. Among these pairs, 79.7% of Party secretaries had previous experience as mayors before assuming the position of Party secretary. Additionally, 48.5% of Party secretaries were promoted to the position of Party secretary from the mayor of the same city. 23% of these Party secretaries were sentenced due to corruption. Among all secretaries, 5.6% of Party secretaries were investigated for corruption during their tenure and were ultimately sentenced.

Considering the time frame, we have recorded a total of 1406 combinations of Party secretaries and prefectures for each year. Figure 1.10 displays the age distribution of Party secretaries during their tenure. The average age of Party secretaries in office is 52.8 years old. Among these 1406 combinations, there were a total of 131 secretaries promoted to primary vice-provincial-level positions, with an average promotion rate of 9.3%.

In my database, a total of 583 mayors are recorded. The average age of these mayors when they first took office is 48.8 years old. Figure 1.11 displays the age distribution of mayors when they assumed the position of mayor for the first time. The average tenure of mayors is 3.33 years, and 62.6% of them eventually get promoted to the position of Party secretary, with 36.7% of mayors being directly promoted to become Party secretaries in the same city. Normally, mayors need to serve in their role for at least 2 years to have a successful transition to secretaryship. 38.9% of mayors are eventually promoted to the rank of vice-provincial-level cadre or above. If we focus on those mayors who are promoted to

the vice-provincial-level or above, we find that 80.2% of them have prior experience as Party secretaries.

In the database, there are a total of 586 pairs of mayors and prefectures, as some mayors have served in multiple prefectures. 20.3% of these mayors are sentenced due to corruption. Among all mayors, 2.1% of mayors are investigated and eventually sentenced due to corruption during their tenure.

In the end, considering all the data over time, we have a total of 1394 mayor-year pairs recorded. Figure 1.12 illustrates the age distribution of mayors during their tenure. The average age of mayors during their tenure is 50.3 years old. Figure 1.13 shows the age of mayors when they transition from being mayors to becoming Party secretaries. The average age at this transition is 52.2 years old.

### 1.3.3 Age constraint of promotion and retirement

Although the legal retirement age for Party secretaries below the vice-provincial-level is 60 years old, in practice, the opportunity for Party secretaries to be promoted to the position of primary vice-provincial-level cadres ceases at the age of 56. The Chinese government hasn't officially published the deadline for promotions at each level, and many previous studies on age constraints for promotions, such as Kou and Tsai (2014), may be misleading. Since I have collected the exact month when the prefectural Party secretary was promoted to the vice-provincial-level cadre position, I can draw conclusions directly from the data rather than relying on unofficial reports. I find that only 3 Party secretaries, got promoted to primary vice-provincial-level positions after the age of 57[2]. Figure 1.14 illustrates the age distribution

[2]Among them, there are two special cases. One is Huang Ke, the Party secretary of Chongzuo prefecture, who is of Zhuang ethnicity and became the president of the high court of Guangxi Zhuang autonomous region. Another is Ye Zhuang, a member of leadership of Sichuan provincial government and the secretary-general. Following the 2013 Ya'an earthquake, he assumed the additional responsibility of Party secretary in Ya'an and was subsequently promoted to the position of vice governor during his tenure.

of Party secretaries when they are promoted to the positions of vice-provincial governor or provincial standing member of the provincial Party committee. It's quite evident that there is a distinct break-point at the age of 56.

Similarly, for mayors, although the legal retirement age is 60 years old, the practical opportunity for mayors to be promoted to Party secretaries ceases around the age of 57. Only a very few mayors have the chance to be promoted to Party secretaries after the age of 57. What's even more crucial for mayors is whether they have the chance for further promotion after transitioning to Party secretaries. As mentioned earlier, if a Party secretary wishes to be promoted to a vice-provincial-level position, they must have served as a Party secretary for at least one year. Therefore, for mayors aiming to retain the possibility of being promoted to primary vice-provincial-level positions, they must become Party secretaries by the age of 54 or earlier. Figure 1.15 displays the age distribution of all prefectural Party secretaries who had experience as mayors and were ultimately promoted to primary vice-provincial-level positions when they transitioned from being a mayor to a Party secretary. It's evident that there are distinct breakpoints around the age of 54.

## 1.4 Reduced Form Empirical Results

### 1.4.1 Which position need better GDP performance

In previous research on the promotion mechanisms of Chinese officials, several factors have been identified as influencing promotions, including but not limited to relationships with higher-level governments (Yi and Liu, 2022), education backgrounds, and in-service economic performance metrics such as GDP growth rates. Luo and Qin (2021) argued that the promotion of prefectural Party secretaries is linked to GDP growth rates, while the promotion of mayors does not show a significant correlation with GDP growth rates. However,

Luo and Qin did not control for officials' career experiences.

In our study, we re-examined the correlation between promotions and GDP performance. Additionally, as GDP data for the previous year is typically published in March of the following year, using current-year GDP data to infer its influence on the probability of promotion in the same year is highly inappropriate. Given that we collected precise promotion dates for all officials down to the month, promotion periods do not need to be constrained by calendar years. Considering that GDP data for each year is typically published in March of the following year, we believe that the GDP data for each year affects the probability of promotion within the 12 months from April of the following year to March of the third year. To investigate this, we conducted the following regression analysis:

$$\begin{aligned} Promotion_{ict} = a + bGDPgrowth_{ct} + cSecExperience_{it} + dSec_{it} \\ + fCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.1}$$

On the left side, the variable is the dummy of promotion result for secretary i of prefecture city c, with next 12 month after government publish the GDP information of year t. I set four values for the dummy, 0 for not get promotion, including retirement, transfer to other prefecture level position and get punishment, 1 for get promoted to NPC or CPPCC, 2 for get promoted to vice governor and 3 for get promoted to standing member of provincial party committee. On the right side, the first variable, a, is the constant, the second variable captures the GDP growth rate of prefecture city c at year t, the third variable is a control variable captures the experience of secretary i at year t, such as experience as mayor or youth league, the forth variable is another control variable captures the character of secretary i at year t, such as gender or age, the fifth variable is the statistical data of prefecture city c at year t, such as population and total GDP, and the rest are prefecture city fixed effect, year

fixed effect and error term. Results are shown in Table 1.1.

I found the positive correlation between promotion and GDP performance, as demonstrated in previous research, does indeed exist. Then, we redefined the "promotion" variable as a binary dummy variable (0/1), where 1 represents promotion, including promotion to NPC or CPPCC, vice governor, or standing member of provincial party committee. 0 represents not receiving any promotion. We also tested the probit model, and the results were consistent. However, due to the distinct pathways of promotion for secretaries, such as the promotion to primary vice-provincial-level officials (vice-governor or standing committee member) versus promotion to NPC or CPPCC, we aimed to clarify which type of promotion was driving the results.

First, I retained only those secretaries who did not receive a promotion and those who were promoted to NPC or CPPCC. Then, I run the following regression:

$$\begin{aligned} Level\_Promotion_{ict} = a + bGDPgrowth_{ct} + cSecExperience_{it} \\ + dSec_{it} + fCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.2}$$

On the left side, the dependent variable as a binary dummy variable (0/1), where 1 represents promotion to NPC or CPPCC and 0 represents not receiving any promotion. On the right side, the independent variables are the same with regression (1).

The results are shown in Table 1.2. Clearly, GDP growth rate no longer significantly affects the promotion to NPC or CPPCC, in contrast to the previous findings. Instead, the length of tenure as a secretary has a greater impact on the probability of being promoted to vice chairman of the People's Congress or the Political Consultative Conference. In fact, this type of promotion that becoming a vice chairman of NPC or CPPCC seems more like a consolation prize for secretaries who have served for many years in various places, and have

neither outstanding performance nor significant misconduct.

Next, I focused on those secretaries who promoted to primary vice-provincial-level positions. I run the following regression:

$$\begin{aligned} Real\_Promotion_{ict} = a + bGDPgrowth_{ct} + cSecExperience_{it} \\ + dSec_{it} + fCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.3}$$

On left side, I once again defined a binary promotion variable (0/1), where 0 indicates no promotion to a primary vice-provincial-level position, including retirement, transfer to other prefecture-level position, get punishment and get promoted to NPC or CPPCC, and 1 indicates promotion to vice governor or standing committee member. On the right side, the independent variables are the same with Regression 1. The results are shown in Table 1.3. I discovered a clear correlation between GDP growth rate and the probability of promotion to vice governor or standing committee member, with extra 1% of GDP growth reported, there is almost extra 1% probability to get promoted to primary vice-provincial-level position, with the average probability of promotion is only about 9% for each year. I also tested the probit model, and the results were stable.

### 1.4.2 Which year of GDP performance matter

I test the influence of GDP performance of previous years and current year. I rerun the regression 3, but changes the definition of dependent variable of promotion and independent variable of GDP growth of year t. For dependent variable, I simply use the promotion status of calendar year t and for independent variable, I use three different measurements of GDP growth: GDP growth of year t, GDP growth of year t-1, and the average of GDP growth of secretaries' tenure. Compare to use the GDP growth at year t as independent variable and

promotion status of next 12 months after publish the GDP growth as dependent variable, the magnitude of coefficient b decreases and significance disappear when using either year t-2, year t, or tenure average as independent variable and promotion status of calendar year t as dependent variable. Results are shown in Table 1.4.

Therefore, I argue that the latest available GDP growth before promotion decision has a much greater impact on whether a promotion is granted than the GDP growth in the preceding years, and since the GDP growth of current year is not available during the year, so it could not have a significant influence on promotion at current year. In all the aforementioned regressions, our promotion data were based on promotions occurring within 12 months after the release of GDP data for the respective prefecture at year t.

### 1.4.3 GDP performance and promotion of mayor

I also tested the impact of GDP performance on the promotion of mayors but did not find stable results. I run the following regression:

$$\begin{aligned} Promotion_{ict} = a + bGDPgrowth_{ct} + cMayorExperience_{it} + dMayor_{it} \\ + fCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.4}$$

On the left side, the variable is the dummy of promotion result for mayor i of prefecture city c, with next 12 month after government publish the GDP growth of year t. I set four values for the dummy, 0 for not get promotion, including retirement, transfer to other prefecture-level city as mayor, transfer to prefecture-level institutions such as provincially-owned enterprises or universities as secretary or executive leader, or get punishment, 1 for get promoted to be director of department of provincial government, such as director of department of commerce and department of education (not including directors of department

that are usually held concurrently by the vice governor, such as department of police), or to be executive vice director of a department of the provincial party committee (the director of such department held concurrently by the standing member of provincial party committee), such as the executive vice director of provincial organization department. 2 for get promoted to party secretary of any prefecture cities and 3 for get promoted to any vice provincial positions. Results are shown in Table 1.5.

I rerun the Regression 4, however, I once defined a binary promotion variable (0/1), where 1 indicates promotion to secretary position or vice-provincial-level position, 0 otherwise. On the right side, the independent variables are the same with Regression (1) but for mayors instead of for secretaries, the results are shown in Table 1.6. I also tested the probit model, and the results were stable.

One conceivable reason is that about 40% of the mayors are promoted to become secretaries of their own cities. Therefore, to some extent, the tenure of secretaries determines the timing of mayors transitioning to become secretaries. Moreover, the promotion of secretaries to primary vice-provincial-level positions based on excellent GDP performance is limited and more secretary positions are left vacant because the secretary is promoted to secondary vice-provincial-level positions unrelated to economic performance or because the secretary steps back to the second line due to age concerns, allowing the mayor to take over. As a result, there might be a lack of strong connection between GDP growth and the promotion of mayors.

Based on these findings, combined with our previous discovery of promotion breakpoints, we can draw the following conclusions: GDP growth of each year primarily affects the chances of secretaries being promoted to primary vice-provincial-level positions next year before the age of 56, for secretaries aged 57 to 60, the assistance in promotion to the NPC and CPPCC is minimal, and for mayors, the influence of GDP performance on promotion to secretaries

is limited.

## 1.5 Model

### 1.5.1 Model foundation

In section 2, I explained that in China, both the Party secretary of a normal prefecture-level city and the mayor of a normal prefecture-level city hold the rank of prefecture level. However, prefecture secretary is typically the final step in the promotion process before becoming a vice-provincial-level official. In contrast, only 6 mayors were directly promoted to a vice-provincial-level position out of 611 mayor-prefecture pairs (583 mayors) in our dataset[3]. If mayors wish to be promoted to vice provincial-level officials, promotion to secretary is the most direct route. Over 80% of mayors who were eventually promoted to vice-provincial level positions first got promoted as prefecture secretary.

In section 3, I showed that even though the official retirement age for prefecture-level officials is 60 years old, in practice, most prefecture secretaries and mayors do not stay in their positions until retirement. More importantly, from previous data analysis, we found that for prefecture Party secretaries, the latest age to be promoted to primary vice-provincial-level positions, such as vice governor or provincial standing committee member, is 56 years

[3]Among these six individuals, one comes from a minority ethnic group, one is female, and another individual is both a member of a minority ethnic group and female. Additionally, two of them were previously directors of department in central government ministries and returned to central government ministries or departments directly under central jurisdiction as vice-provincial-level officials after serving in local government positions. In China, it is customary to have at least one female member in the provincial Party standing committee and one female vice-governor. In minority autonomous regions, both primary and secondary officials should include a certain proportion of officials from the minority ethnic group. Therefore, female and minority ethnic cadre sometimes have an advantage in receiving unconventional promotions. It is a common practice in central government ministries to temporarily assign senior officials at the prefecture-level who are being prepared for promotion or reassignment to work at the local governments for one or two years. This helps enrich their work experience. In fact, only one mayor during the period covered by my database, Chen Baocheng, the mayor of Dongguan Prefecture, was directly promoted to the vice-provincial-level cadre, becoming the vice governor of Guangdong Province.

old. Therefore, if a prefecture Party secretary wishes to impress higher-level authorities with their economic growth performance, the latest time should be at the age of 55, as GDP statistics are usually completed and reported in February or March of the following year.

In section 4, I presented the empirical result that prefecture Party secretaries with better economic performance are more likely to be promoted to primary vice-provincial-level positions. However, there is no significant correlation between a prefecture mayor's promotion to secretary and economic growth. Similarly, there is no significant correlation between a prefecture Party secretary's promotion to positions with vice-provincial-level privileges, such as vice chairman of the provincial People's Congress or vice chairman (NPC) of the provincial Committee of the Chinese People's Political Consultative Conference (CPPCC), and economic growth. Since prefecture Party secretaries typically hold the position for 3-4 years, and the initial economic performance largely depends on the policy effects left by their predecessors, our data demonstrates that the promotion of prefecture Party secretaries is most strongly related to economic performance in the year preceding their promotion and, but not to their economic performance at the beginning of their tenure.

For a prefecture Party secretary, promotion to a primary vice-provincial-level position carries significant benefits. Firstly, compared to the official retirement age of 60 for prefecture-level officials who can only hold the powerful position until 57 to 58 in most situations, vice-provincial-level officials can usually hold the powerful positions until the age of 60. They can also continue to hold a second-line position such as vice chairman of the provincial NPC or CPPCC until 63, thereby extending their political life and increasing political and living benefits every year thereafter. Secondly, promotion to a vice-provincial-level position provides further opportunities for advancement[4]. Finally, promotion to a vice provincial-

[4]Until 2023, there are 27 officials coverd in my dataset that worked as prefecture secretaries or mayors in 2010-2015 serve as provincial secretary, minister, gorvernor or other full-provincial-level officials, some of them may become vice-national-level officials such as vice-prime-minister in 2027

level position offers additional retirement benefits and privileges. Therefore, promotion to primary vice-provincial-level position is highly attractive for prefecture Party secretaries. In fact, this is also the major motivation for mayors to aspire to become prefecture Party secretaries even though mayors and secretaries are officials at the same rank, with similar benefits.

The selection and appointment of vice-provincial-level officials in a province are the result of discussions between the provincial standing committee of the Party and the central organization department. The promotion of a prefecture secretary to the position of vice governor or provincial standing committee member is usually an internal promotion within the province. Here, we do not specifically distinguish between the roles of the provincial standing committee and the central organization department; we collectively refer to them as higher-level authorities. Compared to the promotion of provincial officials or county-level officials, the connection between higher-level authorities and prefecture officials is less influenced by political or personal connections.

### 1.5.2 Model setup

In this section, we construct a theoretical model based on the standard career concern model (Holmström, 1999) and a decision-making model to maximize lifetime expected utility, to explain the decision-making process and outcomes of three important players in the promotion process of prefecture-level officials in China: the Prefecture Party Secretary (secretary), the Prefecture Mayor (mayor), and the Higher-Level Authorities. The model is testable through empirical methods based on our data.

First, we assume that the higher-level authorities simply want to identify the most capable officials, and all the utility from this promotion process is derived from promoting capable secretaries. The higher-level authorities cannot directly observe the abilities of the secretaries

but can observe the GDP growth rate reported by each secretary each year.

For secretaries, the GDP growth rate they report at age "t" consists of three components.

$$GDPgrowth_{it} = a_i + m_{it} + \eta_{it} \tag{1.5}$$

On the right side, the first part is their ability, denoted as $a_i$, the second part is the manipulation decided by secretary which is the reported GDP growth minus what really happened, denoted as $m_{it}$, and the last part is the economic fluctuations, denoted as $\eta_{it}$, with expected value equal to zero. Both of the ability and fluctuations are objective and beyond secretary's control. Here t is the age at the end of current year, and we have t=n+$t_0$, $t_0$ as the age of secretary assigned as secretary and "n" as the difference between current year and $t_0$, which mean the $n^{th}$ year as secretary could determine m.

Here m represents the GDP growth achieved through illegal or short-term means at the expense of the prefecture's future development. This may include but is not limited to excessive auctions of state-owned land to raise funds to increase investment to boost economic growth, negotiations with local companies to obtain advance tax payments in exchange for future tax exemptions, tacit approval of environmental violations or illegal construction by companies, and direct falsification of economic data, among other actions. Such behavior can boost GDP growth for the current year but harm future economic development. Moreover, due to the existence of audits and reporting mechanisms, it may be discovered by the higher-level authorities, leading to disciplinary action against the secretary and the loss of promotion opportunities or even their position.

### 1.5.3 Utility function of Secretaries

I assume that before the start of each year, the higher-level authorities will receive each prefecture Party secretaries' economic growth report of previous year and decided who to promote. Each secretary learn about promotion status at the beginning of each year. For given secretary i, if she fails to get promoted and have not reached actual retirement age at the end of this year t, she chooses $m_{it}$ during the year t based on $\eta_{it}$, and then report $GDPgrowth_{it}$ to higher-level authorities.

For secretaries, each year they have probability of being promoted to a vice-provincial-level position in the following year. As mentioned earlier, the probability of promotion is related to economic performance, which in turn is directly related to their ability.

Since at the beginning of each year, the central government sets economic growth targets for each province. Therefore, the provincial Party committee and provincial government establish a target for their jurisdiction that is typically equal to or higher than the national requirement. In majority cases (992/1372), the GDP growth rates reported by the prefectures will meet this target, since falling short of the target implies incompetence. Furthermore, I found there are 131 secretaries got real promotion and only 7 of them failed to meet both of the requirement from central government and provincial government[5]. From the Data, I found the density of GDP growth report is single peak and the peak location is slight higher than province requirement, showed by Figure 1.16. Since the density is decreasing after fulfill the requirements, for each extra unit of GDP growth given secretary reported, she will surpass less and less peers after fulfill the requirements after pass the peak of provincial requirement.

In conclusion, I assume that the probability of promotion, denoted as $p(g)$ with $p'(g) > 0$,

[5]In fact among these 7 secretaries, 3 of them from provinces that no secretaries fulfill both of national requirement and provincial requirement at that year, which means it's very rare to get a real promotion without fulfill national and provincial requirement of GDP growth.

$p''(g) \leq 0$ and $p(g) > 0$.

Here, we assume that secretaries are risk-neutral, so their utility function consists of a Bayesian utility function. If the secretaries' age still qualified for promotion before the start of next year, $t \leq 56$, the utility function of given year includes four components each year:

First is the basic utility of serving as a secretary, denoted as $u_s$.

Second, if they are promoted at the beginning of current year due to their GDP performance from the previous year, they receive additional utility as a vice-provincial-level official, denoted as $u_e$.

Third, if they are promoted at the beginning of current year due to their GDP performance from the previous year, after the decision making process, they will expect to receive additional retirement utility, denoted as $u_r$, and utility from extending political life (3 years in most cases) as a vice-provincial-level official.

Fourth, if they don't get promoted in beginning of the current year, they incur a cost for the year based on the choice of $m_t$ they made at the end of current year, and $m_{t-1}$ from the previous year, denoted as $C_t(m_{t-1}, m_t)$.

As mentioned earlier, one of the primary methods to accelerate GDP growth in the short term is to increase government investment, which relies on raising more funds through various channels.The main methods for raising funds are through borrowing and land transfer fees. When the government issues bonds through urban investment groups or other economic entities, a higher debt ratio will correspondingly increase the cost of financing. Similarly, putting more land up for auction increases the supply of land and lowers the unit price of land. Both of these factors make fund raising an increasingly challenging process. Therefore, we assume $C_{m_{t-1},m_t}$ is a convex and increasing function with weighted $m_{t-1}$ and $m_t$, and $C_{m_{t-1},m_t} > 0$.

In conclusion, the utility function of each secretary at year t is:

$$U_{t_0+1} = u_s - C_{t_0+1}(m_{t_0}, m_{t_0+1}) \tag{1.6}$$

$$\text{if } t = t_0 + 1$$

$$U_{t_0+n} = u_s + u_e - \{ \prod_{t=t_0+2}^{t_0+n} [1 - p_t(g_{t-1})] \} * [u_e + C_{t_0+n}(m_{t_0+n-1}, m_{t_0+n})] \tag{1.7}$$

$$\text{if } t_0 + 1 < t < 56$$

$$U_{56} = \{1 - \prod_{t=t_0+2}^{56} [1 - p_t(g_{t-1})] \} * u_f \tag{1.8}$$

$$\text{if } t = 56$$

Here we assure secretary assigned as secretary for a given prefecture at age $t_0$. Since many policies may have been determined by previous secretary so we assume there's $m_0$ as given. Except that, as this is not a full year, so we call this year as year 0 as secretary, and normalize the utility and cost from this year 0 equal to 0. Furthermore, it's very rare for secretaries getting promotion within a year after being assigned, we assume the probability of promotion of next year is 0.

Function (6) captures the total utility of year 1 as secretary, it only have two components, the basic utility as secretary and the cost from m, since probability of promotion at the beginning of year 1 is 0.

Function (7) captures the total utility of year n as secretary, the first two components capture the utility as primary vice-provincial-level official, and the third component captures the expect utility loss with probability that failed to get promoted at any year from year 2 to n.

Function (8) captures the expect total utility of retirement and extending of political life as primary vice-provincial-level official with probability that succeed to get promoted at any

year from year 2 to 56.

Since the GDP growth reported by secretary is determined by function (5) and both of $a_i$ and $\eta_{it}$ are objective, each secretary can only choose $m_{it}$. Each secretary i, need to choose $(m_{t_0+1}, \dots, m_{55})$ to maximize the sum of utility over all years from the year 1 as secretary to retirement.

$$\begin{aligned} ExpectUtility_i = \quad & u_s * (1-\beta^{55-t_0})/(1-\beta) + \beta * u_e * (1-\beta^{54-t_0})/(1-\beta) \\ & - \sum_{n=2}^{55-t_0} \{\{\beta^{n-1} * \prod_{t=t_0+2}^{t_0+n} [1-p_{it}(g_{t-1})]\} * [u_e + C_{it}(m_{t-1}, m_t)]\} \\ & - C_{it_0+1}(m_{t_0}, m_{t_0+1}) + \beta^{57-t_0}\{1 - \prod_{t=t_0+2}^{57} [1-p_{it}(g_{t-1})]\} * u_f \end{aligned} \tag{1.9}$$

$$\text{if } t_0 < 54$$

Here the first line on the right side capture the total utility with time discount $\beta$ as secretary and extra utility as primary vice-provincial-level official, the second line capture the total expect utility loss if a given secretary failed to get promotion at each year with time discount, and the cost of m at first year, the third line capture the expect total extra utility as primary vice-provincial-level official after retirement with time discount.

$$ExpectUtility_i = \quad u_s + \beta * p_{56}(g_{55}) * u_f - C_{55}(m_{t_{54}}, m_{t_{55}}) \tag{1.10}$$

$$\text{if } t_0 = 54$$

since $p'(m) > 0$ and $p''(m) \leq 0$ if $p(m) > 0$, and $\frac{\partial C(m_{t-1}, m_t)}{\partial m_{t-1}} > 0$, $\frac{\partial C(m_{t-1}, m_t)}{\partial m_t} > 0$, $\frac{\partial^2 C(m_{t-1}, m_t)}{\partial m_{t-1}^2} > 0$ and $\frac{\partial^2 C(m_{t-1}, m_t)}{\partial m_t^2} > 0$, there's solution $m^* = (m^*_{t_0+1}, \dots, m^*_{55})$.

### 1.5.4 Simple version of the model

In this case, I use a simple two-stage model to analyze the secretary's decision making. For simplicity, I assume the expectation of shock $\eta_{it} = 0$. I further assume the secretary could only choose $m \neq \tilde{m}$ at one single age, either at age 54 or age 55, and for all other age, we have $m_t = \tilde{m}$ and setting $g_t = \tilde{g}$. I also assume m of previous year and m of current year have same influence on cost of current year, which means $\frac{\partial C(m_{t-1},m_t)}{\partial m_{t-1}} = \frac{\partial C(m_{t-1},m_t)}{\partial m_t}$. At last, I assume $p_t(g_{t-1}) = \tilde{p}$ for all t except at age 54 and 55, and $p'(g_{t-1}) > 0$ and $p''(g_{t-1}) < 0$. Since utility before age 54 is independent with choice of $m_{54}$ and $m_{55}$, and choice of change $m_{54}$ or $m_{55}$ have exact same influence on change of $U_{56}$, so the secretary choose to change m at either age 54 or age 55 to maximize: $U_{54} + \beta * U_{55}$

If secretary choose to change $m_{54}$, then need to max:

$$\begin{aligned} U_{54} + \beta * U_{55} \;=\; & u_s + u_e - (1-\tilde{p})^{53-t0}[u_e + C(\tilde{m}, m_{54})] \\ & + \beta * \{u_s + u_e - (1-\tilde{p})^{53-t_0} * (1-p_{54})[u_e + C(m_{54}, \tilde{m})]\} \end{aligned} \tag{1.11}$$

If secretary choose to change $m_{55}$, then need to max:

$$\begin{aligned} U_{54} + \beta * U_{55} \;=\; & u_s + u_e - (1-\tilde{p})^{53-t0}[u_e + C(\tilde{m}, \tilde{m})] \\ & + \beta * \{u_s + u_e - (1-\tilde{p})^{54-t_0}[u_e + C(\tilde{m}, m_{55})]\} \end{aligned} \tag{1.12}$$

Marginal utility of changes $m_{54}$ from $\tilde{m}$ is:

$$\begin{aligned} \left.\frac{dU_{54}}{dm_{54}}\right|_{m_{54}=\tilde{m}} = & -(1-\tilde{p})^{53-t_0} C'_{54} + \beta(1-\tilde{p})^{53-t_0} p'_{54} u_e \\ & - \beta(1-\tilde{p})^{53-t_0} C'_{54} + \beta(1-\tilde{p})^{53-t_0} p_{54} C'_{54} + \beta(1-\tilde{p})^{53-t_0} p'_{54} C_{54} \end{aligned} \tag{1.13}$$

Marginal utility of changes $m_{55}$ from $\tilde{m}$ is:

$$\left.\frac{dU_{55}}{dm_{55}}\right|_{m_{55}=\tilde{m}} = -\beta(1-\tilde{p})^{53-t_0}C'_{55} + \beta(1-\tilde{p})^{53-t_0}\tilde{p}C'_{55} \tag{1.14}$$

The difference between $\left.\frac{dU_{54}}{dm_{54}}\right|_{m_{54}=\tilde{m}}$ and $\left.\frac{dU_{55}}{dm_{55}}\right|_{m_{55}=\tilde{m}}$ is:

$$\left.\frac{dU_{55}}{dm_{55}}\right|_{m_{55}=\tilde{m}} - \left.\frac{dU_{54}}{dm_{54}}\right|_{m_{54}=\tilde{m}} = \beta(1-\tilde{p})^{53-t_0}[C' - \beta p'(u_e + C)] \tag{1.15}$$

Here $C' = \left.\frac{\partial C(\tilde{m},m_{54})}{\partial m_{54}}\right|_{m_{54}=\tilde{m}} = \left.\frac{\partial C(\tilde{m},m_{55})}{\partial m_{55}}\right|_{m_{55}=\tilde{m}}$, $C = C(\tilde{m},\tilde{m})$, $p(\tilde{m}) = p$, $p'_{54}(\tilde{m}) = p'_{55}(\tilde{m}) = p'$. From section 4, we know for secretary, report each extra unit of GDP growth rate would give less than 1% of probability getting promoted to primary provincial position, which means the p' is relative small. Assume $C' > \beta p'(u_e + C)$, we have $\left.\frac{dU_{55}}{dm_{55}}\right|_{m_{55}=\tilde{m}} - \left.\frac{dU_{54}}{dm_{54}}\right|_{m_{54}=\tilde{m}} > 0$. Intuitively, at age 55, there's no future potential cost for manipulate GDP growth since the secretary will leave the office no mater getting promotion or not. As long as the extra utility as primary vice-provincial-level official for single year is not huge enough, secretary should have more incentive to manipulate GDP growth at age 55 instead of age 54. Furthermore, if we assume in different provinces k, the $p_k(g)$ is different for same GDP growth reported, assume province k with higher probability for promotion than province j, we should have $p_k > p_j$ when $p'_k(\tilde{m}) = p'_j(\tilde{m}) = p'$. Then for same $p'$, $\beta(1-p)^{53-t_0}[C' - \beta p'(u_e + C)]$ decreasing with p, that means the difference between marginal utility of manipulation for secretary at age 55 and at age 54 should be smaller at provinces with more chances of promotion.

Similarity, we could have

$$\left.\frac{dU_{t_0+1}}{dm_{t_0+1}}\right|_{m_{t_0+1}=\tilde{m}} - \left.\frac{dU_{t_0+2}}{dm_{t_0+2}}\right|_{m_{t_0+2}=\tilde{m}} = (\beta^2 - 1 - 2p\beta^2 + p^2\beta^2)C' + \beta p'(u_e + C)$$

$$\text{if } t_0 < 54$$

Based on previous literature (Wang et al., 2009), the time discount $\beta$ for Chinese people is around 0.74, with significant positive correlation with Male, Age and education background of Economics, so here I simply use $\beta = 0.8$. From section 2 I calculated that on average, 9.3% of secretaries got promoted to primary vice-provincial-level position each year. Exclude those secretaries in office within a year that normally unqualified for promotion, here I use $\tilde{p}$=0.1. Then we could have

$$\left.\frac{dU_{t_0+1}}{dm_{t_0+1}}\right|_{m_{t_0+1}=\tilde{m}} - \left.\frac{dU_{t_0+2}}{dm_{t_0+2}}\right|_{m_{t_0+2}=\tilde{m}} \approx \beta p'(u_e + C) - 0.5C'$$

If we further assume $C' > 2\beta p'(u_e+C)$, which means the $\left.\frac{dU_{t_0+1}}{dm_{t_0+1}}\right|_{m_{t_0+1}=\tilde{m}} < \left.\frac{dU_{t_0+2}}{dm_{t_0+2}}\right|_{m_{t_0+2}=\tilde{m}}$, that secretaries would have higher and higher incentive to manipulate the GDP growth until the final stage. If we have $C' < 2\beta p'(u_e + C)$, which means the marginal utility decreasing by age until before the final stage, then we should observe U-shaped relationship between the reported GDP growth on average by secretaries' age and the age of secretary. More importantly, we know:

$$\left.\frac{dU_{t_0+1}}{dm_{t_0+1}}\right|_{m_{t_0+1}=\tilde{m}} - \left.\frac{dU_{t_0+2}}{dm_{t_0+2}}\right|_{m_{t_0+2}=\tilde{m}} = (\beta^2 - 1 - 2\tilde{p}\beta^2 + \tilde{p}^2\beta^2)C' + \beta\tilde{p}'(u_e + C)$$

increasing with $\tilde{p}$ if we control $p'$, that means we should observe the GDP growth reported at age $t_0 + 1$ and age $t_0 + 2$ are closer at provinces with higher probability for promotion compare to provinces with lower probability for promotion. In conclusion, the U shape curve

should be flatter at provinces with higher probability for promotion compare to provinces with lower probability for promotion.

To more concretely demonstrate this model, I have defined a series of specific functions according to the trends in the data and in combination with assumptions, which have been incorporated into the model. For details, please see the appendix.

### 1.5.5 Decision making of Higher authority

Next, we can further assume that if the higher-level authorities observe these reported results and understands the motivations of prefecture Party secretaries, what should they do? The higher-level authority's motivation is to select secretaries with higher ability (a), not necessarily higher reported GDP growth (g). The higher-level authorities can only observe the GDP growth reported by secretaries but also knows the age of each secretary. Therefore, if the higher-level authority believe secretary does not make strategic moves but simply makes decisions based on the decision model mentioned earlier, the higher-level authorities will adjust their expectations of the secretary's true ability based on the age of the secretary.

Assume the utility of higher-level authorities is:

$$V = E(U(a|g, age)) + X$$

Here X captures all other unobservable factors higher-level authorities care about promotion, such as political connection or personal taste. For simplicity, I assume X is independent with g and t, and E(X)=0. Assume higher-level authorities will promote secretary if $V > \bar{u}$, then we have $g^*(age) = a^* + E(m|age)$ for secretary at different age solves $E(U(a|g, age) = \bar{u}$. Since we have already know that secretary would have higher incentive to manipulate GDP growth at age 55 compare to age 54, we know $E(m|age = 55) > E(m|age = 54)$. In

order to select secretaries with expected ability no less than $a^*$, higher-level authority should set $g^*(age = 55) > g^*(age = 54)$, which means we should observe that the higher-level authorities have different promotion standards for secretaries of different ages.

However, if secretary finds out that higher-level authority sets different promotion standard depends on secretary's age, then secretary will have less incentive to over-report GDP growth at the age they should over-report more originally solved by Equation 9. On the other side, secretary will have more incentive to over-report GDP growth at the age they should over-report less originally. As a result, the difference between promotion standard at different age should be less significant. Even if secretary report GDP growth strategically, since the higher-level authority will update belief, so in the equilibrium situation there will still be different promotion standards at different age, but the difference will be less. Unfortunately, I could not distinct whether the different standard of promotion is the equilibrium situation that both secretary and higher-level authority behave strategically, or simply because secretary just solve their decision-making model and not find out higher-level authority know their trick and set different promotion standard.

### 1.5.6 Example of mayor's choice

Finally, for the mayor, the motivation is more complex. First, if the secretary get promotion, there is higher probability for the mayor to succeed as the secretary if mayor is qualified, which means by helping secretary manipulate GDP growth, mayor could slightly increase the probability of getting promoted to secretary. Even though we found there's no significant correlation between mayor's promotion and GDP performance in section 5, it could because only very limited number of secretaries get promoted to primary vice-provincial-position at the same time mayors of same city are qualified for promotion. Second, the mayor would consider their own future in the succeeding years, which means over-report GDP growth will

increase future cost of manipulation after succeeding as secretary. Third, if mayor choose not to cooperate with secretary, there would be social cost.

For simplicity, here I focus on a special case about what mayors would do when the secretary of same city at age 55. From previous sub-section, we know secretary would have high incentive to bump the GDP performance at age 55. More importantly, compare to secretaries younger than 55, secretary at age 55 would be more likely to leave the office in next one or two years. As a result, even if secretary at age 55 didn't get a promotion next year, it would be very likely for the mayor to succeed as secretary in next one or two years. Then we could assume the GDP performance will have no influence on mayor's promotion.

Then the utility function of mayor when the secretary she paired with at age 55 is:

$$U(l) = \beta * Q(t) * E[u_s - C(m_s - l, m)] - s(l)$$

Here t is the round up term by year as mayor until the end of year and we have Q(t)=1 if $t \leq 3$ which means normally mayor who has serve as mayor at least for 2.5 years will automatically succeed as secretary if secretary leave the office. And Q(t)=0 if $t < 3$ since the higher authorities could be more likely assign another secretary for mayors with less experience especially those who are not assigned by central or provincial government with prefecture-level before appointment as mayor. $l$ is the cooling down effect that mayor want to reduce from $m_s$ decided by secretary, with $\frac{dC(m_s-l,m)}{dl} < 0$. s($l$) is the social cost with secretary because of $l$, with $s^{'}(l) > 0$. We know

$$\frac{dU}{dl}(Q=1) = -\frac{dC(m_s - l, m)}{dl} - s^{'}(l) > -s^{'}(l) = \frac{dU}{dl}(Q=0)$$

which means only mayors qualified for succeed as secretary have incentive to reduce the $m_s$ decided by secretary at age 55.

Redefine

$$t = \frac{(year - Mayor\_startyear) * 12 + 3 - Mayor\_startmonth}{12}$$

as the exact length in office as mayor until next March to report the GDP growth rate. We could further generalize Q(t) from binary function to continues function with $Q'(t) > 0$, which means the probability for mayor to succeed as secretary when incumbent secretary leave the office increase with the length mayor in office. We should have $MU_l(t)$ increase with t, therefore $l^*(t)$ increase with t, which means mayors the longer stay in office, the more willing to reduce the GDP growth over reported by secretary at age 55.

## 1.6 Empirical Result

### 1.6.1 Summary of testable predictions

There are five testable predictions concluded from previous section.

Prediction 1: Secretaries have more incentive to boost GDP growth at age 55, compare to age 54 and age 56.

Prediction 2: Compare to provinces with higher promotion rate, secretaries from provinces with lower promotion rate have more incentive to boost GDP growth at age 55.

Prediction 3: Higher level authority have incentive to set different promotion standards for secretaries at different age.

Prediction 4: Mayors have incentive to boost GDP growth at age 54 since it's the last chance to promote as secretary with probability of promotion to primary vice-provincial-level position.

Prediction 5: Mayors with higher probability to succeed as secretary have more incentive

to reduce the manipulation of GDP growth made by secretaries.

### 1.6.2 Last chance for secretary

Prediction 1:

Secretaries have a greater incentive to boost GDP growth at age 55 since the next year is their last chance to be promoted to a primary vice-provincial-level position, and there is less future cost for over-reporting GDP growth at this age. However, fabricating GDP data comes with costs, which encompass two aspects: 1) the risk of detection by the discipline committee, and 2) the potential complications of future manipulation in subsequent years as a result of previous manipulations. Importantly, the motivations for secretaries and mayors differ when it comes to data fabrication.

Firstly, secretaries and mayors have different potential rewards that they can obtain through data fabrication. As summarized earlier, secretaries can significantly increase their chances of direct promotion to a position with real authority at the vice-provincial-level by improving GDP performance, creating a strong incentive for such promotion. However, the same does not hold true for mayors. It's extremely rare for "normal" prefecture mayors (those where the prefecture secretary is not a standing member of the provincial party committee, not the capital of the province, and not the most/second most important prefecture of the province) to be promoted to any vice-provincial-level positions.

Furthermore, secretaries have a motivation to start manipulating GDP data in their first year of office because by the second year when the data is published, they will have completed one year in their position and become eligible for promotion. Secretaries need to be cautious about manipulating GDP growth too significantly in a certain year, as if they artificially inflate the growth and don't receive a promotion in the following year, it could make it harder to manipulate data in the future and reduce their chances of promotion.

However, for secretaries who are 55 years old, this concern might not apply, since secretaries over 55 has barely no incentive to manipulate data. As a result, there's two sharp changes, one happened between age 54 and age 55, that for secretaries at age 54 or earlier, they need to worry about the potential future cost of GDP manipulation, but for secretaries at age 55 or later, they don't need to worry about that. The other change happened between age 55 and age 56, for secretaries at age 55 or earlier, they have incentive to bump the GDP growth, but for secretaries at age 56 or later, they have no incentive to do so. This explains why secretaries at the age of 55 might be more inclined to manipulate data. To test the prediction of my model that secretary at age 55 have more incentive to manipulate GDP than secretary at other age, I ran the following regression:

$$GDPgrowth_{ct} = a + bSecAge55_i + cSecExperience_{it} + dSec_{it} + fCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \tag{1.16}$$

Here, I am interested in the second term on the right side, which is a 0/1 variable for 55-year-old secretaries. 0 represents secretaries of other ages, while 1 represents secretaries at aged 55. The results I found are shown in Table 1.7. It's evident that secretaries at aged 55 report higher GDP growth (0.7% of growth rate) than secretaries of other ages when controlling for other variables.

Since age of secretary may correlated to many other characters, I only compare if there's similar effect when secretary at age 54. I checked the balance of each control variables and result showed on Table 1.8. Then I replace the dummy of SecAge55 by SecAge54 and rerun the regression, I didn't find secretaries at aged 54 report higher GDP growth. Result showed on Table 1.9. Then I checked all other potential ages from 50-53, result showed on Table 1.10.

I also observed that secretaries over the age of 56 had significantly lower GDP performance, results showed on Figure 1.17.

To test whether this effect arises from genuine additional effort or data manipulation, we replaced the locally published GDP data on the left side with other indicator of economic development such as the growth in satellite nighttime light and electricity consumption. The results indicated that secretaries at aged 55 do not show a significant relationship with these indicator that difficult to manipulate. Therefore, I believe this significant change likely stems from the manipulation of GDP data in pursuit of promotion. Furthermore, I use the government investment as dependent variable and found secretaries may increase government investment to boost the GDP growth, result showed on Table 1.11.

### 1.6.3 Heterogeneity of provinces

Prediction 2

Compared to provinces with higher promotion rates, secretaries from provinces with lower promotion rates have a greater incentive to boost GDP growth at age 55. In China, the probability of secretaries of prefecture-level cities getting promoted varies significantly among different provinces, primarily due to three factors.

First, in China, except for Xinjiang and Xizang (Tibet), each province has a maximum of 13 standing committee members and up to 8 vice governors. Among these 13 standing committee members, few positions are not open for secretaries of prefecture-level cities to get promoted. The provincial Party secretary and the governor are full-provincial-level officials, and the vice Party secretary is often considered the most senior vice-provincial-level official, which is the final step before promotion to full-provincial-level. In the time frame covered by the database, there are no examples of secretaries from regular prefecture-level cities being promoted to the position of vice province Party secretary. Additionally, the province com-

mission for discipline inspection is under vertical management, and the secretary is typically appointed by the central commission for discipline inspection. Moreover, one member of the standing committee represents the local military force, holding the rank of major general. As a result, only a maximum of 8 positions can theoretically be promoted directly by secretaries of prefecture-level cities. In practice, some positions, such as executive vice provincial governors and the director of the provincial organization department, are rarely directly promoted by secretaries of prefecture-level cities. Among the vice governors, the highest-ranking vice governor, usually known as the executive vice provincial governor, is conventionally held by a member of the provincial standing committee. In some places, the second-ranking vice governor can also become a member of the provincial Party standing committee. By convention, one vice governor is not a member of the Communist Party. Therefore, there are typically only 5 to 6 positions available for direct promotion by secretaries of prefecture-level cities. In practice, the Party standing committees and vice governors may not be fully staffed for a long time, and it is quite common to have a vacancy for one standing committee member or vice governor. In summary, only about 10 positions are typically available for direct promotion by secretaries of prefecture-level cities. Therefore, for larger provinces with a higher number of regular prefecture-level cities in their jurisdiction, such as Guangdong (which has 19 regular prefecture-level cities, excluding the vice-provincial-level cities of Guangzhou and Shenzhen), the difficulty of promotion is higher compared to provinces with fewer regular prefecture-level cities, such as Zhejiang (which has 9 regular prefecture-level cities, excluding the vice-provincial-level cities of Hangzhou and Ningbo).

Second, there is a significant difference in economic development between different provinces in China. Guangdong Province, with the highest total GDP in 2022, had a total GDP exceeding 1.9 trillion in US dollars, while Qinghai Province, with the lowest total GDP, had less than 54 billion (excluding Xizang(Tibet), which has the lowest total GDP in China).

Excluding border areas, traditional ethnic minority regions and Hainan Province, Gansu Province has the lowest total GDP, with a total GDP of only 167 billion. After the implementation of reform and opening up, the eastern regions were the first to achieve rapid development, and as a result, the central government transferred officials from economically developed southeastern coastal areas to regions with lower economic development, such as the northeast, northwest, and southwest. Therefore, many officials from central government and vice-provincial-level officials from more developed provinces are assigned to less developed provinces, rather than promoting local officials within these less developed provinces. For example, as mentioned earlier, in Gansu Province (which has 13 regular prefecture-level administrative units, excluding the provincial capital, Lanzhou, where it's conventionally held by a provincial standing committee member as the party secretary), the probability of secretaries of prefecture-level cities being promoted to primary vice-provincial-level positions is lower compared to more developed provinces such as Shandong province (which has 14 regular prefecture-level administrative units, excluding the vice-provincial-level cities of Jinan and Qingdao).

Third, there are political reasons that will not be further discussed here.

I calculated the total number of secretaries from 2010 to 2015 and how many secretaries got promoted to primary vice-provincial-level positions, including provincial standing committee members and vice governors, in each province. I simply set the average probability of promotion to primary vice-provincial-level positions for secretaries of normal prefecture-level cities.

$$\bar{p}_k = \frac{total\ number\ of\ secretaries\ getting\ promoted\ to\ primary\ vice-provincial\ position}{total\ number\ of\ secretaries}$$

There are 24 provinces in my database and I found $\bar{p}$ is varies from 0.03 to 0.17, exclude Qinghai province with only one normal prefecture-level city after excluding prefecture-level minority autonomous district and provincial capital.

Compare to prefecture secretary from provinces with higher promotion rate, who decide to report a given GDP growth rate to achieve a certain probability of promotion, prefecture secretary from provinces with lower promotion rate need to report higher GDP growth rate to achieve same promotion probability.

Compare to prefecture secretary from provinces with higher promotion rate, prefecture secretary from provinces with lower promotion rate, reporting one additional percentage of GDP growth will surpass less colleagues, since the density decrease with growth rate reported after full-fill the provincial requirement.

As a result, we know the marginal utility of manipulation at age 55 compare to manipulation at age 54 would be higher for secretaries from provinces with lower promotion probability than from provinces with higher promotion probability. Secretaries from high promotion rate provinces will have less incentive to manipulate GDP at age 55 compare to manipulate at age 54 and secretaries from low promotion rate provinces will have more incentive to manipulate GDP at age 55 compare to manipulate at age 54.

I also run the regression of Equation 16 separately with data of top25 % provinces and bottom 25% provinces on $\bar{p}$, the result showed on Table 1.12. I found secretary from provinces with low probability of promotion reported significant higher GDP at age 55. Secretaries reported about an extra 1% of GDP growth compare to the average GDP growth reported by secretaries at other age, which is 10.7%.

Since we found there's no positive correlation between GDP growth reported and age of secretary, if I assume $C' < 2\beta p'(U_e + C)$, that means we should observe the U-shape relationship between GDP growth reported and age of secretary, and the curve should be

flatter at provinces with higher probability of promotion.

To test this prediction, I compared average of GDP growth reported by secretary i at year t minus average GDP growth of province k at year t, reported by prefecture secretaries with different age, which is:

$$\overline{GDPgrowth\ by\ age} = \overline{GDPgrowth_{ct} - \overline{GDPgrowth_{kt}}}$$

from 6 provinces with highest $\bar{p}$ (top 25%) and 6 provinces with lowest $\bar{p}$ (bottom 25%), showed on Figure 1.18.

### 1.6.4 Different standards for secretary

Prediction 3

Higher-level authorities have an incentive to establish different promotion standards for secretaries of different ages. This is because if higher-level authorities understand the motives behind local Party secretaries falsifying GDP growth, they should adjust their belief in the ability of these secretaries based on their behavior. The goal of higher-level authorities is to select capable individuals who can drive genuine economic growth, rather than those who simply report higher GDP growth rates.

For secretaries aged 54 and 55, their differences in other dimensions are minimal. Therefore, if higher-level authorities do not have information about which year secretaries are likely to manipulate GDP growth data, the promotion criteria for 54-year-old and 55-year-old secretaries should be similar. In other words, the average GDP growth rate for promoted 54-year-old secretaries should be similar to that of promoted 55-year-old secretaries.

However, if higher-level authorities can predict that secretaries are more likely to manipulate GDP growth data in their last year when they can directly promote to primary

vice-provincial-level positions, then they should establish different promotion criteria. Assuming that 55-year-old secretaries might have inflated their reported GDP growth rates compared to 54-year-old secretaries, higher-level authorities can raise the promotion criteria for the former to eliminate this inflation. This ensures that promoted 55-year-old secretaries have capabilities similar to those promoted at the age of 54. In fact, higher authorities could set different promotion standards for different ages, resulting in varying average GDP performance reported by secretaries who are promoted to primary vice-provincial positions the following year, as depicted in Figure 1.19.

Furthermore, based on our model, even when comparing only those secretaries who were promoted to primary vice-provincial-level positions, we should still observe that 55-year-old secretaries reported higher GDP growth rates, as shown in Table 1.13. I found that Party secretaries at age 55 have to report, on average, a 1.45% higher GDP growth rate (12.5% of the average GDP growth rate in my data) than Party secretaries at other ages to secure their promotions. However, I didn't find such effect at other ages.

I also tested whether different promotion standards based on age lead to variations in the promotion rates for each age group. However, there was no significant difference among the ratios of secretaries getting promoted to primary vice-provincial positions at each age, as shown in Figure 1.20.

### 1.6.5 Ambition of mayors

Prediction 4

As mentioned earlier, mayors' promotions are weakly connected to GDP performance. However, if mayors aspire to further their careers, the most likely route is to become a secretary, with the easiest path being promotion to the same prefecture city's secretary after the incumbent secretary is promoted.

More than 80% of mayors who eventually get promoted to vice-provincial-level or higher positions have prior experience working as secretaries, and over 70% of mayors are promoted to the position of secretary within the same city after the previous secretary is elevated to the vice-provincial level. After mayors are promoted to secretary, they need to work in that position for at least one year to have a chance for further promotion (only one mayor became a vice-provincial-level official within a year after being promoted to secretary in my dataset).

Therefore, we can infer that if a mayor is involved in the secretary's GDP growth manipulation plan and the secretary gets promoted as planned, the mayor has a high likelihood of succeeding the secretary. In the following one or two years, it would be difficult for the mayor to manipulate data, thereby reducing their future chances of promotion.

Since the last opportunity for secretaries to receive a promotion based on GDP performance is at the age of 56, even though mayors can be promoted to secretary before the age of 57 based on our statistical summary, the last opportunity for mayors to succeed as secretary with a probability of receiving further promotion to a primary vice-provincial-level position based on GDP performance is at the age of 54. During the final opportunity for mayors to be promoted to vice-provincial-level positions, particularly at ages 53-54, a certain level of effect similar to that of 55-year-old secretaries is observed.

I conducted the following regression:

$$\begin{aligned} GDPgrowth_{ct} = a + bMayorAge54_{it} + cMayorExperience_{it} \\ + dMayor_{it} + fCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.17}$$

I found the coefficient of dummy of MayorAge54 is positive and significant, which means mayors reported significant higher GDP at age 54, results showed on Table 1.14. However, such effect does not exist if we use data more difficult to manipulate such as night light

or electricity instead of GDP growth reported. Furthermore, I didn't find any positive effect at age 56 (there's even unstable negative effects, showed on Table 1.14) for mayors even if age 57 is the last chance for mayors to get promoted to secretary. This shows the true incentive for mayors to manipulate GDP growth is to use secretary as a step-stone to get further promotion to vice-provincial-level officials, especially to primary vice-provincial-level position and if can't get further promotion, getting promoted to secretary itself is less attractive. This ambition also makes mayors have incentive to reduce the manipulation made by secretaries, if mayors believe they have higher enough probability to succeed as secretary next year, which would be discussed in next subsection.

### 1.6.6 Help or not

Prediction 5

As mentioned earlier, the average term for a mayor is around 3.3 years. Consequently, the probability of succeeding a secretary varies during different periods of a mayor's tenure. For instance, if a mayor just takes the office and the secretary immediately steps down, it's more likely that a new secretary will be appointed rather than promoting the mayor directly. Therefore, for a mayor in office for just one year, there might be motivation to cooperate with the secretary in data manipulation, since it's less likely for a mayor to succeed them. However, if a mayor has been in office for three years or longer, the succession to secretary might be more expected. Additionally, if a 56-year-old secretary is not promoted, there's still a high probability of them leaving their position. In such a scenario, cooperating with the secretary in data manipulation holds little benefit for the mayor. Furthermore, since mayors and secretaries both hold the position of prefecture-level officials and don't have significant rank differences or strict hierarchical relationships, mayors have the ability to refuse requests from secretaries to manipulate data.

As a result, if the hypothesis presented earlier regarding mayors being able to counterbalance secretaries is indeed valid, we should observe that the effect of secretaries manipulating data at the age of 55 primarily comes from mayors stay in office for only one or two years, since they are less likely to succeed as secretary. Consequently, I ran the following regression:

$$\begin{aligned} GDPgrowth_{ct} = a + bSecAge55_{it} + cMayor\_less3years_{ict} \\ + dSecAge55_{it} * Mayor\_less3years_{ict} + fSecExperience_{it} + gSec_{it} \\ + hMayorExperience_{it} + mMayor_{it} + nCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.18}$$

In this case, we are interested in the interaction term. The first part of the interaction term is the binary variable representing whether the secretary is 55 years old or not as discussed earlier. The second part represents a dummy variable indicating whether the mayor is experienced, where 1 denotes that the mayor has begun their second or more full year term in office (i.e., experienced mayor with more likely to succeed as secretary if secretary get promotion after report GDP growth at the beginning of next year), and 0 represents the opposite scenario. The other two variables on the right side are control variables related to mayors. The results I found are shown in Table 1.15. I also ran regressions without controlling for the situation of secretaries, and the results remained stable. It can be observed that the effect of secretaries manipulating data at the age of 55 indeed comes mainly from their collaboration with less experienced mayors, indicating the presence of a check and balance mechanism between mayors and secretaries.

For a mayor, the probability of succeeding as a secretary when the incumbent secretary leaves is correlated with the number of years served as mayor. If the prediction is correct,

we should observe that for mayors in office for more than two years but less than five years (one term), the longer they serve as mayor, the more likely they are to succeed after the incumbent secretary leaves. Typically, mayors do not assume the position of secretary within two years of taking office as mayor. For the very few officials who are promoted to secretary within this short period, they are mostly individuals sent down by higher-level institutions with the intention of training and promoting them. Their behavior and circumstances differ significantly from those of regular mayors. Additionally, the probability of a mayor who has served for more than one full term, i.e., five years, becoming the secretary is not correlated with their time in office. The reason is quite simple: if a mayor has been in office for five years and has not been promoted, it is more likely due to deliberate arrangements made by the higher-level government.

This also implies that the longer mayors stay in office (over two years but within five years) the more they inclined to reduce the manipulations carried out by the secretary at age 55. To test this, I run the following regression:

$$\begin{aligned} GDPgrowth_{ct} = a + bSecAge55_{it} + cSecAge55_{it} * Mayorlength_{ict} \\ + dSecExperience_{it} + fSec_{it} + gMayorExperience_{it} + mMayor_{it} \\ + nCity_{ct} + \delta_c + \eta_t + \epsilon_{ict} \end{aligned} \tag{1.19}$$

I observed that the reported GDP growth by the secretary at the age 55 decreases with the length of time the mayor is in office increases. Results showed on Table 1.16.

## 1.7 Conclusion

In this paper, I initially confirmed the existence of a tournament model, where in higher-level authorities promote officials based on their GDP performance. Specifically, at the prefecture-level, prefectural Party secretaries with better economic performance are more likely to be promoted to primary vice-provincial-level positions. However, promotions to positions such as vice president of the provincial People's Congress or Political Consultative Conference, which hold less power and are more about length as secretary and prefecture level official, show no significant correlation with in-office GDP performance. Similarly, mayors' promotions are also not significantly related to GDP performance but significantly positive correlated to length in office.

Summarizing the promotions of over 500 secretaries, we found that the final age for prefecture-level Party secretaries to be promoted to primary vice-provincial-level positions is 56. Since Chinese local governments usually announce the previous year's GDP data in March of the following year, prefectural Party secretaries have an incentive to manipulate data at the age of 55 in order to secure their promotion by the time they turn 56, without incurring future potential costs of manipulation. Our findings were supported by nighttime light data and electricity consumption.

Higher-level authorities would observe secretaries' incentive for manipulation at age 55 and establish higher promotion standards based on this to ensure that when promoting prefectural Party secretaries at the age of 55, their reported GDP growth rates are more accurate and reliable, rather than being influenced by manipulated data. This helps ensure the selection of more capable and performance-driven officials, rather than just those skilled at exaggerating GDP growth rates.

The primary motivation for mayors seeking promotion to the position of Party secretary is to pursue chances of further promotion to become primary vice-provincial-level officials,

as the role of prefectural secretary is viewed as only a stepping stone. Since mayors, especially those who are experienced, are likely to succeed secretaries either due to promotion or retirement of the current secretaries, incumbent mayors who hold office for over 2 full years at the end of year choose not to engage in data manipulation, as it could affect their future economic performance if they succeed the secretary position, thereby reducing their probability for further promotion. Additionally, the balanced status of secretaries and mayors empowers mayors to resist secretaries' requests to manipulate data. Therefore, the effect of secretaries' data manipulation at the age of 55 is primarily attributed to the collaboration of relatively junior mayors, highlighting how the presence of mayors can act as a check on secretaries, such that reduced short-sighted economic policies solely aimed at promotion and ensured long-term development.

# Bibliography

D. Acemoglu and J. A. Robinson. Persistence of power, elites, and institutions. *American Economic Review*, 98(1):267–293, 2008.

G. Biglaiser and C. Mezzetti. Politicians' decision making with re-election concerns. *Journal of Public Economics*, 66(3):425–447, 1997.

Y. Chen, H. Li, and L.-A. Zhou. Relative performance evaluation and the turnover of provincial leaders in china. *Economics Letters*, 88(3):421–425, 2005.

E. K. Choi. Patronage and performance: factors in the political mobility of provincial leaders in post-deng china. *The China Quarterly*, 212:965–981, 2012.

C. Ding, Y. Niu, and E. Lichtenberg. Spending preferences of local officials with off-budget land revenues of chinese cities. *China Economic Review*, 31:265–276, 2014.

G. Egorov, S. Guriev, and K. Sonin. Media freedom in dictatorships. *Unpublished paper, Yale University*, 2009.

J. V. Henderson, A. Storeygard, and D. N. Weil. Measuring economic growth from outer space. *American economic review*, 102(2):994–1028, 2012.

B. Holmström. Managerial incentive problems: A dynamic perspective. *The review of Economic studies*, 66(1):169–182, 1999.

R. Jia, M. Kudamatsu, and D. Seim. Complementary roles of connections and performance in political selection in china. 2013.

R. Jia, G. Roland, and Y. Xie. A theory of power structure and institutional compatibility: China vs. europe revisited. *Journal of the European Economic Association*, page jvad050, 2023.

C.-w. Kou and W.-H. Tsai. "sprinting with small steps" towards promotion: solutions for the age dilemma in the ccp cadre appointment system. *The China Journal*, 71(1):153–171, 2014.

D. Lane and C. Ross. Limitations of party control: the government bureaucracy in the ussr. *Communist and Post-Communist Studies*, 27(1):19–38, 1994.

H. Li and L.-A. Zhou. Political turnover and economic performance: the incentive role of personnel control in china. *Journal of public economics*, 89(9-10):1743–1762, 2005.

W. Li. Dual leadership and bureaucratic capacity. *working paper*, 2023.

W. Luo and S. Qin. China's local political turnover in the twenty-first century. *Journal of Chinese Political Science*, pages 1–24, 2021.

E. Maskin, Y. Qian, and C. Xu. Incentives, information, and organizational form. *The review of economic studies*, 67(2):359–378, 2000.

R. B. Myerson. The autocrat's credibility problem and foundations of the constitutional state. *American Political Science Review*, 102(1):125–139, 2008.

F. Su, R. Tao, L. Xi, and M. Li. Local officials' incentives and china's economic growth: tournament thesis reexamined and alternative explanatory framework. *China & World Economy*, 20(4):1–18, 2012.

J. L. Wallace. Juking the stats? authoritarian information problems in china. *British journal of political science*, 46(1):11–29, 2016.

M. Wang, M. O. Rieger, and T. Hens. An international survey on time discounting. *Norwegian School of Economics working paper*, 2009.

M. Y. Wong. Performance, factions, and promotion in china: the role of provincial transfers. *Journal of Chinese Political Science*, 27(1):41–75, 2022.

M. Wu and B. Chen. Assignment of provincial officials based on economic performance: Evidence from china. *China Economic Review*, 38:60–75, 2016.

C. Xu. The fundamental institutions of china's reforms and development. *Journal of economic literature*, 49(4):1076–1151, 2011.

H. Yi and I. Liu. Executive leadership, policy tourism, and policy diffusion among local governments. *Public Administration Review*, 82(6):1024–1041, 2022.

## 1.8 Appendix

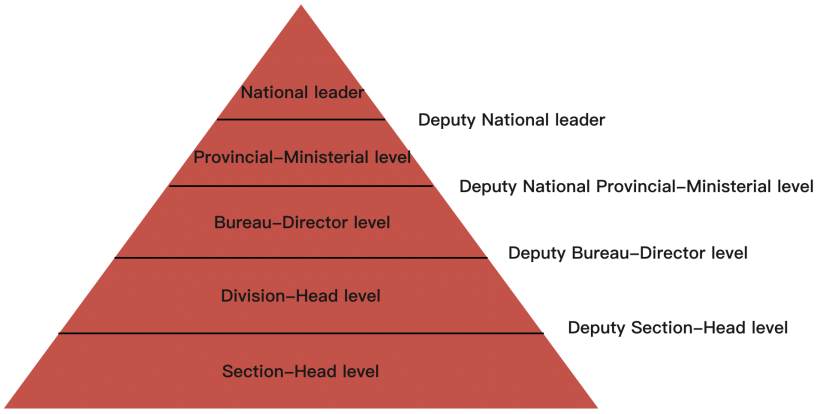



Figure 1.1: Hierarchy in China

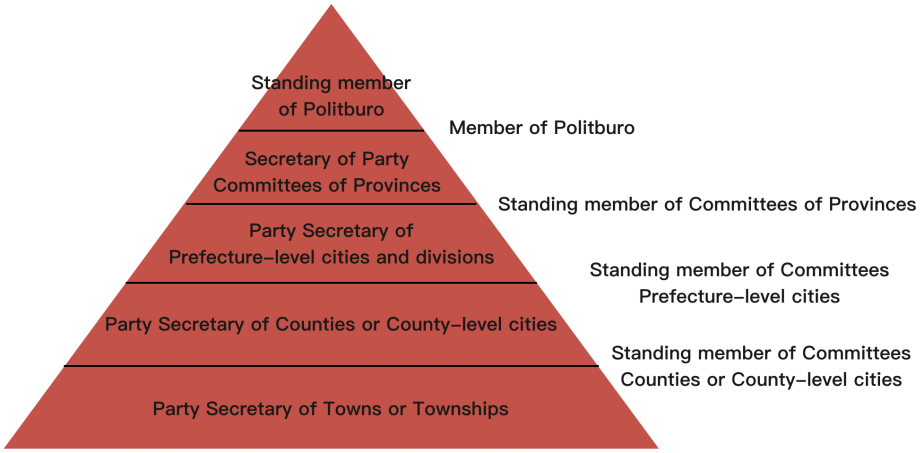



Figure 1.2: Level of Party

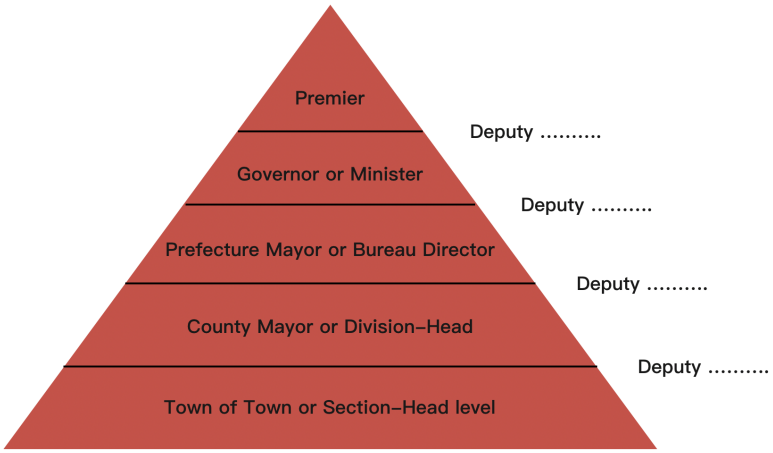



Figure 1.3: Level of Government

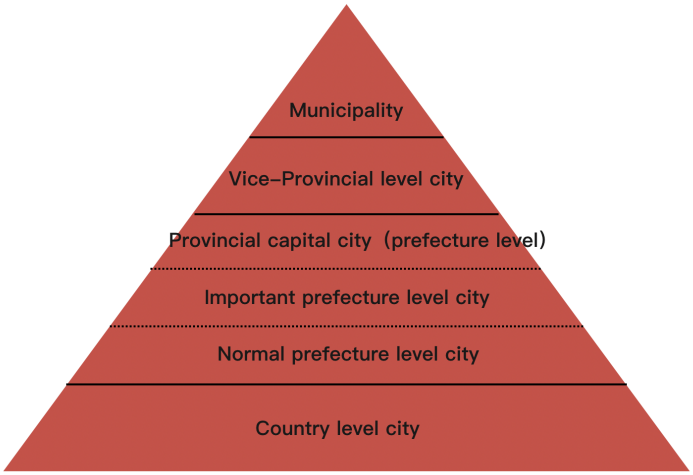



Figure 1.4: Level of City

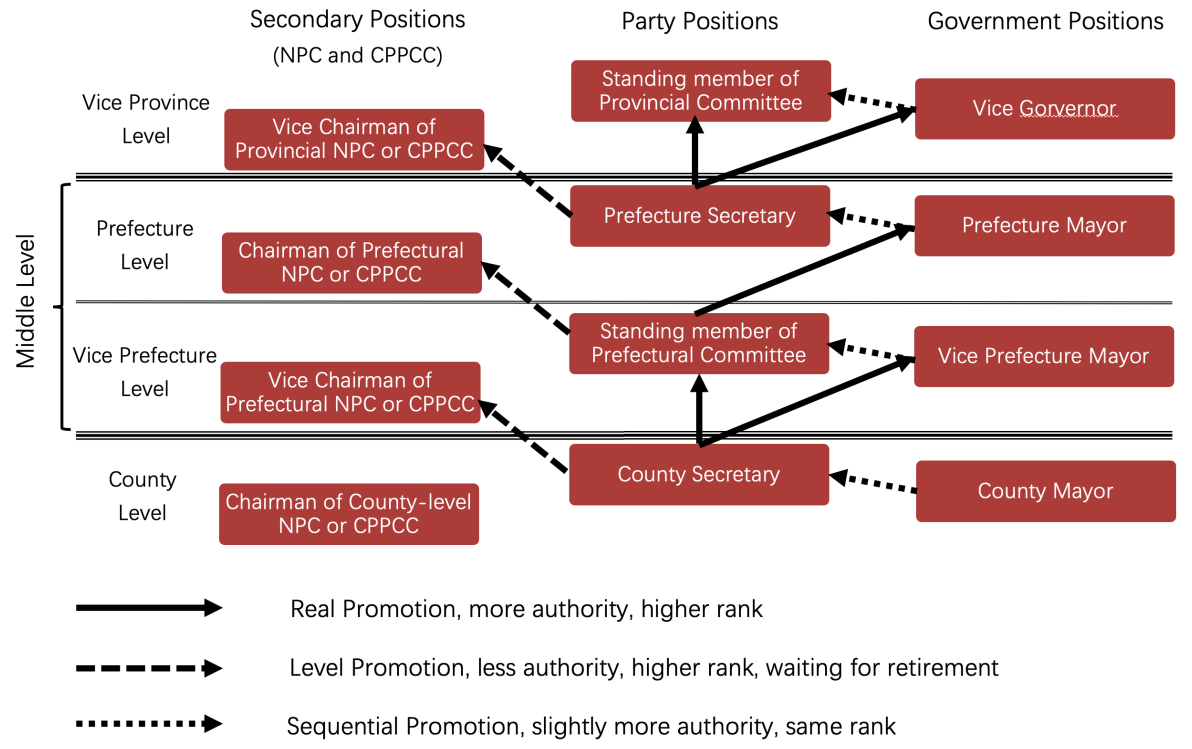



Figure 1.5: Promotion Sequence In Modern China

Note: It's very rare for a standing member of provincial or prefectural committee to be directly promoted to the position of provincial or prefectural secretary, bypassing the role of governor or mayor. An exception to this occurs in Autonomous Districts or Prefectures of Ethnic Minorities, where the governor or mayor is typically selected from officials belonging to an ethnic minority. However, even not the main stream of promotion, it's possible for county or prefectural secretary promoted to the position of standing member of provincial or prefectural committee, bypassing the role of vice governor or vice mayor.


Figure 1.6: Promotion Trajectory of Leaders of the USSR

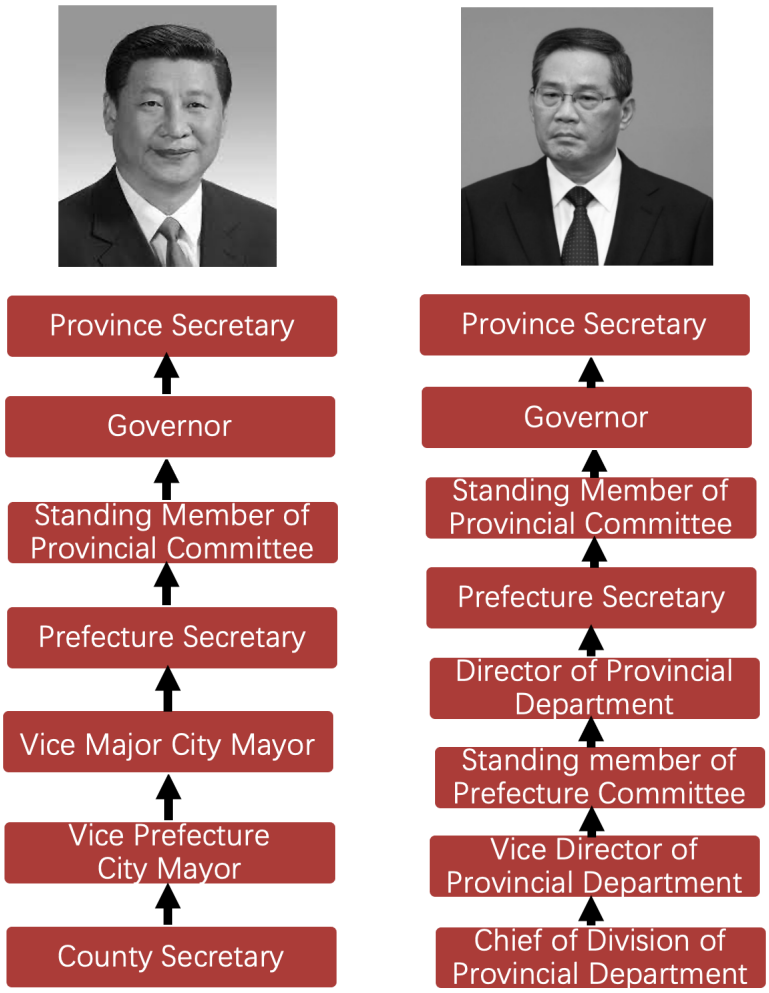



Figure 1.7: Promotion Trajectory of Leaders of the PRC

Note: In fact, Xi Jinping's position didn't change from vice prefecture city mayor to vice major city mayor. The political status of Xiamen city changed at 1988, from normal prefecture level city to vice provincial level city (city specifically designated in the state plan). So his rank changed from vice prefecture level to full prefecture level even though he still works as vice mayor of Xiamen. When Li Qiang served as standing member of prefecture committee, he also concurrently serves as a county Party secretary.

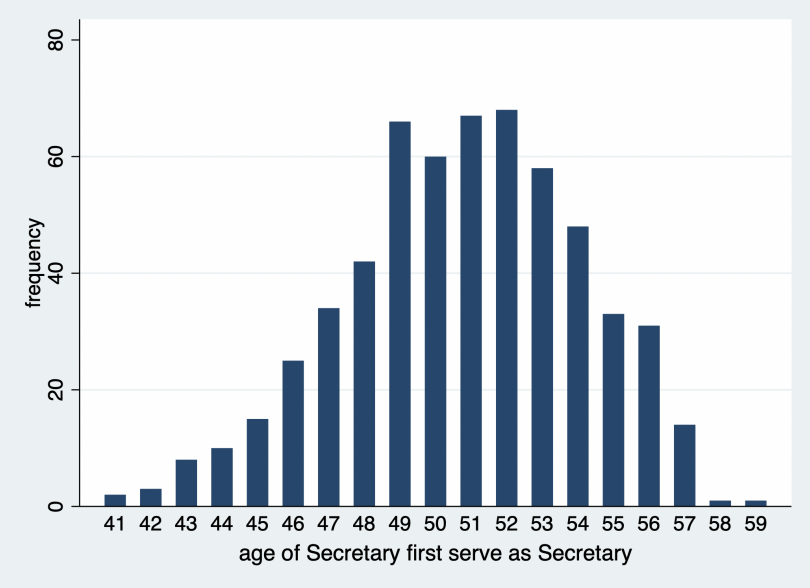



Figure 1.8: Age of Secretary first serve as Secretary

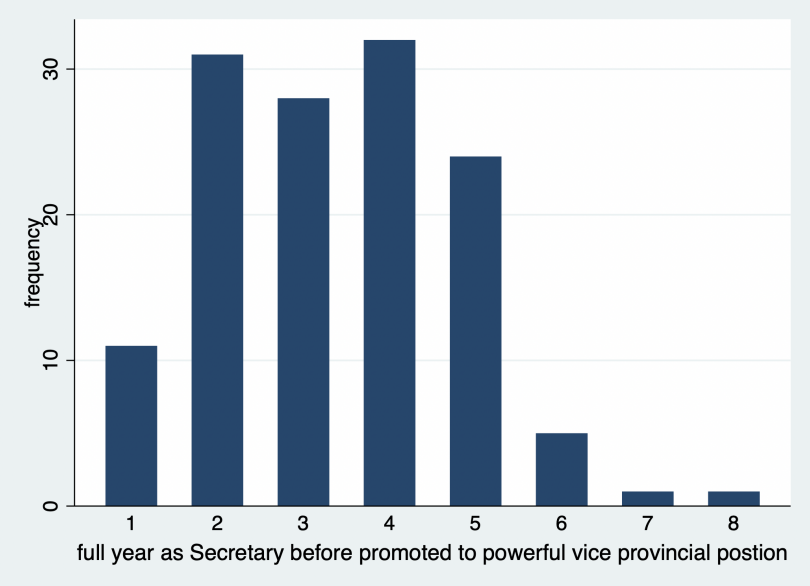



Figure 1.9: Length as Secretary before real promotion

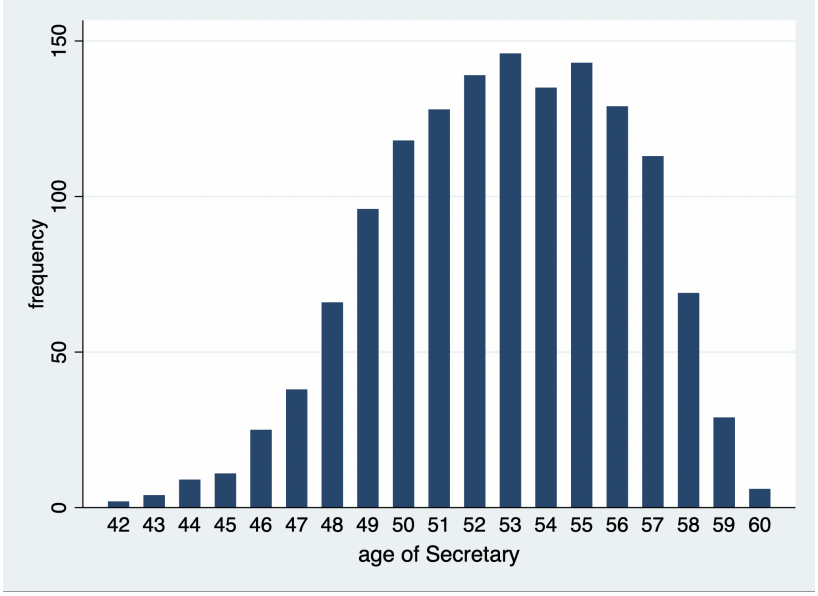



Figure 1.10: Secretary age distribution

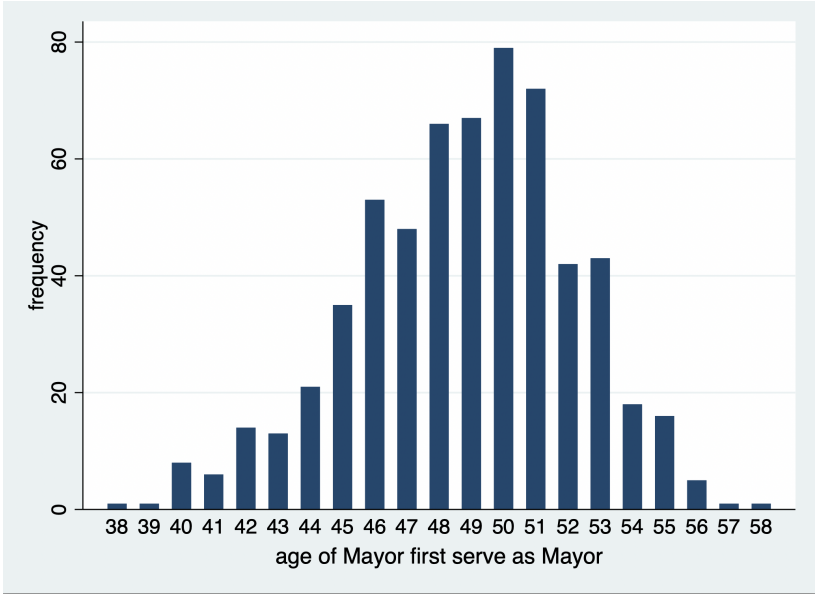



Figure 1.11: Age of Mayor first serve as Mayor

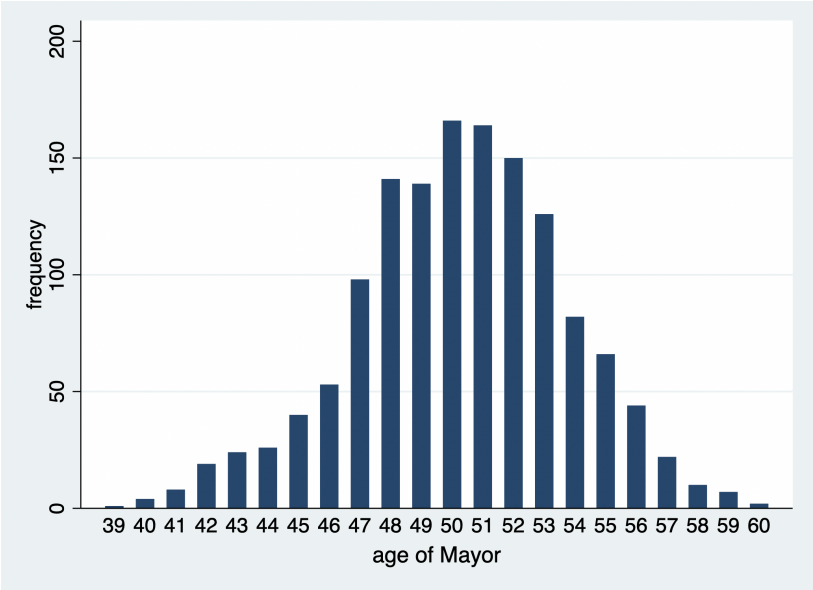



Figure 1.12: Mayor age distribution

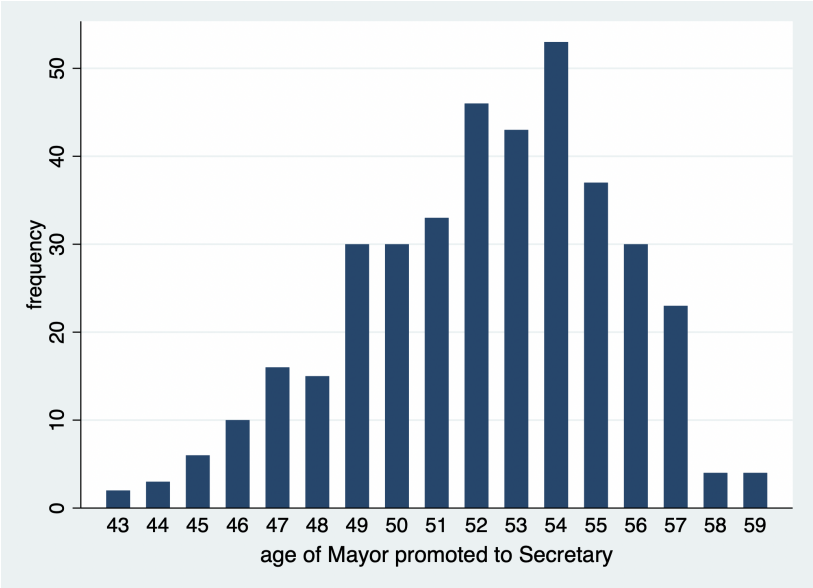



Figure 1.13: Age of Mayor promoted to Secretary

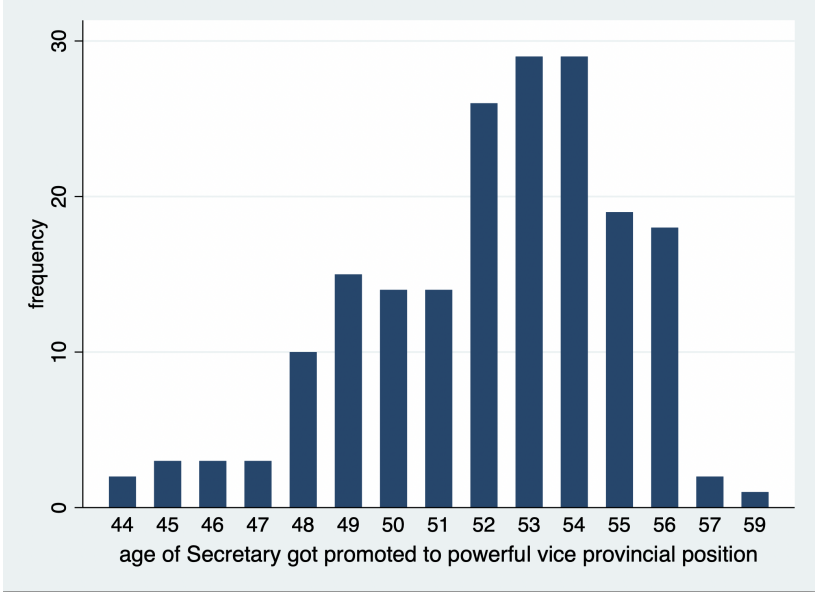



Figure 1.14: Age of Secretary got real promotion

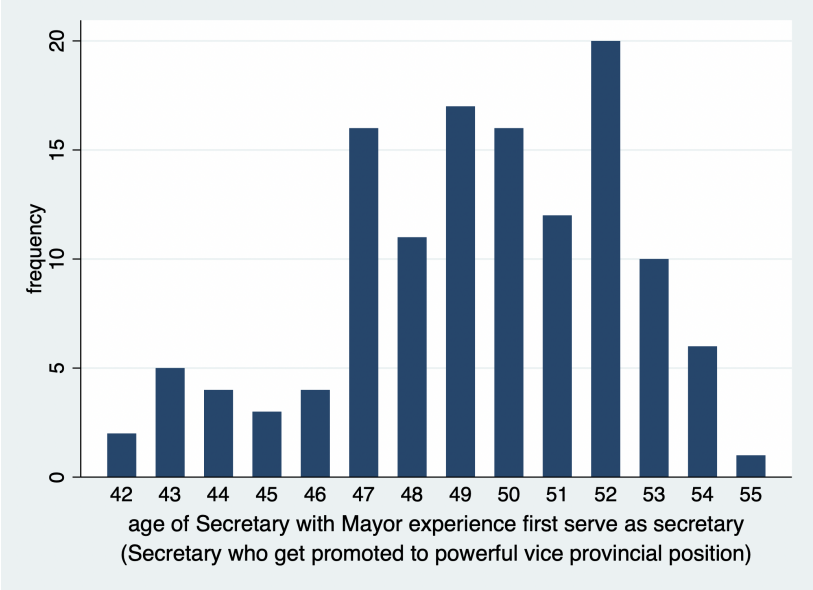



Figure 1.15: Age of Secretary got promoted

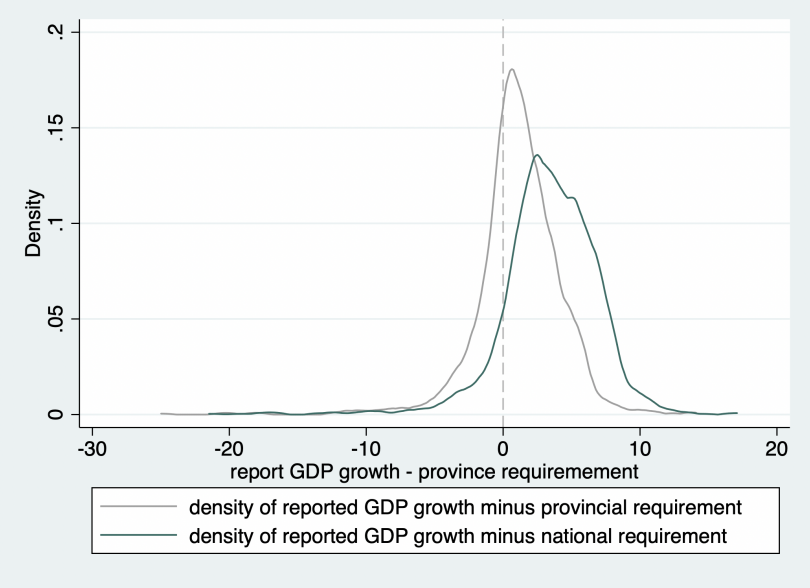



Figure 1.16: Density of reported GDP growth

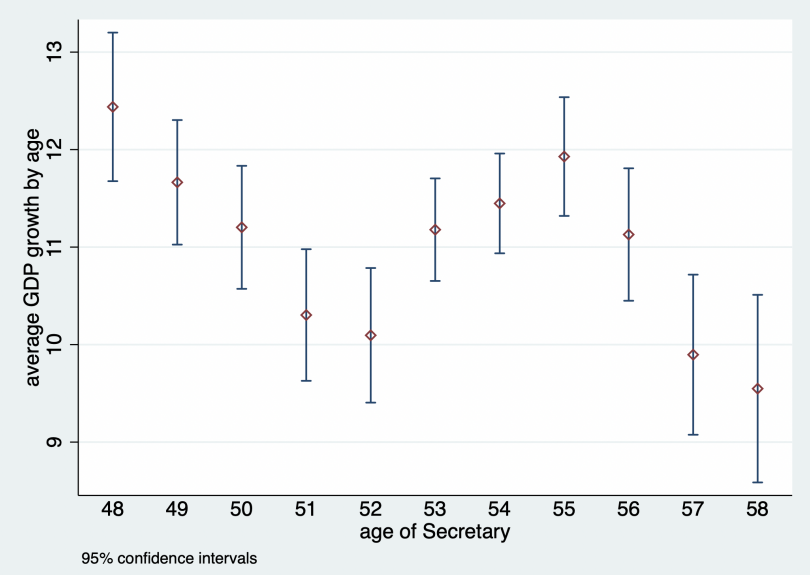



Figure 1.17: Average GDP growth by age of Secretary

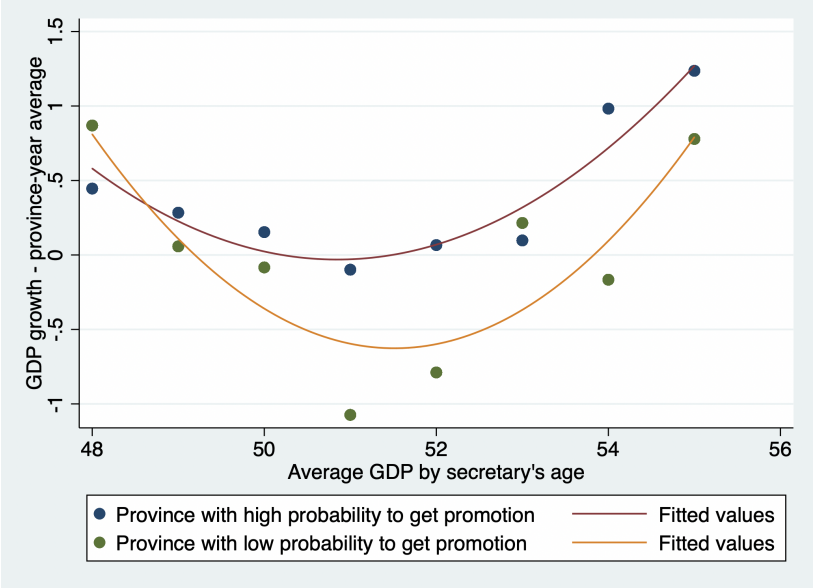



Figure 1.18: GDP growth reported by Secretaries from different provinces

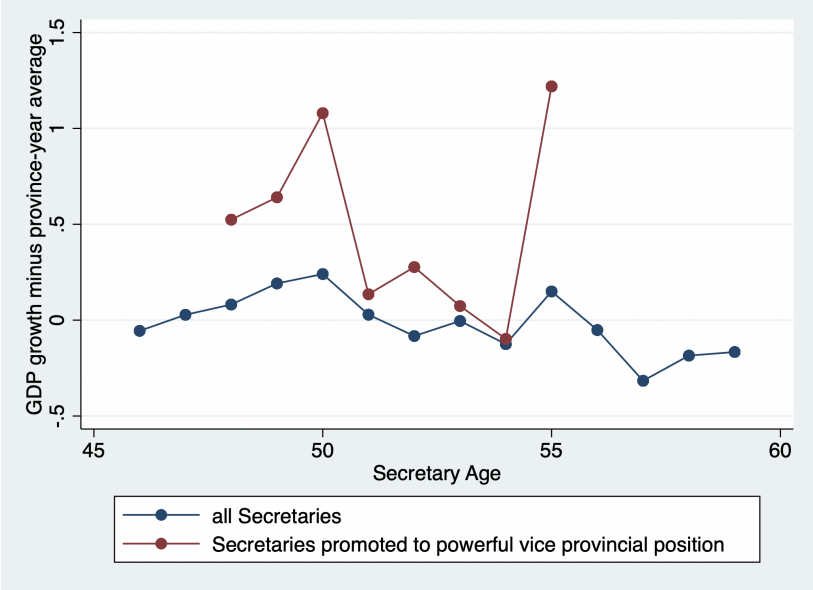



Figure 1.19: Average GDP growth reported by different age of Secretary

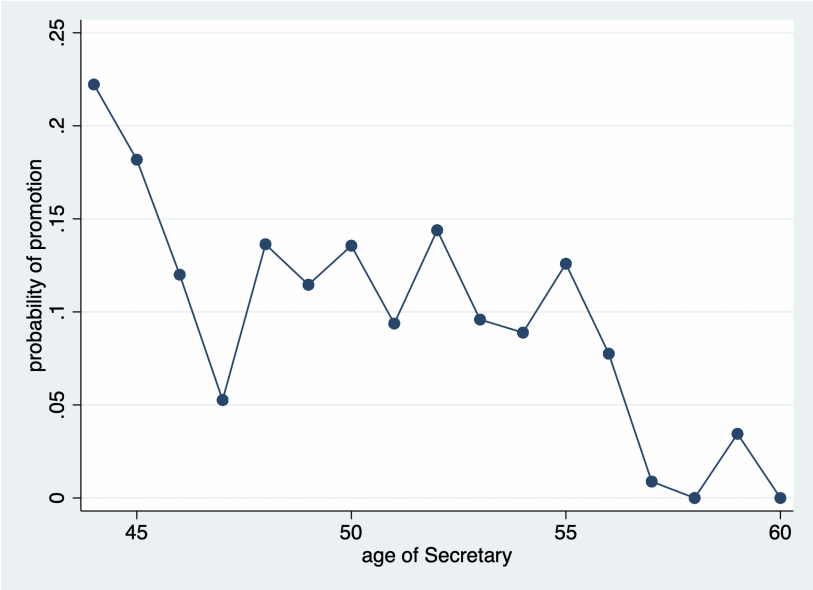



Figure 1.20: Average probability of promotion at different age of Secretary

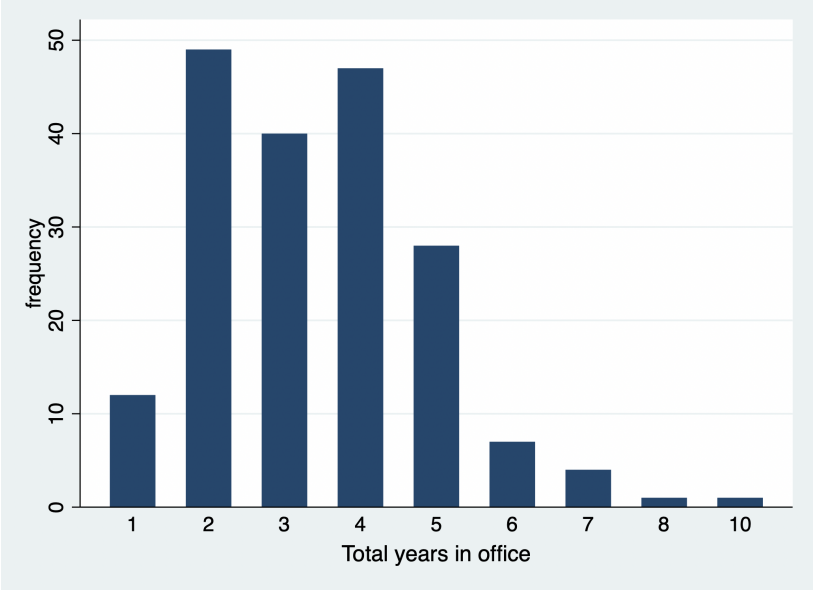



Figure 1.21: Appendix: Years in office of secretaries get promoted to primary positions

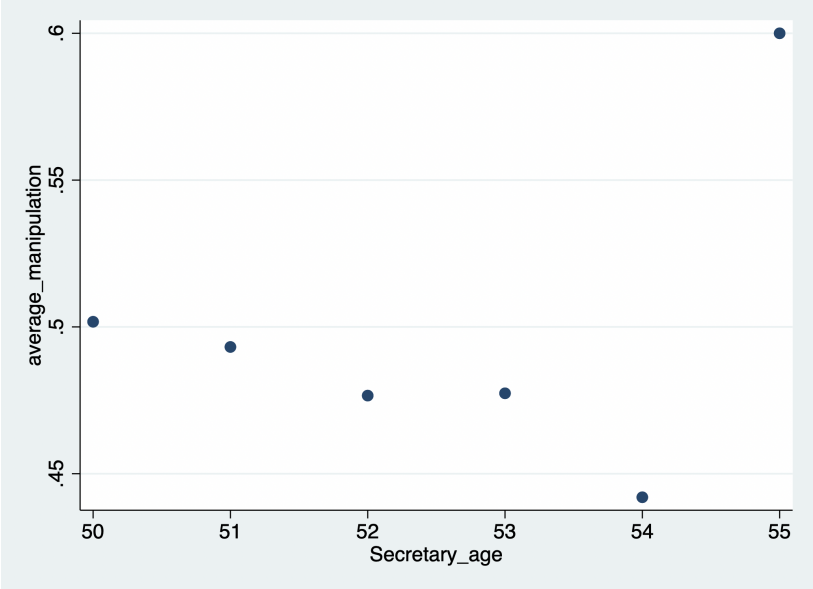



Figure 1.22: Appendix: Model Simulation

Table 1.1: Effect of GDP growth and Secretaries' experience on probability of promotion in general

| Table 1.1: Secretary promoted to vice provincial position | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GDP Growth | 0.0196** | 0.0204** | 0.0214** | 0.0236*** |
| | (0.0083) | (0.0083) | (0.0084) | (0.0091) |
| Years as Secretary | 0.0142 | | 0.0333** | 0.0315** |
| | (0.0118) | | (0.0140) | (0.0141) |
| Experience of Youth-league | -0.0247 | | -0.0520 | -0.0492 |
| | (0.0319) | | (0.0336) | (0.0335) |
| Full time Education | | -0.0344 | -0.0708 | -0.0638 |
| | | (0.0431) | (0.0489) | (0.0486) |
| Final Education | | 0.0411 | 0.0305 | 0.0303 |
| | | (0.0478) | (0.0482) | (0.0474) |
| Gender | | -0.0790 | 0.0474 | 0.0179 |
| | | (0.1190) | (0.1188) | (0.1162) |
| Secretary Experience | Yes | No | Yes | Yes |
| Secretary Characters | No | Yes | Yes | Yes |
| Prefecture Statistic | No | No | No | Yes |
| Obs | 1395 | 1390 | 1384 | 1365 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. The positive correlation shows the higher GDP growth reported, the better position secretary got promoted to. For all four columns, I control year fixed effect and prefecture fixed effect. The variable Years as secretary captures the official's total length working as secretary in one or different prefectures. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.2: Effect of GDP growth and Secretaries' experience on probability of level promotion

| Table 1.2: Secretary promoted to People's Congress or CPPCC | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GDP Growth | 0.0006 | 0.0013 | -0.0001 | 0.0010 |
| | (0.0024) | (0.0025) | (0.0026) | (0.0029) |
| Years as Secretary | 0.0211*** | | 0.0188*** | 0.0185*** |
| | (0.0040) | | (0.0051) | (0.0050) |
| Experience of Youth-league | 0.0091 | | 0.0044 | 0.0059 |
| | (0.0125) | | (0.0134) | (0.0134) |
| Full time Education | | 0.0131 | 0.0034 | 0.0066 |
| | | (0.0208) | (0.0197) | (0.0193) |
| Final Education | | 0.0161 | 0.0123 | 0.0123 |
| | | (0.0167) | (0.0155) | (0.0154) |
| Gender(Female) | | 0.0544 | 0.0603 | 0.0598 |
| | | (0.0584) | (0.0696) | (0.0696) |
| Secretary Experience | Yes | No | Yes | Yes |
| Secretary Characters | No | Yes | Yes | Yes |
| Prefecture Statistic | No | No | No | Yes |
| Obs | 977 | 969 | 966 | 956 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. For all four columns, I control year fixed effect and prefecture fixed effect. The coefficient shows for each extra year as secretary, the probability of getting promotion to secondary vice-provincial-level position increased about 2%. The data excludes secretaries got promoted to primary vice-provincial-level positions. The variable Years as secretary captures the official's total length working as secretary in one or different prefectures. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.3: Effect of GDP growth and Secretaries' experience on probability of real promotion

| Table 1.3: Secretary promoted to primary vice provincial position | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GDP Growth | 0.0077** | 0.0076** | 0.0078** | 0.0090** |
| | (0.0034) | (0.0033) | (0.0034) | (0.0038) |
| Years as Secretary | -0.0005 | | 0.0014 | 0.0007 |
| | (0.0048) | | (0.0065) | (0.0066) |
| Experience of Youth-league | -0.0170 | | -0.0308** | -0.0300** |
| | (0.0136) | | (0.0140) | (0.0140) |
| Full time Education | | -0.0164 | -0.0316 | -0.0300 |
| | | (0.0187) | (0.0202) | (0.0205) |
| Final Education | | 0.0197 | 0.0152 | 0.0151 |
| | | (0.0189) | (0.0191) | (0.0189) |
| Gender(Female) | | -0.0567 | 0.0046 | -0.0100 |
| | | (0.0516) | (0.0535) | (0.0529) |
| Secretary Experience | Yes | No | Yes | Yes |
| Secretary Characters | No | Yes | Yes | Yes |
| Prefecture Statistic | No | No | No | Yes |
| Obs | 1395 | 1390 | 1384 | 1365 |

Note: Secretary Experience, Secretary Characters, and Prefecture Statistic defined same as previous table. The dependent variable defines as follow, 1 for get promotion to primary provincial position including vice governor or higher position, and 0 for no promotion or promoted to secondary vice-provincial-level position. The coefficient shows with extra 1% of GDP growth reported, the secretary would get 0.8% to 0.9% higher probability of getting promoted. The average probability of being promoted to primary vice-provincial-level position is only 9% each year. The variable Years as secretary captures the official's total length working as secretary in one or different prefectures. For all four columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.4: Effect of GDP growth on probability of promotion of Secretary

| Table 1.4: Secretary promoted to primary vice provincial position | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GDP Growth of Two Years | 0.0013 | | | |
| Before Year of Turnover | (0.0040) | | | |
| Latest Reported GDP | | 0.0090*** | | |
| Growth Before Turnover | | (0.0038) | | |
| GDP Growth of | | | 0.0012 | |
| Year of Turnover | | | (0.0026) | |
| Average GDP Growth | | | | 0.0091 |
| During Tenure | | | | (0.0058) |
| Full time Education | -0.0249 | -0.0242 | -0.0028 | -0.0705* |
| | (0.0248) | (0.0203) | (0.0151) | (0.0402) |
| Final Education | -0.0051 | 0.0117 | 0.0165 | 0.1137*** |
| | (0.0211) | (0.0188) | (0.0145) | (0.0361) |
| Experience of Youth-league | -0.0240 | -0.0272* | -0.0058 | -0.0333 |
| | (0.0158) | (0.0145) | (0.0116) | (0.0266) |
| Gender(Female) | -0.0340 | -0.0333 | 0.0099 | 0.1192 |
| | (0.0533) | (0.0490) | (0.0470) | (0.1348) |
| Secretary Experience | Yes | Yes | Yes | Yes |
| Secretary Characters | Yes | Yes | Yes | Yes |
| Prefecture Statistic | Yes | Yes | Yes | No |
| Obs | 1136 | 1365 | 1365 | 578 |

Note: Secretary Experience, Secretary Characters, and Prefecture Statistic defined same as previous table. Column(1) captures the correlation between GDP growth of year t-2 and promotion happened on year t. Column(2) captures the correlation between GDP growth of year t-1 and promotion happened from March of year t to February of year t+1. Column(3) captures the correlation between GDP growth of year t and promotion happened on year t. Column(4) captures the correlation between average GDP growth of secretary and promotion status of secretary, based on 578 secretary-prefecture pairs, here the Secretary Experience does not include the length of experience, such as length as prefecture level official, since length changes every year. For all four columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.5: Effect of Mayors' experience on probability of promotion

| Table 1.5: Promotion of Mayors | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GDP Growth | -0.0080 | -0.0057 | -0.0074 | -0.0091 |
| | (0.0080) | (0.0082) | (0.0082) | (0.0091) |
| Length in office | 0.0584*** | | 0.0697*** | 0.0708*** |
| | (0.0134) | | (0.0162) | (0.0168) |
| Experience of Youth-league | -0.0196 | | -0.0216 | -0.0339 |
| | (0.0232) | | (0.0260) | (0.0262) |
| Full time Education | | -0.0223 | -0.0203 | -0.0228 |
| | | (0.0425) | (0.0439) | (0.0445) |
| Final Education | | 0.0035 | -0.0029 | -0.0133 |
| | | (0.0357) | (0.0380) | (0.0385) |
| Gender(Female) | | -0.0950 | -0.0627 | -0.0409 |
| | | (0.0935) | (0.0988) | (0.0998) |
| Mayor Experience | Yes | No | Yes | Yes |
| Mayor Characters | No | Yes | Yes | Yes |
| Prefecture Statistic | No | No | No | Yes |
| Obs | 1389 | 1378 | 1378 | 1360 |

Note: Mayor Experience includes, but is not limited to, the mayors' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Mayor Characters including but not limited to mayors' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. The dependent variable Promotion of mayors define as follow, 0 for not get promotion, 1 for promotion to department director of provincial government or first vice director of department of provincial committee, 2 for promotion to secretary, 3 for any vice-provincial-level position. There's no significant correlation between GDP growth and higher probability to get promoted to better positions. However, the coefficient shows positive correlation between years served as mayor and promotion. For all four columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.6: Effect of Mayors' experience on probability of real promotion

| Table 1.6: Mayors get promotion to Secretary or higher position | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| GDP Growth | 0.0015 | 0.0037 | 0.0018 | -0.0001 |
| | (0.0081) | (0.0082) | (0.0084) | (0.0092) |
| Length in office | 0.0487*** | | 0.0668*** | 0.0681*** |
| | (0.0133) | | (0.0160) | (0.0166) |
| Experience of Youth-league | -0.0134 | | -0.0157 | -0.0277 |
| | (0.0257) | | (0.0285) | (0.0289) |
| Full time Education | | -0.0120 | -0.0073 | -0.0097 |
| | | (0.0421) | (0.0433) | (0.0441) |
| Final Education | | -0.0059 | -0.0137 | -0.0235 |
| | | (0.0372) | (0.0402) | (0.0409) |
| Gender(Female) | | -0.0861 | -0.0597 | -0.0390 |
| | | (0.1032) | (0.1101) | (0.1118) |
| Mayor Experience | Yes | No | Yes | Yes |
| Mayor Characters | No | Yes | Yes | Yes |
| Prefecture Statistic | No | No | No | Yes |
| Obs | 1389 | 1378 | 1378 | 1360 |

Note: Mayor Experience, Mayor Characters and Prefecture Statistic defined same as previous table. The dependent variable Promotion of mayors define as follow, 0 for not get promotion or promotion to department director of provincial government or first vice director of department of provincial committee, 1 for promotion to secretary or any vice-provincial-level position. There's no significant correlation between GDP growth and higher probability to get a real promotion. However, the coefficient shows positive correlation between years serve as mayor and real promotion. Only 6 mayors got promoted to vice-provincial-level position directly among 609 mayor-prefecture pairs. For all four columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.7: Effect of Secretary at Age 55 on GDP growth reported

| Table 1.7: GDP growth reported by prefectural government | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Secretary at Age 55 | 0.5574** | 0.5579** | 0.7225*** |
| | (0.2756) | (0.2741) | (0.2476) |
| Experience of Academia | -0.2428* | -0.3610** | -0.2599** |
| | (0.1423) | (0.1484) | (0.1257) |
| Experience of Study Abroad | 0.5394** | 0.4031 | 0.5576** |
| | (0.2497) | (0.2753) | (0.2785) |
| Gender(Female) | | -0.9547* | -0.4297 |
| | | (0.4989) | (0.4587) |
| Secretary Experience | Yes | Yes | Yes |
| Secretary Characters | No | Yes | Yes |
| Prefecture Statistic | No | No | Yes |
| Obs | 1395 | 1384 | 1365 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. The coefficient shows that secretaries at 55 reported extra 0.6%-0.7% GDP growth rate on average, compare to secretaries at other age. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.8: Balance check for Secretary at age 54 and 55

Table 1.8: Balance check for Secretary at age 54 and 55

| | mean | | t-test | |
|---|---|---|---|---|
| | Age 54 | Age 55 | t | p |
| Minority | 0.04895 | 0.05926 | -0.38 | 0.705 |
| First Degree | 1.049 | 1.1778 | -1.13 | 0.261 |
| Full time Education | 1.4825 | 1.4593 | 0.21 | 0.835 |
| Final Education | 2.972 | 3.0222 | -0.64 | 0.521 |
| Experience of Local Government | 1.5524 | 1.3407 | 1.25 | 0.214 |
| Experience of Central Government | 0.12587 | 0.2 | -0.94 | 0.348 |
| Experience of Provincial Government | 2.014 | 2.0222 | -0.05 | 0.959 |
| Experience of Leader's Secretary | 0.65035 | 0.71111 | -0.42 | 0.675 |
| Experience of Enterprise | 0.48951 | 0.42222 | 0.64 | 0.525 |
| Experience of Youth-league | 0.47552 | 0.4963 | -0.19 | 0.850 |
| Experience of Academia | 0.18182 | 0.26667 | -1.06 | 0.288 |
| Experience of Study Abroad | 0.13986 | 0.14074 | -0.02 | 0.983 |
| Years as Secretary | 3.6364 | 3.4222 | 0.87 | 0.383 |
| Government Income | 9.8e+05 | 9.5e+05 | 0.26 | 0.792 |
| Population Growth Rate | 6.2835 | 6.4696 | -0.26 | 0.797 |
| Population | 4.1296 | 4.308 | -0.60 | 0.552 |
| Total GDP | 1.3e+07 | 1.4e+07 | -0.31 | 0.761 |
| GDP per capita | 37486 | 35495 | 0.66 | 0.507 |

Note: Minority is 0/1 variable, 0 for Han and 1 for minority ethic group. First Degree is 0/1/2 variable, 0 for not taking college entrance exam, 1 for 2-years college, 2 for 4-years university. Experience of Study Abroad is 0/1 variable. All other experience is 0/1/2/3 variable, 0 for no such experience, 1 for working as section-level (town-level) official, 2 for working as county-level official, 3 for working as prefecture-level official. GDP and Government Income in Chinese yuan. Population in millions. Population Growth Rate in percentage.

Table 1.9: Effect of Secretary at Age 54 on GDP growth reported

| Table 1.9: GDP growth reported by prefectural government | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Secretary at Age 54 | 0.2121 | 0.2248 | 0.2038 |
| | (0.1751) | (0.1730) | (0.1588) |
| Experience of Academia | -0.2577* | -0.3807** | -0.2847** |
| | (0.1438) | (0.1510) | (0.1296) |
| Study abroad | 0.5461** | 0.4194 | 0.5696** |
| | (0.2483) | (0.2734) | (0.2769) |
| Gender(Female) | | -0.9519* | -0.4213 |
| | | (0.4967) | (0.4549) |
| Secretary Experience | Yes | Yes | Yes |
| Secretary Characters | No | Yes | Yes |
| Prefecture Statistic | No | No | Yes |
| Obs | 1395 | 1384 | 1365 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. The coefficient shows that secretaries at 54 didn't report a significant higher GDP growth rate compare to secretaries at other age. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.10: Effect of Secretary at different age on GDP growth reported

| Table 1.10: GDP growth reported by prefectural government | | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Secretary at Age 50 | -0.0225 | | | |
| | (0.1867) | | | |
| Secretary at Age 51 | | -0.1372 | | |
| | | (0.2243) | | |
| Secretary at Age 52 | | | -0.1119 | |
| | | | (0.1983) | |
| Secretary at Age 53 | | | | -0.0205 |
| | | | | (0.1742) |
| Experience of Academia | -0.2818** | -0.2808** | -0.2824** | -0.2821** |
| | (0.1295) | (0.1294) | (0.1295) | (0.1295) |
| Study abroad | 0.5651** | 0.5618** | 0.5646** | 0.5632** |
| | (0.2770) | (0.2764) | (0.2771) | (0.2773) |
| Gender(Female) | -0.4138 | -0.4140 | -0.4161 | -0.4198 |
| | (0.4643) | (0.4566) | (0.4528) | (0.4548) |
| Secretary Experience | Yes | Yes | Yes | Yes |
| Secretary Characters | Yes | Yes | Yes | Yes |
| Prefecture Statistic | Yes | Yes | Yes | Yes |
| Obs | 1365 | 1365 | 1365 | 1365 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. he coefficient shows that secretaries at 50, 51, 52, or 53 didn't report a significant higher GDP growth rate compare to secretaries at other age. For all four columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.11: Other measurement of development

Table 1.11: Other measurement of development

| | (1) | (2) | (3) |
|---|---|---|---|
| | light growth | electricity growth | investment growth |
| Secretary at Age 55 | 0.0055 | -0.0045 | 0.0357* |
| | (0.0041) | (0.0188) | (0.0195) |
| Experience of Academia | 0.0028 | 0.0228 | -0.0090 |
| | (0.0032) | (0.0146) | (0.0187) |
| Study Abroad | -0.0094* | -0.0235 | 0.0213 |
| | (0.0054) | (0.0199) | (0.0358) |
| Gender(Female) | -0.0011 | -0.0154 | 0.1280** |
| | (0.0081) | (0.0517) | (0.0562) |
| Secretary Experience | Yes | Yes | Yes |
| Secretary Characters | Yes | Yes | Yes |
| Prefecture Statistic | Yes | Yes | Yes |
| Obs | 816 | 1310 | 659 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. Column(1) use city light growth from 2010-2013. Column(2) use electricity consumption growth from 2010-2015. Column(3) use investment growth from 2010-2012. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.12: GDP growth of prefectures in different provinces

Table 1.12: GDP growth of prefectures in different provinces

| | (1) high probability | (2) high probability | (3) low probability | (4) low probability |
|---|---|---|---|---|
| Secretary | -0.0733 | -0.1751 | 0.9608** | 0.9124*** |
| at Age 55 | (0.5154) | (0.5505) | (0.4078) | (0.3081) |
| Experience | 0.5750* | 0.3906 | -0.7625** | -0.2006 |
| of Academia | (0.2910) | (0.2757) | (0.3221) | (0.3051) |
| Study Abroad | 0.4119 | 0.3510 | 1.3611 | 1.0169 |
| | (0.6572) | (0.5395) | (1.1086) | (0.9164) |
| Gender | -2.8723** | -3.9104*** | 0.0521 | 1.2442 |
| (Female) | (1.1169) | (1.1557) | (1.5063) | (1.2275) |
| Age | 0.1026 | 0.0435 | -0.1209 | -0.0962 |
| | (0.0930) | (0.0788) | (0.0996) | (0.0871) |
| Secretary Experience | Yes | Yes | Yes | Yes |
| Secretary Characters | Yes | Yes | Yes | Yes |
| Prefecture Statistic | No | Yes | No | Yes |
| Obs | 198 | 191 | 379 | 370 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. Columns (1) and (2) including data from provinces with top 6 highest promotion rate, which is top 25% provinces. Columns (3) and (4) including data from provinces with bottom 6 highest promotion rate which is the bottom 25% provinces. The result is robust if including two more provinces as high probability provinces to make the Observations balance in each group. With the new defined high probability group (330 observations, closest to 370), there's still no significant positive correlation between secretary at age 55 and GDP growth rate. The magnitude is 0.18 and variance is 0.35. For all four columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.13: Effect of Secretary at Age 54 and 55 on reported GDP growth

| Table 1.13: GDP reported before secretaries got promoted | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Secretary at Age 54 | -0.4632 | -0.3693 | -0.3311 |
| | (0.5757) | (0.5102) | (0.4508) |
| Secretary at Age 55 | 0.9459*** | 1.4066*** | 1.4563** |
| | (0.2800) | (0.3848) | (0.5351) |
| Secretary Experience | Yes | Yes | Yes |
| Secretary Characters | No | Yes | Yes |
| Prefecture Statistic | No | No | Yes |
| Obs | 142 | 142 | 141 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. Data included the latest available GDP growth rate before secretaries got promoted to primary vice-provincial-level positions. Coefficient calculated from regression on dummy of SecAge54 and dummy of SecAge55 separately. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.14: Effect of Mayor at Age 54 and 56 on reported GDP growth

| Table 1.14: GDP growth reported by prefectural government | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Mayor at Age 54 | 0.5151** | 0.6416*** | 0.4564*** |
| | (0.2043) | (0.2010) | (0.1670) |
| Mayor at Age 56 | -0.6740** | -0.5152* | -0.3971 |
| | (0.3383 | (0.3069) | (0.2955) |
| Mayor Experience | Yes | Yes | Yes |
| Mayor Characters | No | Yes | Yes |
| Prefecture Statistic | No | No | Yes |
| Obs | 1389 | 1378 | 1360 |

Note: Mayor Experience includes, but is not limited to, the mayors' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Mayor Characters including but not limited to mayors' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. Coefficient calculated from regression on dummy of MayorAge54 and MayorAge56 separately. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.15: Effect of Mayor in office for less than 3 years and Secretary at Age 55 on reported GDP growth

| Table 1.15: GDP growth reported by prefectural government | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Mayor in office for less than 3 years | -0.1294 | -0.1519 | 0.0965 |
| | (0.1671) | (0.1863) | (0.1690) |
| Sec at Age 55 | 0.2653 | 0.3710 | 0.7471 |
| | (0.5382) | (0.5323) | (0.4876) |
| Sec at Age 55*Mayor in office for less than 3 years | 0.6407** | 0.5872* | 0.7518** |
| | (0.2901) | (0.3231) | (0.3122) |
| Secretary Experience | Yes | Yes | Yes |
| Secretary Characters | No | Yes | Yes |
| Mayor Experience | Yes | Yes | Yes |
| Mayor Characters | No | Yes | Yes |
| Prefecture Statistic | No | No | Yes |
| Obs | 1380 | 1361 | 1343 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Mayor Experience includes, but is not limited to, the mayors' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Mayor Characters including but not limited to mayors' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. The interaction captures the difference between pair of secretary at age 55 and mayor in office over 2 full years at the end of current year and pair of secretary not at age 55 and mayor in office less or equal to 2 years at the end of current year. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

Table 1.16: Effect of Mayor length in office and Secretary at Age 55 on reported GDP growth

| Table 1.16: GDP growth reported by prefectural government | | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Sec at Age 55 | 2.6787* | 2.4336 | 2.6420* |
| | (1.5049) | (1.5588) | (1.5764) |
| Mayor Length in Office | -0.0917 | -0.0818 | -0.0846 |
| Sec at Age 55=0 | (0.1566) | (0.1787) | (0.1699) |
| Mayor Length in Office | -0.8468** | -0.7383* | -0.7295* |
| Sec at Age 55=1 | (0.3645) | (0.3984) | (0.3991) |
| Secretary Experience | Yes | Yes | Yes |
| Secretary Characters | No | Yes | Yes |
| Mayor Experience | Yes | Yes | Yes |
| Mayor Characters | No | Yes | Yes |
| Prefecture Statistic | No | No | Yes |
| Obs | 677 | 668 | 664 |

Note: Secretary Experience includes, but is not limited to, the secretaries' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Secretary Characters including but not limited to secretaries' gender, education and ethnic group. Mayor Experience includes, but is not limited to, the mayors' work experience at central Party/government institutions, state-owned enterprises, and the Youth League. It also records the highest rank achieved during each experience. Mayor Characters including but not limited to mayors' gender, education and ethnic group. Prefecture Statistic including the total GDP, GDP per capital, population and etc. The third row shows there's negative correlation between mayor's length in office and GDP growth rate reported by secretary at age 55, with each one extra year as mayor, the GDP rate reported would be 0.7%-0.8% less. For all three columns, I control year fixed effect and prefecture fixed effect. All standard errors are clustered at prefecture level. Significant at *10%, **5%, ***1%.

## Model Result Based on Specific Function Form

$$U_{t_0+1} = u_s - C_{t_0+1}(m_{t_0}, m_{t_0+1}) \tag{1.20}$$

Here I normalize $u_s = 0$, and assume $u_r = 3 * u_e$. [6] From the dataset, the average GDP growth is about 10% and the primary promotion rate is about 9%, after exclude the secretaries not qualified for promotion, the promotion rate would be higher. I assume the promotion probability is equal to:

$$p_t = g_{t-1} = 0.1 + m_{t-1}$$

Since I have already assume the cost function is a increasing convex function, for simplicity, assume:

$$C_t(m_{t-1}, m_t) = m_{t-1}^2 + m_t^2$$

Since from the Figure 18, we could observe that it's very rare for secretaries get promoted to primary positions after 5 full years' service as secretary, so I assume each secretary chooses the future manipulation strategy depend on a five-years tenure or until age 56 (choose m for each year for at most next four years before age 56). The general utility function at $t_0 + n$:

$$U_{t_0+n} = u_s + u_e - \{ \prod_{t=t_0+2}^{t_0+n} [1 - p_t(g_{t-1})] \} * [u_e + C_{t_0+n}(m_{t_0+n-1}, m_{t_0+n})] \tag{1.21}$$

$$\text{if } t_0 + 1 < t < 56$$

[6] since $u_r$ captures the utility as primary vice-provincial-level officials during the extending political life and also at age 56, plus the extra benefit after leave the primary position before 60. Assume the extra benefit as vice provincial official after leave the primary position is equal to 1/3 of $u_e$ each year and the life expectancy is 80. Then $u_r = [(1 - 0.8^3)/(1 - 0.8) + 1/3 * 0.8^3 * (1 - 0.8^{21})/(1 - 0.8)] * u_e \approx 3u_e$

I substitute with specific function and the utility function at time t is:

$$U_t = u_e - [\prod_{t=t_0+2}^{t_0+5}(0.1 - m_{t-1})] * [u_e + m_{t-1}^2 + m_t^2] \tag{1.22}$$

$$\text{if } t_0 < 52$$

Since I have already assume the time discount is 0.8, then I have expect utility for secretary start to serve as secretary from age 46 as an example.

$$\begin{aligned}
ExpectUtility_{it_0=46} &= U_{47} + 0.8 * U_{48} + 0.8^2 * U_{49} + 0.8^3 * U_{50} \\
&+ 0.8^4 * (1 - p_{47}) * (1 - p_{48}) * (1 - p_{49}) * (1 - p_{50}) * u_e \\
&+ 0.8^5 * (1 - p_{47}) * (1 - p_{48}) * (1 - p_{49}) * (1 - p_{50}) * u_e \\
&+ 0.8^6 * (1 - p_{47}) * (1 - p_{48}) * (1 - p_{49}) * (1 - p_{50}) * u_e \\
&+ 0.8^7 * (1 - p_{47}) * (1 - p_{48}) * (1 - p_{49}) * (1 - p_{50}) * u_e \\
&+ 0.8^8 * (1 - p_{47}) * (1 - p_{48}) * (1 - p_{49}) * (1 - p_{50}) * u_e \\
&+ 0.8^9 * (1 - p_{47}) * (1 - p_{48}) * (1 - p_{49}) * (1 - p_{50}) * 3 * u_e \\
&= [1 - (0.9 - m_{47})] * 0.8 * u_e - (0.9 - m_{47}) * 0.8 * (m_{47}^2 + m_{48}^2) \\
&+ [(1 - (0.9 - m_{47})(0.9 - m_{48})] * 0.8^2 * u_e \\
&- (0.9 - m_{47})(0.9 - m_{48}) * 0.8^2 * (m_{48}^2 + m_{49}^2) \\
&+ [(1 - (0.9 - m_{47})(0.9 - m_{48})(0.9 - m_{49})] * 0.8^3 * u_e \\
&- (0.9 - m_{47})(0.9 - m_{48})(0.9 - m_{49}) * 0.8^3 * (m_{49}^2 + m_{50}^2) \\
&+ 0.8^4 * (0.9 - m_{47})(0.9 - m_{48})(0.9 - m_{49}) \\
&* (0.9 - m_{50}) * u_e * (1 - 0.8^5)/0.2 - m_{46}^2 - m_{47}^2 \\
&+ 0.8^9 * (0.9 - m_{47})(0.9 - m_{48})(0.9 - m_{49}) * (0.9 - m_{50}) * 3 * u_e
\end{aligned} \tag{1.23}$$

To maximize this expect utility, I could calculate the best strategy of m($m47^*$, $m48^*$, $m49^*$, $m50^*$), choose by secretaries start at age 46.

Similarity, I could have the expect utility for secretaries start to serve as secretary from different age, from 47 to 54. In my dataset, there are 25 secretaries start to serve as secretary at age 46, 34 secretaries start at age 47, 42 secretaries start at age 48, 66 secretaries start at age 49, 60 secretaries start at age 50, 67 secretaries start at age 51, 68 secretaries start at age 52, 58 secretaries start at age 53, and 48 secretaries start at age 54. I calculate the best strategy of m for secretaries start at each age, and use the number of secretaries as weight. Taking weighted average of manipulation of 50-years-old secretary as an example:

$$\begin{aligned}\text{weighted } m_{50} = &\frac{m^*_{50}(t_0 = 46) \cdot 25 + m^*_{50}(t_0 = 47) \cdot 34}{25 + 34 + 42 + 66} \\ &+ \frac{m^*_{50}(t_0 = 48) \cdot 42 + m^*_{50}(t_0 = 49) \cdot 66}{25 + 34 + 42 + 66}\end{aligned} \tag{1.24}$$

I set the $u_e = 0.005$ [7] and $m < 0.1$, the weighted average m for secretaries at each age from 50 to 55 shows at Figure 19. [8] We can find it has the U shape trend between GDP manipulation and age of secretary that we anticipated based the original general model.

[7] the trend between weighted average GDP manipulation and age of secretaries is similar if set $u_e = 0.01$

[8] since I calculate the strategy choose by secretaries from $t_0 = 46$, so age 50 is the first age with secretaries serving as secretary at different years.

# Chapter 2

# Endogenous Rebellion Benefits and Political Survival

This chapter is joint work with Zhaosong Ruan.

Abstract

Governments and politicians often face survival threats from multiple actors, where the success of a rebellion depends on the coordination and perceived benefits of these actors. While these actors share a common goal of overthrowing the government, they have conflicts regarding the distribution of post-rebellion benefits. This paper investigates how a government can strategically choose institutions to exploit these conflicts, ensuring its survival. By initially implementing institutions that disadvantage certain "weaker" challengers and later transitioning to institutions that empower them, the government can delay rebellions. The timing of this transition is crucial; transitioning too early or late can render the strategy ineffective. This framework sheds light on political dynamics in various contexts, such as the economic and political shifts observed in China. The government's ability to manipulate perceived benefits, as seen with China's economic reforms and subsequent reversals, can play

a pivotal role in delaying potential rebellions and ensuring governmental longevity.

**Keywords:** Government survival, Rebellion, Conflict exploitation, Transition timing, Political dynamics

## 2.1 Introduction

Political actors faces survival threats from multiple sources (Bueno de Mesquita et al. [2003]). A dictator may face threats of rebellion from citizens from different social classes (Acemoglu and Robinson [2006]). A government may face insurgencies formed by different ethnic groups. Dictators may face challenges from both outsiders and their subordinates (Egorov and Sonin [2011]). Even in advanced democracies, such as a Westminster system, a leader may face potential challenges from multiple of her cabinet ministers. How should these political leaders ensure their survival facing such threats? A wealth of studies have examined how these political leaders could use repression to remove these threats to survival. By deploying repressive forces, politicians and governments increase the marginal cost of rebellions, deterring challengers from such attempts. However, fewer studies have focused on how politicians and governments can use policies and institutions to affect the marginal benefit of rebellions for challengers, and thereby achieve survival. This paper shows that endogenously affecting challenger's marginal benefit of rebellions can be another viable strategy for political survival, especially in settings where the challengers themselves face conflicts of interests.

We study settings where the politicians or governments face survival threats from multiple actors. A rebellion is successful if these actors can coordinate their rebellion effort. However coordination depends on these actors' perceived benefit from a successful rebellion. In our setting, they have a common interest in overthrowing the existing government, but they also have conflicts over the distribution of benefits post-rebellion. Challengers who expect to

receive only a small share of the benefits can choose not to participate the rebellion and stall it. Furthermore, the distribution of post-rebellion benefits among challengers is affected by pre-rebellion policies and institutions, which is chosen by the existing government. We show that, the government can ensure its survival by strategically choosing institutions to leverage the conflict of interest among the challengers. Specifically, the government can choose an institution that puts some challengers at a disadvantage now, while promising to choose another institution that puts the same challengers at a more powerful position relative to other challengers in the future. The prospect of becoming more powerful in the future serves as an incentive for these challengers to delay a rebellion to a point where the distribution of payoff is more beneficial to them.

The main result of this paper highlights the government's optimal survival strategy (i.e. optimal institution choice) in the settings discussed above. To ensure maximum survival, the government should first identify the "weaker" ones among the challengers. The weaker challengers are those who stand to enjoy a larger disadvantage (or smaller advantage) under different institutions. Then, the government should choose an institution path that begins with the weaker challengers' less preferred institution. The government should keep this institution for a period of time, before switching to the weaker challengers' more preferred institution and empowering them. Once the weaker challengers are empowered enough, they have no more incentive to delay a rebellion and the government can no longer survive.

Importantly, the timing of the transition is key to survival. If the transition happens too early, the weaker challengers are satiated too early. If the transition happens too late, the weaker challengers will have accumulated too much disadvantage before the transition, making any improvement afterwards insignificant. The government should design institution paths that appeals to the weaker challengers precisely because they have strong incentive to wait for improvements. More complicated institution paths involving more than one changes

of institutions cannot achieve longer survival, since they introduces additional incentive constraints for challengers. Finally, the government's ability to commit to such paths is key for its survival when choosing such institution paths.

Our paper helps explain multiple political scenarios. For example, it explains the instability of many Arab countries due to their reforms preserved rents to connected groups rather than generating benefits for the less-well-off citizens (Commander [2017]). A more detailed example is the reversal of economic reforms in China in the last decade. Briefly put, since 1978 the Chinese government has implemented multiple economic reform measures, including privatization and introduction of market economy to transfer much of its power over the economy to local governments and both state-owned and private entrepreneurs (Lin et al. [2003], Groves et al. [1994]). These reforms bring brought economic benefits to the Chinese government, even though they were accompanied by increasing political risks (Myerson [2010]). But this reform trend has reversed since 2012. From 2015 to 2020, the share of private enterprise revenue in total industrial revenue decreased by 5 percentage points, with an expansion of state-owned enterprise revenue of almost exactly the same magnitude. Even state-owned enterprises saw tighter control from the government. Since 2012, the Organization Department of the Chinese Communist Party, the department that controls staffing positions within the CCP, regained the power to nominate senior executive leaders of high-level state-owned enterprises. The recent tech crack-down is but another example of the government tightening control over the economy. This reversal in economic reforms has been accompanied by a reversal of political reforms. For example, Martinez-Bravo et al. [2020] documents that village governments in China, which were elected in the 1990s, began to lose their autonomy in the early 2000s.

Our paper's main results explains this reversal well. The Chinese government faces potential rebellion threats from its citizens, who are largely divided by economic status.

The four-decade economic reform, while helping the Chinese economy take off, has also greatly widened inequality, with China's Gini coefficient increasing from 0.317 in 1078 to 0.491 in 2009. While the lives of the vast majority of Chinese citizens improved, those with lower economic status gained relatively little from the reform. This makes them the weaker challengers in China. While they may express dissatisfaction with the government, they are still hesitant about a rebellion, since they believe a rebellion would lead the upper class (entrepreneurs and capitalists) reaping all the benefit, further expropriating them. The government leverages this sentiment by partly reversing course on economic policies. This reversal curbs the massive economic and political power the local elites and entrepreneurs have accumulated, putting the working class at a less disadvantageous position. This gives them an incentive to delay their rebellion attempts in expectation of more beneficial economic institutions in the future. Indeed, the Gini coefficient slightly decreased to 0.468 in 2020, signifying that the government is at least partially successful in affecting the relative power of different classes of citizens.

Our paper is situated in the larger literature about institution and political survival. This includes the seminal model of democratization by Acemoglu and Robinson [2006], and political survival Bueno de Mesquita et al. [2003], Bueno de Mesquita and Smith [2009]). In the Acemoglu and Robinson model the non-democratic government democratizes as a commitment devise to ensure higher payoff to its citizens, hence preventing itself from being overthrown. The government achieves survival not via repression, but precisely by affecting the payoffs citizens receive under different political settings. The models of Bueno de Mesquita et al discusses how politicians endogenously chooses institutions that facilitates or hinders the ease of coordinating a rebellion among citizens, given the government's fiscal constraints. Our paper builds on their analysis by explicitly examining the conflict of interest among multiple challengers, and explaining how governments can leverage this conflict to

achieve survival.

Methodologically, our paper is motivated by studies of dynamic institution choices, including Rajan [2009] and Lagunoff [2009]. Specifically, Rajan [2009] discusses the preferences of different citizens in the society over partial versus comprehensive economic reforms based on their marginal return. Due to competitive rent preservation (citizens guarding its rent from the economy due to privileged status against others), the society can trap in inefficient states with no or only partial reform, where political leaders who propose comprehensive reforms do not command broad support from the society. We broadly follow the idea that policy choices affects different citizens' payoff from the economy differentially, which indirectly affects political survival. An earlier version of this paper closely follow the modeling techniques with micro-foundations. Though we abstracted away from those micro-foundations to focus on the aspect of political survival, the general logic of analysis still follow through.

This paper is organized as follows: section 2.2 sets up the main model. section 2.3 presents the main analysis and results. section 2.4 discusses the role of government's ability of commitment. section 2.5 concludes.

## 2.2 Model

**Setup and timing.** We build a simple continuous time game with 3 players: The *G*overnment, social group $a$ and social group $b$ (each regarded as a single player, hereafter referred to as player $a$ and $b$). To simplify the analysis, $G$ only acts once at the beginning of the game at $t = 0$. At this instance, $G$ announces an institution plan, which maps any $t \geq 0$ to one of two institutions: *E*galitarian and *B*iased. Formally, the government announces a mapping $g(t) : \{0\} \cup \mathbb{R}^+ \to \{E, B\}$. To further simplify the analysis, we restrict the government's announcement $g(t)$ to the following form. First, the government announces an

initial institution $I_0 \in \{E, B\}$. Then, the government announces a series of transition time points $t_i$ for $i \in \mathbb{N}$, with $t_0 = 0$ and $t_i > t_{i-1}$. The mapping $g(t)$ is then defined as: $g(t) = I_0$ if $t \in [t_{2n}, t_{2n+1})$ for $n \in \mathbb{N}$, and $g(t) \neq I_0$ if $t \in [t_{2n+1}, t_{2n+2})$ for $n \in \mathbb{N}$. Substantively, the mapping $g(t)$ starts the path with institution $I_0$ at $t = 0$, and changes the institution at each transition time points $t_i$ for $i > 0$. We restrict $t_i$ such that $t_i - t_{i-1} \geq \phi > 0$, so that each pair of consecutive transition points are at least $\phi$ apart. This means that for any finite length $T$, the government can only change the institution for finitely many times. We will discuss the implications of this simplification later.

After this announcement, both social grouops play a continuous time game starting from $t = 0$. Each social gruop has two actions: *R*ebel and *N*ot to rebel. At any time $t$, if both social groups rebel, the game ends and payoffs are realized for all players. Simply put, $G$ lays down the foundation of a continuous time game at $t = 0$, and then is removed from the game. Both social groups then play the game that $G$ lays out by determining whether to rebel at time $t$, with the outcome of the game determined by layout that $G$ sets and both social groups' rebellion decisions.

**Histories and strategies.** The government only plays at $t = 0$, hence the histories of the game at time $t$ is irrelevant for $G$. After the government announces the institution plan, at any time $t$, the history of the game $h(t)$ contains two arguments. The first is whether the game has ended before $t$, which can take one of the following two values: $\{0, 1\}$, with 0 indicating that the game has not ended before time $t$ and 1 vice versa. This component is determined by both players' actions before time $t$. The second component contains both players' political powers at time $t$, which is determined by the institution plan that the government announces at the beginning of the game. Specifically, player $a$'s political power at time $t$ is $p_{at} = \int_0^t \frac{1}{2}\mathbb{1}\{g(t) = E\} + (1-\beta)\mathbb{1}\{g(t) = B\}$, where $\frac{1}{2} < \beta < 1$. Similarly, player $b$'s political power at time $t$ is $p_{bt} = \int_0^t \frac{1}{2}\mathbb{1}\{g(t) = E\} + (\beta)\mathbb{1}\{g(t) = B\}$. Substantively,

for any instance that the political institution is *E*galitarian, both social groups accumulate political power at a rate of $\frac{1}{2}$. For any instance that the political power is *B*iased, player $b$ accumulates political power at a rate of $\beta > \frac{1}{2}$, and player $a$ at a rate $1 - \beta < \frac{1}{2}$. Obviously at any time $t$, $p_{at} + p_{bt} = t$. Hence, at time $t$ where the game has not ended yet, player $i$'s history is $h_i(t) = \{p_{it}, 0\}$, and at time $t$ where the game has not ended yet, player $i$'s history is $h_i(t) = \{p_{it}, 1\}$. pPayer $i$'s strategy $s_i$ is then a mapping from $\{h_i(t)\}$ to $\{R, N, \emptyset\}$, such that $s_i(h_i t) \in \{R, N\}$ if $h_i(t) = \{p_{it}, 0\}$, and $s_i(h_i t) = \emptyset$ if $h_i(t) = \{p_{it}, 1\}$.

The game has complete information, hence the equilibrium concept is Sub-game Perfect Nash equilibrium (SPNE). We restrict our attention to pure strategy SPNEs.

**Payoffs.** The government's payoff is simply the time that the game ends, i.e. the minimum $t$ such that both social groups rebel. That is to say, the government's only incentive is survival. The social groups' payoffs come entirely from successfully ending the game. If the game ends at time $t$, both social groups divide a fixed prize of $V$. In particular, they divide $V$ according to their cumulative political power $p_{at}$ and $p_{bt}$ at time $t$, which is defined earlier. Finally, both social groups have a common instantaneous interest rate $r$, meaning that they discount payoffs at time $t$ at $e^{-rt}$. Hence, if the game ends at time $t > 0$, player $i$'s payoff, evaluated at the beginning of the game (i.e. time 0), is $U_i(t) = e^{-rt} V \frac{p_{it}}{t}$. If the game ends at time $t = 0$, player $a$'s payoff is $\frac{V}{2}$ if $I_0 = E$ and $(1 - \beta)V$ if $I_0 = B$. Similarly, player $b$'s payoff is $\frac{V}{2}$ if $I_0 = E$ and $\beta V$ if $I_0 = B$.

### 2.2.1 Discussion of Setup

Substantively, the game captures a scenario where the government faces the threat of rebellion from two social groups. The government lacks a mechanism to directly repress a rebellion, but does have the ability to endogenously affect both social groups' payoff should a rebellion succeed. Both social groups have a common interest in rebelling (i.e. end the

game) sooner to avoid loss from discounting. But they also have a conflict of interest in dividing the fixed price of $V$. Conditional on a rebellion happening at time $t$, both social groups are engaged in a zero-sum situation. The government leverages on the latter dimension by choosing different institutions at different time to alter the relative political power of both social groups, in order to maximize its survival.

As explained earlier, the government lays down a complete institution path all at once at $t = 0$. Importantly, the government does not "play along" by choosing an institution at every instant $t$. This certainly simplifies the analysis. But this also captures an important feature of the government: full commitment to institutional path. Once the government announces the complete institution path at $t = 0$, it is removed from the game, and both social groups will play the game along the announced institution path, without any player being able to alter it. This means that at any time $t$, social groups have full certainty about the future institutions, and does not have to make anticipations on what institutions are to come. As will be discussed in section 2.4, full commitment power gives the government an advantage with regards to survival. In section 2.4 we will analyze a greatly simplified game where the government actually chooses the institutions as the game progresses. The analysis will show that the government's survival problem is more complicated.

The structure of the game played between both social groups resembles the "simple timing game" (Fudenberg and Tirole [1991], pp. 117), where both players can choose to "stop" or "not to stop" the game at any time $t$. The difference is that in a simple timing game, any single player stopping at time $t$ stops the entire game, whereas in this game, both social groups need to rebel at time $t$ to end the game. In other words, any single social group is pivotal in moving the game forward, but not pivotal in ending the game.

In this game the way both social groups accumulate political power is not symmetric. Payer $a$ prefers institution $E$ and player $b$ prefers institution $B$. However, even under insti-

tution $E$, player $a$ only gets to accumulate as much political power as player $b$, while player $b$ enjoys an absolute advantage under institution $B$. Hence for the purpose of the analysis, we will call player $b$ the stronger social group and player $a$ the weaker social group. The asymmetry between the two social groups will shape the government's survival strategy in a particular manner, as we will see in the following sections.

## 2.3 Analysis

To identify equilibria of the game and the government's optimal strategy for maximum survival time, we first analyze both social groups' rebellion decisions given a particular institution path announced by the government. Then we analyze the government's optimal institution path for maximum survival.

### 2.3.1 Social groups' rebellion decisions

We assume that the social groups play weakly undominated strategies. In other words, we assume that social groups choose whether to rebel as if they are pivotal in ending the game as well. This removes any coordination problem between the two social groups when a rebellion is clearly Pareto optimal. Let $U_{it}$ be player $i$'s payoff if the game ends at time $t$. The above assumption means that if player $i$ chooses to rebel at time $t$, she consider her payoff from rebellion to be simply $U_{it}$, regardless of the other social group's rebellion decision. This brings a simple rebellion rule for both social groups. At time $t$, if player $i$ conjecture that the game will end at some $t' > t$ if she does not rebel at time $t$, then she rebels at time $t$ iff $U_{it} > U_{it'}$. Implicit in this rule is that if a social group is indifferent between rebelling at time $t$ or not, she does not rebel, which is a common assumption in similar games.

Player $a$ rebels for all $t \geq \frac{2\beta-1}{2r(1-\beta)}$, and player $b$ rebels for all $t \geq \frac{2\beta-1}{r}$. The game cannot last longer than $T = \frac{2\beta-1}{2r(1-\beta)}$.

*Proof.* At time $t$, player $a$'s payoff from a rebellion is $U_{at} = e^{-rt}V\frac{p_{at}}{t}$. If instead she delays the rebellion by an additional $\Delta t = h$, her payoff from a rebellion at $t+h$ is $U_{a,t+h} = e^{-r(t+h)}V\frac{p_{a,t+h}}{t+h}$. Hence she delays the rebellion if $\frac{U_{a,t+h}}{U_{at}} \geq 1$. $\frac{U_{a,t+h}}{U_{at}} = e^{-rh}\frac{p_{a,t+h}t}{p_{at}(t+h)}$ is bounded from above by the following:

First, $p_{a,t+h} \leq p_{at} + \frac{h}{2}$, since player $a$ can only accumulate $\frac{h}{2}$ units of additional political power in a time period of $h$. Hence $\frac{U_{a,t+h}}{U_{at}} \leq e^{-rh}\frac{(p_{at}+\frac{h}{2})t}{p_{at}(t+h)}$.

Second, $p_{at} \geq (1-\beta)t$, since player $a$ can at least accumulate $(1-\beta)t$ units of political power up to time $t$. Hence $\frac{U_{a,t+h}}{U_{at}} \leq e^{-rh}\frac{((1-\beta)t+\frac{h}{2})t}{(1-\beta)t(t+h)} = e^{-rh}\frac{2(1-\beta)t+h}{2(1-\beta)(t+h)}$. Hence if $e^{-rh}\frac{2(1-\beta)t+h}{2(1-\beta)(t+h)} < 1$, player $a$ rebels at time $t$.

Note that $e^{-rh}\frac{2(1-\beta)t+h}{2(1-\beta)(t+h)}$ decreases in $t$. Hence for any fixed $\beta$ and $r$, there exists a maximum $t$ such that $e^{-rh}\frac{2(1-\beta)t+h}{2(1-\beta)(t+h)} \geq 1$, so that player $a$ is willing to delay the rebellion. Solving $e^{-rh}\frac{2(1-\beta)t+h}{2(1-\beta)(t+h)} = 1$ gives $t^* = \frac{h(2\beta-1)}{2(1-\beta)(e^{hr}-1)} - h$. $t^*$ decreases in $h$, and $\lim_{h\to 0} t = \frac{2\beta-1}{2r(1-\beta)}$. Hence for all $t > t^*$, delaying the rebellion leads to a lower payoff for player $a$ for sure. Hence she rebels for all $t \geq \frac{2\beta-1}{2r(1-\beta)}$.

The proof that player $b$ rebels for all $t \geq \frac{2\beta-1}{r}$ follows similar arguments.

Since $\beta > \frac{1}{2}$, $\frac{2\beta-1}{2r(1-\beta)} > \frac{2\beta-1}{r}$. Hence for all $t > T = \frac{2\beta-1}{2r(1-\beta)}$, both social groups rebel. Hence the game cannot last longer than $T$. □

Lemma 2.3.1 explains an important dynamic of the game between the two social groups. As the game proceeds, both social groups accumulate more and more political power. As their stock of political power increases, any small change in political power due to a slightly delayed rebellion under certain institution becomes less significant compared to discounting. Ultimately, there comes a point where any change in political power is so small that both

social groups decide to not delay the rebellion any further. This means that while the government can announce an institution plan for all $t \geq 0$, any announcement regarding $t > T = \frac{2\beta-1}{2r(1-\beta)}$ does not matter, since the social groups will not let the government survive past $T$ anyway.

With Lemmas 2.3.1, we can characterize the social groups' optimal rebellion decision via an iterative process. To illustrate how this process works, we first give an example where only one player $i$ exists and decides whether to rebel. Then we extend this process to two players.

- Identify the smallest $t'$ such that $U_{it}$ decreases for all $t \geq t'$ for player $i$. By lemma 2.3.1 this $t'$ exists and is no greater than $T = \frac{2\beta-1}{2r(1-\beta)}$. Denote this $t'$ as $\underline{t_{e0}}$. Player $i$'s optimal strategy is to rebel for all $t \geq \underline{t_{e0}}$. This is obvious. From $\underline{t_{e0}}$ onward, her utility decreases with $t$. Hence she always rebels.

- Identify the smallest $t'' < \underline{t_{e0}}$ such that for all $t$ in $[t'', \underline{t_{e0}})$, $U_{it} \leq U_{i\underline{t_{e0}}}$. This $t''$ exists, since $\underline{t_{e0}}$ is the smallest $t'$ such that $U_{it}$ decreases for all $t \geq t'$ for player $i$. This means for small $\epsilon$, $U_{it}$ is non-decreasing for $t \in [\underline{t_{e0}} - \epsilon, \underline{t_{e0}})$. Denote this $t''$ as $\overline{t_{e1}}$. Player $i$'s optimal strategy for $t \in [\overline{t_{e1}}, \underline{t_{e0}})$ is to not rebel. Substantively. in $t \in [\overline{t_{e1}}, \underline{t_{e0}})$, player $i$'s utility from an immediate rebellion is no higher than her utility from the next conjectured rebellion time, which is $\underline{t_{e0}}$.

- Identify the smallest $t''' < \overline{t_{e1}}$ such that $U_{it}$ decreases for all $t$ in $[t''', \overline{t_{e1}})$ for player $i$. This $t'''$ exists, since $\overline{t_{e1}}$ is the smallest $t''$ such that for all $t$ in $[t'', \underline{t_{e0}})$, $U_{it} \leq U_{i\underline{t_{e0}}}$. This means for small $\epsilon$, $U_{it} > U_{i\underline{t_{e0}}}$ and $U_{it}$ decreases in $t$ for $t \in [\overline{t_{e1}} - \epsilon, \overline{t_{e1}})$ for player $i$. Denote this $t'''$ as $\underline{t_{e1}}$. Player $i$'s optimal strategy is to rebel for all $t \in [\overline{t_{e1}}, \overline{t_{e1}})$. Substantively, for any $t \in [\overline{t_{e1}}, \overline{t_{e1}})$, if player $i$ delays the rebellion, then the next conjectured rebellion always results in a lower payoff.

- Identify $\overline{t_{e(i+1)}}$ based on $\overline{t_{ei}}$ similar to how $\underline{t_{e1}}$ is identified. Player $i$'s optimal strategy for $t \in [\overline{t_{e(i+1)}}, \underline{t_{ei}})$ is to not rebel. Substantively, in $[\overline{t_{e(i+1)}}, \underline{t_{ei}})$, player $i$ delays the rebellion to $\underline{t_{ei}}$.

- Identify $\underline{t_{ei}}$ based on $\overline{t_{ei}}$ similar to how $\underline{t_{e1}}$ is identified. Player $i$'s optimal strategy is to rebel for all $t \in [\underline{t_{ei}}, \overline{t_{ei}})$. Substantively, in $[\underline{t_{ei}}, \overline{t_{ei}})$, delaying the rebellion to the next conjectured time of rebellion leads to lower payoffs for player $i$.

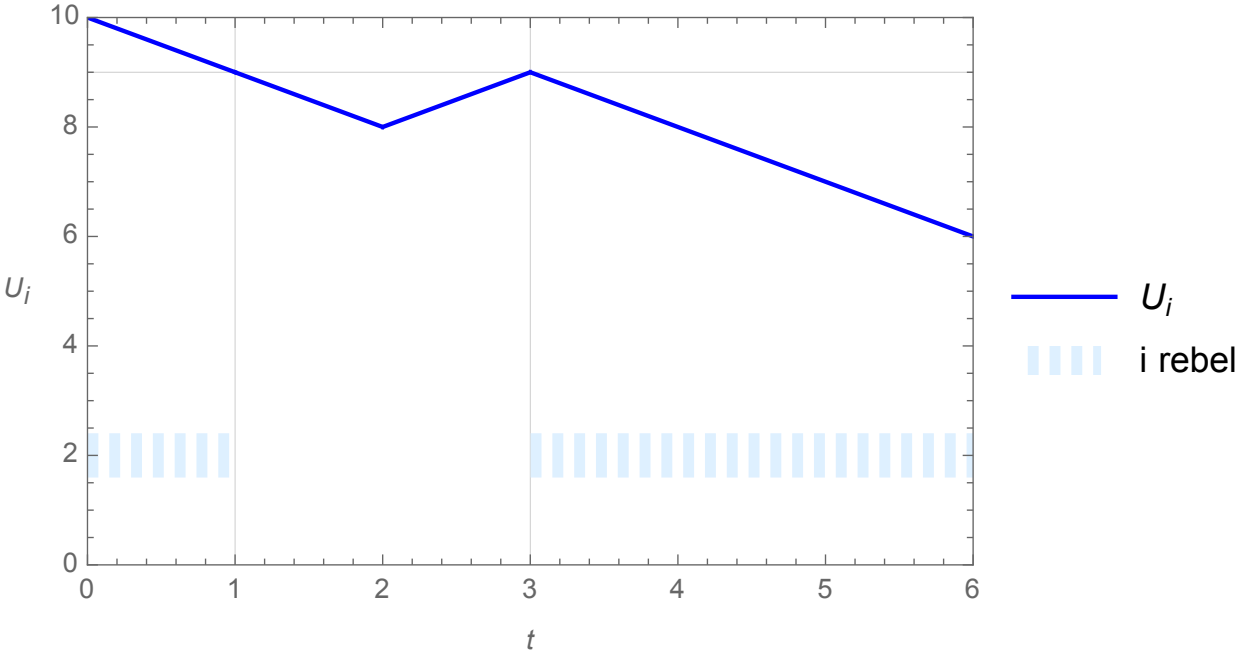



Figure 2.1: Player $i$'s payoff and rebellion decisions.

Figure 2.1 is a hypothetical example. Player $i$'s payoff decreases from $t = 3$ onward. Hence she always rebels from $t = 3$ onward. From $t = 1$ to $t = 3$, her payoff is lower than if she were to rebel at $t = 3$. So she does not rebel between $t = 1$ and $t = 3$. Finally, from $t = 0$ to $t = 1$, her payoff decreases in $t$, and is higher than if she were to rebel at $t = 3$. So she rebels between $t = 0$ and $t = 1$.

Now we extend this iterative process to two players.

- Identify the smallest $t'$ such that $U_{it}$ decreases for all $t \geq t'$ for both social groups. By lemma 2.3.1 this $t'$ exists and is no greater than $T = \frac{2\beta-1}{2r(1-\beta)}$. Denote this $t'$ as $\underline{t_{e0}}$. Both social groups' optimal strategy is to rebel for all $t \geq \underline{t_{e0}}$. This is obvious. From $\underline{t_{e0}}$ onward, both social groups' payoff decrease with $t$, hence they always rebel.

- Identify the smallest $t'' < \underline{t_{e0}}$ such that for all $t$ in $[t'', \underline{t_{e0}})$, at least one player $i$ has $U_{it} \leq U_{i\underline{t_{e0}}}$. This $t''$ exists, since $\underline{t_{e0}}$ is the smallest $t'$ such that $U_{it}$ decreases for all $t \geq t'$ for both social groups. This means for small $\epsilon$, at least one social group's utility $U_{it}$ is non-decreasing for $t \in [\underline{t_{e0}} - \epsilon, \underline{t_{e0}})$. Denote this $t''$ as $\overline{t_{e1}}$. Both social groups' optimal strategy for $t \in [\overline{t_{e1}}, \underline{t_{e0}})$ is to rebel iff $U_{it} > U_{i\underline{t_{e0}}}$. Substantively, in $t \in [\overline{t_{e1}}, \underline{t_{e0}})$, both social groups have a conflict of interest regarding whether to rebel now or to delay the rebellion to the next conjectured time point, which is $\underline{t_{e0}}$. In $t \in [\overline{t_{e1}}, \underline{t_{e0}})$, when one social group has $U_{it} > U_{i\underline{t_{e0}}}$ and wants to rebel now, the other social group always have $U_{jt} \leq U_{j\underline{t_{e0}}}$, so a rebellion does not happen until $\underline{t_{e0}}$.

- Identify the smallest $t''' < \overline{t_{e1}}$ such that $U_{it}$ decreases for all $t$ in $[t''', \overline{t_{e1}})$ for both social groups. This $t'''$ exists, since $\overline{t_{e1}}$ is the smallest $t''$ such that for all $t$ in $[t'', \underline{t_{e0}})$, at least one player $i$ has $U_{it} \leq U_{i\underline{t_{e0}}}$. This means for small $\epsilon$, $U_{it} > U_{i\underline{t_{e0}}}$ and $U_{it}$ decreases in $t$ for $t \in [\overline{t_{e1}} - \epsilon, \overline{t_{e1}})$ for both social groups. Denote this $t'''$ as $\underline{t_{e1}}$. Both social groups' optimal strategy is to rebel for all $t \in [\overline{t_{e1}}, \overline{t_{e1}})$. Substantively, for any $t \in [\overline{t_{e1}}, \overline{t_{e1}})$, if one social group delays the rebellion, then the next conjectured rebellion always results in a lower payoff for both players. Importantly, social groups realize that a rebellion cannot happen in $[\overline{t_{e1}}, \underline{t_{e0}})$, where one social group's payoff may be higher.

- Identify $\overline{t_{e(i+1)}}$ based on $\overline{t_{ei}}$ similar to how $\underline{t_{e1}}$ is identified. Both social groups' optimal strategy for $t \in [\overline{t_{e(i+1)}}, \underline{t_{ei}})$ is to rebel iff $U_{it} > U_{i\underline{t_{ei}}}$. Substantively, in $[\overline{t_{e(i+1)}}, \underline{t_{ei}})$, social groups delay the rebellion to $\underline{t_{ei}}$.

- Identify $\underline{t_{ei}}$ based on $\overline{t_{ei}}$ similar to how $\underline{t_{e1}}$ is identified. Both social group's optimal strategy is to rebel for all $t \in [\underline{t_{ei}}, \overline{t_{ei}})$. Substantively, in $[\underline{t_{ei}}, \overline{t_{ei}})$, delaying the rebellion to the next conjectured time of rebellion leads to lower payoffs for both social groups.

- Repeat the iterative process until no more $\overline{t_{ei}}$ or $\underline{t_{ei}}$ can be identified.

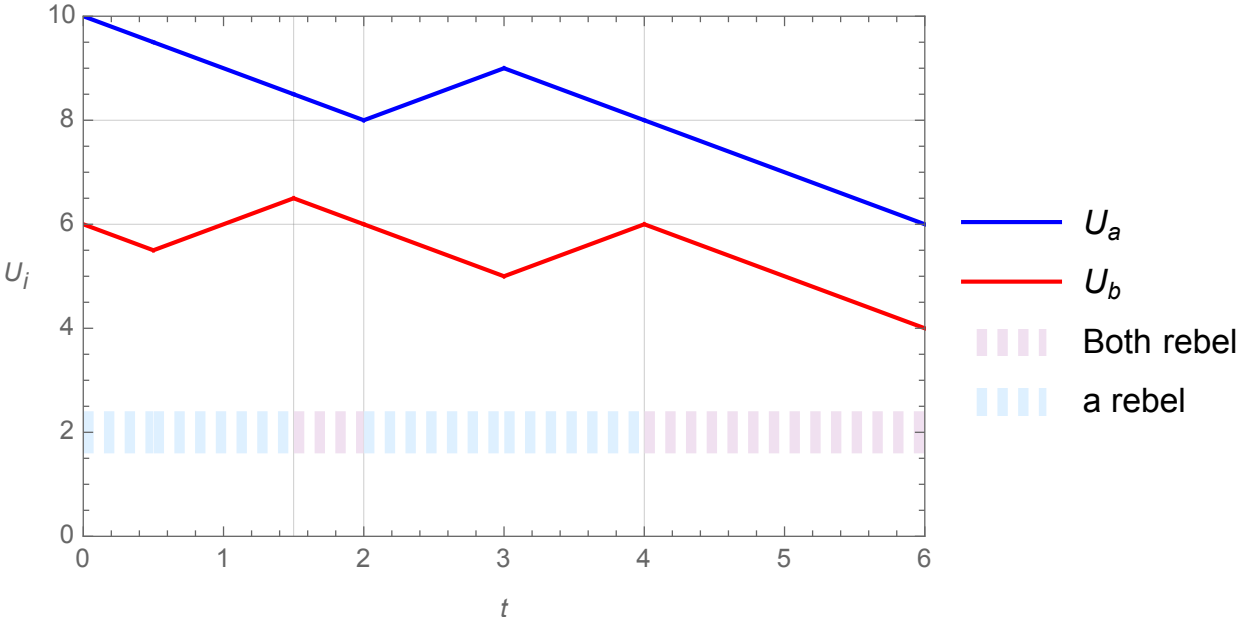



Figure 2.2: Both players' payoff and rebellion decisions.

Figure 2.2 is a hypothetical example. Both players' decreases from $t = 4$ onward. Hence both players rebel from $t = 4$ onward. From $t = 2$ to $t = 4$, player $a$'s utility is higher than if she were to rebel at $t = 4$, but player $b$'s utility is lower than that at $t = 4$. Hence from $t = 2$ to $t = 4$, only player $a$ rebels. Player $b$ delays the rebellion to $t = 4$. From $t = 1.5$ to $t = 2$, both player's payoffs decreases in $t$, and is higher than their respective payoffs if they were to rebel at $t = 4$. Hence both players rebel from $t = 1.5$ to $t = 2$. Finally, from $t = 0$ to $t = 1.5$, player $a$'s utility is higher than if she were to rebel at $t = 1.5$, but player $b$'s utility is lower than that at $t = 1.5$. Hence from $t = 0$ to $t = 1.5$, only player $a$ rebels. Player $b$ delays the rebellion to $t = 1.5$.

### 2.3.2 Institution paths with one transition time point

With the social groups' rebelling decisions characterized, we now turn to the optimal institution path for the government's survival. Before we proceed with formal analysis, we present a rather obvious result: The government cannot survive for any positive amount of time $T > 0$ if she only announces an initial institution $I_0$ without any transition time point (i.e. announces the same institution for all $t \geq 0$). The intuition is very obvious. If the government only announces the same institution for all $t \geq 0$, each social group's share of the prize $V$ is fixed, and does not change with time. Hence both social groups' payoff from a rebellion decrease in $t$ due to discounting. Hence both social groups rebel at $t = 0$ to split $V$ at the earliest instance possible.

Proposition 2.3.2 means that the government cannot survive without introducing some variation in its institution paths. The variation would lead to a change in relative political power along the path, potentially leading social groups to delay a rebellion to a time point where it is relatively more advantageous. In the following sections, we examine how the government should introduce such variations to maximize its survival time. In this section, we show the optimal institution path if the government is restricted to announcing only the initial institution $I_0$ and one transition time point $t$. In the next section, we show that the government cannot survive even longer by announcing more transition time points.

If the government announces an institution path with $I_0 = B$, the optimal transition time point $t_1$ is the unique solution to a function $f_a(t_1) = 0$. Denote this transition time point as $t_a^*$. This optimal transition time point allows the government to survive for $T_a^* = t_a^*(\beta - \frac{1}{2}) + \frac{\sqrt{t_a^*(2\beta-1)(4+(2\beta-1)rt_a^*)}}{2\sqrt{r}}$.

*Proof.* If the government announces an institution path with $I_0 = B$ and one transition time point $t_1$, both players' payoffs decrease with $t$ before $t_1$. This is because before $t_1$, the

institution is fixed at $I_0 = B$. Hence both players accumulate political power at a fixed rate: player $a$'s political power is simply $(1-\beta)t$ and player $b$'s is $\beta t$. This means that they receive a fixed share of $V$ (player $a$ receiving $(1-\beta)V$ and player $b$ receiving $\beta V$). Hence their payoffs simply decrease with $t$ due to discounting before $t_1$. Once the game reaches $t_1$ and the institution changes to $E$, the situation changes for both players. From $t_1$ onward, player $a$'s political power as a function of $t$ is now $(1-\beta)t_1 + \frac{t-t_1}{2}$, and player $b$'s is $\beta t_1 + \frac{t-t_1}{2}$. Correspondingly, player a's share of the prize $V$ is now $\frac{(1-\beta)t_1+\frac{t-t_1}{2}}{t} = \frac{1}{2} + \frac{t_1(\frac{1}{2}-\beta)}{t}$, which now increases in $t$. Substantively, at any $t \geq t_1$, the incremental rate of player $a$'s power accumulation at $t$ is larger than her cumulative share of power up to $t$. Hence for player $a$, delaying the rebellion from $t = 0$ to $t = t_1$ brings no benefit but only loss due to discounting. However delaying the rebellion from $t = t_1$ onward can potentially bring a benefit due to her increased relative political power. On the other hand, similar calculation shows that player $b$'s share of $V$ decreases for $t \geq t_1$. Hence player $b$ always rebels at every $t$. Hence for a rebellion to not happen for some time after $t_1$, it must be that player $a$'s utility increases for some $t$ after $t_1$.

By the proof of Lemma 2.3.1, the transition time point $t_1$ must be smaller than $\frac{2\beta-1}{2r(1-\beta)}$. With a transition time point $t_1 < \frac{2\beta-1}{2r(1-\beta)}$ chosen, player $a$'s payoff as a function of $t$ is as follows: For $t \in [0, t_1)$, her payoff is $U_{at} = (1-\beta)Ve^{-rt}$, which decreases in $t$, and is maximized at $t = 0$ with a value of $(1-\beta)V$. For $t \geq t_1$, her payoff is $U_{at} = \frac{(1-\beta)t_1+\frac{1}{2}(t-t_1)}{t}Ve^{-rt}$, which is concave. For $t_1 < \frac{2\beta-1}{2r(1-\beta)}$, $\frac{(1-\beta)t_1+\frac{1}{2}(t-t_1)}{t}Ve^{-rt}$ increases up to a point $\overline{t_1} = t_1(\beta - \frac{1}{2}) + \frac{\sqrt{t_1(2\beta-1)(4+(2\beta-1)rt_1)}}{2\sqrt{r}}$, and then decreases. Hence player $a$ rebels for all $t \geq \overline{t_1}$. Note that $\overline{t_1}$ increases with $t_1$.

It remains to have player $a$ not rebel before $\overline{t_1}$. This means for all $t < \overline{t_1}$, we must have $U_{at} \leq U_{a,\overline{t_1}}$. Since $U_{at}$ decreases on $t \in [0, t_1)$ and increases on $t \in [t', \overline{t_1}]$, it suffices to have $U_{a,\overline{t_1}} \geq U_{a0} = (1-\beta)V$. $U_{a,\overline{t_1}} = \frac{(1-\beta)t_1+\frac{1}{2}(\overline{t_1}-t_1)}{\overline{t_1}}Ve^{-r\overline{t_1}}$. Plugging in $\overline{t_1} = t_1(\beta - \frac{1}{2}) +$

$\frac{\sqrt{t_1(2\beta-1)(4+(2\beta-1)rt_1)}}{2\sqrt{r}}$, we have:

$$U_{a,\overline{t_1}} = \frac{(2+rt_1(2\beta-1)-\sqrt{rt_1(2\beta-1)(4+(2\beta-1)rt_1)})e^{\frac{rt_1(1-2\beta)-\sqrt{rt_1(2\beta-1)(4+(2\beta-1)rt_1)}}{2}}}{4}V,$$

which is a function of $t_1$. Substantively, $U_{a,\overline{t_1}}$ is the maximum payoff player $a$ can receive if $I_0 = B$ and the transition time point is set at $t_1$. Since player $a$ rebels for all $t \geq \overline{t_1}$, and $\overline{t_1}$ increases with $t_1$, we need to identify the largest $t_1$ such that $U_{a,\overline{t_1}} \geq 1-\beta$.

Let $f_a(t_1) = \frac{U_{a,\overline{t_1}}-(1-\beta)V}{V}$. We have $\lim_{t_1\to 0} f_a(t_1) = \frac{1}{2}+\beta-1 > 0$, and $f_a'(t_1) < 0$ for all $t_1$. Hence $f_a(t_1) = 0$ has a unique solution $t_a^*$. In other words, $t_a^*$ is the largest $t_1$ such that $U_{a,\overline{t_1}} \geq 1-\beta$. Plugging $t_1 = t_a^*$ into $\overline{t_1} = t_1(\beta-\frac{1}{2}) + \frac{\sqrt{t_1(2\beta-1)(4+(2\beta-1)rt_1)}}{2\sqrt{r}}$, we have the government's maximum survival time $T_a^* = t_a^*(\beta-\frac{1}{2}) + \frac{\sqrt{t_a^*(2\beta-1)(4+(2\beta-1)rt_a^*)}}{2\sqrt{r}}$. □

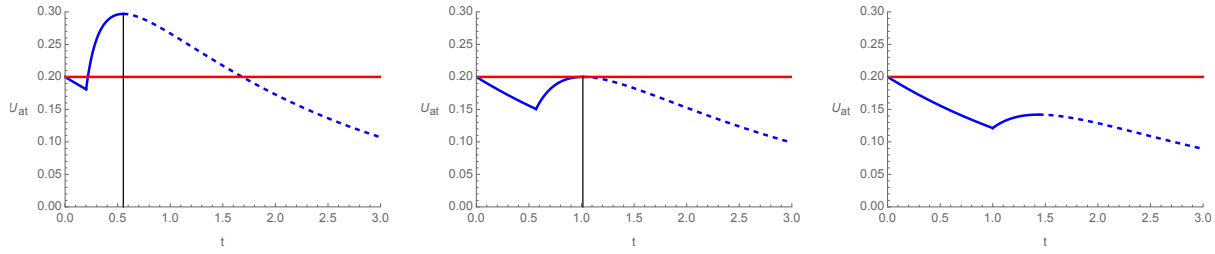



Figure 2.3: Player $a$'s payoff on institution paths with different transition time points. In this figure $\beta = 0.8$ and $r = 0.5$.
Left: Transition time point set too early, player $a$ satiated too early.
Middle: Optimal transition time point.
Right: Transition time point set too late, player $a$ does not have enough improvement.

Figure 2.3 graphically shows the intuition behind Lemma 2.3.2. In each panel, the red horizontal line indicates $(1-\beta)V$, player $a$'s payoff from an immediate rebellion. The blue curve shows player $a$'s payoff along the institution paths with different transition time points. The black vertical line indicates the length of government survival. As can be seen in all panels, her payoff decreases from the beginning of the path to the transition time point, and then increases to a peak, before decreasing again. Since player $a$ will never proceed along

the institution path past the peak after the transition time point, her payoff after the peak is plotted in dashed line. Besides, her payoff at the peak must be at least as high as the red horizontal line, i.e. her payoff at the beginning of the path. In the left panel, the transition time point is set too early. While this ensures that player $a$'s payoff quickly increases past the red horizontal line, an early transition time point also leads to an early peak, which gives the government a short survival time. In the right panel, the transition time point is set too late, so that even though player $a$'s payoff indeed increases after the transition point, it is not able to reach the red horizontal line. In this case, player $a$ rebels immediately. In the middle panel, the optimal transition time point is chosen. The increase in player $a$'s payoff after the transition time point is just enough to make her indifferent between rebelling immediately and rebelling at the peak.

Lemma 2.3.2 identifies the optimal transition time point $t_a^*$ that leverages on player $a$'s decision to delay a rebellion. Similarly, we can construct an institution path with $I_0 = E$ and a transition time point $t_1$ that appeals to player $b$. Lemma 2.3.2 characterizes such an optimal institution path. If the government announces an institution path with $I_0 = E$, the optimal transition time point $t_1$ is the unique solution to a function $f_b(t_1) = 0$. Denote this transition time point as $t_b^*$. This optimal transition time point allows the government to survive for $T_b^* = \frac{t_b^*(2\beta-1)}{4\beta} + \frac{\sqrt{t_b^*(2\beta-1)(8\beta+(2\beta-1)rt_b^*)}}{4\beta\sqrt{r}}$.

*Proof.* Analogous to the proof of Lemma 2.3.2. □

Now that we have two institution paths with one transition time point, starting with $I_0 = B$ and $I_0 = E$ respectively, which should the government choose? Proposition 2.3.2 states that the institution path starting with $I_0 = B$ gives the government a longer time of survival. If the government can only choose institution paths that has one transition time point, the optimal institution path has $I_0 = B$ and transition time point at $t_a^*$. This leads

to a survival time of $T_a^*$.

*Proof.* First, note that $\lim_{t_1 \to 0} f_a(t_1) = \lim_{t_1 \to 0} f_b(t_1) = \beta - \frac{1}{2}$. Then, note that both $f_a(t_1)$ and $f_b(t_1)$ is a specific form of the following function:

$$f(t_1, x) = \frac{(x + rt_1(2\beta - 1) - \sqrt{rt_1(2\beta-1)(2x+(2\beta-1)rt_1)})e^{\frac{rt_1(1-2\beta)-\sqrt{rt_1(2\beta-1)(2x+(2\beta-1)rt_1)}}{x}}}{4} + \frac{x}{4} - 1.$$

If $x = 2$, $f(t_1, x) = f_a(t_1)$. If $x = 4\beta$, $f(t_1, x) = f_b(t_1)$. We have $\frac{\partial^2 f(t_1,x)}{\partial t_1 \partial x} < 0$. Since $4\beta > 2$, this means $f_b'(t_1) < f_a'(t_1)$ for all $t_1 > 0$. Since $t_i^*$ is the unique solution to $f_i(t_1) = 0$, we have $t_b^* < t_a^*$, i.e. the institution path with $I_0 = E$ has an earlier transition time point.

Similarly, note that both $T_a^*$ and $T_b^*$ is a specific form of the following function:

$$T_i^*(t_i^*, x) = \frac{t_i^*(2\beta-1)}{x} + \frac{\sqrt{t_a^*(2\beta-1)(2x+(2\beta-1)rt_a^*)}}{x\sqrt{r}}.$$

If $x = 2$ and $i = a$, $T_i^*(t_i^*, x) = T_a^*$. If $x = 4\beta$ and $i = b$, $T_i^*(t_i^*, x) = T_b^*$. We have $\frac{\partial T_i^*(t_i^*,x)}{\partial x} < 0$. Since $4\beta > 2$, this means $T_b^* < T_a^*$ if $t_a^* = t_b^*$. However the previous paragraph shows that $t_b^* < t_a^*$. Furthermore, $T_i^*$ increases with $t_i^*$. Hence we have $T_b^* < T_a^*$. □

Both institution paths described in Lemmas 2.3.2 and 2.3.2 involve one transition time point, but appeals to a different social group. Recall that in section 2.2.1 we call player $a$ the weaker social group due to her never having an absolute advantage over player $b$ under any institution. Her weakness makes her a better target to appeal for the government, since she is more willing to delay a rebellion to wait for beneficial institution changes. Hence we come to an important takeaway: Institution paths that benefits the weaker social group in the future is better for the government's survival.

Proposition 2.3.2 specifies the government's optimal transition time $t_a^*$ and survival time $T_a^*$. While it is hard to explicitly express them (since solving for them involves transcendent equations), it is possible to plot them for specific values of parameters. Figure 2.4 show plots of $t_a^*$ and $T_a^*$ for different values of $\beta$ and $r$. We can see that both the government's optimal

transition time and survival time increases in $\beta$. As $\beta$ increases, player $a$ is more disadvantaged under the biased institution. This means that she values the change to an egalitarian institution more, and is willing to wait longer for that change to happen. Naturally, the government's optimal transition time and survival time decreases with the interest rate $r$.

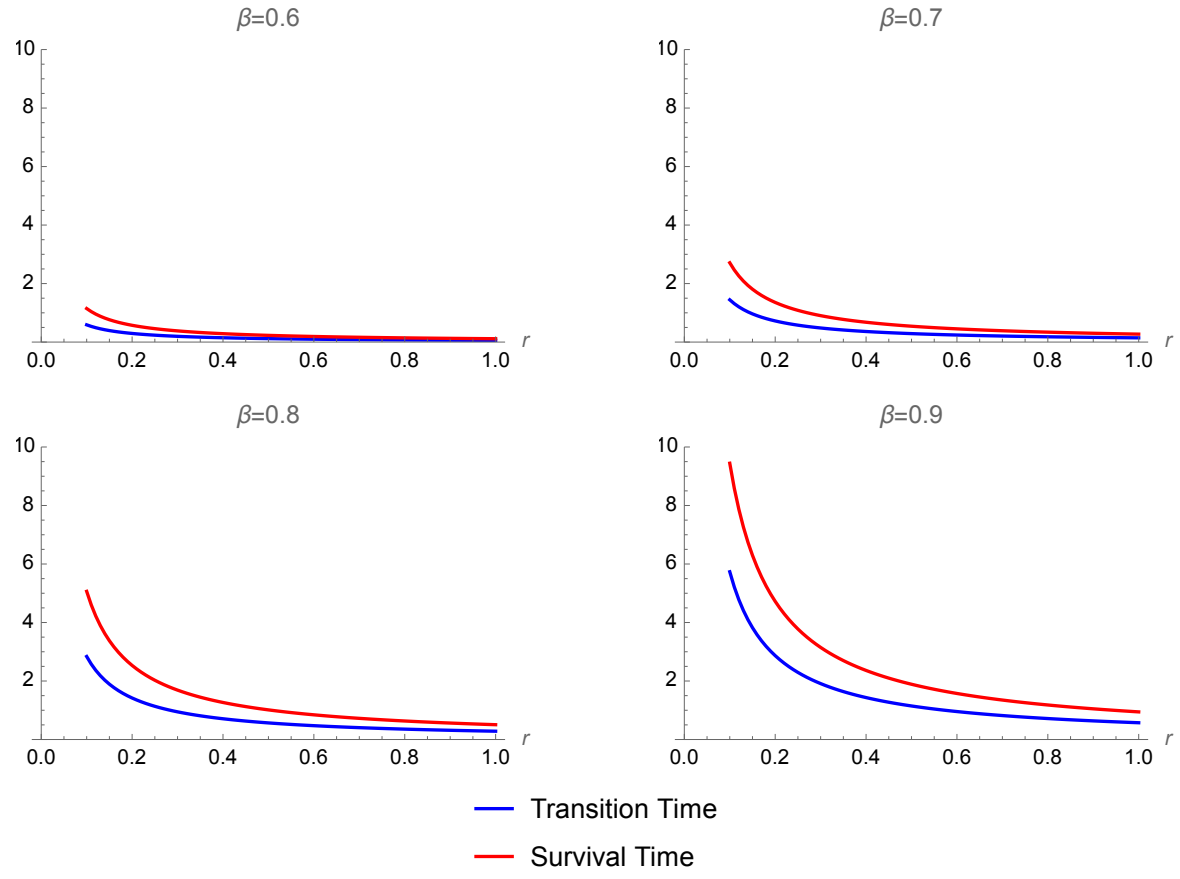



Figure 2.4: Government's transition time ($t_a^*$) and survival time ($T_a^*$) with different $\beta$ and $r$

### 2.3.3 Institution paths with more than one transition time points

In the previous section the government is restricted to announce institution paths with only one transition time point. In this section, we examine whether the government can survive longer than $T_a^*$ by announcing institution paths with more than one transition time points.

We first present a result that simplifies our analysis. If the government announces more than one transition time points $t_1$, $t_2$ ... $t_n$, its survival time $T$ cannot be in any interval $(t_{2i}, t_{2i+1}]$ for $i \in \mathbb{N}^+$. In other words, there must be an odd number of transition time points between $t = 0$ and the government's survival time $T$ ($t_{2i} = T$ is allowed).

*Proof.* Without loss of generality, let $I_0 = B$. The argument for $I_0 = E$ is analogous.

Assume that given an announcement of transition time points $t_1$, $t_2$ ... $t_n$, the government's survival time $T$ falls in $(t_{2i}, t_{2i+1}]$ for some $i \in \mathbb{N}^+$.

We have that along this institution path, $\lim_{t\to 0} \frac{p_{at}}{t} = 1 - \beta$, since the institution path begins with $I_0 = B$. We also have that at the time where the rebellion happens, i.e. at the survival time $T$, $\frac{p_{aT}}{T} = v_a > 1 - \beta$, since during $t \in [t_{2i-1}, t_{2i})$ the institution is $E$, which allows player $a$ to accumulate relatively more political power. We also have that for $t \in [t_{2i}, T]$, $\frac{p_{at}}{t}$ decrease in $t$, since during $t \in [t_{2i}, T]$ the institution is $B$ (the institution is $B$ after each even transition time point). This means that $\frac{p_{a,t_{2i}}}{t_{2i}} > v_a$. Since $\frac{p_{at}}{t}$ is continuous in $t$, there must exist a $t' < t_{2i}$ such that $\frac{p_{a,t'}}{t'} = v_a$. This is to say, a rebellion at $t'$ gives player $a$ (and player $b$) the same share of $V$ as does a rebellion at $T$. Hence both social groups' payoff at $t'$ is strictly higher than at $T$, meaning that they will rebel at $t'$, preventing the government from surviving to $T$. □

Lemma 2.3.3 means that if the government announces more than one transition time points, the institution immediately before the survival time $T$ must be different from $I_0$. If instead the institution immediately before the survival time $T$ is the same as $I_0$, then there must be a point $t' < T$ on the institution path where both social groups divide $V$ the same way as they would do at $T$. This leads to an early rebellion at $t'$ rather than at $T$. Hence, if the government announces more than one transition time points, the survival time $T$ must fall in $(t_{2i-1}, t_{2i}]$ for some $i \in \mathbb{N}^+$. Figure 2.4 shows an example. This figure shows player $a$'s

share of $V$, i.e. $\frac{p_{at}}{t}$, under the following hypothetical institution path: $I_0 = B$ from $t = 0$ to $t = 1$, $I = E$ from $t = 1$ to $t = 2$, and $I = B$ from $t = 2$ to $t = 3$. We can see that at the end of this hypothetical institution path, player $a$'s share of $V$ is $\frac{11}{30}$. However, at $t = 1.5$, her share of $V$ is also $\frac{11}{30}$. If both players rebel at $t = 1.5$, they will receive the same share of $V$ as they will at $t = 3$, but receive a much higher utility due to less discounting. Hence the government cannot survive till $t = 3$ in this institution path, where the ending institution is the same as the initial institution.

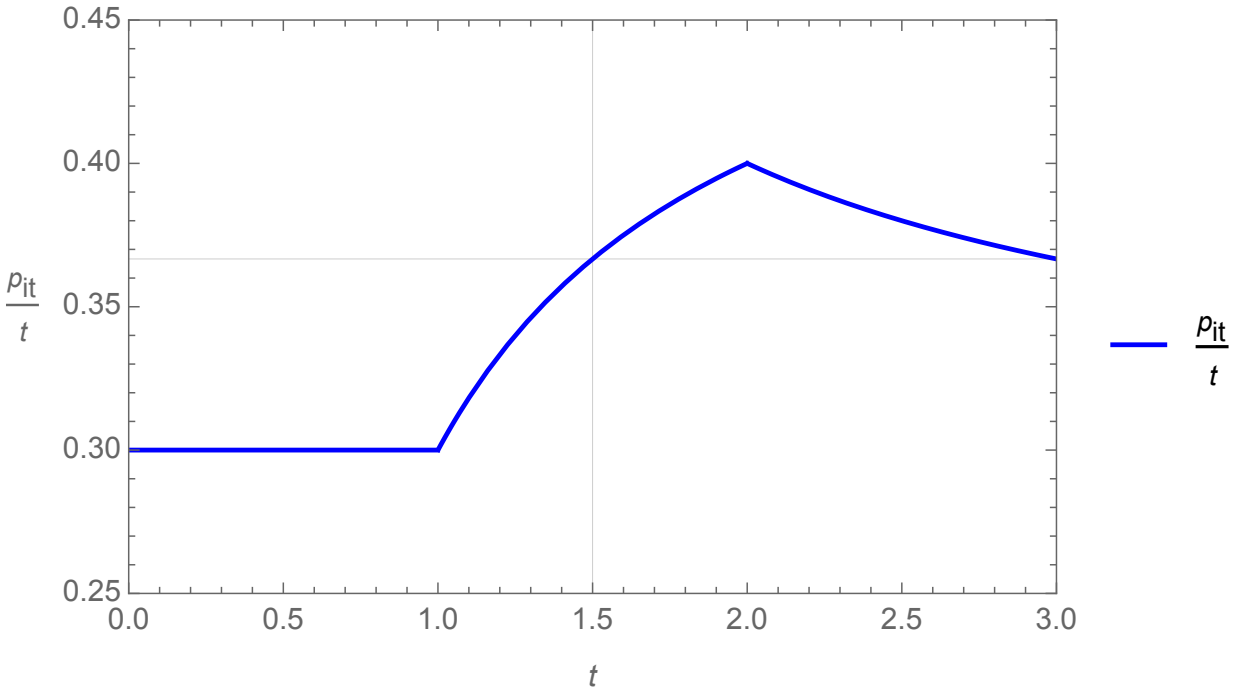



Figure 2.5: Player $a$'s share of $V$, i.e. $\frac{p_{at}}{t}$.

With this knowledge, we present the final major result.

If the government announces more than one transitional time points $t_1$, $t_2$ ... $t_n$, its survival time $T$ cannot be both in $(t_{2i-1}, t_{2i}]$ for some $i \in \mathbb{N}^+$ and be larger than $T_a^*$ from Lemma 2.3.2 and Proposition 2.3.2. This is to say, the government cannot survive for $T > T_a^*$ by announcing an institution path with more than one transition time points.

*Proof.* Without loss of generality, let $I_0 = B$. The argument for $I_0 = E$ is analogous.

Assume that given an announcement of transition time points $t_1$, $t_2$ ... $t_n$, the government's survival time $T$ falls in $(t_{2i-1}, t_{2i}]$ for some $i \in \mathbb{N}^+$, and is larger than $T_a^*$. Denote $t' = \int_0^T \mathbb{1}\{g(t) = B\}$. By Lemma 2.3.1, the government's survival time $T < \frac{2\beta-1}{2r(1-\beta)}$, so $t' < \frac{2\beta-1}{2r(1-\beta)}$. Substantively, $t'$ is the total amount of time along the institution path where the institution is $B$. Notably, since $T \in (t_{2i-1}, t_{2i}]$, i.e. the institution immediately before the rebellion is $E$, a marginal change in $t$ within the interval $(t_{2i-1}, T]$ does not change the value of $t'$. Hence $t'$ is not a function of $t$ in this interval.

We have that for player $b$, $U_{b0} = \beta V$, and $U_{bT} = \frac{\beta t' + \frac{1}{2}(T-t')}{T} V e^{-rT} < U_{b0}$. Hence player $b$ rebels at $t = 0$. Besides, for $t \in [t_{2i-1}, T)$, $U_{bt} = \frac{\beta t' + \frac{1}{2}(t-t')}{t} V e^{-rt}$. Since $t'$ is not a function of $t$ in this interval, we can treat $t'$ as fixed and $U_{bt}$ as a univariate function of $t$. Clearly for $t \in [t_{2i-1}, T)$, $U_{bt}$ decreases in $t$, since player $b$ must endure her less preferred institution $E$ in this interval. Hence player $b$ rebels for all $t \in [t_{2i-1}, T)$. Hence in order for the government to survive to $T$, we must satisfy two necessary conditions: i) player $a$ does not rebel at $t = 0$, and ii) she does not rebel for all $t \in [t_{2i-1}, T)$.

We have that for player $a$, $U_{a0} = (1-\beta)V$, and $U_{at} = \frac{(1-\beta)t' + \frac{1}{2}(t-t')}{t} V e^{-rt}$ for $t \in [t_{2i-1}, T)$. Again, the latter can be treated as a univariate function of $t$. To satisfy the two necessary conditions, we must have i) $U_{at} \geq U_{a0}$ at $t = T$, and ii) $U_{at}$ is non-decreasing for for $t \in [t_{2i-1}, T)$. This brings us to a situation similar to the proof of Lemma 2.3.2. With $t' < \frac{2\beta-1}{2r(1-\beta)}$, $U_{at}$ is concave in $t$, and increases up to a point $\overline{t'} = t'(\beta - \frac{1}{2}) + \frac{\sqrt{t'(2\beta-1)(4+(2\beta-1)rt')}}{2\sqrt{r}}$. So for ii) to hold, i.e. for $U_{at}$ to be non-decreasing for $t \in [t_{2i-1}, T)$, the maximum survival time $T$ can only be as large as $\overline{t'}$. Note that $\overline{t'}$ as a function of $t'$ has the exact same functional form as $T_a^*$ as a function of $t_a^*$ in Lemma 2.3.2. Hence if the government were to survive for $T > T_a^*$, we must have $\overline{t'} > T_a^*$, meaning $t' > t_a^*$. In other words, in an institution path with $I_0 = B$ and more than one transition time points, the cumulative time of institution $B$ must

be higher than $t_a^*$. However, similar steps as in the proof of Lemma 2.3.2 shows that if $t' > t_a^*$, $U_{a,\overline{t'}} < U_{a0} = (1-\beta)V$. This means that player $a$ rebels at $t = 0$. This means if a $T > T_a^*$ satisfies condition ii), it must violate condition i). Hence the two necessary conditions for a survival time $T > T_a^*$ under an institution path with more than one transition points cannot hold simultaneously. Hence the government cannot survive for $T > T_a^*$ by announcing an institution path with more than one transition time points. □

Proposition 2.3.3 show that the government cannot survive for any longer by announcing more than one transition time points. Hence the optimal institution path for the government's survival is the one described in Proposition 2.3.2.

Why institution paths with more than one transition time points cannot bring the government a longer survival time? Lemma 2.3.3 already showed that institution paths that involve an even number of transition time points before the survival time cannot achieve its intended survival time, because there exists a point halfway on the path where both social groups get to split $V$ exactly the same as they would at the end. For institution paths that involve an odd number of transition time points before the survival time, the proof of proposition 2.3.3 shows that at the very beginning of the path and towards the very end of the path, both social groups face the same incentive constraints as they face in an institution path with with only one transition point. In the one-transition path, satisfying these incentive constraints gives a survival time of $T_a^*$. Hence in multiple-transition paths, satisfying these same incentive constraints cannot give a longer survival time. Furthermore, one-transition paths are structurally very simple, such that the incentive constraints at the very beginning and the very end of the path are not only necessary but also sufficient conditions for survival. This is not necessarily the case for multiple-transition paths.

## 2.4 The Role of Commitment

section 2.2.1 briefly discusses that the game describes a government who can fully commit to an institution path by setting the entire path at the beginning of the game and quit. In this section we explicitly examine the consequence of commitment, by building a simple discrete-time 3-period model that is analogous to the main model, with a twist that the government instead chooses an institution per period.

**Setup and Timing.** We build a 3-period model with the same 3 players: The *G*overnment, player $a$ and player $b$. In each period that $G$ is alive, it chooses between two institutions: *E*galitarian and *B*iased. After $G$ chooses the institution, player $a$ and $b$ independently decide whether to rebel against the government. A rebellion succeeds if and only if both social groups rebel. If the rebellion succeeds, the game ends. Otherwise the game proceeds to the next period.

**Payoff.** The government's payoff is simply the number of periods that it survives. The social groups' payoffs come entirely from a successful rebellion. If a rebellion succeeds, both social groups divide a fixed prize of $V$. In particular, they divide $V$ according to their cumulative "political power" up to the point of the rebellion, which we will discuss immediately. Finally, both social groups have a common discount factor $\delta$.

In each period, both social groups accumulate political power that is affected by the institution that the government chooses. Denote $p_{it}$ as player $i$'s political power in period $t$ after the government has chosen an institution. The political power of social groups evolves in the following way: First, $p_{i0} = 0$, that is, at the beginning of the game, both social groups have 0 political power. Second, if the government chooses the *E*galitarian institution in period $t$, then $p_{it} = p_{it-1} + \frac{1}{2}$ for both social groups, as the name of the institution "egalitarian" suggests. Third, if the government chooses the *B*iased institution in period $t$, then $p_{bt} = p_{bt-1} + \beta$, where $\frac{1}{2} < \beta \leq 1$, and $p_{at} = p_{at-1} + 1 - \beta$. That is, player $b$ accumulates

more political power under the biased institution. Hence, If a rebellion succeeds in period $t$, player $i$'s payoff is simply $\frac{p_{it}}{p_{at}+p_{bt}}V = \frac{p_{it}}{t}V$.

**Strategies and equilibrium concept.** Since this is a game with complete information, the solution concept is of course SPNE. The strategy for the government is a 7-tuple $\sigma_G = \{I_\emptyset, I_E, I_B, I_{EE}, ..., I_{BB}\}$, where $I_h \in \{E, B\}$ indicates the government's choice of institution at history $h$. Similarly, the strategy for player $i \in \{a, b\}$ is a 14-tuple

$$\sigma_i = \{r_{i,E}, r_{i,B}, r_{i,EE}, ..., r_{i,BB}, r_{i,EEE}, ..., r_{i,BBB}\},$$

where $r_{i,h} \in \{0, 1\}$ is player $i$'s rebellion decision at history $h$, with 0 being not rebel and 1 being rebel. If $\delta \geq \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$, the game has an SPNE where the government survives for 3 periods. The equilibrium institution path for this SPNE is $BBE$. If $\delta < \frac{3(1+2\beta)}{2(1+4\beta)}$, the game has an SPNE where the government survives for 1 period. The equilibrium institution path for this SPNE is $B$. Specifically, $\frac{3(1+2\beta)}{2(1+4\beta)} > \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$. So for $\sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}} \leq \delta < \frac{3(1+2\beta)}{2(1+4\beta)}$, the game has multiple SPNE where the government survives for different amount of periods, but both starting with $B$.

*Proof.* See appendix. □

Proposition 2.4 shows that when the government cannot commit to an institution path at the beginning of the game, maximum survival is not guaranteed even if it is possible. If $\sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}} \leq \delta < \frac{3(1+2\beta)}{2(1+4\beta)}$, even if the government chooses $B$ in period 1, the social groups may not be convinced that the government will indeed choose $BE$ to follow through. And indeed the government is indifferent in period 3 between $E$ and $B$. If the social groups believe that the government will choose $BB$ to follow $B$ (together with off-equilibrium conjectures), the game will end in a one-period equilibrium, even if $\delta \geq \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$. However, if the government sets the institution path $BBE$ at the beginning of the game and then simply quit, letting the social groups to play along, the government can guarantee surviving through period 3

as long as $\delta \geq \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$. Hence the lack of commitment proves to be an obstacle for the government to achieve maximum survival.

## 2.5 Conclusions

Our paper analyzes scenarios where the government faces survival threats from multiple challengers, who suffer from conflicts of interests over the distribution of post-rebellion benefits. We show that when the distribution of post-rebellion benefits is affected by pre-rebellion policies and institutions chosen by the current government, the government can strategically choose policies and institutions that leverages on such conflict to ensure survival. Specifically, the government should first identify the weaker challenger, who suffers from a larger disadvantage (or smaller advantage) under various institutions. Then, the government should choose an institution path that starts with the weaker challenger's less preferred institution, and then switch to her preferred institution at the optimal transition time point. The optimal transition time point is chosen so that the weaker challenger is not satiated too early, nor does she accumulate too much disadvantage to recover from. More complicated institution paths involving multiple transition time points cannot lengthen the government's survival. Finally, the government needs to be able to commit to the optimal institution path to ensure its survival.

Our paper opens some interesting routes for future work, specifically on the role of commitment. As discussed section 2.4, when the government cannot pre-commit to an institution path, but has to choose institutions along different time points, maximum survival is not guaranteed, as manifested in the multiple equilibria of the model. Yet this is exactly how governments choose institutions and policies in real world: They do it in real time rather than all at once. Without the ability to pre-commit to an institution path, how can the

government "convince" the challengers to coordinate on the "correct" equilibrium becomes important. As a wealth of studies have shown, governments often use propaganda to compliment other mechanisms to ensure its survival, often via signaling (or signal-jamming) about its strength. Whether the government can use propaganda to signal its future institution choices is a natural path to follow our paper.

# Bibliography

D. Acemoglu and J. A. Robinson. Persistence of power, elites, and institutions. *American Economic Review*, 98(1):267–293, 2008.

G. Biglaiser and C. Mezzetti. Politicians' decision making with re-election concerns. *Journal of Public Economics*, 66(3):425–447, 1997.

Y. Chen, H. Li, and L.-A. Zhou. Relative performance evaluation and the turnover of provincial leaders in china. *Economics Letters*, 88(3):421–425, 2005.

E. K. Choi. Patronage and performance: factors in the political mobility of provincial leaders in post-deng china. *The China Quarterly*, 212:965–981, 2012.

C. Ding, Y. Niu, and E. Lichtenberg. Spending preferences of local officials with off-budget land revenues of chinese cities. *China Economic Review*, 31:265–276, 2014.

G. Egorov, S. Guriev, and K. Sonin. Media freedom in dictatorships. *Unpublished paper, Yale University*, 2009.

J. V. Henderson, A. Storeygard, and D. N. Weil. Measuring economic growth from outer space. *American economic review*, 102(2):994–1028, 2012.

B. Holmström. Managerial incentive problems: A dynamic perspective. *The review of Economic studies*, 66(1):169–182, 1999.

R. Jia, M. Kudamatsu, and D. Seim. Complementary roles of connections and performance in political selection in china. 2013.

R. Jia, G. Roland, and Y. Xie. A theory of power structure and institutional compatibility: China vs. europe revisited. *Journal of the European Economic Association*, page jvad050, 2023.

C.-w. Kou and W.-H. Tsai. "sprinting with small steps" towards promotion: solutions for the age dilemma in the ccp cadre appointment system. *The China Journal*, 71(1):153–171, 2014.

D. Lane and C. Ross. Limitations of party control: the government bureaucracy in the ussr. *Communist and Post-Communist Studies*, 27(1):19–38, 1994.

H. Li and L.-A. Zhou. Political turnover and economic performance: the incentive role of personnel control in china. *Journal of public economics*, 89(9-10):1743–1762, 2005.

W. Li. Dual leadership and bureaucratic capacity. *working paper*, 2023.

W. Luo and S. Qin. China's local political turnover in the twenty-first century. *Journal of Chinese Political Science*, pages 1–24, 2021.

E. Maskin, Y. Qian, and C. Xu. Incentives, information, and organizational form. *The review of economic studies*, 67(2):359–378, 2000.

R. B. Myerson. The autocrat's credibility problem and foundations of the constitutional state. *American Political Science Review*, 102(1):125–139, 2008.

F. Su, R. Tao, L. Xi, and M. Li. Local officials' incentives and china's economic growth: tournament thesis reexamined and alternative explanatory framework. *China & World Economy*, 20(4):1–18, 2012.

J. L. Wallace. Juking the stats? authoritarian information problems in china. *British journal of political science*, 46(1):11–29, 2016.

M. Wang, M. O. Rieger, and T. Hens. An international survey on time discounting. *Norwegian School of Economics working paper*, 2009.

M. Y. Wong. Performance, factions, and promotion in china: the role of provincial transfers. *Journal of Chinese Political Science*, 27(1):41–75, 2022.

M. Wu and B. Chen. Assignment of provincial officials based on economic performance: Evidence from china. *China Economic Review*, 38:60–75, 2016.

C. Xu. The fundamental institutions of china's reforms and development. *Journal of economic literature*, 49(4):1076–1151, 2011.

H. Yi and I. Liu. Executive leadership, policy tourism, and policy diffusion among local governments. *Public Administration Review*, 82(6):1024–1041, 2022.

## 2.6 Appendix

**Proof of Proposition 2.4** As in the main model, we assume that social groups play weakly undominated strategies. This means both social groups rebel at the end of period 3 regardless of histories. Hence the social groups' strategies can be simplified to a 6-tuple

$$\sigma_i = \{r_{i,E}, r_{i,B}, r_{i,EE}, ..., r_{i,BB}\}.$$

We also assume that a social group does not rebel if she is indifferent.

Consider an SPNE of the 3-period game where the government survives for 3 periods, with the equilibrium institution path being $BBE$. In this equilibrium we know 3 arguments of the government's strategy $\sigma_G$, which is $I_\emptyset = B$, $I_B = B$ and $I_{BB} = E$. Similarly, we can pin down 2 arguments of each social group's strategy $\sigma_i$, which is $r_{a,B} = r_{a,BB} = 0$, $r_{b,B} = r_{b,BB} = 1$. This is quite intuitive. Along the conjectured equilibrium path $BBE$, player $a$'s relative political power increases, hence she is the only social group who has an incentive to delay a rebellion. In the following paragraphs, we first identify the conditions for player $a$ to not rebel on the conjectured equilibrium institution path. Then we show that the no additional conditions off the equilibrium path is required for this SPNE to exist.

On the conjectured equilibrium path, if player $a$ rebels in period 1, her payoff is $(1-\beta)V$. If she rebels in period 2, her payoff is $(1-\beta)\delta V < (1-\beta)V$. If she rebels in period 3, her payoff is $\frac{2(1-\beta)+\frac{1}{2}}{3}\delta^2 V$, which is no less than $(1-\beta)V$ if $\delta \geq \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$.

If $\delta \geq \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$, player $a$ has $r_{a,B} = r_{a,BB} = 0$. This means that if the government's strategy involves $I_\emptyset = B$, $I_B = B$ and $I_{BB} = E$, she can survive for 3 periods, earning the maximum payoff possible in the game. Importantly, no matter what strategies the players choose off the equilibrium path (i.e. $\{I_{BE}, I_E, I_{EB}, I_{EE}\}$ for the government, and $\{r_{i,BE}, r_{i,E}, r_{i,EB}, r_{i,EE}\}$ for the social groups), the government cannot increase her payoff by deviating from the equilibrium path. Hence $\delta \geq \sqrt{\frac{6(1-\beta)}{4(1-\beta)+1}}$ is the necessary and sufficient

condition for an SPNE where the government survives for 3 periods, with the equilibrium institution path being $BBE$.

Now we construct an SPNE where the government only survives for 1 period, with the equilibrium institution path being $B$, and show that this equilibrium exists for $\delta < \frac{3(1+2\beta)}{2(1+4\beta)}$. The conjectured SPNE is:

$$\sigma_G\text{: } I_\emptyset = I_B = I_{BB} = I_{BE} = I_{EB} = B,\ I_E = I_{EE} = E.$$

$$\sigma_i\text{: } r_{i,B} = r_{i,E} = r_{i,BB} = r_{i,BE} = r_{i,EB} = r_{i,EE} = 1 \text{ for } i = a, b.$$

We check that this is indeed an SPNE by backward induction. Consider the history at period 2 where the institution path thus far is $BB$. The equilibrium conjectures that the government should choose $B$ in period 3 if no rebellion happens in period 2. Clearly there is no reason for both social groups to delay for another period of $B$, since the previous institutions has been $B$ only. Hence $r_{i,BB} = 1$ for both social groups. Similarly, $r_{i,EE} = 1$ for both social groups.

Then consider the history at period 2 where the institution path thus far is $BE$. The equilibrium conjectures that the government should choose $B$ in period 3 if no rebellion happens in period 2. Anticipating $B$ in period 3, player $a$ rebels for sure in period 2, i.e. $r_{a,BE} = 1$. Only player $b$ may have an incentive to delay for another period of $B$ after $BE$. If she delays the rebellion, her payoff is $\frac{2\beta+\frac{1}{2}}{3}\delta^2 V$. If she rebels in period 2, her payoff is $\frac{\beta+\frac{1}{2}}{2}\delta V$. She rebels in period 2, i.e. $r_{b,BE} = 1$, if $\delta < \frac{3(1+2\beta)}{2(1+4\beta)}$. Similarly, $r_{a,EB} = 1$, and $r_{b,EB} = 1$ if $\delta < \frac{3(1+2\beta)}{2(1+4\beta)}$.

Finally consider the history at period 1 where the institution path thus far is $B$. The equilibrium conjectures that the government should choose $B$ in period 2, followed by a rebellion, as stated in the previous proof. Clearly there is no reason for both social groups to delay for another period of $B$, since the previous institutions has been $B$ only. Hence $r_{i,B} = 1$ for both social groups. Similarly, $r_{i,E} = 1$ for both social groups.

Hence if $\delta < \frac{3(1+2\beta)}{2(1+4\beta)}$, the conjectured SPNE exists, where the government only survives for 1 period, with the equilibrium institution path being B.

# Chapter 3

# Government incentives in China's land market auctions

This chapter is joint work with Yifan Yang.

Abstract

This paper studies three government incentives in China's land market auctions that diverge from revenue maximization: corruption incentives, financial pressures, and long-term development objectives. Delving deep into China's land auction dynamics, we explore how local governments balance immediate financial gains with broader economic and developmental goals. Utilizing a diff-in-diff approach, we evaluate the impact of central inspection teams introduced during the 2013 anti-corruption campaign. Our findings indicate that their presence results in more transparent auctions, characterized by lower deposit rates and higher success rates. Furthermore, we characterize a positive correlation between local government debt and final auction prices, suggesting a shift in auction strategies based on financial imperatives. Lastly, our analysis underscores the pivotal role of major developers, such as Wanda Plaza, in shaping subsequent auction prices, highlighting the government's

incentives to guarantee the future developmental potential of their administrative lands.

**Keywords:** Non-revenue-maximizing incentives, Land market auctions, Corruption, Financial pressures, Long-term development goals

## 3.1 Introduction

In China, all urban lands are owned by the state, and the land use rights are allocated by the local government. Since 2003, the local government has become the sole seller of land use rights in the market, and the sales are required to be conducted in the form of auctions. Overall, the land market is an important market and a major source of income for the local government. As of 2019, China's land lease sales is $1.2 trillion, which consists of 8.4% of China's GDP in the same year, and 5.6% of US's GDP that year. The revenue of these land sales goes to the pocket of local government, and constitutes about 50% of the local government's formal budget.

Despite being an important market, the China's land market is a corrupt market. 23% of the 2,802 corruption cases reported in *Procuratorial Daily* (the daily newspaper published by the Supreme People's Procuratorate) between 2000 and 2009 are related to this market. In the reported cases, corruption can happen in almost every stage of land sales. For example, in order to let his favorite developer to win the auction, a local government official could talk to potential bidders in the market and discourage them from participating; or he could tighten the entry requirement to make it harder to meet for other potential bidders. In cases where the land was sold, the local officials could change the land use or land requirements, which relaxes the developer's constraints to maximize profits.

There might be incentives other than personal bribes in land auctions. Local government officials in China compete with each other in terms of economic performance and are rewarded

with promotion (Yao et al. 2013). To increase the chances of being promoted, local officials might want to make sure that the land sold through auctions are developed in a way that best stimulate the economy. Therefore, even though the land parcels are sold through cash auctions, the seller considers the future development of the land in his payoff.

This paper intends to study how the local government's incentives in auctions deviate from revenue maximization. There are three ways in which deviation happen: corruption incentives, financial burden, and development incentives.

### 3.1.1 Corruption Incentives

To understand the corruption incentives, we study the anti-corruption campaign starting 2013 initiated by the general secretary Xi Jinping. According to a speech Xi made in Jan, 2013, corruption in land transfers was one of the main objectives of the anti-corruption campaign. The campaign sent unannounced central inspection teams, one to each randomly selected province, to investigate local officials' corrupt behaviors. There are several notable features of these inspection teams: 1) when and to where the inspection team goes is confidential; 2) the head of each inspection team is chosen to be "unlikely to have local patronage networks"; 3) during inspection, the team provides a phone number to the public which accepts tip-offs, and this number becomes invalid as soon as the team leaves; 4) after collecting evidence of corruption, the inspection teams turn them to the central government, and the teams themselves are not involved in prosecution process of any corrupt officials. The central inspection teams are required to "not interfere with local government's daily work". Because of these features, we can leverage the timing of inspection teams arriving across localities as variation to distinguish the effect of corruption.

We find that when the central inspection team is present, land bureaus choose lower de-

posit rates and auction success rates [1] are higher. We show that a simple model of corruption can explain these patterns. On the side of the auctioneer, land bureaus use high deposit rate to signal that some auctions are corrupt. For bidders, they expect all auctions to be corrupt with a probability when central inspection team is not present, and the probability is 0 when the team is present. Since corrupt bidder has higher valuations of the land, probability of corruption increase the entry threshold for the non-corrupt potential bidders, which lead to higher chances of unsuccessful auctions.

In addition to the reduced-form analysis, we plan to build a structural model to estimate the value and cost distribution of bidders. To be specific, we plan to estimate a structural model using only auctions that happen during the presence of central inspection teams. Based on the value and cost distributions, we can simulate winning bids for auctions that are potentially corrupt, and compare the simulated bids with the actual winning bids to flexibly estimate the effect of corruption.

### 3.1.2 Financial Burden

To understand how local government's incentives change with the intensity of the financial burden they face, we examine the relationship between local government debt and land market auctions. Intuitively, more debt is correlated with higher final prices of auctions sold. We find that more local government debt is correlated with the local officials using lower deposit rates and less two-stage auctions (both allows them to obtain higher revenue), suggesting that local government might put higher weight on revenue maximization when an imminent debt need to be paid.

[1] a successful auction is an auction where the land is successfully sold

### 3.1.3 Development Incentives

To understand local government's incentives in ensuring future development of the land, we build a model where the government trades off revenue maximization and future development (proxied by deposit rate). The model implies that local government is able to use higher deposit rate to increase the winning chances of big developers. The less they care about revenue, the higher the equilibrium deposit rate is. We then provide empirical evidence on why this incentive is plausible using the example of Wanda Plaza. Wanda is a big developer in China with Wanda Plaza being one of the most successful chain business districts in China. We find that the opening of Wanda Plaza significantly increases the final price of subsequent auctions, which is consistent with the hypothesis that big developers are better for future development of a piece of land.

## 3.2 Background

### 3.2.1 Land Auctions

In China, all pieces of land are owned by the government and the land use rights are sold through auctions. For each auction, the winner enjoys land use right for a specified number of years (ranging from 20-70 years). Typically, the bidders in these land auctions are land developers. After they purchased the land, they develop it for the designated purpose of use (types of designated uses include condo, business, etc., which are determined by the government prior to land auctions) under pre-announced restrictions. The revenue obtained from the land auctions belongs solely to the local government: for districts governed by cities, the revenue goes to the city; for counties, the revenue goes to the county. Similarly, auctions of a district's land parcels are managed by city land bureau, while auctions of a

county's land parcels are managed by county land bureau.

**Decision process** The government's decision process for each piece of land is as follows. Each year, a land use allocation committee, which typically consists of the mayor and heads of relevant bureaus, decides the use, development restrictions (e.g. limited heights, floor-to-area ratio, green areas) and sequencing of sales for land parcels available this year. Afterwards, each piece of land is appraised by a third party - an independent appraiser. Base on this appraisal, the committee set reserve price for the land. Lands are then turned over to the land bureau, which decides the deposit rate (the ratio of required deposit on reserve price) and the auction type. After these decisions are made, the land bureau makes an announcement to the public for the auction, which has all relevant information above (an example of an announcement is given in the appendix). Around 20 days after the announcement, the land bureau starts the auction.

**Auction format** Since the early 2000s, land sales are restricted to three types of auctions: contract auction, English auction and two-stage auction. In the analysis, we'll focus on English auctions and two-stage auctions. There are two reasons: 1) the winner in contract auctions is determined by a score rating the contract each bidder submits, instead of the bidding price alone; 2) contract auction only consists of less than 4% of auctions in all the auctions that we observe. Below we introduce how these two auction formats work.

English auction is the standard open ascending auction. Every bidder is required to pay a deposit (ranging from 20%-100% of the reserve price) and submit qualification documents to the land bureau around 1-3 days before the auction starts. On the auction day, qualified bidders bid in the English auction and the one with highest bid wins.

Two-stage auction consists of two stages: the first stage usually lasts for 10 days, where the bidders can submit ascending bids. To be qualified to participate in the auction, the

bidders are required to pay a deposit and submit qualification documents before a deadline, which is usually 1-2 days before the first stage ends. The bids from the first stage are made public immediately, with the identity of the bidders concealed. At the end of the first stage, if only one active bidder remains, this bidder is assigned the property at his bidding price. If there are multiple active bidders remaining, the auction enters a second stage where the active bidders from the first stage bids in an English auction. There isn't a strict definition for who counts as an active bidder. In practice, sometimes bidders who submit a bid half an hour before the first stage ends count as active bidders; in some cases, what the land bureaus do is that they ask bidders who submit bids whether they would like to continue bidding in the second stage.

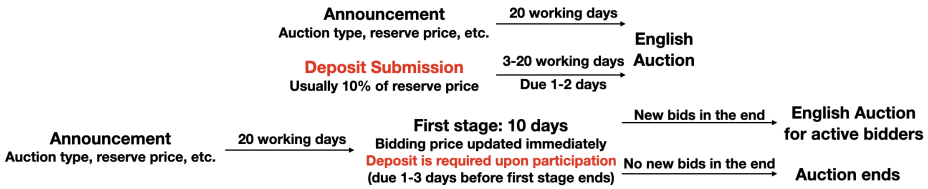



Figure 3.1: Timing of English auction and two-stage auction

### 3.2.2 Central Inspection Team

When the general secretary of the Chinese Communist Party Xi Jinping assumed office in November 2012, he initiated an anticorruption campaign. In a speech he made on Jan 23rd, 2013, he made it clear that "land transfers" is one of the main targets.

As part of the anticorruption campaign, from 2013 to 2016, he sent two rounds of 43 central inspection teams to provincial-level administrative units to inspect on local government officials. Each team consists of 10-12 high level government officials. The head of each central inspection team is selected specifically for every commission. To make sure that the

head is unlikely to be tied to local patronage networks, the central government selects high-level officials who has never worked in the inspected province. The timing and sequencing of these inspection teams is random and kept confidential until inspection begins.

When and where the central inspection team visited is shown in the table. In the first round of inspection from 2013-2014, each of the 31 provinces, autonomous administrative regions and municipalities (that is, all of the provincial-level administrative units excluding Taiwan, Hong Kong and Macau) was inspected once. From 2015-2016, 16 provinces were inspected for the second time.

| Time | Province/autonomous region/municipality |
|---|---|
| 1st round: 2013.6-2013.7 | Hubei, Inner Mongolia, Chongqing, Guizhou, Jiangxi |
| 1st round: 2013.11-2013.12 | Jilin, Yunnan, Shanxi, Anhui, Guangdong, Hunan |
| 1st round: 2014.3-2014.4 | Gansu, Beijing, Ningxia, Shandong, Tianjin, Xinjiang, Hainan, Henan, Fujian, Liaoning |
| 1st round: 2014.7-2014.8 | Guangxi, Shanghai, Qinghai, Tibet, Zhejiang, Hebei, Shaanxi, Heilongjiang, Sichuan, Jiangsu |
| 2nd round: 2016.3-2016.4 | Liaoning, Shandong, Anhui, Hunan |
| 2nd round: 2016.7-2016.8 | Tianjin, Hubei, Jiangxi, Henan |
| 2nd round: 2016.11-2016.12 (not included in our data) | Beijing, Chongqing, Guangxi, Gansu |

Table 3.1: When and where the central inspection team was sent during 2013-2016

*Note: All the placed listed on the right column is either a province, autonomous region or a municipality. They all are provincial-level administrative units.*

The presence of central inspection teams is usually publicly announced 1-5 days prior to the start of inspection. With announcement of inspection, the team provides a phone number to the public that accepts tip-offs, which becomes invalid as soon as the team leaves. The team stayed for two months in each province. During this time, the team members talk to hundreds of local officials and investigate on the tip-offs they receive. After collecting evidence of corrupt behaviors of local officials, they turn the evidence over to the central government. The team itself is not involved in prosecuting or arresting local officials, and they are required not to interfere with local government's daily work.

The arrival of the central inspection team is confidential. In Chinese Communist Party Inspection Work Regulations, the 35th rule says that people in the inspection team will be pun-

ished if they divulged confidential information, the interpretation of which includes divulging the planning and arrangements of the team's work prior to inspection. However, since their presence is announced 1-5 days prior to inspection, and their arrival might take around 7 days (as reported in Xinwen Lianbo, a daily news program by China Central Television (CCTV), a state broadcaster), the local government officials and developers might have information on their arrival beforehand. For example, they might be informed about the team through their arrival through public transportation or local hotels. We don't know to what extent this happens, although we do know that the regulations of inspection teams take secrecy seriously.

### 3.2.3 Local Government Finances

Currently, there are five practical levels of the local government: the provincial (province, autonomous region, municipality, and special administrative region), prefecture (cities, autonomous prefectures, leagues), county, township, and village. Our purpose is to understand how debt burden and land revenue affect the tradeoffs in land sales, so we focus on the prefecture level, the county level debt and debt for municipalities (provincial level), matching the jurisdiction of each land bureau.

Since 1994, the national budget reform channeled more tax revenue to the central government, with local government spending roughly unchanged. Despite central government transfer, there is a mismatch between local government's income and spending. Two typical sources to balance this mismatch are extra revenue (such as land sales) and debt.

The local government's debt consists of two parts: local government debt and urban investment bonds. In provincial level places and 5 separate state-planning cities, the local governments are allowed to issue bonds on the market, so these bonds are explicit. We call them local government bonds. In other prefectures or counties, the local governments are

usually not allowed to issue bonds. They created local government financial vehicles (LGFV) – corporations that can obtain bank loans and issue bonds. These bonds are implicitly backed by the local government's land revenue, indirectly backed by the central government. We called them urban investment bonds.

## 3.3 Literature Review

This paper is closely related to the literature on corruption and Chinese land market auctions. Using 2302 complete auctions from 2003-2007, Cai, Henderson and Zhang (2013) shows that government officials use two-stage auctions to corrupt, where the corrupt bidder can signal that the auction is "taken" by bidding the reserve price at two-stage auctions and therefore scare off other potential bidders. By comparing English auction and two-stage auctions, it finds lack of jump-bids in two-stage auctions and positive selection (that is, selection of hotter properties) into two-stage auctions. This evidence contradicts the predictions of their model, therefore taken as evidence of corruption in two-stage auctions.

There are several setbacks of this paper. First of all, by assuming English auction is not corrupt, the paper couldn't answer the question of whether there is corruption in English auctions and how corruption happens there. Second, in its model of two-stage auctions, they do not show why jump bids are preferred in equilibrium, which weakens the evidence of no jump-bids. Third, in their empirical analysis, the paper do not argue why their instruments are valid, which weakens its evidence of selection of hotter properties into two-stage auctions. We can show that when central inspection teams arrive to inspect on corruption, the difference between two-stage auctions and English auctions persists, which suggests that the difference might not be because of corruption.

Chen and Kung (2018) examine the effect of Xi's anti-corruption campaign on princeling

firms' (that is, firms owned by relatives of high level government officials) winning prices in land auctions. The paper finds that local government provides discounts to princeling firms, and these discounts become significantly less when the central inspection team is present.

Our paper contributes to this literature in using a diff-in-diff design to evaluate how corruption affects choices of auction elements and the outcomes of auctions.

The paper contributes to the literature on the mechanisms of corruption in auctions, where corruption takes place as collusion between auctioneer and a bidder, through choice of auction format and choice of deposit rate. The literature on corruption in auctions documents collusion in bidding ring (McAfee and McMillan, 1992; Burguet and Che, 2004; Compte, Lambert-Mogiliansky, and Verdier, 2005; Menezes and Monteiro, 2006). Cai (2013) suggests corruption through choice of auction format, but the choice is different from what our findings imply.

This paper contributes to the literature on corruption and monitoring. Ferrez and Finan 2008 finds evidence of grassroot monitoring on corruption containment through reelection incentives. Olken (2007) uses evidence from a randomized controlled trial and argue that central auditing reduce corruption, while inducing substitution to alternative forms of corruption. By evaluating the effect of central government's anti-corruption campaign, we contribute to this literature in how central government's inspection alleviate corruption.

This paper contributes to the literature on the relationship between land auction element and government debt. Andrew, Bai and Zhou (2016) finds evidence of Chengtou bonds urban construction and investment bonds, backed mostly by land sales, are the major financing source for Chinese local governments. By evaluating the correlation between government debt and auction elements for each given quarter, we contribute to this literature in how local government change auction element to raise funds under different debt pressure.

## 3.4 Theoretical Framework

There are two parts of our theoretical framework. The first part builds a simultaneous entry model and analyzes how central inspection teams affect auction outcomes through bidders' behaviors. The second part presents a theory where the local government have an incentive and is able to use deposit rate to screen out small developers.

### 3.4.1 Corruption in auctions

Consider an auction game with $N$ potential bidders and 1 seller. Bidder $i$'s valuation is $V_i = v_0 + v_i$, which is i.i.d. according to $F(V)$ on $[0, \bar{V}]$. $v_0$ is the common value (same across bidders) and $v_i$ is bidder $i$'s private value. Bidder $i$'s payoff from winning is $V_i - B_i - C$, where $B_i$ is the bid he submits, $C$ is the participation cost (cost of paying deposit, submitting qualifications, consulting, etc.). The seller maximizes the auction revenue.

The $N$ potential bidders simultaneously decide to enter, and pay cost of entry $C$ if they enter. Denote the entry threshold of any bidder as $\hat{V}$. For any bidder, if his valuation $V$ exceeds $\hat{V}$, he will enter the auction. Consider a bidder whose valuation is exactly at the threshold $\hat{V}$, his expected profit equals expected cost:

$$F(\hat{V})^{N-1}(\hat{V} - r) = C \tag{3.1}$$

where $r$ is the reserve price.

Now let's consider English auction with corruption. We assume that the auctioneer can be colluding with at most one bidder. The auctioneer is ex ante paired with the corrupt bidder and can promise to change land use or land requirements ex post if the corrupt bidder wins the land, so that the land value will be increased. Therefore, the corrupt bidder gets an additional value of $\kappa$, which is the benefit of collusion minus the bribe he pays to the

auctioneer for it.

Let $\hat{V}_{1P}$ be the entry threshold for bidder 1 when corrupt, $\hat{V}_{-1}$ be the entry threshold for all other bidders. With possibility $p$ that bidder 1 is corrupt, other bidders' entry decisions $\hat{V}_{-1}$ satisfy

$$\begin{aligned} &F\left(\hat{V}_{-1}\right)^{N-2}\left\{p\left[F\left(\hat{V}_{-1}-\kappa\right)-F\left(\hat{V}_{1p}\right)\right]E\left[\left(\hat{V}_{-1}-V_1-\kappa\right)\mid V_1\in\left[\hat{V}_{1p},\hat{V}_{-1}-\kappa\right]\right]\right. \\ &\left.+pF\left(\hat{V}_{1p}\right)\left(\hat{V}_{-1}-r\right)+(1-p)F\left(\hat{V}_{-1}\right)\left(\hat{V}_{-1}-r\right)\right\}=C \end{aligned} \tag{3.2}$$

If there is a corrupt bidder, his entry threshold $\hat{V}_{1P}$ satisfies

$$F\left(\hat{V}_{-1}\right)^{N-1}\left(\hat{V}_{1p}+\kappa-r\right)+\sum_{m=1}^{N-1}\hat{w}_m=C \tag{3.3}$$

where $\hat{w}_m$ is bidder 1's expected rent when his valuation is $\hat{V}_{1P}+\kappa$ and there are $m$ other active bidders whose valuations are above $\hat{V}_{-1}$ and less than $\hat{V}_{1P}+\kappa$.

Intuitively, the entry threshold for the non-corrupt bidder is lower when there is a possibility that the auction is corrupt.

**Proposition 1.** *When there is a positive possibility that the English auction is corrupt, potential bidder's entry threshold will be higher comparing to when the English auction is known to be non-corrupt.*

Therefore, when the bidders know that the central inspection team arrives, they expect auctions to be non-corrupt. This leads to lower entry thresholds of bidders, which results in higher success rate of auctions.

### 3.4.2 Deposit rate and bidder selection

In this simple model, we show our intuitions of how government's incentives to select big developers affect the equilibrium in English auctions.

Consider an game with three relevant parties: a local government official, bidders with low financial cost (big developers) and bidders with high financial cost (small developers). The timing of the game is as follows: 1) the local government official decides a deposit rate $r$ that maximizes their utility; 2) bidders simultaneously decide whether to enter the auction or not; 3) bidders bid in open ascending auction; payoffs realized.

We make the three following assumptions.

**Assumption 1.** *Big developers have lower financial cost than small ones.*

That is, for a given amount of deposit that a firm has to pay to enter an auction, the cost of it to a big developer is $C_B$, while the cost of it to a small developer is $C_S > C_B$.

**Assumption 2.** *All developers draw their value independently from the same distribution* $F(\cdot)$.

We do not assume that big developers have higher valuations of land parcels. Big developers are more competent than small ones, only in the sense that they can be trusted more to complete the development of a land parcel.

**Assumption 3.** *Government trades off revenue and the competence of the winning developer, while developer's competence can be selected through choosing a higher deposit rate.*

Since it's hard to solve for the equilibrium, we conduct a simulation with an example.

Suppose $C_B = 0.05$, $C_S = 0.1$, values are distributed uniformly on $[0, 1]$, and the starting price $r = 0.8$. Suppose the government's utility takes Cobb-Douglas form: $U(R, d) = R^{\alpha} * d^{1-\alpha}$, where $R$ denotes the expected revenue from the auction, $d$ denotes deposit rate,

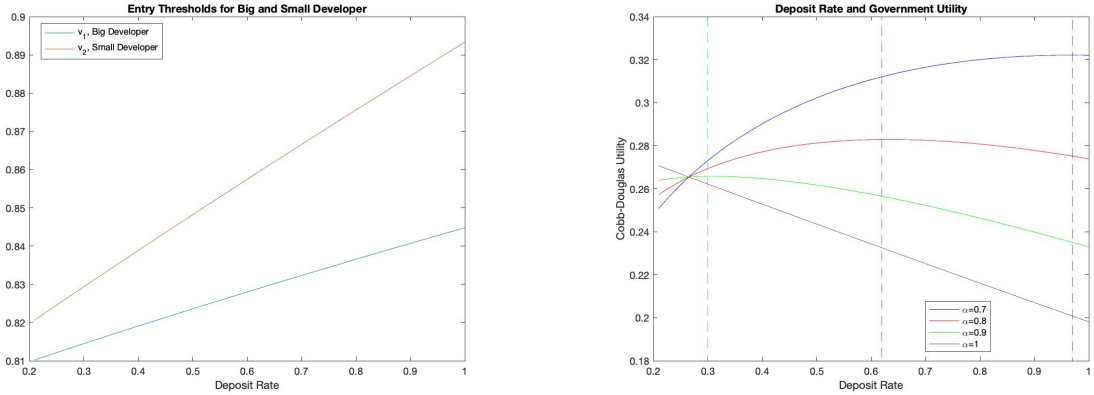
$\alpha$ is the utility parameter. This implies that the marginal utility of increasing deposit rate around zero is infinity, which makes sense since setting deposit rate to zero will bring tremendous risk of failure in development.

Consider the case with only one big developer and one small developer as potential entrants.

Let $\hat{V_B}$, $\hat{V_S}$ denote the entry thresholds for the big and small developers respectively. Since $C_B < C_S$, small developer must have a higher entry threshold comparing to the big developer. They satisfy the following equations:

$$\begin{aligned} F(\hat{V_B}) * (\hat{V_B} - r) &= r * d * C_B \\ F(\hat{V_S}) * (\hat{V_S} - r) + (F(\hat{V_S}) - F(\hat{V_B})) * (\hat{V_S} - E(V_B | \hat{V_S} > V_B > \hat{V_B})) & \\ = r * d * C_S & \end{aligned} \tag{3.4}$$

If we numerically solve for the entry thresholds and government's utilities for different deposit rates, they can be shown by the following figures.




(a) Entry threshold

(b) Government utility

Figure 3.2: Simulation results

We can see that as deposit rate increases, the difference in entry thresholds between big and small developers is increasing, implying that entry becomes more selective of small developers. As we decrease the weight $\alpha$ that the local government puts on revenue, the optimal deposit rate level increases, as illustrated in the figure. This simulation suggests that if the local government cares about the successful development of the land auctioned, it has an incentive to increase deposit rate to screen out small developers. The stronger this incentive is, the higher deposit rate it will employ.

## 3.5 Data Description

### 3.5.1 Chinese Land Auctions

Our data has 545,086 land auctions that started between Jan. 2003 to Oct. 2016 in China. The data is collected from Chinese government's public announcements, including information on characteristics of the land sold and elements of the auctions. We mainly look at how four variables are affected by the central inspection teams: auction type, the deposit rate, auction success rate and the final price if the auction is successful.

To understand the incentives of local government officials, we need to understand who makes the decision on these auctions. Therefore, we match each auction to the land bureau in charge of it. If the land parcel is located in a city district, it is managed by the city's land bureau; if it is located in a county, it is managed by the county land bureau. After the match is completed, there are 2,130 land bureaus that have organized at least on auction in our data. We observe significant variation across the decisions of these land bureaus. The figure below shows how many land bureaus use a certain percentage of two-stage auctions. There are 804 land bureaus that use two-stage auctions exclusively, 17 that use English auctions exclusively and 1309 land bureaus that use a varying percentage of both.

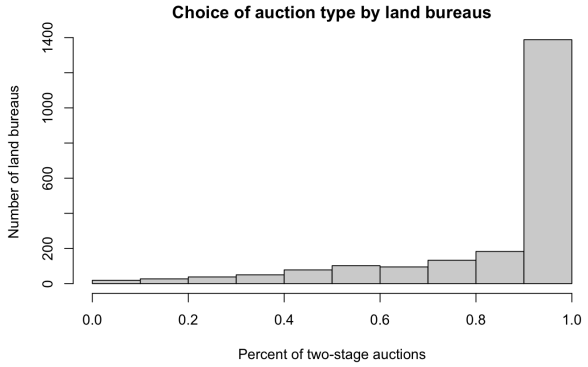



Figure 3.3: Number of land bureaus that choose certain percentage of two-stage auctions

*Note: the x-axis is percentage of two-stage auctions used by a land bureau from 2003-2016, the y axis is the number of land bureaus that falls into each bin of percentages.*

We find that the data quality is increasing over time. A more detailed description of data quality can be found in the appendix. To ensure that the data we use is of high quality, we use a subset of data which includes all auctions that 1) starting in 2013, 2) the land uses are restricted to either residential, residential business and business, 3) there is no affordable housing requirements on the land. This way, our data covers all the presence of the central inspection teams and the lands are comparable across auctions.

The summary statistics of this data subset we use is shown in the table below. There are 8,995 auctions that start during inspection, 128,602 auctions that start in other months. The percentage of successful auctions during inspection (68.8%) is higher than that in other periods (65.8%). The total land area of the lands in these auctions are quite large, with an average of 25,700 $m^2$ for the inspected group and 24,722 $m^2$ for the other group. The reserve price is high. For the inspected group, the average reserve price is 57 million yuan, which is equivalent to $8.89 million. The average deposit rate is around 50% for both groups, which implies an average deposit of $4.45 million. The average final price of the inspected auctions (65.9 million yuan) is lower than that of the other auctions (74.6 million yuan), although

the variance is very large.

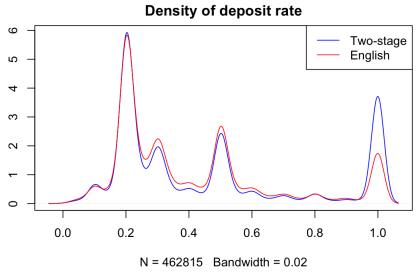
| | Start during inspection | Other auctions |
|---|---|---|
| #Auctions | 8,995 | 128,602 |
| Successful auctions (%) | 68.6% | 65.8% |
| Two-stage auctions (%) | 76.6% | 77.6% |
| English auctions (%) | 22.9% | 22.2% |
| Total land area ($m^2$) | 25,700<br>(35985) | 24,722<br>(35407) |
| Reserve price<br>(10,000 yuan) | 5,700<br>(17315) | 5,639<br>(16977) |
| Deposit rate | 0.507<br>(0.302) | 0.489<br>(0.300) |
| Final price if successful<br>(10,000 yuan) | 6,590<br>(23946) | 7,458<br>(25437) |

Table 3.2: Summary statistics for post-2013, comparable auctions

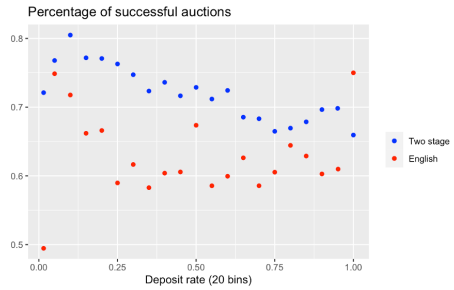
**Deposit rate** One important aspect of land auctions which is ignored in previous literature is deposit rate, the ratio of required deposit to reserve price. Cai et al (2013) assumes a constant deposit rate, and only considers the effect of reserve price. In their model, deposit is a major source of participation cost; because of the constant deposit rate, it is colinear with reserve price, so they don't consider it.

However, we can show that, deposit rate varies a lot across auctions (see figure below). For both two-stage auctions and English auctions, deposit rate is spread around 20%, 30%, 50% and 100%. 95% of auctions' deposit are between 30,000 and 98,978,750 yuan.

In the figure below, we separate deposit rate into 20 equally sized bins and look at the percentage of auctions that are successful within each bin. We find that there is a negative correlation between deposit rate and auction success rate for two-stage auctions. For English auctions, there seems to be no correlation.




(a) Density of deposit rate by auction format




(b) Percentage of successful auctions by auction format

Figure 3.4: Deposit rate

*Note: figure (a) compares the distribution of deposit rate used by land auctions for different auction format. The kernel bandwidth is chosen to be 0.02 for both formats. Figure (b) shows for each bin of deposit rate, the percentage of auctions with land successfully sold. There is a negative correlation between deposit rate and success rate for two-stage auctions.*

### 3.5.2 Local government debt and urban investment bonds

Our data on local government debt and urban investment bonds is aggregated at the land-bureau-month level, documenting the amount of official debt that each land bureau need to pay in each month.

**Local government debt** Our data was obtained from Wind Financial Terminal, including 472 local government debt bonds for 9 cities since 2009: Beijing, Shanghai, Tianjin, Chongqing, Dalian, Qingdao, Xiamen, Ningbo, Shenzhen. Each city is either a municipality or a separate state-planning city. The bonds are selected so that at least one payment was made before Nov. 2016 (either interests or principal).

**Urban investment bonds** We are able to match 892 urban investment bonds from Wind Financial Terminal to 236 land bureaus in our data for land auctions. These investment bonds are borrowed by state-owned enterprises as representatives of the local government.

The bonds are selected so that at least one payment was made before Nov. 2016 (either interests or principal).

## 3.6 The Effect of Central Inspection Teams on Auctions

### 3.6.1 Empirical Strategy

We use a diff-in-diff strategy to evaluate the effect of central inspection teams on auction choices and outcomes. The effect is identified with within-month-within-land-bureau variation. To be specific, we run the following regression:

$$y_{ijt} = \alpha + \beta CIT_{ijt} + \delta X_{ijt} + \gamma_j + \lambda_t + \epsilon_{ijt} \tag{3.5}$$

where $y_{ijt}$ is an auction element or outcome in auction $i$, land bureau $j$, in month $t$, $CIT_{ijt}$ is a dummy for whether the central inspection team is present in land bureau $j$ in month $t$ when auction $i$ starts, $\gamma_j$ and $\lambda_t$ are land bureau and month fixed effects respectively. $X_{ijt}$ are control variables. When we use land characteristics and reserve price as outcomes, we don't include controls. We find that land characteristics and reserve price are not changing with the team's arrival, which confirms that the land characteristics, sequencing of land sales and reserve price are pre-determined, and the reserve price is determined based on appraisal of a third party. Therefore, we control for land characteristics, land use and reserve price when we take auction elements and auction outcomes as $y$.

The identifying assumption is that the within-land-bureau within-month variation of auction outcomes are uncorrelated with the presence of central inspection teams. Since when and where the team visits is random, there is no selection into treatment. The challenge is

that there might be unobserved land-bureau-specific time trends or policy changes that are concurrent with the central inspection team's arrival. The figure below shows the pre-trends of average reserve price for the first round of inspection. Each of the figure corresponds to a group of several inspection teams that were sent out on the same month. For example, on the top-left, the blue line shows the trends of average reserve price for land bureaus that were inspected on Jun 2013, while the red line shows the same thing for land bureaus that were not inspected that time.

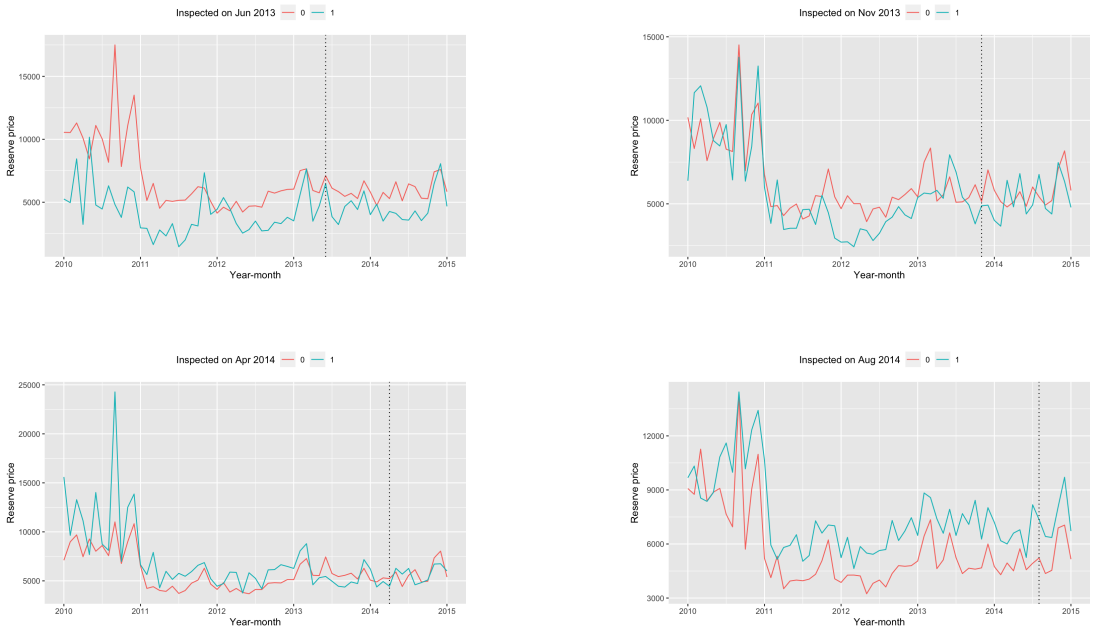
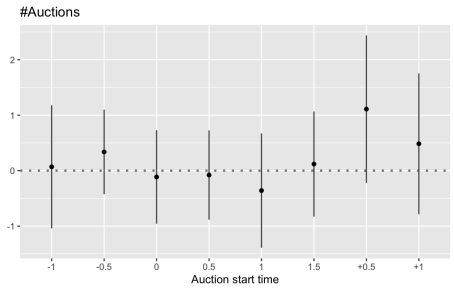



Figure 3.5: Reserve price pre-trends for land bureaus inspected in the first round

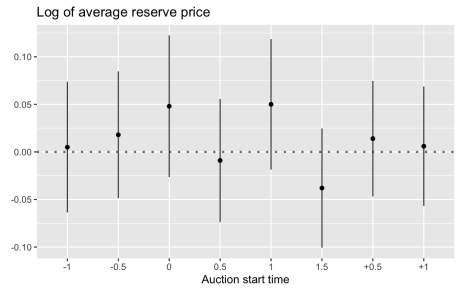
### 3.6.2 Results

We estimate two versions of the diff-in-diff regression. One is a flexible one that tracks how auction elements and outcomes change as the team comes and goes, another separates the auctions based on their overlap with central inspection team's presence which allows us to distinguish between mechanisms.

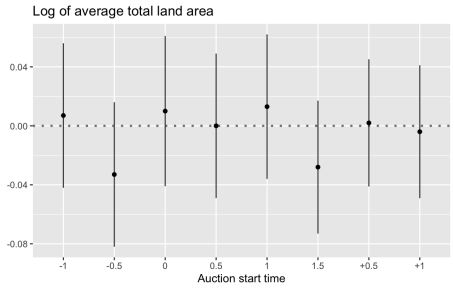
**Event Study** In the event study, we look at how auction elements and outcomes change with respect to the presence of central inspection teams. We group auctions into land bureaus and half months and see how land characteristics, auction elements and auction outcomes change. The results are shown in the figures below. The x-axis is normalized with respect to the arrival of central inspection teams: 0 corresponds to the interval of the first half-month period when the team arrives, and 0, 0.5, 1, 1.5 covers the team's entire stay. + and − corresponds to the months after the team leaves and before the team arrives.




(a) Number of auctions




(b) Total land area

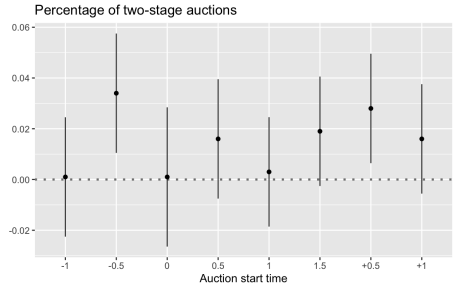



(c) Reserve price

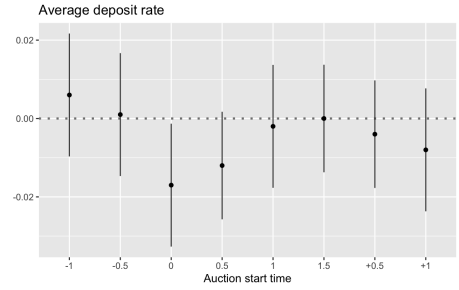
Figure 3.6: Event study results: number of auctions, total land area, reserve price

We find no evidence of change in number of auctions, land characteristics or reserve price during the team's presence. The results confirm that the land characteristics and sequencing of land sales are pre-determined. The unannounced central inspection teams change the auctions through changing the behaviors of government officials in land bureaus.

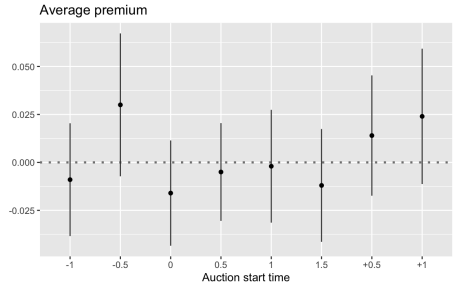
Then we proceed to look at the effect of central inspection teams on land bureau's choice



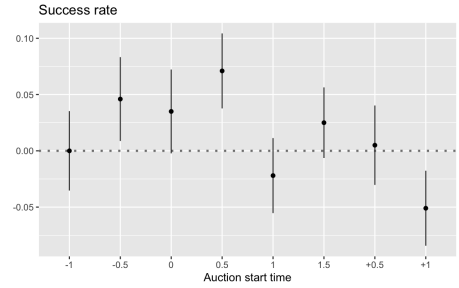

(a) Percentage of two-stage auctions




(b) Deposit rate




(c) Premium




(d) Success rate

Figure 3.7: Event study results: auction choices and outcomes

of auction format, deposit rate, and auction outcomes (success rate and premium). As illustrated in Figure, we find that land bureaus use significantly more two-stage auctions right before and right after the team arrives, and they choose lower deposit rates when the team arrives. The average premium increases right before the team arrives but not significantly. The auction success rate significantly increases when the team arrives and significantly decreases after the team leaves.

There seem to be disturbing pre-trends for some of these outcomes. One explanation is that the local government or bidders might know the arrival of the teams before the inspection begins, possibly through the team's interaction with local hotels or public transportation when they arrive around 1 or 2 weeks before. If this explanation is valid, then we expect to see that more informative land bureaus respond earlier than less informative ones. We test this implication in the later specification.

**Regression Specification** There are two possible mechanisms of how the presence of central inspection teams could affect corrupt behaviors: auction selection and auction outcomes. Once the local government officials know of the presence of a central inspection team, corrupt officials might have an incentive to push off auctions of "hot properties" or change auction elements (eg. auction format, deposit rate, etc.). This effect is expected to happen only for auctions that are announced after local government officials know of the central inspection team's arrival. The second mechanism in which central inspection teams can affect corruption is through affecting auction outcomes. The auctions that happen during inspection are expected to be less corrupt, either because the corrupt bidder might not participate, or because other potential bidders are less likely to be scared off.

Based on the analysis above, I label auctions that overlap with central inspection team's presence (denoted as CIT) into three periods:

| | | |
|---|---|---|
| Period 1 | Announced before CIT arrived | Happen during CIT presence |
| Period 2 | Announced after CIT arrived | Happen during CIT presence |
| Period 3 | Announced after CIT arrived | Happen after CIT left |
| Benchmark period | No overlap with CIT from announcement to end | |

Table 3.3: How auctions are separated into different period groups, based on their overlap with CIT presence

If the central inspection team's Work Regulations were enforced, the local government shouldn't know when and where the team arrives. Therefore, auctions that happen in period 1 and 2 should be less corrupt in terms of auction outcomes, while auctions that happen in period 2 and maybe period 3 should be less corrupt in terms of auction selection. We can then proceed to estimate the effect of central inspection team on auction selection and outcomes to disentangle these two mechanisms.

To construct period dummies, I use information on announcement time, auction start time and end time. Period 1 includes all auctions that are announced before local government

| Period | Land bureau response | Bidder response |
|---|---|---|
| Period 1 | No | Yes |
| Period 2 | Yes | Yes |
| Period 3 | No | No |

Table 3.4: Disentangle the potential mechanisms by period dummies

knows about the CIT's arrival and starts after CIT arrives; period 2 includes all auctions that are announced after local government knows about CIT's arrival, and start during CIT's presence; period 3 includes all auctions that are announced after local government knows about CIT's arrival, and start after CIT leaves.

To estimate the effect of these period dummies on auction market, I run the following regression:

$$y_{ijt} = Period1_{ijt} + Period2_{ijt} + Period3_{ijt} + \beta X_{ijt} + \alpha_j + \lambda_t + \epsilon_{ijt} \tag{3.6}$$

where $y_{ijt}$ is an auction element or outcome in auction $i$, land bureau $j$, in month $t$, $Period1_{ijt}$, $Period2_{ijt}$, $Period3_{ijt}$ are period dummies for which group the auction $i$ that starts in land bureau $j$ in month $t$ belongs to. $\gamma_j$ and $\lambda_t$ are land bureau and month fixed effects respectively. $X_{ijt}$ are control variables. When we use land characteristics and reserve price as outcomes, we don't include controls.

We run the regression separately for city land bureaus and county land bureaus, the results are shown in Table. The period dummies have no effect on all outcomes for city land bureaus. For counties, land bureaus switch to more two-stage auctions in period 2, and the success rate significantly increases for both period 1 and period 2 auctions. This is consistent with our hypothesis that county land bureaus have less information about the arrival of central inspection teams, therefore we expect a larger effect.

Furthermore, the effects are consistent with our hypothesis of the mechanisms. In period

| | (1) Log land area | (2) Log start price | (3) Deposit rate | (4) Two-stage auction | (5) Premium premium | (6) Success deal |
|---|---|---|---|---|---|---|
| period1 | -0.0768 | 0.0391 | -0.0019 | 0.0247 | 0.0019 | 0.0043 |
| | (0.0867) | (0.0497) | (0.0143) | (0.0208) | (0.0251) | (0.0305) |
| period2 | 0.0768 | -0.0045 | 0.0095 | 0.0257 | -0.0044 | -0.0034 |
| | (0.0611) | (0.0312) | (0.0135) | (0.0168) | (0.0139) | (0.0181) |
| period3 | 0.0670 | -0.0125 | 0.0079 | 0.0048 | -0.0088 | -0.0088 |
| | (0.0821) | (0.0458) | (0.0120) | (0.0253) | (0.0228) | (0.0266) |
| Land characteristics | N | Y | Y | Y | Y | Y |
| Reserve price | N | N | Y | Y | Y | Y |
| Month FE | Y | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y | Y |
| Obs | 42760 | 42454 | 42454 | 42454 | 30380 | 42454 |

Table 3.5: The effect of central inspection teams, for auctions organized by city land bureaus

*Note: premium is defined as the ratio of final price to reserve price; success is a dummy indicating whether the land auctioned is successfully sold. The data doesn't include any auctions organized by county land bureaus, pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. All standard errors are clustered at the land bureau level.*

1 and period 2, we find the effect through bidder response on auction success rate. Since the inspection teams are unannounced, the local land bureaus can't respond to their arrival for period 1 auctions since these auctions are announced to the public before they know the teams' arrivals. The arrival of these inspection teams are public information when period 1 auction starts, giving potential bidders time to respond. Based on our theoretical model of corruption, when the inspection team comes, potential bidders of period 1 and 2 auctions know that there won't be corruption in the announced auctions, which lowers their entry threshold, and eventually lead to more successful auctions.

We find evidence of effect through the land bureaus' response as well. Land bureaus substitute to using more two-stage auctions for auctions in period 2. For these auctions, the county land bureaus know about the central inspection team's arrival before they make

| | (1) Log land area | (2) Log start price | (3) Deposit rate | (4) Two-stage auction | (5) Premium premium | (6) Success deal |
|---|---|---|---|---|---|---|
| period1 | -0.0289 | 0.0519 | -0.0121 | -0.0031 | -0.0032 | 0.0405* |
| | (0.0880) | (0.0353) | (0.0104) | (0.0164) | (0.0181) | (0.0246) |
| period2 | 0.0858 | -0.0228 | 0.0026 | 0.0206* | 0.0001 | 0.0307* |
| | (0.0665) | (0.0285) | (0.0101) | (0.0119) | (0.0119) | (0.0174) |
| period3 | -0.1246 | 0.0424 | 0.0026 | -0.0186 | 0.0182 | -0.0010 |
| | (0.0971) | (0.0327) | (0.0091) | (0.0151) | (0.0139) | (0.0213) |
| Land characteristics | N | Y | Y | Y | Y | Y |
| Reserve price | N | N | Y | Y | Y | Y |
| Month FE | Y | Y | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y | Y | Y |
| Obs | 96546 | 96000 | 96000 | 96000 | 60388 | 96000 |

Table 3.6: The effect of central inspection teams, for auctions organized by county land bureaus

*Note: premium is defined as the ratio of final price to reserve price; success is a dummy indicating whether the land auctioned is successfully sold. The data doesn't include any auctions organized by city land bureaus, pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. All standard errors are clustered at the land bureau level.*

announcement, which allows them to respond by changing the auction format and the deposit rate. Why do the land bureaus make this switch? A common reason proposed by local government officials is that two-stage auctions might have less "problems", for example, bidders engage in less irrational bidding because they have more time to think about the bids they submit. It could also be corruption. During the period of our study, two-stage auctions are gradually transitioning to online format, while English auctions mostly stay offline. This might breed corruption through English auctions. We plan to explore this further.

## 3.7 Local Government Debt and Land Market Auctions

In this section, we show how local government debt due next quarter is correlated with auction choices and outcomes. As introduced in the background section, land lease sale revenue is one of the major sources of local government income, constituting about 50% of the formal budget. The local government gets all of the revenue from land lease sales. If the local government is revenue maximizing in land auctions, that is, the deposit rate level and the auction format are set at the revenue maximizing level, we shouldn't expect these choices to change when they have more debt to pay. However, if the local government has other incentives other than revenue maximizing, we expect to see a switch to putting more weights on revenue maximizing when there is more matured debt.

Consistent with our hypothesis, we find that the more matured debt next quarter is correlated with significantly lower deposit rate and significantly less two-stage auctions; and it is eventually correlated with higher average and total revenue. There is evidence that local land bureaus switch to less number of auctions, less land with restrictions and more land with higher values to start with, so we need to be cautious about the results.

## 3.8 Real Estate Developer Selection on Land Auction

### 3.8.1 Government incentives on selection of developer

Although local government only obtain revenue from the initial land auctions, local officials might care about future development. According to Li and Zhou (2005), economic performance is used to evaluate local officials when the central government makes promotion decisions. To ensure economic growth, local officials might have an incentive to select big

| | (1) Number of auctions | (2) Land with restrictions rate | (3) Two-stage auction rate | (4) Log land area for low-price apartments | (5) Average deposit rate |
|---|---|---|---|---|---|
| Debt due next quarter | -0.3475** (0.1640) | -0.0019*** (0.0007) | -0.0011** (0.0005) | 0.0044 (0.0045) | -0.0004** (0.0002) |
| Land characteristics | N | N | N | N | Y |
| Auction elements | N | N | N | N | N |
| Season FE | Y | Y | Y | Y | Y |
| Land bureau FE | Y | Y | Y | Y | Y |
| Pre-2009 | N | N | N | N | N |
| Land with restrictions | Y | Y | Y | Y | Y |
| Obs | 33804 | 33804 | 33804 | 7381 | 33750 |

*Note: here debt due next quarter is the total amount of matured debt and interest that the local government need to pay during next season. Land with restrictions rate defined as the percentage of numbers of auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). Land area for low-price apartments is defined as the total land area of land auctioned with low-price restrictions. To control for Land characteristics, we include sum of total land area, total construction land area, total planned building area and percentages of land uses. To control for auction elements, we include percentage of English auction,average deposit rate and average reserve price. All standard errors are clustered at the land bureau level.*

Table 3.7: The effect of local government debt on auction elements and auction outcomes

developers in land auctions, since large developers usually have more stable cash flows, more professional construction teams and nationwide reputation built over the years. Comparing to small developers that usually operate in limited local areas, these large developers conduct businesses across provinces. Therefore, their development have higher completion rate and are usually completed with higher quality.

Since local government cares about completion and future spill-over effect of the land projects, they have incentives to select big firms and they may use auction elements to achieve their goal. According to the China Social Financing Cost Index published by Tsinghua University in 2018, the financial cost is 5% to 6% for the listed companies and 10% to 20% for small firms. As a Capital-intensive industry, the financial cost is one of the major cost for real estate developers. With the large difference in financial cost between big and small

| | (1) Log avergae startprice | (2) Log total startprice | (3) Log avergae dealprice | (4) Log total dealprice | (5) Avergae premium |
|---|---|---|---|---|---|
| Debt due next quarter | 0.0067** (0.0028) | 0.0008 (0.0013) | 0.0032* (0.0019) | 0.0069*** (0.0025) | 0.0010*** (0.0003) |
| Land characteristics | Y | Y | Y | Y | Y |
| Auction elements | N | N | Y | Y | Y |
| Season FE | Y | Y | Y | Y | Y |
| Land bureau FE | Y | Y | Y | Y | Y |
| Pre-2009 | N | N | N | N | N |
| Land with restrictions | Y | Y | Y | Y | Y |
| Obs | 33750 | 33750 | 30446 | 30446 | 30446 |

*Note: here debt due next quarter is defined as the total amount of debt and interest that the local government need to pay during next quarter. Total start price is the total amount of reserve price per quarter. Total deal price is defined as the total amount of final price. Premium is defined as the ratio of final price to reserve price; success is a dummy indicating whether the land auctioned is successfully sold, and average premium is defined as the mean of premium of auctions of each season. To control for Land characteristics, we include sum of total land area, total construction land area, total planned building area and percentages of land uses. To control for auction elements, we include percentage of English auction,average deposit rate and average reserve price. All standard errors are clustered at the land bureau level.*

Table 3.8: The effect of local government debt on auction elements and auction outcomes, continued

firms, the local government may use deposit rate as a tool to help the big firms to win the land auction.

### 3.8.2 Spillover effects of successful real estate development

**Background: Wanda Plaza** In this case study, we look at the relationship between Wanda Plaza and local land value. Wanda Plaza is the most successful shopping mall chain in China, owned by private real estate developer Wanda Group. Until 2021, there are 368 Wanda Plazas located at all 31 provincial administration division in mainland China. From 2012-2017 there are 162 new-opened Wanda Plaza located in 161 county level administration

divisions. The average construction time is 20 months.

**Spillover effects of Wanda Plaza** As the largest shopping mall chain, Wanda Plaza increases the boutiques and brands enter which would increase business activities. One of famous advertisement of Wanda Group is "Wanda Plaza is the city center" which describe the positive effect on land value close to the Wanda Plaza. Since Wanda Plaza may increase the land value around the location and even across the whole district area which means the local government can expect higher future land transfer income, which may give the local government extra incentive to help Wanda Group win the auction even if the price of Wanda Group willing to bid is not the highest price in the auction.

**Reduced form regression** We run a reduced form regression with county and time fixed effect to show the relationship between successful real estate development such as Wanda Plaza and local land value. We use the open time of these 162 new opened Wanda Plaza as cut off to set up the dummy.

$$y_{ijt} = a + bWanda_{jt} + cX_{ijt} + \delta_j + \lambda_t + e_{ijt}$$

where $y_{ijt}$ is an auction element or outcome in auction $i$, land bureau $j$, in month $t$, $Wanda_{jt}$ are period dummies, label 1 for group of the auctions that starts in county $j$ in month $t$ after Wanda Plaza opened in such county. $\gamma_j$ and $\lambda_t$ are county and month fixed effects respectively. $X_{ijt}$ are control variables. When we use land characteristics and reserve price as outcomes, we don't include controls.

**Result** As a large firm with deep connection with the central government, Wanda might have extra information on trends of housing prices comparing to small firms. Therefore,

| | (1) Log land area | (2) Two-stage auction | (3) Log start price | (4) Log start floor price |
|---|---|---|---|---|
| Wanda open time | 0.0769 (0.1011) | -0.0092 (0.0209) | 0.0526 (0.0458) | 0.0526 (0.0458) |
| Land characteristics | N | Y | Y | Y |
| Auction elements | N | N | N | N |
| Month FE | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y |
| Pre-2013 | N | N | N | N |
| Land with restrictions | N | N | N | N |
| Obs | 111476 | 110684 | 110684 | 110684 |

*Note: Wanda open time is defined as the month when Wanda Plaza opened at such specify county-level administrative district. Start floor price is defined as the reserve price divided by the maximum floor area can be built in such land permitted by the government, which captures the reserve unit value of such land. The data doesn't include any pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. To control for auction elements, I include English auction dummy, deposit rate, reserve price. All standard errors are clustered at the land bureau level.*

Table 3.9: The effect of Wanda Plaza Opening on auction elements and auction outcomes, using post-2013 data, part 1

Wanda might only bid on lands in places with a faster growing trend. If this hypothesis is valid, we should observe that the land prices start to increase as soon as Wanda Group win an auction. However, while the opening of Wanda Plaza has a significantly positive effect on land prices, we find no effect of Wanda winning an auction. The results show that Wanda has a positive effect on development and rules out the mechanism where the firm selects places with faster growing trend to bid (Table 11 and Table 12).

We find no evidence of change in land characteristics or reserve price after Wanda Plaza open. The results shows that there's no re-planning of the urban design after Wanda Plaza open. More importantly, we find no evidence that reserve prices increase after Wanda Plaza open which is consistent with the mechanism of reserve price set up that the reserve price is determined by a third-party based on land deal price of past three years. We find a

| | (1) Deposit rate | (2) Log deal price | (3) Log deal floor price | (4) Premium |
|---|---|---|---|---|
| Wanda open time | -0.0694* | 0.0332* | 0.0332* | 0.0419** |
| | (0.0399) | (0.0175) | (0.0175) | (0.0211) |
| Land characteristics | Y | Y | Y | Y |
| Auction elements | N | Y | Y | Y |
| Month FE | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y |
| Pre-2013 | N | N | N | N |
| Land with restrictions | N | N | N | N |
| Obs | 110684 | 73857 | 73857 | 73857 |

*Note: Wanda open time is defined as the month when Wanda Plaza opened at such specify county-level administrative district. Deal floor price is defined as the final price divided by the maximum floor area can be built in such land permitted by the government, which captures the final unit value of such land. Premium is defined as the ratio of final price to reserve price. The data doesn't include any pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. To control for auction elements, I include English auction dummy, deposit rate, reserve price. All standard errors are clustered at the land bureau level.*

Table 3.10: The effect of Wanda Plaza Opening on auction elements and auction outcomes, using post-2013 data, part 2

significant positive relationship between the deal price and premium with control of land characteristics and auction elements, which support our guess that the local government may have incentives to select big firms such as Wanda Group to make sure the land got successful development with positive spill-over effect.

### 3.8.3 Potential method of developer selection

**Model implication** Based on the simulation results of our model, given the difference in financial cost between big and small firms, if the local government cares about future development, it can increase the deposit rate for a given auction to increase the entry threshold

| | (1) Log land area | (2) Two-stage auction | (3) Log start price | (4) Log start floor price |
|---|---|---|---|---|
| Wanda Group auction time | -0.0653 (0.0616) | -0.0353 (0.0493) | 0.0045 (0.0376) | 0.0045 (0.0376) |
| Land characteristics | N | Y | Y | Y |
| Auction elements | N | N | N | N |
| Month FE | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y |
| Pre-2013 | N | N | N | N |
| Land with restrictions | N | N | N | N |
| Obs | 111476 | 110684 | 110684 | 110684 |

*Note: Wanda auction time is defined as the month when Wanda Group win the first bid for building Wanda Plaza at such specify county-level administrative district. We label 1 for group of the auctions that starts at such specify county-level administrative district after Wanda Group win the bid for Wanda Plaza. Start floor price is defined as the reserve price divided by the maximum floor area can be built in such land permitted by the government, which captures the reserve unit value of such land. The data doesn't include any pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. To control for auction elements, I include English auction dummy, deposit rate, reserve price. All standard errors are clustered at the land bureau level.*

Table 3.11: The effect of Wanda Plaza finish land transfer on auction elements and auction outcomes, using post-2013 data, part 1

disproportionately for small firms, which increases winning probabilities of big firms.

**Reduced form regression** We run a reduced form regression with county and time fixed effect to show whether there's a significant higher deposit rate, significant lower deal price and significant lower premium for bids win by Wanda Group.

$$y_{ijt} = a + bWanda\_win_{ijt} + cX_{ijt} + \delta_j + \lambda_t + e_{ijt}$$

where $y_{ijt}$ is an auction element or outcome in auction $i$, land bureau $j$, in month $t$, $Wanda\_win_{ijt}$ is a dummy capture whether Wanda Group win the bid, we label 1 if Wanda

| | (1) Deposit rate | (2) Log deal price | (3) Log deal floor price | (4) Premium |
|---|---|---|---|---|
| Wanda Group auction time | -0.0149 (0.0150) | 0.0144 (0.0127) | 0.0144 (0.0127) | 0.0406 (0.0254) |
| Land characteristics | Y | Y | Y | Y |
| Auction elements | N | Y | Y | Y |
| Month FE | Y | Y | Y | Y |
| County FE | Y | Y | Y | Y |
| Pre-2013 | N | N | N | N |
| Land with restrictions | N | N | N | N |
| Obs | 110684 | 73857 | 73857 | 73857 |

*Note: Wanda auction time is defined as the month when Wanda Group win the first bid for building Wanda Plaza at such specify county-level administrative district. We label 1 for group of the auctions that starts at such specify county-level administrative district after Wanda Group win the bid for Wanda Plaza.Deal floor price is defined as the final price divided by the maximum floor area can be built in such land permitted by the government, which captures the final unit value of such land. Premium is defined as the ratio of final price to reserve price. The data doesn't include any pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for land characteristics, I include total land area, construction land area, planned building area, land use dummies. To control for auction elements, I include English auction dummy, deposit rate, reserve price. All standard errors are clustered at the land bureau level.*

Table 3.12: The effect of Wanda Plaza finish land transfer on auction elements and auction outcomes, using post-2013 data, part 2

Group win the bid and 0 if Wanda Group lose. From 2013-2017, Wanda Group win 228 bids at 168 county-level administrative districts. $\gamma_j$ and $\lambda_t$ are county and month fixed effects respectively. $X_{ijt}$ are control variables. When we use land characteristics, we don't include controls.

**Result** We find that for land auctions won by the Wanda Group, the deposit rate is 20% higher comparing to other auctions. The final prices and premium are significantly lower. This is consistent with theory that local government officials, by choosing higher deposit

rates to select big developers, decrease competition in auctions. In these auctions, the local governments trade off higher revenue with higher winning probability of big firms by their choice of deposit rates.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | Log land area | Two-stage auction | Log reserve price | Log start floor price |
| Wanda win | 0.9503*** | 0.0271 | -0.1069 | -0.1069 |
| the auction | (0.0749) | (0.0338) | (0.1164) | (0.1164) |
| Land characteristics | N | Y | Y | Y |
| Auction elements | N | N | N | N |
| Month FE | Y | Y | Y | Y |
| Land bureau FE | Y | Y | Y | Y |
| Pre-2013 | N | N | N | N |
| Land with restrictions | N | N | N | N |
| Obs | 111476 | 110684 | 110684 | 110684 |

*Note: Wanda win the auction is a dummy capture whether Wanda win the bid, we label 1 if Wanda Group win the bid and 0 if Wanda Group lose. Start floor price is defined as the reserve price divided by the maximum floor area can be built in such land permitted by the government, which captures the reserve unit value of such land. The data doesn't include any pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. To control for auction elements, I include English auction dummy, deposit rate, reserve price. All standard errors are clustered at the land bureau level.*

Table 3.13: The effect of Wanda Plaza win the bid on auction elements and auction outcomes, using post-2013 data, part 1

## 3.9 Conclusion

In this paper, we first look at how corruption incentives respond to the anti-corruption campaign, and to be specific, the presence of central inspection teams. We find that when central inspection team is present, local government officials respond by choosing lower deposit rates and switch to more two-stage auctions. The success rate of these auctions increase, which might be explained by potential bidders' belief that there is no corrupt

| | (1) Deposit rate | (2) Log final price | (3) Log final floor price | (4) Premium |
|---|---|---|---|---|
| Wanda win the auction | 0.1998*** (0.0456) | -0.0960*** (0.0254) | -0.0960*** (0.0254) | -0.1001*** (0.0205) |
| Land characteristics | Y | Y | Y | Y |
| Auction elements | N | Y | Y | Y |
| Month FE | Y | Y | Y | Y |
| Land bureau FE | Y | Y | Y | Y |
| Pre-2013 | N | N | N | N |
| Land with restrictions | N | N | N | N |
| Obs | 110684 | 73857 | 73857 | 73857 |

*Note: Wanda win the auction is a dummy capture whether Wanda win the bid, we label 1 if Wanda Group win the bid and 0 if Wanda Group lose. Deal floor price is defined as the final price divided by the maximum floor area can be built in such land permitted by the government, which captures the final unit value of such land. Premium is defined as the ratio of final price to reserve price. The data doesn't include any pre-2013 auctions or auctions with special requirements (i.e. affordable housing requirements, low-price apartments requirements). To control for Land characteristics, I include total land area, construction land area, planned building area, land use dummies. To control for auction elements, I include English auction dummy, deposit rate, reserve price. All standard errors are clustered at the land bureau level.*

Table 3.14: The effect of Wanda Plaza win the bid on auction elements and auction outcomes, using post-2013 data, part 2

auction during inspection.

Second, we find that larger financial burden is correlated with the local government's choice of lower deposit rate and less two-stage auctions, which are positively correlated with the revenue from land sales. This is consistent with the story that local government, when faced with financial burdens from debt, chooses to decrease deposit rate and switches to more two-stage auctions to increase revenue.

Third, we find that the opening of the Wanda plaza increases revenue from land sales, while selling the land to Wanda Inc. doesn't have the same effect, which implies that big developers might have a positive impact on local economy through developing the land. This

could give local officials an incentive to screen out big developers by choosing a higher deposit rate, which is consistent with our findings for auctions won by the Wanda Group.

Overall, we present evidence on the existence of local government's multiple incentives in land auctions other than revenue maximization.

# Bibliography

D. Acemoglu and J. A. Robinson. Persistence of power, elites, and institutions. *American Economic Review*, 98(1):267–293, 2008.

G. Biglaiser and C. Mezzetti. Politicians' decision making with re-election concerns. *Journal of Public Economics*, 66(3):425–447, 1997.

Y. Chen, H. Li, and L.-A. Zhou. Relative performance evaluation and the turnover of provincial leaders in china. *Economics Letters*, 88(3):421–425, 2005.

E. K. Choi. Patronage and performance: factors in the political mobility of provincial leaders in post-deng china. *The China Quarterly*, 212:965–981, 2012.

C. Ding, Y. Niu, and E. Lichtenberg. Spending preferences of local officials with off-budget land revenues of chinese cities. *China Economic Review*, 31:265–276, 2014.

G. Egorov, S. Guriev, and K. Sonin. Media freedom in dictatorships. *Unpublished paper, Yale University*, 2009.

J. V. Henderson, A. Storeygard, and D. N. Weil. Measuring economic growth from outer space. *American economic review*, 102(2):994–1028, 2012.

B. Holmström. Managerial incentive problems: A dynamic perspective. *The review of Economic studies*, 66(1):169–182, 1999.

R. Jia, M. Kudamatsu, and D. Seim. Complementary roles of connections and performance in political selection in china. 2013.

R. Jia, G. Roland, and Y. Xie. A theory of power structure and institutional compatibility: China vs. europe revisited. *Journal of the European Economic Association*, page jvad050, 2023.

C.-w. Kou and W.-H. Tsai. "sprinting with small steps" towards promotion: solutions for the age dilemma in the ccp cadre appointment system. *The China Journal*, 71(1):153–171, 2014.

D. Lane and C. Ross. Limitations of party control: the government bureaucracy in the ussr. *Communist and Post-Communist Studies*, 27(1):19–38, 1994.

H. Li and L.-A. Zhou. Political turnover and economic performance: the incentive role of personnel control in china. *Journal of public economics*, 89(9-10):1743–1762, 2005.

W. Li. Dual leadership and bureaucratic capacity. *working paper*, 2023.

W. Luo and S. Qin. China's local political turnover in the twenty-first century. *Journal of Chinese Political Science*, pages 1–24, 2021.

E. Maskin, Y. Qian, and C. Xu. Incentives, information, and organizational form. *The review of economic studies*, 67(2):359–378, 2000.

R. B. Myerson. The autocrat's credibility problem and foundations of the constitutional state. *American Political Science Review*, 102(1):125–139, 2008.

F. Su, R. Tao, L. Xi, and M. Li. Local officials' incentives and china's economic growth: tournament thesis reexamined and alternative explanatory framework. *China & World Economy*, 20(4):1–18, 2012.

J. L. Wallace. Juking the stats? authoritarian information problems in china. *British journal of political science*, 46(1):11–29, 2016.

M. Wang, M. O. Rieger, and T. Hens. An international survey on time discounting. *Norwegian School of Economics working paper*, 2009.

M. Y. Wong. Performance, factions, and promotion in china: the role of provincial transfers. *Journal of Chinese Political Science*, 27(1):41–75, 2022.

M. Wu and B. Chen. Assignment of provincial officials based on economic performance: Evidence from china. *China Economic Review*, 38:60–75, 2016.

C. Xu. The fundamental institutions of china's reforms and development. *Journal of economic literature*, 49(4):1076–1151, 2011.

H. Yi and I. Liu. Executive leadership, policy tourism, and policy diffusion among local governments. *Public Administration Review*, 82(6):1024–1041, 2022.

## 3.10 Appendix. Example of an Announcement of China's Land Auction

As approved by Yancheng City government, Yancheng City Land Bureau decided to sell the use right of one piece of country-owned land by two-stage auction. Now the related matters are announced below:

1. Basic info and requirements for the land

| | | | | | |
|---|---|---|---|---|---|
| Land number | 20130601 | Land area | 34948 m2 | Location | [Location] |
| Total years | 40 | Floor-to-area ratio | $< 2$ | Building density (%) | 25 |
| Greening rate (%) | $>= 20$ | Limited height | | Land use | Business finance |
| Investment intensity | $10,000$ /acre | Deposit | ¥46 million | | |
| Reserve price | 228.35 million | Price increment [2] [3] | $349,481$ | | |
| Land condition [3] [4] | Cleaned | | | | |
| Two-stage auction start time | $2013-6-21, 8:30$ | Two-stage auction end time | $2013-7-1, 17:00$ | | |

Table 3.15: Information and Requirements for Land

2. Legal persons, natural persons and other organizations within and outside the People's Republic of China can apply for participation, and applicants should apply separately. Other conditions that the applicant should meet: legal persons within the territory of the People's Republic of China, unless otherwise stipulated by the law or the two-stage auction transfer documents, can apply for participation in the bidding, and the applicant can only apply for it alone.

3. For this transfer of state-owned land use right, the highest bidder wins.

4. The detailed materials and specific requirement for this auction are in the two-stage auction transfer document. Applicants can obtain this document on the second floor of Yancheng City National Land Resources Bureau or the city's Administrative Approval Center national land counter from 2013-6-10 to 2013-6-20.

5. Applicants can turn in application from 2013-6-21 to 2013-6-28 to the second floor of Yancheng City National Land Resources Bureau. The deadline to submit deposit is 2013-6-28 16:00. Our bureau will confirm the qualification of applicants who turn in deposit in time and satisfies the application requirements.

6. This two-stage auction land right sales will take place at the second floor of Yancheng City National Land Resources Bureau. The auction time:
Land No. 20130601: 2013-6-21 8:30 to 2013-7-1 17:00;

7. Others: (1) When the two-stage auction ends, if participants are willing to continue bidding, they proceed to an English auction, and determine the winner by this English auction.

8. Contact information and bank account [Contact info and bank account]

Yancheng City National Land Resources Bureau

## 3.11 Appendix. Missing Value Problem

For all auctions in our dataset, we have information on the province, prefecture, county of the auction, the auction start time, end time, type of auction format, reserve price, required deposit, deposit rate, total land area, construction land area, whether the auction was successful.

However, some data entries have missing value problems.

The figure below shows the percentage of auctions that has information on auction announcement time in each month. In 2011 and 2013, there are jumps in data quality. Since Jan 2013, which is before the first round of central inspection teams, more than 99.8% auctions in each month have information on announcement time. This tells us that we need to be cautious when using announcement time info for pre-2013 data.

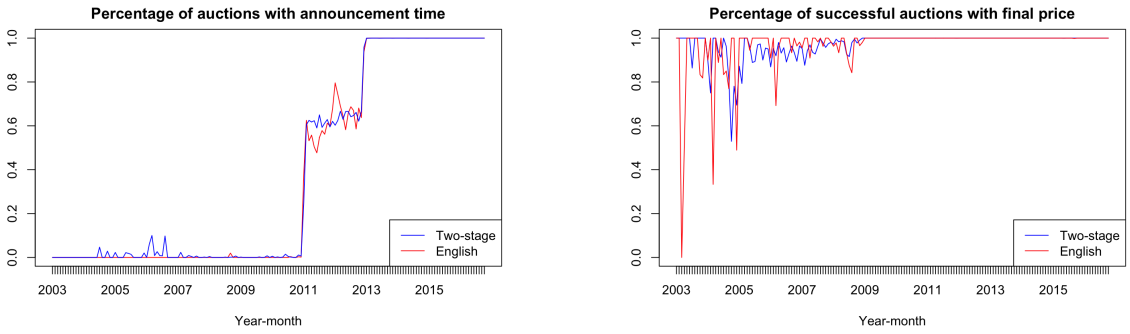



Figure 3.8: Missing data on announcement time and final price

For some successful auctions, the data on final price is unavailable. The following figure plots the percentage of successful auctions with information on final price for each month and for both types of auctions. We can see that starting Jan. 2009, almost all successful auctions have information on final price. Therefore, we need to be cautious when using final price info for pre-2009 data.