Target Setting in Tournaments: Theory and Evidence from China*

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Abstract

Motivated by the prevalence of economic targets in all levels of territory administrations in China, this paper proposes a Tullock contest model to study optimal target setting in a multi-layered tournament-based organization. In our model, targets are used by the upper-level official to convey the importance for economic growth and incentivize her subordinates in the tournaments. Our model predicts a top-down amplification of economic growth targets along the jurisdiction levels, which is consistent with the observed pattern in China. Using both provincial and prefectural level data, we test the model predictions and find consistent evidence.

JEL Classification: H11, H7, O2, P3

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Performance targets are widely used to incentivize managers in modern organizations. In practice, they commonly exhibit a hierarchical nature: both superiors and subordinates

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establish their targets sequentially in large, multi-layered organizations.[1] This paper studies the role of target setting in one such organization – sub-national government in China, where different levels of government officials announce growth targets at a regular basis, and they compete for promotion by delivering economic growth in their jurisdictions.[2] Growth targets on various economic indicators – including GDP, investment, and fiscal revenues – are announced following rounds of discussion and debate within the government. Among all growth targets, the GDP growth target is undoubtedly the single most important one.

The paramount popularity of growth targets in China raises two puzzles. First, although target setting was once an indispensable component of China's former planned economy before the profound market-oriented reforms in 1978, growth targets are *no longer mandatory*, either legally or bureaucratically, and serve more like guidelines. It is therefore unclear why Chinese officials at all levels continue to take growth targets so seriously even though the planning regime was abolished decades ago. Second, growth targets exhibit a persistent pattern of "top-down amplification" along different jurisdiction levels, where lower-level governments' growth targets are typically higher than the upper-level ones. In this paper, we propose a theoretical model of target setting to explain these puzzles in the context of promotion tournament among Chinese officials. In our model, targets are used as incentive mechanisms for local officials who play a key role in the economy.

Our model is based on two salient features of the China's political economy. First, the promotion of Chinese local officials is highly linked with the economic growth in their jurisdictions. This strong linkage between the private interests of local officials and regional economic development thereby triggers an intensive tournament competition (Chen et al., 2005; Li and Zhou, 2005; Fan et al., 2009; Xu, 2011; Choi, 2012; Wu et al., 2013; Yao and Zhang, 2015; Jia et al., 2015). Second, Chinese local officials take the leading position in

[1]Existing economic studies have focused primarily on the determination of one *single* target at one time, and also on the temporal relationship for targets by the same agent at different times (e.g., ratchet effect). See Weitzman (1976, 1980); Holmstrom (1982); Milgrom and Robert (1992); Murphy (2000).

[2]Walder (1995) argued that the Chinese bureaucratic system can be viewed a large organization, in which each local government can be viewed as an industry unit and the political leaders of the government can be viewed as the managers of the unit.

promoting the local economy (Frye and Shleifer, 1997; Qian and Weingast, 1997; Blanchard and Shleifer, 2001; Bardhan and Mookherjee, 2006; Zhou, 2010; Xu, 2011). Due to administrative and economic decentralization, Chinese local officials are highly capable of leveraging local investment and promoting local economic growth.[3]

In our model, local officials compete for promotion via a Tullock contest based on economic growth that is determined by officials' efforts. The superior official set a GDP growth target to incentivize her subordinates by affecting their Contest Success Function (hereafter referred to as CSF) simultaneously. In particular, we make a "complementarity" assumption that a higher target will cause subordinates' promotion probability to become more sensitive to realized GDP growth rates. By changing the target and affecting subordinates' promotion rule, the superior conveys to her subordinates the importance of economic growth in their job responsibilities, and aligns her own interest with those of her subordinates.

We investigate the target setting behavior in a symmetric model with three layers of government (e.g., central, provincial and prefectural) and two levels of tournaments (among provincial and prefectural leaders respectively). We posit that the realized GDP growth rate in each prefecture is jointly determined by the efforts exerted by the central, provincial and prefectural leaders. The central, provincial and prefectural leaders move in a sequential manner to determine their efforts to promote economic growth and growth targets faced by their subordinates, and leaders at the same layer move simultaneously. Provincial and prefectural leaders are incentivized only by promotion, and they always have the option to quit the tournament by exerting zero effort, which implies their participation constraints.[4]

We characterize the *unique* symmetric subgame perfect equilibrium of this game. Observing the effort and target selected by the superior, a subordinate official will either choose

[3]There are at least three channels for local officials to stimulate local economic growth. First, they can make direct investment through local government-owned investment and financing vehicles. Second, they may influence the investment of state owned enterprises. Third, they may issue a variety of preferential policies (e.g. subsidies and cheap land) to encourage investment from the private sector (Yu et al., 2016).

[4]In Chinese political tournament, government officials' "outside" options include leaving the bureau for another job, or moving to a position in People's Congress or People's Political Consultative Conference. The benefits from these outside options are usually much lower. This assumption is less true in modern corporations with an efficient labor market and non firm-specific human capital.

an effort level in pure strategy when facing a low target, or randomize between a positive effort and quitting (in mixed strategy) when facing a high target. By setting a higher target, an upper-level official can incentivize her subordinates to exert higher efforts, but may also increase their probabilities of quitting. If the target is set so high as to induce mixed strategies, subordinates' expected efforts become lower, because the additional strategic risk makes it harder to satisfy their participation constraints. Therefore, the optimal target is set such that the lower-level officials exert a pure-strategy effort level, with binding participation constraints. This enables us to explicitly characterize the equilibrium targets.

Our model attributes the top-down amplification of growth targets to the decreasing number of jurisdictions along hierarchical levels of government in China.[5] As the number of contestants decreases from the top down, the probability of winning the Tullock contest increases. Correspondingly, it becomes easier to satisfy contestants' participation constraints, and the superior can set a higher target to induce higher efforts. So in equilibrium the growth target is higher at lower level of government.

We empirically investigate both the assumptions and the predictions of our theoretical model. We first estimate the promotion function in the tournament implied by our model. We apply a structural approach as simple OLS neither captures the nonlinearity of the promotion function nor deals with the situation that a contestant's probability of promotion depends on the economic performances of *all* contestants. Our estimates support the key assumptions in our model: the probability of promotion increases in the realized GDP growth rates, and is consistent with our complementarity assumption.

We then test our model predictions using GDP growth targets and economic performance in various provinces in China. We find a negative relationship between the number of prefectures and the provincial target, which is consistent with our major prediction. We also leverage on two policy experiments in China, the *Western Development Program* and the *Northeast Revival Program*, to provide supporting evidence for our explanation.

[5]China has 31 provincial units. The number of prefectural cities varies across provinces and the average is 10-11. Each prefectural city has about 8-9 counties.

Admittedly, our theory is not exhaustive and only provides one explanation of the targeting process in a multi-layered organization. In our theory, a superior convey the target to the subordinate officials. We finally discuss two other alternative explanations, where a subordinate convey the target to the superior official: announcing growth potential for support, and signaling political loyalty. Both alternatives happen to be (statistically) inconsistent with some of our empirical patterns.

This paper is related to several strands of literature. Firstly, there is a long history of research on the rationale of performance targets in an organization.[6] Our study proposes an economic explanation of aligning interests in a tournament setting. As was summarized in Milgrom and Robert (1992) and Murphy (2000), targets are determined by one of the three factors: past performance, relative performance of outside peers, and evaluation of the difficulties of particular operations. We propose a new determination of the targets, which is the importance weight of one specific activity for the superior.[7] Secondly, we build our theoretical model of multi-layered tournament upon previous studies on tournament as an incentive scheme in a single-layered organization (Tullock, 1980; Lazear and Rosen, 1981; Green and Stokey, 1983; Konrad, 2009).[8] Finally, we provide new insights to understand role of local leaders' political incentives in China's economic development. We extend the performance-based promotion tournament into a multi-layered structure,[9] and we rationalize the role of economic growth targets in such setting.[10]

[6]A consensus has emerged in the psychology literature that goal-setting improves organizational performance through psychological processes such as directing attention, mobilizing effort, increasing persistence, and motivating strategy development (Locke and Latham, 2006).

[7]This determination is related to the second and third factors above. The first factor is linked with the famous "ratchet effect": managers tend to withhold effort in the current period in order to avoid facing a higher target in the next period. Recent empirical works find that such a ratchet effect may not exist, at least in some empirical contexts (Indjejikian et al., 2014).

[8]Previous empirical works test tournament theories in the context of sports and modern corporations. See Ehrenberg and Bognanno (1990); Levitt (1994); Eriksson (1999); Guryan et al. (2009); Carpenter et al. (2010); Brown (2011); Pope and Schweitzer (2011).

[9]Studies on Chinese performance-based promotion tournament include Maskin et al. (2000); Blanchard and Shleifer (2001); Li and Zhou (2005); Chen et al. (2005); Fan et al. (2009); Zhou (2010); Xu (2011); Choi (2012); Wu et al. (2013); Yao and Zhang (2015).

[10]Similar to our paper, both Tsui and Wang (2004) and Xu (2011) point out that growth targets help to align the interests of leaders and subordinates. Deviating from studies that only argue for the role of economic targets, our paper conducts a formal theoretical and empirical analysis of economic targets and

The remainder of this paper is organized as follows. Section 1 provides some stylized facts on target setting in China, and it documents the top-down amplification of growth targets. Section 2 sets up our model and Section 3 analyzes the model and derives some comparative statics results. Section 4 presents empirical evidence to support our theoretical assumptions and predictions. Section 5 concludes the paper.

1 Target Setting in China

1.1 Institutional Backgrounds

Target setting in economic plans originated from the early 1950s when China started to adopt the Soviet model of a planned economy. While economic reforms have abolished most planning practices, the making of economic plans on both five-year and annual basis survives and remains a routine practice for Chinese governments at all levels to this day. A major difference between economic targets nowadays and those during the planned economy period is that they are no longer mandatory or binding and only serve as guidelines.

The typical sequence of plan drafting is a top-down process: the central government sets the national plan first, and then provincial and prefectural governments follow sequentially and establish their own economic plans. Government leaders at all territory levels take the economic plans very seriously. It usually takes several months for each level of government to complete the plan, and in order to set up a proper target, the government holds numerous meetings to seek advice and build consensus (Kennedy and Johnson, 2016). The finalized versions are released in *Outline of the Five-Year Plan for the National Economic and Social Development of China* for five-year plans, and *Report on the Work of the Government* for annual plans. They include key economic targets, such as the growth rates of GDP, industry value added, fiscal revenues and expenditures, as well as some social development targets, such as population growth and environmental protection.

more importantly establishes and rationalizes the "top-down amplification" phenomenon, which previous studies do not touch upon at all.

1.2 Top-Down Amplification of GDP Growth Targets

The non-binding nature of economic targets in the post-reform era raises the suspicion that targets are redundant and convey no informational content. Although the prolonged discussions and deliberations that precede the public release of targets have already signaled the prominence of targets, we want to add more pieces of evidence to refute this concern. Firstly, targets are responsive to large economic shocks, as government officials announce growth targets to demonstrate their blueprint of economic development. For example, when the Asian Financial Crisis struck China in 1998, the central government set the annual growth target at 8 percent and urged local governments to guarantee the achievement of this target.[11] Secondly, the private sector regards the growth target as an important economic indicator that affects the business operations, investments, and other activities. The announcement of growth targets always receives intensive media coverage domestically and abroad (e.g., Economist, 2015). International financial actors, such as IMF, World Bank, and investment banks, make or adjust their forecasts on the Chinese economy as well as the global economy based on China's announced economic growth targets (see IMF, 2016; Kennedy and Johnson, 2016).

A third piece of evidence, which we regard as the most important substantiation of the critical importance of target setting, is the persistent pattern of top-down amplification of GDP growth targets. In the following paragraphs, we document the patterns of growth targets across different levels of government during the post-reform era.[12] See Appendices for a detailed description of the data source.

Table 1 reports the relationship between growth targets set by the central and provincial governments, using province-level data on five-year plans ranging from the 7th to the 13th

[11] Although it was widely believed that 8 percent GDP growth was virtually impossible to fulfill in that year, the central government still used this target to show its pressing need to avoid an economic free-fall. Similar episodes reoccurred when the global financial crisis hit China in 2008. Chen et al. (2016) also find that the growth targets have a huge impact on China's monetary policy.

[12] The pattern of growth targets before 2010 was also documented in Zhou et al. (2015). But that paper did not provide any theoretical explanation.

plans (starting in 1986 and ending in 2016).[13] We observe a clear pattern of amplification from the center to the provinces for the five-year targets during this period. Systematically, provincial targets are 10% - 30% higher than the central one, and the amplification is quite widespread, as the proportion of provinces with targets higher than the central ones ranges from 74% to 100%. Table 2 reports a similar pattern using annual plans from 1997 to 2015.[14]

Table 3 documents the average annual growth targets for both provinces and prefecture cities from 2004 to 2015.[15] We observe an overwhelming acceleration of growth targets from provinces to prefecture cities. Generally speaking, the city targets are 2-3 percentage points higher than provincial ones (columns 1 and 3). Given the fact that provincial governments have already added 2-3 percentage points to the central benchmark (for the 10th and the 11th five year plans), the amplification of city government targets over the provincial benchmarks implies that at the city level about 4-6 percentage points are added up to the central targets. This result is not driven by a small number of provinces with abnormally high prefectural targets. In fact, we find that 90% of the provinces have provincial targets lower than the average prefectural targets in their territories across all years through 2015 (column 2).

Given these facts about target setting behavior in the Chinese government, a fundamental question remains: do the growth targets actually translate into realized growth rates at all? We find a positive correlation between targeted and realized GDP growth rate both for provinces and for prefectures, as illustrated in Table 4 after controlling for province (prefecture) fixed effects, year fixed effects, and lagged dependent variables.[16] In column 4,

[13]Our data starts from the 7th five-year plan, because the National Bureau of Statistics reported GNP instead of GDP in the earlier time.

[14]In Table 1 of Online Appendix, we also provide evidence of top-down amplification at the prefectural level using county target data from three provinces: Shanxi, Fujian, and Gansu.

[15]We focus on the annual growth targets here since the five-year plans for prefectural cities are not available. The prefectural annual targets start from 2004 because prior to 2004 missing data is quite serious. Ideally we wish to tabulate provincial and city growth targets for each province during this time period, but the space limitation prevents us from doing this. Instead we only report the average growth targets for 27 provinces (excluding four directly-administrated metropolitans: Beijing, Tianjin, Shanghai and Chongqing due to data availability), and the average growth targets of prefecture cities for these provinces.

[16]See Online Appendix Figure 2 for an illustration of the correlation without any control. China's economic data system is a work in progress and a hurdle that statisticians have yet to overcome. The Chinese NBS could improve its system by offering greater transparency behind the data-gathering process and statistical procedures, allowing data users to better identify weaknesses in the official numbers. But the heavy criticism

we use the growth rate of electricity consumption to proxy realized economic growth, due to long-standing concerns about the validity of Chinese GDP data. We still find a positive correlation with the provincial annual growth targets.

1.3 Target Setting in Response to National Regime Switching

Our understanding about the role of growth targets is greatly shaped by two turning points since 1986: Deng Xiaoping's championing of market-oriented reform during his Southern Tour in 1992, and Xi Jinping's downplaying of GDP-growth-oriented evaluation in 2014.[17] In both events, there were dramatic changes of central targets, which strongly affected the mentality of the Chinese Communist Party (CCP) about GDP growth and in turn profoundly shaped the phenomenon of target amplification.

Before 1992, there was a heated debate between revolutionaries advocating the reform and conservatives at the central level, on whether China should move to a market-oriented economy or stick to the planning regime with certain modest modifications. As a result, some provincial leaders take a strategic position and respond to the growth targets in a modest way. Other leaders might align with the conservative stance and set a target even lower than the central one (column 7, Table 1).[18] In order to break this stalemate, Deng Xiaoping, then the de-facto top leader of the CCP, made a well-known Southern Tour in 1992 to fight back against the conservative policies, urging the Party and government to boldly embrace market-oriented reforms.

This tour proved to be a big breakthrough in China's economic reform process. Since then, pushing for market-oriented reforms and high economic growth has dominated the agendas, and both central and local governments has revised their 8th five-year plans. The central government reset its national GDP growth target in 1993 from 6 percent to 8.5

of Chinese officials and accusations of intentional falsification or manipulation are likely misplaced. Clark et al.(2017) even provide solid evidence that China's GDP Growth may be understated.

[17]MacFarquhar (2011) and Rapoza (2013) list these two events as the most significant change in Chinese history since 1978. MacFarquhar (2011) provides historical details on Deng Xiaoping's South Tour in 1992, and Rapoza (2013) provides a background introduction to Xi Jinping's New Normal.

[18]See MacFarquhar (2011, p. 529) for details.

percent. Provincial governments revised their targets even more aggressively from an average of 6.83 percent to 10.37 percent, and only three provinces set targets slightly lower than the central one. In the following three five-year plans, the central growth target virtually became the baseline for the provincial targets: in the 9th five-year plan, there was only one province (Qinghai) with a target slightly lower than the central benchmark; in the 10th and 11th plans, every province set a growth target higher than the central plan. The difference between the provincial and central targets since the 9th five-year plan ranges from 1.98 to 2.45 percentage points, which accounts for 30 percent of the central benchmark.

Prevailing emphasis on GDP growth has continued until recently. In May 2014, Xi Jinping delivered a public speech in Henan province, proclaiming that China must adapt itself to a "New Normal" of modest growth and keep more focus on preventing risks, maintaining sustainability, and reforming the banking system (Bloomberg, 2014). According to Xi's speech, GDP growth will no longer predominate in the performance evaluation of local leaders as much as before. The notion of a "New Normal" became widespread immediately, and as a result, the amplification of growth targets became much smaller than in previous five-year plans, indicating that provincial leaders have adapted themselves to a new regime of performance evaluation. As shown in Table 1, the percentage of provinces with target amplification dropped significantly to 84 percent in the new regime of Xi. Table 2 shows a more detailed change in provincial target amplifications. Since Xi took power in late 2012, the percentage of target amplifications has declined from 100 percent in 2012 to 84 percent in 2016. A more revealing change is the existence of annual provincial targets lower than the central one since 2015, which has never occurred since 1997, even in the worst years of 1997 and 2008 when China was struck by the Asian and global financial crises.

2 Promotion Tournament with Targets

This section presents a model to analyze the promotion tournament with targets. We model the top-down hierarchical government structure with three layers of government: central,

provincial, and prefectural. The model is also applicable to other specifications of government hierarchy (e.g. from provincial to prefectural to county level). Although we only consider three layers of government, the number of layers can be easily extended. The provincial and prefectural leaders compete for promotion through realized GDP growth rates via relative performance evaluation in a promotion tournament. We use the Tullock contest model incorporating targets to capture the promotion rule, where targets change the shape of the CSF as described in Section 2.2.

2.1 Model Setting

We model China's promotion tournament in the following way. There is one central government and $n \geq 2$ symmetric provincial governments. In each province $i = 1, 2, \cdots, n$, there are $k \geq 2$ symmetric prefectural cities denoted by $\mathcal{K}_i = \{i1, \cdots, ik\}$.[19] There are $n + 1$ tournaments in our setting: one among provincial leaders, and n among prefectural leaders in each province. In the provincial (prefectural) tournament, n (k) contestants compete via economic performance to get promoted. For the sake of simplicity, we assume that in each of the $n + 1$ tournaments, only one of the contestants gets promoted. The case of multiple winners can be similarly analyzed following the models summarized in Sisak (2009), and the analysis is relegated to the Online Appendix. Suppose the gain from promotion for a provincial (prefectural) leader is V_1 (V_2). We treat the values of V_1 and V_2 to be predetermined (such as political rents or social prestige) and unable to be changed by the political leaders.

The final output in each prefecture city $ij \in \mathcal{K}_i$ is denoted as y_{ij} (interpreted as GDP growth rate). y_{ij} is determined jointly by the efforts of the central leader, provincial leader i and prefectural leader ij.[20] In particular, we assume that $y_{ij} = Ax_{ij}x_ix_0$, where x_{ij} is the effort made by prefectural leader ij, x_i the effort made by the provincial leader i and

[19]The symmetry assumption is just for analytical simplicity. Tournaments with asymmetric players can be analyzed similarly but only in general without explicit solutions.

[20]We use "effort" to proxy officials' decisions to stimulate economic growth. Examples include, but are not limited to, infrastructure investment and economic-stimulating policies. This assumption simplifies the determination of China's GDP growth while reflecting the leading role of government in the process of economic growth, as emphasized in the introduction section.

x_0 the effort made by the central leader. x_0 benefits all cities nationwide, and x_i benefits all cities in province i. The efforts by different levels of officials are complements, which reflects the reality, since there is wide-spread complementarity among different units within one organization (Milgrom and Brynjolfsson, 2012). Our main comparative statics results do not change in the case with substitutional efforts, as shown in the Online Appendix.

Effort x_0 costs $\frac{1}{2}c_0x_0^2$ to the central leader; effort x_i costs $\frac{1}{2}c_1x_i^2$ to the provincial leader i; and effort x_{ij} costs $\frac{1}{2}c_2x_{ij}^2$ to the prefectural leader ij. Parameters c_0, c_1 and c_2 measure the difficulties of improving economic performance for each layer of government. For the sake of simplicity, we assume that the values of c_0, c_1 and c_2 are common knowledge. The functional forms of production and cost are not restrictive, as our analysis can be easily extended to more general forms. In particular, our main results still hold for any twice continuously differentiable, convex, strictly increasing cost function C with $C(0) = 0$.

The central leader has utility function:

$$u_0 = \frac{\lambda}{nk}\sum_{i=1}^{n}\sum_{j=1}^{k} y_{ij} - \frac{1}{2}c_0x_0^2,$$

where λ measures the relative importance of economic growth in the central leader's preferences. Chinese officials bear a range of responsibilities in their territories for tasks such as economic growth, fiscal revenues, environmental protection, education, and social stability (Qian and Weingast, 1997; Zhou, 2010). Although economic growth is always a key component, its relative importance λ among all responsibilities may vary. For the theoretical analysis, it is without loss of generality to normalize $\lambda = 1$.

The provincial (prefectural) leaders incur a cost $\frac{1}{2}c_1x_i^2$ ($\frac{1}{2}c_2x_{ij}^2$), and if they get promoted, they will gain a value of V_1 (V_2). So the provincial leader i gets payoff $u_i = V_1 \cdot \mathbb{1}(\text{promoted}) - \frac{1}{2}c_1x_i^2$, and prefectural leader ij gets payoff $u_{ij} = V_2 \cdot \mathbb{1}(\text{promoted}) - \frac{1}{2}c_2x_{ij}^2$.[21]

[21]It is assumed for the sake of tractability that the provincial and prefectural leaders do not get any payoff from the realized economic growth. Our analysis can be easily extended to the case where realized economic growth also enters into officials' payoff functions., which is analyzed in the Online Appendix.

Finally, each player has a normalized reservation utility of zero. The introduction of reservation utility imposes an individual participation constraint in our model: by participating in the contest, each player's expected payoff should be at least zero.

2.2 The Role of Targets

Local government leaders compete through a Tullock contest for promotion.[22] In reality, a leader with the best economic performance will not necessarily get promoted because there are other factors such as political loyalty and political connections (Jia et al., 2015). The probabilistic feature of Tullock competition is consistent with this reality in China. The game proceeds as follows. First, the central leader chooses a growth target $\bar{y}_0$ and an effort level x_0. Observing $\bar{y}_0$ and x_0, each provincial leader i simultaneously chooses his own targets $\bar{y}_i$ and effort x_i. Finally, the prefectural leaders ij simultaneously choose efforts x_{ij}.

We incorporate the role of targets into a standard Tullock model in the following way. For a prefectural leader $ij \in \mathcal{K}_i$, the probability of being promoted p_{ij} depends on his relative output among all of the prefectures within province i and the target set by province i. More specifically, when the leader has an output of $y_{ij} > 0$, the promotion probability is:

$$p_{ij}(y_{i1}, \cdots, y_{ik}, \bar{y}_i) = \frac{g(y_{ij}, \bar{y}_i)}{\sum_s g(y_{is}, \bar{y}_i)}.$$

The above specification inherits the standard form of CSF, and the score function $g(y_{ij}, \bar{y}_i) \geq 0$ measures the impact of y_{ij} in the contest. Notice that we allow the function $g(y_{ij}, \bar{y}_i)$ to depend on $\bar{y}_i$, the target set by province i. A change in $\bar{y}_i$ changes the shape of CSF, and hence affects the optimal effort level chosen by each prefecture leader in province i. We assume that any leader has zero probability of promotion if his output is zero, even when all of his competitors have zero output. This assumption is natural since exerting zero effort means giving up the promotion tournament.

[22]The introduction of Tullock contest model can be found in Tullock (1967), Tullock (1980), Corchón (2007), and Konrad (2009).

Similarly, for provincial leader $i = 1, 2, \cdots, n$, the promotion probability function q_i is specified as:

$$q_i(y_1, \cdots, y_n, \bar{y}_0) = \frac{h(y_i, \bar{y}_0)}{\sum_t h(y_t, \bar{y}_0)},$$

where $y_i = \frac{1}{k}\sum_j y_{ij}$ is the average performance in province i. In the above specification, we use a different functional form h to allow for different promotion rules for central and provincial tournaments.

We impose several natural assumptions on both g and h functions in CSF. Since the roles of g and h in CSF are identical, we only state assumptions on function g and the assumptions on function h are exactly the same.

ASSUMPTION 1 *For any $\bar{y}$, function $g(y, \bar{y})$ satisfies:*

1. *$g(\cdot, \bar{y}) \geq 0$ is twice continuously differentiable in $\mathbb{R}_+$;*

2. *$\frac{\partial g}{\partial y} > 0$, $\frac{\partial^2 g}{\partial y^2} \leq 0$;*

3. *$\lim_{y \searrow 0} \frac{\partial g}{\partial y} = +\infty$, $\lim_{y \nearrow +\infty} \frac{\partial g}{\partial y} = 0$.*

The above assumptions are standard in a Tullock contest model (Corchón, 2007). Part (2) says that better performance increases the probability of promotion, which is consistent with the fact that the promotion of Chinese local officials has been significantly linked with the GDP growth of their jurisdictions. We further require that function g is concave in the final output to guarantee the validity of first order approach. Part (3) essentially imposes the well-known Inada condition.

Assumption 1 specifies the relationship between score g and realized economic growth y. The next assumption specifies how growth target $\bar{y}$ affects score g through the elasticity: $e_g(y, \bar{y}) = \frac{\partial g / \partial y}{g / y}$, in accordance to the anecdotal evidence shown in Section 1.3.

ASSUMPTION 2 *Function $e_g(y, \bar{y})$ satisfies:*

1. *For any $\bar{y}$, $e_g(y, \bar{y})$ is decreasing in y;*

2. *For any* y, $e_g(y, \bar{y})$ *is increasing in* $\bar{y}$;

3. *For any* y, $\lim_{\bar{y}\searrow 0} e_g(y, \bar{y}) = m$ *and* $\lim_{\bar{y}\nearrow +\infty} e_g(y, \bar{y}) = M$ *with* $m < 2 < 4 < M$.

Part (1) of Assumption 2 is a technical assumption to guarantee the uniqueness of symmetric Nash equilibrium (Proposition 1). The key assumption is part (2), which further requires that the elasticity of function g with respect to the final output be increasing in $\bar{y}$. In other words, under a higher target, one *percentage* increase in output y will induce a higher proportional increase in the score, and thus a larger increase in the probability of promotion. It is called the "complementarity assumption" because the realized growth rate and the target proposed by the superior are complements. We later provide empirical support for this condition in Section 4.1. Finally, the two additional requirements in part (3) are imposed to guarantee the existence of an interior optimal target $\bar{y}$.

A leading example of the score function which satisfies Assumption 2 is $g(y, \bar{y}) = \alpha_0 + \alpha_1(y - \bar{y})$, with $\alpha_1 > 0$.[23] This is an extension of the score function $g = y$, which is widely used in the literature. There is a very intuitive interpretation of the score function $g(y, \bar{y}) = \alpha_0 + \alpha_1(y - \bar{y})$. Under this function form, the score of the subordinates depends on the difference between their own GDP growth rates and the target set by their superior. This actually highlights the role played by the target as an incentive scheme. When the superior considers economic growth more (or less) valuable due to the change of λ, she can set a higher (or lower) target to make subordinates' promotion more (or less) responsive to their economic performance, as illustrated by the anecdotal evidence in Section 1.3. In response, the subordinates will exert more effort to achieve the target in pursuit of their promotion. Therefore the superior can use target as a guideline to incentivize subordinates to exert greater effort and promote economic growth, even though it is not mandatory.

[23]Part (1) of Assumption 2 is satisfied only when $e_g > 1$. As evident from the analysis below, the equilibrium cannot occur at $e_g \leq 1$. The Inada condition of Assumption 1 is not satisfied by this linear functional form. But the Inada condition is unnecessarily strong to guarantee the existence of the symmetric Nash equilibrium for general score functions (see the proof of Proposition 1). It is straightforward to show the existence of symmetric Nash equilibrium in linear score function specification.

In this sense, growth targets help to align the interests of leaders and subordinates in the promotion tournament.

3 Model Analysis

The game is solved in a backward procedure. We first characterize the equilibrium in the last period where the prefectural leaders choose their efforts simultaneously. Given the best responses of the prefectural leaders, we solve the optimal efforts and targets chosen by the provincial leaders in the second period. Finally, we characterize the central leader's optimal strategy in the first period.

3.1 Equilibrium in the Last Period

In the last period, prefectural contestants act in a simultaneous move game with complete information. Since national and provincial level targets and efforts have already been chosen, they are fixed and the game in the last period becomes a standard Tullock contest setting. Hence, it is straightforward to characterize the symmetric Nash equilibrium in this period given the previous choices x_0, x_i and $\bar{y}_i$. The detailed proofs of the following and all subsequent results can be found in the Online Appendix A. In the Appendix, we provide a sketch of the proofs for Proposition 1 and 2.

PROPOSITION 1 *Given $x_0 > 0$, $x_i > 0$ and $\bar{y}_i$, denote $x_{ij}^{\star}$ to be the unique solution to the following equation about x_{ij}:*

$$(k-1)V_2 e_g(y_{ij}, \bar{y}_i) = k^2 c_2 x_{ij}^2, \tag{1}$$

where $y_{ij} = A x_{ij} x_i x_0$.

*Then, there exists a **unique** symmetric Nash equilibrium in the third period where each*

contestant's effort is given by the following:

$$x_{ij} = \begin{cases} x_{ij}^{\star} & \text{if } 0 \leq \frac{V_2}{k} - \frac{1}{2}c_2(x_{ij}^{\star})^2; \\ \begin{cases} \hat{x}_{ij} \quad w/p\ \gamma; \\ 0 \quad w/p\ 1-\gamma \end{cases} & \text{otherwise.} \end{cases}$$

$\hat{x}_{ij}$ and $x_{ij}^{\star}$ are identical to all $ij \in \mathcal{K}_i$ (i.e., $\hat{x}_{ij} = \hat{x}_{ij'}$ and $x_{ij}^{\star} = x_{ij'}^{\star}$), and $\hat{x}_{ij}$ and γ are determined uniquely by the following system of equations:

$$[1-(1-\gamma)^k]V_2 = \frac{1}{2}\gamma k c_2 \hat{x}_{ij}^2 \tag{2}$$

and

$$\sum_{t=0}^{k-1} \binom{k-1}{t} \gamma^t (1-\gamma)^{k-t-1} \frac{t}{(t+1)^2} V_1 e_g(\hat{y}_{ij}, \bar{y}_i) = c_2 \hat{x}_{ij}^2, \tag{3}$$

where $\hat{y}_{ij} = A\hat{x}_{ij}x_i x_0$.

The above characterization of the symmetric Nash equilibrium reflects the most important feature of our model: the target is not mandatory but plays the role of a guideline. Applying the complementarity assumption to (1), it is straightforward to verify that $x_{ij}^{\star}$ is increasing in $\bar{y}_i$. As the provincial target increases, the prefectural leaders will put more effort into promoting economic growth, even though they are not required to achieve the targeted growth. This is because a higher provincial target signals that economic performance plays a more important role in the promotion of prefectural leaders. However, provincial leaders cannot achieve an arbitrarily high economic growth rate by setting an arbitrarily high target, because of the individual rationality constraint on the prefectural leaders. In particular, when the provincial target is set too high, compared to exerting effort $x_{ij}^{\star}$, the prefectural leaders would rather quit the tournament by exerting zero effort. This is allowed since the target is not mandatory to reach. Therefore, in the unique symmetric Nash equilibrium, the realized provincial growth rate increases with the provincial target as long as the

provincial target is not set so high as to violate the prefectural leaders' individual rationality constraints. Otherwise, the prefectural leaders are likely to quit by playing a symmetric mixed strategy Nash equilibrium. Using Assumptions 1 and 2, we show that this symmetric mixed strategy Nash equilibrium has a very simple structure: player ij exerts effort $\hat{x}_{ij}$ with probability γ, and quits with the complementary probability. And the next corollary shows that as the growth target $\bar{y}_i$ increases, the effort level $\hat{x}_{ij}$ will increase but the probability γ of choosing effort $\hat{x}_{ij}$ will decrease.

COROLLARY 1 *When* $0 > \frac{V_2}{k} - \frac{1}{2}c_2(x_{ij}^{\star})^2$ *and the prefectural contestants are playing the unique symmetric mixed strategy Nash equilibrium, the effort* $\hat{x}_{ij}$ *and the probability* γ *satisfy:*

$$\frac{\partial \hat{x}_{ij}}{\partial \bar{y}_i} > 0 \quad \textit{and} \quad \frac{\partial \gamma}{\partial \bar{y}_i} < 0.$$

Since the effort level $\hat{x}_{ij}$ and the probability γ change in different directions, the realized provincial growth rate may not necessarily increase with the provincial target. As will be shown later, the realized provincial growth rate *decreases* with the provincial target when the prefectural leaders are playing the symmetric mixed strategy Nash equilibrium.

3.2 Equilibrium in the First Two Periods

In the second period, anticipating the prefectural leaders' best responses in the third period, the provincial leaders choose their efforts and targets simultaneously, given the central leader's effort and target. From Proposition 1, a provincial leader can either choose a high target to induce the symmetric mixed strategy Nash equilibrium in the third period, or choose a low target to induce the symmetric pure strategy Nash equilibrium. The next proposition implies that the optimal provincial target must induce pure strategy equilibrium and extract the full surplus from the prefectural leaders in the third period.

PROPOSITION 2 *In the second period, if provincial leader chooses* $x_i > 0$*, the optimal target* $\bar{y}_i$ *set by this leader induces the prefectural leaders to choose* $x_{ij}^{\star} = \sqrt{\frac{2V_2}{kc_2}}$*, and thus*

$$e_g(y_{ij}^e, \bar{y}_i) = \frac{2k}{k-1}, \tag{4}$$

where $y_{ij}^e = A\sqrt{\frac{2V_2}{kc_2}} x_i x_0$.

The above proposition is quite intuitive. When the prefectural leaders play the symmetric pure strategy Nash equilibrium, an increase in the target $\bar{y}_i$ will increase prefectural leader's equilibrium effort level without any cost. Naturally, it is optimal to keep increasing until $x_{ij}^\star = \sqrt{\frac{2V_2}{kc_2}}$, which makes the participation constraint binding. By doing so, the provincial leader extracts the full surplus from the prefectural leaders. Notice that the provincial leader also extracts the full surplus if the prefectural leaders play mixed strategy equilibrium in the third period. But it is always suboptimal to do so. This result comes from the concavity of g and h functions with respect to the final outputs. First, the concavity of $h(y, \cdot)$ with respect to y makes the provincial leaders actually be risk-averse and playing mixed strategy will reduce the provincial leaders' expected payoffs. Second, the concavity of $g(y, \cdot)$ with respect to y makes the prefectural leaders risk-averse as well. As a result, the induced expected effort will be lower to compensate the strategic risk, which implies that the expected realized provincial growth rate decreases with the provincial target. Therefore, the optimal provincial target level set in the second period should induce the pure strategy effort $\sqrt{\frac{2V_2}{kc_2}}$ in the third period.

The provincial leaders face another promotion tournament with promotion probability

$$q_i(y_1, \cdots, y_n, \bar{y}_0) = \frac{h(y_i, \bar{y}_0)}{\sum_t h(y_t, \bar{y}_0)}.$$

Denote $e_h(y, \bar{y}) = \frac{\partial h / \partial y}{h/y}$. Given that the target is set such that the prefectural leaders always choose $\sqrt{\frac{2V_2}{kc_2}}$ in equilibrium, the equilibrium effort level exerted by the provincial leaders can be characterized in the following proposition:

PROPOSITION 3 *Given* $x_0 > 0$ *and* $\bar{y}_0$*, denote* $x_i^\star$ *to be the unique solution to equation*

$(n-1)V_1 e_h(y_i, \bar{y}_0) = n^2 c_1 x_i^2$, *where* $y_i = A\sqrt{\frac{2V_2}{kc_2}} x_i x_0$.

Then, there exists a unique symmetric Nash equilibrium in the second period where each contestant's effort is given by the following:

$$x_i = \begin{cases} x_i^\star & \text{if } 0 \leq \frac{V_1}{n} - \frac{1}{2}c_1(x_i^\star)^2; \\ \begin{cases} \hat{x}_i \quad w/p\ \zeta; \\ 0 \quad w/p\ 1-\zeta \end{cases} & \text{otherwise.} \end{cases}$$

$\hat{x}_i$ *and* ζ *are determined uniquely by the following system of equations:*

$$[1-(1-\zeta)^n]V_1 = \frac{1}{2}\zeta n c_1 \hat{x}_i^2 \tag{5}$$

and

$$\sum_{t=0}^{n-1} \binom{n-1}{t} \zeta^t (1-\zeta)^{n-t-1} \frac{t}{(t+1)^2} V_1 e_h(\tilde{y}_i, \bar{y}_0) = c_1 \hat{x}_i^2, \tag{6}$$

where $\tilde{y}_i = A\sqrt{\frac{2V_1}{kc_2}} \hat{x}_i x_0$.

Given this characterization of the equilibrium strategies of the provincial and prefectural leaders, we can finally solve the optimal effort and target chosen by the central leader in the first period. The results are given by the following proposition:

PROPOSITION 4 *In the first period, it is optimal for the central leader to choose effort*

$$x_0^\star = \frac{A\sqrt{\frac{2V_2}{kc_2}}\sqrt{\frac{2V_1}{nc_1}}}{c_0}, \tag{7}$$

and the optimal target $\bar{y}_0^\star$ *is set such that*

$$e_h(y^\star, \bar{y}_0) = \frac{2n}{(n-1)}, \tag{8}$$

where $y^\star = (A\sqrt{\frac{2V_2}{kc_2}}\sqrt{\frac{2V_1}{nc_1}})^2/c_0$.

As in Proposition 2, the optimal target $\bar{y}_0$ is set such that the provincial leaders play the symmetric pure strategy Nash equilibrium with the highest effort $x_i^\star = \sqrt{\frac{2V_1}{nc_1}}$ and hence in the first period, x_0 is chosen to maximize:

$$A\sqrt{\frac{2V_2}{kc_2}}\sqrt{\frac{2V_1}{nc_1}}x_0 - \frac{1}{2}c_0x_0^2,$$

where $\sqrt{\frac{2V_2}{kc_2}}$ is the equilibrium effort exerted by the prefectural leaders and $\sqrt{\frac{2V_1}{nc_1}}$ is the equilibrium effort exerted by the provincial leaders. The first order condition immediately implies that the optimal effort chosen in the first period is given by (7). In the symmetric equilibrium, all cities have the same growth rate $y^\star = (A\sqrt{\frac{2V_2}{kc_2}}\sqrt{\frac{2V_1}{nc_1}})^2/c_0$.

3.3 Testable Implications

Our model has rich testable implications for both the targets and the realized economic growth rates. Since the focus of our study is the role of targets in the promotion tournament, we will devote our attention to the model predictions and empirical tests regarding the targets. The first sub-section discusses how the equilibrium targets change with the underlying parameters. The second sub-section compares the equilibrium targets set by the central leader and provincial leaders, and investigates the conditions under which there would be a top-down amplification of targets.

3.3.1 Comparative statics

The next proposition provides a set of comparative statics results about the provincial targets $\bar{y}_i$ based on the equilibrium characterizations. All results apply to any functional form of $g(\cdot)$ and $h(\cdot)$ that satisfy Assumptions 1 and 2.

PROPOSITION 5 *In equilibrium, we have: 1)* $\frac{\partial \bar{y}_i^\star}{\partial V_1} > 0$ *and* $\frac{\partial \bar{y}_i^\star}{\partial V_2} > 0$*; 2)* $\frac{\partial \bar{y}_i^\star}{\partial A} > 0$, $\frac{\partial \bar{y}_i^\star}{\partial c_1} < 0$ *and* $\frac{\partial \bar{y}_i^\star}{\partial c_2} < 0$*; and 3)* $\frac{\partial \bar{y}_i^\star}{\partial k} < 0$.

The comparative statics results shown in the above proposition are very intuitive. The equilibrium provincial target level becomes higher if (1) government officials get a higher value from promotion, measured by a higher V_1 or V_2; and (2) it is easier to promote economic growth (higher A and lower c_1, c_2). Notice that the provincial targets change with the prefectural leaders' effort cost parameter as well. So when the prefectural leaders' effort cost parameter c_2 decreases, the provincial leaders will increase the target by anticipating that the prefectural leaders will increase their efforts. In addition, the equilibrium target decreases with the number of prefectural contestants: $\frac{\partial \bar{y}_i^\star}{\partial k} < 0$. This is due to the fact that in our Tullock contest setting, an increase in the number of contestants generates a negative externality in the sense that each prefectural leader faces a lower chance of winning the promotion tournament. As a result, the prefectural leaders' individual rationality constraints to play the symmetric pure strategy of high effort become harder to satisfy. Anticipating this, the provincial leader will decrease the target level to lessen the individual rationality constraint for each prefectural leader.

3.3.2 Top-down amplification of targets

Proposition 4 and Proposition 2 characterize the equilibrium central target $\bar{y}_0^\star$ and the equilibrium provincial targets $\bar{y}_i^\star$, respectively. In the symmetric equilibrium, the final output is the same as $y^\star = (A\sqrt{\frac{2V_2}{kc_2}}\sqrt{\frac{2V_1}{nc_1}})^2/c_0$, and hence the equilibrium targets should satisfy the following equations:

$$e_h(y^\star, \bar{y}_0^\star) = \frac{2n}{(n-1)} \quad \text{and} \quad e_g(y^\star, \bar{y}_i^\star) = \frac{2k}{(k-1)}. \tag{9}$$

As documented in section 2, we observe a significant pattern of top-down amplification: $\bar{y}_0^\star < \bar{y}_i^\star$. The following theorem states when this phenomenon can occur in equilibrium.

THEOREM 1 *If $h = g$, top-down amplification $\bar{y}_0^\star < \bar{y}_i^\star$ occurs if and only if $n > k$.*

The above theorem offers a novel explanation for the top-down amplification phenomenon.

First of all, it implies that this phenomenon has nothing to do with other parameters such as the values of promotion (V_1 and V_2) and the cost of promoting economic growth (c_0, c_1, and c_2). No ad-hoc assumptions are required about the relative promotion valuation / effort cost for officials at different levels of jurisdiction. These parameters affect the level of targets as shown by Proposition 5, but the impact is only through the change in final outputs. As the real economic growth for provinces (prefectures) is the same, these parameters do not affect the central (provincial) targets.

Secondly, Theorem 1 attributes the top-down amplification to the larger number of provinces compared to the number of prefectures in each province. The number of jurisdictions in our model proxies the number of players faced by local political leaders at each hierarchical government level. As in the traditional Tullock contest model, when the number of contestants increases, the degree of competition increases and each contestant's probability of winning the contest decreases. Moreover, as the probability of winning decreases, the participation constraint of playing the symmetric pure strategy equilibrium is more likely to fail, and hence due to the complementarity assumption, the upper-level leader will lower the target to soften competition and incentivize subordinates. So the top-down amplification phenomenon comes from the decrease in promotion probability along the hierarchical levels.

The decreasing number of jurisdictions under each level of government accords exactly with China's reality. China has 31 (n) province-level administrative units and 333 city-level administrative units. On average, each province has about 10-11 (k) city-level administrative units and no province has more than 30 city-level administrative units. Therefore, the condition $n > k$ in Theorem 1 is satisfied and this explains why the provincial targets exceed the central target. Moreover, although we only include central, provincial and prefectural governments in our model, it is straightforward to extend the model to include county level governments. Similar logic implies that the prefectural targets will exceed the provincial targets if the number of counties in each city is smaller than the number of cities in each province. This is also true in reality. In China, there are 2,862 county-level administrative

units and on average each city has about 8-9 county-level administrative units, which is smaller than the number of administrative units within one province.

Another implicit assumption in our model is that only one of the local leaders can get promoted. In reality, the number of possible positions that local leaders may be promoted to in the next layer of government may vary and exceed just one. Therefore, the number of jurisdictions is not the only determinant of the competitiveness faced by each layer of political leaders. Using our data, we also calculate the promotion probabilities of provincial and prefectural leaders. From Online Appendix Table 3, it is obvious that the provincial leaders are much less likely to get promoted than the prefectural leaders. The logic in Theorem 1 then implies that the provincial targets should be higher than the central target.

3.4 Model Extensions

In the Online Appendix, we consider several natural extensions of our baseline model, including (i) the number of prizes is not restricted to one in the tournament; (ii) efforts are substitutes instead of complements in the production function; (iii) local officials receive additional payoffs from the realized outputs; and (iv) regional externality in the production function: effort exerted by one prefectural leader decreases the output in the other prefectures. In all these extensions, the comparative statics results in Proposition 5, in particular, the comparative statics with respect to the number of prefectures k still hold, and the decreasing number of jurisdictions along hierarchical levels in China is still one driving force for the top-down amplification of targets. However, the "only if" part of Theorem 1 may not hold in these extension, as new factors introduced by these extensions also affect the target setting behavior.[24] In the next section, we test our comparative statics using target levels and other economic data in China.

[24]Even in our benchmark setting with different promotional rule ($h \neq g$), it may still predict top-down amplification when the number of jurisdictions are the same in two layers ($k = n$), if the central government's promotion rule is more sensitive to economic growth ($e_h > e_g$).

4 Empirical Tests

This section reports the empirical evidence for our theoretical assumptions and predictions about the target setting behavior. We first empirically test the key complementarity assumption of our model by estimating the promotion function in a structural way. We then show supporting evidence on the comparative statics derived from our model, including the effect of contestant number on target setting, and the response to policy shocks that may alter the cost parameters of local officials' efforts in pushing economic growth. Finally, we rule out two alternative explanations for target setting: announcing growth potential for support, and signaling political loyalty.

4.1 Structural Estimation of Promotion Function

We make two key assumptions in our theoretical model: (1) the probability of promotion increases with realized GDP growth; (2) the complementarity assumption that the higher the growth target the subordinate faces, the more responsive his promotion is to GDP growth. The first assumption has gained empirical support in the existing literature (Chen et al., 2005; Li and Zhou, 2005; Wu et al., 2013; Yao and Zhang, 2015), whereas the second complementarity assumption has never been tested before. Our first goal is to show some empirical evidence validating these two assumptions.

Standard linear regression does not offer consistent evidence because promotion is determined by the local officials' own growth rates as well as by the growth rates of their competitors. The nonlinearity of the promotion function is another factor that invalidates the OLS estimation. In order to enable consistent inference and more precise quantification, we employ a structural approach to estimate the promotion function. More specifically, we assume a linear score function for contestant i in tournament t as

$$g(y_{it}, \bar{y}_t, x_{it}) = 1 + \alpha_1 y_{it} + \alpha_2 \bar{y}_t + x_{it}\beta$$

where y_{it} is the realized GDP growth rate by contestant i in tournament $t \in \{1, 2, ..., T\}$, $\bar{y}_t$ is the target imposed by the superior and faced by all contestants in this tournament, and x_{it} includes other control variables. The intercept term is not identified, thus is normalized to one. The corresponding promotion probability is

$$p_{it} = \frac{g(y_{it}, \bar{y}_t, x_{it})}{\sum_j g(y_{jt}, \bar{y}_t, x_{jt})}$$

We observe $(y_{it}, \bar{y}_t, x_{it})$ together with the indicator for promotion $d_{it} \in \{0, 1\}$, so the log-likelihood is

$$\log L = \frac{1}{T} \sum_{i,t} \left(d_{it} \log p_{it} + (1 - d_{it}) \log(1 - p_{it}) \right)$$

From our parametric model above, the two key assumptions we have made are interpreted as $\alpha_1 > 0$ and $\alpha_2 < 0$.[25] Table 5 reports our estimates above using provincial tournaments for the promotion of prefectural leaders. In column (1), although insignificant, the promotion score function is estimated to be increasing in the realized growth rate (b=0.004, se=0.007), and decreasing in the provincial target made by superiors (b=-0.061, se=0.021). After including officials' characteristics in column (2), this two estimates become significant at 0.014 (se=0.003) and -0.081(se=0.030).

4.2 Target Setting and Number of Contestants

The central prediction of our model is the negative relationship between the target level and the number of contestants in the tournament, which is critical for our explanation of the top-down amplification phenomenon. A higher target can incentivize subordinates to exert more effort to promote economic growth, but at a cost of making contestants more likely to give up the tournament and exert zero effort. When there are more contestants participating in the tournament, the chance of winning, thus the expected gain from exerting positive effort, is smaller. So the target has to be lower to lessen the individual rationality constraint. In

[25] It is easy to show $e_g = \frac{\alpha_1 y}{1+\alpha_1 y+\alpha_2 \bar{y}+x\beta}$, which is increasing in $\bar{y}$ if and only if $\alpha_2 < 0$.

our content of Chinese sub-national government bureaucracy, our model predicts a negative correlation between the growth target and the number of jurisdictions in the territory.

Table 6 confirms our prediction using data from provincial five-year plans in Panel A, and annual economic plans in Panel B.[26] All columns include year fixed effects for common economic trends, lagged realized GDP and logarithm of GDP per capita for economic shocks, and average distance to provincial capital for the administrative complexity.[27]

In column 1, we find a negative correlation between provincial five-year targets and the number of cities in a province. One additional prefecture lowers the provincial target by 0.027 (se = 0.026, p = 0.31) percentage point. This result may under estimate the real effect due to the attrition bias, as subordinate cities are asymmetric in contributing the economics, as well as participating the political tournament. For example, in the provincial tournament with city leaders as contestants, only those leaders from rich cities are likely to be the winners of the tournament. The chances of promotion for leaders from small cities are quite small.[28] In order to capture this effect, we construct a measure for the number of effective contestants by calculating the number of important cities within a province, which equals the minimum number of cities that make up to 70% of the total GDP in that province.[29] Column 2 reports the estimates using the number of effective cities. We find a larger effect due to the change in effective city number. One additional effective city will lower the provincial target by 0.127 percentage point. The average number of effective city is 6, which implies that doubling the effective city number will lower the average provincial target from 9.24% to 8.48%.

Finally, we use the number of cities in 1956 as an instrumental variable for the number

[26]Results for the prefectural targets are similar and are shown in the Online Appendix.

[27]One contaminating explanation for the negative correlation between provincial growth targets and number of cities is administrative and monitoring costs: a province with more cities to govern probably has higher administrative and monitoring costs than those provinces with fewer subordinate cities, which leads to a lower provincial growth target. To rule out this explanation, we include the average distance to provincial capital across all cities as a measure of administrative and monitoring costs.

[28]In some cases, a province consists of a dozen cities, but several bigger ones contribute the lion's share of the provincial GDP. For example, Hebei province has 11 prefectural cities, but the five biggest ones contribute 70 percent of its GDP.

[29]The results are robust to different threshold levels of the GDP share for important cities, ranging from 60%, 70%, 80% to 90%.

of city today in order to control for potential endogeneity from reverse causality: provinces with higher economic performance may tend to build more cities, producing a downward bias for the negative effect of the number of cities on provincial targets. Columns 3 – 4 report this estimate using the instrumental variable. As expected, after dealing with such inverse causality, the city number becomes a more important determinant of the provincial target level. One more city will lower the provincial target by 0.179 percentage point.

Panel B replicates the above estimation using the provincial annual targets. All patterns are similar; however, the effect is smaller compared to the five-year targets. One additional city will lower the provincial annual target by 0.023 (column 5), which is smaller than the effect for the five-year plan in column 1. Annual targets are noisier and more subject to unanticipated, short-run economic shocks, and thus less predictable than the five-year ones. This explanation is also confirmed by a larger effect of the provincial specific time-varying economic factors measured by the lagged realized growth rate.

4.3 Targets in Response to Large Economic Programs

The Chinese central government is capable of influencing the economy through large economic stimulus programs. We exploit two economic stimulus programs in our data window, the *Western Development Program* and the *Northeast Revival Program*. The central government initiated and launched both programs in 2000 and 2006 respectively. These two programs aimed at directing resources towards the two specific regions and boosting economic development, by offering better access to bank loans, more fiscal funding and tax benefits, higher infrastructure investment from the central government, and other policy benefits.[30] In

[30]The *Western Development Program* involves 12 provinces located in the western part of China, specifically including: Shanxi, Shaanxi, Gansu, Qinghai, Ningxia, Gansu, Xinjiang, Guizhou, Sichuan, Yunan, Tibet and Chongqing. These provinces tend to be relatively poor regions, and the main goal of the program is to mitigate the regional imbalance between eastern and western provinces. See e.g., `https://en.wikipedia.org/wiki/China_Western_Development`. The *Northeast Revival Program* targets four provinces: Heilongjiang,Jilin, Liaoning, and Inner Mongolia. The northeastern region used to be a major manufacturing center in China, but has lagged behind economically since the 1980s. In China both the western and northeastern regions have been well defined in terms of their geographical boundaries and the provinces they include.

our framework, the two programs had the effect of lowering the cost of stimulating economic growth for local officials in the beneficiary regions.

We examine whether provinces in the affected regions increase their target levels more after the policy implementation, compared to provinces in non-affected regions.[31] Table 7 reports the results. We define a province being affected ("West" or "Northeast") if it is located in the one of the program regions. In all regressions, we include provincial fixed effects to control for province-specific unobservables, and year fixed effects for time-varying common economic shocks. Columns 1 and 3 use the sample of provincial five-year plans while columns 2 and 4 use annual provincial plans. All results are consistent with our model predictions: that the treated provinces are induced to announce higher targets. Specifically, we find that five-year and annual targets for western provinces are 10.8% and 11% higher respectively after the *Western Development Program* in 2000 (columns 1 and 2). And the *Northeast Revival Program* also increases the provincial targets by 15.5% and 9.3% for five-year and annual plans respectively (columns 3 and 4).

5 Alternative Explanations

Up till now, we propose one explanations for the targeting setting behavior of Chinese sub-national government. Despite it's parsimonious, intuitive, and consistent with a batch of empirical evidences, our theory is not exhaustive, and there exists other explanations. In this section, we rule out two alternatives: resource budgeting, and loyalty signaling.

5.1 Growth Potential and Central Transfers

One rationale for the target setting is to signal locality's growth potential. Local government announces growth target to the superior in order to gain more support (e.g. fiscal transfers) in the budgeting process.

[31] Although our specification implements the difference-in-difference strategy, we do not claim causality here, as the identification assumptions may not stand. The timing as well as the affected area of the stimulus program may be endogenous, say, some negative economic shocks. And these two changes are contemporaneous with many other smaller economic changes. We thank our referees to point this out.

We test this explanation directly using the transfer payments received by the local governments, which proxies the support from the superior. Specifically, we regress the logarithm of transfer payments on the growth targets; a positive coefficient implies the validity of the above support-seeking argument. Table 8 reports the results, with columns 1 – 2 for provincial level, and columns 3 – 4 for prefectural level. In all columns, the growth target has no significant correlation with the transfer payments from the upper level, thereby inconsistent with the above support-seeking argument. As the main purpose of transfer payment is income redistribution from rich regions to poor ones, we control for per-capital GDP, with an indeed negative and significant coefficient (columns 2 and 4).[32]

5.2 Loyalty Signaling

Another rationale for the target setting is to signal local leaders' political loyalty. As the upper-level official is competing with his counterparts in the performance-based promotion tournament, he needs strong support from his subordinate officials to work on the economic performance in his territory. One possible role for the growth target is to express his determination and thus political loyalty to his upper-level official.[33]

But this explanation is problematic in the following sense. Since the local leaders are free to set any target without any cost, it is optimal for every leader to set a target as high as possible but then target itself is meaningless. One way to avoid this situation is to add the realized output in the CSF (i.e., the score function g depends on $\bar{y}_i$, $\bar{y}_{ij}$, and y_{ij}). When a superior decides whom to promote, he looks at both the performance and the political loyalty of each subordinate. We rule out this explanation using our structural estimation of promotion function.

[32]The support-seeking argument also struggles to explain the top-down amplification. In particular, for the purpose of seeking support, the target announced by each local government should be orthogonal to the upper-level growth target. Hence, this argument also goes against the existence of top-down amplification.

[33]It is easy for the superior to induce such loyalty signaling by changing the score function, say, the score function g just depends on $\bar{y}_i$, the target set by his superior, and $\bar{y}_{ij}$, the target set by himself. More specifically if $g(\bar{y}_i, \bar{y}_{ij}) = \alpha_0 + \alpha_1(\bar{y}_{ij} - \bar{y}_i)$, then top-down amplification of targets (i.e., $\bar{y}_{ij} > \bar{y}_i$) naturally arises.

Column 3 of Table 5 includes the growth targets made by prefectural leaders themselves as an independent variable. If there is loyalty signaling, the coefficient of this variable should be significantly positive. However, it is insignificant, which supports our favored explanation for the target setting: targets are mainly used as a mechanism to convey preference to subordinates, but prefectural officials who set the targets cannot benefit directly from the increase of their own targets. As a result, we do not find evidence to support hat self-made targets are used for loyalty signaling.

6 Conclusion

China's sustained and strong economic growth for nearly four decades has spawned myriad studies about the potential driving forces behind the country's remarkable development. This paper offers a clue to understanding China's strong growth by focusing on the role of growth targets in political competition at the multiple layers of government in China. Using a large dataset on five-year and annual economic development plans, we first document stylized facts about the top-down amplification of growth targets along hierarchical levels of government. We then build a Tullock contest model with targets to analyze target setting as an incentive scheme for local government officials to promote regional economic growth. In our model, political superiors use targets to convey their preference for economic growth and align the interests of superiors and their subordinates involved in promotion tournaments. This model explains the top-down amplification of economic growth targets along the different levels of jurisdiction that is observed in China. The model also derives other testable predictions supported by the empirical evidence. In addition, we rule out an alternative resource-seeking explanation of the growth targets.

While target setting in multi-layered political competition is helpful to generate high economic growth in the context of China, it may also produce overly strong incentives for boosting economic growth at the expense of other equally important government goals. The undesirable side effects that typically occur in a multi-tasking setting are manifest in China's

worsening environmental quality, excessive energy consumption, insufficient provision of education and social security and other socio-economic problems. The current administration led by Xi Jinping recognizes the severity of these side effects, and it has already started to lower the growth target in the 12th five-year plan in order to address the issues that arise in a multi-tasking setting. How the lowered growth targets impact multi-layered political competition and China's future growth path is an important topic for future research.

Our research also contributes to the large literature on target setting and its effect on organizational performance. In particular, our paper is the first to investigate both theoretically and empirically how a multi-layered hierarchical organization sets performance targets at its different hierarchical levels. Using an innovative theoretical model and supporting empirical evidence, we argue that in a multi-layered tournament-based organization, targets can serve an important function by transmitting superiors' preferences to subordinates, and hence incentivizing subordinates to behave in accordance with the superiors' preferences. Since such hierarchical target setting is very common in large, multi-layered corporations, we hope that our study can inspire more future research on the target setting behavior in such organizations.

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Table 1: Growth Targets in Provincial Five-year Plans

Five-year Plan	Central Targets	Provincial Growth Targets			Compared to Central (%)		
		Mean	Min	Max	Above	Equal	Below
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
7th (1986-1990)	7.50	8.15	4.41	10.90	0.69	0.10	0.21
8th (1991-1992)	6.00	6.83	5.00	15.50	0.50	0.23	0.27
8th (1993-1995)	8.50	10.37	7.75	16.00	0.83	0.07	0.10
9th (1996-2000)	8.00	10.45	7.50	15.00	0.94	0.03	0.03
10th (2001-2005)	7.00	8.98	7.50	12.05	1.00	0.00	0.00
11th (2006-2010)	7.50	10.15	8.55	13.05	1.00	0.00	0.00
12th (2011-2015)	7.00	10.70	8.00	13.00	1.00	0.00	0.00
13th (2016-2020)	6.55	7.68	6.05	10.05	0.84	0.06	0.10

Table 2: Growth Targets in Provincial Annual Plans

Year	Central Targets	Provincial Growth Targets			Compared to Central (%)		
		Mean	Min	Max	Above	Equal	Below
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1997	8.00	10.19	8.50	13.00	1.00	0.00	0.00
1998	8.00	9.67	8.00	12.00	0.93	0.07	0.00
1999	7.00	8.79	7.05	10.05	1.00	0.00	0.00
2000	7.00	8.53	7.00	13.00	0.90	0.10	0.00
2001	7.00	8.90	7.00	12.05	0.97	0.03	0.00
2002	7.00	8.84	7.00	12.05	0.97	0.03	0.00
2003	7.00	9.37	7.55	12.05	1.00	0.00	0.00
2004	7.00	9.77	8.00	13.00	1.00	0.00	0.00
2005	8.00	10.30	8.50	15.00	1.00	0.00	0.00
2006	8.00	10.27	8.50	15.00	1.00	0.00	0.00
2007	8.00	10.40	9.00	15.00	1.00	0.00	0.00
2008	8.00	11.01	9.00	15.00	1.00	0.00	0.00
2009	8.00	10.09	8.00	13.00	0.94	0.06	0.00
2010	8.00	10.36	8.00	13.05	0.94	0.06	0.00
2011	8.00	10.92	8.00	13.50	0.94	0.06	0.00
2012	7.50	11.08	8.00	14.00	1.00	0.00	0.00
2013	7.50	10.66	7.50	14.00	0.97	0.03	0.00
2014	7.50	9.68	7.50	12.50	0.94	0.06	0.00
2015	7.00	8.30	6.00	12.00	0.80	0.07	0.13
2016	6.75	7.81	6.00	10.05	0.84	0.10	0.06

Table 3: Growth Targets in Prefectural Growth Targets

Year	Provincial Targets		Prefectural Targets	Compared to Superior Provincial (%)			
	Mean	Ampl.		Above	Equal	Below	Missing
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
2004	9.73	0.89	12.10	0.74	0.02	0.05	0.18
2005	10.27	0.93	12.65	0.73	0.05	0.05	0.16
2006	10.27	0.93	13.01	0.83	0.03	0.05	0.10
2007	10.46	0.89	13.19	0.86	0.03	0.04	0.07
2008	11.01	0.93	13.52	0.85	0.04	0.03	0.07
2009	10.03	0.93	12.06	0.79	0.12	0.03	0.06
2010	10.30	0.96	12.57	0.82	0.09	0.04	0.05
2011	11.00	0.93	13.69	0.86	0.03	0.02	0.08
2012	11.18	0.93	13.33	0.81	0.06	0.03	0.09
2013	10.78	0.89	12.27	0.78	0.06	0.08	0.08
2014	9.74	0.93	10.63	0.70	0.17	0.06	0.07
2015	8.26	0.82	8.73	0.62	0.19	0.12	0.07

Notes:

1. Columns 1 and 2 report the provincial level statistics across 27 provinces in each year, excluding four direct-controlled municipals: Beijing, Tianjin, Shanghai and Chongqing. Column 1 reports the average provincial target, and column 2 the percentage of provinces with amplifications. A province with amplification is defined as the one whose province-level target is lower than the average targets of all its subordinate prefectures.
2. Columns 3 – 7 report the summary statistics across all prefectural targets. Column 3 reports the average prefectural targets, columns 4 – 6 report the percentage of prefectures with targets smaller than its superior provincial target, and column 7 reports the percentage of prefectures with missing targets due to the lack of data availability.
3. Provincial and prefectural annual targets are collected from *Government Development Plans* in various years.

Table 4: Realized Growth Rates and Targets

	Realized GDP Growth			Electricity Growth
	Provincial		Prefectural	Provincial
	(1)	(2)	(3)	(4)
Target growth rate	0.966***	0.479***	0.503***	1.036***
	(0.251)	(0.087)	(0.033)	(0.185)
Lag dependent variable		0.404***	0.174***	0.142
		(0.053)	(0.030)	(0.124)
Five year FE	Yes	No	No	No
Year FE	No	Yes	Yes	Yes
Provincial FE	Yes	Yes	No	Yes
Prefectural FE	No	No	Yes	No
Observations	183	527	3189	424
Adjusted R^2	0.403	0.799	0.522	0.566

Notes: Column 1 includes 31 provinces over six five-year periods from 7th to 12th five-year plans (1986-1990, ..., 2011-2015), excluding 7th five-year plan for Hainan province, 7th and 8th five-year plans for Chongqing, when they were not yet established as separate provincial units. Column 2 includes 31 provinces over 18 years from 1997 to 2014. Column 3 includes 337 prefectures over 12 years from 2003 to 2014. Prefectural targets are missing for 15% of the prefecture-years. Column 4 includes 31 provinces over 15 years from 1997 to 2011, where the dependent variable, energy growth rate, is missing for 6% of province-years. Column (5) includes 31 provinces over 15 years from 2000 to 2014, where the dependent variable, electricity growth rate, is missing for 2% of the province-years. Clustered standard errors are reported in the parenthesis. Coefficients marked with *, **, and *** are significant at 10%, 5%, and 1% respectively.

Table 5: Promotion Function for Prefectural Leaders

	(1)		(2)		(3)	
	b	se	b	se	b	se
Realized growth	0.004	(0.007)	0.014***	(0.003)	0.014***	(0.004)
Target faced	-0.061***	(0.021)	-0.081***	(0.030)	-0.084**	(0.042)
Target made					-0.004	(0.003)
Missing target made					-0.476	(0.407)
Party secretary			0.617	(0.391)	0.524*	(0.269)
Age			0.003	(0.006)	0.001	(0.010)
Tenure			0.306***	(0.066)	0.359***	(0.047)
College graduate			0.102	(0.391)	0.355***	(0.072)
Number of tournaments	517		517		517	
Number of contestants	6441		6441		6441	
Log Likelihood	-4.988		-4.802		-4.772	

Notes: All columns use 517 provincial level tournaments over 27 provinces (excluding four direct-controlled municipalities: Beijing, Tianjin, Shanghai, and Chongqing) from 2003 to 2014 among prefectural secretaries and mayors.

Table 6: Provincial Targets and the Number of Subordinate Cities

	Dependent variable: Provincial target			
	OLS		2SLS	
Panel A: Five-year plans	(1)	(2)	(3)	(4)
City number	-0.027		-0.095**	
	(0.026)		(0.038)	
Effective city number (70%)		-0.127**		-0.179***
		(0.048)		(0.063)
Realized growth, lag 1	0.125***	0.129***	0.080*	0.075
	(0.037)	(0.039)	(0.045)	(0.052)
Log avg. distance to capital	0.192	0.310	0.197	0.124
	(0.210)	(0.271)	(0.206)	(0.336)
Five-year FE	Yes	Yes	Yes	Yes
Log gdp per capita, lag 1	Yes	Yes	Yes	Yes
Observations	153	134	135	120
Adjusted R^2	0.644	0.659	0.650	0.640
	OLS		2SLS	
Panel B: Annual plan	(5)	(6)	(7)	(8)
City number	-0.023		-0.089***	
	(0.020)		(0.022)	
Effective city number (70%)		-0.114***		-0.187***
		(0.031)		(0.054)
Realized growth, lag 1	0.488***	0.461***	0.480***	0.482***
	(0.033)	(0.036)	(0.032)	(0.038)
Log avg. distance to capital	0.159	0.285*	0.084	0.038
	(0.105)	(0.159)	(0.107)	(0.192)
Log gdp per capita, lag 1	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	558	486	486	432
Adjusted R^2	0.637	0.632	0.654	0.628

Notes: Columns 1 – 4 include five five-year periods from 8th to 12th five-year plans (1991-1995, ..., 2011-2015). Column 1 includes all 31 provinces, excluding 8th five-year plans for Chongqing and Hainan, when they were not established as separate provincial units yet. Column 2 includes 27 provinces without four directly-administrated metropolitans: Beijing, Tianjin, Shanghai and Chongqing, and also excludes 8th five-year plan for Hainan. Column 3 includes 27 provinces without Hainan, Chongqing, Tibet, Ningxia that were not established as separate provincial units in 1956. Column 4 includes 24 provinces, excluding seven provinces that are either directly-administrated metropolitans, or not established in 1956. Columns (5)-(8) include 18 years from 1997 to 2014. Column 5 includes all 31 provinces. Column 6 includes 27 provinces without four directly-administrated metropolitans: Beijing, Tianjin, Shanghai and Chongqing. Column 7 includes 27 provinces without Hainan, Chongqing, Tibet, Ningxia that were not established as separate provincial units in 1956. Column 8 includes 24 provinces, excluding seven provinces that are either directly-administrated metropolitans, or not established in 1956. Clustered standard errors are reported in the parenthesis. Coefficients marked with *, **, and *** are significant at 10%, 5%, and 1% respectively.

Table 7: Provincial Targets and Policy Shocks

	Dependent variable: Ln provincial target			
	Five-year	Annual	Five-year	Annual
	(1)	(2)	(3)	(4)
West * After2000	0.108*	0.110***		
	(0.059)	(0.039)		
Northeast * After2006			0.155***	0.093***
			(0.047)	(0.021)
Log gdp per capita, lag 1	Yes	Yes	Yes	Yes
Provincial FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Observations	183	558	183	558
Adjusted R^2	0.611	0.401	0.610	0.390

Notes: Columns 1 and 3 include 31 provinces over six five-year periods from 7th to 12th five-year plans (1986-1990, ..., 2011-2015), and excludes 7th five-year plan for Hainan, 7th and 8th five-year plan for Chongqing, when they were not established as separate provincial units yet. Columns 2 and 4 include 31 provinces over 18 years from 1997 to 2014. Clustered standard errors are reported in the parenthesis. Coefficients marked with *, **, and *** are significant at 10%, 5%, and 1% respectively.

Table 8: Annual Transfer Payment and Growth Targets

	Dependent variable: Ln transfer payment			
	Provincial		Prefectural	
	(1)	(2)	(3)	(4)
Target Made	-0.005	-0.019	-0.001	-0.002
	(0.025)	(0.022)	(0.004)	(0.004)
Ln(lag GDP per capita)	-0.014	-0.033	0.082	0.043
	(0.029)	(0.026)	(0.088)	(0.095)
Lag(Tertiary GDP/Secondary GDP)		-0.372*		-0.147*
		(0.184)		(0.075)
Missing target made			-0.055	-0.065
			(0.048)	(0.049)
Year FE	Yes	Yes	Yes	Yes
Provincial FE	Yes	Yes	No	No
Prefectural FE	No	No	Yes	Yes
Observations	558	558	1961	1961
Adjusted R^2	0.955	0.957	0.902	0.902

Notes: Columns 1 and 2 include 31 provinces over nine years from 1997 to 2014. Columns 3 and 4 include 286 prefectures over seven years from 2003 to 2009. Clustered standard errors are reported in the parenthesis. Coefficients marked with *, **, and *** are significant at 10%, 5%, and 1% respectively.

A Proof

A.1 Proof of Proposition 1 (Sketch)

Proof The proof of this proposition proceeds in four steps. The first step utilizes Assumption 1 (the concavity of g) to establish an important property of any equilibrium: there cannot exist two interior efforts both maximizing a prefectural leader's expected payoff given the other players' strategies. The second step characterizes the unique symmetric Nash equilibrium in pure strategies, and this step is similar to the derivation of the symmetric Nash equilibrium in a standard Tullock contest game. However, this equilibrium only exists when the expected equilibrium payoff is higher than the outside option: $0 \leq \frac{V_2}{k} - \frac{1}{2}c_2(x_{ij}^{\star})^2$. The third step derives the candidate symmetric Nash equilibria in mixed strategies when the symmetric pure strategy Nash equilibrium does not exist. Thanks to the first step, we find that a player cannot randomize between interior efforts, and hence the only possible symmetric mixed strategy Nash equilibria are such that each prefectural leader is mixing over a positive effort and zero effort. And the final step shows that the symmetric Nash equilibrium in mixed strategies is unique, and this equilibrium exists if and only if the symmetric pure strategy Nash equilibrium does not exist. These four steps complete the characterization of the unique Nash equilibrium in the last period.

A.2 Proof of Proposition 2 (Sketch)

Proof The key of this proof is to show that it is optimal for the provincial leader i to choose $\bar{y}_i$ such that the prefectural leaders are induced to play the unique symmetric pure strategy Nash equilibrium with zero expected equilibrium payoff: $0 = \frac{V_2}{k} - \frac{1}{2}c_2(x_{ij}^{\star})^2$. This is obviously optimal for the provincial leader among all of the symmetric pure strategy Nash equilibria. So it remains to show that this symmetric pure strategy Nash equilibrium also dominates any symmetric mixed strategy Nash equilibrium. This is true because the expected output in any symmetric mixed strategy Nash equilibrium characterized in Proposition 1 is lower

than the expected output in this symmetric pure strategy Nash equilibrium. The detailed proof can be found in the Online Appendix.

B Data

We collect our data from various sources. In this part, we list all sources for references. See Table B.9 for details.

B.1 Growth Targets and Economic Variables

Five-year growth targets are collected from *Outline of the Five-Year Plan for the National Economic and Social Development of the People's Republic of China* from 7th to 13th five-year plan.[34] Annual growth targets are collected from the *Report on the Work of the Government* in various years and various levels of governments (e.g., national, provincial, prefectural).

Realized economic growth rates and other economics variables – including GDP per capita, tertiary GDP, etc – for provincial and prefectural governments are collected from *China Statistical Yearbooks* and *China City Statistical Yearbooks* for various years.

Finally, we collect the fiscal transfer payment from *Fiscal Statistical Compendium for All Prefectures and Counties (Quanguo Dishixian Caizheng Tongji Ziliao)* for different provinces between 1997 and 2009.

B.2 Promotion

In Section 4.1, we estimate the score function for contestants in all provincial-level tournaments. The dependent variable is a dummy for getting promoted, and we construct this variable in the following procedure.

Firstly, we collect the names of all prefectural secretaries and mayors in each province-year from the *Statistical Yearbook (Sheng Nianjian)* in various provinces and years. For

[34]Our data starts from the 7th five-year plan, as the National Bureau of Statistics report GNP instead of GDP in the earlier time.

each name, we search for their personal biographies – including demographics and career path – from the government website.[35] Based on their career path, we label an officer to be promoted in the tournament if she has appointed to an *higher* position in the proceeding year, where the *higher* position is defined as follows.

For prefectural party secretaries, their higher positions include (1) vice party secretary or governor at the provincial level, (2) head of the "strategically important" departments.[36] For prefectural mayors, we define their higher positions include the higher positions for the prefectural party secretaries, as well as the party secretary in the same or a different prefecture.

For the promotion of provincial officials, we collect their names and career paths in the same way. We regard a provincial secretary as promoted if he becomes a member of the Politburo (the second highest decision-making body in the Communist Party, consisting of 20 to 25 members that include all members of the PSC), a Vice-Premier or a State Councilor in the central government. A provincial governor is promoted if he becomes a provincial secretary.

[35]Xinhua Net, `http://news.xinhuanet.com/`. We complement with Baidu Encyclopedia for some old officers whose bios are missing from Xinhua Net.

[36]Prominent examples include the Department of Organization and Public Security Bureau. According to the Chinese Communist Party's own internal ranking system, the head of "strategically important" departments is considered equivalent in rank to either vice party secretary or governor at the provincial level and thus promotion. For details see Provisional Terms and Regulations Governing the Top Leadership (Party and Government Officials) (Guojia Gongwuyuan Zhanxing Tiaoli), State Council, and Regulations on the Selection and Appointment of Top Party Secretaries and Government Officials" (Dangzheng Lingdao Ganbu Xuanba Renyong Gongzuo Tiaoli), Department of Organization. See also Landry (2008) and Li (2001)

Table B.9: Summary Statistics

	source	obs	mean	sd	min	max
Five-year:						
Central target (%)	B	6	7.17	0.68	6.00	8.00
Provincial target (%)	B	183	9.24	1.95	4.41	15.50
Annual:						
Central target (%)	A	18	7.64	0.45	7.00	8.00
Provincial target (%)	A	558	9.94	1.44	7.00	15.00
Provincial realized growth (%)	C	558	11.19	2.45	4.90	23.80
Provincial GDP per capita (1K RMB)	C	558	18.87	19.25	0.00	100.11
Provincial electricity growth (%)	C	455	10.73	6.63	-28.31	37.94
Provincial tertial GDP / secondary GDP	C	558	0.97	0.44	0.50	3.58
Provincial transfer payment to local government (1M RMB)	E	558	515.01	621.22	4.89	3277.31
Government Officials:						
Promotion	D	6441	0.13	0.33	0.00	1.00
Dummy for secretary	D	6441	0.51	0.50	0.00	1.00
Tenure	D	6441	2.18	1.64	0.00	11.08
Age	D	6441	51.01	3.93	34.00	61.00
College degree	D	6441	0.94	0.23	0.00	1.00
Time-invariant Provincial Characteristics:						
City number	C	31	13.84	6.50	3.00	40.00
Effective city number (70%)	F	27	5.74	2.18	1.00	10.00
City number in 1956	F	27	14.74	4.82	8.00	28.00
Average distance to capital	F	31	200.47	118.62	24.38	543.29
Dummy for west region	F	31	0.39	0.50	0.00	1.00
Dummy for northeast region	F	31	0.13	0.34	0.00	1.00

Notes: Data sources (listed in column 2) are: A. Report on the Work of the Government; B. Five-Year Plan for the National Economic and Social Development of the People's Republic of China; C. China Statistical Yearbooks and China City Statistical Yearbooks; D. Provincial Yearbook and Xinhua Net (`http://news.xinhuanet.com/`); E. Prefectural and County Financial Statistics; F. Other sources.