Crony Capitalism, the Party-State, and the Political Boundaries of Corruption[*]

Weijia Li[†]   Gérard Roland[‡]   Yang Xie[§]

December 18, 2020

Abstract

China's anti-corruption campaign since 2012 has raised questions about the role of corruption in China's political economy. To analyze this issue systematically, we build a model that unifies crony capitalism, the hierarchy of the Chinese party-state system, and the decision-making process inside the Party Center. We show that inefficient economic institutions create local corruption that improves productivity, while generating rents that flow along the party-state hierarchy up to the provincial level, threatening the Center's control in potential crises. Given a general fat-tailed risk of crisis, we show that the Center will choose its tolerance of local corruption in priority to maximize crisis control, at the expense of the economy. Power structure and corruption within the Party Center and the reciprocal accountability between the central and provincial leaders are also modeled and analyzed. Our analysis explains recent developments in the Chinese economy and politics.

Keywords: autocracy, corruption control, state apparatus, reciprocal accountability, Communist Party of China

JEL codes: D73, P30, H12, H77.

[†]Department of Economics, Monash University; `weijia.li@monash.edu`.

[‡]Department of Economics, University of California, Berkeley, CEPR, and NBER; `groland@econ.berkeley.edu`.

[§]Department of Economics, University of California, Riverside; `yang.xie@ucr.edu`.

1 Introduction

The coexistence of inefficient economic institutions and very high economic growth in China in recent decades has been a puzzle to economists (e.g., Brandt and Rawski, 2008; Xu, 2011; Qian, 2017).[1] Bai et al. (2014, 2020) argue that corruption between officials and businesses has been an important part of China's growth miracle, as corruption protects cronies' businesses from the inefficiency of economic institutions, while damages of classic crony capitalism are alleviated by certain "Chinese characteristics," such as competition between local governments. This model of crony capitalism with Chinese characteristics has been considered one of the benchmarks in understanding the political economy of China's growth (as in, e.g., An et al., 2016; Francois et al., 2016; Lorentzen, 2017; Lei, 2018; Chen and Kung, 2019; He et al., 2020).

Questions on this model of Chinese crony capitalism have been raised in light of the anti-corruption campaign launched by Xi Jinping since 2012. The scale of the campaign has shown the resolution of the leadership of the Communist Party of China (CPC), and empirical evidence suggests that this campaign, whatever its motives are, represents indeed a serious effort to crackdown on corruption (e.g., Central Commission for Discipline Inspection of the Party, CCDI, 2017; Francois et al., 2016; Lu and Lorentzen, 2018; Chen and Kung, 2019).[2] If we take seriously the model of crony capitalism with Chinese characteristics, this crackdown must have been imposing great economic costs, and recent empirical evidence does support this prediction (e.g., Araral et al., 2018; Chen and Zhong, 2018; Qu et al., 2018; Xi et al., 2018).[3] Given that the legitimacy

---

[1]China's economic development has been impressive since the market economy was introduced 40 years ago, but economic institutions in China are still widely considered to be inefficient. For example, barriers to entry and mobility abound, protection of private property rights is weak, and commitment to policies is fragile at best – the World Bank's "starting a business" indicator measuring institutional friendliness to the private economy ranks China barely above Iraq and Ethiopia. Brandt and Rawski (2008) summarize the puzzle as "China's remarkable mixture of high-speed growth and deeply flawed institutions."

[2]The CCDI reported that, by 2017, more than 1.5 million officials had been disciplined under the Party rules and 58 thousands officials had been charged with crimes (CCDI, 2017). Besides the scale of the campaign, Francois et al. (2016) estimate that the share of each faction among the indicted high-ranking officials generally corresponds to the faction's overall representation in the CPC leadership; Lu and Lorentzen (2018) document that corrupt officials' personal ties to top leaders have not provided much protection, apart from those close to Xi, and that areas where firms complained about corruption more were more likely to be investigated; Chen and Kung (2019) document a more than 30% reduction in corruption "in the provinces either targeted by the central inspection teams or whose party secretary was replaced by one appointed by Xi", where corruption is measured by the price discount enjoyed by "firms linked to members of ... the Politburo" in the primary land market.

[3]Premier Li Keqiang also stated in a 2014 State Council executive meeting that many local officials were shirking their duties to evade being suspected of corruption (State Council of China, 2014).

of the CPC's rule relies crucially on economic performance (e.g., Zhao, 2009), why did the Party leadership implement such an intensive, large-scale crackdown, despite the significant economic cost? Should not a mostly superficial but well-publicized campaign be sufficient, if it were primarily to pacify the popular anger for corruption? Can the motives behind the campaign also shed light on why the campaign started in 2012, not in earlier years?

In light of the campaign, further fundamental questions can be asked about China's political economy. First, the campaign has exposed widespread vertical collusive corruption among officials along the personnel hierarchy of the party-state, including buying and selling of positions.[4] What are the institutional reasons behind the pervasive corruption, both between firms and officials and along the party-state hierarchy? Empirical evidence also shows that investigations have targeted large patronage networks among officials and deviations from meritocracy in promotion practices in a few provinces (e.g., Lu and Lorentzen, 2018; Goh et al., 2019). Why these targets of the campaign? Moreover, the Party Center, i.e., the Politburo Standing Committee (PSC), has been streamlined into reinforcing Xi's dictatorial graps on power almost simultaneously with the anti-corruption campaign (e.g., Li, 2016; Fewsmith, 2018; Shirk, 2018; Tsai and Zhou, 2019; Chen and Kung, 2019). Why has the Party leadership conducted these two major political tasks, i.e., anti-corruption campaign and streamlining of the PSC, together?

To answer these questions systematically, a theoretical framework is needed to put together China's crony capitalism, the hierarchy of the Chinese party-state system, and the decision making of the Party Center. We build the first such model in this paper. The model has three modules. Module 1 focuses on crony capitalism in the spirit of Bai et al. (2014, 2020), where regulations are distortionary as given. We show that given this economic institution, if the Center tolerates greater local corruption, then more firms will become the local officials' cronies and enjoy higher productivity by having the distortionary regulations circumvented, leading to not only a higher economic output, but also higher rents obtained by the local officials. This mechanism corresponds to a large body of empirical literature across disciplines.[5]

---

[4]The CCDI report (2017) also stated that eliminating the "systematic, landslide-like" collusive corruption among officials in Shanxi Province exemplifies the spirit of the anti-corruption campaign. Using data on corruption indictments collected by Lu and Lorentzen (2018), we show, in Table 1 in Appendix A, a vertical correlation between corruption indictments at higher levels (provincial party secretary and governors) and lower ranks across provinces.

[5]For example, see Lin (2001), Sheng et al. (2011), Osburg (2013), Fisman and Wang (2015),

Module 2 focuses on the party-state hierarchy, where superior officials have personnel power over their subordinates. We show that the superior officials can capitalize on their political power by selling positions to their subordinates. As a result, except for a part of rents needed to retain lower-level officials in the party-state system, the rest of the rents from crony capitalism will be diverted along the party-state hierarchy up to the provincial level. This result resonates with the scholarly consensus in sociology and political science (e.g., Zhu, 2008; Zhou, 2013; Pei, 2016).

Module 3 focuses on the Center's choice of its tolerance of local corruption. In the spirit of Li et al. (2019), we assume that the Center cares about not only the economic output from crony capitalism but also about its ability to respond to potential crises, and the response will depend on cooperation from the provincial officials. As a crisis gives the provincial officials an opportunity to consolidate their vested interests, greater rents accumulated at this level pose a threat to the Center's crisis response ability. The Center then faces a political–economic trade-off between this ability and economic output when choosing its tolerance of local corruption. This setting is in line with some classical themes in political philosophy and a few existing understandings of governance in China.[6] Under a general condition of a fat-tailed risk of crisis, we show that since the fat-tailed risk makes the political side of the trade-off dominate, the Center's solution is to set the corruption tolerance at the level that maximizes its ability to manage crises firstly, while promoting the economy secondly.

The model therefore helps us answer several of the raised questions. First, it is the inefficient economic institutions and the personnel power along the party-state hierarchy up to the provincial level that condition the pervasive corruption between firms and officials and among officials, respectively, and the former type of corruption finances the latter. Second, given the Center's solution to set the level of corruption tolerance, any perceived looming risk of crisis would thus push the Center to crack down on corruption to avoid potential loss of control of the party-state hierarchy, despite serious economic

Chen et al. (2017), Lu (2017), Araral et al. (2018), Chen and Zhong (2018), Chen et al. (2018), Kung and Ma (2018), Lin et al. (2018), Qu et al. (2018), Xi et al. (2018), Ying and Liu (2018), and Ang (2020).

[6]Veg (2019) discusses the influence of Schmitt (1921, 1922) in China in recent decades, which emphasizes the ability of the state to respond to crises. The importance of this ability has also been well recognized by the highest leaders of the Party, who realize that the Center's crisis management ability depends crucially on its ability to mobilize provincial resources and to be able to come up with a well coordinated response (e.g., Xi Jinping, 2014; 2017a; 2018). The trade-off between growth and control (and more generally between routine performance and discretionary power) is consistent with the views of China scholars (e.g., Will, 1980; Huang, 1981; Kuhn, 1990; Zhou, 2008, 2012, 2017; Sng, 2014; Walder, 2015; Zhang, 2018).

costs. This explanation of the anti-corruption campaign turns out to be consistent with Xi's own narrative (e.g., Xi, 2017b; People's Daily, 2019), if we take his speeches at face value. Third, because securing crisis control requires real reduction of rents controlled by the officials, the campaign has to be conducted at a great intensity and scale, and mostly exhibitive show trials would not suffice. Fourth, because the corruption rents flow along the party-state hierarchy through personnel decisions, the Party Center has to destroy patronage networks in personnel management within each province to regain control.

These leave only the questions about the timing of the campaign and the political changes within the Center unanswered. We therefore extend Module 3 by assuming that a successful crisis response requires not only the provincial officials' cooperation, but also the consensus from each leader in the Center. Therefore, any attempt to secure control would be in vain unless the Center will be able to reach a quick consensus when a crisis happens. A dictatorship is thus desirable for this purpose. As it was only in 2012, when the Party granted the newly elected General Secretary Xi a rare window to consolidate power, that crackdown on corruption became meaningful, Xi's anti-corruption campaign and power consolidation within the Center have been proceeding simultaneously.

The model highlights the key role of the provincial officials in the accumulation of rents from corruption and their threats to the Center's control in crises. Why could not the Party Center always force provincial officials to comply, as the provincial officials could with the lower-level cadres? To answer this question, we go one step deeper by modeling the relationship between members of the Center and their provincial protégés. We note that the Chinese party-state is marked by two features. The first is the *reciprocal accountability* between the Center and provincial officials: as first analyzed by Shirk (1993), not only provincial officials are appointed by and accountable to central leaders, but the central leaders also rely on the support from the provincial officials to stay in power. The second is the lack of reciprocal accountability below the provincial level: following the 1984–1995 cadre management reform (People's Daily, 1984; Burns, 1987, 1994; Central Committee of the Party, 1995; Pei, 2016, p. 35), only the local officials are accountable to their provincial superiors, but not the other way around. We show that the combination of the two features can indeed limit the Center's ability to discipline provincial officials, while allowing the provincial officials to tread on the lower-level ones, leading to substantial rents being captured at the provincial level and threatening the power of the Center. We also show that given this institutional

context, corruption within the Center can further damage its disciplining ability upon the provincial leaders.

Although our analysis is largely motivated by Xi's anti-corruption campaign, it is not normative but purely positive. We contribute to the literature from at least three aspects. First, in the recent literature, a long list of empirical studies have examined Xi's anti-corruption campaign (e.g., Francois et al., 2016; Ding et al., 2017; Araral et al., 2018; Chen and Kung, 2019; Chen and Zhong, 2018; Lin et al., 2018; Lu and Lorentzen, 2018; Qu et al., 2018; Xi et al., 2018; Ying and Liu, 2018; Goh et al., 2019), but, to our knowledge, we are the first to explain its motives, timing, targets, and accompanying political changes within the Party Center in a unified theoretical framework.

Second, in the recent literature on China's political economy, Bai et al. (2014, 2020) investigate the functioning of crony capitalism in China; Wang and Zheng (2019) analyze how the lack of safety of corruption rents at lower levels in the state hierarchy incentivizes officials to actively participate in the meritocratic promotion scheme. These works focus on the economic or efficiency implications of corruption in the Chinese context. On the political side, Francois et al. (2016) theorize how the factional balance is achieved within the leadership of the Party; Xie and Xie (2017) analyze the impact of different opinions within the Party leadership on the choice of reform strategies; Che et al. (2019) explore the cost of removing leaders' criminal immunity given the current Chinese political institution; related but not limited to China, Li et al. (2019) model the corrosive impact of corruption on the power relationship inside a state apparatus. Our paper looks at the economic and political (party-state) spheres simultaneously, and we show the pivotal role of reciprocal accountability, a prominent institutional arrangement, in corruption inside the Chinese party-state hierarchy.

Third, a group of studies have emerged on the political economy of autocracy (e.g., surveys by Gehlbach et al., 2016; Egorov and Sonin, 2020). In the Chinese context, the focus has been mostly on the incentive structure, contentious politics, and reform experiences given the Chinese institution (e.g., surveys by Xu, 2011, 2015, 2019; Lorentzen, 2017; Qian, 2017; Roland, 2018). Our analysis in this paper suggests that corruption can prevail in a country where there is crony capitalism and the state has great economic power. This can in turn lead to anti-corruption campaigns in anticipation of a looming crisis; simultaneously, power consolidation within the head of the state may happen and be rationalized as to help prepare future crisis responses. These implications contribute further to the literature by linking the economic institution, governance initiatives, and elite politics together.

The paper is organized as follows. Section 2 presents the three modules of the model and analyzes the effects of power structure within the Center. Section 3 analyzes collective decision-making inside the Center under reciprocal accountability. Section 4 concludes.

2 The Model

Figure 1 shows the overall structure of the model: Module 1 models the interaction between local firms and a local official, who represents the lower-level officials in the party-state (e.g., the municipality and county levels); Module 2 models the interaction between the local official and his provincial supervisor, who represents the officials in the Central Committee of the Party, taking Module 1 as given; Module 3 models the Party Center (Politburo Standing Committee, PSC)'s choice of tolerance of local corruption, taking all the Modules 1 and 2 as given. We now introduce and analyze the three modules one by one.

2.1 Module 1: Crony Capitalism

Assume a continuum of firms with a mass of 1 in a local official's jurisdiction, each with a potential productivity of 1. Given the persistent appearance of barriers to firm mobility and the prevalence of local protectionism in China (e.g., Wedeman, 2003; Bai et al., 2004, 2014, 2020; Zhou, 2004; Barwick et al., 2017), we assume that these firms are immobile. Because of existing economic distortions (e.g., red tape, institutional weaknesses, and lack of access to credit), assume that only an exogenously given share $\alpha \in (0, 1)$ of potential productivity can be realized. Each firm has an opportunity to give an exogenously given bribe b to the local official, in which case the realized productivity will be lifted to 1 *ad hoc* through privileges that non-crony firms would not enjoy (e.g., barriers to entry for other firms, privileged access to government contracts, discounts on utility prices, and tax breaks). A lower α then denotes more distortionary regulation and a greater power that the local official can have over the local economy. The exogenous bribe b can be interpreted as the highest level of bribes tolerated by the Party Center, and since there is an infinite number of firms, they can bid up the price of bribes up to its maximum tolerated level b.

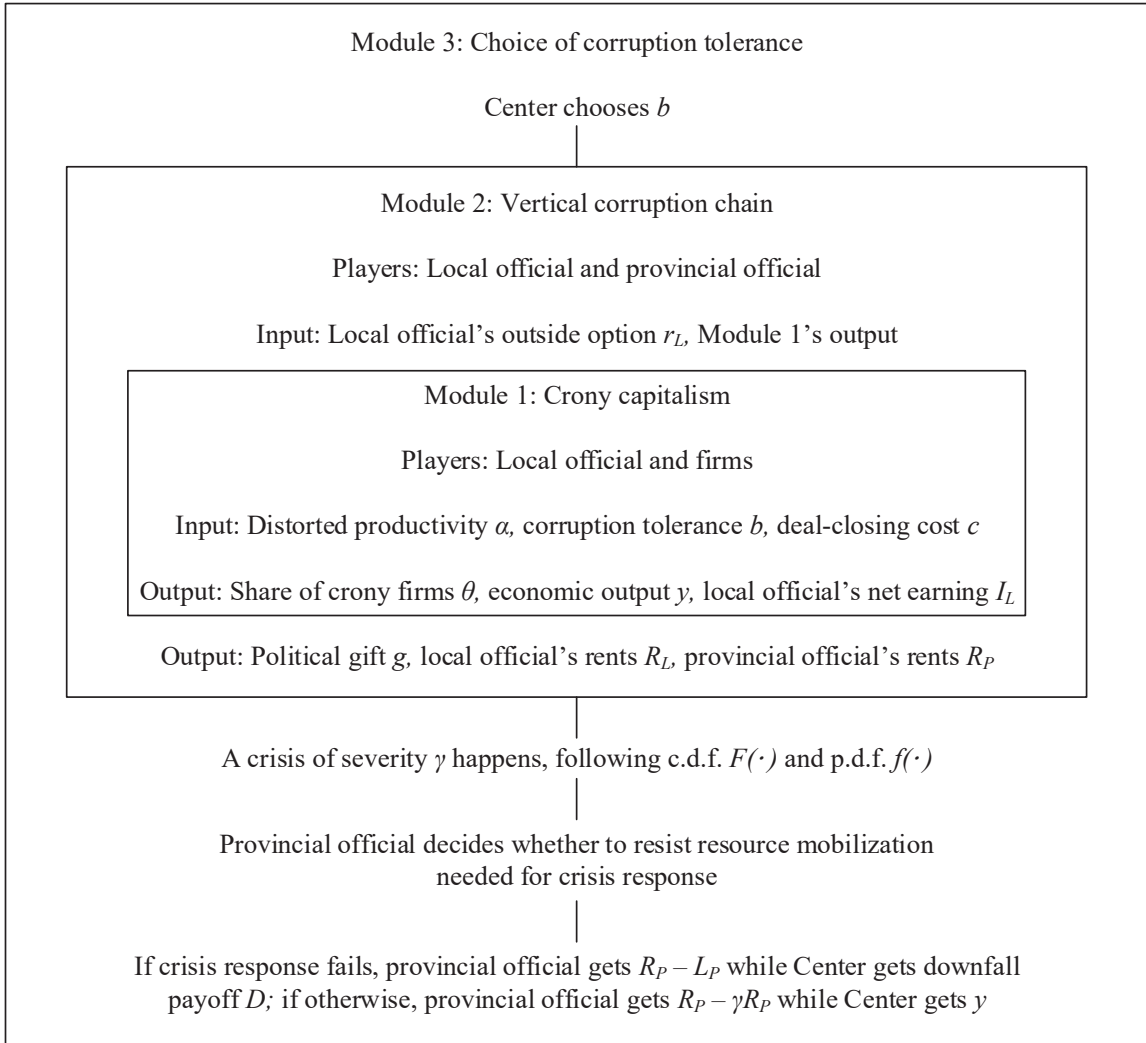This setting highlights the institutional origin of crony capitalism:

Figure 1: Three modules of the model

Lemma 1. *Firms will bribe the local official only when the existing regulation is sufficiently distortionary, i.e., $\alpha \leq 1 - b$.*

This lemma suggests that crony capitalism is institutionally founded on distortionary regulations, and on the government's economic power cultivated by those distortions. As crony capitalism is prevalent in China, we assume hereafter that $\alpha \leq 1 - b$ so that all firms want to pay the bribe, narrowing our focus onto the only empirically relevant scenario.[7]

---

[7]For example, sociologist Lin (2001, p. 6) argues that "[i]n the reform era, effective manipulation of state action – i.e., making gains from ad hoc favorable treatment by the state – constitutes a necessary condition for the success of firms." On the ubiquity of firms trying to bribe local officials in China, anthropologist Osburg (2013, p. 52) quotes a Chinese government contractor: "[e]ven if you're just a

We also assume that the local official's total cost to break rules and close deals is $c\theta^2/2$, which is convex in θ with the exogenous parameter $c > 0$, because the local officials' time, energy, and other resources that can be devoted to crony capitalism are limited. Given all the assumptions, the local official is then to choose the share of businesses, $\theta \in (0, 1]$, from which to accept the bribe so as to maximize his bribe earnings, θb, net of the total cost, $c\theta^2/2$:

$$\max_{\theta \in (0,1]} \quad U_L(\theta; b, c) = \theta b - c\theta^2/2. \tag{1}$$

The first-order condition of this program is

$$b - c\theta = 0 \tag{2}$$

and the second-order condition, $-c < 0$, holds trivially. Since in reality not all firms are cronies, we assume that the cost intensity of the local official to close deals is so high $(c \geq b)$ that an interior solution can be reached in equilibrium. The equilibrium share of firms that become cronies is thus

$$\theta = b/c, \tag{3}$$

which is increasing in b and decreasing in c. Local economic output is then the total output from all the firms,

$$y = (1 - \theta)\alpha + \theta = \alpha\left(1 - b/c\right) + b/c = \alpha + (1 - \alpha) \cdot b/c, \tag{4}$$

which is increasing in α and b and decreasing in c. In equilibrium, the local official's net earning is then

$$I_L(b, c) \equiv U_L^* = \left(b/c\right) \cdot b - c \cdot \left(b/c\right)^2 /2 = b^2/2c, \tag{5}$$

which is increasing in b and decreasing in c, too. We can thus formulate the following proposition:

Proposition 1. *The prevalence of crony capitalism θ, economic output y, and rents of the local official I_L increase with b and decrease with c.*

---

county head (*xianzhang*), there are literally thousands of businessmen lining up at your door to give you money."

Since a higher b and a lower c are equivalent in their positive effect on the prevalence of crony capitalism, economic output, and the local official's rents, we call b the *corruption tolerance* and focus on its implications hereafter, always assuming c as an exogenous parameter in our analysis.

Proposition 1 is in line with Bai et al. (2014, 2020) on the complementarity between corruption and economic growth under crony capitalism in China. It is also consistent with Xi et al. (2018)'s evidence that in the recent anti-corruption campaign in China "officials with better economic performance were more likely to be investigated." Since the existing distortion is severe, crony firms and local officials are both willing to engage in corruption, because they benefit from the output increases gained from the privileged relationship and from the rents from bribery, respectively. As corruption exempts the crony firms from inefficient regulations, it reduces the economic distortion, thereby enhancing economic performance. In other words, following the tradition of Leff (1964) and Huntington (1968), corruption "greases the wheels" of the economy.

Several features of this complementarity deserve attention. First, this complementarity does not mean that more distortionary regulations would promote economic growth. On the contrary, as Equation (4) shows, economic output (y) increases with regulatory efficiency (α).

Second, this complementarity exists only when the existing regulation is sufficiently distortionary ($\alpha \leq 1 - b$). Otherwise, by Lemma 1, paying the bribe would not be beneficial to firms, and any corruption between the local official and the firms would be detrimental to the economy. Consistent with this point, Lin et al. (2018) document that the recent anti-corruption campaign in China raised the share values of private firms in provinces where market institutions were more developed, i.e., the corruption–economy complementarity disappears when α is high, while those in provinces where market institutions remained weak suffered a hit, i.e., the complementarity exists when α is low; Ying and Liu (2018) also have similar findings.

Third, it might be tempting to argue, on the basis of Equations (3) and (5) that, in equilibrium, the prevalence of corruption (θ) and the rents of local officials (I_L) do not depend on the efficiency of the existing regulations (α). This is not true, however, since Equations (3) and (5) describe only the equilibrium when the existing regulation is sufficiently distortionary. By Lemma 1, there will be no corruption or rent creation if the existing regulation is sufficiently efficient.

Finally, the complementarity between corruption and economic growth would not be affected if heterogeneity in firm productivity were assumed, as in Bai et al. (2014,

2020). In that case, the model would only lead to predictions about which firms the local official would choose as his cronies.

This module of the model illustrates how crony capitalism creates official–business corruption. To understand the full effects of corruption, we need to consider the interactions inside the party-state.

2.2   Module 2: Vertical Corruption Chain

We now consider the relation between the local official and his direct superior in the party-state hierarchy, a provincial official, who has the personnel power to remove him from his post. We assume that if the local official is removed, he will lose his opportunity to extract bribes from local firms but will receive instead a reservation payoff $r_L \geq 0$, which is assumed to be exogenous.[8] The local official is assumed to have a chance to give a political gift, g, to the provincial official, in the hope of not being removed. If he is not removed, he will be able to use bribes received from business firms to finance this gift, and enjoy the residual amount for his own private consumption. We assume that there is no commitment problem in the local–provincial interaction, since both sides can expose anyone who did not fulfill the transaction.

Because the provincial official has the power to remove the local official, he can demand a gift up to $g = b^2/2c - r_L$. If kept in office, the local official enjoys $I_L(b,c) - g = b^2/2c - g$. If $g = b^2/2c - r_L$, the provincial official will enjoy $R_P = b^2/2c - r_L$ and the local official $R_L = r_L$. In that case, if $I_L(b,c) = b^2/2c \geq r_L$, the rents of the local official and the provincial official and their sum are, respectively,

$$R_L = r_L, \qquad R_P = b^2/2c - r_L, \qquad R_L + R_P = b^2/2c; \qquad (6)$$

if on the other hand, $b^2/2c < r_L$, the local official will prefer to quit his position and gets r_L, while the provincial official will get 0.

Therefore, to keep the local official in the party-state system, the level of bribes needs to be above a lower bound, i.e.,

$$b \geq \sqrt{2cr_L} \equiv \underline{b}. \qquad (7)$$

This is summarized as the following lemma:

---

[8]The reservation payoff can be related to possibilities of getting jobs in the private sector. This means that the higher the development of the private sector, the higher the reservation payoff.

Lemma 2. *To keep local officials in the party-system, the corruption tolerance b must be above $\underline{b}$.*

We have also the following result:

Proposition 2. *If the local official is retained, then rents of provincial officials R_P increase with the corruption tolerance b.*

The intuition is as follows: corruption rents of local officials are captured by provincial officials because of their power to remove local officials; rents go up through the vertical corruption chain along the personnel hierarchy; therefore, higher tolerance of corruption, i.e., higher b, feeds the provincial official, leading to a higher R_P. This is consistent with observations from China: personnel power of the direct supervisor in the party-state hierarchy generates huge rents in areas where firm–official corruption prevails, as discussed by sociologists and political scientists, such as Zhou (2013) and Pei (2016). In line with these observations, This corollary will be instrumental later when we examine the Center's decisions.

2.3   Module 3: Choice of Corruption Tolerance

In contrast to provincial officials, the Center has the ultimate responsibility over actions at the national level. We assume that the Center cares for the economic performance, i.e. wants to maximize economic output, but also wants to be able to respond to unexpected crises that may occur randomly and challenge the survival of the regime. These crises include primarily the political ones, such as coups, revolts, and wars, but also the natural and economic ones that are sufficiently serious, such as a significant pandemic or financial crisis. Responses to these crises would naturally rely on cooperation from officials in the party-state hierarchy and, especially, the provincial officials.

Given this setting, denote a random variable $\gamma \in [0, \bar{\gamma}]$ as the severity of occurring crises, where the Center will need to mobilize a share γ of the rents from the provincial official to respond to the crisis or implement an urgent reform. The highest possible severity is denoted by $\bar{\gamma} \leq 1$.[9] We also denote the cumulative distributive and probability density functions of γ as $F(\cdot)$ and $f(\cdot)$, respectively, and we assume $F(\cdot)$ is continuous.

---

[9]This setting of a *relative* severity of crisis γ provides tractability. One can verify that, given any crisis, the *absolute* amount of rents that the Center would need to appropriate in response to a crisis increases with economic output and, equivalently, with the total amount of the rents captured by the provincial and local officials.

Assume further that the provincial official will suffer an exogenous loss L_P if he refuses to submit the required rents and, therefore, the Center cannot successfully manage the crisis.[10] In this case, the payoff to the provincial official would then be $R_P - L_P$. If instead he decides to submit the resources, the crisis will be successfully managed, and his payoff will be $R_P - \gamma R_P$.

Under these assumptions, given γ, the provincial official will resist the resource mobilization from the Center, if and only if

$$R_P - L_P > R_P - \gamma R_P, \quad \text{i.e.,} \quad \gamma > L_P/R_P = \frac{L_P}{b^2/2c - r_L} \equiv \hat{\gamma}, \tag{8}$$

where $\hat{\gamma}$ denotes the critical level of γ above which the provincial official will resist the resource mobilization.

Corruption can thus threaten the ability of the Center to respond to a crisis due to resistance from the corrupt party-state machine, because a higher tolerance of corruption b will increase the provincial official's rents R_P, as stated in Proposition 2, lowering the critical level $\hat{\gamma}$ and making crisis management more likely to fail. In other words, corruption creates incentive misalignment between the Center and the provincial official when a crisis happens. This incentive misalignment is widely considered as one of the primary problems that corruption can cause (e.g., Pei, 2016) and has been recognized by the highest leaders of the Party (e.g., Xi, 2015, 2016).[11]

Now consider the Center's choice of its tolerance of local corruption b, while taking the institutional efficiency α in the economy as given. This setting is consistent with the Chinese reality that the Center often finds it extremely difficult to improve institutional efficiency without first reducing corruption, because the officials have had substantial vested interests in keeping institutions inefficient and rent-generating; at the same time, the Center can often enforce its corruption tolerance by anti-corruption campaigns, marked by intensive investigations, overwhelming propaganda, and mobilization of the common people in short periods of time, thereby deterring local corruption.[12]

---

[10]Since the Center's failure to manage a crisis is an exceptional scenario, we find it not too controversial to assume that when deciding whether to resist the resource mobilization, the provincial official takes his loss in the exceptional scenario as an exogenous amount. Alternatively, if $L_P \equiv L(R_P)$, then all results in the model will hold, as long as the loss is not too sensitive to the corruption rents $(R_P \cdot L'(R_P)/L(R_P) < 1)$.

[11]For example, Xi (2015, 2016) warned repeatedly that high-level officials in the Party must not violate the central directives, cultivate "independent kingdoms," or act independently.

[12]The CPC leaders, such as Premier Li Keqiang (2015), understand that "sustaining steady and sound development" requires "deepening reform" (raising α) to tackle the "systemic, institutional

About the relevant range of b, we have two considerations based on Modules 1 and 2. First, given the Chinese reality of crony capitalism, we assume that the Center will only consider a range of b such that the local economy always works as modeled in Module 1. This requires the existing regulation to be sufficiently distortionary ($\alpha \leq 1 - b$) and the local official's cost to close deals to be sufficiently high ($c \geq b$), i.e., $b \leq \min\{1 - \alpha, c\} \equiv \bar{b}$. Second, we assume that it would be disastrous to the Center if the local official have decided to leave the party-state system in Module 2, as the Center would not be able to maintain the party-state apparatus even without any crisis. This requires $b \geq \underline{b}$. Given the two considerations, we have assumed that the Center will consider only $b \in [\underline{b}, \bar{b}]$. To prevent this range from being empty, we assume $\underline{b} \leq \bar{b}$, i.e., $\alpha \leq 1 - \sqrt{2cr_L}$ and $c \geq 2r_L$, which are consistent with the spirit of our assumptions for Module 1, again, that the regulatory distortion is so severe and the local official's cost to close deals is so high.

We assume that the Center benefits from economic output when crises are successfully managed ($\gamma \leq \hat{\gamma}$) and gets a payoff D for downfall, if a crisis leads the Center to lose control. We assume that the Center is risk neutral. The Center's program is then

$$\max_{b \in [\underline{b}, \bar{b}]} F(\hat{\gamma}) \cdot y + (1 - F(\hat{\gamma})) \cdot D, \quad \text{i.e.,} \quad \max_{b \in [\underline{b}, \bar{b}]} F(\hat{\gamma}) \cdot (y - D), \quad (9)$$

where

$$\hat{\gamma} = \frac{L_P}{b^2/2c - r_L} \quad \text{and} \quad y = \alpha + (1 - \alpha) \cdot b/c. \quad (10)$$

This program suggests that as long as surviving a crisis is better than losing power ($y > D$), which will always hold when the downfall payoff is lower than the lowest possible economic output ($D < \alpha$), the Center will always face a fundamental trade-off between regime stability and economic performance: a higher b will lead to a higher output level y but also with a higher probability of loss of control when challenged by a large crisis ($1 - F(\hat{\gamma})$). We can then derive the following proposition:

Proposition 3. *Given a sufficiently low downfall payoff ($D < \alpha$), if the distribution of the crisis severity satisfies that $\epsilon \equiv \gamma \cdot f(\gamma) / F(\gamma) > 1/2$ holds for any $\gamma \in (0, \bar{\gamma})$, then*

...problems" (low α). That said, the reform has always been "even more difficult than ...assaulting a fortified position," because it "must touch vested interests" (Xinhua News Agency, 2013). Li has also openly complained that many directives that the State Council had issued to cut red tape (raising α) were "obstructed in transmission" and could not be implemented at the local level (State Council of China, 2014). The corruption problem is often regulated by anti-corruption campaigns, however, not on an everyday basis. On the campaign-styled governance in China, see Zhou (2012).

the Center's optimal corruption tolerance b^* follows:

- *if $\sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)} \leq \underline{b}$, then $b^* = \underline{b}$;*

- *if $\underline{b} < \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)} < \bar{b}$, then $b^* = \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)}$;*

- *if $\sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)} \geq \bar{b}$, then $b^* = \bar{b}$.*

Proof. Since $F(\cdot)$ is continuous, the Center's objective function is continuous. We now examine its monotonicity. When $\hat{\gamma} \geq \bar{\gamma}$, i.e., when $b \leq \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)}$, regime stability is never compromised, so the objective function is increasing in b, just as the economic output y does, by Proposition 1.

When $\hat{\gamma} < \bar{\gamma}$, i.e., $b > \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)}$, however, there is a non-zero probability of regime breakdown. Observe that the first-order derivative of the objective function with respect to b is

$$\frac{1-\alpha}{c} \cdot F(\hat{\gamma}) - \frac{L_P}{\left(b^2/2c-r_L\right)^2} \cdot \frac{b}{c} \cdot f(\hat{\gamma}) \cdot (y-D). \tag{11}$$

It will be negative, given $\hat{\gamma} = \frac{L_P}{b^2/2c-r_L}$ and $y = \alpha + (1-\alpha)\cdot b/c$, if

$$\hat{\gamma}\cdot\frac{f(\hat{\gamma})}{F(\hat{\gamma})}\cdot\left(\frac{(1-\alpha)b}{c}+\alpha-D\right) > \frac{(1-\alpha)b}{2c} - \frac{1-\alpha}{b}\cdot r_L, \tag{12}$$

which, when $D < \alpha$, is equivalent to

$$\hat{\gamma}\cdot\frac{f(\hat{\gamma})}{F(\hat{\gamma})} > \frac{1}{2}\cdot\frac{(1-\alpha)b-2cr_L(1-\alpha)/b}{(1-\alpha)b+c(\alpha-D)}. \tag{13}$$

Note that, when $D < \alpha$,

$$\frac{1}{2}\cdot\frac{(1-\alpha)b-2cr_L(1-\alpha)/b}{(1-\alpha)b+c(\alpha-D)} < \frac{1}{2}. \tag{14}$$

Therefore, we can conclude that given $D < \alpha$, if $\gamma\cdot f(\gamma)/F(\gamma) > 1/2$ for any $\gamma \in (0,\bar{\gamma})$, then the Center's objective function is decreasing over $b > \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)}$.

Therefore, if $\gamma\cdot f(\gamma)/F(\gamma) > 1/2$, then the Center's objective function is increasing over $b \leq \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)}$ and decreasing over $b > \sqrt{2c\left(L_P/\bar{\gamma}+r_L\right)}$. The optimal choice b^* then follows. $\square$
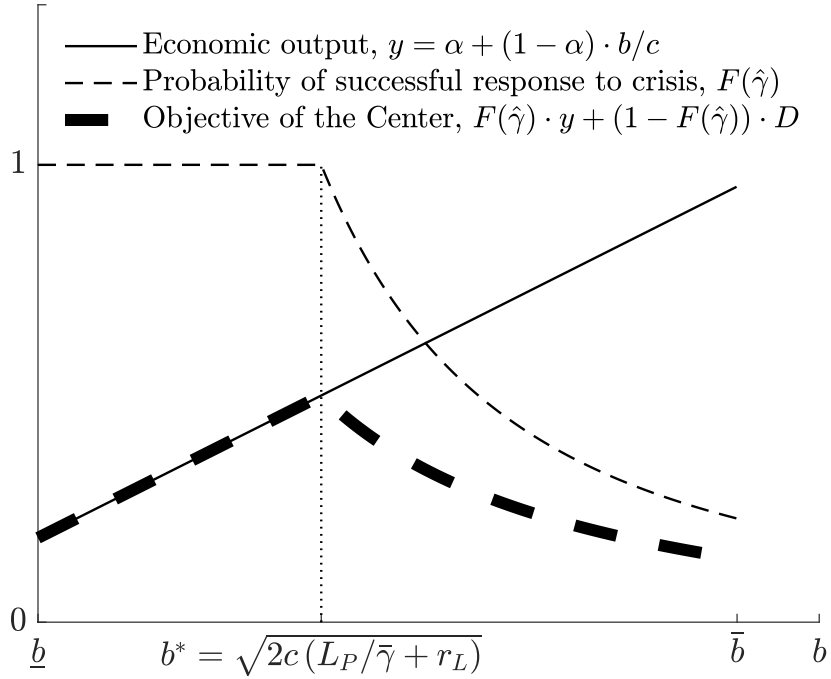
15

Figure 2: Center's optimal choice of corruption tolerance b, b^*, given fat-tailed crisis risk ($\epsilon > 1/2$) and interior solution ($\underline{b} < \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)} < \bar{b}$)

The intuition for Proposition 3 is illustrated in Figure 2. A higher corruption tolerance raises economic output, while lower tolerance increases the Center's control in crises until the Center never loses control in any crisis. Therefore, on the one hand, when the tolerance is so low that full security is reached ($b \leq \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}$), the Center can always raise the tolerance to gain more economic output without sacrificing any security. On the other hand, the condition $\epsilon > 1/2$ means that the right tail or end of the crisis risk distribution is fat. This condition suggests that, when corruption tolerance is still too high to secure control in all possible crises ($b > \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}$), a lower tolerance would lead to a smaller output loss compared to the larger gain in regime stability. Therefore, the Center will set the corruption tolerance at such a level that crisis management ability always remains fully secured while output is maximized ($b^* = \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}$), as long as this particular level is within the relevant range $b \in [\underline{b}, \bar{b}]$, as in Figure 2. If this particular level is outside the relevant range, then the Center will set the corruption tolerance at one of the boundaries of the range, respectively.

Before discussing the implications of this proposition, one may wonder the role of the fat-tail condition ($\epsilon > 1/2$) in the result and whether it is likely to hold or not, espe-

cially in the Chinese context. Indeed, the trade-off between crisis control and economic output is governed by the tail-thickness of the crisis risk; in Appendix B, we provide an additional result that under a sufficiently thin-tailed crisis risk, the Center will sacrifice some crisis control for economic output, even when securing crisis control is possible. That said, having a sufficiently fat-tailed distribution of crisis severity is consistent with empirical evidence on crisis and the general approach in risk management modeling of crises (e.g., Taleb, 2007; Ackerman, 2017).[13] In particular, in the Chinese context, Xi has been using "black swans," a term commonly associated with fat-tailed risk, when addressing the "major risks" that the Party faces in a wide spectrum of realms (People's Daily, 2019).

Given this fat-tailed risk, Proposition 3 implies that the Center will follow a lexicographic rule when choosing the optimal corruption tolerance: stability comes first, while the economic output is maximized only given stability has been maximized. It is important to note that this lexicographic rule is *endogenous* in our model, rather than *exogenous.* Proposition 3 thus provides a micro-foundation of the CPC's "repeatedly emphasized" principle in developing the Chinese economy – "[social and political] stability overrides everything, and we must not relax the People's democratic dictatorship," as stated by Deng Xiaoping (1993, originally 1990, p. 364). It also explains Xi (2014)'s obsession for "security" – "[we] must insist on a holistic view on national security, acknowledging the people's security as our mission, political security the fundamental, economic security the basic, military, cultural, and social security the safeguard, and international security the support, paving a path to national security with Chinese characteristics."

The solution in Proposition 3 suggests that a higher crisis risk can push the Center to crack down on corruption:

Corollary 1. *Corruption tolerance b^* is weakly decreasing in the crisis risk, represented by the greatest possible crisis severity $\bar{\gamma}$; strict monotonicity holds when b^* is an interior solution within $[\underline{b}, \bar{b}]$.*

This corollary is consistent with the Party narratives since 2012. For example, in his report to the 19th National Congress of the Party, Xi (2017b) stated: "confronting the crucial tests of enormous risks faced by the Party ... we cracked down on corruption,

---

[13]The probability distribution of a random variable, X, is often considered to be fat-tailed if $\mathbf{P}[X > x] \sim x^{-\eta}$ when x is large, where $\eta > 0$ is the tail index (e.g., Cooke et al., 2014, p. 2). The measure $\frac{xf(x)}{F(x)}$ would then converge to η. If we followed this convention, Proposition 3 would require $\eta > \frac{1}{2}$.

wiping out significant hidden hazards from the inside of the party-state." In particular, framing corruption as "hidden hazards" matches to our theory: the threats of corruption to the control of the Center is "hidden" and matters only when control is urgently needed, i.e., in a crisis. Again, in a later important speech to the provincial and ministerial leaders, Xi stated that cracking down on corruption is critical to "preventing and solving major risks in the political, ideological, economic, scientific and technological, social, international-relation, and party-building realms" (People's Daily, 2019, p. 1). Taken at face value, these quotes suggest that the increasing risk faced by the Party was a primary motive behind Xi's anti-corruption campaign.

2.4 Power Distribution within the Center

Besides the anti-corruption campaign, the most prominent development in Chinese politics since 2012 has been the streamlining of the Center in two directions. First, the number of members of the Politburo Standing Committee, the highest governing body of the Party, has decreased from nine under Hu Jintao (2002–2012) to seven in Xi's era (since 2012). Second, as Shirk (2018, p. 32) observes, "[u]nder Hu, the general secretary was only first among equals," while Xi has successfully carried out a series of institutional reforms within the Center to consolidate his own power (Li, 2016; Tsai and Zhou, 2019). Due to this streamlining, the Center's power has become less fragmented, and personalistic rule has almost been achieved (Shirk, 2018). How would the power distribution within the Center shape the boundaries of corruption, and why did Xi carry out the two major projects – one to streamline the Center, the other to crack down on corruption – at the same time?

Since we have read the anti-corruption campaign as a drive to securing control in potential crises, the answer to the above question may lie in how the power distribution within the Center would affect its ability to respond to crises. Notably, for a crisis response to succeed, not only must the mobilization of local resources succeed, but the central leaders must in the first place agree on an urgent response plan. If the Center is too fragmented, it could be paralyzed without any response plan, losing its crisis response ability. This risk created by central fragmentation was evident during the two most challenging political crises that the CPC has faced since the end of the Cultural Revolution – the political unrest in 1989 and the Bo Xilai scandal in 2012.[14] Therefore,

---

[14]As Shirk (2018, p. 30 and 33) states, in the spring and summer of 1989, the Party leaders "split on how to respond" to "the widespread unrest," and "open divisions at the top drove the political system

any effort to limit corruption, which helps resource mobilization during crises, may be meaningful only when the Center is sufficiently streamlined.

To formally analyze this possibility, we extend Module 3 by opening up the Center: we assume that when facing a crisis of severity γ, the Center of N leaders has a short time window to decide whether to mobilize the γ-share of the rents from the provincial official, to manage the crisis. The crisis response will succeed 1) if the central leaders agree on the response and 2) if the provincial official cooperate. If the response succeeds, the Center will share the economic output among themselves as their rents $R(b) \equiv y$, which is increasing in the corruption tolerance, b, as in Module 1. When the response fails, each leader will receive a downfall payoff, D, as in Module 3. Call $p_i > 0$ the power of leader i, which depends on his official ranking in the Center, where $\sum_{i=1}^{N} p_i = P > 0$ is exogenous and p_i/P corresponds to leader i's share of the Center's rents. Given that important decision-making in the Party Center usually requires consensus (at least before Xi's reign, e.g., Shirk, 1993; Huang, 2000; Vogel, 2005; Xie and Xie, 2017), we assume that when the Center decides on the crisis response, the response will be taken only by consensus from all the central leaders, regardless of each leader's power p_i.[15]

Given this setting, a successful crisis response requires $R(b) \cdot p_i/P \geq D$ for all i, which will be the case if $\min_i p_i/P \geq D/R(b)$, i.e., the Center is so streamlined that even the weakest central leader has a sufficient stake in the status quo and, therefore, is willing to approve the response. Therefore, this setting imposes an additional constraint about power distribution on successful responses to crises:

Lemma 3. *A crisis will be successfully managed if and only if it is not so severe and the Center is sufficiently streamlined, i.e., $\gamma \leq \hat{\gamma}$ and $\min_i p_i/P \geq D/R(b)$.*

Given this constraint, how would the paramount leader, who chairs the Center and is denoted by $i = 1$, set the corruption tolerance b, the Center's size N, and the distribution of power $\{p_i\}_1^N$ at the same time, if he has the ability to do so? The

---

to the brink of collapse;" "on the eve of Xi's 2012 ascension to power," "[t]he leadership split ... under collective leadership," and "[n]either Hu nor the Standing Committee as a whole had the gumption to stop Bo's open campaigning for power," which eventually failed only thanks to the dramatic turn around the murder of Neil Heywood (Gracie, 2017).

[15]This suggests that a leader who has $p_i = 0$ would still be able to veto a decision because of his presence in the Center. Therefore, not only the series $\{p_i\}_1^N$ but also the number of central leaders N are affecting the decision making process. The consensus requirement is instrumental in building a united image of the Party leadership, legitimizing the single-party authority. The disastrous outcomes in Mao's last years also reminded the leaders of the danger of personalistic rule. For more discussions on the consensus requirement, see Shirk (1993) and Huang (2000).

paramount leader's program is thus

$$\max_{b\in[\underline{b},\bar{b}),\ N,\ \{p_i\}_1^N} \left(F(0) + \big(F(\hat{\gamma}(b)) - F(0)\big) \cdot \mathbf{1}_{\min_i p_i/P \geq D/R(b)}\right) \cdot \left(R(b) \cdot p_1/P - D\right), \quad (15)$$

where

$$N \geq 1, \quad \sum_i^N p_i = P, \quad p_i > 0, \quad i = 1, \ldots, N,$$

$$\hat{\gamma}(b) \equiv \frac{L_P}{b^2/2c - r_L}, \quad R(b) \equiv y = \alpha + (1 - \alpha) \cdot b/c, \quad (16)$$

and $\mathbf{1}_.$ is an indicator function.

The following proposition describes the solution:

Proposition 4. *Given $D < \alpha$ and if $\epsilon \equiv \gamma \cdot f(\gamma)/F(\gamma) > 1/2$ holds for any $\gamma \in (0, \bar{\gamma})$ as in Proposition 3, then the paramount leader should choose a dictatorship, i.e., $N = 1$ and $p_1/P = 1$, and then crack down on corruption, i.e., $b = b^*$, where b^* follows the solution in Proposition 3.*

Proof. Note that, given any corruption tolerance b, the paramount leader would like to maximize his own survival payoff, i.e., his share of rents p_1/P. At the same time, he would also like to maximize the likelihood that all central leaders would be able to agree on a crisis response, i.e., to maximize the power of the Center's lowest ranking member $\min p_i/P$. Since a dictatorship ($N = 1$) implies $p_1/P = \min_i p_i/P = 1$, it solves the two maximization problems simultaneously and is thus optimal for the paramount leader. As a dictator, the paramount leader's program is then reduced to the Center's program in formerly modeled Module 3, with the Center being the paramount leader himself. The solution in Proposition 3 then follows. □

One may wonder whether the result of a dictatorship ($N = 1$) comes only from the fact that it maximizes the share of rents the paramount leader would enjoy. The answer is no. To see this point, suppose that the paramount leader chooses $N > 1$ while $p_i = 0$ for any $i \neq 1$. This institution would maximize the paramount leader's share of rents, i.e., $p_1/P = 1$, but it leaves the Center paralyzed during crises, since the Center-streamlining condition $\min_i p_i/P \geq D/R(b)$ would become $0 \geq D/R(b)$ and never hold if $D > 0$. Therefore, the power consolidation in Proposition 3 indeed results from the Center-streamlining requirement of the crisis response.

To summarize, Proposition 4 implies that the paramount leader will try to consolidate power within the Center, and if he can do so, he will then crack down on corruption at the same time. In particular, without power consolidation, only cracking down on corruption might not be enough to guarantee a successful crisis response. Without cracking down on corruption, only consolidating power might still leave too much rents to prevent the provincial officials from resisting resource mobilization in the crisis.

This implication lends an explanation to the timing of the recent anti-corruption campaign and the general political developments in China since 2012. As Shirk (2018, p. 30) observes, in Xi's first General Secretary term, "Jiang Zemin [was] ... hobbled politically by age," while "Hu Jintao, a far more self-effacing figure than Jiang, [stayed] out of Xi Jinping's way," symbolized by his stepping down from the Central Military Commission of the Party right when Xi took the General Secretary position, and "there [was] no pre-appointed successor with whom Xi must share the elite's loyalty." These conditions created a rare window for Xi to consolidate his power, which he has been doing consistently, up to the point that recent developments have clearly suggested he will break the post-1989 norm that one should not serve as the paramount leader for more than ten years (Fewsmith, 2018; McGregor et al., 2018).[16] Starting from the initial window, the recent anti-corruption campaign and this operation of power consolidation have been closely complementing each other.

3   Reciprocal Accountability

In our model, provincial officials are especially powerful in the party-state system and can threaten the control of the Center if they are too corrupt. In this section, we go deeper by investigating why this is the case, i.e., why members of the Center may resist a collective decision to discipline a provincial official for corruption, non-cooperation in resource mobilization, or other non-compliance behaviors. When examining the Chinese party-state system, an important feature stands out: the reciprocal accountability between the central leaders and provincial officials.

---

[16]The 19th Politburo Standing Committee does not include any apparent successor to Xi, and the *2018 Amendment to the Constitution of the People's Republic of China* has abolished the term limit for the Presidency of China.

3.1 Power of Provincial Officials

As documented by Shirk (1993), not only do the central leaders hold provincial officials accountable through the party hierarchy, but provincial officials also hold the central leaders accountable because, in political struggles inside the Center, each central leader counts on his support base among provincial leaders. This reciprocal accountability is not surprising, given that 1) provincial officials occupy about half of the Central Committee of the Party, which elects the Politburo and its Standing Committee, and that 2) central leaders are at the very top of the party hierarchy so they have no higher authority to appeal to, other than their direct subordinates, i.e., the provincial officials.[17] As Shirk (2018, p. 32) states, "[u]nder reciprocal accountability, these [provincial] officials [in the Central Committee] are not mere agents of the Party center."

Would this reciprocal accountability prevent the Center from being able to discipline non-compliant provincial officials whenever it wants? We start by modeling a hypothetical case in which provincial officials do not hold central leaders accountable, and then compare it with the more realistic case in which they do hold them accountable.

As in the previous section, we still assume that each central leader has his *de jure* power, $p_i > 0$, determined by the official ranking in the Party, where $P \equiv \sum_i p_i > 0$ is exogenous. We assume that these leaders share an exogenous rent $R > 0$ among them, and each of them gets a share p_i/P. Under what condition would each leader inside the Center be willing to purge a non-compliant provincial official, claiming he is too corrupt and bringing in his rent, $b^2/2c - r_L$, to share among the leaders?

The answer is that each central leader would support the removal, if and only if the payoff from doing so is not lower than the status quo payoff, i.e.,

$$\frac{p_i}{P} \left(\frac{b^2}{2c} - r_L + R \right) > \frac{p_i}{P} \cdot R. \tag{17}$$

This condition will always hold, given that local officials are staying in the hierarchy, i.e., $b \geq \underline{b}$ or $b^2/2c - r_L \geq 0$. Therefore, all leaders in the Center would always support disciplining any non-compliant provincial official, and most rents created by crony capitalism would eventually flow to the Center. In this case, the Center can always discipline any non-compliant provincial officials.

Assume now reciprocal accountability between provincial officials and central lead-

---

[17]Shirk (1993) documents how provincial officials can wield power over central leaders. For example, Deng Xiaoping withdrew his proposal to promote Zhu Rongji to the PSC after he met strong resistance from the Central Committee.

ers. We assume that each central leader i has $m_i > 0$ provincial officials as his protégés, where we denote the total number of provinces as $M \equiv \sum_i m_i$. His *de facto* power in the Center is then $p_i + m_i$, and his share of the central rent is then $(p_i + m_i)/(P + M)$.

Under these assumptions, this central leader will then block disciplining one of his own protégés, if and only if

$$\frac{p_i + m_i - 1}{M + P} \left(\frac{b^2}{2c} - r_L + R \right) < \frac{p_i + m_i}{M + P} \cdot R. \tag{18}$$

Comparing this condition with Condition (17), without reciprocal accountability, each central leader cares only about his *de jure* power, and disciplining provincial officials will not affect that power, i.e., p_i/P appears on both sides of (17); when reciprocal accountability does exist, each leader depends additionally on his provincial support, so removing one of his protégés will weaken his *de facto* power, decreasing his share of the Center's rents from $(p_i + m_i)/(M + P)$, which appears on the right-hand side of Condition (18), to $(p_i + m_i - 1)/(M + P)$, which appears on the left-hand side. Therefore, with reciprocal accountability, the leader has an incentive to protect his protégés.

To see this point even more clearly, Condition (18) is equivalent to

$$R > (p_i + m_i - 1) \left(\frac{b^2}{2c} - r_L \right) \equiv \bar{R}. \tag{19}$$

This inequality is still possible to hold if R is sufficiently large or $p_i + m_i$ is sufficiently small, even given local officials are staying in the hierarchy, i.e., $b \geq \underline{b}$ or $b^2/2c - r_L \geq 0$, a condition under which the disciplining would have always happened if reciprocal accountability did not exist. We then have the following result:

Proposition 5. *Without reciprocal accountability, central leaders can always discipline non-compliant provincial officials, as long as local officials are staying in the hierarchy, i.e., $b^2/2c - r_L \geq 0$. Given this condition, with reciprocal accountability, instead, each central leader will protect his protégés, if the Center's rent is sufficiently large, i.e., $R \geq \bar{R}$, where $\bar{R}$ is increasing in the leader's de jure power p_i.*

This proposition implies that the weaker the leader is inside the Center de jure (lower p_i), the more actively he would protect his own protégés (lower $\bar{R}$). This implication is consistent with the fact that Zhou Yongkang, who was the lowest in the official ranking of the Politburo Standing Committee, actively protected Bo Xilai, who had gained

23

enormous popularity across the country as the Party secretary of Chongqing.[18]

The analysis above explains how reciprocal accountability between the Center and provincial officials can prevent the Center from using personnel power to reap rents from provincial officials and disciplining them. It also illustrates why provincial officials can reap rents from local officials. Announced in *People's Daily* (1984), the 1984 cadre management reform "replaced the two-level down principle with one-level down," granting provincial and local officials personnel authority over their immediate subordinate (Burns, 1987, p. 49). As observed by Pei (2016, p. 35), after some back-and-forth between 1985 and 1994 (e.g., Burns, 1994 on the 1990 adjustment), "the full institutionalization of this far-reaching reform" was eventually settled by the Central Committee of the Party (1995). Each level of the party organization along the hierarchy then behaved like the hypothetical case we discussed where the subordinates cannot hold their supervisors accountable, so the supervisors can force the subordinates to surrender their rents, and the rents are eventually reaped along the party hierarchy up to the provincial level. The combination of 1) reciprocal accountability between the Center and provincial officials and 2) the lack of it below the provincial level in the hierarchy then causes most rents created by crony capitalism to be captured at the provincial level, threatening the Center's power.

3.2   A Corrupt Center

So far we have analyzed corruption below the top of the hierarchy, assuming that central leaders are clean. This assumption can be challenged, especially in light of the indictment of Zhou Yongkang, a member of the Politburo Standing Committee between 2007 and 2012, who protected corrupt officials in exchange for a great amount of wealth. Chen and Kung (2019) also document that, in the primary land market, provincial officials gifted massive price discounts to firms linked to central leaders in exchange for promotion to the national leadership. How would corruption in the Center affect the disciplining ability of the Center, and its interaction with provincial officials?

Assume that the central leader i receives a bribe, $e > 0$, from each of his protégés. Each protégé finances this bribe from his corruption rents $R_P = b^2/2c - r_L$, and the central leader does not share this bribe with the other leaders. Disciplining one of his protégés will, however, force the central leader to submit this protégé's bribe, together

---

[18]Zhou Qiang (2015), the Chief Justice and President of the Supreme People's Court, wrote publicly that Zhou Yongkang and Bo Xilai engaged in "political activities beyond the Party organization."

with all the rest of this protégé's rents, and share them within the Center given the pressure from other central leaders.

Under these assumptions, the leader will then protect the protégé if and only if

$$\frac{p_i + m_i - 1}{M + P} \cdot \left(\frac{b^2}{2c} - r_L + R\right) + (m_i - 1)e < \frac{p_i + m_i}{M + P} \cdot R + m_i e. \tag{20}$$

This condition differs from Condition (18) only in that it features the added bribes, i.e., $(m_i - 1)e$ and $m_i e$, respectively, on each side. This condition can be rewritten as follows:

$$R > (p_i + m_i - 1)\left(\frac{b^2}{2c} - r_L\right) - (M + P)e \equiv \bar{R}_{\text{Corrupt Center}}. \tag{21}$$

Comparing Condition (21) with the condition without corruption, i.e., Condition (19),

$$R > \left(p_i + m_i - 1\right)\left(\frac{b^2}{2c} - r_L\right) \equiv \bar{R}_{\text{Uncorrupt Center}}, \tag{22}$$

we can formulate the following proposition.

Proposition 6. $\bar{R}_{Corrupt\ Center} < \bar{R}_{Uncorrupt\ Center}$, i.e., corruption in the Center makes it more difficult for the Center to discipline non-compliant provincial officials.

The intuition for this result is that the central leader has to sacrifice his private gain of bribes when his protégés are removed, which makes the removal less attractive to him. This result suggests that corruption in the Center can greatly damage the disciplining ability of the Center, especially given the consensus requirement for important decision-making in the Party Center (Shirk, 1993; Huang, 2000; Vogel, 2005; Xie and Xie, 2017), since one corrupt leader can almost on his own block disciplining measures towards his protégés. This is consistent with the observation that only one corrupt Zhou Yongkang sufficed to paralyze the Politburo Standing Committee from taking any serious disciplining measures against his corrupt protégés.

A corollary of the proposition concerns the case of an extremely corrupt Center, i.e., when e is sufficiently large:

Corollary 2. If $e > \bar{e}$ where $\bar{e} \equiv \frac{(\max_i\{p_i + m_i\} - 1)\left(b^2/2c - r_L\right)}{M + P}$, then $R > \bar{R}_{Corrupt\ Center}$ will always hold and the central leaders will always protect their own protégés.

This result comes from the fact that extreme corruption at the Center would imply $\bar{R}_{\text{Corrupt Center}} \leq 0$ for any central leader. In this case, given the consensus requirement

for personnel disciplining, the Center will lose all of its *de facto* personnel power. In other words, absolute corruption in the Center corrupts its power absolutely.

To summarize the results from this section, it is because of 1) the reciprocal accountability between the central leaders and their provincial-level protégés and 2) the lack of reciprocal accountability below the provincial level that provincial officials emerge as powerful players in the party-state, threatening the Center's control of the system. This is especially true if corruption has reached the top level of the Party leadership.

4   Concluding Remarks

In this paper we provide a theoretical framework that puts together in a single model crony capitalism, the Chinese party-state, and the decision making of the leadership of the Communist Party of China. It helps us understand the recent anti-corruption campaign under Xi and the role of corruption in the Chinese political economy. Analysis and extensions explain the campaign's motive, timing, targets, and accompanying political changes within the Party Center. The model also highlights the roles of inefficient economic institutions and the party-state hierarchy in creating, directing, and cracking down on corruption.

A key insight from our exercise is that when the Party leadership faces a commonly fat-tailed risk of crisis, its political concerns will dominate the economic ones. This insight implies that an anti-corruption campaign can be understood as an attempt to consolidate the compliance of the party-state to the Party leadership in potential crises. This understanding can help reconcile seemingly conflicting empirical evidence about the anti-corruption campaign. For example, although the campaign has responded to economic problems associated with corruption (e.g., Chen and Kung, 2019; Lu and Lorentzen, 2018; Goh et al., 2019) and the stock market reacted generally positively to it (e.g., Ding et al., 2017; Lin et al., 2018), it has slowed down economic growth and investment (Araral et al., 2018; Qu et al., 2018) and has brought down officials who were more capable of generating economic growth (Xi et al., 2018); although the campaign has targeted patronage networks and deviations from meritocracy within the party-state (e.g., Lu and Lorentzen, 2018; Goh et al., 2019), there was considerable or even greater room for political connections to influence the personnel management within the party-state (e.g., Lu and Lorentzen, 2018; Xi et al., 2018; Goh et al., 2019).

Given our understanding, it is natural for the campaign to respond to economic

problems, as they warn about potential crises. The campaign has to eradicate any non-Party personnel system within the party-state, if its ultimate goal is to consolidate control. Meritocracy, however, is essentially rule-based and fundamentally against the exceptional power of the Party leadership, so it has to be replaced by a more personalistic system, with the Party leadership, i.e., Xi, monopolizing political connections and influences. As the personalistic system crowds out meritocracy, it is unsurprising to see further economic costs being paid.

Our research also highlights that the exact interaction between economic cronyism and corruption in autocracies relies on the institutional arrangements in the economy and politics, and one would expect that the economic and political effect of corruption to vary certainly according to these institutional arrangements. Our analysis of the Chinese case is only a first step in that direction.

References

Ackerman, Frank. 2017. *Worst-Case Economics: Extreme Events in Climate and Finance.* London: Anthem Press.

An, Heng, Yanyan Chen, Danglun Luo, and Ting Zhang. 2016. Political uncertainty and corporate investment: Evidence from China. *Journal of Corporate Finance* **36**: 174–189.

Ang, Yuen Yuen. 2020. *China's Gilded Age: The Paradox of Economic Boom and Vast Corruption.* Cambridge University Press.

Araral, Eduardo, Hui Li, Minh Khuong Vu, and Kris Hartley. 2018. Has China's anti-corruption campaign slowed down growth? Lee Kuan Yew School of Public Policy Research Paper No. 17-29.

Bai, Chong-En, Yingjuan Du, Zhigang Tao, and Sarah Y. Tong. 2004. Local protectionism and regional specialization: Evidence from China's industries. *Journal of International Economics* **63**: 397–417.

Bai, Chong-En, Chang-Tai Hsieh, and Zheng Michael Song. 2014. Crony capitalism with Chinese characteristics. Working paper, May 2014.

Bai, Chong-En, Chang-Tai Hsieh, and Zheng Michael Song. 2020. Special deals with Chinese characteristics. In Eichenbaum, Martin S., Erik Hurst, and Jonathan A. Parker (eds.) *NBER Macroeconomics Annual 2019.* Chicago: University of Chicago Press, 341–379.

Barwick, Panle Jia, Shengmao Cao, and Shanjun Li. 2017. Local protectionism, market structure, and social welfare: China's automobile market. National Bureau of Economic Research Working Paper No. 23678.

Brandt, Loren, and Thomas G. Rawski (eds.). 2008. *China's Great Economic Transformation*. New York: Cambridge University Press.

Burns, John P. 1987. China's *Nomenklatura* system. *Problems of Communism* **36**: 36–51.

Burns, John P. 1994. Strengthening central CCP control of leadership selection: The 1990 *Nomenklatura*. *China Quarterly* **138**: 458–491.

Central Commission for Discipline Inspection of the Communist Party of China. 2017. Report of the 18th Central Commission for Discipline Inspection to the 19th National Congress of the Communist Party of China. October 24, 2017.

Central Committee of the Communist Party of China. 1995. Provisional rules on promotion and appointment of Party and governmental officials. February 9, 1995.

Che, Jiahua, Kim-Sau Chung, and Xue Qiao. 2019. The king can do no wrong: On the criminal immunity of leaders. *Journal of Public Economics* **170**: 15–26.

Chen, Nan, and Zemin Zhong. 2018. The economic impact of China's anti-corruption campaign. Working paper.

Chen, Ting, Li Han, James Kai-sing Kung, and Jiaxin Xie. 2017. Through the revolving door: The trading of favors between public officials and firms in China's land market. Working paper.

Chen, Ting, and James Kai-sing Kung. 2019. Busting the "princelings": The campaign against corruption in China's primary land market. *Quarterly Journal of Economics* **134**: 185–226.

Chen, Zhiyuan, Xin Jin, and Xu Xu. 2018. Is cracking down on corruption really good for the economy? Firm-level evidence from a natural experiment in China. Working paper, Pennsylvania State University.

Cooke, Roger M., Daan Nieboer, and Jolanta Misiewicz. 2014. *Fat-Tailed Distributions: Data, Diagnostics and Dependence*. London: John Wiley & Sons, Inc.

Deng, Xiaoping. 1993, originally 1990. Well exploit opportunities to solve the development problem. In *Selected Works of Deng Xiaoping, Volume 3: 1982–1992*. Beijing: People's Publishing House, 363–365.

Ding, Haoyuan, Hanming Fang, Shu Lin, and Kang Shi. 2017. Equilibrium consequences of corruption on firms: Evidence from China's anti-corruption campaign. Working paper, University of Pennsylvania.

Egorov, Georgy, and Konstantin Sonin. 2020. The political economics of non-democracy. National Bureau of Economic Research Working Paper 27949.

Fewsmith, Joseph. 2018. The 19th Party Congress: Ringing in Xi Jinping's new age. *China Leadership Monitor* **17**: 1–22.

Fisman, Raymond, and Yongxiang Wang. 2015. The mortality cost of political connections. *Review of Economic Studies* **82**: 1346–1382.

Francois, Patrick, Francesco Trebbi, and Kairong Xiao. 2016. Factions in nondemocracies: Theory and evidence from the Chinese Communist Party. National Bureau of Economic Research Working Paper No. 22775.

Gehlbach, Scott, Konstantin Sonin, and Milan W. Svolik. 2016. Formal models of nondemocratic politics. *Annual Review of Political Science* **19**: 565–584.

Goh, Jing Rong, Hong Ru, and Kunru Zou. 2019. Force behind anti-corruption: Evidence from China. Working paper, Nanyang Technological University.

Gracie, Carrie. 2017. Murder in the Lucky Holiday Hotel. British Broadcasting Corporation, March 17, 2017.

He, Guojun, Yang Xie, and Bing Zhang. 2020. Expressways, GDP, and the environment: The case of China. *Journal of Development Economics* **145**: 102485.

Huang, Jing. 2000. *Factionalism in Chinese Communist Politics*. New York: Cambridge University Press.

Huang, Ray. 1981. *1587, a Year of No Significance: The Ming Dynasty in Decline*. New Haven: Yale University Press.

Huntington, Samuel P. 1968. *Political Order in Changing Societies*. New Haven: Yale University Press.

Kuhn, Philip A. 1990. *Soulstealers: The Chinese Sorcery Scare of 1768*. Cambridge: Harvard University Press.

Kung, James Kai-sing, and Chicheng Ma. 2018. Friends with benefits: How political connections help to sustain private enterprise growth in China. *Economica* **85**: 41–74.

Leff, Nathaniel H. 1964. Economic development through bureaucratic corruption. *American Behavioral Scientist* **8**: 8–14.

Lei, Yu-Hsiang. 2018. Quid pro quo? Government–firm relationships in China. Working paper, Yale-NUS College.

Li, Cheng. 2016. *Chinese Politics in the Xi Jinping Era: Reassessing Collective Leadership*. Washington, D.C.: Brookings Institution Press.

Li, Keqiang. 2015. Report on the work of the government. Delivered at the 3rd Session of the 12th National People's Congress, March 5, 2015.

Li, Weijia, Gérard Roland, and Yang Xie. 2019. Erosion of state power, corruption control, and political stability. Working paper, University of California, Riverside.

Lin, Chen, Randall Morck, Bernard Yeung, and Xiaofeng Zhao. 2018. Anti-corruption reforms and shareholder valuations: Event study evidence from China. Working paper, May 2018.

Lin, Yi-min. 2001. *Between Politics and Markets: Firms, Competition, and Institutional Change in Post-Mao China.* Cambridge: Cambridge University Press.

Lorentzen, Peter. 2017. Designing contentious politics in post-1989 China. *Modern China* **43**: 459–493.

Lu, Xi. 2017. Greasing the wheels of economy: Corruption or anticorruption? Evidence from China's residential land market. Working paper.

Lu, Xi, and Peter L. Lorentzen. 2018. Personal ties, meritocracy, and China's anti-corruption campaign. Working paper.

McGregor, Richard, Taisu Zhang, Susan Shirk, Robert Daly, Orville Schell, Kerry Brown, Ezra Vogel, Stanley Lubman, Jessica C. Teets, Jonathan Fenby, Jude Blanchette, Margaret Lewis, Michael Thompson, Yanmei Xie, Francesco Sisci, Roderick MacFarquhar, and Sophie Richardson. 2018. Xi won't go. ChinaFile Conversation, February 25–28, 2018.

Osburg, John. 2013. *Anxious Wealth: Money and Morality among China's New Rich.* Stanford: Stanford University Press.

Pei, Minxin. 2016. *China's Crony Capitalism: The Dynamics of Regime Decay.* Cambridge: Harvard University Press.

People's Daily. 1984. The Central Committee only supervises key cadre positions one level down. Page 1, July 20, 1984.

People's Daily. 2019. Strengthen the ability of prevention and control, focus on preventing and resolving major risks, and maintain sustained and healthy economic development and social stability. Pages 1–2, January 22, 2019.

Qian, Yingyi. 2017. *How Reform Worked in China: The Transition from Plan to Market.* Cambridge: MIT Press.

Qu, Guangjun, Kevin Sylwester, and Feng Wang. 2018. Anticorruption and growth: Evidence from China. *European Journal of Political Economy* **55**: 373–390.

Roland, Gérard. 2018. The evolution of post-communist systems: Eastern Europe vs. China. *Economics of Transition* **26**: 589–614.

Schmitt, Carl. 1921. *Die Diktatur: Von den Anfängen des Modernen Souveränitätsgedankens bis zum Proletarischen Klassenkampf.* Leipzig: Duncker & Humblot.

Schmitt, Carl. 1922. *Politische Theologie: Vier Kapitel zur Lehre von der Souveränität.* Berlin: Duncker & Humblot.

Sheng, Shibin, Kevin Zheng Zhou, and Julie Juan Li. 2011. The effects of business and political ties on firm performance: Evidence from China. *Journal of Marketing* **75**: 1–15.

Shirk, Susan L. 1993. *The Political Logic of Economic Reform in China.* Berkeley: University of California Press.

Shirk, Susan L. 2018. The return to personalistic rule. *Journal of Democracy* **29**: 22–36.

Sng, Tuan-Hwee. 2014. Size and dynastic decline: The principal-agent problem in late imperial China, 1700–1850. *Explorations in Economic History* **54**: 107–127.

State Council of China. 2014. Li Keqiang: The State Council never issues dishonored directives. May 30, 2014.

Taleb, Nassim Nicholas. 2007. *The Black Swan: The Impact of the Highly Improbable.* New York: Random House.

Tsai, Wen-Hsuan, and Wang Zhou. 2019. Integrated fragmentation and the role of leading small groups in chinese politics. *China Journal* **82**: 1–22.

Veg, Sebastian. 2019. The rise of China's statist intellectuals: Law, sovereignty, and "repoliticization". *China Journal* **82**: 23–45.

Vogel, Ezra F. 2005. Chen Yun: His life. *Journal of Contemporary China* **14**: 741–759.

Walder, Andrew G. 2015. *China Under Mao: A Revolution Derailed.* Cambridge: Harvard University Press.

Wang, Bin, and Yu Zheng. 2019. A model of tournament incentives with corruption. *Journal of Comparative Economics* **48**: 182–197.

Wedeman, Andrew H. 2003. *From Mao to Market: Rent Seeking, Local Protectionism, and Marketization in China.* New York: Cambridge University Press.

Will, Pierre-Étienne. 1980. *Bureaucratie et Famine en Chine au XVIIIe Siècle.* Paris: École des Hautes Études en Sciences Sociales.

Xi, Jinping. 2014. Speech in the first meeting of the Central National Security Commission of the Communist Party of China. April 15, 2014.

Xi, Jinping. 2015. Speech in the study conference of provincial and ministerial officials on the spirit of the 4th Plenary Meeting of the 18th Central Committee of the Communist Party of China. February 2, 2015.

Xi, Jinping. 2016. Speech in the 6th Plenary Meeting of the 18th Central Commission for Discipline Inspection of the Communist Party of China. January 12, 2016.

Xi, Jinping. 2017a. Opening speech of the study conference of provincial and ministerial officials in preparation for the 19th National Congress of the Communist Party of China. July 26, 2017.

Xi, Jinping. 2017b. Report to the 19th National Congress of the Communist Party of China by Xi Jinping on behalf of the 18th Central Committee of the Party. October 18, 2017.

Xi, Jinping. 2018. Opening speech of the study conference of central commision, provincial, and ministerial officials on the Xi Jinping Thought on Socialism with Chinese Characteristics for a New Era and the spirit of the 19th National Congress of the Communist Party of China. January 5, 2018.

Xi, Tianyang, Yang Yao, and Qian Zhang. 2018. Dilemmas of autocratic governance: Theory and evidence from the anti-corruption campaign in China. Working paper.

Xie, Yinxi, and Yang Xie. 2017. Machiavellian experimentation. *Journal of Comparative Economics* **45**: 685–711.

Xinhua News Agency. 2013. Premier Li Keqiang and others met with journalists covering the Two Sessions and answered questions. Transcript of the Press Conference of the 1st Session of the 12th National People's Congress, March 17, 2013.

Xu, Chenggang. 2011. The fundamental institutions of China's reforms and development. *Journal of Economic Literature* **49**: 1076–1151.

Xu, Chenggang. 2015. China's political-economic institutions and development. *Cato Journal* **35**: 525–548.

Xu, Chenggang. 2019. The pitfalls of a centralized bureaucracy. *Acta Oeconomica* **69**: 1–16.

Ying, Qianwei, and Jinsong Liu. 2018. Anti-corruption campaign in China: Good news or bad news for firm value? *Applied Economics Letters* **25**: 1183–1188.

Zhang, Fan. 2018. *The Institutional Evolution of China: Government vs Market*. Cheltenham: Edward Elgar Publishing.

Zhao, Dingxin. 2009. The Mandate of Heaven and performance legitimation in historical and contemporary China. *American Behavioral Scientist* **53**: 416–433.

Zhou, Li-An. 2004. The incentive and cooperation of government officials in the political tournaments: An interpretation of the prolonged local protectionism and duplicative investments in China. *Economic Research Journal* **39**: 33–40.

Zhou, Li-An. 2008. *Local Government in Transition: Official Incentives and Governance*. Shanghai: Truth & Wisdom Press.

Zhou, Qiang. 2015. Strengthen the supervision over power and deepen the reform of the judicial system. China Discipline Inspection and Supervision Newspaper, March 17, 2015.

Zhou, Xueguang. 2012. Mechanism of campaigning governance: Rethinking the institutional logic of the Chinese state governance. *Open Times* **31**: 105–125.

Zhou, Xueguang. 2013. Logic of the state governance and Chinese bureaucracy: A Weberian perspective. *Open Times* **32**: 5–28.

Zhou, Xueguang. 2017. *The Institutional Logic of Governance in China: An Organizational Approach*. Beijing: SDX Joint Publishing Company.

Zhu, Jiangnan. 2008. Why are offices for sale in China? A case study of the office-selling chain in Heilongjiang Province. *Asian Survey* **48**: 558–579.

Appendix

A Vertical Correlation of Indictments

Table 1 shows a vertical correlation between corruption indictments at higher levels (provincial party secretaries and governors) and lower ranks across provinces.

Table 1: Vertical chains: Correlation between higher and lower rank corruption

	(1)	(2)	(3)	(4)	(5)
	Rank 3–4 (provincial secretary or governor) indictments				
Rank 5–6 indictments	0.078***			0.071***	0.050***
	(0.016)			(0.021)	(0.024)
Rank 7–8 indictments		0.191***			0.096
		(0.054)			(0.060)
Rank 5–8 indictments			0.067***		
			(0.013)		
Number of cities				−0.001	0.002
				(0.031)	(0.030)
Number of counties				0.004	0.005
				(0.007)	(0.007)
Constant	0.925*	1.923***	0.874*	0.809	0.668
	(0.478)	(0.395)	(0.453)	(0.627)	(0.615)
N	31	31	31	30	30

A larger rank number denotes a lower level in the hierarchy; cross-province regression; data from Lu and Lorentzen (2018); heteroskedasticity-robust standard errors in parentheses; *, $p < 0.1$; **, $p < 0.05$; ***, $p < 0.01$.

B Thin-tailed Risk

Proposition 7. *As in Proposition 3, assume the downfall payoff is sufficiently low ($D < \alpha$). Consider the case of interior solutions in Proposition 3 ($\underline{b} < \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)} < \bar{b}$).*

If the distribution of the crisis severity satisfies that $\epsilon \equiv \gamma \cdot f(\gamma)/F(\gamma) < \underline{\epsilon}$ holds for any $\gamma \in (\underline{\gamma}, \bar{\gamma})$, where

$$\underline{\epsilon} \equiv \frac{1}{2} \cdot \frac{\sqrt{L_P/\bar{\gamma} + r_L} - r_L/\sqrt{L_P/\bar{\gamma} + r_L}}{\sqrt{L_P/\bar{\gamma} + r_L} + \sqrt{c}(\alpha - D)/\sqrt{2}(1 - \alpha)} < 1/2 \qquad (23)$$

and $\underline{\gamma} \geq 0$ is given, then the Center's optimal corruption tolerance $b^* \geq \sqrt{2c\left(L_P/\underline{\gamma} + r_L\right)}$, which implies that the Center will sacrifice some crisis control for economic output.

Proof. By the proof of Proposition 3, we know that when $b \leq \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}$, the Center's objective function is increasing in b; when $\hat{\gamma} < \bar{\gamma}$, i.e., $b > \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}$, the objective function will be strictly increasing if

$$\hat{\gamma} \cdot \frac{f(\hat{\gamma})}{F(\hat{\gamma})} < \frac{1}{2} \cdot \frac{(1 - \alpha)b - 2cr_L(1 - \alpha)/b}{(1 - \alpha)b + c(\alpha - D)}. \qquad (24)$$

Note that, when $D < \alpha$ and $b > \sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}$,

$$
\begin{aligned}
\frac{1}{2} \cdot & \frac{(1 - \alpha)b - 2cr_L(1 - \alpha)/b}{(1 - \alpha)b + c(\alpha - D)} \\
> & \frac{1}{2} \cdot \frac{(1 - \alpha)\sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)} - 2cr_L(1 - \alpha)/\sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)}}{(1 - \alpha)\sqrt{2c\left(L_P/\bar{\gamma} + r_L\right)} + c(\alpha - D)} \\
= & \frac{1}{2} \cdot \frac{\sqrt{L_P/\bar{\gamma} + r_L} - r_L/\sqrt{L_P/\bar{\gamma} + r_L}}{\sqrt{L_P/\bar{\gamma} + r_L} + \sqrt{c}(\alpha - D)/\sqrt{2}(1 - \alpha)} \equiv \underline{\epsilon},
\end{aligned} \qquad (25)
$$

where $\underline{\epsilon} < 1/2$. Therefore, given the objective function is continuous, we can conclude that if $\gamma \cdot f(\gamma)/F(\gamma) \leq \underline{\epsilon}$ for any $\gamma \in (\underline{\gamma}, \bar{\gamma})$, then the Center's objective function is strictly increasing over $b < \sqrt{2c\left(L_P/\underline{\gamma} + r_L\right)}$. The result then follows. $\qquad \square$