SOE INSPECTIONS AND CORPORATE POLICIES IN CHINA

WUKUANG CUN
Shanghai University of Finance and Economics

VINCENZO QUADRINI
University of Southern California, CEPR and NBER

QI SUN
Shanghai University of Finance and Economics

JUNJIE XIA
Central University of Finance and Economics and Peking University

Using firm-level data from China we find that inspections of central SOEs have significant impact on the investment and performance of the controlled companies. Companies controlled by indicted SOEs invested less, experienced lower performance but allocate more resources toward 'social' objectives in the aftermath of the inspection. To rationalize these findings and to study the implications of inspections for allocation efficiency, we propose a dynamic model with repeated moral hazard with two types of productions: market and social production. Although inspections could be instrumental to achieve social goals, they also carry some costs. We also investigate the effectiveness of how alternative corporate policies toward central SOEs such as managerial monitoring and tenure.

KEYWORDS: Optimal contracts, SOEs' policies, firm dynamics.

Wukuang Cun: wukuang.cun@outlook.com
Vincenzo Quadrini: quadrini@usc.edu
Qi Sun: qisun2013@gmail.com
Junjie Xia: junjiexia@nsd.pku.edu.cn

1. INTRODUCTION

State-owned enterprises (SOEs) are pivotal players in the global economy. In 2018, their assets were valued at $45 trillion, representing about half of the global GDP.[1] As part of corporate restructuring campaigns, SOE management is often subjected to external scrutiny, which can significantly impact corporate governance and policies both within the SOEs and their controlled companies.

In this paper we focus on China where some of the most important SOEs have been subjected to inspections conducted by the central government, some of which resulted in notable management indictment. The goal is to explore how the outcome of these inspections impacted the corporate policies and performance of companies controlled by the inspected SOEs. Using firm-level data we find that, after the inspections:

1. The investment and corporate performance of companies controlled by *indicted* SOEs declined compared to those controlled by *non-indicted* SOEs.
2. Spending on environmental protection and poverty alleviation increased in companies controlled by *indicted* SOEs, compared to those controlled by *non-indicted* SOEs. Their ESG (Environmental, Social and Governance) score also improved.
3. Managerial promotions declined in companies controlled by *indicted* SOEs, compared to those controlled by *non-indicted* SOEs.

These findings raise the question of why the corporate performance and investment of controlled companies deteriorated following the indictment of the controlling SOEs. Perhaps this followed from the replacement of the indicted managers with less experienced managers, which resulted in lower productivity. However, it is unlikely that this is the primary reason. Our empirical analysis estimates the impact of the inspection outcomes on companies that are controlled by the inspected SOEs, not the controlling SOEs themselves. Even if new managers of indicted SOEs are less experienced, it is unlikely that their inexperience could affect so quickly the productivity of the controlled companies. Replaced managers are typically high-ranking officials who do not directly manage day-to-day operations in the controlled companies. Furthermore, it remains unclear why these companies increased spending on environmental and social programs following the management indictment of their controlling parents.

[1] Source: Chapter 3, *IMF Fiscal Monitor*, 2020.

To understand the empirical findings, we develop a model that features agency frictions between the central government and the managers of central SOEs. Corporate policies emerge from optimal dynamic contracts between the central government (the principal) and the managers (the agents). Although contracts can always be structured to incentivize managers to implement the desired objectives, they may not be economically viable. Thus, policy deviations and indictments can occur even if contracts are optimally designed.

Our model embeds two types of agency frictions. The first is standard moral hazard: due to information asymmetry, managers can divert firm revenues for personal gains. This friction is important for generating managerial compensation and investment that correlates with the market performance of the firm. The second friction arises because the central government cannot observe how managers allocate their skills between market and social activities. A novel feature of the model is that SOEs produce both market output and social services. However, while managers prioritize market activities, the central government values both market and social activities, thus creating a conflict of interest over the allocation of skills. Inspections by the central government could uncover the manager's allocation of skills but only with some probability. Indictment occurs when an inspection reveals a deviation from the allocation prescribed by the optimal contract. While these contracts are designed to minimize deviations, eliminating them entirely could be too costly for the central government. As a result, mis-allocation (and indictment) could emerge in equilibrium even if contractual arrangements are optimal.

The firm dynamic properties generated by the optimal contract are consistent with our empirical findings. Specifically, following an indictment, firms' investment and performance decline compared to non-indicted firms. Additionally, firms increase social production after an indictment. Although our model does not formalize explicitly managerial promotion, it predicts that managerial compensation increases, on average, in firms that are inspected but not indicted. Since in the data compensation usually increases with career promotion, our model can be seen as consistent with the observation that a higher number of managers are promoted when the controlling SOE is not indicted.

Our theory builds on foundational work in dynamic principal-agent models with information frictions and moral hazard, developed in Spear and Srivastava (1987) and Thomas and Worrall (1990). These studies provide a widely used framework to analyze executive compensation, investment, and firm dynamics. Examples include Wang (1997), Quadrini

(2004), Clementi and Hopenhayn (2006), DeMarzo et al. (2012), Miao and Rivera (2016), Ai et al. (2023) and Ai et al. (2024). While the models studied in these papers are based on information asymmetries, other papers such as Albuquerue and Wang (2008) and Bolton et al. (2019) have used dynamics models with limited enforcement. These studies focus on agency frictions in firms that are privately owned, and shareholders are concerned primarily with the market value of the firm. However, SOEs have broader objectives including social responsibilities, which complicate the agency frictions between their managers and the central government (Lin et al. (1998) and Lin and Tan (1999)). Even though the agency issues became somewhat less important with the expansion of privately-owned companies (Fan et al. (2014), Iyer et al. (2019) and Fang et al. (2023)), they are still at the center of the corporate sector in China. The consideration of social objectives by the major SOEs' shareholder—the central government—is a special feature of our model. An additional feature is the consideration of two sources of moral hazard: output diversion and allocation of managerial skills between market and social activities. Both frictions are important for the model to replicate the empirical findings.

The empirical section of our paper is also related to studies of China's anti-corruption campaign. Xu (2018) finds that anti-corruption measures reduce firm value through disincentive effects. Chen et al. (2018) shows that corruption scandals trigger negative stock market reactions but reduce the risk of future stock price crashes. Ding et al. (2020) observes positive stock market responses to anti-corruption announcements. Our paper focuses on the impact of inspections on corporate policies and performance, including sales, investment, and social indicators such as ESG ratings, environmental spending, and poverty alleviation donations.

The organization of the paper is as follows. Section 2 describes the institutional environment in which SOE inspections take place. Section 3 conducts the empirical analysis. Section 4 introduces the model and characterizes its properties. Section 5 extends the model and shows that its properties replicate the empirical findings. Section 6 discusses normative policies to improve efficiency. Section 9 concludes.

2. INSTITUTIONAL ENVIRONMENT

We describe here the institutional environment in which corporate inspections take place. This is important for understanding where agency frictions arise within the organizational

structure, and how the outcome of the inspections could affect corporate policies. This is also important for designing the empirical analysis.

State Owned Enterprises (SOEs) conduct commercial activities on behalf of the Chinese government and the Communist Party of China (CPC). They are dominant in some industries such as energy, telecom, transportation, and finance. According to the 2018 economic census, SOEs' total assets account for approximately 56.3% of the whole country's assets. Because of the strategic sectors in which they operate, SOEs are often encouraged to pursue social objectives that differ from those of purely market-oriented corporations. The focus on social objectives could generate conflicts of interest between the management of SOEs and the central authority. These conflicts are additional to the typical agency frictions that emerge in private corporations between managers and other stakeholders.

The Chinese Central Commission for Discipline Inspection (CCDI) has conducted inspections on central SOEs as part of the campaign initiated by President Xi Jinping. The aim of the inspections was to reinforce the leadership of the CPC and improve SOEs' implementation of CPC's policies and directives.

In addition to detecting corporate malpractice, the goal of the CCDI is also to provide instructions to central SOEs on how to align their business strategies with the state-led development vision, and improve the implementation of the administration's political and economic reform agenda. This includes financial reform, environmental protection, and poverty alleviation.

CCDI started the inspections in May 2013 and targeted all central SOEs with management ranked at the level of 'ministry'. As long as some of the top management was at the ministry level, the SOE would be inspected. In 2019 there were 128 central SOEs, with 55 meeting the criteria for mandatory inspection. In the remaining 73 SOEs, instead, the top management was ranked at the lower level of general bureau or department, and were not inspected. Thus, the management rank is the only criterium used to select the sub-group of inspected SOEs. In 10 of the 55 inspected SOEs, chairmen and top leaders were indicted for malpractice. Appendix A.I provides the complete list of inspected SOEs and whether they were indicted.

Our analysis focuses on the group of inspected SOEs and use the outcome of the inspection (indictment or non-indictment) as a shock to companies controlled by the inspected SOEs. The goal is to investigate how that shock impacted on the corporate policies of the

controlled companies. It is important to emphasize that the focus of the analysis is the comparison between indicted and non-indicted SOEs, not the comparison between inspected and non-inspected SOEs, since our sample includes only SOEs that have been inspected. Thus, the endogenous selection of our sample (based on whether SOEs were inspected) should not be an issue for our empirical results.

Figure 1 illustrates the governance structure of State-Owned Enterprises. At the top there is the central government which provides general directions to the central SOE. The central SOE is, effectively, a holding company managed by government appointed officials. Being a holding company, the SOE controls many firms as indicate in the bottom layer. The policies of these controlled companies should also be aligned to the general government directives. But the implementation of these directives relies on the action of the central SOE. Although there could be distinct agency frictions in both layers of the organization (central government with central SOE, and central SOE with controlled firms), in this study we focus on the agency frictions that emerge in the first layer of the organization, that is, between the central government and the central SOE.

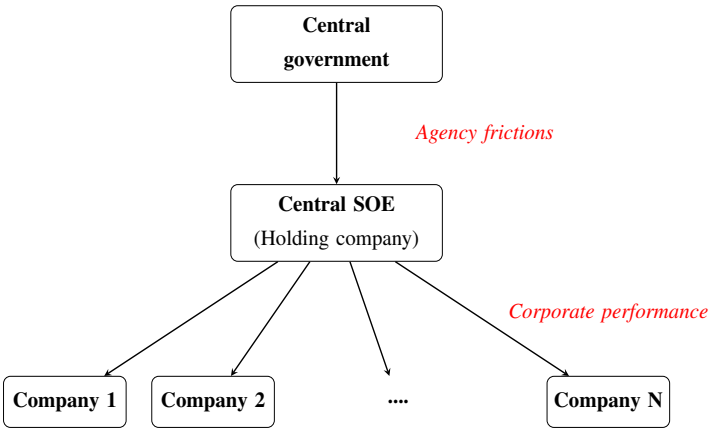


FIGURE 1.—Governance structure of Chinese SOEs.

Because of agency frictions, the corporate policies of firms located at the bottom of the organization may not be perfectly aligned with the objectives of the central government. Indicted SOEs are probably less observant of the central government's directives. An indictment should then trigger changes in the corporate policies of firms controlled by the

indicted SOEs, compared to firms controlled by SOEs that were not indicted. This is the key insight around which we design our empirical analysis.

3. EMPIRICAL ANALYSIS

The empirical analysis, which motivates our paper, uses data on public traded companies controlled by the 55 inspected central SOEs. Effectively, these firms are subsidiaries of the inspected SOEs. We find 173 public traded firms that are controlled by the 55 central SOEs. For each of these controlled firms we have data for operational activities and balance sheet at the yearly frequency, as well as management's background.

3.1. *Data sources*

We primarily use two firm-level databases. The first is the China Stock Market and Accounting Research (CSMAR) database, which contains firm-level information on balance sheet, investment, labor, ownership structure and other information. To determine the firms that are controlled by central SOEs we use the Chinese Business Registration System and shareholding disclosure statement for public listed companies. Our final sample comprises all publicly traded firms controlled by these 55 central SOEs. Since the inspection campaign began in 2012, we construct a panel dataset spanning the ten-year window from 2007 to 2017, covering five years before and after the campaign. Table A.II in the Appendix reports summary statistics for main variable used in our empirical analysis.

The second database provides Environmental, Social, and Governance (ESG) ratings for Chinese publicly listed firms from Bloomberg and are available at an annual frequency. The ESG rating evaluates a company's performance in sustainability and social responsibility. It results from the aggregation of various indicators such as environmental impact, innovation, labor relations, board structure, charity and social media reports.

Although balance sheet data are available at a quarterly frequency, the empirical analysis is conducted at an annual frequency because some series—particularly ESG scores—are only available annually.

3.2. *Sample selection*

The goal of our empirical analysis is to investigate how the outcomes of inspections conducted on SOEs (those located in the middle layer of Figure 1) impacted the performance

of the controlled companies (firms located in the lower layer of Figure 1). As noted above, there are 55 central SOEs, and they were all inspected. Our sample includes all public companies controlled by these 55 central SOEs, regardless of whether the managers of the controlling SOE were indicted or not indicted after the inspections.

The selection of the 55 central SOEs, all of which were inspected, was based solely on the presence of managers ranked at the ministry level. The selection was not based on other SOE characteristics or characteristics of the controlled companies. Naturally, the presence of high-ranking officials at the top of these organizations reflects the economic and political significance of the SOEs. In this sense, the selection of these SOEs was not random. However, the goal of our empirical analysis is not to compare the performance of companies controlled by the 55 central SOEs to companies controlled by other non-inspected SOEs. Instead, our difference-in-differences (DID) estimation is to compare companies controlled by the indicted central SOEs (10 out of 55 representing the treated group) to companies controlled by non-indicted central SOEs (the remaining 45 representing the control group). This should mitigate concerns that our results are driven by endogenous sample selection.

3.3. *Inspection outcome and corporate performance*

To investigate how the outcome of the inspections conducted on the 55 central SOEs impacted the performance of the companies controlled by the inspected SOEs, we estimate the following regression equation:

$$Y_{i,t} = \alpha + \beta_1 Post_{i,t} + \beta_2 Indicted_{i,t} + \beta_3 Post_{i,t} \cdot Indicted_{i,t} + \gamma X_{i,t} + \varphi_i + \theta_t + \varepsilon_{i,t}. \quad (1)$$

The subscript i is the index for the firm included in the sample (firms controlled by inspected central SOEs) and the subscript t indexes year. The dependent variable $Y_{i,t}$ refers to firm-level outcomes. Specifically, we examine four key measures: (i) investment, (ii) total factor productivity (TFP), (iii) Tobin's Q, (iv) ESG ratings

On the right-hand-side of the equation we have the variable $Post_{i,t}$ which is an indicator taking the value of 1 if a central SOE has been inspected by the CCDI, and 0 otherwise. This variable could differ across firms because central SOEs were inspected in different years. The variable $Indicted_{i,t}$ is an indicator that takes the value of 1 if the chairman or managers of the central SOE that controls company i have been indicted for malpractice,

and 0 otherwise. The term $X_{i,t}$ contains firm-level controls, including firm age, leverage ratio, cash flow, total sales and intangible assets. We include firm fixed effects, ε_i, and year fixed effects, θ_t, to control for unobserved omitted variables. The variable $\varepsilon_{i,t}$ is the error term. We allow for clustering at the level of central SOEs to account for serial correlation in the data. Note that the data contains information for each firm controlled by SOEs that were targeted for inspection and some firms are controlled by the same SOE.

Table I presents the results from the estimation of Equation (1). The key parameter is β_3, that is, the coefficient for the interaction between the dummies $Post_{i,t}$ and $Indicted_{i,t}$. The coefficient measures the impact that the indictment of a central SOE has on the performance of the controlled companies, relatively to companies controlled by SOEs that were not indicted (either because the controlling SOE were not inspected yet or the inspection did not result in indictment). Columns (1)–(3) show that the estimated interaction coefficient is negative and statistically significant (at the 5% level) for investment, TFP, and Tobin's Q.

3.4. *Identification concerns and robustness*

The DID approach underlying the estimation of Equation (1) assumes that the indictment of an SOE is conditionally exogenous. The conditionality derives from the fact that the estimation controls for 'observed' prior characteristics by adding them as independent variables. However, after controlling for these observable characteristics, the residual effects should reflect only the 'random' outcome of the inspection. Of course, it is still possible that the probability of indictment differs among inspected SOEs due to unobservable factors. If such differences were anticipated, the SOEs could implement policies prior to the inspection that would depend on the anticipated probability of indictment. After the inspection, then, these policies could be corrected again if the SOE is indicted. Since the composition of indicted SOEs is biased toward those with an ex-ante higher probability of indictment, the group of indicted SOEs will experience larger policy corrections. Thus, the estimation results could be driven by unobservable differences among inspected SOEs rather than the random outcome of the inspections.

One way to explore whether this is a likely mechanism is to compare the observable characteristics of companies controlled by indicted and non-indicted SOEs *before* the inspections. The idea is that if there were unobservable differences between SOEs that led

TABLE I

IMPACT OF INDICTMENT ON CORPORATE INVESTMENT AND PERFORMANCE

	Investment	TFP	TobinQ	ESG	E	S	G
Post × Indicted	-0.005**	-0.100**	-0.466***	2.065**	2.839**	3.269**	-0.299
	(-2.11)	(-2.15)	(-2.98)	(2.41)	(2.58)	(2.32)	(-0.24)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,832	1,832	1,832	783	727	764	783
R^2	0.454	0.972	0.727	0.838	0.782	0.847	0.766

*N*ote: This table presents results from panel regressions on firm-level outcomes from 2007 to 2017. $Post$ is a binary indicator equal to 1 if the central SOE has been inspected in or before year t, and 0 otherwise. $Indicted$ is a binary indicator equal to 1 if the chairman or senior manager of the inspected SOE was indicted for corruption. TFP is firm-level total factor productivity. $TobinQ$ is the ratio of market value to book value of assets. ESG refers to the rating for the Environmental, Social and Governance. E, S, and G refer to Environment rating, Social rating, and Governance rating, respectively. $Controls$ refers to firm-level control variables including $Leverage$ (the ratio of total debt to total assets); $Cashflow$ (the ratio of net operating cash flow to total assets); Age (the natural logarithm of one plus the number of years listed); $Sales$ (the natural logarithm of total sales); $Intangible$ (the ratio of intangible assets to total assets). All regressions include firm and year fixed-effects. T-statistics are shown in parentheses. The superscript ***, **, or * indicates statistical significance at the 1%, 5% or 10% level, respectively.

to variation in the probability of indictment, these differences should be reflected in the actual policies implemented by the controlled companies—again, before the inspections. Appendix A.4 explores this possibility and does not find statistically significant differences.

Another concern is that the 'initial state' could be a confounder: If the corporate goals of the controlled companies were not aligned with government objectives before the inspections, it is possible that they will eventually be aligned even in absence of inspections. A the same time, the lack of alignment could lead to higher probability of indictment. Under this hypothesis, the observed policy changes would be correlated with indictment but they are not caused by it. On this regards we would like to make two observations. First, our regression includes a firm fixed effect and many firm-level controls. Thus, the initial state is largely controlled in the estimation. Second, a placebo test conducted in Appendix A.4

shows that the performance of the controlled companies suddenly changed immediately after the indictment (not before, not after). Thus, indictment has at least an incremental effect on the realignment process.

Appendix A.4 presents additional empirical exercises to ensure that our results are robust, including parallel trend tests and placebo tests. In particular, the parallel trend tests reveal no significant pre-trends in the outcomes prior to the inspections. To address concerns about selection, we perform a placebo test using a Monte Carlo permutation method, in which individual observations are randomly assigned to the treatment group and the regression analysis is repeated 500 times. The results indicate no systematic bias.

3.5. *Inspections and social policies*

The purpose of inspections is to ensure that the corporate policies of the controlled companies align with the objectives of the Chinese government. These objectives go beyond the typical corporate goals and the role of central SOEs is to insure that the corporate policies of the controlled companies are aligned with the government objectives. Still, central SOEs may not be fully effective in shaping the corporate policies of the controlled companies in ways that are consistent with the social goals of the government. Inspections, then, could be important for reinforcing the incentive of central SOEs to encourage the controlled companies to pursue more active social policies. In this subsection we test whether inspections affect the social policies of the controlled companies.

President Xi initiated two important domestic policies. The first was the poverty alleviation program, announced in 2015, with the goal of eradicating absolute poverty in China by the end of 2020.[2] The second initiative was the anti-pollution program, which aimed to address the environmental impact of China's rapid economic expansion in the 1990s and 2000s. The rapid growth was associated with intensive energy use and a consequent rise in carbon emissions.

To examine the impact of the inspections on the social policies conducted by the controlled firms, we use the Environmental, Social and Governance (ESG) score for these

[2]The original articles can be found in the government official public media web sites: `http://www.xinhuanet.com/politics/2015-11/28/c_1117292150.htm`, and `http://politics.people.com.cn/n/2015/1124/c1001-27849715.html`

companies. We re-estimate Equation (1) but using the ESG score as the dependent variable. The regression results, reported the Column (4) of Table I, show that firms controlled by indicted SOEs received a higher ESG score after the indictment, compared to firms controlled by non-indicted SOEs. Column (5), (6), and (7) in the table show that the rise in ESG score derives, mainly, from the rise in the Environmental and Social components of ESG. The change in Governance is not statistically significant.

To further investigate the impact of SOEs indictment on the social policies of the controlled companies, we use expenditures on environmental protection.[3]

Figure 2 plots the mean difference of environmental expenses between firms controlled by indicted SOEs and firms controlled by non-indicted SOEs, suggesting that environmental expenses made by firms controlled by indicted SOEs increased sharply after 2015, that is, after the inspection period.[4] We also show that firms controlled by indicted SOEs made more donations for poverty reduction after the inspections, compared to firms controlled by non-indicted SOEs.[5]

3.6. *Inspections and promotions*

Finally, we employ text analysis approach to investigate how the indictment affects the managerial promotion. Specifically, we identify 136,796 announcements from 173 listed companies and extract specific information pertaining to changes in management roles by applying text analysis techniques, keywords including "promotion", "joining the board", "appointment as board member", and "concurrent positions". We find a significant surge in promotions during 2016 and 2017 only in companies controlled by non-indicted SOEs. Appendix A.5 provides a comprehensive analysis on how managerial job positions change before and after the inspection.

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[3]Data for spending on environmental protection are provided by the annual report of public traded companies, and are available for years 2011-2017.

[4]In Figure 2, every dot depicts the mean difference of firm environmental investment between firms controlled by indicted SOEs and firms controlled by non-indicted SOEs, associated 90% confidence intervals.

[5]Table A.IV in the appendix reports the average expenses in poverty donation for the two groups of firms. The comparison is based on the best available data on firms' expenses on reducing poverty over the period of 2016-2020, which is after the inspections.

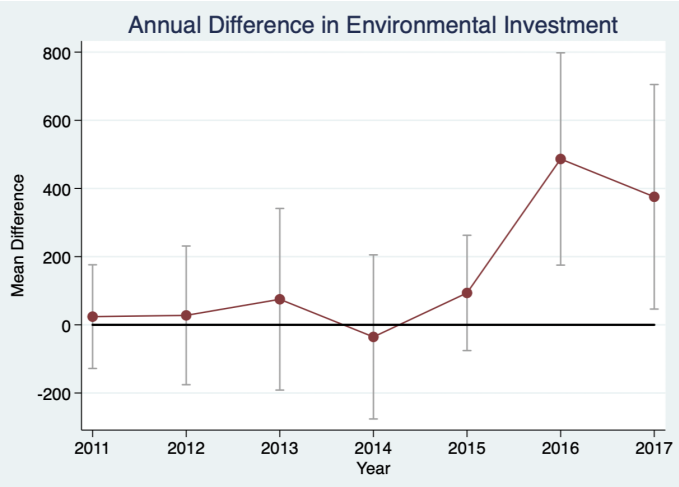


FIGURE 2.—Impact of inspection outcome on environmental investment.

3.7. *Discussion*

The empirical analysis provides evidence that the indictment of central SOEs' management affects adversely the investment and performance of the controlled companies. At the same time, the affected companies allocated more resources to social objectives such as pollution abatement and poverty reduction—policies that are more aligned to the objectives of the central government. One hypothesis behind the lower corporate investment and performance associated with indictment is that this is a consequence of replacing skilled and experienced managers with new and unexperienced managers. This is unlikely to be the primary explanation because the replaced managers are those operating in central SOEs, not in the controlled companies, that is, the companies that experience the performance decline. Rather, the decline in investment and performance could be the consequence of a shift in corporate policies towards different objectives, something that the top management of central SOEs can impose on the controlled companies.

The policy shift is consistent with the second evidence presented above, that is, spending on pollution abatement and poverty reduction, all increased following the indictment of the controlling SOE. These are important objectives for the central government and an indictment could be interpreted as evidence that the management did not fully abide to the objectives of the central government.

4. THE MODEL

Consider an economy with a central government and a continuum of managers who have the ability to run state owned enterprises. SOEs produce two types of output with the input of capital: market output and social services. Managers care about their expected lifetime utility $\mathbb{E}_0 \sum_{t=0}^{\infty} \beta^t c_t$, where β is the inter-temporal discount factor and $c_t \geq 0$ is consumption of market output. The central government cares about market output but also the production of social services.

The production function for market output is $y_t^M = z_t k_t$, where $z_t \in \{z_L, z_H\}$ is stochastic productivity (shock). The realization of z_t is observed only by the manager. This introduces the first source of agency frictions which, as we will see, makes the optimal compensation of the manager increasing in the stock of capital k_t.

The second source of agency frictions derives from the assumption that the probability distribution of the shock z_t depends on the allocation of managerial skills. The manager can choose to allocate the discretionary part of his/her skills to market or social activities, which is also unobservable by the central government. By allocating the discretionary skills to market activities, the manager increases the probability of high productivity draws $z_t = z_H$. For notational convenience we denote the probability distribution of z_t by $\varphi(z_t|e_t)$, where e_t is the dummy variable that takes the value of 1 if the manager allocates the skills to market activities and zero otherwise. Thus, $\varphi(z_H|e=1) > \varphi(z_H|e=0)$.

The production function for social services is $y_t^S = A + s(e_t)k_t$. Through the function $s(e_t)$ the allocation of managerial skills e_t affects the productivity of capital in the production of social services. The assumption is that $s(e_t = 1) < s(e_t = 0)$, meaning that productivity in social services decreases when the manager allocates his/her skills to market activities (remember that $e_t = 1$ indicates that skills are allocated to market activities).

Another important assumption is that the production of social services is not publicly observable. With this assumption the central government cannot infer the allocation of managerial skills e_t from the production of social services. This introduces a second source of moral hazard which is additional to the one created by the non-observability of z_t.

For notational convenience we denote the sum of social services and market output, $y^S + y^M$, with the function

$$F(k_t, z_t, e_t) = A + \Big[s(e_t) + z_t\Big]k_t.$$

Total production is linear in capital k_t with a constant term $A > 0$. The linearity simplifies the characterization of the optimal contract while the constant A ensures that the initial value of the contract for the principal is positive. We will explain the relevance of a positive A later when we characterize the optimal contract.

ASSAMPTION 1: *Total expected production (sum of social and market output) is higher when managerial skills are allocated to social services, that is,*

$$\sum_z F\Big(k_t, z, e_t = 0\Big)\varphi(z|e_t = 0) > \sum_z F\Big(k_t, z, e_t = 1\Big)\varphi(z|e_t = 1).$$

With this assumption, it is socially optimal (from the government stand point) to allocate managerial skills to the production of social services. However, the central authority does not have direct control over the allocation of managerial skills. Therefore, the optimal allocation will be achieved only if two conditions are met: (i) the manager has the incentive to do so; (ii) it is not too costly for the government to provide the incentives.

Contractual frictions: Productivity z_t and allocation of managerial skills e_t are both private information. As hinted earlier, this creates two moral hazard problems. First, the manager could divert part of the market output by claiming that productivity was low when the actual realization was high. The output diverted is $(z_H - z_L)k_t$. A fraction γ will be consumed by the manager while the remaining fraction will be lost. Second, the manager could allocate the skills to market activities to increase the probability of a high market productivity $z_t = z_H$. This raises the expected value of diversion $\gamma(z_H - z_L)\, k_t\, \varphi(z_H|e)$. For notational convenience we define $\alpha = \gamma(z_H - z_L)$ the value of diversion per unit of capital. The total value of diversion when productivity is high is then αk_t.

Corporate inspections conducted by the central government can be used to alleviate the second moral hazard problem, that is, the temptation to allocate the discretionary skills to market production. When a manager deviates from the socially optimal allocation by choosing $e_t = 1$, an inspection reveals the deviation with probability η. We denote by d_t the outcome of the inspection: It takes the value of 1 if it successfully reveals the deviation and zero if it does not. Importantly, a corporate inspection could reveal (with some probability) that the manager has deviated. However, it cannot reveal whether the manager has not deviated. In other words, an inspection could observe that $e_t = 1$ but not $e_t = 0$.

If a deviation is not observed (i.e., $d_t = 0$), the manager will continue managing the SOE. Otherwise, the manager is indicted and replaced by a newly hired manager. The reservation value for the indicted manager is q_R. We further assume that indictment also prevents the manager from diverting revenues (γ becomes zero). The way we model an inspection captures the fact that the CCDI's ultimate goal is to align the SOEs' corporate policies to the CCP's social goals.[6]

The final assumption is that the manager quits with an exogenous probability $1 - \rho$ after production. We denote by λ_t the binary variable that takes the value of zero when the manager quits and 1 when he or she stays. Exogenous quits guarantee that managers will eventually receive a payment rather than postponing compensation perpetually.

Timing: At the end of period $t-1$ the SOE (interpreted as the aggregation of all companies controlled by the SOE) invests in capital k_t and the manager chooses the allocation of skills e_t. At the beginning of the next period t, after knowing whether the manager stays (which arises with probability ρ), the SOE is inspected. If caught deviating ($d_t = 1$), the manager will be replaced by a newly hired manager. Otherwise ($d_t = 0$) the manager continues managing the SOE. Notice that quitting, which happens with probability $1 - \rho$, becomes known at the beginning of the period but the actual separation arises at the end of the period, that is, after production and possible diversion of market production.

4.1. *Recursive formulation of the long-term contract*

Our goal is to characterize the optimal contract between the principal (the central government) and the agent (the manager). We formalize the contractual problem as the maximization of the principal's value subject to the constraint that the manager does not divert revenues and the participation constraint is satisfied. The problem is made stationary by

[6] We could assume that the reservation value for the indicted manager is lower than q_R due to direct punishments. This would make the analytical characterization of the optimal contract more complex but would not change the key theoretical properties of the model. However, if we assume that the punishment is proportional to k (so that the reservation value with indictment takes the linear form $q_R - \mu k$), the properties of the optimal contract are essentially analogous to those without direct punishment. Bigger is the parameter μ, and higher is the enforceability of the optimal allocation. But besides this, the structure of the optimal contract does not change.

using promised utility as a state variable, which is standard in dynamic principle-agent models.[7]

Denote by q the manager's promised utility *after* current consumption. For each q, the contract chooses the new capital, the next period compensation for the manager (consumption), and next period continuation utility. Next period compensation and continuation utility are conditional on three states: (i) whether the manager continues, $\lambda \in \{0,1\}$; (ii) whether diversion is observed by the inspection, $d \in \{0,1\}$; (iii) the value of productivity $z \in \{z_L, z_H\}$ 'reported' by the manager.

When the manager does not quit ($\lambda = 1$), next period consumption conditional is denoted by $c(d,z)$. The variable d is a dummy that takes the value of zero if a deviation is not observed and 1 if a deviation is observed. Next period continuation utility is denoted by $q(z)$ if the manager is not indicted while it is the reservation value q_R if the manager is indicted. When the manager quits, the next period consumption is denoted by $c^\ell(d,z)$ while the continuation utility is the reservation value q_R.

The optimal contract solves the following problem:

$$V(q) = \max_{\substack{k,c(d,z),\\ q(z),c^\ell(d,z)}} \left\{ -k + \beta \sum_{d,z} \left[F(k,z,e) + \rho \Big(-c(d,z) + (1-d)V\Big(q(z)\Big) + dV(q_R) \Big) + (1-\rho)\Big(-c^\ell(d,z) + V(q_R) \Big) \right] \Upsilon(d,z|e) \right\} \tag{2}$$

subject to

$$q = \beta \sum_{d,z} \left[\rho \Big(c(d,z) + (1-d)q(z) + dq_R \Big) + (1-\rho)\Big(c^\ell(d,z) + q_R \Big) \right] \Upsilon(d,z|e) \tag{3}$$

$$c(0,z_H) + q(z_H) \geq c(0,z_L) + q(z_L) + \alpha k \tag{4}$$

$$c^\ell(0,z_H) + q_R \geq c^\ell(0,z_L) + q_R + \alpha k \tag{5}$$

$$c(d,z), c^\ell(d,z) \geq 0; \qquad q(z) \geq q_R \tag{6}$$

[7] There are other approaches proposed in the literature to characterize and solve dynamic contracts with agency frictions that use other state variables such as Marcet and Marimon (2019) and Pavoni et al. (2018). See also Miao and Zhang (2015) for continuous time models with limited enforcement.

$$e = \arg \max_{e \in \{0,1\}} \beta \sum_{d,z} \Big[\rho \Big(c(d,z) + (1-d)q(z) + dq_R \Big) + (1-\rho) \Big(c^{\ell}(d,z) + q_R \Big) \Big] \Upsilon(d,z|e). \tag{7}$$

The function $\Upsilon(d,z|e)$ denotes the joint probabilities of d and z conditional on the allocation of skills. Given the distributional assumptions for productivity and inspection success, the joint probabilities are given by

$$\Upsilon(d,z|e) = \begin{cases} (1-e\eta)\,\varphi(z_L|e), & \text{for } d=0 \;\&\; z=z_L \\ (1-e\eta)\,\varphi(z_H|e), & \text{for } d=0 \;\&\; z=z_H \\ e\eta\,\varphi(z_L|e), & \text{for } d=1 \;\&\; z=z_L \\ e\eta\,\varphi(z_H|e), & \text{for } d=1 \;\&\; z=z_H \end{cases}$$

The contractual problem (2) is solved at the end of the period and the function $V(q)$ is the end-of-period value for the principal. Notice that, in the event of separation—either because the manager quits or the incumbent manager is caught deviating—the firm will continue with a newly hired manager that starts with promised utility q_R. Thus, in the event of separation, the value for the principal is $V(q_R)$.

Equation (3) is the promised-keeping constraint, and Equations (4)-(5) are the incentive-compatibility constraints. Incentive-compatibility makes sure that, when productivity is high, the manager will get an expected lifetime utility at least as large as the utility received if market output were diverted. This constraint must be satisfied only when the inspection does not reveal a deviation, that is, when $d = 0$. If indicted, the manager is no longer able to divert output. Loosing the ability to divert output represents a cost for the manager. In expectation, the cost increases with η, that is, the probability of being caught when the manager chooses $e = 1$.

Constraints (6) impose limited liability for the manager. The assumption is that current consumption (payout) cannot be negative and the continuation value must be at least as large as the reservation value q_R.

To maximize the incentive to enforce the recommended allocation of skills, the values received by the manager when caught deviating—the terms $c(1,z) + q_R$ and $c^{\ell}(1,z) + q_R$—

should be set to the lowest possible values, which implies

$$c(1,z) = c^{\ell}(1,z) = 0.$$

Still, this may not be sufficient to implement the optimal allocation of skills because deviations are observed only with probability $\eta < 1$.

The last Equation (7) defines the allocation of skills chosen by the manager given the structure of the contract. The manager chooses $e \in \{0,1\}$ to maximize his/her value. The contractual problem (2) solves a Stackelberg's game where the leader (the central government) chooses the structure of the contract (*i.e.*, k, $c(d,z)$, $q(z)$, $c^{\ell}(d,z)$) and the follower (the manager) responds by choosing the allocation of skills.

4.2. *Characterization of the optimal contract*

We proceed in two steps. In the first step (Subsection 4.2.1) we consider a simplified version of the contract where the principal does not attempt to implement the socially desirable allocation of skills. This solves Problem (2) ignoring condition (7) and taking as given the allocation of skills e. Given the structure of the contract for given allocation of skills, we ask whether the manager prefers $e = 0$ or $e = 1$. In the second step (Subsection 4.2.2) we return to the original problem and establish whether it is optimal for the principal to enforce $e = 0$.

4.2.1. *Optimal contract when e is taken as given*

The goal is to characterize the optimal contract for a given allocation of skills as if the contract cannot affect the value of e chosen by the manager.

PROPOSITION 1: *If the optimal contract is designed taking as given the allocation of skills, the manager chooses $e = 0$ if and only if*

$$\varphi(z_H|0) > (1-\eta)\varphi(z_H|1).$$

PROOF: Appendix B. *Q.E.D.*

There is a simple intuition for this result. In absence of a successful inspection, $e = 1$ provides more value to the manager because the probability of high market productivity

is higher than with $e = 0$, that is, $\varphi(z_H|1) > \varphi(z_H|0)$. However, by choosing $e = 1$, the manager faces the risk of being caught deviating by an inspection, which arises with probability η. In this case the manager will lose the ability to divert output and the continuation value falls to q_R. The first effect dominates when $\varphi(z_H|1)$ is large compared to $\varphi(z_H|0)$, and the probability of a successful inspection η is small. The second effect dominates when $\varphi(z_H|1)$ is not much bigger than $\varphi(z_H|0)$, and the probability of a successful inspection η is large. These two effects are captured by the condition $\varphi(z_H|0) > (1-\eta)\varphi(z_H|1)$.

If $\varphi(z_H|0) < (1-\eta)\varphi(z_H|1)$, the skill allocation $e = 0$ cannot be enforced. In this case the manager always chooses $e = 1$, deviating from the socially desirable allocation.

We now derive analytical expressions for the value of the contract when the probability η takes two specific values: $\bar{\eta}$ and $\underline{\eta}$. The first value satisfies $\varphi(z_H|0) > (1-\bar{\eta})\varphi(z_H|1)$ while the second satisfies $\varphi(z_H|0) < (1-\underline{\eta})\varphi(z_H|1)$. Based on Proposition 1, a manager with $\eta = \bar{\eta}$ always chooses $e = 0$ while a manager with $\eta = \underline{\eta}$ always chooses $e = 1$.

Case I: High success probability of inspections ($\eta = \bar{\eta}$). Define $\overline{V}(q)$ the value of the contract for the principal when $\eta = \bar{\eta}$. To define this function we use the optimal policies for current and future consumption derived in the proof of Proposition 1 (Appendix B). In particular, when $\eta = \bar{\eta}$, we established that the optimal allocation of skills is $e = 0$ for all t, and it is optimal to set $c(0, z_L) = 0$, $q(0, z_L) = q_R$, $c(0, z_H) = 0$, $q(0, z_H) = q_R + \alpha k$, $c^{\ell}(0, z_L) = 0$, $c^{\ell}(0, z_H) = \alpha k$. Using these properties, the value of the contract for the principal specified in Equation (2) simplifies to

$$\overline{V}(q) = -k + \beta \Bigg\{ \mathbb{E}_z F(k, 0, z) + \rho \Big[\overline{V}(q_R)\Big(1 - \varphi(z_H|0)\Big) + \overline{V}(q_R + \alpha k)\varphi(z_H|0) \Big] + (1-\rho)\Big[-\alpha k \varphi(z_H|0) + \overline{V}(q_R) \Big] \Bigg\} \tag{8}$$

subject to

$$q = \beta \Big[q_R + \alpha k \varphi(z_H|0) \Big]$$

The Bellman's equation takes into consideration that the manager does not quit with probability ρ. In this case the compensation of the manager is deferred to the future: the continuation value is q_R if the realization of productivity is low and $q_R + \alpha k$ if productivity is high. If the manager quits, he/she receives the payment αk if productivity is high (the

value of diverting) and zero if productivity is low. The quitting manager will be replaced by a new manager who starts with promised utility q_R. Thus, the continuation value for the principal is $\overline{V}(q_R)$.

We now focus on the promise-keeping constraint to Problem (8). This constraint implies the following linear relation between q and k,

$$k = \frac{1}{\alpha\varphi(z_H|0)}\left(\frac{q}{\beta} - q_R\right). \tag{9}$$

This expression makes clear that k depends positively on the value of the contract for the manager, the variable q.

Appendix B also establishes that the next period promised utility is

$$q' = \begin{cases} q_R + \alpha k & \text{if} \quad \lambda = 1 \ \ \& \ \ z = z_H, \\ q_R & \text{otherwise.} \end{cases} \tag{10}$$

Remember that when $\eta = \bar{\eta}$, the manager always chooses $e = 0$, indicating that $d = 0$ for all t. With probability ρ, the manager continues ($\lambda = 1$). In this case the continuation value q' rises to $q_R + \alpha k$ if $z = z_H$, and drops to q_R if $z = z_L$. With probability $1 - \rho$, the manager quits ($\lambda = 0$) and a new manager starts with promised utility q_R. The value of quitting is $q_R + \alpha k$ when $z = z_H$, and q_R when $z = z_L$. However, while a staying manager receives $q_R + \alpha k$ as promised utility, a quitting manager receives this value in part in the form of a payment, αk, in part as reservation value q_R.

Combining (9) and (10) and taking expectations, the expected continuation value, conditional on continuation, is

$$\mathbb{E}\Big(q'|\lambda = 1\Big) = \frac{q}{\beta}. \tag{11}$$

Thus, conditional on continuation, the promised utility q grows on average at rate $1/\beta$. Unconditionally, however, the expected continuation value for the manager is

$$\mathbb{E}(q') = \rho \cdot \left(\frac{q}{\beta}\right) + (1 - \rho) \cdot q_R. \tag{12}$$

This takes into account that, if the manager quits (which happens with probability $1 - \rho$), the continuation value drops to q_R. Thus, on average, q grows faster if a manager stays longer in the current position (higher ρ).

The following lemma provides an analytical expression for the value of the contract for the principal (the central government).

LEMMA 1: *When $\eta = \bar{\eta}$, the contract value of the principal is*

$$\overline{V}(q) = \frac{\beta A}{1-\beta} + \bar{\chi}\, q, \tag{13}$$

with $\bar{\chi} = [s(0) + \mathbb{E}(z|e=0) - 1/\beta]/[\alpha\varphi(z_H|0)(1-\rho)] - 1$.

PROOF: Appendix C. *Q.E.D.*

The contract value is linear in the manager's value. The intercept, $\beta A/(1-\beta)$, and the factor of proportionality, $\bar{\chi}$, are only functions of parameters with the precise analytical expressions derived in the proof of the lemma.

We now make an assumption ensuring that the contract value $\overline{V}(q)$ decreases with the manager's promised utility q. The optimal contract has then a bounded solution.

ASSAMPTION 2: *Parameter values are restricted to satisfy* $\bar{\chi} < 0$.

To understand why this assumption guarantees that the optimal contract has a bounded solution, suppose that $\bar{\chi} > 0$. This implies that, increasing the value of the contract for the manager also increases the value for the principal: even if an increase in q raises the liability that the principal has toward the manager, the higher value of q relaxes the incentive-compatibility constraints and allows for more capital. With $\bar{\chi} > 0$, the increase in capital raises the total surplus more than the increase in q. It is then optimal to choose the value of q (and k) as large as possible. With $\bar{\chi} < 0$, instead, the increase in the surplus induced by a one unit increase in q is lower than 1, so that the contract has a bounded solution. The intercept, which is positive if $A > 0$, guarantees that there are values of q for which the value of the contract for the principal is positive. This is necessary for the participation of the principal and explains why we added A in the production function.

Case II: Low success probability of inpsections ($\eta = \underline{\eta}$). When $\eta = \underline{\eta}$, the manager chooses $e_t = 1$ for all t. This implies that there is a positive probability that the manager is caught deviating. The value of the contract for the principal—denoted by $\underline{V}(q)$—can be

written as

$$\underline{V}(q) = -k + \beta\Bigg\{\mathbb{E}_z F(k,1,z) + (1-\underline{\eta})\rho\Big[\underline{V}(q_R)\Big(1-\varphi(z_H|1)\Big) + \underline{V}(q_R+\alpha k)\varphi(z_H|1)\Big] + (1-\underline{\eta})(1-\rho)\Big[-\alpha k\varphi(z_H|1) + \underline{V}(q_R)\Big] + \underline{\eta}\underline{V}(q_R)\Bigg\} \tag{14}$$

subject to

$$q = \beta\Big[q_R + (1-\underline{\eta})\alpha k\varphi(z_H|1)\Big]$$

In this case the Bellman's equation contains more terms because the manager could be caught deviating with probability $\underline{\eta}$. This is captured by the last term in (14). When caught deviating, the manager will be replaced by a new manager who starts with promising utility q_R (again, provided that the principal has the whole bargaining power in the negotiation with the newly hired manager).

The promise-keeping constraint in Problem (14) can be rewritten as

$$k = \frac{1}{(1-\underline{\eta})\alpha\varphi(z_H|1)}\left(\frac{q}{\beta} - q_R\right). \tag{15}$$

The expression shows a positive relation between investment k and manager's utility q. Comparing it to Equation (9) derived in case I, we can see that, for any given q, investment k is lower when $\eta = \underline{\eta}$ than when $\eta = \bar{\eta}$.

The continuation utility q' depends on the realization of λ, d and z, according to

$$q' = \begin{cases} q_R + \alpha k & \text{if} \quad \lambda = 1,\, d = 0, \text{ and } z = z_H, \\ q_R & \text{otherwise.} \end{cases} \tag{16}$$

With probability ρ the manager continues. In this case, the next period promised utility rises to $q_R + \alpha k$ when $z = z_H$ and $d = 0$, that is, when the manager is not caught deviating. Otherwise, it drops to q_R. With probability $1-\rho$, the manager quits and a new manager takes over with initial promised utility q_R. We can also show that, when $\eta = \underline{\eta}$, the next period expected promised utilities are given by (11) and (12).

LEMMA 2: *When $\eta = \underline{\eta}$, the contract value for the principal is*

$$\underline{V}(q) = \frac{\beta A}{1-\beta} + \underline{\chi}\, q, \tag{17}$$

with $\underline{\chi} = [s(1) + \mathbb{E}(z|e=1) - 1/\beta]/[(1-\underline{\eta})\alpha\varphi(z_H|1)(1-\rho)] - 1$.

PROOF: Appendix C. *Q.E.D.*

For any q, the value of $\underline{V}(q)$ defined in (17) is smaller than $\overline{V}(q)$ defined in (13). Thus, the value of the contract for the principal is lower when deviations are detected with lower probability. There are two reasons. First, when $\eta = \underline{\eta}$, the manager's skills are allocated less efficiently ($e = 1$), leading to lower social return on investment. Second, when $\eta = \underline{\eta}$, investment tends to be lower given the value of q.

Assumption 2 also ensures $\underline{\chi} < 0$, that is, the contract value $\underline{V}(q)$ is decreasing in q. Since the value for the principal decreases in q, it is optimal to set the initial promised utility for a new manager to the lowest possible value, that is, the reservation value q_R (given the assumption that the principal has the full bargaining power when negotiating with a new manager). To ensure that the contract value for the principal is positive at q_R we make the following assumption:

ASSAMPTION 3: $A > -(1-\beta)\underline{\chi}q_R/\beta$.

This condition also guarantees that the contract value for the principal is positive at $q = q_R$ when $\eta = \bar{\eta}$.

4.2.2. *Fully optimal contract*

The previous analysis showed that, when the principal does not attempt to enforce $e = 0$, the manager chooses $e = 1$ if $\varphi(z_H|0) < (1-\eta)\varphi(z_H|1)$. Would it be possible to change the structure of the contract so that the manager has an incentive to choose $e = 0$? Furthermore, even if this is possible, is it optimal for the principal to enforce $e = 0$? We show here that enforcing $e = 0$ is always feasible but not always optimal.

To show that it is always possible to design a contract that enforces $e = 0$, we look at the incentive-compatibility constraints for the true reporting of z. The incentive-compatibility constraints when $d = 0$ are

$$c(0, z_L) + q(0, z_L) = q_R,$$
$$c(0, z_H) + q(0, z_H) = q_R + \alpha k,$$

$$c^{\ell}(0, z_L) + q_R = q_R,$$
$$c^{\ell}(0, z_H) + q_R = \alpha k + q_R.$$

The first two constraints are for a continuing manager (with $z = z_L$ and $z = z_H$, respectively) and the last two for a quitting manager (with $z = z_L$ and $z = z_H$, respectively).

Suppose that the principal raises all promised utilities by Δ, but only when inspections do not reveal a deviation, that is, when $d = 0$. The four conditions become

$$c(0, z_L) + q(0, z_L) = \Delta + q_R,$$
$$c(0, z_H) + q(0, z_H) = \Delta + q_R + \alpha k,$$
$$c^{\ell}(0, z_L) + q_R = \Delta + q_R,$$
$$c^{\ell}(0, z_H) + q_R = \Delta + \alpha k + q_R.$$

With this modification the contract preserves incentive-compatibility. In fact, the difference in contract values when reporting z_H and z_L remains the same. Thus, the incentive of the manager to report the true value of z does not change.

Let's see now how the manager's value depends on the allocation of skills. If the manager chooses $e = 0$, the expected utility is

$$Q_0 = \beta\Big[q_R + \Delta + \varphi(z_H|0)\alpha k\Big].$$

If the manager choose $e = 1$, the expected utility is

$$Q_1 = \beta\Big[q_R + (1-\eta)\Delta + (1-\eta)\varphi(z_H|1)\alpha k\Big].$$

By comparing the two expressions we can verify that, as long as $\eta > 0$, we can make Q_0 bigger than Q_1 by choosing a sufficiently large Δ. The intuition is that, raising the value of the contract for the manager by Δ only when a deviation is not observed ($d = 0$) reduces the incentive to choose $e = 1$. By choosing $e = 1$, the manager faces the risk of losing the extra Δ (remember that Δ is received only if $d = 0$, which happens with probability $1 - \eta$).

Even if the contract can always be structured to enforce $e = 0$, it may not be optimal for the principal. Increasing the manager's value implies a reduction of the contract value for the principal. Thus, even if $e = 0$ increases the total surplus, it may not be enough to cover

the higher payments required to make the contract incentive-compatible. The next proposition establishes that the principal finds it optimal to enforce $e = 0$ only if the probability η is sufficiently large.

PROPOSITION 2: *The optimal contract will enforce* $e = 0$ *if and only if the probability of successful inspection satisfies*

$$\eta > \left(\frac{\varphi(z_H|1) - \varphi(z_H|0)}{\varphi(z_H|1)}\right)\left(\frac{\beta[s(1) + \mathbb{E}(z|1)] - 1}{\beta[s(0) + \mathbb{E}(z|0)] - 1}\right).$$

PROOF: Appendix D. *Q.E.D.*

The probability η captures the ability of the principal to punish the manager for choosing $e = 1$. Higher is η and higher is the probability that a deviating manager gets punished. The first term on the right-hand-side is the ratio of the difference in the probabilities of $z = z_H$ conditional on $e = 1$ and $e = 0$, over the probability conditional on $e = 1$. This captures the incentive of the manager to deviate from the socially desirable allocation of skills. When this value is low, the manager does not gain much from deviating. As a result, it becomes optimal for the principal to enforce $e = 0$.

The second term on the right-hand-side is the ratio of the marginal return on capital when $e = 1$ (numerator) and when $e = 0$ (denominator). This term—which by Assumption 1 is smaller than 1—captures the social losses when the manager chooses $e = 1$. Smaller is this ratio and larger are the losses. Thus, it is optimal to enforce $e = 0$ when this term is small.

The characterization of the optimal contract shows that, provided that certain conditions are satisfied, corporate inspections lead to occasional indictment of managers. However, the model is not yet capable of replicating all the empirical facts that we listed in the Introduction. In the next section we extend the model and characterize an industry equilibrium with properties that resemble those characterized in the empirical section of the paper.

5. STOCHASTIC η AND DYNAMICS OF INVESTMENT

The manager's ability to disguise the allocation of skills while minimizing the probability of being caught by an inspection, is itself a skill; A skill that is likely to rise with experience inside the organization. A newly appointed manager needs time to learn how to disguise corporate policies that are different from the mandate.

To formalize this idea, we assume that the probability η is time-varying. A newly appointed manager starts with $\eta_t = \bar{\eta}$ but, afterwards, he/she could switch to $\underline{\eta} < \bar{\eta}$ with probability p. The transition probabilities are

$$P(\eta_t, \eta_{t+1}) = \begin{bmatrix} 1-p & p \\ 0 & 1 \end{bmatrix}$$

ASSAMPTION 4: *The probabilities $\underline{\eta}$ and $\bar{\eta}$ satisfy*

$$\bar{\eta} > \frac{\varphi(z_H|1) - \varphi(z_H|0)}{\varphi(z_H|1)},$$
$$\underline{\eta} < \left(\frac{\varphi(z_H|1) - \varphi(z_H|0)}{\varphi(z_H|1)}\right)\left(\frac{\beta[s(1) + \mathbb{E}(z|1)] - 1}{\beta[s(0) + \mathbb{E}(z|0)] - 1}\right).$$

The first condition implies that, when the detection probability is $\bar{\eta}$, the manager finds optimal to choose $e = 0$. To see this more clearly, the condition can be rewritten as $\varphi(z_H|0) > (1-\bar{\eta})\varphi(z_H|1)$. According to Proposition 1, the manager always chooses $e = 0$ when this condition is satisfied.

The second condition implies that, when the probability of successful inspection is $\underline{\eta}$, the principal does not find it optimal to enforce $e = 0$ (see Proposition 2). The manager, then, optimally chooses $e = 1$.

The value of η_t is public information. This implies that, once the value of η_t switches from $\bar{\eta}$ to $\underline{\eta}$, it becomes optimal for the principal to replace the manager with a newly hired manager. However, we assume that dismissal only arises if the manager is caught deviating, that is, when an inspection reveals that $e_t = 1$. In this case the incumbent manager is replaced by a new manager who starts with $\eta_t = \bar{\eta}$.

The assumption that the manager can be dismissed only if caught deviating is, admittedly, a stark assumption. However, it captures the fact that in most SOEs the appointment and replacement of board members and senior executives are determined by government entities staffed by public servants who tend to lack flexibility (World Bank (2021)).[8]

[8] A less stark assumption is that η_t is not observable by the principal. In this case the optimal contract will be based on prior beliefs about η_t, which are updated over time. However, if only the manager knows η_t, the principal and the manager would have different beliefs which would make the characterization of the optimal

5.1. *Contractual problem with evolving η*

To characterize the contractual problem with stochastic η, we use some of the properties established earlier. In particular, we use the property that the manager chooses $e = 0$ when $\eta = \bar{\eta}$, while he/she chooses $e = 1$ when $\eta = \underline{\eta}$.

Let $V(q, \eta)$ be the value of the contract for the principal at the end of the period, given the promised utility q and the detection probability $\eta \in \{\bar{\eta}, \underline{\eta}\}$. When $\eta = \bar{\eta}$ (and $e = 0$), the contractual Problem (2) can be rewritten as

$$V(q,\bar{\eta}) = -k + \beta\Bigg\{\mathbb{E}F(k,0,z') + \rho\sum_{\eta'}\Bigg[V(q_R,\eta')\Big(1-\varphi(z_H|0)\Big) + V(q_R+\alpha k,\eta')\times \varphi(z_H|0)\Bigg]P(\eta'|\bar{\eta}) + (1-\rho)\Bigg[-\alpha k\varphi(z_H|0) + V(q_R,\bar{\eta})\Bigg]\Bigg\} \quad (18)$$

subject to

$$q = \beta\Big[q_R + \alpha k\varphi(z_H|0)\Big]$$

This problem is similar to the one formalized in Equation (8) where η is fixed at $\bar{\eta}$. Here, however, η could switch to $\underline{\eta}$ in the next period with probability p. The derivation of this problem follows the same steps as those used in Section 4.2.1 to derive Problem (8).

Similarly, when $\eta = \underline{\eta}$ (and, thus, $e = 1$), the contractual problem can be written as

$$V(q,\underline{\eta}) = -k + \beta\Bigg\{\mathbb{E}F(k,1,z') + (1-\underline{\eta})\rho\Bigg[V(q_R,\underline{\eta})\Big(1-\varphi(z_H|1)\Big) + V(q_R+\alpha k,\underline{\eta})\times \varphi(z_H|1)\Bigg] + (1-\underline{\eta})(1-\rho)\Bigg[-\alpha k\varphi(z_H|1) + V(q_R,\bar{\eta})\Bigg] + \underline{\eta}V(q_R,\bar{\eta})\Bigg\} \quad (19)$$

subject to

$$q = \beta\Big[q_R + (1-\underline{\eta})\alpha k\varphi(z_H|1)\Big].$$

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contract much more difficult. We would also lose the ability to characterize the optimal contract analytically. To avoid these difficulties, we assume that η_t is public information.

This takes into account that a manager caught deviating by an inspection is replaced by a new manager who starts with $\eta = \bar{\eta}$ and promised utility q_R. Also in this case the derivation follows the same steps used in Section 4.2.1 to derive Problem (14).

5.2. *SOEs dynamics*

In any period there are two types of SOEs: those run by managers of type $\bar{\eta}$, and those run by managers of type $\underline{\eta}$.

After the inspection, a fraction $\underline{\eta}$ of the $\underline{\eta}-$managers are indicted and they are replaced by new managers at the end of the period. A fraction p of continuing $\bar{\eta}-$managers become $\underline{\eta}-$managers at the end of period. Continuing $\underline{\eta}-$managers do not switch type.

Investment k is positively related to promised utility q. However, the relationship depends on the manager's type. When η is stochastic, the promise-keeping constraint is

$$q = \beta\Big[q_R + (1 - \eta e)\alpha k \varphi(z_H|e)\Big].$$

This posits a linear relation between the value of the contract for the manager, q, and the invested capital, k. This depends on the manager's type η.

By inverting the promise-keeping constraint, we can express capital k as a linear function of the promise-utility q,

$$k(\eta) = c(\eta) + s(\eta) \cdot q,$$

where the constant and slope coefficients are given by

$$c(\bar{\eta}) = -\frac{q_R}{\alpha\varphi(z_H|\bar{\eta})}, \qquad s(\bar{\eta}) = \frac{1}{\alpha\beta\varphi(z_H|\bar{\eta})},$$
$$c(\underline{\eta}) = -\frac{q_R}{\alpha(1-\underline{\eta})\varphi(z_H|\underline{\eta})}, \qquad s(\underline{\eta}) = \frac{1}{\alpha\beta(1-\underline{\eta})\varphi(z_H|\underline{\eta})}.$$

The derivation takes into account that the allocation of skills e depends on η (remember that $\bar{\eta}-$managers choose $e = 0$ and $\underline{\eta}-$managers choose $e = 1$). This explains why the coefficients are functions of η.

We are now ready to state the main theoretical result.

PROPOSITION 3: *Suppose that* $\frac{(1-\underline{\eta})\varphi(z_H|1)}{\varphi(z_H|0)} < 1 + \frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}$. *Then, in the period after inspection, SOEs with indicted managers experience:*

1. *Lower average market return compared to non-indicted SOEs;*
2. *Lower average growth in investment compared to non-indicted SOEs.*

PROOF: Appendix E. *Q.E.D.*

These properties are consistent with the empirical findings shown in the first part of the paper. Although the detailed proof is involved, the intuition is straightforward.

Let's consider the average market productivity of a SOE,

$$\mathbb{E}z = z_L \cdot \Big(1 - \varphi(z_H|e)\Big) + z_H \cdot \varphi(z_H|e).$$

Since $\varphi(z_H|1) > \varphi(z_H|0)$, market productivity is higher when managers choose $e = 1$. Thus, SOEs with managers choosing $e = 1$ have higher average market productivity than SOEs where managers choosing $e = 0$. An indicted manager has $\eta = \underline{\eta}$, and therefore, $e = 1$. This implies that the average productivity of the managed SOE is high. However, after indictment, the manager is replaced by a new manager who starts with $\eta = \bar{\eta}$. Since a new manager chooses $e = 0$, market productivity drops.

To understand the drop in investment, we have to consider that a new manager starts with a contract value of q_R. Before the replacement, the average q across all firms is higher than q_R. Thus, a replacement causes a drop in the average value of q' since new managers start with q_R. Because capital is an increasing function of q', the drop in average q' causes a drop in average investment k'. The contract value of non-indicted managers, however, continues to increase on average.

The difficulty to establish this result with closed form solutions is that the relation between q' and k' changes depending on η'. Moreover, the contract value for managers does not grow in all SOEs with non-indicted managers. However, we are able to prove this result analytically in the appendix. The proof shows that the average growth of capital is bigger for SOEs with non-indicted managers compared to SOEs with indicted managers. The average differential is what the empirical regressions capture.

6. OPTIMAL MONITORING, INSPECTIONS AND TENURE

The presence of agency frictions impacts on the allocation efficiency. In this section we analyze some policies that could improve efficiency.

We define an allocation improvement as an increase in the initial value of the contract for the central government. Since a new manager always gets the reservation value q_R, which is exogenous in the model, increasing the initial value of the contract for the central government is Pareto efficient.

We first derive an expression for the contract value. Appendix F shows that the value of the contract for the principal when the firm is run by a new manager—with $\eta = \bar{\eta}$ and promised utility q_R)—is given by

$$V(q_R, \bar{\eta}) = \omega \cdot \overline{V}(q_R) + (1 - \omega) \cdot \underline{V}(q_R). \tag{20}$$

The functions $\overline{V}(q_R)$ and $\underline{V}(q_R)$ are the contract values when the detection probability η is fixed at $\bar{\eta}$ and $\underline{\eta}$, respectively. More specifically $\overline{V}(q_R)$ is the contract value when the manager's type η is not stochastic and remains constant at $\bar{\eta}$. Similarly, $\underline{V}(q_R)$ is the contract value when the manager's type η remains constant at $\underline{\eta}$. We characterized these functions in Section 4.2 and showed that their functional forms are given by (13) and (17).

Appendix F also shows that the relative weight ω is

$$\omega = \frac{(1-\rho)\left[1 - \beta\rho(1-\underline{\eta})\right]}{\left[1 - \rho(1-p)\right]\left[1 - \beta\rho(1-\underline{\eta}-p)\right]}, \tag{21}$$

which is only a function of parameters.

Differentiating ω with respect to p and $\underline{\eta}$, we can verify that the weight is strictly decreasing in p—the probability that η switches—and strictly increasing in $\underline{\eta}$—the probability of successful inspections for experienced managers.

The goal is to explore how policies affect $V(q_R, \bar{\eta})$. We consider three types of policies:

- **Ex-ante monitoring.** More frequent monitoring reduces the ability of the manager to disguise corporate policies. We formalize it with a lower probability $p = P(\underline{\eta}|\bar{\eta})$.
- **Ex-post inspections.** More intensive or frequent inspections increase the odds that an inspection detects deviations. We formalize it with higher probabilities $\bar{\eta}$ and $\underline{\eta}$.
- **Tenure limits.** Tenure limits reduce the number of years a manager can remain in the current position. We formalize it with a lower probabilities of continuation ρ.

Although higher intensity of monitoring and/or inspections could improve the value of the contract for the principal, there are also costs. The costs are not only in the resources

that need to be deployed to perform these tasks but also, and perhaps more importantly, in creating a more hostile environment for the manager. Nobody likes to be constantly monitored and inspected. A simple way to capture this is to assume that more intensive monitory and inspections increase the manager's dis-utility from managing a SOE.

Denote by $\psi(p, \underline{\eta})$ the flow dis-utility from managing a SOE. The function depends on p and $\underline{\eta}$ as they reflect, respectively, the intensity of monitoring and inspection. Since a newly hired manager must be promised the reservation utility q_R, the manager's compensation increases with the dis-utility. Thus, indirectly, $\psi(p, \underline{\eta})$ is a cost for the principal. We make the following assumptions about this cost.

ASSAMPTION 5: *The cost is incurred independently of whether the current state is $\eta = \underline{\eta}$ or $\eta = \bar{\eta}$, and the function $\psi(p, \underline{\eta})$ satisfies*

- $\psi(p, \underline{\eta}) = \psi_1(p) + \psi_2(\underline{\eta})$.
- $\psi_1' < 0$, $\psi_1'' > 0$, $\psi_1(0) = \infty$, $\psi_1(1) = 0$.
- $\psi_2' > 0$, $\psi_2'' > 0$, $\psi_2(1) = \infty$, $\psi_2(0) = 0$.

The assumption that the manager always incurs the cost is justified by the fact that in practice SOEs are monitored and inspected independently of their current state η. The additive separability is for analytical convenience while the remaining assumptions guarantee interior solutions for the government's choices of p and $\underline{\eta}$.

For given values of p and $\underline{\eta}$, and thus $\psi(p, \underline{\eta})$, the optimal contract can be characterized following the same steps as in the environment without the dis-utility cost. All we have to do is to redefine the promised utilities.

Define $\kappa = \beta\psi(p, \underline{\eta})/(1 - \beta)$. Using κ we redefine the continuation utilities as

$$Q = q + \kappa,$$

$$Q(d, z) = q(d, z) + \kappa,$$

$$Q_R = q_R + \kappa.$$

Replacing q with Q as the state variable, the contract has the same structure as for the model without dis-utility (which is a special case of the extended model with $\kappa = 0$). Once we have characterized the optimal contract in terms of the state variable Q, we can derive the original value of the contract for the manager $q = Q - \kappa$. This highlights an important

property: A higher value of $\psi(p, \underline{\eta})$ is equivalent to increasing the reservation value of the manager from q_R to $Q_R = q_R + \kappa$.

Reducing p or increasing $\underline{\eta}$ has two contrasting effects (trade-off). On the one hand, it increases the expected discounted value of compensations paid to managers. This is captured by the increase in the reservation value to $Q_R = q_R + \kappa$. Even if the lifetime utility for a newly hired manager remains q_R, the lifetime compensation must be increased to $Q_R = q_R + \kappa$ so that the manager receives the reservation utility. Lower values of p and higher values of $\underline{\eta}$ increase κ, and therefore, the effective cost for the principal. On the other hand, reducing p and increasing $\underline{\eta}$, alleviate the agency frictions and make the allocation of skills more efficient. Given the lifetime compensation of the manager Q_R (which is related to the lifetime utility q_R), lower values of p and higher values of $\underline{\eta}$ increase the contract value for the principal. The optimal choices of these two variables optimize this trade-off.

The two contrasting effects are illustrated in Figure 3. The figure plots the value of the contract for the principal as a function of the expected managerial compensation $Q = q + \kappa$. The value for the principal is linear in Q with a negative slope (given the parameter assumptions made earlier in the paper). The thinner line is for a higher value of p and/or lower value of $\underline{\eta}$. The thicker line is for a lower value of p and/or higher value of $\underline{\eta}$. Reducing the probability of switching to a lower detection state, p, or increasing the probability of detection, $\underline{\eta}$, increases the value of the contract for the principal (from the thinner line to the thicker line). However, this requires an increase in the compensation that the principal must pay to the manager, which raises the initial Q_R to $\hat{Q}_R$. In the example, the net effect is positive since $\hat{V}$ is bigger than V. However, depending on parameters, it could also be negative.

In the next subsections we explore in more detail each of the three policies.

6.1. *Optimal level of monitoring*

Monitoring makes more difficult for the manager to figure out (or learn) how to disguise policies in ways that are difficult for the central authority to verify. In the model this is captured by the assumption that monitoring reduces p, that is, the probability with which η switches from $\bar{\eta}$ to $\underline{\eta}$.

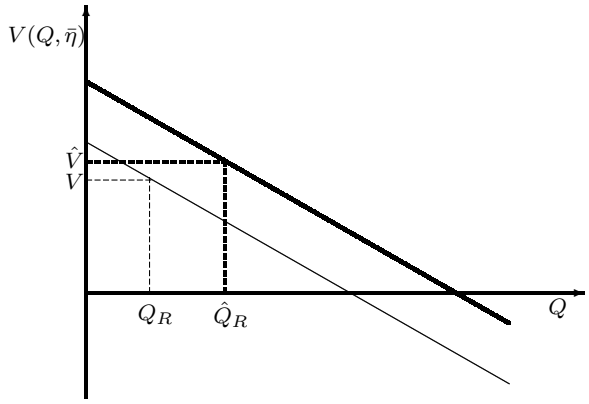


FIGURE 3.—Contract value for the principal with a newly employed manager.

An example of actual monitoring is the party-building policy launched by the Chinese Communist Party (CCP) in 2015. This policy requires SOEs to formalize and elevate the role of the CCP in their corporate governance.

A lower value of p reduces agency frictions and improves allocations, at least from the point of view of the central government. But, of course, monitoring is not without costs.

Taking the derivative of (20) with respect to p we obtain

$$\frac{\partial V(Q_R,\bar{\eta})}{\partial p} = \underbrace{\frac{\partial \omega}{\partial p}\cdot\left[\overline{V}(Q_R)-\underline{V}(Q_R)\right]}_{\textit{Negative effect}} + \underbrace{\left[\omega\cdot\frac{\overline{V}(Q_R)}{\partial Q_R}+(1-\omega)\cdot\frac{\underline{V}(Q_R)}{\partial Q_R}\right]\cdot\frac{\partial Q_R}{\partial p}}_{\textit{Positive effect}}$$

Since $\overline{V}(Q_R) > \underline{V}(Q_R)$, the initial value of the contract for the principal, $V(Q_R,\bar{\eta})$, is positively related to the weight ω. The weight, defined in Equation (21), is negatively related to p. Thus, the first term is negative, and captures the marginal benefit of lowering p with more intensive monitoring. The second term is positive because both $\overline{V}(Q_R)$ and $\underline{V}(Q_R)$ depend negatively on Q_R, which in turn depends negatively on p. This second term captures the marginal cost of monitoring. Thus, lowering p improves the value of the contract for the principal, but at the cost of increasing Q_R. Appendix G.1 derives the second derivative and shows that, provided that $\psi_1''(p)$ is sufficiently large, the second order condition is always satisfied. Thus, there is a unique interior solution to the optimal monitoring problem, which we can solve using the first order condition.

6.2. *Optimal level of inspection*

Inspections provide a mechanism to punish the manager when deviating from the recommended allocation of skills. As a result, more intensive or frequent inspections could improve allocations. We formalize this by assuming that more intensive inspections increase $\underline{\eta}$, that is, the probability that an inspection reveals the actual allocation of skills.

Taking the derivative of (20) with respect to $\underline{\eta}$ we obtain

$$\frac{\partial V(Q_R,\bar{\eta})}{\partial \underline{\eta}} = \underbrace{\frac{\partial \omega}{\partial \underline{\eta}} \cdot \left[\overline{V}(Q_R) - \underline{V}(Q_R)\right]}_{\textit{Positive effect}} + \underbrace{(1-\omega)\cdot \frac{\partial \underline{V}(Q_R)}{\partial \underline{\eta}}}_{\textit{Positive effect}} + \underbrace{\left[\omega \cdot \frac{\partial \overline{V}(Q_R)}{\partial Q_R} + (1-\omega)\cdot \frac{\partial \underline{V}(Q_R)}{\partial Q_R}\right] \cdot \frac{\partial Q_R}{\partial \underline{\eta}}}_{\textit{Negative effect}}$$

Since $\overline{V}(Q_R) > \underline{V}(Q_R)$, the initial value of the contract for the principal, $V(Q_R,\bar{\eta})$, is positively related to the weight ω, which increases in $\underline{\eta}$. Thus, the first term is positive.

The second term is also positive. Although $\overline{V}(Q_R)$ does not depend on $\underline{\eta}$ (see Equation (13)), the function $\underline{V}(Q_R)$ increases in $\underline{\eta}$ (see Equation (17)). Together, the first two terms capture the marginal benefit of more intensive inspections.

The third term is negative since both $\overline{V}(Q_R)$ and $\underline{V}(Q_R)$ depend negatively on Q_R, while Q_R depends positively on $\underline{\eta}$. This term captures the marginal cost of inspection. Thus, increasing $\underline{\eta}$ with more intensive inspections improves the value of the contract for the principal, but at a cost of a higher Q_R.

Appendix G.2 shows that, if $\psi_2''(\underline{\eta})$ is sufficiently large, the solution for the optimal $\underline{\eta}$ is unique and interior, and can be characterized with the first order condition.

6.3. *Optimal length of tenure*

Limiting the tenure length of managers is part of an ongoing reform of Chinese SOEs. The stated purpose is to alleviate agency problems. We ask whether this is a desirable policy in the context of our model.

In the model, tenure is captured by the survival probability ρ. We can then explore the impact of tenure on the value of the contract for the principal by taking the derivative of $V(Q_R,\bar{\eta})$ with respect to ρ. We obtain the following expression:

$$\frac{\partial V(Q_R,\bar{\eta})}{\partial \rho} = \underbrace{\frac{\partial \omega}{\partial \rho}\cdot\left[\overline{V}(Q_R)-\underline{V}(Q_R)\right]}_{\textit{Negative effect}} + \underbrace{\omega\cdot\frac{\partial \overline{V}(Q_R)}{\partial \rho}+(1-\omega)\cdot\frac{\partial \underline{V}(Q_R)}{\partial \rho}}_{\textit{Positive effect}}$$

A marginal increase in ρ has two contrasting effects. Since $\overline{V}(Q_R) > \underline{V}(Q_R)$, the contract value is positively related to the weight ω, which is decreasing in ρ.[9] Thus, increasing the manager's tenure reduces the contract value. This effect—captured by the first term of the derivative—reflects the fact that longer tenure (i.e., a higher ρ) increases the chances that the manager learns the 'skill' to disguise corporate policies, making the agency problem more severe.

The second effect—capture by the second term of the derivative—follows from the impact of ρ on $\overline{V}(Q_R)$ and $\underline{V}(Q_R)$. An increase in ρ has a positive impact on both of these two value functions. This is because when tenure increases, the promised utility of the manager, q, grows for a longer period of time. Since investment k is positively related to q, the overall investment increases with ρ.

The two contrasting effects—one negative and one positive—imply that reducing the tenure of a manager does not necessarily lead to greater social value. In fact, only when p (i.e., the probability with which η switches from $\bar{\eta}$ to $\underline{\eta}$) is large enough, the social value of an SOE—$V(Q_R|\bar{\eta})$—increases with a lower value of ρ (lower tenure). We illustrate this result in more detail with a numerical example provided in Appendix I.1.

7. CHANGES IN ECONOMIC CONDITIONS

Arguably, the intensity of monitoring and inspection on central SOEs in China increased significantly since the early 2010s. Can we rationalize the increase in monitoring and inspection as the optimal response to changes that took place in the Chinese economy? We consider three changes: (i) an increase in the reservation value for managers, q_R; (ii) a higher value of social activities, $s(e)$; and (iii) a higher return from market activities, z.

[9] Expression (21) can be written as $\omega = \omega_1 \cdot \omega_2$ where $\omega_1 \equiv (1-\rho)/[1-\rho(1-p)]$ and $\omega_2 \equiv [1-\beta\rho(1-\underline{\eta})]/[1-\beta\rho(1-\underline{\eta}-p)]$. Note that $1/\omega_1 = 1 + p\cdot\rho/(1-\rho)$, which is positive and increasing in ρ. Similarly, $1/\omega_2$ is also positive and increasing in ρ. This indicates that both ω_1 and ω_2 are positive and decreasing in ρ. It follows that ω is decreasing in ρ.

Higher reservation utility. The rise of private corporations increased the outside option of SOEs' managers. The competition for managers coming from private corporations forced SOEs to raise the compensation of their managerial teams. This is captured in the model by an increase in the reservation utility q_R. In the model, a higher value of q_R increases the optimal levels of monitoring and inspections.

Intuitively, the manager's compensation is a fraction of the SOE's investment revenue. We have shown that a larger value of q_R allows for a higher initial investment k and, thus, a larger initial size of the firm. But when the firm is larger, the allocation of skills becomes more important (since skills are multiplicative to k). As a result, the benefits of a more efficient allocation of skills rises, making monitoring and inspections more desirable.

Higher social return. Environmental protection and poverty alleviation are becoming more pressing policy issues in China, increasing the social responsibility of SOEs. This could be formalized in the model with an increase in $s(e)$, that is, the social value of managerial skills in social activities. This rises the optimal levels of monitoring and inspection.

Also this result has a simple intuition. With a higher return from social activities, the efficiency losses caused by the mis-allocation of skills is higher. More intensive monitoring and inspections are then desirable.

Higher market return. As the economy becomes more prosperous in China, the market return of SOEs also rises. This is captured in the model by higher values of both z_H and z_L. In this case, the impact on the optimal value of monitoring and inspection is ambiguous.

A higher market return increases not only total output but also the share of market output in total output (market plus social). As the share of market output increases, the social cost of skill misallocation, captured by $\overline{V}(Q_R) - \underline{V}(Q_R)$, decreases. This makes monitoring and inspections less desirable. At the same time, the higher market return also lowers the marginal cost of monitoring and inspections, $-\partial\overline{V}(Q_R)/\partial Q_R$ and $-\partial\underline{V}(Q_R)/\partial Q_R$. Therefore, we have two contrasting effects with ambiguous implications for the optimal levels of monitoring and inspections.

The properties described above are stated formally in the next proposition.

PROPOSITION 4: *Suppose that p and $\underline{\eta}$ are at their optimal levels. Then,*

1. *The optimal p decreases when q_R or $s(e)$ rise. However, the optimal p can either increase or decrease when z_H and z_L rise.*
2. *The optimal $\underline{\eta}$ increases when q_R or $s(e)$ rise. However, the optimal $\underline{\eta}$ can either increase or decrease when z_H and z_L rise.*

PROOF: Appendix H. *Q.E.D.*

8. MANAGERIAL TURNOVER

How does the intensity of monitoring and inspections affect managerial turnover? To answer this question we use a numerical example since an analytical characterization is not available. The parameter values are listed in Table I.I in the appendix.

Monitoring reduces the probability p with which η switches from $\bar{\eta}$ to $\underline{\eta}$. This implies that it will take longer for a new manager to learn how to disguise policies. The first panel of Figure 4 shows that, with more intensive monitoring (i.e., an increase in $1-p$), the expected time a new manager remains in the current position with $\eta = \bar{\eta}$ increases. Thus, the average duration moves closer to the duration limit $1/(1-\rho)$ (dashed line). The expected duration in the current position, independently of the value of η, increases as well (solid line).

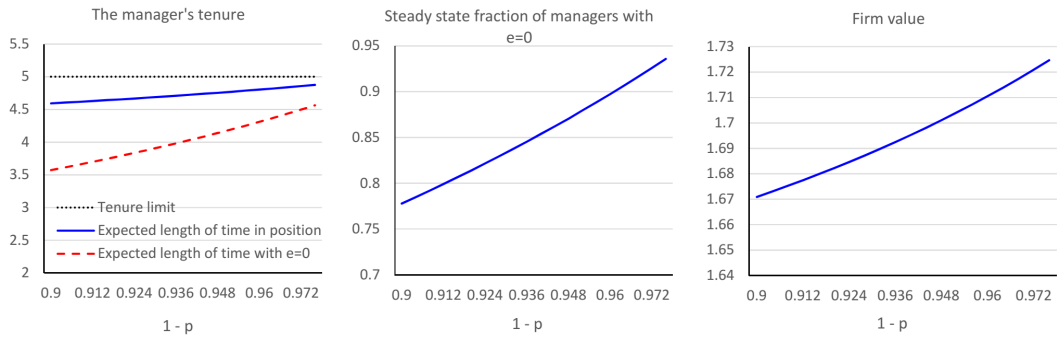


FIGURE 4.—Effects of ex-ante monitoring. Parameter values in the appendix.

Given the survival rate ρ, a lower p implies that it is more likely for a manager to quit before switching to $\eta = \underline{\eta}$. As a result, the fraction of managers with $\eta = \bar{\eta}$ increases.

Let's consider now the sensitivity to inspections. More intensive inspections increase the probability $\underline{\eta}$ with which a deviation is detected. Thus, it takes less time for the principal to detect the actual allocation of skills. As shown in the first panel of Figure 5, more intensive

inspections, *i.e.*, higher $\underline{\eta}$, is associated with lower expected duration of the current job, while the expected duration with $\eta = \bar{\eta}$ remains unchanged. As a result, the average fraction of managers with $\eta = \bar{\eta}$ increases.

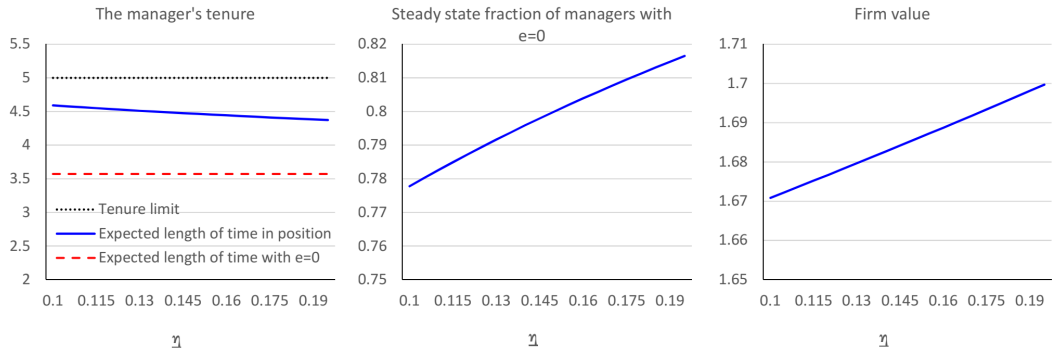


FIGURE 5.—Effects of ex-post inspections. Parameter values in the appendix.

The numerical example shows that ex-ante monitoring not only increases the contract value for the principal (third panel of Figure 4), but it also increases the average job duration. The turnover rate is then lower. In contrast, the intensity of ex-post inspections raises both the contract value and the turnover rate.

Although we abstracted from search frictions, finding a suitable managerial replacement for a SOE in a short period of time may not be easy. This suggests that, if search frictions are severe, ex-ante monitoring could be a better instrument compared to ex-post inspections.

9. CONCLUSION

Using Chinese firm-level data, we find that companies controlled by indicted SOEs experience lower market performance and reduced investment following inspections compared to companies controlled by non-indicted SOEs. The indictment of the controlling SOEs is also associated with an increase in environmental and poverty alleviation spending by the controlled companies, as well as an improvement in their ESG ratings.

To rationalize these empirical findings, we constructed a principal-agent model with repeated moral hazard that formalizes key corporate control features of Chinese SOEs, including their broader social objectives. After demonstrating that the model can replicate the corporate responses to inspections observed in the data, we analyzed the impact of

three policies on allocation efficiency: the intensity of ex-ante monitoring, the intensity of ex-post inspections, and the tenure length of managers.

Although more intensive monitoring and inspections reduce agency frictions, they also discourage managers from accepting these positions, leading to higher costs for SOEs. Thus, increasing monitoring and inspections is not always desirable. Shortening managerial tenure produces two contrasting effects. On the one hand, shorter tenure reduces the average production scale of firms and lowers social surplus. On the other hand, managers with shorter tenure may be less prone to misallocating skills. These theoretical findings provide useful insights for understanding some of the ongoing discussions about SOE reforms in China.

APPENDIX A: EMPIRICAL ANALYSIS

A.1. *List of inspected SOEs*

Table A.I lists the inspected central SOEs. The order is based on the chronological dates of the inspections. Order numbers with a star superscript indicate SOEs in which some of the top managers were indicted according to CCDI's official announcements.

TABLE A.I

INSPECTED CENTRAL SOES.

	SOE name		*SOE name*
1	China Grain Reserves Corp.	29	State Nuclear Power Technology Corp.
2	China Three Gorges Corp.	30*	China National Offshore Oil Corp.
3	China Oil & Foodstuffs Corp.	31	China Datang (Group) Corp.
4*	China FAW Group Corp.	32	State Power Investment Corp. Limited
5	China Huadian Corp.	33	China Nuclear Engineering & Construction Corp.
6*	Sinopec Group	34	China National Nuclear Corp.
7	China Shenhua Group	35	China Minerals Corp.
8	China Unicom	36*	China Dongfang Electric Corp.
9	Dongfeng Motor Corp.	37	China Southern Power Grid Corp.
10*	China Southern Airlines	38	SINOCHEM Group
11	China State Shipbuilding Corp.	39	China State Railway Group
12	China Shipping (Group) Corp.	40	China Post (Group) Corp.
13	State Grid Corp. of China	41	China North Industries Group Corp.
14	China Huaneng Group Corp.	42*	Aluminum Corp. of China
15	China Ship Building Industry Corp.	43	China South Industries Group Corp.
16	China National Machinery Industry Corp.	44	Ansteel Group Corp.
17*	Wuhan Iron and Steel Group	45	Commercial Aircraft Corp. of China
18	China Ocean Shipping (Group) Corp.	46	China Eastern Airlines Corp.
19	China Electronics Corp.	47	China National Aviation Holding Company
20	China Electronics Technology Group	48	Aviation Industry Corp. of China
21	State Development & Investment Corp.	49*	China National Travel Service (HK) Group Corp.
22	China State Construction Engineering Corp.	50	China Aerospace Science and Industry Corp.
23	China Guodian Group Corp.	51	China Merchants Group Corp.
24	China General Technology (Group) Corp.	52	China Aerospace Science and Technology Corp.
25	China Baowu Steel Group	53*	China Resources (Holdings) Corp.
26	China Telecom	54	Harbin Electric Corp.
27	China Mobile Communications Group	55	China First Heavy Industries Corp.
28*	China National Petroleum Corp.		

Note: Asterisk * denotes central SOEs in which some of the top managers were indicted.

A.2. *Data and baseline estimation*

Table A.II presents summary statistics for the main variables used in the empirical analysis. Table A.III reports the complete results for the estimation shown in Table I.

TABLE A.II

SUMMARY STATISTICS

Variable	Obs	Mean	StDev	Min	Median	Max
Investment	1,835	0.014	0.017	-0.124	0.009	0.181
TFP	1,832	9.347	1.057	4.314	9.279	12.455
TobinQ	1,835	1.707	1.462	0.139	1.271	7.518
Leverage	1,832	0.539	0.206	0.016	0.549	1.262
Cash flow	1,832	0.047	0.080	-0.463	0.045	0.438
Age	1,835	2.436	0.573	0.693	2.565	3.219
Intangible	1,832	0.034	0.033	0.000	0.027	0.249
Sales	1,832	22.472	1.852	16.171	22.182	28.689

Note: $Investment$ is measured as the ratio of capital expenditures to total assets. $TobinQ$ is ratio of market value to book value of assets. TFP is total factor productivity. $CashFlow$ is the ratio of total debts to total assets. $CashFlow$ is the ratio of net operating cash flow to total assets. Age is the natural logarithm of one plus the number of years listed. $Intangible$ is the natural logarithm of total employment.

TABLE A.III

IMPACT OF INDICTMENT ON CORPORATE INVESTMENT AND PERFORMANCE.

	Investment	TFP	TobinQ	ESG	E	S	G
Post × Indicted	-0.005**	-0.100**	-0.466***	2.065**	2.065**	3.269**	-0.299
	(-2.11)	(-2.15)	(-2.98)	(2.41)	(2.58)	(2.32)	(-0.24)
Leverage	0.000	-0.225**	-1.882***	2.322	3.683	0.194	-0.244
	(0.01)	(-2.11)	(-3.25)	(0.68)	(1.03)	(0.05)	(-0.15)
Cash Flow	0.003	0.242***	1.363***	0.804	1.689	-1.634	2.545
	(0.46)	(2.76)	(2.77)	(0.29)	(0.50)	(-0.47)	(1.37)
Age	-0.018***	-0.152**	-0.160	-1.080	-1.103	1.764	-4.463**
	(-4.50)	(-2.34)	(-0.46)	(-0.53)	(-0.50)	(0.72)	(-2.53)
Sales	0.038	0.721***	-0.309***	-0.676	-0.441	-0.265	-0.332
	0.038	-22.96	(-2.88)	(-1.30)	(-0.64)	(-0.32)	(-0.83)
Intangible	0.038	-0.389	0.170	7.783	0.781	17.495	5.640
	-1.56	(-1.35)	-0.13	(0.91)	(0.09)	(1.33)	(0.86)
Firm F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,832	1,832	1,832	783	727	764	783
R^2	0.454	0.972	0.727	0.838	0.782	0.847	0.766

*N*ote: This table presents results from panel regressions on firm-level outcomes from 2007 to 2017. $Post$ is an indicator equaling to 1 if a central SOE has been inspected, and otherwise zero. $Indicted$ is an indicator equaling to 1 if an inspected central SOE's chairman or manager is indicted for corruption, and otherwise zero. TFP is firm-level total factor productivity. $TobinQ$ is the ratio of market value to book value of assets. ESG refers to the rating for the Environmental, Social and Governance. E, S, and G refer to Environment rating, Social rating, and Governance rating, respectively. $Controls$ refers to control variables including $Leverage$ (the ratio of total debt to total assets); $CashFlow$ (the ratio of net operating cash flow to total assets); Age (the natural logarithm of one plus the number of years listed); $Sales$ (the natural logarithm of total sales); $Intangible$ (the ratio of intangible assets to total assets). All regressions include firm and year fixed-effects. T-statistics are shown in parentheses. The superscript ***, **, or * indicates statistical significance at the 1%, 5% or 10% level, respectively.

A.3. *Additional empirical results*

To further investigate the impact of SOEs indictment on the social policies of the controlled companies, we use expenditures on environmental protection and donations to reduce poverty (a category called Targeted Poverty Alleviation).

Data for spending on environmental protection and poverty alleviation are provided by the annual report of public traded companies. Environmental expenses are available for years 2009-2017, while poverty donations are available starting in 2016. We use these variables to assess the statistical difference between companies controlled by central SOEs in which the top management was convicted and those controlled by central SOEs without conviction. Since data on environmental protection spending and poverty donations are available only annually, the analysis will be conducted at an annual frequency.

Table A.IV reports the average expenses in environmental protection for the two groups of firms. The comparison is based on firm-level averages over the period of 2016-2020, which is after the inspections. Firms controlled by indicted SOEs made more donations for poverty reduction and invested more in environmental protections after the inspections, compared to firms controlled by non-indicted SOEs. Unfortunately, data prior to inspections for these variables is not available and, therefore, we cannot compute the changes between the pre and post inspection periods.

TABLE A.IV

IMPACT OF INSPECTION OUTCOME ON ENVIRONMENTAL PROTECTION AND POVERTY ALLEVIATION SPENDING.

	Companies controlled by non-indicted SOEs	*Companies controlled by indicted SOEs*
Investment in environmental protection	144.7	573.8
Donations to reduce poverty	7.49	21.45

Note: The table reports averages of yearly firm-level donations to reduce poverty and expenditures on environmental protection over the period of 2016-2020, in millions of RMB.

A.4. *Robustness checks*

We perform a parallel-trend test to validate the key identification assumption. Figure A.1 illustrates the dynamic responses to the inspection, including investment, TFP, Tobin Q and ESG rating. Each dot in the figure represents the estimated coefficient, along with the associated 90% confidence intervals, derived from the leads and lags regression specified in Equation (1). The comparison group is set to time -1, representing the period immediately prior to the inspection. The result reveals no significant pre-trend in the outcomes in the pre-inspection period, indicating that the parallel trends assumption holds. Furthermore, there is a shift in both the magnitude and statistical significance of the coefficients following the inspection.

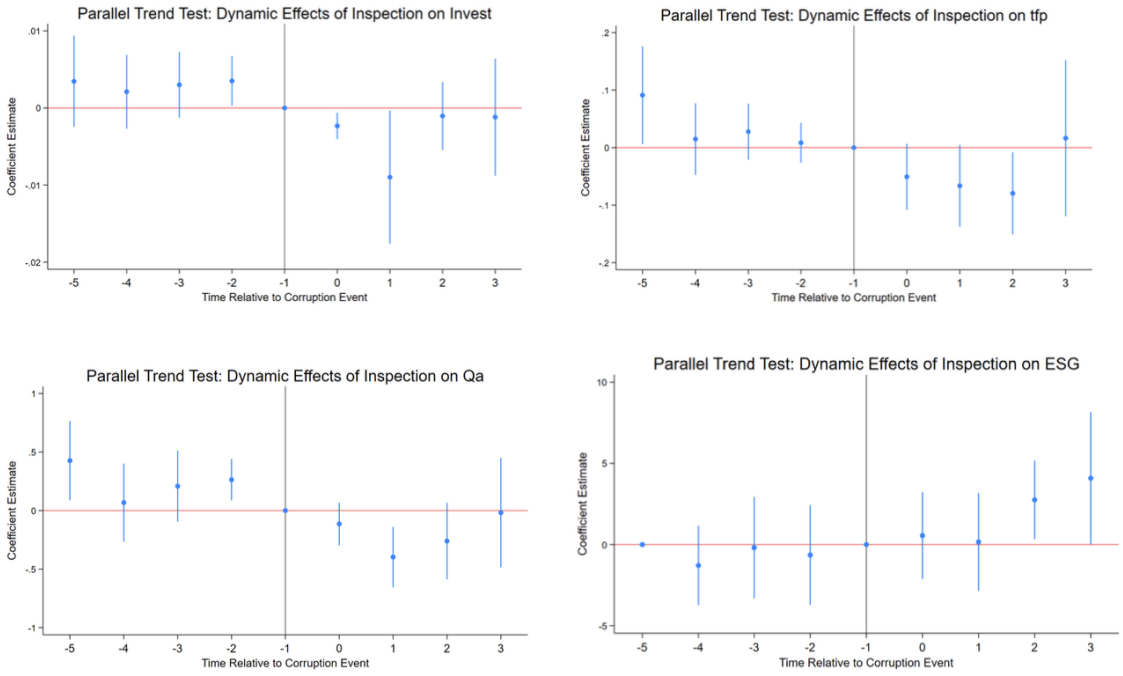


FIGURE A.1.—Parallel trend test

Another concern is selection. To mitigate this concern, we conduct the placebo test by using Monte Carlo permutation method in which we randomly assign individual observations to the treatment group and repeat the regression analysis 500 times, generating 500 sets of regression results. We plot the distribution of the 500 estimated coefficients along-

side their corresponding p-values to visually illustrate the results of the placebo test. Figure depicts the these distributions that are centered around zero, indicating no systematic bias in the placebo tests. Furthermore, the estimated coefficients from our baseline analysis are significantly smaller than the values observed in the placebo distributions. This presents strong evidence supporting the validity of our baseline estimates.

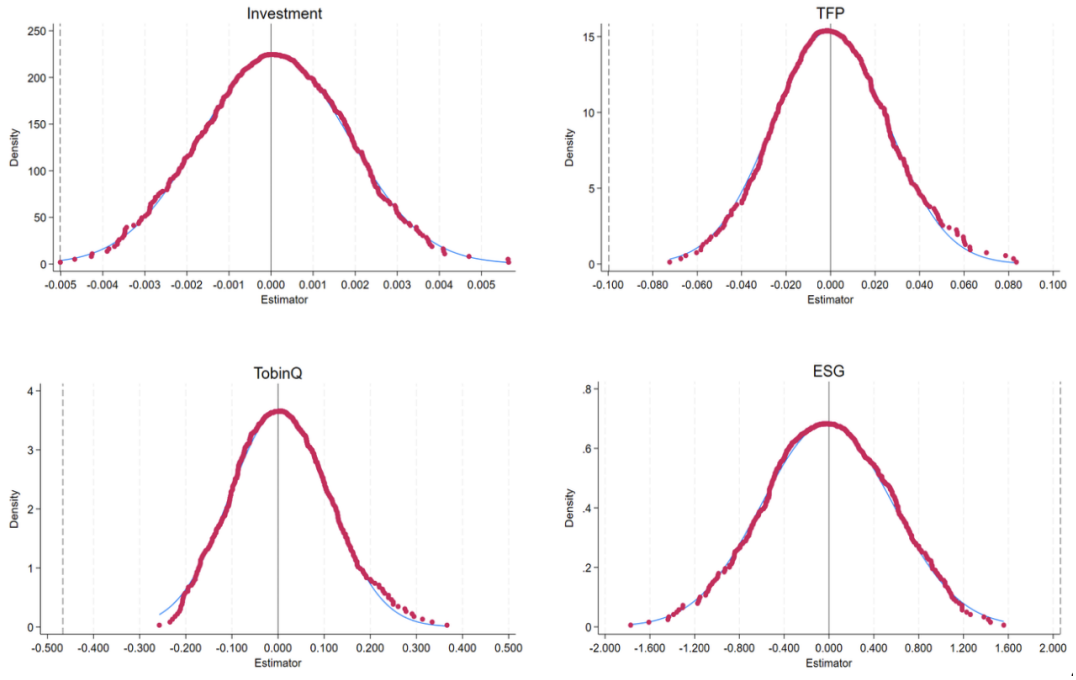


FIGURE A.2.—Placebo test – distribution of falsified estimates

A.5. *Inspection and promotion*

Does indictment affect the promotion prospects in companies controlled by inspected SOEs? To address this question we manually collect all public announcements made by listed companies during the sample period. We identify 136,796 announcements from 173 listed companies. On these announcements we apply text analysis techniques to extract specific information pertaining to changes in management roles. The text analysis is based on keywords such as “promotion”, “joining the board”, “appointment as board member”, and “concurrent positions”.

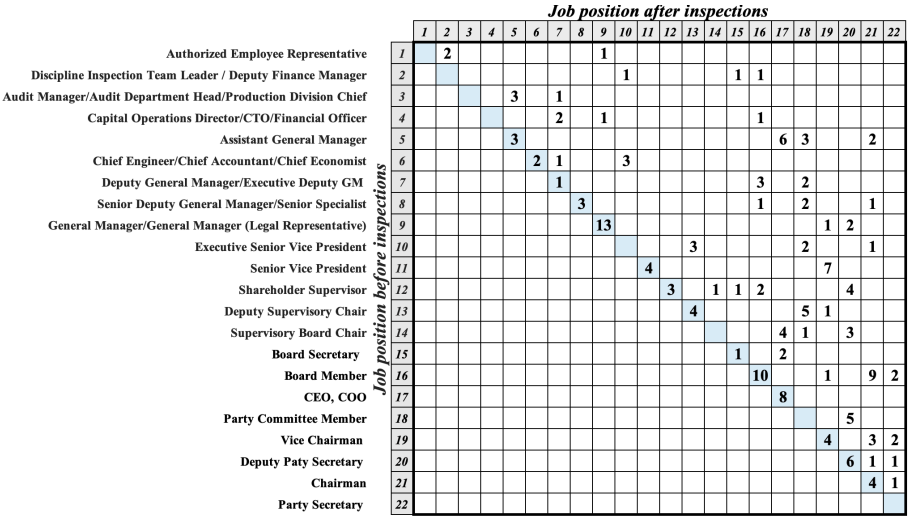
To determine whether managers have been promoted, we analyze historical data for their positions and compare the original job titles to the job positions stated in public announcements. We categorize promotions into two categories. The first category includes vertical promotions that occur when a manager moves to a higher position or is elected to a board position. For example, a deputy manager is promoted to chief manager or becomes a regular board member or an executive director. The second category consists of additional job titles while retaining the pre-inspection position. For instance, in addition to the current position, a manager may become a chief financial officer, chief accountant, or party secretary.

We identified 22 distinct management job titles and ranked them from the lowest to the highest based on the job descriptions. This ranking allows us to construct career paths within an organization in the form of a transition matrix. Figure A.3 shows the transition for managers employed in companies controlled by indicted SOEs (section A) and non-indicted SOEs (section B).

The lowest position is “Authorized Employee Representative” while the highest position is “Party Secretary”. Numbers reported in off-diagonal cells indicate vertical promotions. For example, the cell located at the intersection of row 14 and column 19 in the first matrix tells us that two managers of companies controlled by indicted SOEs have been promoted from the position of “Supervisory Board Chair" to “Vice Chairman”. Cells located in the diagonal (same row/column) indicate the number of managers who did not move to a higher job ranking but were promoted with additional job titles (second type of promotion). For example, the cell located at the intersection of row and column 16 in the first matrix tells us that one manager kept the position of “Board Member” but received additional job titles.

Comparing the two transition matrices we can glance that the number of post-inspection promotions are more numerous in companies that were not indicted. This is not because non-indicted companies employ more managers. In fact, Figure A.4 plots the total number of managers who received promotions in companies controlled by non-indicted SOEs compared to those controlled by indicted SOEs. The figure highlights a significant surge in promotions during 2016 and 2017 only in companies controlled by non-indicted SOEs.

A. Companies controlled by non-indicted SOEs



B. Companies controlled by indicted SOEs

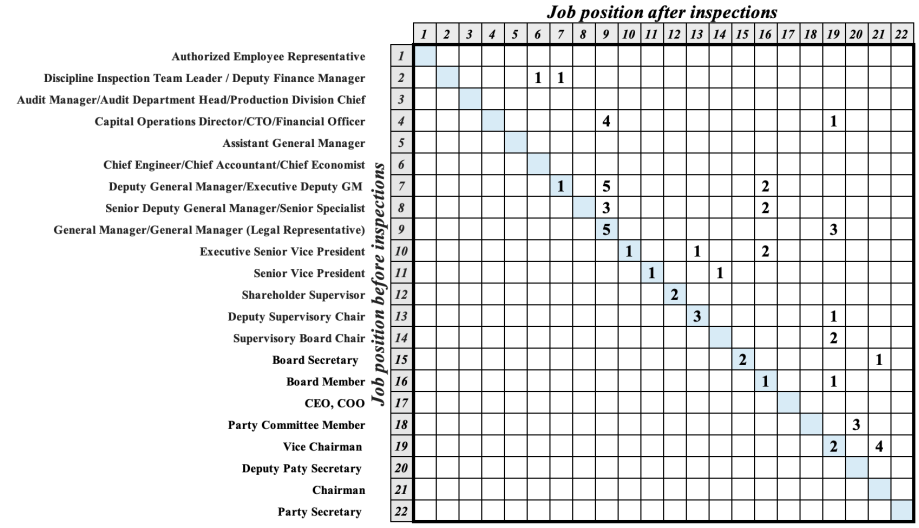


FIGURE A.3.—Promotions in companies controlled by non-indicted (top matrix) and indicted SOEs (bottom matrix). Off-diagonal numbers indicate how many managers switched to a higher job position (vertical promotion and/or election to board). Diagonal numbers indicate how many managers were promoted with additional job titles while retaining the pre-inspection job position.

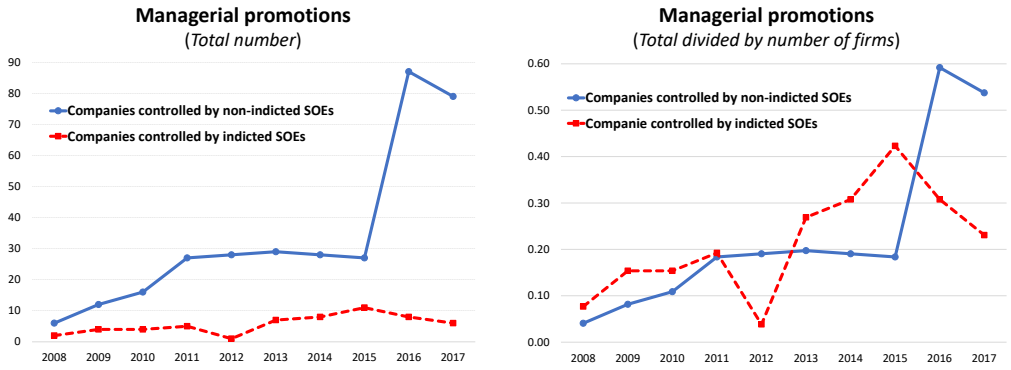


FIGURE A.4.—Impact of inspection outcome on managerial promotions.

APPENDIX B: PROOF OF PROPOSITION 1

Suppose that a continuing manager does not deviate, that is, $e = 0$. Given the contractual policies, the expected value for the manager is

$$Q_0 = \beta \sum_z \left[\rho \Big(c(0,z) + q(0,z) \Big) + (1-\rho) \Big(c^\ell(0,z) + q_R \Big) \right] \varphi(z|0). \tag{22}$$

If the manager deviates and chooses $e = 1$, the expected value is

$$Q_1 = \beta \left\{ (1-\eta) \sum_z \left[\rho \Big(c(0,z) + q(0,z) \Big) + (1-\rho) \Big(c^\ell(0,z) + q_R \Big) \right] \varphi(z|1) + \eta q_R \right\}. \tag{23}$$

Thus, Q_0 denotes the value for the manager when he/she chooses the socially optimal allocation of skills, and Q_1 the value when he/she deviates from the socially desirable allocation of skills. The manager will then choose $e = 0$ if $Q_0 > Q_1$ and viceversa.

We now take advantage of the linearity of the model to derive sharper characterizations of Q_0 and Q_1. Provided that the total surplus increases in k (this is a necessary condition for the firm to exist), it will be optimal to choose the highest input of capital that is compatible with the incentive of the manager to not divert market output. This implies that constraints (4)-(5) will be satisfied with equality. The intuition is that a larger spread between the values received by the manager under the two realizations of productivity allows a higher input of capital without violating incentive-compatibility. It is important to clarify that this is true here because we are assuming that the principal takes e as given. Later, however, we will see that this is not necessarily the case when we solve the original problem which takes into account the impact of the contract structure on the choice of e.

We can also show that the (simplified) optimal contract will set

$$c(0, z_L) = c^\ell(0, z_L) = 0 \qquad \text{and} \qquad q(0, z_L) = q_R. \tag{24}$$

Thus, the incentive-compatibility constraint can be simplified to

$$c(0, z_H) + q(0, z_H) = q_R + \alpha k, \tag{25}$$

$$c^\ell(0, z_H) = \alpha k. \tag{26}$$

This takes into account that, when the manager quits, the promised utility is the reservation value q_R.

The last constraint says that, upon quitting (which happens with probability $1-\rho$), the payment received by the manager is exactly equal to the benefit of diverting output. In the case of continuation only the total value of the contract for the manager is determined. This can be delivered with higher current payments $c(0,z_L)$ or, alternatively, with higher future payments $q(0,z_L)$. As we will see, however, when the manager stays in the contract, it is always optimal for the principal to postpone the managers' consumption by setting $c(0,z_H)=0$ and $q(0,z_H)=q_R+\alpha k$. This is because a higher $q(0,z_H)$ allows more investment in the next period without violating the incentive compatibility constraint. What this means is that the manager receives zero payments until quitting.

We can now use conditions (24)-(26) to rewrite (22)-(23) as

$$Q_0=\beta\Big[q_R+\varphi(z_H|0)\alpha k\Big], \tag{27}$$

$$Q_1=\beta\Big[q_R+(1-\eta)\varphi(z_H|1)\alpha k\Big]. \tag{28}$$

To enforce $e=0$, the value of the manager defined in (27) must be greater than the value defined in (28), that is, $Q_0\geq Q_1$. Using the definition of these two values, the enforcement condition simplifies to

$$\varphi(z_H|0)>(1-\eta)\varphi(z_H|1), \tag{29}$$

which is the condition stated in Proposition 1.

Notice that the manager's continuation value does not enter the above condition. Therefore, if the optimal allocation of skills chosen by the manager is $e=0$, it will also be optimal in the future. This follows from the linear structure of utility and technology. *Q.E.D.*

APPENDIX C: DERIVATION OF $\overline{V}(q)$ AND $\underline{V}(q)$

We start by deriving Equation (13) (i.e., the expression for $\overline{V}(q)$) using (8). For convenience, we define

$$\overline{U}(q_t)=\overline{V}(q_t)+q_t.$$

Thus, (8) can be re-written as

$$\overline{U}(q_t) = \beta\Big[A + \hat{r}(0)\cdot k_t\Big] + \beta\cdot\mathbb{E}_t\overline{U}(q_{t+1}), \tag{30}$$

where $\hat{r}(0) \equiv s(0) + \mathbb{E}(z|e=0) - 1/\beta$, and

$$q_{t+1} = \begin{cases} q_R + \alpha k_t & \text{with prob. } \rho\cdot\varphi(z_H|0), \\ q_R & \text{with prob. } 1-\rho\cdot\varphi(z_H|0). \end{cases} \tag{31}$$

Recall that k_t depends on q_t according to the function

$$k_t = \frac{1}{\alpha\varphi(z_H|0)}\Big(\frac{q_t}{\beta} - q_R\Big).$$

Thus, (31) indicates that the expected q in the next period is

$$\mathbb{E}_t(q_{t+1}) = \rho\cdot\left(\frac{q_t}{\beta}\right) + (1-\rho)\cdot q_R,$$

which implies

$$\mathbb{E}_t(q_{t+n}) = \left(\frac{\rho}{\beta}\right)^n q_t + \frac{\beta(1-\rho)}{\beta-\rho}\Big[1-\left(\frac{\rho}{\beta}\right)^n\Big]q_R.$$

Re-arranging (30), we derive

$$\overline{U}(q_t) = \frac{\beta A}{1-\beta} + \hat{r}(0)\cdot\mathbb{E}_t\sum_{n=0}^{\infty}\beta^{n+1}k_{t+n}.$$

The expected life-time investment, denoted by $\overline{K}(q_t)$, is

$$\begin{aligned}\overline{K}(q_t) \;\equiv\; \mathbb{E}_t\left[\sum_{n=0}^{\infty}\beta^{n+1}k_{t+n}\right] &= \frac{1}{\alpha\varphi(z_H|0)}\cdot\mathbb{E}_t\left[\sum_{n=0}^{\infty}\beta^n(q_{t+n}-\beta q_R)\right] \\ &= \frac{1}{\alpha\varphi(z_H|0)}\cdot\frac{q_t}{1-\rho}.\end{aligned}$$

Thus, we have

$$\overline{U}(q_t) = \frac{\beta A}{1-\beta} + \frac{\hat{r}(0)}{\alpha\varphi(z_H|0)}\cdot\frac{q_t}{1-\rho},$$

which implies

$$\overline{V}(q_t) = \frac{\beta A}{1-\beta} + \Big[\frac{\hat{r}(0)}{\alpha(1-\rho)\varphi(z_H|0)} - 1\Big]q_t.$$

With a similar derivation, we can show that $\underline{V}(q_t)$ is as specified in (17).

APPENDIX D: PROOF OF PROPOSITION 2

To enforce $e = 0$, we need to make sure that the value of the contract for the manager when $e = 0$ is greater than the value when $e = 1$. As shown in Section 4.2.2 this requires to raise continuation utilities when $d = 0$ (no observability of e and z) by a sufficiently high value of Δ. Without loss of generality we express this value $\Delta = \theta\alpha k$. Thus, choosing a sufficiently high value of Δ is equivalent to choosing a sufficiently high value of θ.

Using the expressions derived in Section 4.2.2, the contract values for the manager conditional on e can be written as

$$Q_0 = \beta\Big[q_R + \hat{\varphi}(z_H|0)\alpha k\Big],$$
$$Q_1 = \beta\Big[q_R + (1-\eta)\hat{\varphi}(z_H|1)\alpha k\Big],$$

where $\hat{\varphi}(z_H|0) = \theta + \varphi(z_H|0)$ and $\hat{\varphi}(z_H|1) = \theta + \varphi(z_H|1)$. Thus, in order to enforce $e = 0$, we need to have that $Q_0 > Q_1$. Substituting the above expressions, this condition requires $\hat{\varphi}(z_H|0) > (1-\eta)\hat{\varphi}(z_H|1)$ or, equivalently, $\theta > [(1-\eta)\varphi(z_H|1) - \varphi(z_H|0)]/\eta$.

We now derive the value of the contract for the principal when

$$\theta = \frac{(1-\eta)\varphi(z_H|1) - \varphi(z_H|0)}{\eta}, \tag{32}$$

that is, the extra value Δ is the minimum required to enforce $e = 0$. By choosing this value of θ the manager always chooses $e = 0$. This allows us to use Lemma 1 to derive the value of the contract for the principal, that is,

$$\hat{V}(q|\eta) = \frac{\beta A}{1-\beta} + \hat{\chi}\, q, \tag{33}$$

where $\hat{\chi} = [s(0) + \mathbb{E}(z|e=0) - 1/\beta]/[\alpha\hat{\varphi}(z_H|0)(1-\rho)] - 1$.

On the other hand, if the principal decides not to enforce $e = 0$ by choosing $\theta = 0$ and, under this contract the manager chooses $e = 1$, the value of the principal can be derived from Lemma 2. In this case it takes the form

$$\hat{\hat{V}}(q|\eta) = \frac{\beta A}{1-\beta} + \chi\, q, \tag{34}$$

where $\hat{\hat{\chi}} = [s(1) + \mathbb{E}(z|e=1) - 1/\beta]/[(1-\eta)\alpha\varphi(z_H|1)(1-\rho)] - 1$.

The principal will find optimal to enforce $e = 0$ if $\hat{V}(q|\eta) > \hat{\hat{V}}(q|\eta)$. Using the definition of the two values provided in (33) and (34), this requires $\hat{\chi} > \hat{\hat{\chi}}$ or, equivalently

$$\frac{s(0) + \mathbb{E}(z|e=0) - 1/\beta}{\theta + \varphi(z_H|0)} > \frac{s(1) + \mathbb{E}(z|e=1) - 1/\beta}{(1-\eta)\varphi(z_H|1)}.$$

Substituting θ with its minimum value required to enforce $e = 0$ indicated in (32) and rearranging, we obtain the condition in Proposition 2. *Q.E.D.*

APPENDIX E: PROOF OF PROPOSITION 3

The proof of the first part of the proposition is simple. Market production is zk. Therefore, z is the (gross) market return on capital. The average return is

$$\mathbb{E}z = z_L \cdot \Big(1 - \varphi(z_H|e)\Big) + z_H \cdot \varphi(z_H|e).$$

The assumption that $\varphi(z_H|1) > \varphi(z_H|0)$ implies that SOEs in which managers choose $e = 1$ have higher average market return than SOEs with managers choosing $e = 0$. A convicted manager chooses $e = 1$ while his replacement (at least in the first period after replacement) chooses $e = 0$. This determines a drop in the market return of the SOE. Among the SOEs where managers are not indicted, some will choose $e = 1$ (those with $\eta = \underline{\eta}$) and some will choose $e = 0$ (those with $\eta = \bar{\eta}$). So average productivity depends on the composition of these two types of SOEs. The Markov process assumed for η, implies that SOEs in which surviving managers are not indicted, will have a larger fraction of $\underline{\eta}$-managers in the next period. As a result, the average return of these SOEs increases in the next period.

We now prove the second property stated in the proposition, that is, the impact of indictment on investment. To prove the impact on investment we derive first the average growth of capital for SOEs with $\underline{\eta}$-managers who are indicted and $\underline{\eta}$-managers who are not indicted. We then derive the average growth of capital for SOEs with $\bar{\eta}$-managers. The goal is to prove that the growth of capital of indicted managers is smaller than the average of all other firms.

SOE with indicted $\underline{\eta}$-managers. Only managers with $\eta = \underline{\eta}$ are indicted and this happens with probability $\underline{\eta}$. An indicted manager is replaced by a new manager with $\eta = \bar{\eta}$ and with

initial contract value q_R. The next period investment is then determined by the promise-keeping constraint $q' = \beta[q_R + \varphi(z_H|0)\alpha k']$ with $q' = q_R$, since the new manager starts with q_R. Inverting the promise-keeping constraint we obtain

$$k' = \frac{(1-\beta)q_R}{\alpha\beta\varphi(z_H|0)}.$$

Dividing both size by the initial capital k (chosen by the indicted manager now replaced by the new manager) we obtain the gross growth rate of capital,

$$\frac{k'}{k} = \frac{(1-\beta)q_R}{\alpha\beta\varphi(z_H|0)}\frac{1}{k}. \tag{35}$$

This is the growth of capital for a SOE with initial capital k in the period after the indicted manager has been replaced by a new manager. Our goal is to show that the growth of capital for this firm is lower than the average growth of capital for all other firms with the same initial capital k.

SOE with non-indicted $\underline{\eta}$-managers. Given the capital invested in the previous period, the expected value of the contract for a manager, conditional on not being indicted, is

$$\mathbb{E}q' = q_R + \varphi(z_H|1)\alpha k. \tag{36}$$

Notice that the term $1-\underline{\eta}$ does not show in this expression because this is conditional on not being caught deviating.

Consider now the promise-keeping constraint in the new period after the realization of q', that is, $q' = \beta[q_R + (1-\underline{\eta})\varphi(z_H|1)\alpha k']$. Inverting this promise-keeping constraint we obtain the new capital as a function of the new realized value for the manager,

$$k' = \frac{q' - \beta q_R}{\alpha\beta(1-\underline{\eta})\varphi(z_H|1)}.$$

Taking expectations we obtain

$$\mathbb{E}k' = \frac{\mathbb{E}q' - \beta q_R}{\alpha\beta(1-\underline{\eta})\varphi(z_H|1)}.$$

We can now use (36) to eliminate $\mathbb{E}q'$ in the expression for the expected new investment. After re-arranging terms we arrive at the following expression

$$\frac{\mathbb{E}k'}{k} = \frac{1}{\beta(1-\underline{\eta})} + \left[\frac{(1-\beta)q_R}{\alpha\beta(1-\underline{\eta})\varphi(z_H|1)}\right]\left(\frac{1}{k}\right). \tag{37}$$

This is the expected gross growth rate of capital for SOEs managed by non-indicted $\underline{\eta}$-managers. This expression shows that the expected growth rate of capital is positive (that is, the gross growth rate is greater than 1) but declines in the size of the firm, that is, the initial stock of capital k.

Comparing indicted and non-indicted $\underline{\eta}$-managers. We can now compare the growth rate of capital for indicted and non-indicted managers who are both characterized by $\eta = \underline{\eta}$. We want to show that, if they have the same initial capital k, the growth rate of capital of SOEs with indicted manager—defined in Equation (35)—is always smaller than the average growth of SOEs with non-indicted managers—defined in Equation (37).

Let $\Delta(k)$ be the growth differential between SOEs where managers are not indicted and SOEs where managers are indicted (difference between (37) and (35)). This is equal to

$$\Delta(k) = \frac{1}{\beta(1-\underline{\eta})} + \left[\frac{(1-\beta)q_R}{\alpha\beta(1-\underline{\eta})\varphi(z_H|1)} - \frac{(1-\beta)q_R}{\alpha\beta\varphi(z_H|0)}\right]\left(\frac{1}{k}\right).$$

The growth differential depends on the initial capital. Taking the first derivative we can show that $\Delta(k)$ increases in k. Therefore, if we can prove that $\Delta(k) > 0$ for the smallest admissible k, we have also proved that $\Delta(k) > 0$ for any k.

The smallest k is the capital determined by the promise-keeping constraint when the value of the contract for the manager is $q = q_R$ and $\eta = \underline{\eta}$, that is,

$$q_R = \beta\Big[q_R + (1-\underline{\eta})\varphi(z_H|1)\alpha k_{min}\Big].$$

Using this condition to eliminate k in the definition of $\Delta(k)$ and re-arranging, the condition for a positive growth differential associated with the lowest possible k, that is, $\Delta(k_{min}) > 0$, is

$$1 + \frac{1}{\beta(1-\underline{\eta})} > \frac{(1-\underline{\eta})\varphi(z_H|1)}{\varphi(z_H|0)}. \tag{38}$$

We can verify that this condition is satisfied if the (sufficient) condition imposed in Proposition 3 is satisfied.

SOE with $\bar{\eta}$-managers. So far we have compared SOEs with indicted $\underline{\eta}$-managers and non-indicted $\underline{\eta}$-managers. We now consider SOEs where managers have $\eta = \bar{\eta}$ initially. Again, the goal is to show that the average growth rate of capital for these SOEs is greater than for SOEs with indicted managers.

Given the stock of capital invested in the previous period, the expected next period value of the contract for a manager with $\eta = \bar{\eta}$ is

$$\mathbb{E}q' = q_R + \varphi(z_H|0)\alpha k. \tag{39}$$

Once q' is realized, a $\bar{\eta}$-manager could switch from $\bar{\eta}$ to $\underline{\eta}$ with probability p. The promise-keeping constraint in the next period will then depend on the new η.

When the manager's type does not change, that is, $\eta' = \bar{\eta}$, the promise-keeping constraint in the next period is $q' = \beta[q_R + \varphi(z_H|0)\alpha k']$, We can invert it to obtain

$$k' = \frac{q' - \beta q_R}{\alpha\beta\varphi(z_H|0)}.$$

When the manager's type changes, that is, $\eta' = \underline{\eta}$, the promise-keeping constraint is $q' = \beta[q_R + (1-\underline{\eta})\varphi(z_H|1)\alpha k']$, which we can also invert to obtain

$$k' = \frac{q' - \beta q_R}{\alpha\beta(1-\underline{\eta})\varphi(z_H|1)}.$$

Using these expressions and considering that the switch happens with probability p, we can derive the expected next period capital

$$\mathbb{E}k' = \left[\frac{1-p}{\varphi(z_H|0)} + \frac{p}{(1-\underline{\eta})\varphi(z_H|1)}\right]\left(\frac{\mathbb{E}q' - \beta q_R}{\alpha\beta}\right).$$

We now use (39) to eliminate $\mathbb{E}q'$. Dividing by k we obtain

$$\frac{\mathbb{E}k'}{k} = \frac{1}{\beta}\left[1 - p + p\frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}\right] + \frac{(1-\beta)q_R}{\alpha\beta\varphi(z_H|0)}\left[1 - p + p\frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}\right]\left(\frac{1}{k}\right). \tag{40}$$

Comparing indicted and non-indicted $\bar{\eta}$-managers. We want to prove that (40) is always bigger than (35). As before, let's define $\Delta(k)$ the growth differential between (40) and

(35). After substituting the corresponding expressions and collecting terms, the growth differential is

$$\Delta(k) = \frac{1}{\beta}\left[1 - p + p\frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}\right] - \frac{p(1-\beta)q_R}{\alpha\beta\varphi(z_H|0)}\left[1 - \frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}\right]\left(\frac{1}{k}\right)$$

We first notice that, since the term that multiplies $1/k$ is negative, $\Delta(k)$ is increasing in k. Therefore, to prove that $\Delta(k)$ is always positive, we only need to show that this is true for the lowest possible value of k. We derive this from the promise-keeping constraint $q = \beta[q_R + (1-\underline{\eta})\varphi(z_H|1)\alpha k]$, that is, the promise-keeping constraint for an $\underline{\eta}$-manager. The lowest value of k is obtained when the value of the contract for this manager is at the lowest bound, that is, $q = q_R$. Thus, setting $q = q_R$ allows us to derive

$$k_{min} = \frac{(1-\beta)q_R}{\alpha\beta(1-\underline{\eta})\varphi(z_H|1)}.$$

Substituting k_{min} in the growth differential we obtain

$$\Delta(k_{min}) = \frac{1}{\beta}\left[1 - p + p\frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}\right] - p\left[\frac{(1-\underline{\eta})\varphi(z_H|1)}{\varphi(z_H|0)} - 1\right].$$

A sufficient condition for $\Delta(k_{min}) > 0$ is

$$\frac{(1-\underline{\eta})\varphi(z_H|1)}{\varphi(z_H|0)} < \frac{1}{p} + \frac{\varphi(z_H|0)}{(1-\underline{\eta})\varphi(z_H|1)}. \tag{41}$$

This is obtained by eliminating $1/\beta$ on the right-hand-side of the expression that defines $\Delta(k_{min})$. Since $1/\beta > 1$, if the modified expression is positive, the original expression will also be positive. At this point we can verify that the (sufficient) condition imposed in Proposition 3 implies that condition (41) is satisfied. *Q.E.D.*

APPENDIX F: DERIVATION OF CONTRACT VALUE WITH STOCHASTIC η

We derive the function $V(q_t, \bar{\eta})$ reported in Equation (20) using (18) and (19). For convenience, we define $U(q_t, \eta) = V(q_t, \eta) + q_t$. We can then rewrite Equation (19) as

$$U(q_t, \underline{\eta}) = \beta(A + \hat{r}(1)\cdot k_t) + \beta\underbrace{[1-\rho(1-\underline{\eta})]\cdot U(q_R, \bar{\eta})}_{Replaced} + \beta\underbrace{\rho(1-\underline{\eta})\cdot \mathbb{E}_t[U(q_{t+1}, \underline{\eta})]}_{Continue}.$$

where $\hat{r}(1) = s(1) + \mathbb{E}(z|e=1) - 1/\beta$.

Conditional on continuation, the next period promised utility is

$$q_{t+1} = \begin{cases} q_R + \alpha k_t & \text{with prob. } \varphi(z_H|1), \\ q_R & \text{with prob. } 1 - \varphi(z_H|1). \end{cases}$$

Capital k_t depends on q_t according to the function

$$k_t = \frac{1}{\alpha(1-\underline{\eta})\varphi(z_H|1)}\Big(\frac{q_t}{\beta} - q_R\Big).$$

Thus, conditional on continuation, the expected q in the next period is

$$\hat{q}_{t+1} \equiv \mathbb{E}(q_{t+1}|\lambda_t = 1, d_t = 0) = \frac{1}{1-\underline{\eta}} \cdot \frac{q_t}{\beta} - \frac{\underline{\eta}}{1-\underline{\eta}} \cdot q_R.$$

which implies

$$\hat{q}_{t+n} = \frac{1}{\beta^n(1-\underline{\eta})^n} \cdot q_t - \frac{\beta\underline{\eta}}{1-\beta(1-\underline{\eta})}\Big[\frac{1}{\beta^n(1-\underline{\eta})^n} - 1\Big] q_R.$$

By re-arranging the expression to derive $U(q_t, \underline{\eta})$, we obtain

$$U(q_t, \underline{\eta}) = \frac{\beta}{1-\beta\rho(1-\underline{\eta})} \cdot \Big\{A + [1-\rho(1-\underline{\eta})] \cdot U(q_R, \bar{\eta})\Big\} + \hat{r}(1) \cdot \mathbb{E}_t \sum_{n=0}^{\infty} \beta\big[\beta\rho(1-\underline{\eta})\big]^n k_{t+n}$$

The expected life-time investment, $\hat{K}(q_t, \underline{\eta})$, is

$$\begin{aligned} \hat{K}(q_t, \underline{\eta}) &\equiv \mathbb{E}_t \sum_{n=0}^{\infty} \beta\big[\beta\rho(1-\underline{\eta})\big]^n k_{t+n} \\ &= \frac{1}{\alpha(1-\underline{\eta})\varphi(z_H|1)} \cdot \sum_{n=0}^{\infty} \big[\beta\rho(1-\underline{\eta})\big]^n (\hat{q}_{t+n} - \beta q_R) \\ &= \frac{1}{\alpha(1-\underline{\eta})\varphi(z_H|1)} \cdot \left\{\frac{q_t}{1-\rho} - \beta\Big[\frac{1-\rho(1-\underline{\eta})}{(1-\rho)[1-\beta\rho(1-\underline{\eta})]}\Big] q_R\right\}. \end{aligned}$$

Thus, we have

$$U(q_t, \underline{\eta}) = \frac{\beta}{1-\beta\rho(1-\underline{\eta})} \cdot \Big\{A + [1-\rho(1-\underline{\eta})] \cdot U(q_R, \bar{\eta})\Big\}$$

$$+\frac{\hat{r}(1)}{\alpha(1-\underline{\eta})\varphi(z_H|1)}\cdot\left\{\frac{q_t}{1-\rho}-\beta\Big[\frac{1-\rho(1-\underline{\eta})}{(1-\rho)[1-\beta\rho(1-\underline{\eta})]}\Big]q_R\right\}. \tag{42}$$

We now consider Equation (18) that can be re-written as

$$U(q_t,\bar{\eta})=\beta(A+\hat{r}(0)\cdot k_t)+\beta\underbrace{(1-\rho)\cdot U(q_R,\bar{\eta})}_{Replaced}+$$
$$\underbrace{\mathbb{E}_t\Big[\beta\rho p\cdot U(q_{t+1},\underline{\eta})+\beta\rho(1-p)\cdot U(q_{t+1},\bar{\eta})\Big]}_{Continue}.$$

where $\hat{r}(0)=s(0)+\mathbb{E}(z|e=0)-1/\beta$. Conditional on continuation, the next period promised utility is

$$q_{t+1}=\begin{cases}q_R+\alpha k_t & \text{with prob. } \varphi(z_H|0),\\ q_R & \text{with prob. } 1-\varphi(z_H|0).\end{cases}$$

Recall that k_t depends on q_t through the equation $k_t=\frac{1}{\alpha\varphi(z_H|0)}\Big(\frac{q_t}{\beta}-q_R\Big)$. Thus, conditioned on continuation, the expected next period promised utility is $\mathbb{E}_t(q_{t+1}|\lambda_t=1)=\frac{q_t}{\beta}$, which implies $\hat{q}_{t+n}=q_t/\beta^n$. Re-arranging the above expression for $U(q_t,\bar{\eta})$ we obtain

$$U(q_t,\bar{\eta})=\frac{\beta}{1-\beta\rho(1-p)}\cdot\Big\{A+(1-\rho)U(q_R,\bar{\eta})\Big\}+$$
$$\hat{r}(0)\cdot\mathbb{E}_t\sum_{n=0}^{\infty}\beta[\beta\rho(1-p)]^n k_{t+n}+\beta\rho p\cdot\mathbb{E}_t\sum_{n=0}^{\infty}[\beta\rho(1-p)]^n U(q_{t+1+n},\underline{\eta}).$$

Using Equation (42) we derive

$$\mathbb{E}_t\sum_{n=0}^{\infty}[\beta\rho(1-p)]^n U(q_{t+1+n},\underline{\eta})=\frac{1}{1-\beta\rho(1-p)}\times$$
$$\left\{\frac{\beta}{1-\beta\rho(1-\underline{\eta})}\cdot\Big\{A+[1-\rho(1-\underline{\eta})]\cdot U(q_R,\bar{\eta})\Big\}\right.$$
$$\left.-\frac{\hat{r}(1)}{\alpha(1-\underline{\eta})\varphi(z_H|1)}\cdot\beta\Big[\frac{1-\rho(1-\underline{\eta})}{(1-\rho)[1-\beta\rho(1-\underline{\eta})]}\Big]q_R\right\}$$
$$+\frac{\hat{r}(1)}{\alpha(1-\underline{\eta})(1-\rho)\varphi(z_H|1)}\cdot\frac{q_t/\beta}{1-\rho(1-p)},$$

and the expected life-time investment with $\eta = \bar{\eta}$ is

$$\begin{aligned}\hat{K}(q_t, \bar{\eta}) &\equiv \mathbb{E}_t \sum_{n=0}^{\infty} \beta[\beta\rho(1-p)]^n k_{t+n} \\ &= \frac{1}{\alpha\varphi(z_H|0)} \cdot \mathbb{E}_t \sum_{n=0}^{\infty} [\beta\rho(1-p)]^n (q_t - \beta q_R) \\ &= \frac{1}{\alpha\varphi(z_H|0)} \cdot \Big[\frac{q_t}{1-\rho(1-p)} - \frac{\beta q_R}{1-\beta\rho(1-p)}\Big].\end{aligned}$$

For convenience, we define

$$x_p \equiv \frac{\beta}{1-\beta\rho(1-p)}, \quad x_e \equiv \frac{\beta}{1-\beta\rho(1-\underline{\eta})}, \quad c_p \equiv 1-\rho(1-p), \quad c_e \equiv 1-\rho(1-\underline{\eta}),$$

$$\hat{R}_H \equiv \frac{\hat{r}(0)}{\alpha(1-\rho)\varphi(z_H|0)}, \quad \hat{R}_L \equiv \frac{\hat{r}(1)}{\alpha(1-\underline{\eta})(1-\rho)\varphi(z_H|1)}.$$

This allows us to rewrite $U(q_t, \bar{\eta})$ as

$$\begin{aligned}U(q_t, \bar{\eta}) =& x_p[A + (1-\rho)\cdot U(q_R, \bar{\eta})] + \rho p x_p x_e [A + c_e \cdot U(q_R, \bar{\eta})] + \\ & \hat{R}_H \cdot \Big[\Big(\frac{1-\rho}{c_p}\Big)\cdot q_t - (1-\rho)x_p \cdot q_R\Big] + \\ & \hat{R}_L \cdot \Big[\Big(1 - \frac{1-\rho}{c_p}\Big)\cdot q_t - \rho p c_e x_p x_e \cdot q_R\Big].\end{aligned}$$

By setting $q_t = q_R$ and rearranging the above equation we have

$$\begin{aligned}U(q_R, \bar{\eta})\cdot[1-(1-\rho)x_p - \rho p c_e x_p x_e] &= A\cdot(x_p + \rho p x_p x_e) \\ &+ \hat{R}_H \cdot \Big[\Big(\frac{1-\rho}{c_p}\Big) - (1-\rho)x_p\Big] q_R + \hat{R}_L \cdot \Big[\Big(1 - \frac{1-\rho}{c_p}\Big) - \rho p c_e x_p x_e\Big] q_R.\end{aligned}$$

Note that $\beta[1-(1-\rho)x_p - \rho p c_e x_p x_e] = (1-\beta)(x_p + \rho p x_p x_e)$.[10] Thus,

$$U(q_R, \bar{\eta}) = \frac{\beta A}{1-\beta} + \omega \cdot \hat{R}_H \cdot q_R + (1-\omega)\cdot \hat{R}_L \cdot q_R,$$

[10] Note that $\beta[1-(1-\rho)x_p - \rho p c_e x_p x_e] = \beta(1-c_p x_p) + \rho p \cdot \beta(1-c_e x_e)$, where $\beta(1-c_p x_p) = (1-\beta)x_p$ and $\beta(1-c_e x_e) = (1-\beta)x_e$.

where $\omega \equiv \frac{(1-\rho)/c_p-(1-\rho)x_p}{1-(1-\rho)x_p-\rho p c_e x_p x_e}$.

APPENDIX G: FIRST AND SECOND ORDER CONDITIONS FOR p AND $\underline{\eta}$

The function $V(Q_R, \bar{\eta})$ given by (20) can be re-written as

$$V(Q_R, \bar{\eta}) = \frac{\beta A}{1-\beta} - \Big[1 - \omega\bar{R} - (1-\omega)\frac{\underline{R}}{1-\underline{\eta}}\Big]Q_R,$$

where

$$\bar{R} = \frac{s(0) + \mathbb{E}(z|e=0) - 1/\beta}{\alpha(1-\rho)\varphi(z_H|e=0)} \qquad \text{and} \qquad \underline{R} = \frac{s(1) + \mathbb{E}(z|e=1) - 1/\beta}{\alpha(1-\rho)\varphi(z_H|e=1)}.$$

We can verify that $\frac{\underline{R}}{1-\underline{\eta}} < \bar{R} < 1$.

G.1. *Optimal conditions for monitoring, p.*

Taking the derivative of $V(Q_R, \bar{\eta})$ with respect to p, we obtain

$$\frac{\partial V(Q_R, \bar{\eta})}{\partial p} = \frac{\partial \omega}{\partial p} \cdot \Big(\bar{R} - \frac{\underline{R}}{1-\underline{\eta}}\Big)Q_R - \Big[1 - \omega\bar{R} - (1-\omega)\frac{\underline{R}}{1-\underline{\eta}}\Big] \cdot \frac{\partial Q_R}{\partial p}.$$

The second derivative is

$$\frac{\partial^2 V(Q_R, \bar{\eta})}{\partial p^2} = \frac{\partial^2 \omega}{\partial p^2} \cdot \Big(\bar{R} - \frac{\underline{R}}{1-\underline{\eta}}\Big)Q_R + 2 \cdot \frac{\partial \omega}{\partial p} \cdot \frac{\partial Q_R}{\partial p} \cdot \Big(\bar{R} - \frac{\underline{R}}{1-\underline{\eta}}\Big) - \Big[1 - \omega\bar{R} - (1-\omega)\frac{\underline{R}}{1-\underline{\eta}}\Big] \cdot \frac{\partial^2 Q_R}{\partial p^2}.$$

Note that $1 - \omega\bar{R} - (1-\omega)\underline{R}/(1-\underline{\eta}) > 0$ and $\partial^2 Q_R/\partial p^2 = \psi_1''(p) > 0$. Thus, $\partial^2 V(Q_R, \bar{\eta})/\partial p^2 < 0$ when $\psi_1''(p)$ is large enough.

G.2. *Optimal conditions for inspection, $\underline{\eta}$.*

Taking the derivative of $V(Q_R, \bar{\eta})$ with respect to $\underline{\eta}$, we obtain

$$\frac{\partial V(Q_R, \bar{\eta})}{\partial \underline{\eta}} = \Big[\frac{\partial \omega}{\partial \underline{\eta}} \cdot \Big(\bar{R} - \frac{\underline{R}}{1-\underline{\eta}}\Big) + (1-\omega)\frac{\underline{R}}{(1-\underline{\eta})^2}\Big]Q_R - \Big[1 - \omega\bar{R} - (1-\omega)\frac{\underline{R}}{1-\underline{\eta}}\Big] \cdot \frac{\partial Q_R}{\partial \underline{\eta}}.$$

The second derivative is

$$\frac{\partial^2 V(Q_R,\bar{\eta})}{\partial \underline{\eta}^2} = \Big[\frac{\partial^2 \omega}{\partial \underline{\eta}^2}\cdot\Big(\bar{R}-\frac{\underline{R}}{1-\underline{\eta}}\Big) - 2\cdot\frac{\partial \omega}{\partial \underline{\eta}}\cdot\frac{\underline{R}}{(1-\underline{\eta})^2} + 2\cdot(1-\omega)\frac{\underline{R}}{(1-\underline{\eta})^3}\Big]Q_R + 2\Big[\frac{\partial \omega}{\partial \underline{\eta}}\cdot\Big(\bar{R}-\frac{\underline{R}}{1-\underline{\eta}}\Big) + (1-\omega)\cdot\frac{\underline{R}}{(1-\underline{\eta})^2}\Big]\cdot\frac{\partial Q_R}{\partial \underline{\eta}} - \Big[1-\omega\bar{R}-(1-\omega)\frac{\underline{R}}{1-\underline{\eta}}\Big]\cdot\frac{\partial^2 Q_R}{\partial \underline{\eta}^2}.$$

Note that $1-\omega\bar{R}-(1-\omega)\underline{R}/(1-\underline{\eta})>0$ and $\partial^2 Q_R/\partial\underline{\eta}^2=\psi_2''(\underline{\eta})>0$. Thus, $\partial^2 V(Q_R,\bar{\eta})/\partial\underline{\eta}^2<0$ when $\psi_2''(\underline{\eta})$ is large enough.

APPENDIX H: PROOF OF PROPOSITION 4

Assume that the initial intensity of monitoring and inspection are optimal, that is, p and $\underline{\eta}$ satisfy $\partial V(Q_R,\bar{\eta})/\partial p=0$ and $\partial V(Q_R,\bar{\eta})/\partial\underline{\eta}=0$, with $\partial^2 V(Q_R,\bar{\eta})/\partial p^2<0$ and $\partial^2 V(Q_R,\bar{\eta})/\partial\underline{\eta}^2<0$ (see Appendix G.1 and G.2).

Changes in optimal p. Suppose an increase in q_R raises $Q_R=q_R+\kappa(p,\underline{\eta})$. As a consequence of that, $\partial V(Q_R,\bar{\eta})/\partial p$ becomes negative (since $\partial\omega/\partial p<0$). Because $\partial V(Q_R,\bar{\eta})/\partial p<0$ after the rise in q_R, to reach the optimal condition p has to decrease. Thus, all else being equal, the optimal level of monitoring rises with reservation utility q_R.

Suppose $s(0)$ and $s(1)$ rise, let's say, by 1%. This raises both $\bar{R}$ and $\underline{R}$ and also widens the spread between $\bar{R}$ and $\underline{R}/(1-\underline{\eta})$.[11] As a result of this change, $\partial V(Q_R,\bar{\eta})/\partial p$ drops below zero (since $\partial\omega/\partial p$ and $\partial Q_R/\partial p$ are negative). Then, for the first-order condition to return to zero after the rise in $s(e)$, p has to decrease. Thus, all else being equal, the optimal level of monitoring rises with the rise in social return $s(e)$.

Suppose both z_H and z_L rise by 1%. This generates an increase in $\bar{R}$ and $\underline{R}$. However, it may reduce the spread between $\bar{R}$ and $\underline{R}/(1-\underline{\eta})$. Thus, it is unclear whether this generates shifts in $\partial V(Q_R,\bar{\eta})/\partial p$ in one direction or the other. We conclude then that an increase in market returns z_H and z_L may have ambiguous effects on the optimal level of monitoring.

Changes in optimal $\underline{\eta}$. Similarly, $\partial V(Q_R,\bar{\eta})/\partial\underline{\eta}$ becomes positive after a rise in reservation utility q_R or an increase in social return $s(e)$. Then, for the first-order condition to

[11] Recall that $s(0)>s(1)$ and $\varphi(z_H|e=0)<(1-\underline{\eta})\varphi(z_H|e=1)$.

return to zero after the rises in q_R or $s(e)$, $\underline{\eta}$ has to increase. Thus, all else being equal, the optimal level of inspection rises with increases in q_R and $s(e)$. Also, since the rise in z_H and z_L may generate shifts in $\partial V(Q_R, \bar{\eta})/\partial \underline{\eta}$ in one direction or the other. We conclude then that an increase in market returns may have ambiguous effects on the optimal level of inspection.

APPENDIX I: NUMERICAL EXAMPLE

Duration of a position. The expected length of tenure is $T_L = \mathbb{E}_0 \sum_{t=0}^{\infty} \rho^t = \frac{1}{1-\rho}$. The expected duration of a position with $\eta = \bar{\eta}$ is $T_E = \mathbb{E}_0 \sum_{t=0}^{\infty} [\rho \cdot (1-p)]^t = \frac{1}{1-\rho(1-p)}$. The expected duration after η switches to $\underline{\eta}$ is $T_D = \mathbb{E}_0 \sum_{t=0}^{\infty} [\rho \cdot (1-\underline{\eta})]^t = \frac{1}{1-\rho(1-\underline{\eta})}$. Base on these definitions, the expected duration of a position is $T_A = 1 + \rho[(1-p) \cdot T_A + p \cdot T_L]$, from which we can derive $T_A = \frac{1-\rho(1-\underline{\eta}-p)}{\left[1-\rho(1-p)\right]\left[1-\rho(1-\underline{\eta})\right]}$.

Distribution of managers. The transition probabilities for manager's types are

$$\tilde{P}(\eta, \eta') = \begin{bmatrix} 1-\rho p & \rho p \\ 1-\rho(1-\underline{\eta}) & \rho(1-\underline{\eta}) \end{bmatrix}.$$

If $\eta = \bar{\eta}$ in the current period, the next period type is $\eta' = \bar{\eta}$ with probability $1-\rho p$ and $\eta' = \underline{\eta}$ with probability ρp. If instead $\eta = \underline{\eta}$ in the current period, the next period type is $\eta' = \bar{\eta}$ with probability $1-\rho(1-\underline{\eta})$ and $\eta' = \underline{\eta}$ with probability $\rho(1-\underline{\eta})$.

The steady state fractions of managers with $\eta = \bar{\eta}$ and $\eta = \underline{\eta}$, denoted by (π_H^*, π_L^*), are

$$\pi_H^* = 1 - \frac{\rho p}{1-\rho(1-\underline{\eta}-p)} \quad and \quad \pi_L^* = \frac{\rho p}{1-\rho(1-\underline{\eta}-p)}.$$

I.1. *The effects of raising tenure limit, ρ*

Using the parameter values listed in Table I.I, the dependence on the tenure limit ρ is shown in Figures I.1 and I.2.

TABLE I.I

PARAMETER VALUES

Parameter	Description	Value
ρ	Probability of continuation	0.8
p	Probability with which η switches to $\underline{\eta}$	0.1
$\underline{\eta}$	Probability that deviation of an experienced manager is detected	0.1
A	Constant in the production function	2
$s(0)$	Social return when $e = 0$	1.05
$s(1)$	Social return when $e = 1$	0.45
z_H	Market return when productivity is high	0.7
z_L	Market return when productivity is low	0
$\varphi(z_H\|0)$	Probability that productivity is high when $e = 0$	0.1
$\varphi(z_H\|1)$	Probability that productivity is high when $e = 1$	1
α	Share of value that can be diverted	0.5
β	Discount factor	0.9

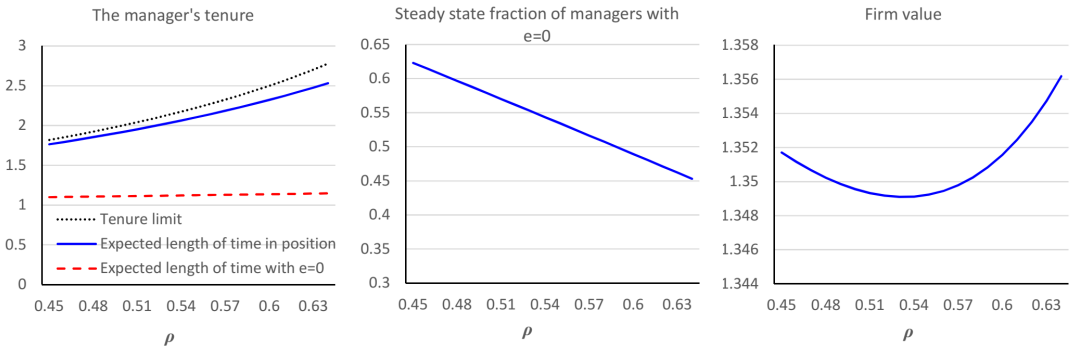


FIGURE I.1.—Effects of raising tenure limit ρ when $p = 0.8$.

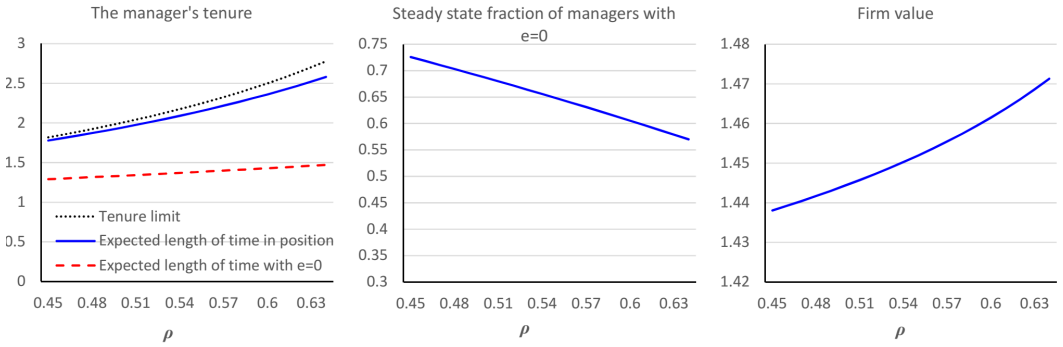


FIGURE I.2.—Effects of raising tenure limit ρ when $p = 0.5$.

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