Relationships in the Wild: How Institutions Affect the Governance of Firms

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Abstract

We study how institutional constraints on the executive affect the governance and performance of firms. In our model, each firm can be privately or state owned, and can elicit effort from a manager and an upstream agent through incentive contracts. We show that in contrast to the conventional wisdom, private ownership and effective incentives are not always an optimal governance bundle. Under weak constraints on the executive, state-owned firms can sustain better incentives and higher output than private ones. As institutions begin to strengthen, firms are optimally privatized and yet are trapped into worse incentives and lower output than the state-owned firms they replaced. Only under strong enough institutions we see "Toyotas," highly productive firms governed by private ownership and effective incentive contracts, optimally emerge in equilibrium. Our model sheds light on the mixed success of privatizations the slow diffusion of best management practices, and the uncertain path of political reforms in developing countries.

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1 Introduction

What makes firms like Toyota or Netflix successful? Being asked this question, a Martian visitor may notice three things. First, these firms flourished in countries with democratic institutions and checks and balances on the government. Second, they are privately owned. Third, they embraced and sometimes pioneered pay-for-performance and other advanced management practices, such as delegation of authority and relational supply chain governance.

Consistent with the observations of our Martian visitor, separate streams of economic literature have emphasized the efficiency-enhancing effects of private asset ownership (Hart, Shleifer and Vishny, 1997; Megginson and Netter, 2001), incentives and governance (Williamson, 1979; Holmstrom and Milgrom, 1991; Bloom, Sadun and Van Reenen, 2012), and political checks and balances (Acemoglu, Johnson and Robinson, 2001; North, Wallis and Weingast, 2009). An implication of these literatures is that one can increase firms' performance and economic development both by improving governance (i.e., privatizing firms and/or implementing high-powered incentives) under fixed political institutions and by improving political institutions under fixed governance.

The empirical evidence, however, suggests that the economic effects of political institutions and governance do not simply add to each other but rather, they interact with and constrain each other in subtle ways. On the one hand, private firms in developing and transition countries have been unable to replicate the incentive systems and management practices of their counterparts in advanced liberal democracies (Blanchard and Kremer, 1997; Bloom, Schweiger and Van Reenen, 2012; Knyazeva, Knyazeva and Stiglitz, 2013). Figure 1 below illustrates this point by showing that delegation of authority – one of the managerial best practices identified by the World Management Survey – is less frequently adopted by private firms in countries with weak protection of property rights. On the other hand, state-owned firms are still abundant in countries ruled by autocratic regimes, and many of them did successfully replicate the management practices of firms in liberal democracies (Groves, Hong, McMillan, and Naughton, 1994; Xu, 2000). If these patterns are equilibrium outcomes to be explained (and not simply errors to be corrected), then we need economists to begin studying political institutions and the governance of firms in conjunction, rather than in isolation. The purpose of this paper is to develop a tractable model that makes progress in that direction.

[1]Note: The decentralization index (z-scored) by country is measured as the average plant manager's degree of autonomy over hiring, investment, products, and prices. The source is the LSE-CEP organizational survey (see Bloom et al., 2012). The index of security of property rights is by Ouattara and Standaert (2020). Regression analyses, available upon request, show that the positive correlation between delegation and institutional quality is robust to controlling for generalized and bilateral trust, both of which Bloom et al. (2012) found to be positively associated with delegation.

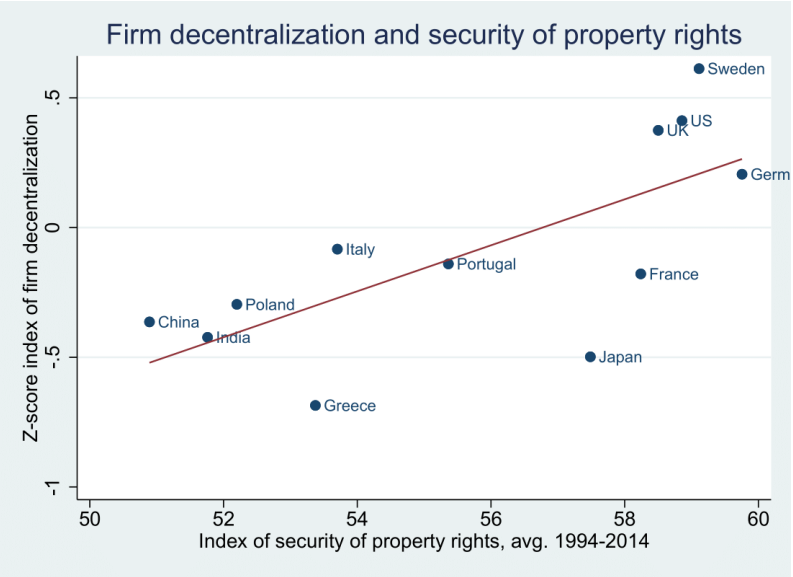

Figure 1: Firm decentralization and security of property rights[1]

In our model, a firm consists of two productive agents, a "seller" (equivalently, a supplier or an employee) and a "buyer" (a manager), whose efforts jointly contribute to generate output. We assume that while output is always contractible, efforts are non-contractible in certain states of the world, in which case an incentive contract that assigns an output share to the agents is needed to induce them to work. The central feature of our model is that unlike in standard agency settings, firms operate in the shadow of a third party, the ruler, who has an opportunity to expropriate the whole output at the risk of being deposed. Preventing expropriation therefore requires the ruler to receive a share of the output, which limits the contracts a firm can enter with the agents, and thus the agents' incentives to exert effort. The lower the probability of removal following expropriation (which we interpret as weak political institutions), the larger the ruler's share, and hence the lower the agents' efforts that can be sustained in equilibrium.

In the first part of the paper, we study how the presence of a ruler constrains incentive provision and efforts under two alternative modes of firm ownership. In the first mode, which we interpret as private ownership, one of the agents (say, the buyer) owns the firm and contracts for effort with the other agent; courts enforce these productive contracts between agents, while a "political contract" requires the ruler not to expropriate output, in exchange for taxes (and under the penalty of potential removal). In the second structure, which we interpret as state ownership, the ruler owns the firm and contracts for effort with the buyer and the seller. Here, unlike the buyer under private ownership, the ruler has an option to ignore a court's order to pay the agreed upon output shares, and thus the

political contract requires her to do so (again, under the penalty of potential removal). We find that under a low enough probability of ruler removal (weak political institutions), firms are optimally owned by the ruler and governed by simple contracts where the agents commit to exert effort in exchange for a fixed wage. In contrast, under higher removal probability (stronger political institutions), firms are optimally owned by the buyer and governed by incentive contracts that share output among the agents. Consistent with the empirical evidence, but in contrast to the conventional wisdom in economics, our model thus shows that production in autocracies is (optimally) organized through state-owned firms, even though these SOEs are more bureaucratic (i.e., governed by fixed wage contracts) and less productive (lower efforts and output) than the private firms one observes in advanced liberal democracies.

Two intertwined forces drive this result. First, due to the ruler's expropriation threat, it is not possible to allocate output shares to the agents under weak political institutions, in which case a firm's best hope is to rely on fixed wage contracts when efforts are contractible. Second, while state ownership has an advantage in sustaining fixed wage contracts, and hence dominates under weak political institutions, private ownership has an advantage in sustaining output sharing, and thus dominates under stronger institutions. Intuitively, private ownership has a disadvantage in fixed-wage contracts because the agents must leave some output to a third party (the ruler) via taxes, and hence will contract effort levels that maximize their joint output share (net of effort costs) rather than the full output. In contrast, under state ownership, the ruler is a party in the productive contract with the two agents, and thus is happy to negotiate effort levels that maximize the full output (again, net of effort costs). At the same time, state ownership has a disadvantage in incentive contracts because the ruler collects output, and hence if she chooses to deviate, she can consume the agents' shares before being deposed. In contrast, under private ownership the ruler must make a move to expropriate output that is not in her possession, and thus there is a chance for her to be deposed after making such a move but before consuming the output.

In the second part of our paper, we enrich the baseline model to allow firms to complement objective output shares with subjective bonuses as a reward of the agents' efforts (Baker, Gibbons and Murphy, 1994). Doing so is potentially valuable because even when unconstrained by the presence of the ruler, output sharing alone cannot elicit first best efforts due to freeriding among the agents (Holmstrom, 1982). Indeed, real-world "Toyotas" (i.e., the most productive firms) rely more on subjective incentives based on individual performance than on piece rates when managing their employees or suppliers (Gibbons and Henderson, 2012; Helper and Henderson, 2014). The downside is that while subjective incentives are more precise and effective than objective ones, they are also relational, rather than contractual, in nature: the promise to pay effort-contingent bonuses must be

self-enforcing (Levin, 2003). While the basic tradeoff between state and private ownership continues to exist in this richer model, the interaction between subjective incentives and the ruler's threat of expropriation generates additional insights on the optimal structure of firms' incentive systems, which can explain many of the patterns of governance in developing countries discussed above.

Our key finding in this second part of the paper is that the effectiveness of incentives, and the surplus generated by firms, have a U-shaped relationship with the strength of political institutions. When the probability of ruler removal is low, state ownership and low output sharing continue to be optimal (due to the overwhelming taxes under private ownership); unlike in the baseline model, however, the ruler can now use subjective bonuses to better incentivize the agents. If the ruler reneges on these bonuses, mutual trust is broken and the parties revert to optimal "spot market" governance - that is, state or private ownership without subjective incentives (Baker et al., 2002). Under weak political institutions, this fallback option is unattractive for the ruler, and thus state-owned firms can credibly sustain relatively high bonuses and efforts. At intermediate levels of removal probability, however, the ruler's post-deviation fallback improves, the bonuses she can credibly promise become smaller, and efforts and output decrease. After a point, subjective bonuses under state ownership become so weak that private ownership becomes optimal, and the economy enters a "privatization trap": while private firms are now sufficiently productive to crowd out state ownership, they are quite heavily taxed (to deter full expropriation by the ruler), and can sustain neither high bonuses nor high efforts. In other words, private firms under mediocre political institutions are more poorly managed and less productive than the state-owned firms that existed under more autocratic institutions. It is only after the quality of political institutions increases further (and the ruler becomes highly constrained) that incentives in private firms become sufficiently effective for these firms to catch up with and finally outperform state-owned firms under autocracy.

These results can simultaneously explain the relative success of state-owned firms in autocratic regimes like contemporary China (Groves et al., 1994; Xu, 2000), and the failure of private firms in transition countries (Bloom, Schweiger and Van Reenen, 2012), at replicating the incentive systems and performance of private firms in advanced liberal democracies. The privatization trap can also explain why the transition to democracy in Russia, back in the 1990s, reduced economic output (Blanchard and Kremer, 1997; Brown, Earle and Telegdy, 2006). While the transition process introduced formal property rights and democratic elections, these institutions remained relatively weak and unstable, and the government often engaged in arbitrary taxation, especially against foreign firms (Spar and Jarosz, 1996; Paltseva et al., 2023). The option to "squeeze" privatized firms may have caused post-soviet rulers to breach the relational contracts that state-owned firms had de-

veloped with employees and suppliers under their fully autocratic predecessors, imprisoning the newly privatized firms into a trap of weak governance and low productivity. Indeed, it is only after political institutions and property rights somewhat stabilized in the early Putin years (that is, prior to the post-2012 autocratic turn) that privatized firms began outperforming their state-owned counterparts (Brown, Earle and Gehlbach, 2013).

Our model has three broad implications. First, it shows that political institutions can importantly constrain firms' governance (ownership and incentive systems), suggesting that the political/institutional and the managerial/organizational determinants of economic development should be modeled in conjunction rather than in isolation. While the most productive firms are privately owned and adopt "Toyota-style" incentive systems, that might be driven by the fact that those firms are located in countries with low risk of governmental expropriation. For a firm that operates under weaker political institutions, following a consultant's recommendation to copy Toyota may backfire and completely break down cooperation. Relatedly, transferring Toyota's management practices to firms located in autocratic regimes might have greater chances of success if those firms are state-owned, while privatizing a state-owned firm under weak political institutions may reduce the firm's productivity. Second, our model suggests that political institutions have a first order effect on development, relative to governance. Rather than attempting to import strong governance into a weak institutional environment, hoping that political improvements will follow economic growth, reformers should prioritize the creation of checks and balances on the government (as difficult as it is) because that is a precondition for strong governance to be transferable. Third, and less optimistically, the U-shaped relationship between surplus and political institutions uncovered by our model suggests that while advanced liberal democracies may be global optima, autocracies are local ones. If the institutional and political reforms needed to reach the global optimum (i.e., a fully constrained ruler) are too costly, and in the absence of exogenous accelerators like wars or revolutions, reverting from a mediocre democracy to autocracy may be economically too attractive, and as a result, gradual projects of political reform may fail.

The rest of this paper is organized as follows. Section 2 discusses how our model relates to the economic literature. Section 3 presents the baseline model. Section 4 analyzes how political institutions affect the optimal ownership of firms. Section 5 studies how political institutions affect the governance of firms, defined as the bundle of ownership and incentive system. Section 6 discusses some applications of the model and section 7 discusses extensions. Section 8 concludes.

2 Relation to the literature

Our paper relates to both the economic literature on contracts and organizations and the literature on political institutions. On the one hand, classic models of incentives (reviewed by Gibbons and Roberts, 2013, and Malcomson, 2013) and asset ownership (reviewed by Segal and Whinston, 2013) focus on imperfections in contractual enforcement, assuming strong political institutions and hence no risk of expropriation. On the other hand, models of political institutions study how repeated interaction with traders overcomes the commitment problem of rulers (e.g., Olson, 1993; Greif, Milgrom and Weingast, 1994; Dixit, 2004; North, Wallis and Weingast, 2009) but abstract from contracting among the traders themselves. By exploring how institutional constraints on rulers shape the incentive systems and ownership structure of firms, our paper builds a bridge between these two literatures, which we hope will stimulate further inquiry into the interplay of political institutions and organization.

Our paper also contributes to a (small) theoretical literature in economics, which uses an incomplete contracting approach to study the choice between state and private firm ownership. Contributions to this literature include Sappington and Stiglitz (1987), Laffont and Tirole (1993, ch. 17), and the more recent papers by Schmidt (1996), Hart et al. (1997), and Williamson (1999). Roland (2008) provides a concise review. While these papers adopt different modeling approaches and highlight different tradeoffs between state and private ownership, they have two common features that sharply differentiate them from our model. First, they do not study how the optimal design of incentives and contracts differs across state-owned and privately owned firms. Second, these papers do not model how political institutions affect the choice between private and state ownership.[2]

3 Baseline model

We study an economy consisting of four groups of players: a ruler (she), two unit masses of identical productive agents (he), and the courts. We will call the two masses of productive agents "buyers" and "sellers" for brevity. One can think of the buyers as downstream firms and the sellers as their upstream suppliers. Alternatively, one can think of the buyers as managers of the downstream firms and the sellers as their employees. Production of output requires the matching of a buyer and a seller and their joint efforts, and these

[2] A partial exception is Che and Qian (1998), which focuses on the Chinese case to show that in an autocracy, private firms distort the production technology to hide revenue from the government. Unlike us, Che and Qian (1998) do not allow for variation in institutions and hence do not study how institutional differences affect firm ownership.

activities are overseen by the courts and the ruler, as discussed below. All players are risk-neutral, infinitely lived, and discount the future at a common factor $\delta \in [0,1)$. The model's ingredients are described in detail below.

Production: Once a buyer and a seller are matched, they jointly produce output $Y \in \{0, y\}$. The probability that high output $y > 0$ is produced is

$$\Pr(Y = y) = a_B + a_S, \tag{1}$$

where a_B, a_S are the productive actions of the buyer and the seller, respectively. For concreteness, we will refer to these actions as "efforts," although other interpretations, such as specific investments or input adaptation, are also possible. The cost of effort is borne privately by each agent and given by $c(a_i) = \frac{1}{2}a_i^2$, with $i \in \{B, S\}$. Given the unit mass of buyers and sellers and their pairwise effort choices, the total output in the economy is then given by $\Pi = y \int_j \sum_i (a_{i,j})\, dj$ while the social surplus is given by $\pi = \int_j \sum_i (y a_{i,j} - c(a_{i,j}))\, dj$, where $j \in [0,1]$ indexes the particular pair formed.[3] To satisfy the interpretation of efforts as generating a probability of successful output, we assume that $y \leq 1/2$.

Output at each firm will be owned either by one of the productive agents, say, the buyer (*private ownership*) or by the ruler (*state ownership*), and the owner will need to contract with the remaining productive agents for their efforts. In other words, if the ruler owns a firm's output, she will need to contract with both the buyer and the seller at that firm, while if the buyer owns the output, he will need to contract with the seller. Since our main purpose is to study the optimal governance of a typical firm (i.e., the bundle of contract design and ownership structure), we assume for simplicity that firms in the economy are either all privately owned or state-owned. We consider the possibility of a mixed economy with both private and state-owned firm in section 7.

Productive contracts: Contracts are needed to ensure that the buyer and the seller in each firm exert the desired effort. A contract for agent i consists of three components: (i) a fixed payment β_i (which could be negative), (ii) a share b_i of the realized output Y, and (iii) specified effort levels to be exerted. As in standard agency models, while output and monetary transfers (upfront payments and shares) are perfectly verifiable (and hence enforceable) by courts, effort levels are not, implying that output sharing may be needed to incentivize the agents. Unlike in standard models, however, there are states of the world where efforts are verifiable, in which case fixed wage contracts suffice to elicit

[3]Note that while the output of any given pair is stochastic, the aggregate output in the economy will be a deterministic function of the effort choices.

the desired efforts. Formally, there is a stochastic state variable $\theta_j \in \{E, N\}$, specific to each firm, that determines whether the contracted effort is verifiable. This state is realized and observed by the parties after the contract is signed but before efforts are chosen. In the "enforcement state" E, courts will enforce specific performance, compelling the agents to exert the contracted efforts. In the "non-enforcement" state N, the agents have an opportunity to "game the system," (Baker, 1992; Baker et al., 1994) exerting zero effort while still collecting the contracted payments. We assume for simplicity that the enforcement probability, denoted by $\Pr(\theta_j = E) = q_j$, is the same across productive agents: $q_j = q_{j'} = q$.[4] We shall see momentarily that this partial contractibility of effort plays a crucial role in generating a trdeoff between private and state ownership of firms.

Ruler and political contracts: The ruler has an opportunity to expropriate the entire economy's output - by moving to take it from each firm's buyer and seller under private ownership, or by refusing to pay the two agents the promised output shares under state ownership. To prevent full expropriation, which would destroy the agents' incentive to participate in production, the ruler enters a "political contract" with the buyers and sellers, which specifies a promise to obey the courts' order to make due payments (under state ownership) or a level of taxes below total output to be collected from the buyers and sellers (under private ownership). Given that output and monetary transfers can be verified, we allow these taxes to include both lump sum transfers and shares of the agents' profits. Thus, the total tax liability of a typical buyer and seller are given, respectively, by $T_B = \kappa_B \left(y\left(1 - b_S\right) - B_{S,N} - \beta_S\right) + t_B$, and $T_S = \kappa_S \left(y b_S + \beta_S + B_{S,N}\right) + t_S$, where κ_B and κ_S are marginal tax rates, and t_B and t_S are the lump-sum taxes. [5] As we will show momentarily, marginal taxes are important as they enable the ruler to endogenously elicit firms' production levels that make the political contract incentive compatible.

If the ruler reneges on the political contract, courts enforce it with probability $\tau \in [0, 1]$, after which a new ruler is installed and the current ruler is deposed and receives a payoff of zero going forward. With probability $1 - \tau$, courts fail to enforce the political contract and the ruler remains in power. We interpret τ as the quality of political institutions. [6] An important observation here is that while the ruler's future payoff following breach and enforcement of the political contract is zero regardless firm ownership, her present

[4] We interpret the gaming probability, $1-q$, as a combination of two factors: (1) the difficulty of objectively specifying and measuring efforts (a feature of the firm's production process), and (2) the ability of courts to interpret and enforce contracts (a feature of the legal and judicial system).

[5] This formulation seems to be most representative of practical taxation. Given the normalization of low output to zero, the literal interpretation does mean that some firms will get subsidies when the output fails and the buyer still owes payments to the seller. We could avoid this by considering a positive baseline output level but which would generate no new qualitative insights while adding notational complexity. Alternatively, we could consider a situation where the ruler taxes output directly, which would lead to different equilibrium tax rates but again no qualitative differences in the logic of the model.

[6] For parsimony, we assume courts enforce both productive contracts and political contracts. In practice,

post-deviation payoff does depend on firm ownership. Under state ownership, the ruler deviates by consuming each firm's output, which she owns and collects, instead of paying the agents their due shares. Output is therefore the ruler's present post-deviation payoff. Under private ownership, however, a deviating ruler must take output from the buyers before she can consume it, implying that courts have a chance to depose the ruler before she consumes output. $(1-\tau)\,\Pi$ is therefore the ruler's present post-deviation expected payoff under private ownership. The fact that the ruler's post-deviation payoff is lower under private ownership than under state ownership plays an important role in generating a trade-off between the two ownership structures, as formally shown below.

Other assumptions: Outside of the structural framework outlined above, we make three additional assumptions. First, all players have deep pockets, so that they are able to make the contracted payments even if no output is realized, and can buy stakes in a firm if needed. Second, we assume that output cannot be leveraged contractually, so that $\sum b_i \leq 1$. This is effectively a "no-sabotage" constraint, requiring that no player in the game has a payoff that is negatively related to the output of a firm. Third, we assume that the ruler cannot pledge wealth at the beginning of the game as a hostage to ensure compliance with her promised behavior. Assumptions 1 and 3 could be easily relaxed without qualitatively affecting the results. Assumption 2 ensures that output sharing alone cannot elicit first-best efforts, and thus the analysis is non-trivial.

4 Firms' ownership under different political institutions

Using the model described above, we now study the optimal choice between private and state ownership of firms under different kinds of political institutions. We proceed in two steps. First, we separately characterize equilibrium efforts and output under each ownership structure. Then, we characterize the optimal ownership structure at different levels of τ.

4.1 Private ownership

The timeline in each period under private ownership is as follows. First, the ruler chooses the marginal and lump sum taxes that will be collected, $(\kappa_B, \kappa_S, t_B, t_S)$. Next, the buyer at each firm makes a TIOLI offer to the seller, which specifies a contract $(\beta_S, b_S, a_{B,E}, a_{S,E})$ that includes (a) efforts to be exerted in the enforcement state, (b) upfront payments, and

institutions other than courts, such as parliaments, may be in charge of the latter (although supreme or constitutional courts may also be involved in such task).

(c) the output sharing rule. If the seller accepts, the agreed upon fixed payments are made, after which the agents observe whether the contracted efforts are enforceable (the state $\theta_j \in \{E, N\}$), and choose their efforts accordingly. Once the efforts are sunk, output at each firm is realized and the contracted shares are paid out, after which the ruler chooses whether to collect the agreed upon taxes or move to expropriate the entire output. If the ruler moves to expropriate, she is immediately deposed with probability τ whereas with probability $(1-\tau)$, she consumes the output and remains in power.

To characterize the equilibrium under private ownership, we begin by solving for the optimal contract between the buyer and the seller at a typical firm, conditional on taxes. Then, we solve for the taxes that maximize total surplus.

Under given contracts and taxes, the buyer's and the seller's expected payoffs (and the resulting participation constraints) are

$$\begin{aligned} &u_B = (1-\kappa_B)\left((1-b_S)\, y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)-\beta_S\right) \\ &-t_B - \tfrac{1}{2}q a_{B,E}^2 - \tfrac{1}{2}(1-q)a_{B,N}^2 \geq 0, \end{aligned} \tag{2}$$

$$\begin{aligned} &u_S = (1-\kappa_S)\left(b_S y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)+\beta_S\right) \\ &-t_S - \tfrac{1}{2}q a_{S,E}^2 - \tfrac{1}{2}\left(1-q\right)a_{S,N}^2 \geq 0. \end{aligned} \tag{3}$$

In words, each player expects to receive his share of the output and to incur the effort cost (both of which depend on whether the realized state of the world supports enforceable efforts ($a_{i,E}$) or not ($a_{i,N}$)), makes (or receives) the prescribed fixed transfer β_i, and is taxed by the ruler at the prescribed marginal rate κ_i and lump-sum level t_i.

As noted above, when the contracted efforts are enforceable, courts can compel the buyer and the seller to comply. However, when efforts are not enforceable, the agents choose them to maximize their individual payoffs, given the output shares and marginal taxes. That is, efforts in the non-enforcement state satisfy the incentive constraints

$$a_{B,N}^{ps} = (1-\kappa_B)\,(1-b_S)\,y \text{ and } a_{S,N}^{ps} = (1-\kappa_S)\,b_S y. \tag{4}$$

Then, the buyer in each private firm chooses the contract terms that maximize his payoff (which given deep pockets and the TIOLI offer, coincides with the joint surplus net of taxes), subject to the participation and incentive constraints:

$$\max_{\beta_S, b_S, a_{B,E}, a_{S,E}} u_B$$

s.t. equations 3 and 4.

Anticipating the efforts that buyers and sellers will exert under given taxes, as determined by the program above, the ruler chooses tax levels in the political contract to maximize the economy's total surplus. If the ruler could commit to honor the political contract, it would be optimal for her to maximize efforts and output by imposing no marginal taxes ($\kappa_B = \kappa_S = 0$) while using the lump-sum transfers to extract surplus. Since the ruler cannot commit, however, the political contract must be incentive compatible: the ruler's stream of tax revenues, which she risks losing upon being deposed, must offset her present gains from expropriation, or else the agents will not participate in production. A key point here is that in the absence of marginal taxes, high efforts and output might make expropriation too tempting for the ruler. Thus, positive marginal taxes may be necessary for the ruler to select incentive compatible output levels. Formally, if the ruler honors the political contract, her payoff is

$$u_R = \kappa_B \left((1 - b_S) \Pi - \beta_S \right) + \kappa_S \left(b_S \Pi + \beta_S \right) + t_S + t_B, \tag{5}$$

where $y \left(q \left(a_{B,E} + a_{S,E} \right) + (1 - q) \left(a_{B,N} + a_{S,N} \right) \right) = \Pi$ denotes both a typical firm's expected output and the economy-wide output level.[7] If instead the ruler breaches the political contract and expropriates output, her payoff is given by

$$(1 - \tau) \left(\Pi + \frac{\delta}{1 - \delta} u_R^{dev} \right), \tag{6}$$

In words, if expropriation fails (which occurs with probability τ), the ruler is deposed and, as a result, does not receive any output in the current and future periods. If expropriation is successful, however, the ruler consumes current output and remains in power, thus continuing to receive the tax revenue u_R forever after.[8] Thus, the ruler's incentive constraint for the political contract is

$$\frac{u_R}{1 - \delta} \geq (1 - \tau) \left(\Pi + \frac{\delta}{1 - \delta} u_R \right), \tag{7}$$

The optimal political contract then maximizes total surplus, $u_R + u_B + u_S$, subject to the

[7] Given the mass of firms, fraction q of the firms is always in the enforceable state while a fraction $1 - q$ is the non-enforceable state.

[8] In all deviations to be considered, there is some ambiguity as to the most natural timing, which has no qualitative impact on the analysis but can have a quantitative impact on the exact levels. Here, the assumption is that the ruler needs to make the decision to expropriate at the same time as collecting the taxes. It is not possible to collect the taxes, then consume the taxes, and then attempt to expropriate the rest. Either the private sector consumes their value after the tax collection but before the ruler could try to grab the rest, or the ruler does not have time to consume her taxes if the expropriation effort fails.

ruler's incentive constraint 7 and the agents' efforts as determined by the buyer's program from above. The resulting solution is summarized in the following proposition:

Proposition 1 ***Efforts and taxes under private ownership:***
(i) the optimal marginal tax rate is equal across the productive agents, $\kappa_B = \kappa_S = \kappa^{ps}$*, and is given by* $\max(0, \kappa^*)$*, where* $\kappa^* = 1 - \frac{4\tau(1+q)}{(1+3q)(1-(1-\tau)\delta)}$*, with* $\frac{d\kappa^*}{d\delta} < 0$*,* $\frac{d\kappa^*}{dq} > 0$ *and* $\frac{d\kappa^*}{d\tau} < 0$*.*
(ii) the optimal contract sets effort levels $a^{ps}_{B,E} = a^{ps}_{S,E} = (1-\kappa^{ps})\, y$ *in the enforcement state, and an output-sharing rule* $b^{ps}_S = \frac{1}{2}$ *that induces effort levels* $a^{ps}_{B,N} = a^{ps}_{S,N} = \frac{1}{2}(1-\kappa^{ps})\, y$ *in the non-enforcement state.*

Proof. See Appendix A.1. ■

When efforts are enforceable, the buyer and the seller at each firm agree on the levels that maximize their joint output share given taxes, minus the effort costs: $a^{ps}_{B,E} = a^{ps}_{S,E} = (1-\kappa^{ps})\, y$. When efforts are not enforceable, output-sharing is used to incentivize the agents, and given convexity of the effort costs, a 50/50 output-sharing rule is optimal, which elicits efforts $a^{ps}_{B,N} = a^{ps}_{S,N} = \frac{1}{2}(1-\kappa^{ps})\, y$.

Regarding the political contract, the optimal marginal tax rates are equal across agents, due again to effort cost convexity: under unequal tax rates, the agents would agree to assign a higher output share to the less taxed party, creating an imbalanced allocation of effort that reduces output and tightens the ruler's incentive constraint. Most importantly, as discussed above, positive marginal taxes may be needed to induce an output level low enough to deter expropriation and make the political contract incentive compatible for the ruler. In turn, taxes reduce the surplus available to the buyer and the seller when negotiating their contract while tightening the ruler's incentive constraint. As a result, taxes directly reduce the agents' contracted efforts in the enforcement state, and indirectly reduce efforts in the non-enforcement state by constraining the agents' effective output shares. The equilibrium marginal tax rate and the ensuing effort distortion decrease in both the quality of political institutions, τ, and the ruler's patience, δ.

Interestingly, the quality of contract enforcement (measured by q) has the opposite effect. By raising output, better contract enforcement increases the ruler's gains from expropriation and thus requires a higher marginal tax to reduce output and restore the political contract's credibility. An empirical implication of this result is that increasing the professionalism and efficiency of courts in an autocratic regime may backfire, as the government would be too tempted to appropriate the extra output generated. This prediction is consistent with cross-country evidence showing that improvements in legal institutions are less beneficial than

improvements in political institutions (Acemoglu and Johnson, 2005), and may even reduce GDP when political institutions are too weak (Aldashev and Zanarone, 2017).

4.2 State ownership

Under state ownership, the ruler owns the output and contracts with the agents for their efforts. Other than that, the timeline is similar to that under private ownership. At the outset, the ruler makes a TIOLI offer specifying a contract $(\beta_i, b_i, a_{i,E})$. After that, the state of the world is realized and observed, the agents choose their efforts, output is realized, and the ruler chooses whether to pay out the agreed upon shares or consume the entire output. If the ruler consumes output, thereby violating the political contract, she is deposed with probability τ whereas she remains in power with probability $(1-\tau)$. Notice that because the ruler negotiates effort levels and output shares with the agents, and can use fixed transfers in the contract to extract surplus, there is no need for the ruler to collect taxes under state ownership.

Given identical agents and linear output, the optimal contract must be symmetric. The ruler's per period payoff is thus given by

$$u_R = (1-2b)\,\Pi - 2\beta, \tag{8}$$

while the agents' payoffs and participation constraints are given by

$$u_i = b\Pi + \beta - q\frac{1}{2}a_E^2 - (1-q)\,\frac{1}{2}a_N^2 \geq 0. \tag{9}$$

where $\Pi = y\,(qa_E + (1-q)\,a_N)$ denotes the firm's expected output and the economy's aggregate output, as before.

When the contracted efforts are unenforceable, the agents will select them to maximize their payoffs so the effort levels in this state are given by the incentive constraint

$$a_N = by. \tag{10}$$

Additionally, the contracted payments must be incentive compatible for the ruler, who unlike the buyer under private ownership, has an opportunity to withhold them. This condition is easily satisfied for the fixed wage β: if the ruler does not pay it upfront, the agents can hold their efforts as a hostage because courts will not compel the agents to exert effort in the enforcement state unless the contracted wage has been paid. This mechanism

does not apply to the output share b, however, which must be paid after the efforts are sunk. Thus, for b to be incentive compatible, the threat to be deposed must be strong enough to deter expropriation by the ruler, that is:

$$\frac{\delta}{1-\delta}u_R \geq 2b\Pi + (1-\tau)\left(\frac{\delta}{1-\delta}u_R\right). \tag{11}$$

The optimal contract under state ownership then maximizes u_R subject to equations 9, 10, and 11, and it is given by the following proposition:

Proposition 2 ***Efforts under state ownership:***
Under state ownership, the equilibrium efforts are (i) $a_E^{ss} = y$ *in the enforcement state and (ii)* $a_N^{ss} = by$ *in the non-enforcement state. Moreover, the output sharing rule is (iii)* $b^{ss} = \min\left\{\frac{1}{2}, \frac{\sqrt{q^2+4\phi^2(1-q)}-(q-2(1-q)\phi)}{2(1-q)(1+\phi)}\right\}$, *where* $\phi = \frac{\tau\delta}{4(1-\delta)}$.

Proof. See Appendix A.2 ■

Unlike under private ownership, the ruler contracts efficient efforts in the enforcement state. That occurs for two reasons. First, the hostage mechanism discussed above commits the ruler to honor the promised fixed wages. Second, under state ownership the ruler negotiates the effort levels directly with the agents, and hence chooses them to maximize output minus the effort costs. In contrast, under private ownership, it is the buyer and the seller who negotiate the effort levels, which they then choose to maximize output net of the taxes paid to the ruler (again, minus the effort costs.

At the same time, the optimal sharing rule under state ownership is generally lower than under private ownership ($b^{ss} \leq \frac{1}{2}$) due to the ruler's commitment problem. If political institutions were strong enough to induce the ruler to pay the promised shares, and if the ruler were sufficiently patient (i.e., for δ, τ sufficiently large), the optimal contract would share output 50/50 among the buyer and the seller, as under private ownership. As political institutions weaken (or as the ruler becomes more impatient), however, the ruler becomes less and less afraid of being deposed, down to the point where she has no incentive to split output among the agents. In that case, output shares must be set below 1/2 to restore credibility of the political contract, and the lower τ and δ, the farther the output sharing rule is from the 50-50 benchmark.

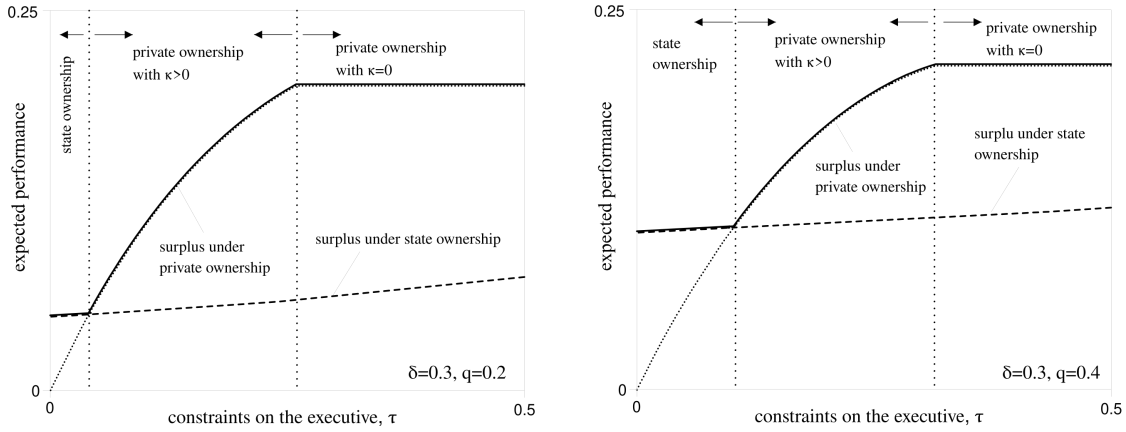

Figure 2: Firm ownership under different political institutions

4.3 Horserace between ownership structures

Figure 2 depicts the total surplus generated under private ownership (solid curve) and state ownership (dashed curve) at different strengths of political institutions, τ, holding contract enforceability, q, and the players' patience, δ, constant.

When political institutions are weak (τ close to zero), the ruler's incentive constraint is too tight to sustain output sharing, and thus efforts in the non-enforcement state are low under either ownership structure. However, while state-owned firms are at least able to contract high efforts in the enforcement state, high taxes prevent private firms from doing so, implying that state ownership, combined with fixed wages and low output sharing, is optimal at low levels of τ. In contrast, when political institutions are strong enough (high τ), and hence some output sharing is feasible, private ownership dominates. This occurs because expropriation is more severely punished under private ownership, and thus the ruler's incentive constraint is less stringent than in state-owned firms.

Figure 3 provides a more complete characterization of optimal governance by representing the surplus curves for different quality levels of both political institutions, τ, and contract enforcement, q (again, holding δ constant). This figure shows that state ownership becomes more attractive at high q because state-owned firms can more efficiently contract for effort in the enforcement state. Additionally, the zero marginal tax region under private ownership shrinks in q because strong contract enforcement increases output for given efforts, thus making expropriation more attractive for the ruler. For the same reason, while surplus under both state ownership and private ownership with zero marginal tax rate increase in q, strong contract enforcement can actually reduce output under private ownership when the marginal tax rate is positive.

Our baseline model elucidates the tradeoff between private and state ownership - tax-

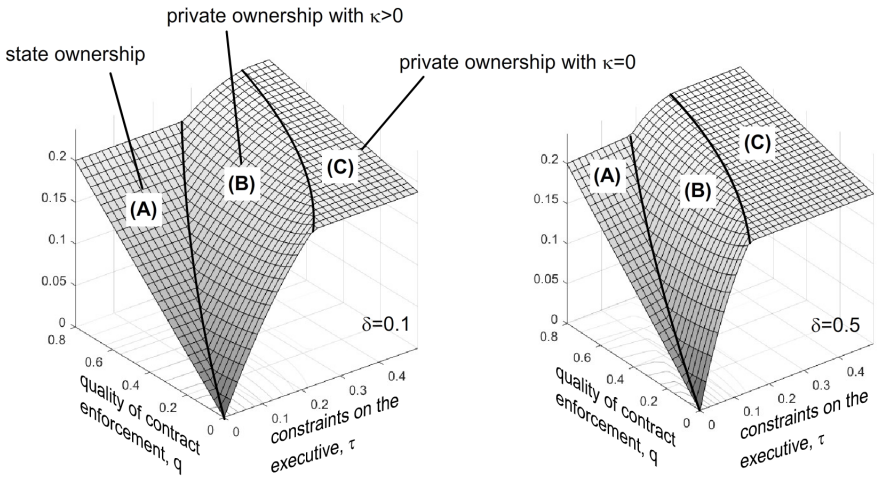

Figure 3: Firm ownership under different political institutions and contract enforceability

ation vs. low-powered incentives - that arises from imperfect political institutions. It also provides theoretical foundations for one of the stylized facts described in the introduction - namely, the high incidence of state ownership in developing countries characterized by weak constraints on the executive.

Our baseline model is also restrictive, however, in that it assumes output sharing is the only incentive tool available to firms. In the next section, we therefore enrich the model to allow for more sophisticated and realistic incentive systems in which firms can combine output sharing with subjective incentives. We will see that while the basic tradeoff between state and private ownership continues to apply, this richer model can explain additional observed linkages between political institutions and the governance of firms - in particular, the fact that in developing countries, state-owned firms are more successful that private firms at replicating the incentive systems of their counterparts in developed countries, and the fact that privatized firms in transition countries performed worse than the state-owned firms they replaced.

5 Joint analysis of incentive systems and ownership

We have seen above that even when the political contract is not binding and there are no marginal taxes in equilibrium, output sharing cannot elicit first best efforts in the non-enforcement state $\theta_j = N$, due to the freeriding-in-teams problem (Holmstrom, 1982). Thus, efforts at each firm can potentially be increased by supplementing output sharing with subjective incentives, which reward each agent $i \in \{B, S\}$ with a discretionary bonus

payment $B_{i,N}$ for the delivery of an informally agreed level of effort $a_{i,N}$ (Baker et al., 1994; Levin, 2003).

While output sharing agreements can be enforced by courts, subjective incentives are linked to observable but non-verifiable effort levels, and hence must be self-enforcing, that is, they must be part of a subgame perfect Nash equilibrium of the infinitely repeated game. Given the features of our environment (absence of liquidity constraints and observability of efforts), Levin (2003) applies, and we can focus without loss on stationary "relational contracts" in which on-path efforts and bonuses are the same in every period, and off-path deviations are deterred by the threat of future punishments. Because optimal punishments depend on the identity of the deviating player (ruler vs. buyer or seller), we describe them below, when we formally state the relational contracting problem under each ownership structure.

5.1 Incentive systems under private ownership

The analysis of private ownership is similar to the previous section, except that court-enforced contract terms are now complemented by relational ones, that is, efforts $a_{B,N}, a_{S,N}$ to be exerted in the non-enforcement state, and a discretionary bonus $B_{S,N}$ that the buyer should pay the seller upon delivery of the promised effort. For given taxes, the goal of relational contracts is to improve on the efforts elicited by output sharing and move towards the efficient level, $(1-\kappa)\,y$. The buyer's and the seller's participation constraints at each firm are now given by

$$\begin{array}{l} u_B = (1-\kappa_B)\left((1-b_S)\,y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)-\beta_S-(1-q)B_{S,N}\right) \\ -t_B-\frac{1}{2}qa_{B,E}^2-\frac{1}{2}(1-q)a_{B,N}^2\geq 0 \end{array} \tag{12}$$

$$\begin{array}{l} u_S = (1-\kappa_S)\left(b_S y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)+\beta_S+(1-q)B_{S,N}\right) \\ -t_S-\frac{1}{2}qa_{S,E}^2-\frac{1}{2}\left(1-q\right)a_{S,N}^2\geq 0 \end{array} \tag{13}$$

Additionally, the two agents' promise to exert effort in the non-enforcement state, and the buyer's promise to pay an effort-contingent bonus to the seller, must satisfy the self-enforcement incentive constraints:

$$\begin{array}{l} -\left(1-\kappa_B\right)B_{S,N}+\left(1-\kappa_B\right)\left(1-b_S\right)y\left(a_{B,N}+a_{S,N}\right)-\frac{1}{2}a_{B,N}^2+\frac{\delta}{1-\delta}u_B \\ \geq \max\limits_{a_B}\left(\left(1-\kappa_B\right)\left(1-b_S\right)y\left(a_B+a_{S,N}\right)-\frac{1}{2}a_B^2\right)+\frac{\delta}{1-\delta}u_B^{dev} \end{array} \tag{14}$$

$$\begin{aligned}&(1-\kappa_S)\left(b_S y\left(a_{B,N}+a_{S,N}\right)+B_{S,N}\right)-\tfrac{1}{2}a_{S,N}^2+\tfrac{\delta}{1-\delta}u_S\\&\geq \max_{a_S}\left(\left(1-\kappa_S\right)b_S y\left(a_{B,N}+a_S\right)-\tfrac{1}{2}a_S^2\right)+\tfrac{\delta}{1-\delta}u_S^{dev}.\end{aligned}\tag{15}$$

In words, in the non-enforcement state, each agent must prefer to pay (or accept) the promised bonus, exert the promised effort, consume his output share, and continue the relational contract rather than to renege on the bonus, choose the effort opportunistically, and terminate the relational contract. The terms u_B^{dev} and u_S^{dev} denote the buyer's and the seller's per period payoffs following termination of the relational contract, to be precisely characterized by Lemma 4 below. The optimal deviations from a given promised effort are $a_B^{dev}=(1-\kappa)(1-b_S)\,y$ for the buyer and $a_S^{dev}=(1-\kappa)\,b_S y$ for the seller.

The solution to the private firm's contract design problem is simplified by the following lemma, which follows from the same intuitive arguments underlying Proposition 1 above.

Lemma 3 *The optimal contract prescribes output-sharing rule $b^{pr}=\frac{1}{2}$ and symmetric efforts in both the enforcement state ($a_{B,E}=a_{S,E}=a_E$) and the non-enforcement state ($a_{B,N}=a_{S,N}=a_N$). Moreover, for a given marginal tax rate, efforts in the enforcement state are given by $a_E^{pr}=(1-\kappa)\,y$*

Proof. See Appendix A.3. ■

After substituting the buyer's and seller's optimal deviations, and taking into account Lemma 3, we can sum up the two agents' incentive constraints to obtain a unique condition for the private firm's incentive system to be sustainable:

$$\frac{\delta}{1-\delta}\left(\left(u_B+u_S\right)-\left(u_B^{dev}+u_S^{dev}\right)\right)\geq\frac{1}{4}\left(1-\kappa\right)^2y^2-\left(\left(1-\kappa\right)ya_N-a_N^2\right),\tag{16}$$

In words, the present discounted surplus generated by the relationship between the buyer and the seller must exceed their joint present gains from reneging. The optimal contract then consists of the buyer and the seller choosing a_N to maximize their joint surplus (that is, the firm's total surplus minus taxes)

$$u_B+u_S=\left(1-\kappa\right)^2y^2q+\left(1-q\right)\left(2\left(1-\kappa\right)ya_N-a_N^2\right)-\left(t_B+t_S\right),\tag{17}$$

subject to (16).

To complete the analysis, we must now consider the ruler's choice of taxes, and how this interacts with firms' incentive systems. As usual, the ruler's incentive constraint prescribes that his payoff from collecting taxes must exceed the payoff from expropriation, that is:

$$\frac{1}{1-\delta}u_R \geq (1-\tau)\left(\Pi^{pr} + \frac{\delta}{1-\delta}u_R^{dev}\right), \tag{18}$$

where $u_R = \kappa\Pi^{pr} + t_B + t_S$ is the ruler's per period equilibrium payoff, the term $\Pi^{pr} = 2y\left(q\left(1-\kappa\right)y + \left(1-q\right)a_N\right)$ denotes both a typical private firm's expected output and the total output generated by the economy under private ownership, and u_R^{dev} denotes the ruler's per period payoff following successful expropriation. The ruler's post-deviation payoff differs from section 4 because now we must specify how the relational incentive contracts between buyers and the sellers at each firm adjust following a deviation by the ruler. For symmetry with our analysis of state ownership below, we assume that the ruler's deviation permanently destroys trust in the economy, and hence causes these relational contracts to terminate. As a result, following a successful deviation, the economy reverts forever after to the optimal ownership in the absence of subjective incentives: the ruler's fallback option, u_R^{dev}, is the total surplus under such ownership structure. This assumption is not essential, however: our results on the optimal governance below would continue to hold if buyers and sellers at private firms continued to use subjective incentives following a deviation by the ruler.

The last step in our analysis is to combine incentive constraints (16) and (18) to characterize the sustainability of firms' incentive systems under private ownership. In order to do so, we must specify how deviations of the buyer or the seller on their relational contract are punished, that is, we must define u_B^{dev} and u_S^{dev}. The next Lemma shows that the two agents' deviations can be optimally punished, in the sense that the equilibrium lump sum taxes can always be set to push the agents' post-deviation payoffs down to zero, while allowing the ruler to extract all the surplus in equilibrium.

Lemma 4 *The lump-sum taxes t_B and t_S are set in the optimal equilibrium at a level that prevents the two agents from participating in production following a deviation, that is: $u_B^{dev} = u_S^{dev} = 0$.*

Proof. See Appendix A.4. ■

Given the above results, we can sum the agents' and the ruler's incentive constraints to obtain a unique sustainability constraint for private firms' incentive systems.

$$
\begin{aligned}
&qy^2\left(1-\kappa^2\right)+(1-q)\left(2ya_N-a_N^2\right)\geq \\
&(1-\tau)\left(2\left(1-\delta\right)y\left(q\left(1-\kappa\right)y+(1-q)a_N\right)+\delta u_R^{dev}\right) \\
&+\tfrac{(1-\delta)}{\delta}\left(\tfrac{1}{4}\left(1-\kappa\right)^2y^2-\left(\left(1-\kappa\right)ya_N-a_N^2\right)\right),
\end{aligned}
\tag{19}
$$

The first line in the sustainability constraint is total surplus in the economy, the second line is the (normalized) deviation payoff the ruler obtains from expropriating output, and the third line is the buyer's and seller's joint payoff from deviating from their relational contract. Surplus then needs to be sufficient to deter both of these potential deviations. We can thus write the ruler's design problem under private ownership as

$$
\begin{aligned}
&\max_{\kappa} qy^2\left(1-\kappa^2\right)+(1-q)\left(2ya_N^{pr}-\left(a_N^{pr}\right)^2\right) \\
&\text{s.t.} \qquad a_N^{pr}=\max_{a_N}\left(\left(1-\kappa\right)\left(2ya_N\right)-a_N^2\right), \text{ and constraint (19) under } a_N=a_N^{pr}.
\end{aligned}
$$

In words, the marginal tax rate is chosen to maximize total surplus, subject to the constraints that (1) efforts in the non-enforceable state maximize the buyer' and the seller's joint surplus given marginal taxes, and (2) both the marginal tax rate and the effort levels satisfy the sustainability constraint.

5.2 Incentive systems under state ownership

Under state ownership, the ruler enters relational contracts $(B_{i,N}, a_{i,N})$ with the two productive agents, which supplement the contracts analyzed in section 4 by specifying efforts in the non-enforcement state and discretionary bonuses rewarding those efforts.

Since firms face the same contracting friction q, agents are identical, and effort costs are convex, we can focus on a representative firm with $b_S = b_B$, $\beta_B = \beta_S$, $B_{B,N} = B_{S,N}$, $a_{B,E} = a_{S,E}$, and $a_{B,N} = a_{S,N}$. As a result, the ruler's and productive agents' participation constraint can be written as

$$
u_R = 2\left(\left(1-2b\right)y\left(qa_E+(1-q)a_N\right)-(1-q)B_N-\beta\right)\geq 0, \tag{20}
$$

$$
u_i = 2by\left(qa_E+(1-q)a_N\right)+(1-q)B_N+\beta-q\frac{1}{2}a_E^2-(1-q)\frac{1}{2}a_N^2\geq 0. \tag{21}
$$

Notice that because of the continuum of (identical) firms, the ruler's realized payoff for the whole economy is equal to the expected payoff from a representative firm, so with slight abuse of notation, we will use u_R to denote both payoffs.

The incentive constraints of the buyer and seller are similar to those under private ownership, except that now incomes are not subject to taxes:

$$B_N - \frac{1}{2}a_N^2 + 2bya_N + \frac{\delta}{1-\delta}u_i \geq \max_{a_i}\left(by\left(a_i + a_N\right) - \frac{1}{2}a_i^2\right) + \frac{\delta}{1-\delta}u_i^{dev}, \qquad (22)$$

For the ruler, we need to specify how failure to pay a buyer or seller in any given firm will affect the future behavior of other buyers and sellers, and hence the ruler's post-deviation payoff. Because the ruler is a common counterpart to all buyers and sellers, maximal multilateral punishments of deviations on the subjective bonuses are optimal (Levin, 2002): if the ruler fails to pay bonuses at a particular firm, buyers and sellers in other firms will refuse to enter relational contracts with the ruler forever after after, and parties will revert to optimal ownership in the absence of subjective incentives (Baker et al., 2002). However, unlike in standard relational contracting models (and unlike under private ownership), a state owned firm's owner (namely, the ruler!) has the opportunity to renege not only on subjective bonuses but also on the formally contracted output shares. We assume that because the ruler and the agents now have a relational contract in place, deviations on output shares are treated like the deviations on subjective bonuses - that is, in addition to triggering an institutional punishment (deposition of the ruler with probability τ), they also trigger multilateral termination of relational contracts at all firms.

Formally, and given these assumptions, the ruler has two alternative deviation opportunities, and thus two separate incentive constraints. First, she may choose to renege on the subjective bonuses, while honoring the contracted output shares. Given mass one of both buyers and sellers, of which fraction $1-q$ is in the non-enforcement state for which a subjective bonus is needed, the ruler can save $-2B_N(1-q)$ by reneging on all bonuses at once. Thus, the incentive constraint that deters this deviation is given by

$$\frac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) \geq 2(1-q)B_N, \qquad (23)$$

where u_R^{dev} is surplus under the optimal owbership without subjective bonuses, as discussed above.

Alternatively, the ruler may choose to simultaneously default on both the bonuses and the output shares. By doing so, the ruler gains more in the present from a deviation but risks being deposed if the courts successfully intervene to sanction her abuse of power. The incentive constraint that deters this joint deviation is:

$$\frac{\delta}{1-\delta}\left(u_R - (1-\tau)\,u_R^{dev}\right) \geq 2(1-q)B_N + 4by\left(qa_E + (1-q)a_N\right). \qquad (24)$$

where the left hand side denotes the ruler's net continuation payoff following a joint deviation, while the right hand side denotes the present gains from such deviation - that is, the bonuses and output shares saved by the ruler.

Given the participation and incentive constraints described above, we can write the ruler's problem as

$$\max_{b,\beta,B_N,a_E,a_N} u_R$$

s.t. equations 23,24,22 and $u_i \geq 0$

The optimal incentive system under state ownership is summarized in the following lemma:

Lemma 5 *The optimal incentive system under state ownership,* $(b^{sr}, \beta^{sr}, B_N^{sr}, a_E^{sr}, a_N^{sr})$*, has the following properties: (i) efforts in the enforcement state are set at the first best level:* $a_E^{sr} = y$*; (ii) all surplus goes to the ruler:* $u_i = u_i^{dev} = 0$*; (iii) both of the ruler's incentive constraints, (23) and (24), are binding as long as* $a_N^{sr} < a^{FB}$ *and (iv) efforts in the non-enforcement state are given by* $a_N^{sr} = b^{sr}y + \sqrt{2B_N^{sr}}$

Proof. See Appendix A.5 ■

Two observations are in order. First, Surplus is more effectively used to motivate the ruler than the productive agents because (a) the ruler can default on formally contracted payments and (b) she faces the relational deviation temptation only with respect to a fraction $1-q$ of the firms. As a result, it is optimal for the ruler to extract all the surplus. Second, the optimal mix of objective and subjective incentives (b, B_N) is such that the ruler's incentive constraint is binding. The implication of this observation is that as long as the first-best is not attained, $b < 1/2$ and so there will be less output sharing under state ownership than under private ownership, as in the baseline model. Given that the fixed wages only reallocate surplus, we will ignore them from now on, and so long as the incentive constraints are binding, we can simplify the ruler's problem to:

$$\max_{b,B_N} u_R = \left(qy^2 + (1-q)\left(2ya_N - a_N^2\right)\right)$$

s.t. $a_N = by + \sqrt{2B_N}$

$\frac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) = 2(1-q)B_N$

$\frac{\delta}{1-\delta}\tau u_R^{dev} = 4by\left(qy + (1-q)a_N\right)$

Having characterized optimal incentive systems under state and private ownership, we now conclude our model by analyzing the optimal governance of firms (that is, the surplus-maximizing combination of incentive systems and ownership) under different kinds of political institutions.

5.3 Optimal governance

Figure 4 illustrates the optimal governance of firms under different levels of τ, the strength of political constraints on the ruler. The solid and dashed curves represent surplus under state and private ownership, respectively, when both output sharing and subjective incentives are available. The dotted curve represents surplus under the optimal ownership structure in the absence of subjective incentives - that is, the ruler's fallback option after a deviation.

We know from our baseline model that at low τ, deterring expropriation of output under private ownership requires high marginal taxes; these taxes, in turn, limit the effort levels that private firms are willing to contract. By capping the surplus available to sustain relational contracts, high taxes hamper a fortiori the use of subjective incentives, and as a result, these incentives are either weak or non-existent in private firms at low τ. We also know from the baseline model that even under low τ, state ownership can implement efficient efforts in the enforcement state. Moreover, unlike in the baseline model, state-owned firms can now also use subjective incentives to elicit effort in the non-enforcement state. Because output sharing is not feasible at low τ, the ruler's fallback option following a deviation on the subjective bonuses is low, and thus the ruler/owner can credibly promise relatively high bonuses and elicit relatively high efforts. State ownership, in combination with low output sharing but strong subjective incentives, is therefore the optimal governance at low τ, which is consistent with the observed adoption of advanced incentive systems and management practices by state-owned firms in China and other autocratic regimes.

As τ grows, the ruler's reneging temptation decreases while her fallback option improves but because of low output sharing, both of these opposite effects are small and tend to offset each other. As τ continues to grow, however, private ownership without subjective incentives becomes the ruler's fallback option, and because its attractiveness grows rapidly in τ, the sustainability of subjective incentives under state ownership is eroded by a mechanism similar to Baker et al. (1994, 2002). As a result, subjective bonuses, equilibrium efforts and surplus in state-owned firms start decreasing. Eventually, subjective incentives under state ownership either become completely unsustainable or are dominated by private ownership, even though private ownership itself still supports limited subjective incentives and surplus. In this intermediate range of political institutions, we then see firms that are nominally

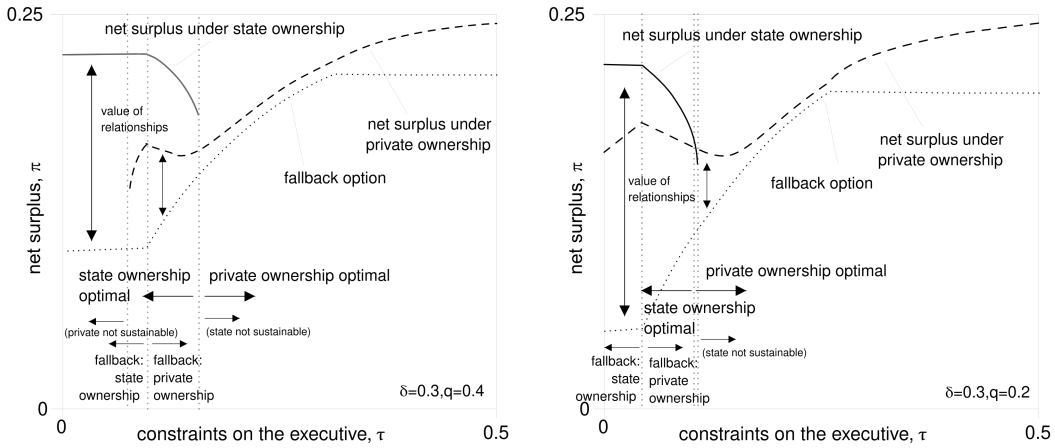

Figure 4: Ownership and incentive systems under different political institutions

private yet are heavily taxed and relatively poorly managed, in the sense that they are governed by less effective incentive systems than the state-owned firms they replaced.

As τ increases further, taxes continue to decrease and the subjective incentives, effort and surplus that can be sustained under private ownership increase until eventually, private firms catch up with and even surpass state-owned firms at their best (that is, under low τ). Notice that under private ownership, this surplus-enhancing effect of improved political institutions on taxes and subjective incentives more than compensates the increase in the ruler's fallback option.

Altogether, the fact that stronger political institutions increase effort and the effectiveness of private firms' incentive systems provides theoretical foundations for the empirical observation that private firms are more likely to adopt best management practices in developed countries than in developing ones. Additionally, non-monotonicity of firm surplus in τ describes a "privatization trap," whereby firms that are (optimally) privatized under mediocre political institutions have worse incentive systems and performance than the state-owned firms they replaced. This result is consistent with the empirical evidence on privatizations in transition countries, on which we return below. Lastly, the U-shaped form of surplus under the optimal governance suggests that from the standpoint of economic output and productivity, autocracies (low τ) may be local optima. Thanks to their ability to implement subjective incentives in state-owned firms, autocracies perform much better than mediocre democracies (intermediate τ). It is only after radical improvements in political institutions (high τ) that democracies can support Toyota-like, well managed private firms, thus outperforming autocracies. Insofar as implementing a radical increase in τ is more costly than implementing a small decrease, mediocre democracies may therefore "look up" to autocracies, and have an inherent incentive to revert to the latter.

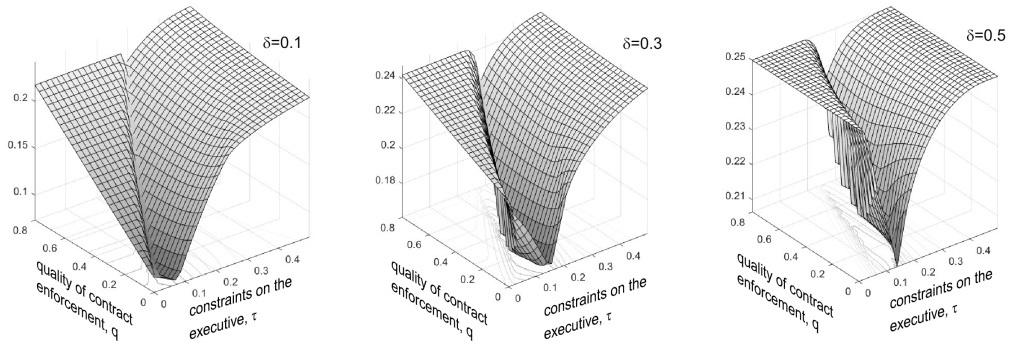

Figure 5: Ownership and incentive systems under different political institutions and contract enforceability

The non-monotonic, U-shaped relationship between political institution and economic surplus is further illustrated in Figure 5, which plots surplus for various levels of players' patience and contract enforcement quality. All of the patterns discussed above, including the privatization trap, are present for various levels of contract enforcement quality. In fact, while better contract enforcement improves incentives and performance under very weak (low τ) or very strong (high τ) political institutions, it can amplify the trap at intermediate levels of τ, as further illustrated in Figure 6.

We conclude by commenting on how the players' patience (δ) affects governance. The comparative statics on δ are illustrated in Figure 7. While higher patience (for instance, due to a more stable and prosperous economic outlook) improves governance under all firm ownership structures, our numerical analysis reveals that patience is relatively more valuable under state ownership. Formally, state ownership becomes optimal under a wider range of parameters as the players become more patient. This result stands in contrast to the baseline model from sections 3-4, where the region of optimal state ownership shrank as the players became more patient. The intuition behind this result is that because output sharing is a less effective incentive instrument under state ownership, subjective incentives are relatively more valuable in such a setting. In turn, this implies that increased patience, which helps to sustain the latter, benefits state ownership relatively more than private ownership. This finding is consistent with Williamson (1999), who argues that relative to private sector managers, public sector ones tend to have low-powered formal incentives and are primarily rewarded through the threat of losing their privileged position and rents in the event of egregious non-performance.

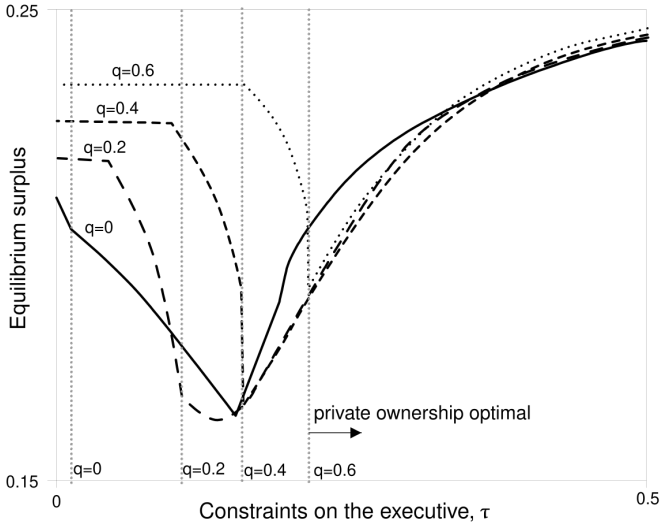

Figure 6: Ownership and incentive systems under different levels of contract enforceability

6 Applications and empirical relevance

We conclude our paper by discussing empirical patterns consistent with our model and opportunities for future empirical research. We begin by reviewing historical evidence on the relative performance of and transition from state to private firm ownership in the former Soviet bloc and South Korea. We then discuss how one could move beyond these encouraging historical correlations and develop a thorough test of our model to jointly examine our theoretical prediction on how institutions affect firm ownership and incentive systems.

6.1 Privatizations

An extensive empirical literature, reviewed by Megginson and Netter (2001), finds that privatization in the OECD countries has been generally successful in increasing the productivity and profitability of firms. Some developing and transition economies, most notably Chile and the Czech Republic, also undertook successful privatizations (Biais and Perotti, 1999). Contrarily, in several developing countries, particularly in the former Soviet area, output has declined following privatizations (Blanchard and Kremer, 1997), and privatizations have been shown to reduce the productivity of formerly state-owned firms in some of these countries (e.g., studies in Roland, 2008; Knyazeva et al., 2003; Brown et al., 2006; Guriev and Megginson, 2007). In Russia, Karas et al. (2010) find that private banks perform worse than state-owned banks, even in the late 2000s, and that this difference cannot

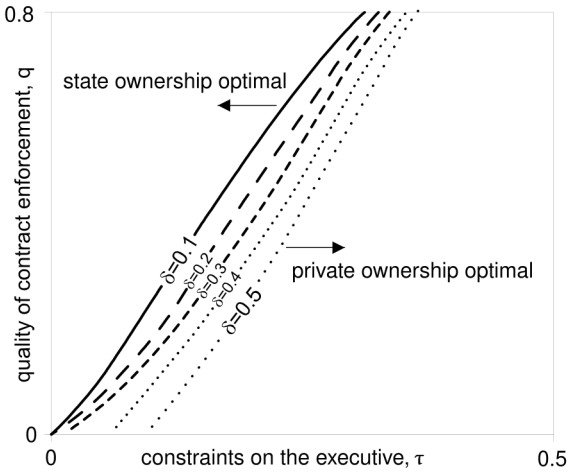

Figure 7: The effect of patience levels on the choice between state and private ownership.

be explained by the choice of production process, the bank's environment, management's risk preferences, the bank's activity mix, or bank size. Anderson et al. (2000) study the early-1990s privatization in Mongolia and find that after privatization, firms with residual state ownership appear to be more efficient than fully private firms. More generally, Nellis (1999) argues that "the farther east one travels, the less likely is one to see rapid or dramatic returns to privatization" (p. 6).

Our model can explain these seemingly conflicting facts. The OECD countries had relatively developed political institutions as they started to privatize state firms in the 1990s (mostly to ease their government budgetary constraints). In all of those countries, the government's taxation power was constrained by an independent elected parliament, though there were differences across them in the strength of broader checks and balances on the government's discretion. In contrast, many developing countries on which privatizations were imposed (often as a precondition for international loans) had weak political institutions. In particular, despite their formal transition to democracy and the creation of checks and balances that did not exist under communist rule, the ex-Soviet countries, and especially Russia, in the 1990s continued to have imperfect protection of property rights and an unpredictable and punitive tax system (Black et al., 2000). Consistent with these patterns, our model predicts that under mediocre political institutions (i.e., neither autocracy nor advanced democracy), privatizing and then expropriating state-owned enterprises is too attractive for the government, preventing the development of even the modest relational contracts with employees and suppliers that were sustainable under state ownership during autocratic rule. As a result, privatized firms experience a decline in productivity, and are caught in a low-productivity trap until political institutions move closer to the advanced

democracy benchmark. Indeed, the historical evidence suggests that privatizations did succeed in countries that transitioned more rapidly to advanced democratic institutions, such as Chile (1986-91) and the Czech Republic (1991-94). Moreover, even in Russia, the performance of privatized firms appears to have increased and surpassed that of SOEs after political institutions and property rights somewhat stabilized in the early Putin years, prior to the autocratic turn post-2012 (Brown, Earle and Gehlbach, 2013).

6.2 Industrial development in South Korea

Prior to 1987 (the Sixth Republic), South Korea was essentially governed by military rule (although in 1963-1987 the political regime was nominally democratic). In 1987, anti-government protests induced a regime change and led to the first direct presidential election in 16 years. Although the first president in this new regime (Roh Tae-woo) came from the military, his government promoted democratization (by increasing freedom of the press, liberalizing international travelling, and giving autonomy to the universities). As a result of these reforms, in 1992 South Koreans elected the first civilian president in 30 years (Kim Young-sam). Since then, South Korea has been effectively a democratic regime.

Amsden (1989) argues that the sustained economic growth of South Korea in a period characterized by weak political institutions (1960-1980) was enabled by the state's involvement in productive activities and by its tight links to business conglomerates (chaebols). Consistent with that, Lane (2019) shows that firms in sectors declared as militarily strategic by the state in 1973 (e.g., the heavy chemicals industry) grew 80 per cent more than comparable manufacturing firms not targeted by the state. Milhaupt and Pistor (2008) investigate in greater depth the role of the chaebols. They note that in the absence of investor protections and a legal framework for financial contracts, the chaebols engaged in a symbiotic relationship with the government, which could influence their business decisions but provided in exchange capital protection from competition, licenses, and favorable regulations. In other words, the chaebols could be seen as quasi-state actors.

The Korean chaebol system was fairly productive when Korean industry primarily relied on the diffusion of foreign technology (Amsden, 2001). However, once the country reached the technological frontier, the Korean model of economic development began showing weaknesses. In additional to the lack of modern legal institutions, the corrupt interlinkage between government and the chaebols was financially harmful for the state (Pirie 2007: 76). Moreover, the chaebols wanted to relax (at least partially) their alliance with the government to gain access to international credit markets (Hundt 2009: 94). As a result of these deficiencies, economic reformers gradually took control of the government's agenda and launched a new wave of institutional reforms in 1997, following the financial crisis.

Reforms between 1997 and 2000 deregulated economic activity and established an independent financial regulator, an autonomous central bank, and other checks and balances and market-supporting institutions (Pirie 2007: 107-122). Altogether, these reforms sparked a new and different growth model, based on private economic initiative, which led to a rapid increase in South Korea' R&D intensity (Santacreu and Zhu 2018) and innovation (Jamrisko et al. 2019).

Like the historical patterns of privatizations, those of Korean industrial development are consistent with our model. State-owned and semi-private firms performed relatively well under non-democratic institutions, then declined when the country established free elections but lacked the checks and balances of advanced liberal democracies. As the country completed its democratization process, its economic system transitioned to full private ownership and firm productivity increased.

6.3 Testability

Testing our model requires firm-level data on ownership structure and incentive systems and management practices, and exogenous variations in political institutions and firm ownership. While gathering such data is ambitious, recent advances in empirical research in both organizational economics and development suggest it is feasible. The World Management Survey research program has collected (and continues to collect) firm-level data on management practices, including the use of pay-for-performance and delegation, across several countries. Recent studies (Macchiavello and Morjaria, 2020) have surveyed relational management practices in buyer-supplier relationships within a given developing country, providing a benchmark that could be leveraged in future cross-country studies. There are well established approaches to instrument for political checks and balances and the protection of private property rights across countries (Acemoglu, Johnson and Robinson, 2001; Acemoglu and Johnson, 2005), which could be combined with the aforementioned data to study the effect of institutions on firm governance and management practices. Lastly, field experiments on organizational design and management practices have been increasingly conducted in large emerging economies, such as China and India (e.g., Kala, 2022), where there is within-country variation in both institutional quality and firm ownership.

One plausible strategy to test our model would be to develop a field experiment in which relational management practices are introduced in random samples of state-owned and private firms within country, or across randomly chosen suppliers of a multinational firm operating in multiple countries with varying political institutions. The former experiment could be conducted in collaboration with a governmental or international agency whereas the latter experiment could be conducted in collaboration with a multinational. In the latter

experiment, buyer-supplier relationships in which a supplier of the multinational works for a local state-owned firm could serve as a control group. Empirical studies along these lines would provide important insight for research on organizations and development as well as for policy, and we hope they will be pursued in the near future.

7 Extensions

In this section, we will briefly outline two potential extensions to the model. First, the analysis above focused on the whole economy being under either private or state ownership. However, even if the productive activities are similar, it is possible that the optimal equilibrium may exhibit mixed ownership, with a fraction of the firms state-owned and the remaining being private, and we will consider that first. Second, the analysis assumed that both "buyers" and "sellers" are needed to complete the productive task. In other words, the analysis assumed that the parties had specialized in their roles. Alternatively, each productive agent might be able to undertake the whole productive task himself, thus avoiding the need for formal or relational contracting altogether, but at the loss of specialization. Allowing for such an extra choice illustrates how the ruler's expropriation temptation and the resulting limited ability to build relationships may hinder the level of specialization that rises in the economy under private ownership.

7.1 Economy with mixed ownership

The main analysis focused on comparing the outcomes between fully private and fully state ownership. While this provides a logical benchmark since all the firms are equivalent, the existence of a continuum of productive agents allows for the ruler to own only a fraction of the productive sector. In this section, we will briefly consider the implications of fractional ownership, both for the fallback and the equilibrium outcome. First, consider the determination of the fallback option. Given the analysis from above, the fallback option in the case of mixed ownership, with λ fraction of the economy under private ownership, is simply a weighted average of the two constraints from earlier. In particular, the pooled constraint becomes

$$\frac{\delta\tau}{1-\delta}\left(\lambda\pi^{priv}+(1-\lambda)\,\pi^{state}\right)\geq\left(2\,(1-\lambda)\,b\Pi^{state}+\lambda\left((1-\tau)\,\Pi^{priv}-T\right)\right). \tag{25}$$

In short, if the ruler deviates, she loses her future surplus with probability τ and this loss must outweigh the potential gains, which are now composed of saving the output shares promised in the state sector, plus the probability of successful expropriation over and above the set taxes. The ability to pool the two constraints creates the possibility of transferring slack across the individual constraints. Numeric analysis reveals that mixed fallback option can indeed be optimal when the stand-alone productivity of the two sectors is not too different. The logic is that the ruler strategically lowers the formal incentive pay b in the state sector, where pay-for-input contracts are useful for providing performance, which creates slack in the incentives and allows the ruler to lower the marginal tax rate in the private sector. The resulting equilibrium then has a high-productivity private sector co-existing with a low-productivity public sector, but it is exactly the low productivity of the public sector which still generates rents to the ruler that is helping to discipline her not to expropriate the private sector.

The logic behind the best equilibrium, which allows for relational contracts, follows similarly, with the exception of adding the relational contract (B_N, a_N) as an additional choice variable for both sectors. From the analysis above, we have immediately that the condition for honoring the relational contract under state ownership continues to be given by

$$\frac{\delta}{1-\delta}\left(u_R - \widetilde{u}_R^{dev}\right) \geq 2\left(1-\lambda\right)\left(1-q\right)B_N, \tag{26}$$

while we can construct the joint constraint on honoring relationships and formal contracts by pooling the constraints across the two sectors and we get

$$\begin{array}{l} \frac{\delta}{1-\delta}\left(u_R - \left(1-\tau\right)u_R^{dev}\right) \geq 2\left(1-\lambda\right)b\pi^{state} + 2\left(1-\lambda\right)B(1-q) \\ +\lambda\left(\left(1-\tau\right)\Pi^{priv} - \pi^{priv}\right) + \lambda\frac{1-\delta}{\delta}\left(\frac{1}{4}\left(1-\kappa\right)^2 y^2 - \left(\left(1-\kappa\right)ya_N^{priv} - \left(a_N^{priv}\right)^2\right)\right) \end{array}, \tag{27}$$

while the private parties continue to set their relational contract to maximize their surplus $2\left(1-\kappa\right)ya_N^{priv} - \left(a_N^{priv}\right)^2$, but now with respect to the above constraint.

The only complication that remains is considering how the various potential deviations impact the continuation play of the game. When the ruler deviates from either of the formal obligations (profit-sharing and taxation), we can continue to assume that if the ruler is not deposed, she will then pick the most-favorable fallback option for her with no further relational contracts possible. Similarly, the taxation remains such that the private parties, in the absence of a relational contract, prefer to exit the productive sector. The

only challenge is to determine how the ruler is impacted if she deviates on her relational contract with the state sector. For simplicity, we will assume here that if the ruler breaks her relational commitments in the state-owned sector, the news spreads and the trust in the ruler is lost even in the private sector (and so the bilateral buyer-seller relationships are terminated due to the collapse of overall trust), and so the ruler reverts to her preferred fallback equilibrium. Under this stark assumption, numeric simulations suggest the opposite result from above. Now, the ruler can use the private sector surplus as a hostage to pay high relational bonuses in the state sector, and we can observe equilibria with mixed ownership where the state sector performs strictly better than the private sector. The equilibrium results are, however, sensitive to the assumptions regarding the consequences of a relational deviation by the ruler, and arise only in the vicinity of parameters where the performance of fully private or state-owned economies are sufficiently similar so that the ability to transfer slack across the constraints on the margin dominates the inherent performance differences identified in the main analysis. Therefore, more detailed considerations of the implications of mixed ownership are left for future analysis.

7.2 Economy with a choice to specialize

Consider the possibility that the agents are able to perform the productive task all by themselves but at a lower efficiency. In particular, suppose that if an agent undertakes both tasks by himself, the probability of successful outcome is $\overline{a}$, and the cost of effort is given by $\frac{c}{2}\overline{a}^2$. Alternatively, the agents can specialize in each of the two tasks, and the production takes place as above. Finally, assume that $c > 1$, so that in the absence of contracting frictions, it is efficient for the agents to specialize in their respective tasks. Then, under state ownership, the agents will continue to specialize since the ruler is unable to avoid the contracting friction whether interacting with one or two agents. Under private ownership, however, an agent is able to avoid the frictions by engaging in production himself. Further, if agents choose not to specialize under private ownership, there is clearly no need for building relationships and the best equilibrium is determined by the ruler's expropriation constraint. Solving the agent's effort problem under marginal tax rate κ allows us to write the total surplus and the output generated by the economy as $\pi = \frac{\left(1-\kappa^2\right)y^2}{c}$ and $\Pi = \frac{2(1-\kappa)y^2}{c}$, respectively. The ruler's expropriation constraint then becomes

$$\frac{1}{1-\delta}\frac{\left(1-\kappa^2\right)y^2}{c} \geq (1-\tau)\left(\frac{2\left(1-\kappa\right)y^2}{c} + \frac{\delta}{1-\delta}\frac{\left(1-\kappa^2\right)y^2}{c}\right), \tag{28}$$

which we can then rearrange to solve

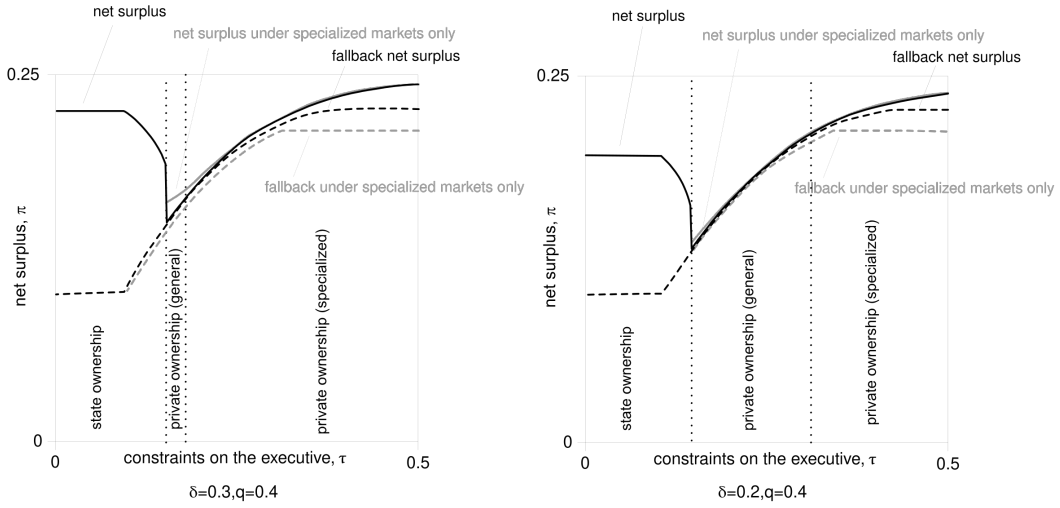

Figure 8: Examples (and comparison) of the equilibria under the choice to specialize (c=1.1)

$$\kappa \geq \kappa^* = 1 - \frac{2\tau}{1-(1-\tau)\,\delta}. \tag{29}$$

This option not to specialize provides a potentially better fallback option than either private markets with specialization or state ownership. On one hand, this option can be valuable if the parties are unable to sustain relationships in the first place and thus benefit from the extra security that individual production provides. On the other hand, exactly because it provides a more attractive fallback option, it can limit the parties ability to sustain relationships under specialization.

Two illustrations of the resulting equilibrium are provided in Figure 8, where the black (solid and dashed) lines illustrate the equilibrium surplus and the fallback surplus under the option to specialize, while the gray lines illustrate the same under the assumption of specialized production only (main analysis). In both cases, the optimal fallback option for private ownership is to engage in general production, shifting the fallback value up. This result, in turn, amplifies the initial dip in performance, making sustaining any relational contracts impossible due to the more attractive fallback option. Thus, not only does performance drop as we transition from state to private ownership, but firms also switch to generalist production. It is only once the constraints on the executive become strong-enough that we transition to high-performing private ownership under specialization.

8 Conclusion

In this paper, we have studied theoretically how political institutions affect the management and ownership of firms. The key insight from our model is that the "capitalist paradigm," whereby firms should be privately owned and managed through high-powered incentive systems, does not hold for countries with weak constraints on the executive. We have shown that under such weak political institutions, state-owned firms can sustain more effective incentive systems and higher output than private ones. We have also shown that as institutions become marginally stronger, it becomes too attractive for the state to privatize and tax state-owned firms, which destroys the credibility of subjective incentives under state ownership. As a result, state-owned firms are replaced by private firms that employ weaker incentive systems, and produce lower output, than the state-owned firms they replaced. Only after radical institutional improvements the capitalist paradigm emerges as the optimal equilibrium. We have discussed several implications of our model for both organizational design and economic development and policy.

By integrating a ruler endowed with expropriation into a model of contract design, our paper provides a tractable framework that could be used in the future to study how various dimensions of firms' governance, such as delegation and organizational structure, optimally adapt to different institutional environments. Additionally, our model could be extended to study the role of non-governmental "rulers" within organizations and in interfirm relationships. For instance, a CEO or upper executive may be able to "expropriate" the output generated by a corporate division, thereby affecting contracting between the division's director and its employees or suppliers. Moreover, the contracting frictions resulting from this expropriation risk may play out differently if employees and lower managers respond directly to the corporate headquarters (akin to our state ownership scenario). Similarly, by switching partners, canceling orders, or engaging in holdup, a large manufacturer may expropriate the output that a tier-1 supplier and a subcontractor can use to negotiate their contract within firms or tier-1 suppliers. Moreover, these forms of non-governmental expropriation are often constrained by relatively exogenous and stable features of corporate governance and organization, such as corporate and contract law, and the use of industry-wide, boilerplate contractual provisions. Exploring the implications of our modeling framework for these non-political settings is beyond the scope of our paper but may constitute an important opportunity for future research.

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A Proofs

A.1 Proof of proposition 1

First, when the state is non-enforceable, the buyer and the seller are free to choose their effort levels, and thus the buyer chooses $a_{B,N}$ to maximize (**??**) while the seller chooses $a_{S,N}$ to maximize (13), which give $a_{B,N} = (1-\kappa_B)(1-b_S)y$ and $a_{S,N} = (1-\kappa_S)b_S y$.[9] Second, deep pockets allows the buyer to push the seller to his participation constraint, which allows us to write the minimum compensation to ensure participation as

$$\left(b_S y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)+\beta_S\right) = \frac{t_S+\frac{1}{2}qa_{S,E}^2+\frac{1}{2}(1-q)a_{S,N}^2}{(1-\kappa_S)},$$

which then allows us to write the buyer's problem as

$$\begin{aligned}\max_{a_{B,E},a_{S,E},b_S} u_B = (1-\kappa_B)&\left(\Delta y\alpha\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)-\frac{t_S+\frac{1}{2}qa_{S,E}^2+\frac{1}{2}(1-q)a_{S,N}^2}{(1-\kappa_S)}\right)\\ &-t_B-\tfrac{1}{2}qa_{B,E}^2-\tfrac{1}{2}(1-q)a_{B,N}^2\end{aligned}$$

$$\text{s.t.}\qquad a_{B,N} = (1-\kappa_B)(1-b_S)y \text{ and } a_{S,N} = (1-\kappa_S)b_S y.$$

From here it then follows immediately that the formal contract sets $a_{S,E} = (1-\kappa_S)y$ and $a_{B,E} = (1-\kappa_B)y$ as the surplus-maximizing enforceable actions that can be specified in the contract. Performing the substitutions allows us to write the buyer's payoff as

$$\begin{aligned}u_B = (1-\kappa_B)&\left(q\left(2-\kappa_B-\kappa_S\right)+(1-q)\left(\left(1-\kappa_B\right)\left(1-b_S^2\right)+(1-\kappa_S)b_S\left(2-b_S\right)\right)\right)\frac{(\Delta y\alpha)^2}{2}\\ &-\tfrac{(1-\kappa_B)}{(1-\kappa_S)}t_S-t_B,\end{aligned}$$

which the buyer then maximizes with respect to b_S, which then gives $b_S = \frac{(1-\kappa_S)}{(1-\kappa_B)+(1-\kappa_S)}$. As a side note, note that while this solution follows from the assumption of deep pockets, it is actually not necessary since a strategic allocation of the lump-sum tax liability could be used to ensure $\beta_S \geq 0$.

Next, to establish $\kappa_S = \kappa_B = \kappa$ for the optimal tax policy, recall that the ruler's expropriation constraint was given by

[9] Indeed, this is the reason why the buyer also wants to commit to an action in the formal contract. Without commitment, his action would be driven by the profit-share instead of efficiency, worsening net surplus. And momentarily, we will see that the optimal contract calls for $b_S > 0$ so that such commitment is strictly optimal.

$$\frac{1-(1-\tau)\delta}{1-\delta}\pi \geq (1-\tau)\,\Pi,$$

where $\pi = \Pi - E\left(\sum_i c\left(a_i\right)\right)$. Assume $\kappa_B > \kappa_S$ without loss of generality and increase κ_S and decrease κ_B so that the overall output level, Π, is unchanged. Then, if the expected cost $E\left(\sum_i c\left(a_i\right)\right)$ decreases as a result of this, the constraint is relaxed and the optimal tax policy needs to satisfy $\kappa_B = \kappa_S$. Now, from above we have that $a_{B,N} = \frac{(1-\kappa_B)^2}{(1-\kappa_B)+(1-\kappa_S)}y$, $a_{S,N} = \frac{(1-\kappa_S)^2}{(1-\kappa_B)+(1-\kappa_S)}y$, $a_{S,E} = (1-\kappa_S)\,y$ and $a_{B,E} = (1-\kappa_B)\,y$, while the output level is simply

$$y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right).$$

Then, for the output to be unchanged, we need

$$\begin{array}{l} y\frac{d}{d(1-\kappa_B)}\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right) \\ +\,y\frac{d}{d(1-\kappa_S)}\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)\frac{d(1-\kappa_S)}{d(1-\kappa_B)} = 0, \end{array}$$

which we can write as

$$-\frac{\left(((1-\kappa_B)+(1-\kappa_S))^2-2(1-q)(1-\kappa_S)^2\right)}{\left(((1-\kappa_B)+(1-\kappa_S))^2-2(1-q)(1-\kappa_B)^2\right)} = \frac{d(1-\kappa_S)}{d(1-\kappa_B)}.$$

The expected cost of effort, in turn, is given by

$$\begin{array}{l} q\left(\frac{1}{2}a_{B,E}^2+\frac{1}{2}a_{S,E}^2\right)+(1-q)\left(\frac{1}{2}a_{B,N}^2+\frac{1}{2}a_{S,N}^2\right) = \\ \frac{1}{2}y^2\left[q\left(\left(1-\kappa_B\right)^2+\left(1-\kappa_S\right)^2\right)+(1-q)\left(\frac{(1-\kappa_B)^4+(1-\kappa_S)^4}{((1-\kappa_B)+(1-\kappa_S))^2}\right)\right], \end{array}$$

and differentiating with respect to the tax level we get

$$\begin{array}{l} 2q\left(1-\kappa_B\right)+(1-q)\frac{(1-\kappa_B)^4+2(1-\kappa_B)^3(1-\kappa_S)-(1-\kappa_S)^4}{((1-\kappa_B)+(1-\kappa_S))^3} \\ +\left(2q\left(1-\kappa_S\right)+(1-q)\frac{(1-\kappa_S)^4+2(1-\kappa_S)^3(1-\kappa_B)-(1-\kappa_B)^4}{((1-\kappa_B)+(1-\kappa_S))^3}\right)\frac{d(1-\kappa_S)}{d(1-\kappa_B)}, \end{array}$$

which we can rearrange to[10]

$$\frac{2q(1-\kappa_B)((1-\kappa_B)+(1-\kappa_S))^3+(1-q)\left((1-\kappa_B)^4+2(1-\kappa_B)^3(1-\kappa_S)-(1-\kappa_S)^4\right)}{2q(1-\kappa_S)((1-\kappa_B)+(1-\kappa_S))^3+(1-q)\left((1-\kappa_S)^4+2(1-\kappa_S)^3(1-\kappa_B)-(1-\kappa_B)^4\right)} \leq \frac{\left(((1-\kappa_B)+(1-\kappa_S))^2-2(1-q)(1-\kappa_S)^2\right)}{\left(((1-\kappa_B)+(1-\kappa_S))^2-2(1-q)(1-\kappa_B)^2\right)},$$

as the condition for costs to decrease as the result of the change. The remainder is just

[10]Noting that since $(1-\kappa_B) < (1-\kappa_S)$ is our starting assumption, both denominators are positive and so we can do the division involved in this step without reverting the sign of the inequality needed for cost reduction to occur.

some arduous simplification. To simplify the notation, let $x = (1 - \kappa_B)$ and $y = (1 - \kappa_S)$, with $x < y$ since $\kappa_B > \kappa_S$. Then, the expression becomes

$$\frac{2qx(x+y)^3+(1-q)\left(x^4+2x^3y-y^4\right)}{2qy(x+y)^3+(1-q)(y^4+2y^3x-x^4)} \leq \frac{\left((x+y)^2-2(1-q)y^2\right)}{\left((x+y)^2-2(1-q)x^2\right)}.$$

Cross-multiplying, expanding the expressions and grouping like-terms gives

$$\begin{aligned}
&q\left(x-y\right)\left[\left(x+y\right)^2-\left(1-q\right)\left(x^2+xy+y^2\right)\right]\left(x+y\right)^3\\
&-q\left(1-q\right)\left(x+y\right)^3\left(x^3-y^3\right)\\
&\left(1-q\right)\left[x^4-y^4\right]\left(x+y\right)^2-2(1-q)^2xy\left(x^4-y^4\right)\\
&-(1-q)^2\left[x^6-y^6\right]\\
&+(1-q)xy\left[x^2-y^2\right]\left(x+y\right)^2-(1-q)^2x^2y^2\left[x^2-y^2\right]\\
&\leq 0,
\end{aligned}$$

which we can simplify to

$$\begin{aligned}
&q\left(x-y\right)\left(xy+q\left(x^2+xy+y^2\right)\right)\left(x+y\right)^3\\
&-q\left(1-q\right)\left(x+y\right)^3\left(x^3-y^3\right)\\
&\left(1-q\right)\left(x^2+y^2\right)\left(x^4-y^4\right)+2q(1-q)xy\left(x^4-y^4\right)\\
&-(1-q)^2\left(x^6-y^6\right)\\
&+(1-q)xy\left(x^2+\left(1+q\right)xy+y^2\right)\left(x^2-y^2\right)\\
&\leq 0,
\end{aligned}$$

$$\begin{aligned}
&q\left(x-y\right)\left(xy+q\left(x^2+xy+y^2\right)\right)\left(x+y\right)^3\\
&(1-q)x^2y^2\left(x^2-y^2\right)-3yx(1-q)q\left(x^3-y^3\right)\left(x+y\right)\\
&+2q(1-q)xy\left(x^4-y^4\right)\\
&+(1-q)xy\left(x^2+\left(1+q\right)xy+y^2\right)\left(x^2-y^2\right)\\
&\leq 0,
\end{aligned}$$

and finally we get

$$\begin{aligned}
&q\left(x-y\right)\left(xy+q\left(x^2+xy+y^2\right)\right)\left(x+y\right)^3\\
&2(1-q)x^2y^2\left(x^2-y^2\right)\\
&+q(1-q)xy\left(-x^4-3x^3y+3y^3x+y^4\right)\\
&+(1-q)q\left(xy\right)^2\left(x^2-y^2\right)\\
&+(1-q)xy\left(x^4-y^4\right)\\
&\leq 0
\end{aligned}$$

$$q\left(x-y\right)\left(xy+q\left(x^2+xy+y^2\right)\right)\left(x+y\right)^3$$

$$
\begin{aligned}
&2(1-q)^2x^2y^2\left(x^2-y^2\right)+(1-q)^2xy\left(x^4-y^4\right)\\
&\leq 0,
\end{aligned}
$$

which is true since $x<y$.

Finally, having established symmetry of the marginal tax rate, the formal contract simplifies to $b_S=\frac{1}{2}$ and thus $a_{B,N}=a_{S,N}=\frac{(1-\kappa)}{2}y$ while $a_{B,E}=a_{S,E}=(1-\kappa)\,y$. From here, it then follows that the total output produced in the economy becomes

$$
\Pi=y\left(q\left(a_{B,E}+a_{S,E}\right)+(1-q)\left(a_{B,N}+a_{S,N}\right)\right)=y^2\left(1-\kappa\right)\left(1+q\right),
$$

while the total surplus becomes

$$
\pi=y^2\left(\tfrac{(1+q)}{2}\left(1-\kappa^2\right)+\tfrac{(1-q)(1-\kappa)^2}{4}\right).
$$

Then, given that the ruler continues to be able to extract the full surplus under taxation while grabbing the whole output under deviation, it needs to be that (recall that under formal contracts only, no further punishment can be imposed on the ruler if expropriation succeeds)

$$
\tfrac{1}{1-\delta}\pi\geq(1-\tau)\left(\Pi+\tfrac{\delta}{1-\delta}\pi\right)\Leftrightarrow\left(\tfrac{1-(1-\tau)\delta}{(1-\tau)}\right)\pi\geq(1-\delta)\,\Pi,
$$

which then becomes

$$
\begin{aligned}
&\left(\tfrac{1-(1-\tau)\delta}{(1-\tau)}\right)\left(\tfrac{(1+q)}{2}\left(1-\kappa^2\right)+\tfrac{(1-q)(1-\kappa)^2}{4}\right)\geq(1-\delta)\left(1-\kappa\right)\left(1+q\right)\\
&\left(1-\left(1-\tau\right)\delta\right)\left(2\left(1+q\right)\left(1+\kappa\right)+\left(1-q\right)\left(1-\kappa\right)\right)\geq4\left(1-\tau\right)\left(1-\delta\right)\left(1+q\right)\\
&\kappa\left(1+3q\right)\geq\tfrac{4(1-\tau)(1-\delta)(1+q)}{(1-(1-\tau)\delta)}-(3+q)\\
&\kappa\left(1+3q\right)\geq\tfrac{(1-\delta)(1+3q)-\tau(4(1+q)-\delta(1+3q))}{(1-(1-\tau)\delta)}\\
&\kappa\geq1-\tfrac{4\tau(1+q)}{(1+3q)(1-(1-\tau)\delta)}.
\end{aligned}
$$

From here it follows immediately that

$$
\begin{aligned}
&\tfrac{d\kappa}{d\delta}=-\tfrac{4\tau(1+q)(1-\tau)}{(1+3q)(1-(1-\tau)\delta)^2}<0\\
&\tfrac{d\kappa}{dq}=\tfrac{8\tau}{(1-(1-\tau)\delta)(1+3q)^2}>0\\
&\tfrac{d\kappa}{d\tau}=-\tfrac{4(1+q)(1-\delta)}{(1+3q)(1-(1-\tau)\delta)^2}<0
\end{aligned}
$$

A.2 Proof of proposition 2

If the ruler does not utilize relational contracts, we only need to ensure that the promised formal incentives are credible. We can write this solution constraint as

$$(1-2b)\,2y\left(qa_E+(1-q)a_N\right)+\tfrac{\delta}{1-\delta}u_R \geq 2y\left(qa_E+(1-q)a_N\right)+(1-\tau)\left(\tfrac{\delta}{1-\delta}u_R\right),$$

which simplifies to

$$\tau\tfrac{\delta}{1-\delta}u_R \geq 4by\left(qa_E+(1-q)a_N\right),$$

while the agent's action choice in the non-contractible state is $a_N = by$ and the absence of a budget breaker requires that $b \leq 1/2$. The ruler's problem is then

$$\max_{a_E,b} u_R = \left(2qya_E - a_N^2 + (1-q)\left(2ya_N - a_N^2\right)\right)$$

subject to the above, where u_R follows from the deep pockets assumption so that the ruler is able to extract all the surplus from the relationships. From here, it follows immediately that $a_E = y$ while substituting the agent's action choice in the expressions we get

$$\max_{b} u_R = y^2\left(q+(1-q)\left(2b-b^2\right)\right)$$

$$\text{s.t.} \qquad \tau\tfrac{\delta}{1-\delta}u_R \geq 4by^2\left(q+(1-q)b\right) \qquad \textit{and} \qquad b \leq 1/2.$$

Now, u_R is increasing while the constraint is tightening in b, so either the constraint is binding or $b = 1/2$. From here it then follows that the maximal formal incentives are given by

$$\tfrac{\tau\delta}{4(1-\delta)}\left(q+(1-q)\left(2b-b^2\right)\right) = b\left(q+(1-q)b\right).$$

Define $\phi = \frac{\tau\delta}{4(1-\delta)}$ and rearrange the expression to yield

$$0 = (1-q)\left(1+\phi\right)b^2 + b\left(q-2(1-q)\phi\right) - q\phi,$$

which then allows us to write the maximal credible formal incentive strength to be given by

$$b = \tfrac{-(q-2(1-q)\phi)+\sqrt{q^2+4\phi^2(1-q)}}{2(1-q)(1+\phi)}.$$

A.3 Proof of Lemma 3

Recall that we can write the constraint for the sustainability of $(a_{B,N}, a_{S,N})$ as

$$\begin{aligned}&\tfrac{\delta}{1-\delta}\left((u_B+u_S)-\left(u_B^{dev}+u_S^{dev}\right)\right)\geq \tfrac{1}{2}\left(\left(1-\kappa\right)\left(1-b_S\right)y\right)^2+\tfrac{1}{2}\left(\left(1-\kappa\right)b_S y\right)^2\\&-\left[\left(\left(1-\kappa\right)\left(1-b_S\right)ya_{B,N}-\tfrac{1}{2}a_{B,N}^2\right)+\left(\left(1-\kappa\right)b_S ya_{S,N}-\tfrac{1}{2}a_{S,N}^2\right)\right].\end{aligned}$$

Now, let us consider minimizing the right-hand side for a given target effort level, $a_{B,N}+a_{S,N}$, where equal efforts would strictly maximize net surplus and thus the left-hand side of the expression. Given b_S, the optimal allocation of efforts would solve

$$\left(1-\kappa\right)\left(1-b_S\right)y-a_{B,N}-\left(1-\kappa\right)b_S y+a_{S,N}=0,$$

which we can rearrange to $a_{S,N}=a_{B,N}+\left(1-\kappa\right)y\left(2b_S-1\right)$, which allows us to write the total effort as

$$a_{S,N}+a_{B,N}=2a_{B,N}+\left(1-\kappa\right)y\left(2b_S-1\right).$$

Later, we want to consider the optimal b_S, so to hold the total effort constant, it needs to be that

$$2\tfrac{da_{B,N}}{db_S}+2\left(1-\kappa\right)y=0\rightarrow\tfrac{da_{B,N}}{db_S}=-\left(1-\kappa\right)y.$$

Next, using $a_{S,N}=a_{B,N}+\left(1-\kappa\right)y\left(2b_S-1\right)$, we can expand the right-hand side of the expression to

$$\tfrac{1}{2}\left(\left(1-\kappa\right)\left(1-b_S\right)y\right)^2+\tfrac{1}{2}\left(\left(1-\kappa\right)b_S y\right)^2-\left[2\left(1-\kappa\right)y\left(1-b_S\right)a_{B,N}-a_{B,N}^2+\tfrac{\left(1-\kappa\right)^2y^2\left(2b_S-1\right)}{2}\right],$$

and then differentiating the expression with respect to b_S we have that the optimal profit share is given by

$$\begin{aligned}&-\left(\left(1-\kappa\right)^2\left(1-b_S\right)y^2\right)+\left(\left(1-\kappa\right)^2b_S y^2\right)\\&-\left[-2\left(1-\kappa\right)ya_{B,N}+2\left(1-\kappa\right)y\left(1-b_S\right)\tfrac{da_{B,N}}{db_S}-2a_{B,N}\tfrac{da_{B,N}}{db_S}+\left(1-\kappa\right)^2y^2\right]=0,\end{aligned}$$

which then simplifies to

$$\left(1-\kappa\right)^2y^2\left(2b_S-1\right)=\left(1-\kappa\right)^2y^2\left(2b_S-1\right),$$

so that while $b_S = 1/2$ provides a solution, the effort interactions are such that the right-hand side is actually independent of the profit share. But the net surplus itself is maximized by setting $a_{S,N} = a_{B,N}$ (efficient allocation of costs given the target level of total effort), which then uniquely identifies $b_S = 1/2$ as the optimal profit share.

A.4 Proof of Lemma 4

Suppose, for simplicity and realism, that if a buyer or a seller deviates from the pairwise relational contract, this deviation is not observed by anyone else. Then, while trust between the two agents is broken after the deviation, and their relationship reverts to purely formal contracting, their tax liabilities remain the same as in the equilibrium. Then, if the two agents continue to participate in a post-deviation subgame, $(u_B + u_S) - \left(u_B^{dev} + u_S^{dev}\right)$ is independent of $(t_B + t_S)$. That subgame cannot be part of an optimal equilibrium, however, because then the ruler's non-expropriation constraint could be relaxed by increasing $(t_B + t_S)$ up to the point where following a deviation, the buyer and the seller are better off exiting the productive sector and realizing $\left(u_B^{dev} + u_S^{dev}\right) = 0$. In other words, the equilibrium taxation provides endogenously a maximal punishment, as if there were contagion among punishments and deviations were punished multilaterally by the ruler and all other buyers and sellers.

A.5 Proof of Lemma 5

For the solution, we need to simply combine the ruler's and the agents' reneging temptations. Consider first the sustainability of the relational contracts alone. We have that for the ruler to adhere to the agreement, it needs to be that

$$\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) \geq 2(1-q)B_N,$$

while for the agent(s) to adhere to the agreement, it needs to be that

$$B_N - \tfrac{1}{2}a_N^2 + 2bya_N + \tfrac{\delta}{1-\delta}u_i \geq \max_{a_i} by\left(a_i + a_N\right) - \tfrac{1}{2}a_i^2 + \tfrac{\delta}{1-\delta}u_i^{dev}.$$

Now, the agent's optimal deviation is given by $a_i = by$, which simplifies the agent's constraint to

$$B_N \geq \tfrac{(by)^2}{2} - \left(bya_N - \tfrac{1}{2}a_N^2\right) - \tfrac{\delta}{1-\delta}\left(u_i - u_i^{dev}\right).$$

Combining the constraints gives us

$$\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) \geq 2(1-q)\left(\tfrac{(by)^2}{2} - \left(bya_N - \tfrac{1}{2}a_N^2\right) - \tfrac{\delta}{1-\delta}\left(u_i - u_i^{dev}\right)\right).$$

Relatedly, we can write the ruler's constraint for not deviating on both her relational and formal contracts as

$$\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) + \tau\tfrac{\delta}{1-\delta}u_R^{dev} \geq 2(1-q)B_N + 4by\left(qa_E + (1-q)a_N\right),$$

which becomes, once substituting in the agent's constraint

$$\begin{aligned}&\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) + \tau\tfrac{\delta}{1-\delta}u_R^{dev} \geq \\ &2(1-q)\left(\tfrac{(by)^2}{2} - \left(bya_N - \tfrac{1}{2}a_N^2\right) - \tfrac{\delta}{1-\delta}\left(u_i - u_i^{dev}\right)\right) \\ &+4by\left(qa_E + (1-q)a_N\right).\end{aligned}$$

From the two joint constraints it follows immediately that all surplus should be allocated to the ruler, so that $u_i = u_i^{dev} = 0$. Given this, we can write the agent's constraint as

$$B_N - \tfrac{1}{2}a_N^2 + bya_N \geq \tfrac{(by)^2}{2},$$

which allows us to write the maximal effort that the ruler is able to request from the agent as a function of both the formal and informal incentives as

$$a_N^{sr} = \sqrt{2B_N} + by.$$

Thus, we can now reduce the ruler's problem to

$$\max_{a_E, b, B_N} u_R = q\left(2ya_E - a_E^2\right) + (1-q)\left(2ya_N - a_N^2\right)$$

subject to $a_N = \sqrt{2B_N} + by$ and the two joint reneging constraints above. Finally, note that it immediately follows that $a_E = y$. And then, going back to the ruler's reneging constraints, which were

$$\begin{aligned}&\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) \geq 2(1-q)B_N \\ &\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) + \tau\tfrac{\delta}{1-\delta}u_R^{dev} \geq 2(1-q)B_N + 4by\left(qy + (1-q)a_N\right),\end{aligned}$$

consider increasing B_N and decreasing b in a way that holds a_N and so u_R constant. The first constraint is clearly tightened while for the second constraint we have the net effect as

$$2(1-q) + 4\tfrac{db}{dB_N}y\left(qy + (1-q)a_N\right),$$

while the constant effort assumption requires that the change satisfies

$$\tfrac{1}{2}\sqrt{2}B_N^{-1/2} + \tfrac{db}{dB_N}y = 0 \rightarrow \tfrac{db}{dB_N} = -\tfrac{1}{2y}\sqrt{2}B_N^{-1/2},$$

so we have

$$\begin{array}{l} 2(1-q) + 4\tfrac{db}{dB_N}y\left(qy + (1-q)a_N\right) \\ 2(1-q) - 4\tfrac{1}{2y}\sqrt{2}B_N^{-1/2}y\left(qy + (1-q)\left(\sqrt{2B_N} + by\right)\right) \\ -(1-q) - \sqrt{2}B_N^{-1/2}\left(qy + (1-q)by\right) < 0. \end{array}$$

Thus, the change always relaxes the second constraint. Thus, both constraints must always be binding. And then, given that the first constraint gives

$$\tfrac{\delta}{1-\delta}\left(u_R - u_R^{dev}\right) = 2(1-q)B_N,$$

the second constraint simplifies to

$$\tau\tfrac{\delta}{1-\delta}u_R^{dev} = 4by\left(qy + (1-q)a_N\right).$$

Now, using these it is technically possible to solve b and B_N even in closed-form but the expressions are cumbersome and contain no particular additional economic intuition.