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Bribery, hold-up, and bureaucratic structure

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Abstract

We consider infrastructure provision by a foreign investor when the domestic bureaucracy is corrupt, but also cares for domestic welfare. Bureaucrats bargain with the investor over price and (potentially) bribes, both before the investment is sunk and afterwards, using the threat of expropriation. We show that domestic welfare may be greater in equilibria with bribery than in equilibria without. We specify conditions under which changes in the degree of bureaucratic centralization or of bureaucratic care have a positive, negative, or nonmonotonic effect on domestic welfare. The impact of centralization on domestic welfare is mediated through the level of bureaucratic care.

KEYWORDS

bribery, bureaucratic structure, centralized bureaucracy, corruption, decentralized bureaucracy, hold-up, renegotiation

JEL CLASSIFICATION

D73; H11; H57

1 | INTRODUCTION

Bribery of public officials by private agents has been estimated to amount to about $1 trillion per annum across the world (World Bank, 2016). It may take the form of "grand corruption," with small numbers of firms or their representatives paying large amounts of money, or of "petty corruption," for example with many people paying small bribes to avoid fines for traffic offenses. In this paper we focus on grand corruption, examining how bribery may be related to contract terms in a context that has been of considerable significance to developing economies in the last 30 years or so—investment in infrastructure and public service provision by a foreign firm.[1]

For such projects, corruption may occur both before and after an investment has been sunk. As noted by Transparency International (2017), large investments in infrastructure provide significant opportunities for bribery in the awarding of the lucrative contracts involved. Moreover, in many developing economies the rule of law is insufficient to prevent governments from reneging on contracts. Because investments in infrastructure can involve a sunk element that is long-lived and specific, investors are particularly vulnerable to hold-up, leading to renegotiation (Laffont, 2005). Kenny and Søreide (2008), for instance, find that although the efficiency effects of private provision have been positive, because of high fixed costs there are few potential providers, and the fiscal costs associated with bribery have been high.[2]

There is a large body of evidence that, at the national level, bribery has a pernicious effect on welfare (Rose-Ackerman & Palifka, 2016). In cross-country analyses bribery is typically found to correlate negatively with per capita national income and growth, and with the quality of government.[3] Nonetheless, some studies, such as by Méon and Weill (2010) and Dreher and Gassebner (2013), find that in highly regulated economies and where institutions are ineffective, bribery may have a positive association with measures of efficiency, and it is argued that such results are consistent with the "grease hypothesis," whereby bribery may facilitate some transactions in a socially beneficial way.[4] However, such aggregate studies may be consistent with other routes through which bribery can in some circumstances have a beneficial effect. We identify one such route in this paper (although we also specify various conditions under which bribery has an adverse effect on welfare).

Despite its pervasiveness, the existence of bribery does not necessarily imply that the individuals concerned care only about their own incomes or utilities, narrowly defined. In his classic contribution, Klitgaard (1988) shows, using five case studies from developing economies, that corruption can be limited by raising its "moral costs." More recently, using data from a large international panel, Dong et al. (2012) find that the willingness to undertake corrupt activities is limited by social norms.

Evidence provided by Svensson (2003) suggests that when bribery occurs, its level is determined by bargaining. He finds that firms' ability to pay, proxied by their current and expected future profitability, and "refusal power," measured by the estimated alternative return on capital, can explain a large part of the variation in bribes across firms. Furthermore, the role that hold-up can play in determining bribe levels is established empirically by Olken and Barron (2009), who study the payments by truck drivers to various officials on trips in Indonesia. Consistent with hold-up theory, they find that drivers who have more to lose, and those who have to pass through more check-points, pay more in bribes.

Although there have been numerous empirical studies of the impact of decentralization on corruption, many employing cross-national regressions, the evidence is mixed. Thus, a survey of 260 studies from across the social sciences by Gans-Morse et al. (2018) concludes that a consensus has not been reached. This suggests that, irrespective of the effect that corruption may have on welfare, the effect of decentralization on welfare, as mediated through the transmission mechanism of corruption, will not be clear-cut. And indeed, the empirical literature that considers more generally whether decentralization is beneficial or costly for government performance and welfare is inconclusive (see Goel et al., 2017).

In this paper we attempt to capture the characteristics of infrastructure provision in developing economies discussed above and, in this context, to throw some light on the interrelationships between (de)centralization, the values of bureaucrats, the incidence of bribery, and the level of welfare. We analyze potential bribery in a framework in which bureaucrats bargain sequentially with an investor on behalf of the government both over the initial contract and through hold-up after an investment is made.[5] We assume that the investor has already been chosen by the government, any preliminary feasibility studies having already been undertaken, and that the size of the investment has been fixed. Thus it would be costly for the government to begin the process again with another firm, even if one were available.

In our model, bureaucrat B_1 agrees a contract with the investor, specifying the price the investor will be paid and may, as part of the deal, also negotiate a bribe payment in return for a higher price.[6] Then, after the investment has been sunk, bureaucrat B_2 may hold up the investor, using the threat of "direct" expropriation (whereby the state would seize the assets and operate them itself).[7] To avert direct expropriation, B_2 may either demand a bribe, or may require the investor to pay a tax. The latter is commonly referred to as 'indirect' expropriation—see UNCTAD (2012).[8] In the equilibria we analyze, investment takes place and direct expropriation, although a credible threat, is averted.

As in the seminal analysis of bureaucratic corruption by Shleifer and Vishny (1993), we allow for the extreme cases of pure centralization, where the two bureaucrats collude fully to maximize their joint payoff, and pure decentralization, where each bureaucrat independently maximizes his or her own payoff; but we take a more general approach, also covering intermediate cases in which there is imperfect collusion between bureaucrats. Bureaucrats may coordinate their behavior because they are engaged in a long-term relationship, but, as argued by Mookherjee (2013), the enforceability of side contracts between colluding agents may be limited. We develop a simple linear model, excluding any considerations of asymmetric information, to focus on the relationship between the bureaucrats' "corruptibility" and the potential hold-up of the investor. The bureaucrats' corruptibility depends on the extent of centralization and the concern they may have for domestic welfare.

Solving by backward induction, we first consider the second period, with the investment already having been sunk. If the price agreed by the investor with B_1 exceeds a critical level, B_2 will hold up the investor using the threat of direct expropriation. If corruptibility is positive, B_2 will negotiate a bribe with the investor, leaving the price paid to the government unchanged. But if corruptibility is nonpositive B_2 will negotiate a tax to be paid into public coffers, the investor thus receiving a lower price net of tax. In the first period, anticipating what will happen in the second, B_1 and the investor negotiate the contract price for the project, with an associated bribe possibly being paid to B_1. For realism, we assume that there is a nonnegativity constraint on any bribe.

The main part of our exposition assumes, for simplicity, that if expropriation were to occur the government would be only marginally inefficient in running the project. The price agreed by B_1 and the investor is always then high enough for hold-up to occur in the second period.[9] If the nonnegativity constraint does not bind, the equilibrium first-period bribe splits the bargaining surplus equally between B_1 and the investor. If the constraint binds, then the bribe is set at zero, and the bureaucrat receives more than half the surplus.

We first solve the model for price, bribe and tax levels and their relationship with corruptibility. We then focus on the roles of bureaucratic care and centralization and the impacts on domestic welfare.

We find that, depending on parameter values, there are three different types of equilibrium. The full-bribery solution holds if corruptibility is at least as high as a critical level. Then both bureaucrats secure bribes and price is set at its maximal level (equal to the domestic benefit from the project). The partial-bribery solution holds if corruptibility is below the critical level but still positive. Then B_2 secures a bribe, but B_1 does not, and price is set below the maximal level. The no-bribery solution obtains if corruptibility is nonpositive, in which case B_2 imposes a tax. While the net-of-tax price in this case is less than the maximal level, it may nevertheless be greater or less than price in the partial-bribery case. Implicit collusion between B_1 and the investor plays an important role here. When B_2 secures a bribe this constitutes a leakage in the bargaining surplus available to B_1 and the investor, and this leakage is greater when price is higher. So, in equilibria with a bribe for B_2, one of the forces at work is that B_1 and the investor would rather hold back price to some extent to limit the leakage.

We then focus on the roles of bureaucratic care and centralization in these equilibria. We consider first how variation of the degree of bureaucratic care may cause a transition between the three types of equilibrium, and how this may affect domestic welfare. As might be expected, we find that a decrease in the degree of care that causes a transition from a partial-bribe equilibrium to a full-bribe equilibrium has a negative effect on domestic welfare. If, however, the decrease in care causes a transition from a no-bribe to a partial-bribe equilibrium, the effect on domestic welfare may be of either sign. Thus, we specify conditions under which a reduction in bureaucratic care causes bribery to occur, with this having a positive effect on domestic welfare.

Moreover, the above-mentioned transitions between equilibria may also occur as a result of an increase in the degree of centralization. Consequently, in the partial-bribe to full-bribe transition less centralization has a negative effect on domestic welfare. In the no-bribe to partial-bribe transition, however, less centralization may have an effect on domestic welfare of either sign. This is consistent with the mixed results for the centralization-welfare relationship found in both the empirical literature, as noted above, and in the theoretical literature (which we discuss in Section 2).

An implication of these results is that transitions across the three types of equilibrium caused by variation in the degree of centralization or of bureaucratic care may have a nonmonotonic effect on domestic welfare. We depict a complex interaction between these parameters, as well as with the terms on which direct expropriation would occur. At a low enough or high enough level of bureaucratic care for domestic welfare, variation of the degree of centralization has no effect on domestic welfare. However, for an intermediate level of care, the sign of this effect depends on the precise level of care; that is, the welfare impact of having a greater degree of bureaucratic centralization depends on the values of the bureaucrats involved.

In Section 2 we give a short review of related literature, and in Section 3 we formulate our model. In Section 4 we consider the renegotiation (hold-up) stage. In Section 5 we examine the negotiation stage, at which the contract price is agreed. Section 6 brings the results together and characterizes the equilibrium of the model. Section 7 provides some further discussion, and Section 8 concludes. Appendix gives proofs omitted from the text.

2 | RELATED LITERATURE

In this section we discuss theoretical literature that is broadly related to the themes of this paper.[10] We note first the difference between our formulation and the hypothesis put forward by Leff (1964) that corruption may increase domestic welfare by "greasing the wheels" of transactions, enabling entrepreneurs to circumvent bureaucratic obstacles that impede efficiency. A bribe may, for example, be paid by an entrepreneur to obtain a license more quickly (Lui, 1985) or bribe offers by entrepreneurs for a license may in effect constitute a competitive auction, with the highest offer coming from the most efficient entrepreneur (Lien, 1986).

In our model, however, there is only one firm and its costs are given. Grease exists, but only in the background, in the sense that a bribe may avert direct expropriation, which would have been followed by inefficient government provision. We consider only equilibria in which direct expropriation does not occur, and the difference in domestic welfare between solutions with and without bribery stems purely from the difference in the net-of-tax payments the government makes to the investor, rather than from a difference in the efficiency of resource use. The source of the possible beneficial effect of bribery is how the payment by the government is affected by collusion between one bureaucrat and the investor against the interests of the other bureaucrat.

Whereas in our formulation bribes are determined sequentially, Shleifer and Vishny (1993) assume that bureaucrats make simultaneous decisions about granting licenses to firms for operation in an industry. The internalization of bribe externalities by bureaucrats that occurs with centralized corruption is then found to be associated with a lower total value of bribes, and higher output and welfare than obtains with decentralized corruption. However, in the literature that elaborates on this framework, it is found, as we find in our model, that centralization may not yield a clear-cut advantage. We consider here three prominent examples of this literature.

First, Waller et al. (2002) examine the potential role for an administrator, who would specify how much each bureaucrat should take in bribes. The administrator would keep a proportion of the proceeds and would monitor each bureaucrat imperfectly, penalizing any discovered deviation of a bribe from the mandated level. This form of centralization allows some internalizing of bribe externalities, but adds another bribe-taking player into the model, and so does not necessarily have a positive effect on welfare.

Second, Choi and Thum (2003) formulate a two-period variation of the Shleifer–Vishny model where in each period a single bureaucrat can grant licenses for firms to enter an industry, and may demand bribes. Firms differ in their profitability, which at least initially is their private knowledge. Choi and Thum compare the effects of having the same or different bureaucrats in post in the two periods, which may be regarded as a parallel to centralization and decentralization in our model. As we find, the relative impacts of the two structures on bribe levels and welfare are not clear-cut.

Third, Echazu and Bose (2008) incorporate an informal production sector into the Shleifer–Vishny framework. Any firm may operate formally or informally, but with lower productivity in the latter case. The authors find that if all bribe activity (across both sectors) is centralized, the effects on bribes and total welfare may go in either direction. This is because formal sector bribery causes endogenous switching of firms to the informal sector, where productivity is lower (and monitoring costs exist). Thus, it is again found that adding complications to the Shleifer–Vishny framework results in conclusions about (de)centralization that are conditional.

Another aspect of decentralization, albeit one outside the scope of our analysis, is the potential benefit from devolving responsibility for public service delivery to local elected officials. This is explored by Bardhan and Mookherjee (2006), who assume that central government officials are less informed than local officials about local needs and are less able to monitor effectively. This benefit of decentralization of decision-making must be set against the disadvantage that local officials may be susceptible to capture by local elites. In addition, as shown by Albornoz and Cabrales (2013), a sufficiently high level of political competition may result in less corruption.

Expropriation and hold-up are modeled in a multi-period framework by Thomas and Worrall (1994) and Dechenaux and Samuel (2012). In each of these models the sunk investment is chosen endogenously, whereas in our model we assume a given level of sunk cost in order to focus on the interaction of (de)centralization and bureaucratic care for domestic welfare. Thomas and Worrall assume that the fear of expropriation may cause foreign investors to adopt technologies with inefficiently low sunk costs. The government balances the short-run benefits from expropriating against the impact on the country's reputation with potential future foreign investors. Dechenaux and Samuel (2012) develop an intertemporal model of bribery and hold-up in which a regulator hires an inspector to monitor regulatory compliance by a firm. The inspector may exert effort, which raises the probability of revealing whether the "right" technology has been chosen. There is also a higher-level principal who (probabilistically) penalizes both the firm and the inspector if it discovers that a bribe has been taken. Nonetheless, repeated interaction between the inspector and the firm can support a bribe equilibrium in trigger strategies.

Our model also relates to the literature on sequential common agency, which analyzes dynamic games in which multiple principals contract sequentially with the same agent (see Pavan & Calzonari, 2009, for an overview). This literature focuses on mechanism design, incorporating private information and private contracting. However, an early contribution by Martimort (1996) is closer to our framework. He develops a model with two government principals who may behave nonbenevolently. These principals must accept or reject projects proposed by private investors who have private information on their own costs. He shows that having independent principals is more distortionary than if the principals act as a unit.[11] This distortion is greater if the principals deal sequentially, rather than simultaneously, with any given investor. But he notes that his results require asymmetric information in order to hold. Without it, integration and separation of principals (corresponding to centralization and decentralization in our model) are equivalent. However, as the corruption literature initiated by Shleifer and Vishny indicates, this result may not hold in other institutional frameworks. Indeed, our analysis shows that welfare may even be nonmonotone in the degree of separation of government officials.

Our assumption that bureaucrats are concerned about domestic welfare, as well as bribes, accords with the analysis by Balafoutas (2011), who models corruption as a repeated psychological game where bureaucrats suffer from guilt aversion and are less likely to take bribes if this is thought to let the public down. A related approach is taken by Ahlin and Bose (2007), who consider a partially corrupt bureaucracy. There are some bureaucrats who would always reject the offer of a bribe and others who would have no compunction about accepting one; applicants for licenses do not know which type they will encounter. Also, Hajzler and Rosborough (2016) formulate a dynamic model where the type of bureaucrat is uncertain and corrupt types encourage investment in return for bribes using the threat of direct expropriation.

Whereas we examine renegotiation as the result of hold-up, Guasch et al. (2006, 2008) consider renegotiation of concession contracts resulting from informational shocks that occur after the initial contract is agreed. The government and the investor fix initial contract terms by reference to expected payoffs, but when the value of a stochastic variable is revealed, one of the players then may wish to renegotiate. The 2006 paper examines the case in which the investor may wish to renegotiate, for example because the investor's profits are unexpectedly low; the 2008 paper analyzes government-led renegotiation resulting from unexpectedly high profits.

Finally, it is worth mentioning the contribution of Bliss and Di Tella (1997) which, despite its different context, like our model yields what may be seen as a counter-intuitive conclusion as a result of endogenous adjustment of critical variables in the face of parameter changes. They model a competitive industry in which firms may differ in their overhead costs and each firm is dealt with by a corrupt official who has the power to close it down. What they call greater “deep competition” (lower overhead costs or more similar cost structures) can result in higher total bribes and lower welfare. This occurs through the endogenous adjustment of the number of firms and bribe behavior by officials.

3 | THE MODEL

Consider an infrastructure project that requires a fixed investment to be sunk by a given foreign firm (‘the investor’), and for which payment will be made out of public sector funds. This is consistent with the output of the project having a large public good element (e.g., a port or a road) or being a merit good for which a policy decision has been taken that distribution will be free or at a nominal price (e.g., water).

The timeline for the bargaining game is shown in Figure 1. At time $t = 1$ the investor and bureaucrat B_1 agree a price P_1 for the project. Failure to agree would yield default payoffs which we normalize to zero. The agreement may involve the payment by the investor of bribe $b_1 > 0$ to B_1. At time $t = 1\frac{1}{2}$, the investor sinks an investment K, leaving it vulnerable to hold-up. At $t = 2$, bureaucrat B_2 will trigger renegotiation if the threat of direct expropriation is credible, demanding a payment by the investor. Depending on parameter values, this payment may take the form of a tax T paid to the government (indirect expropriation) or a bribe b_2 to bureaucrat B_2. The final (net) price paid by the government is therefore $P = P_1 - T$.

The contract is seen to be incomplete, with the bureaucracy having de facto residual control rights over the asset. We assume that each player has perfect foresight. If direct expropriation were to occur, the government would operate the project; but we focus on cases in which, in equilibrium, the investor undertakes the investment, correctly anticipating any renegotiation, and then operates the project.

Let W denote the running costs of the project for the investor and Π its profit (for simplicity, we exclude discounting). If the investor sinks capital K and operates the project,

$$\Pi = P_1 - K - W - T - b_1 - b_2. \tag{1}$$

The investor would only undertake the project if $\Pi > 0$, a necessary condition for which is $P > K + W$. Accordingly, we assume that

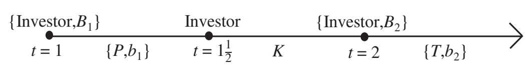

FIGURE 1 The bargaining game

$$1 > K + W. \tag{2}$$

We normalize the utility of the project output to the domestic population to be 1, and we assume that the budget available to finance the project imposes the constraint $P \leq 1$ on the net price (hence, $P_1 \leq 1 + T$). The net impact of the project on domestic welfare is[12]

$$D = 1 - P. \tag{3}$$

For all $P < 1$, $D > 0$.

We assume that each bureaucrat B_i places a unit value on bribe income, and places a value $\eta \in [0, 1]$ on each unit of domestic welfare D, achieving utility

$$v_i = b_i + \eta D, \quad i \in \{1,2\}. \tag{4}$$

The behavior of each bureaucrat depends on the extent to which the bureaucrats collude. At one extreme, there may be pure centralization, so that they coordinate their behavior perfectly to maximize the sum of their utilities. At the other extreme, there may be pure decentralization, with the two bureaucrats pursuing their own objectives independently (perhaps belonging to different government agencies). We characterize the extent of enforceable collusion between the bureaucrats by the value $\theta \in [0, 1]$ a bureaucrat places on the utility of the other bureaucrat, as given by (4). Thus, B_i maximizes the utility function

$$u_i = v_i + \theta v_j \quad i \in \{1,2\};\ j \neq i. \tag{5}$$

If $\theta = 1$, (5) reduces to pure centralization, with each bureaucrat B_i weighting v_1 and v_2 equally; if $\theta = 0$ we have pure decentralization, with each bureaucrat B_i maximizing v_i ($i = 1, 2$). While θ is a measure of the degree of centralization, for brevity we shall refer it as the "centralization" parameter. Substituting from (3) and (4), u_i writes in full as

$$u_i = b_i + \theta b_j + \eta(1+\theta)(1 - P_1 + T). \tag{6}$$

If the total concern $\eta(1 + \theta)$ for a unit of domestic welfare were sufficiently great a bureaucrat would be willing to use his or her own funds to pay a bribe to the investor to undertake the project. However, as it seems unlikely that individual bureaucrats could offer bribes from their personal funds on a scale sufficient to influence materially major infrastructure projects, we impose the restriction that bribes can only be positive.

From (6), and taking into account the different roles that the two bureaucrats play, we define

$$\kappa = 1 - \eta(1+\theta)$$

to be an index of "corruptibility," which applies for each bureaucrat. This is derived by considering the cost–benefit decision facing bureaucrat B_2 at $t = 2$ if hold-up is a credible threat, in which case B_2 will choose whether to procure a bribe b_2 or to levy a tax T. From (6), each \$1 of bribe yields B_2 a unit benefit, while each \$1 of tax yields a unit of domestic welfare, with a value to B_2 of $\eta(1 + \theta)$. If $\kappa > (<)0$, u_2 is greater (smaller) when B_2 secures \$1 of bribe income rather than levying \$1 of tax. The size of κ is also relevant for bureaucrat B_1 (although we shall see that whether B_1 secures a bribe does not depend on the sign of κ). B_1 agrees with the investor the price P_1 and possibly a bribe b_1. If $\kappa > (<)0$, B_1 would gain more (less) from \$1 of bribe income than s/he would lose from having price \$1 lower.[13]

We assume that if direct expropriation were to occur the project would still yield 1 of benefit, but that the state would be less efficient than the investor at operating the facility, with running costs $(1 + \gamma)W$, where $\gamma \in (0, K/W)$. (The rationale for the upper bound on γ will be explained below.) The cost to the government of direct expropriation would be $C(P_1) + (1 + \gamma)W$, where $C(P_1) > 0$ denotes the compensation paid to the investor. We assume that $C(P_1)$ is independent of $\{\eta, \theta\}$. In practice, international investment is protected by customary international law and by numerous International Investment Agreements. Most agreements follow the Hull standard, typically specifying compensation according to "fair market value" for the asset, but there is no agreed precise definition (UNCTAD, 2012). We make the following assumptions:

1. $C'(P_1) = \alpha \in (0, 1)$ for all $P_1 \in (K + W, 1 + T)$;
2. $C(K + W) < K - \gamma W$;
3. $C\left(\frac{1+K+W}{2}\right) > \frac{1+K-W}{2} - \gamma W$.

The first assumption is that compensation responds positively to the agreed price, but by less than one-for-one.[14] It implies that compensation is of the form $\{\alpha P_1 + \text{constant}\}$. This is consistent with the investor being partially compensated for the forgone profit $P_1 - W$ from running the project. A larger α denotes a greater sensitivity of compensation to forgone profit; if α is small this might reflect the role of a lump-sum penalty or a compensation payment more closely related to the sunk investment. The other two assumptions are boundary conditions that are explained below our first lemma.

At $t = 2$, both the investment K and any bribe b_1 are bygones. In making a decision over whether to hold up the investor, bureaucrat B_2 takes into account that, if the contract is honored, $D = 1 - P_1$, while if there were direct expropriation, $D = 1 - [C(P_1) + (1 + \gamma)W]$. The threat of direct expropriation is therefore credible if $P_1 > C(P_1) + (1 + \gamma)W$. We then have the following result.

Lemma 1. *Given Assumptions 2 and 3, there exists a unique price $P^H \in (K + W, (1 + K + W)/2)$ satisfying*

$$P^H = C\left(P^H\right) + (1+\gamma)W \tag{7}$$

such that hold-up will occur when $P_1 > P^H$, but not when $P_1 \le P^H$.

Assumptions 2 and 3 ensure that P^H is in the specified range, allowing us to exclude some potential degenerate and multiple solutions.[15] Given Assumption 2, it is necessary that $\gamma < K/W$, as specified earlier, for $C(P_1)$ to be positive for all $P_1 \in [K + W, 1]$. When $P_1 > P^H$, since $\gamma > 0$, (7) implies that $P_1 - W > C(P_1)$. Thus, when direct expropriation is a credible threat, the profitability of the project if the contract is honored, $P_1 - W$, exceeds the compensation, $C(P_1)$, that would be paid if direct expropriation were to occur. In other words, when direct expropriation is a credible threat the investor prefers that it should not occur.

We proceed by backward induction. First, for given price P_1, we determine either the tax T or bribe b_2, if any, that will be agreed by B_2 and the investor at $t = 2$. Then we determine the price P_1 and any bribe b_1 that will be agreed by B_1 and the investor at $t = 1$, assuming that they anticipate correctly how T or b_2, as appropriate, will depend on P_1.

We assume that in their agreement at each stage, $t = 1, 2$, the investor and the relevant bureaucrat exhaust any possible mutually beneficial gains, and that on the set of feasible outcomes that—for these two players—are Pareto efficient, their behavior is determined by a Nash bargain.

4 | POTENTIAL HOLD-UP ($t = 2$)

Solving by backward induction, we first take price P_1 as given and focus on time $t = 2$. If $P_1 > P^H$ hold-up takes place, in which case B_2 demands a payment, either in the form of a tax or in the form of a bribe. If $P_1 \le P^H$ there is no hold-up at $t = 2$ and so $T = b_2 = 0$. In the hold-up case, given the linearity of u_2, if bureaucrat B_2 eschews bribery, that is, if $b_2 = 0$, s/he will wish to negotiate as high a tax T as possible. Similarly, if, B_2 is willing to take at least \$1 of bribe then, s/he will instead wish to negotiate as high a bribe b_2 as possible. As we saw in Section 2, if corruptibility $\kappa > 0$, B_2 prefers to take a bribe, and so $T = 0$; but, if $\kappa \le 0$, B_2 prefers to negotiate a tax $T > 0$.

Given the price P_1 agreed at $t = 1$, we assume that a Nash bargain takes place between bureaucrat B_2 and the investor.[16] This gives the following solution for $t = 2$.

Lemma 2. *Assume hold-up is feasible, that is, $P_1 > P^H$. Then*

i. *If $\kappa \le 0$, $b_2 = 0$ and*

$$T = (1-\alpha)\left(P_1 - P^H\right) + \frac{\gamma}{2}W \equiv T^*(P_1) > 0.$$

ii. *If* $\kappa > 0$, $T = 0$ *and*

$$b_2 = \frac{1}{2}\left[(1-\alpha)(2-\kappa)\left(P_1 - P^H\right) + \gamma W\right] \equiv b_2^*(P_1) > 0.$$

Thus, the charge to the investor—whether as a bribe or a tax—is increasing in the price P_1 agreed at $t = 1$, but at a rate of less than one-for-one:

$$\begin{aligned} &T^{*\prime}(P_1) = 1-\alpha \in (0,1); \\ &b_2^{*\prime}(P_1) = \frac{1}{2}(1-\alpha)(2-\kappa) \in (0,1). \end{aligned} \tag{8}$$

Intuitively, $b_2^*(P_1)$ is related negatively to corruptibility κ. This is because, for given P_1, domestic welfare if the investor runs the project is smaller than it would be if there were direct expropriation (this is what makes the threat credible). A lower level of corruptibility κ inflates the negative impact on u_2 of not expropriating. As a result, the size of the bribe $b_2(P_1)$ that the investor must pay in the Nash bargaining solution to prevent expropriation, is larger. If, for any P_1, the compensation parameter α is greater, then T or b_2, as appropriate, is smaller. Since compensation C is greater, the utility to B_2 of direct expropriation is smaller. Consequently, the Nash-bargaining payment that the investor must pay with hold-up is smaller.

5 | THE INITIAL AGREEMENT ($t = 1$)

In negotiations at $t = 1$ bureaucrat B_1 and the investor will anticipate how potential hold-up at $t = 2$ will depend on first-period price P_1. It follows from Lemma 2 that, when $P_1 > P^H$, so that hold-up will occur, we may write the net price as

$$P = \begin{cases} P_1 - T^*(P_1) & \text{if } \kappa \le 0,\ P_1 > P^H; \\ P_1 & \text{otherwise.} \end{cases}$$

Subsuming T and P_1 into P, we can write $\Pi \equiv \Pi(b_2) = P - K - W - b_1 - b_2$ and $u_1 \equiv u_1(b_2) = b_1 + \theta b_2 + (1-\kappa)(1-P)$. Henceforth, we therefore work directly in the net price P in our derivations. As $\lim_{P_1 \downarrow P^H} T^*(P_1) = \gamma W/2$, the critical net price above which hold-up occurs, $\underline{P}$, is given by

$$\underline{P} = \begin{cases} P^H - \dfrac{\gamma W}{2} & \text{if } \kappa \le 0; \\ P^H & \text{otherwise.} \end{cases}$$

Behavior at $t = 2$ implies that the total surplus to be bargained over at $t = 1$ is given by

$$S_1(P) = \begin{cases} \Pi\left(b_2^*(P)\right) + u_1\left(b_2^*(P)\right) & \text{if } \kappa > 0,\ P \in (\underline{P}, 1]; \\ \Pi(0) + u_1(0) & \text{otherwise.} \end{cases} \tag{9}$$

Using (1) and (6), it can be seen that $S_1(P)$ is independent of b_1, for this variable acts in a purely redistributive manner between B_1 and the investor. This is in contrast to P, which affects the size of the surplus as well as how it is distributed. It is instructive to note how b_2 and T affect the surplus. From (1), (6), and (9),

$$\frac{\partial S_1(P)}{\partial b_2} = \begin{cases} -(1-\theta) \leq 0 & \text{if } \kappa > 0,\ P \in (\underline{P}, 1]; \\ 0 & \text{otherwise.} \end{cases} \tag{10}$$

$$\frac{\partial S_1(P)}{\partial T} = \begin{cases} -\kappa \geq 0 & \text{if } \kappa \leq 0,\ P \in (\underline{P}, 1]; \\ 0 & \text{otherwise.} \end{cases} \tag{11}$$

Equation (10) clarifies that when B_2 obtains a higher bribe from the investor, this yields (weakly) a collective loss to B_1 and the investor. As the bribe does not affect domestic welfare, the only impact on u_1 is the value $\theta \leq 1$ that B_1 puts on each unit of bribe paid to B_2. Thus B_1's additional utility is (weakly) outweighed by the investor's unit loss of profit. By contrast, when B_2 levies a tax, this yields (weakly) a collective gain to B_1 and the investor.

This finding has important consequences for the model. Noting from Lemma 2 that $\lim_{P \downarrow \underline{P}} b_2^*(P) = \lim_{P \downarrow \underline{P}} T^*(P) = \gamma W/2 > 0$, there is a discrete jump in the surplus when P is raised above $\underline{P}$ so that hold-up will occur. When $\kappa > 0$ there is a jump upward in b_2 (from 0). This, in turn, causes a discrete fall in the surplus available to B_1 and the investor. When $\kappa \leq 0$ there is instead a jump upward in T. This, in turn, causes a discrete increase in the surplus available to B_1 and the investor.

The discrete change in the surplus as P is raised above $\underline{P}$ is proportional to γW. Focusing on the case in which the surplus falls ($\kappa > 0$), if γW is sufficiently small then the loss in surplus is too small to deter B_1 and the investor from negotiating a price above P^H, if they would otherwise wish to. This is necessarily the case in the limit if the government is almost as efficient as the firm in running the project ($\gamma \downarrow 0$). If γW is sufficiently large, however, then B_1 and the investor will negotiate a price at least as low as $\underline{P} = P^H$, so that hold-up will not occur. To permit the simplest exposition of our main findings, we now focus on the case with $\gamma \downarrow 0$, before briefly considering the case of more inefficient government provision (larger γ) in Section 7.

First, however, we narrow down the range of potential solutions for price P.

Lemma 3. *The Nash product for B_1 and the investor is maximized on $P \in [K + W, P^H]$ at $P = P^H$ and is increasing in P for $P \downarrow P^H$.*

In the absence of hold-up, the Nash product is strictly concave and is maximized at $P = (1 + K + W)/2$. From Lemma 1 $P^H < (1 + K + W)/2$, and so on $P \in [K + W, P^H] P = P^H$ is optimal. When $P \downarrow P^H$, the Nash product is continuous through P^H and still increasing. Until Section 7, therefore, we may limit attention to $P > P^H$, hold-up always occurring.

5.1 | Bribe negotiation

The bribe b_1 plays a purely redistributional role for bureaucrat B_1 and the investor, leaving the total surplus S_1 unchanged. Taking into account how the solution at $t = 2$ depends on P, the Nash product in the bargain between these two players is maximized if b_1 is set such that the surplus $S_1(P)$ is split equally. We constrain b_1 to be nonnegative, however, and so this solution may not be feasible. Consider the level of P at which, in the absence of a bribe b_1, $\Pi = u_1$. Starting at $b_1 = 0$, if P is below this critical level, $\Pi > u_1$, in which case an increment to b_1 would raise the Nash product. However, for P above this critical level, $\Pi < u_1$, a decrement to b_1 would raise the Nash product. Thus, only at a sufficiently high price P will B_1 secure a positive bribe in the bargaining solution.

Now suppose the bribe that splits the surplus equally is positive. The bargaining outcome is then described by the first-order conditions

$$\frac{\Pi(0)}{S_1(P)} = \frac{1}{2}; \quad \kappa \leq 0; \tag{12}$$

$$\frac{\Pi\left(b_2^*(P)\right)}{S_1(P)} = \frac{1}{2}; \quad \kappa > 0. \tag{13}$$

Denote the bribe b_1 that satisfies these conditions by $b_1^*(P)$. Then, using (1), (6), (9) and Lemma 2,

$$b_1^*(P) = \begin{cases} \frac{1}{2}[(2-\kappa)(P-K-W)-(1-\kappa)(1-K-W)] & \text{if } \kappa \leq 0; \\ \frac{1}{2}\left[(2-\kappa)(P-K-W)-(1-\kappa)(1-K-W)-(1+\theta)b_2^*(P)\right] & \text{if } \kappa > 0. \end{cases} \tag{14}$$

Note that, for a given level of P, bribe b_1 is *lower* when corruptibility $\kappa > 0$ than when $\kappa \leq 0$. If $\kappa > 0$ the bribe b_2 is paid, and this constitutes a leakage to the third player, B_2, from the surplus $S_1(P)$. Thus the investor is not willing to pay so much to B_1. In contrast, when $\kappa \leq 0$ the tax T is paid, each unit of which has a utility $\eta(1+\theta)$ to B_1 and an impact -1 on the investor's profit. With $\kappa = 1-\eta(1+\theta) \leq 0$, $S_1(P)$ (weakly) increases by $-\kappa$. If instead the constraint on b_1 binds, the bargaining outcome satisfies $b_1 = 0$ and $\Pi/S_1 < 1/2$.

Let $\hat{P}$ denote the price P above which B_1 secures a positive bribe. As specified in the next lemma, such a price always exists for $\kappa > 0$, whereas for $\kappa \leq 0$ it exists if an additional condition, which we assume to hold, is fulfilled.

Lemma 4. *If* $\kappa > 0$, *or if* $\kappa \leq 0$ *and*

$$1-K-W < (1-\alpha)(1+\theta)\left(1-P^H\right),$$

then there exists a $\hat{P} \in (K+W, 1)$ *such that* B_1 *will not take a bribe if* $P \leq \hat{P}$, *but will take a bribe if* $P > \hat{P}$.

For $P > \hat{P}$, given (8), the comparative statics of b_1 with respect to price are

$$b_1^{*\prime}(P) = \begin{cases} \frac{2-\kappa}{2} \in (1, 1-\kappa) & \text{if } \kappa \leq 0; \\ \frac{1}{2}\left\{(2-\kappa)-(1+\theta)b_2^{*\prime}(P)\right\} \in (0,1) & \text{if } \kappa > 0. \end{cases} \tag{15}$$

Accordingly, the first-period optimal bribe is increasing in price. When corruptibility is nonpositive, $b_1^*(P)$ increases by more than one-for-one in price.

5.2 | Price negotiation

We now consider the effects of a marginal increase in P on Π and u_1, the respective payoffs of the investor and B_1. For the investor, these follow from (1), (8), and (15) and are given by

$$\Pi'(P) = \begin{cases} 1 > 0; & \text{if } \kappa \leq 0,\ P \leq \hat{P}; \\ 1-b_1^{*\prime}(P) < 0 & \text{if } \kappa \leq 0,\ P > \hat{P}; \\ 1-b_2^{*\prime}(P) > 0 & \text{if } \kappa > 0,\ P \leq \hat{P}; \\ 1-b_1^{*\prime}(P)-b_2^{*\prime}(P) \gtreqless 0 & \text{if } \kappa > 0,\ P > \hat{P}. \end{cases} \tag{16}$$

A higher level of P has a one-for-one effect on profit, but the endogenous variation of bribe levels must also be taken into account. If $P \leq \hat{P}$, so that $b_1 = 0$, as in the first and third rows of (16), the investor always benefits from a price increase, as this more than offsets the extra bribe (if any) to be paid to B_2. If $P > \hat{P}$, so that $b_1 > 0$, the sign of the effect on profit of a higher price depends on the sign of corruptibility κ. When $\kappa \leq 0$, so that $b_2 = 0$, but $b_1 > 0$, as in the second row, the bribe b_1 responds more than one-for-one with the price, so the investor actually prefers a lower price. When, however, $\kappa > 0$, as in the fourth row, with both bribes positive the effect could be of either sign depending on the strength of the bribe responses to a price increase.

The corresponding incentives for B_1 are more complicated than those for the investor. Using (6), along with (8) and (15), we have

$$u_1'(P) = \begin{cases} -(1-\kappa) < 0 & \text{if } \kappa \leq 0,\ P \leq \hat{P}; \\ b_1^{*\prime}(P) - (1-\kappa) < 0 & \text{if } \kappa \leq 0,\ P > \hat{P}; \\ \theta b_2^{*\prime}(P) - (1-\kappa) \gtrless 0 & \text{if } \kappa > 0,\ P \leq \hat{P}; \\ b_1^{*\prime}(P) + \theta b_2^{*\prime}(P) - (1-\kappa) \gtrless 0 & \text{if } \kappa > 0,\ P > \hat{P}. \end{cases} \tag{17}$$

As P affects domestic welfare negatively, an increase in P has a (weakly) negative impact on B_1's utility, as shown by the term $-(1-\kappa)$ in all rows. When corruptibility κ is nonpositive, as in the first two rows, so that B_2 chooses to levy a tax, B_1 will prefer a lower price. In this case, any additional bribe would be insufficient to compensate B_1 for the disutility felt from the loss of domestic welfare. When corruptibility κ is positive, however, $u_1'(P)$ may take either sign. As shown in the third row of (17), if $P \leq \hat{P}$, so that $b_1 = 0$, the increase in B_2's bribe yields B_1 a utility of θ per unit. As shown in the fourth row, if $P > \hat{P}$, so that $b_1 > 0$, B_1 benefits directly from an increase in b_1 as well as indirectly from the increase in b_2. In these latter two cases, therefore, given that B_1 also experiences the disutility $1-\kappa$ for each unit of domestic welfare forgone, there exists a critical level of corruptibility below which B_1 prefers a lower price. This is specified in the following lemma.

Lemma 5. i. *If $\kappa > 0$ and $P \leq \hat{P}$—so that b_1 is constrained to be zero, as in the third row of Equation (17)—then B_1 prefers a lower price P if and only if*

$$\kappa < 2\left[1 - \frac{1}{2-\theta(1-\alpha)}\right] \equiv \kappa_1 \in (0,1].$$

ii. *If $\kappa > 0$ and $P > \hat{P}$—so that $b_1 > 0$, as in the fourth row of Equations (16) and (17)—then both the investor and B_1 prefer a lower price P if and only if*

$$\kappa < 2\left[1 - \frac{2}{2+(1-\theta)(1-\alpha)}\right] \equiv \kappa_2 \in (0,\kappa_1).$$

Since $\kappa_1 > \kappa_2$, if B_1 prefers a lower price when $b_1 > 0$, s/he will also prefer a lower price when $b_1 = 0$. Note that part (ii) of the lemma applies to both the investor and B_1. The alignment of the interests of the investor and B_1 is a general feature of the model when $b_1 > 0$, as there is then a clean division of duties between P and b_1 in attaining a Nash bargaining solution. Specifically, for each P, b_1 can be chosen to distribute the surplus equally between the investor and bureaucrat according to the first order conditions (12) and (13). Knowing each will receive half the surplus, both parties then desire that P be chosen to maximize the surplus.

κ_2 is the value of κ that makes the surplus S_1 independent of P. More generally, as implied by the lemma,

$$\kappa \gtreqless \kappa_2 \Leftrightarrow S_1'(P) \gtreqless 0. \tag{18}$$

Since $S_1 = \Pi + u_1$, (18) can be verified by adding the corresponding rows of (16) and (17). Note that κ_2 is itself a function of θ: centralization θ has an independent role in determining the results, in addition to being a component of corruptibility κ.

To locate the bargaining outcome for price we consider each of the "local" bargaining solutions that apply in the different regions of the model. To do this, in Figure 2 we pull together the information in (16) and (17). The figure partitions (κ, P)-space into a set in which $u_1'(P) < 0$ and $\Pi'(P) < 0$ (denoted "−: −"); a set in which $u_1'(P) < 0$ and $\Pi'(P) > 0$ (denoted "−: +"); and a set in which $u_1'(P) > 0$ and $\Pi'(P) > 0$ (denoted "+: +").[17]

From (16) and Lemma 2, variation of P and of κ has opposite effects on b_1. Starting at a point on either $\hat{P}$-segment in the figure, so that $b_1 = 0$, suppose κ is increased marginally. Because this translates into a decrease in total care $\eta(1+\theta)$ for domestic welfare, it reduces u_1. To restore equal payoffs for B_1 and the investor, b_1 would therefore have to become positive. To return to the $\hat{P}$-segment, a negative impact on b_1 is required, which is achieved by lowering P. Thus, each segment of $\hat{P}$ is negatively sloped.

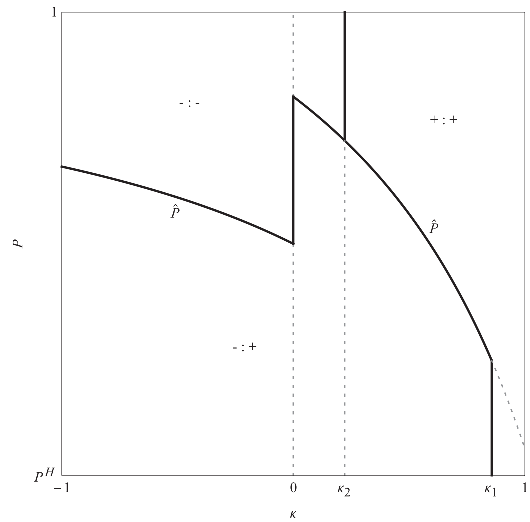

FIGURE 2 Price incentives in (κ, P)-space. Regions are labeled in the format sign (u_1'): sign (Π')

The same argument applies if κ begins at a value just below 0 and changes to a value just above 0, but there is an additional discrete effect. The bribe $b_2 > 0$ then applies, which is a leakage from the surplus S_1. This has a discrete negative impact on b_1, and so to restore b_1 to zero a discrete increase in P is necessary, resulting in the discontinuity in $\hat{P}$ in the figure.

For given κ, any P such that $u_1'(P) < 0$ and $\Pi'(P) < 0$ (as occurs when P is relatively large and κ relatively small) does not belong to the domain of the Pareto frontier, and can therefore be ruled out as a bargaining outcome.

On the interval of P for which $u_1'(P) > 0$ and $\Pi'(P) > 0$ (which occurs at relatively high levels of both P and κ) it is a Pareto improvement for both parties to raise the price to the maximum price on the interval. The maximal P is therefore the only candidate for the local bargaining outcome.

On the interval of P for which $u_1'(P) < 0$ and $\Pi'(P) > 0$ the Nash product is strictly concave, and therefore attains a maximum (albeit this may not be interior). As shown in Figure 2, this occurs when $\kappa \leq \kappa_1$ and $P \leq \hat{P}$ (and so $b_1 = 0$). In this region the bargaining solution differs according to the sign of κ. When $\kappa \leq 0$ an interior bargaining outcome exists and is the solution to the first-order condition

$$\frac{\Pi(0)}{S_1(P)} = \frac{1}{2-\kappa}. \tag{19}$$

This condition obtains because in a Nash bargain where the agent that makes the transfer places a value of $z_P > 0$ on an additional unit of transfer, while the agent that receives the transfer places a value of $z_R < 0$ on each unit received, the solution results in the share $z_P/(z_P - z_R)$ of the surplus for the paying agent. In the present case there is no bribery and hold-up occurs through the requirement of paying tax T. The investor values additional profit one-for-one, while B_1 places a value $-\eta(1+\theta) = -(1-\kappa)$ on each unit of price.

When $\kappa \in (0, \kappa_1)$ an interior bargaining outcome, if it exists, is the solution to the first order condition

$$\frac{\Pi\left(b_2^*(P)\right)}{S_1(P)} = \frac{\Pi'}{\Pi' - u_1'}, \tag{20}$$

where

$$\Pi' = 1 - b_2^{*\prime}(P) > 0; \tag{21}$$

$$u_1' = \theta b_2^{*\prime}(P) - (1-\kappa) < 0. \tag{22}$$

In this case $b_1 = 0$ but $b_2 > 0$. From (8), $b_2^{*\prime}(P)$ is independent of both P and θ. The right-side of (20) is therefore constant. To explain (20)–(22), note first that a unit increase in P has both a direct effect on the payoffs of the investor and B_1, and an indirect effect through the endogenous adjustment of $b_2^*(P)$. The first term on the right-side of (21) is the direct effect on Π, and the second term shows the loss from the induced higher level of bribe paid to B_2. Equation (22) shows similar effects for B_1, although here the weights in the utility function (6) apply: the increase in $b_2^*(P)$ is weighted by θ, while for the higher price the weight $\eta(1+\theta) = 1-\kappa$ applies. The net impact of these factors is that P is adjusted so that the investor receives the proportion of the surplus shown in (20).[18]

6 | THE BARGAINING SOLUTION

We are now in a position to state the "global" bargaining solution:

Proposition 1. *The Nash bargaining solution if government provision would be almost efficient is as follows*:

i. *If* $\kappa \in [\kappa_2, 1]$, *then*

$$P = P_1 = 1; \quad b_1 = b_1^*(1) > 0; \quad b_2 = b_2^*(1) > 0.$$

ii. *If* $\kappa \in (0, \kappa_2)$, *then*

$$P = P_1 = \frac{1+K+W}{2} - \frac{\Pi' u_1\left(\frac{1+K+W}{2}\right) + u_1' \Pi\left(\frac{1+K+W}{2}\right)}{2u_1'\Pi'} \equiv P_{ii};$$

$$b_1 = 0; \quad b_2 = b_2^*(P_{ii}) > 0;$$

where $\{\Pi', u_1'\}$ *are given by* (21) *and* (22).

iii. *If* $\kappa \leq 0$, *then*

$$P = P_1 - T^*(P_1) = \frac{1+K+W}{2}; \quad b_1 = b_2 = 0.$$

With sufficiently high corruptibility (as in part (i) of the proposition), both bureaucrats secure positive bribes. With moderate corruptibility (as in part (ii)) only bureaucrat B_2 secures a positive bribe; bureaucrat B_1 is not bribed. With nonpositive corruptibility, neither bureaucrat is bribed. We shall refer to the three types of solution as the "full-bribery," "partial-bribery," and "no-bribery" cases, respectively.

The full-bribery case (i) results from high corruptibility $\kappa \in [\kappa_2, 1]$, with the bargaining solution characterized by hold-up, a maximal project price, and both B_1 and B_2 securing positive bribes. The interval $\kappa \in [\kappa_2, 1]$ can be partitioned into the subintervals $\kappa \in [\kappa_2, \kappa_1)$ and $\kappa \in [\kappa_1, 1]$. On the latter interval, Figure 2 shows that both B_1 and the investor always prefer a higher price, so the Nash product is monotone in P. On the former interval, Figure 2 shows that, although both B_1 and the investor prefer a higher price for $P \geq \hat{P}$, their interests over P conflict for $P < \hat{P}$. The proof of Proposition 1 establishes that, nevertheless, the Nash product is monotone on $P \in (K+W, \hat{P})$, and therefore globally monotone. As such, although the constant κ_1 is of importance in developing the intuitions behind the model, it plays no role in the characterization of the bargaining outcome.

The partial-bribery case (ii) holds when there is moderate corruptibility $\kappa \in (0, \kappa_2)$; the Nash product is strictly concave and nonmonotone on $P \in (K+W, \hat{P})$, such that the first-order condition in (20) admits an interior solution. This is the unique bargaining outcome as neither B_1 nor the investor wish to agree a price $P > \hat{P}$. Accordingly, although corruptibility is positive, B_1 nevertheless behaves honestly in the bargaining solution. Note that, unlike in the other two cases, price in this case not constant: P_{ii} is a function of $\{\eta, \theta\}$.

The no-bribery case (iii) obtains when corruptibility is nonpositive. With neither B_1 nor B_2 taking a bribe, the bargaining outcome is instead the solution to (19), at which B_2 levies a tax on the investor. This is the same solution as would be found if the bureaucrats eschewed bribery on principle.

An immediate implication of Proposition 1(ii) is the following:

Corollary 1. *$P_{ii} \gtrless \frac{1+K+W}{2}$ as*

$$\Pi' u_1\left(\frac{1+K+W}{2}\right) + u_1'\Pi\left(\frac{1+K+W}{2}\right) \gtrless 0. \tag{23}$$

It might have been expected that for transitions across the three cases in Proposition 1 P would be greatest with full bribery, lower with partial bribery, and lowest with no bribery. Interestingly, however, the corollary confirms that it is possible that the lowest price occurs with partial bribery. In particular, when (23) is negative at $\kappa = 0$ then P, having fallen from 1 at high κ to below $(1 + K + W)/2$ at $\kappa = 0$, jumps discretely *upward* for κ below zero. This result is driven by different impacts on the surplus S_1 of varying P when there is a bribe and when there is taxation at $t = 2$. In the partial bribery case, with $b_2 > 0$ as part of the bargaining solution, a marginal increase in P causes bribe b_2 to be larger, which increases the leakage in the surplus available to B_1 and the investor. This limits the incentive to set a relatively high price. In contrast, in the no-bribery case tax is part of the bargaining solution, and, from (8) and (11), a higher P is associated with a higher tax and larger surplus.

To understand the direction of the price jump for κ below zero the condition in Corollary 1 must be evaluated at this point.

Lemma 6. *There exists $\eta_c \in \left(\frac{1}{2}, 1\right)$ such that the direction of the price jump below $\kappa = 0$ (from P_{ii} to $(1+K+W)/2$) is upward if and only if $\eta > \eta_c$.*

The possibility that P is nonmonotone in κ has important implications for the relationship between P and care η for domestic welfare. To analyze these implications it is necessary to understand at a detailed level the role of $\{\eta, \theta\}$ in the bargaining solution.[19] This cannot be inferred straightforwardly from Proposition 1 for, as we have noted, θ does not only appear in κ; the critical level κ_2 is also a function of θ. Moreover, for a given η, independent variation of θ can only vary corruptibility on the interval $\kappa \in [1 - 2\eta, 1 - \eta]$ and, similarly, independent variation of η for a given θ can only vary corruptibility on the interval $\kappa \in [0, 1 + \theta]$. Accordingly, some outcomes in Proposition 1 are infeasible for some parameter ranges.

The first insight not immediate from Proposition 1 is the important role of α, the responsiveness of compensation, in determining the shape of the set of $\{\eta, \theta\}$ for which $\kappa \in (0, \kappa_2)$. We therefore split the results into two parts according to the size of α.

Proposition 2A. *When $\alpha \geq \frac{1}{3}$ the bargaining solution depends on care η for domestic welfare as follows:*

i. *If $\eta = 1$ then $P = \frac{1+K+W}{2}$.*
ii. *If $\eta \in \left[\frac{1+\alpha}{3-\alpha}, 1\right)$ then $P = P_{ii}$ if $\theta < \frac{1-\eta}{\eta}$ and $P = \frac{1+K+W}{2}$ otherwise.*
iii. *If $\eta \in \left[\frac{1}{2}, \frac{1+\alpha}{3-\alpha}\right)$ then there exists a unique $\hat{\theta} \in \left(0, \frac{1-\eta}{\eta}\right)$ such that if $\theta \leq \hat{\theta}$ then $P = 1$; if $\theta \in \left(\hat{\theta}, \frac{1-\eta}{\eta}\right)$ then $P = P_{ii}$; and if $\theta \geq \frac{1-\eta}{\eta}$ then $P = \frac{1+K+W}{2}$.*
iv. *If $\eta < \frac{1}{2}$ then $P = 1$.*

The proposition is illustrated in Figure 3, which plots the $\kappa = 0$ and $\kappa = \kappa_2$ loci. Above $\kappa = 0$, $P = (1 + K + W)/2$. Between the two loci $P = P_{ii}$, while below the $\kappa = \kappa_2$ locus $P = 1$.

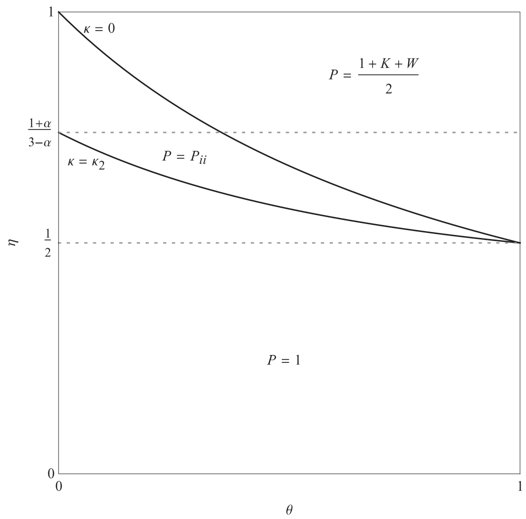

FIGURE 3 The bargaining outcome in (κ, η)-space when $\alpha \geq 1/3$

In this proposition α is relatively large, the key feature being that when $\alpha \geq 1/3$ the $\kappa = \kappa_2$ locus is downward-sloping in θ, as seen in the figure. To understand the shape of the $\kappa = \kappa_2$ locus, recall that $\kappa \gtreqless \kappa_2 \Leftrightarrow S_1'(P) \gtreqless 0$, where, using (1) and (6),

$$S_1'(P) = \kappa - (1-\theta) b_2^{*\prime}(P). \tag{24}$$

The first term in (24) is the marginal utility from a fall in domestic welfare, whereas the second term is the marginal leakage of surplus to B_2. Importantly, $\partial b_2^{*\prime}(P)/\partial\alpha < 0$, implying that, for higher α, b_2^* becomes less price-responsive (thereby reducing the marginal leakage). The interaction $\partial^2 b_2^{*\prime}(P)/\partial\theta\partial\alpha$ is also negative, so the marginal leakage becomes less sensitive to centralization with α. From (8) and (24), it is found that

$$\frac{\partial S_1'(P)}{\partial \eta} = -(1+\theta)\left[1 + (1-\theta)\frac{1}{2}(1-\alpha)\right] < 0; \tag{25}$$

$$\frac{\partial S_1'(P)}{\partial \theta} \gtrless 0 \Leftrightarrow \theta \gtrless \frac{1}{1-\alpha} - \frac{1}{2\eta}. \tag{26}$$

Equation (25) confirms that, beginning at $S_1' = 0$, an increase in η turns S_1' negative. Equation (26) confirms that to restore $S_1' = 0$ may require θ either to be increased or decreased. As the threshold θ in (26) is an increasing function of α, for sufficiently high α, $\partial S_1'(P)/\partial\theta < 0$. In this case, therefore, one must *decrease* θ to return to $S_1' = 0$, consistent with Proposition 2A.

The second insight emerging from Proposition 2A is that, whereas in the analyses of Shleifer and Vishny (1993) and Waller et al. (2002) centralization necessarily shapes the equilibrium outcome actively, in our model the role of θ is importantly conditioned by the level of concern for domestic welfare, η. As seen in Figure 3, for η sufficiently low, θ plays no role in shaping the bargaining solution. For η sufficiently high, θ plays an active but limited role, as it can only induce price to switch from P_{ii} to $(1 + K + W)/2$. It is only at intermediate levels of η, $\eta \in \left[\frac{1}{2}, \frac{1+\alpha}{3-\alpha}\right)$, that centralization is highly influential in the model. In particular, on this interval, it is seen that all three price outcomes in Proposition 1 are feasible for given η. Note also that the effect is asymmetric: extreme values of θ do not limit the role of η in the same way.

A final set of insights from Proposition 2A arise when considering the price transitions as $\{\eta, \theta\}$ are raised separately. In light of Lemma 6, the nature of these price transitions is affected critically by the location of η_c. We focus on one of the most interesting possibilities, when η_c lies on the intermediate range of η, $\eta \in \left[\frac{1}{2}, \frac{1+\alpha}{3-\alpha}\right)$. This case is depicted in Figure 4, which covers the parameter ranges assumed in parts (ii) and (iii) of Proposition 2A. The figure shows the loci $\kappa = 0$, $\kappa = \kappa_2$, and $P_{ii} = (1 + K + W)/2$ such that condition (23) in Corollary 1 is exactly zero. The critical value η_c is therefore indicated at the η for which the $\kappa = 0$ and $P_{ii} = (1 + K + W)/2$ loci intersect.

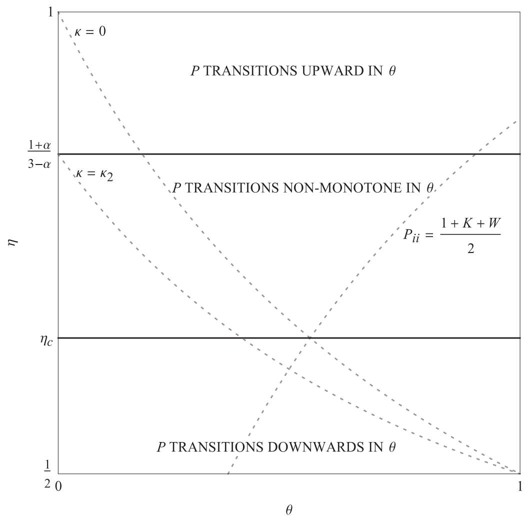

FIGURE 4 The bargaining outcome when $\eta \in (1/2, 1)$ and $\eta_c \in (1/2, (1+\alpha)/(3-\alpha))$. Indicated are the regions for which price transitions are increasing, decreasing, and nonmonotone in θ

Consider increasing θ in Figure 4, beginning at $\theta = 0$, for $\eta \in \left[\eta_c, \frac{1+\alpha}{3-\alpha}\right)$. We see that price transitions are nonmonotone in centralization. Initially $P = 1$, before transitioning downwards to price $P = P_{ii} < 1$. But, when θ is such that $\kappa = 0$ the price jumps discretely upward to $P = (1+K+W)/2$. This discrete jump arises as B_2 switches discretely from demanding a (surplus-leaking) bribe, to instead demanding a (surplus-enhancing) tax.

As well as the possibility of nonmonotone price transitions, it is apparent from studying Figure 4, when allowing θ to vary for (i) different levels of η, and (ii) η_c to be either above or below $\eta = \frac{1+\alpha}{3-\alpha}$, that a range of outcomes are possible, including the possibilities that price is independent of θ (for η sufficiently low), that price transitions are all upward, or that price transitions are all downward. Thus, the interplay between $\{\eta, \theta\}$, further mediated by α, is sufficient to drive a potentially complex relationship between price (and therefore ultimately domestic welfare) and centralization.

Nonmonotone price transitions are also possible as η is varied independently. According to Figure 3, as η is raised, price transitions (downwards) from 1 to P_{ii}, and then from P_{ii} to $(1+K+W)/2$. If θ is to the left of the $P_{ii} = (1+K+W)/2$ locus in Figure 4 the latter transition is upward (implying a nonmonotone pattern) and downwards otherwise.

In Proposition 2B, we assume that α is smaller than in 2A. This might reflect a greater sensitivity of compensation to fixed costs or an element of fixed penalty in compensation.

Proposition 2B. *When $\alpha < \frac{1}{3}$ (b_2 more price-responsive) the bargaining solution depends on care η for domestic welfare as follows*:

i. *If $\eta = 1$ then $P = \frac{1+K+W}{2}$.*
ii. *If $\eta \in \left[\frac{1}{2}, 1\right)$ then $P = P_{ii}$ if $\theta < \frac{1-\eta}{\eta}$ and $P = \frac{1+K+W}{2}$ otherwise.*
iii. *If $\eta \in \left(\frac{1+\alpha}{3-\alpha}, \frac{1}{2}\right)$ then there exists a unique $\hat{\theta} \in (0,1)$ such that if $\theta \le \hat{\theta}$ then $P = P_{ii}$, and $P = 1$ otherwise.*

In the subcase $\alpha \le 3 - 2\sqrt{2}$,

iv. *if $\eta < \frac{1+\alpha}{3-\alpha}$ then $P = 1$.*

In the subcase $\alpha \in \left(3 - 2\sqrt{2}, \frac{1}{3}\right)$,

v. *if $\eta \in \left(\eta_1, \frac{1+\alpha}{3-\alpha}\right)$ then there exists $0 < \hat{\theta}_1 < \hat{\theta}_2 < 1$ such that $P = 1$ if either $\theta \le \hat{\theta}_1$ or $\theta \ge \hat{\theta}_2$, and $P = P_{ii}$ otherwise, where*

$$\eta_1 \equiv \frac{(1-\alpha)\left[\alpha + 2\left(1 + \sqrt{2\alpha}\right)\right]}{2(2-\alpha)^2} \le \frac{1}{2}.$$

vi. *If $\eta \in [0, \eta_1]$ then $P = 1$.*

Figure 5a illustrates the proposition, with the exception of part (v), which we discuss separately. Compared to Figure 3, the order of the critical values of η, 1/2, and $(1 + \alpha)/(3 - \alpha)$, is reversed. Importantly, in parts (i)–(iv) α is sufficiently low ($\alpha < 1/3$) that the prior analysis of the slope of the $\kappa = \kappa_2$ locus is turned on its head such that it becomes upward-sloping. As a direct consequence, even for intermediate levels of η, only a single price transition is possible as θ is varied on [0, 1]. With at most one price transition, therefore, at this very low level of α it is not possible to observe nonmonotone patterns of price transition with respect to θ. There remain, nevertheless, two price transitions as η is varied independently, and these may be nonmonotone (depending upon η_c).

The analysis for an intermediate level of α, $\alpha \in (3-2\sqrt{2}, 1/3)$ is similar, but with one crucial difference, which is manifested at intermediate levels of η, $\eta \in \left(\eta_1, \frac{1+\alpha}{3-\alpha}\right)$. Figure 5b, which shows the main result, therefore focuses solely on this interval of η. In this intermediate range α is too small for the $\kappa = \kappa_2$ locus to be everywhere decreasing, and too large for it to be everywhere increasing. Rather, as seen in the figure, the $\kappa = \kappa_2$ locus is approximately U-shaped. Thus, when drawing horizontal lines across Figure 5b, the $\kappa = \kappa_2$ locus is intersected *twice*.

Consequently, price is nonmonotone in θ: the high price $P = 1$ pertains for extreme values of θ, but the lower price P_{ii} applies for intermediate θ. Although the nonmonotonicity explored in Proposition 2A also entails higher prices at extreme levels of centralization, this pattern of nonmonotonicity is qualitatively different in that it involves a transition between just two equilibria, rather than between three. From (26), when θ increases from a relatively low value this causes $S_1'(P)$ to fall, and may change from positive to negative. If so, from (18) we first have $\kappa > \kappa_2$ and then $\kappa < \kappa_2$ and, from Proposition 1, P switches from 1 to P_{ii}. However, again from (26), when θ increases from a relatively high value, $S_1'(P)$ increases, and the sign of $S_1'(P)$ may switch from negative to positive, with a corresponding switch from $\kappa < \kappa_2$ and $P = P_{ii}$ to $\kappa > \kappa_2$ and $P = 1$. The set of parameter values assumed in Proposition 2B(v) is such that these changes in the sign of $S_1'(P)$ occur.

Since domestic welfare $D = 1 - P$, Propositions 2A and 2B (which relate to P) have immediate implications for domestic welfare.

Corollary 2. *Consider a decrease in care η or centralization θ (and thus in total care $\eta(1 + \theta)$). (i) If this increases corruptibility from $\kappa \leq 0$ to $\kappa \in (0, \kappa_2)$ (a transition from a no-bribe to a partial-bribe equilibrium) the effect on domestic welfare D may be of either sign. (ii) If it increases corruptibility from $\kappa \in (0, \kappa_2)$ to $\kappa \in [\kappa_2, 1]$ (a transition from a partial-bribe to a full-bribe equilibrium) there is a negative effect on domestic welfare D. (iii) If $\kappa \leq 0$ or $\kappa \in [\kappa_2, 1]$ (either a no-bribe or a full-bribe equilibrium obtains) then domestic welfare D is unaffected; but if $\kappa \in (0, \kappa_2)$ (a partial-bribe equilibrium still obtains) the effect on domestic welfare is unclear.*

Consider two bureaucracies. In bureaucracy A bureaucrats have an intermediate level of care for domestic welfare, whereas in bureaucracy B bureaucrats care deeply about domestic welfare. Intuition would dictate that, ceteris paribus,

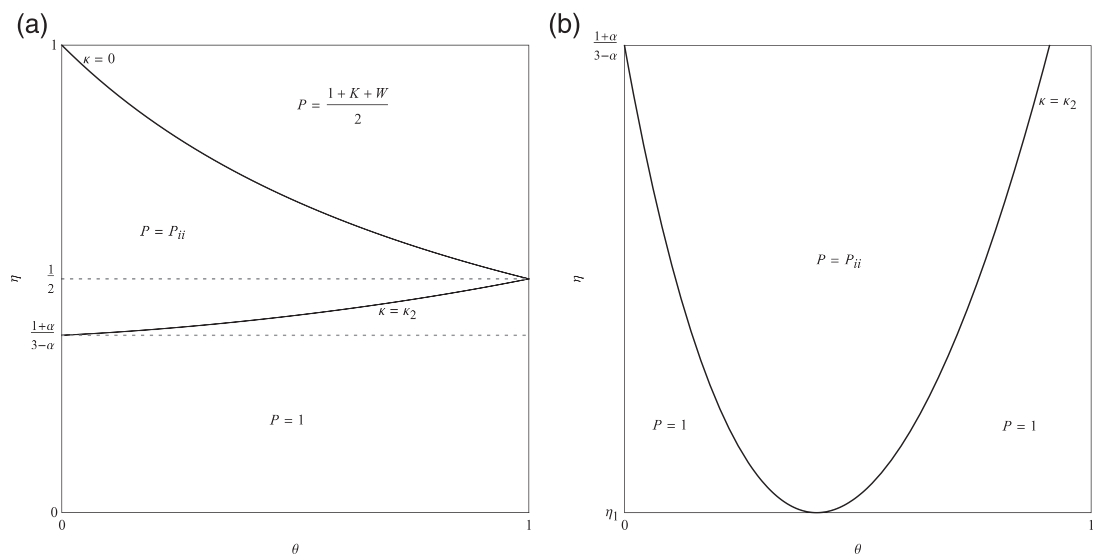

FIGURE 5 (a) The bargaining outcome in (κ, η)-space when $\alpha < 3-2\sqrt{2}$. (b) The bargaining outcome in (κ, η)-space when $\alpha \in (3-2\sqrt{2}, 1/3)$ and $\eta \in (\eta_1, [1+\alpha]/[3-\alpha])$

domestic welfare outcomes would be superior in bureaucracy B relative to bureaucracy A. While Corollary 2 rules-in such intuition, it makes clear that welfare outcomes could nonetheless be better in bureaucracy A. The reason for this is that a transition from a no-bribe to a partial-bribe equilibrium (which occurs at an intermediate level of care) can be associated with a higher project price. This result, when combined with part (i), allows for price transitions to be non-monotone in total care. In particular, the highest and lowest levels of care can be associated with lower welfare outcomes than are attained at intermediate levels of care. We note in part (iii) of the corollary that, for changes in care that move the bargaining outcome within the set of partial-bribe equilibria, tractability precludes a definite statement as to the effect on welfare.

It is worth emphasizing that Corollary 2 embeds two distinct ways in which a similar nonmonotone pattern of welfare transitions to changes in centralization can occur. The first way is via the analysis in Proposition 2A, whereas the (seemingly counter-intuitive) nonmonotonicity in welfare can be traced directly to the seemingly counter-intuitive ordering of the prices in Proposition 1, specifically that $P_{ii} < (1 + K + W)/2$ when $\kappa = 0$. This ordering can, in turn, be accounted for by the price-restraint imposed on the investor and B_1 when raising price causes leakage of the surplus to B_2. By contrast, the second route to nonmonotonicity—that via the analysis of Proposition 2B—holds even when the ordering of the prices in Proposition 1 is in the intuitive direction. It relies only on the way in which centralization interacts with α in determining how the surplus responds to price. Accordingly, even when the ordering of the prices in Proposition 1 is in the intuitive direction, the model still indicates the possibility of a nonmonotone relationship between centralization and welfare.

7 | FURTHER DISCUSSION

A key qualitative implication of the analysis is that the relationship between centralization and domestic welfare can take many shapes, consistent with the mixed evidence found empirically. Consider a researcher with data on welfare and corruption (bribery) in countries with bureaucracies differing in centralization. According to Propositions 2A and 2B, the relationships that will be estimated, both between centralization and corruption, and between corruption and welfare will depend on the prevailing η and α. Our model predicts that, for each relationship, the possible outcomes include the finding of no relationship, the finding of a positive relationship, or the finding of a negative relationship. As a consequence, the overall relationship estimated between centralization and welfare, with corruption as an intermediary, will also depend on both η and α. The possibility of non-monotonicity between centralization and welfare arising from Proposition 2A (high α) derives from non-monotonicity in the relationship between corruption and welfare. The possibility of nonmonotonicity between centralization and welfare arising from Proposition 2B (intermediate α) instead derives from nonmonotonicity in the relationship between centralization and corruption.

We now discuss informally some possible generalizations of our analysis. First we consider the effects of dropping the assumption that the government is only marginally inefficient. We go on to discuss the potential effects of dropping the assumption that the two bureaucrats have the same preferences, and we consider this possibility further by supposing that bureaucrat B_1 has imperfect information regarding B_2's preferences. Then we comment briefly on some changes that might be made to how the investor's behavior is modeled.

If the government were to expropriate the project directly, the running costs would be $(1 + \gamma)W$, where the parameter γ is a measure of its inefficiency. For simplicity, we have assumed that $\gamma \downarrow 0$, as this ensures that hold-up always takes place. If, however, a larger value of γ is allowed, the Nash bargaining product for bureaucrat B_1 and the investor has a finite discontinuity at $P = \underline{P}$. When $\kappa > 0$, as P is raised through $\underline{P} = P^H$ there is a downward step in the Nash bargaining product, and the step is larger when γ is greater.

We have seen that on $P \in [K + W, \underline{P}]$ the Nash bargaining product is maximized at $P = \underline{P}$, which is the highest price at which hold-up will not occur. If we only consider the interval $P \in (\underline{P}, 1]$ then, with minor modifications due to the presence of the term γW in b_2^* and T^*, the analysis in the sections above holds. However, without restriction of P to this interval, for $\kappa > 0$ the Nash bargaining product for any potential solution in this interval must be compared with the Nash bargaining product for $P = P^H$. Because of the finite step down at $P = P^H$ it cannot be discounted a priori that for some parameter values $P = P^H$ will be the global solution. Including this factor in the exposition would complicate it considerably, adding little insight.[20] Nonetheless, if the government would be greatly inefficient at running the project, so that direct expropriation would not be a credible threat, the outcome would be that P takes a lower value, and domestic welfare a greater value, than in the solutions we have analyzed in this paper.

Consider now the effects of extending the analysis so that care for domestic welfare is heterogeneous across the two bureaucrats, such that B_i, $i \in \{1, 2\}$, has care η_i. A full exposition of this case is beyond the scope of the paper, but some indicative points may be made. The analogues of (25) and (26) in this case are given by $\partial S_1/\partial b_2|_{\kappa_2>0} = -(1-\theta) \leq 0$ and $\partial S_1/\partial T|_{\kappa_2 \leq 0} = -\kappa_1 \geq 0$, where $\kappa_i = 1 - \eta_i(1+\theta)$. Thus, the differential effects of b_2 and T on the first-stage surplus (which drive the nonmonotonicity result in Proposition 2A) are still present, but it is only the care of B_1 that plays a role in the effect of T. The marginal surplus, which governs the shape of the $\kappa = \kappa_2$ locus, is now given by $S_1' = \kappa_1 - (1-\theta)b_2^{*\prime}(P;\kappa_2)$. Accordingly, the way in which η_1 affects the marginal surplus is independent of η_2 $(\partial^2 S_1'(P)/\partial\eta_1\partial\eta_2 = 0)$. By contrast, the effect on S_1' from θ is mediated (positively) by η_2 $(\partial^2 S_1'(P)/\partial\theta\partial\eta_2 = \theta(1-\alpha) > 0)$. Noting that $\partial^2 b_2^{*\prime}(P)/\partial\theta\partial\alpha < 0$, increases in η_2 play a role similar to decreases in α. Nonmonotone price transitions eventually disappear for sufficiently low α (Proposition 2B). Accordingly, relative to our analysis with $\eta_1 = \eta_2$, for given η_1 the scope for nonmonotone price transitions appears to be greater when $\eta_2 < \eta_1$, and smaller when $\eta_2 > \eta_1$.

Heterogeneity in the η_i could also be subject to imperfect information. In particular, B_1 may bargain at $t = 1$ not knowing for sure whether B_2 will take a (surplus-leaking) bribe or demand a (surplus-enhancing) tax at time $t = 2$. In this case B_1's uncertainty gradually attenuates the sharp differentiation in the effects of $\{b_2, T\}$ on the surplus around $\kappa_1 = 0$. This makes it less likely, in an a priori sense, that the nonmonotonicity result in Proposition 2A would obtain. It is unclear that this consideration affects importantly the source of nonmonotonicity in Proposition 2B, however.

Other amendments of the model, such as assuming that alternative investors compete for the contract, or making investment an endogenous variable, would require more extensive revisions. However, in the absence of further complications, in each of these cases, after the investment has been sunk, the second period of the model would be the same as in the current formulation. Consequently, we would expect the rationale for bureaucrat B_1 and the investor to collude against the interests of bureaucrat B_2 by holding back price would remain. This factor drives some of our more interesting welfare results, so we expect that, qualitatively, these results would still hold.

8 | CONCLUSION

In this paper we have analyzed bribery and bureaucratic structure in the context of an infrastructure investment by a foreign firm, focusing on equilibria in which the threat of hold-up is insufficient to prevent the investment from occurring. In our model there are two bureaucrats. The first agrees the price for the project with the investor, and the second may then hold up the investor. We characterize our results in terms of bureaucratic corruptibility, which depends on both the care bureaucrats have for domestic welfare and the degree of centralization (i.e., how far the bureaucrats collude with one another).

Intuitively, we might expect less bureaucratic care to be associated with lower domestic welfare. However, we specify ranges of parameter values for which the opposite result holds. The main underlying complication that causes this result is that bureaucrat B_1 and the investor in effect can collude against the interest of bureaucrat B_2 in order to maximize their own bargaining surplus. The impact of less bureaucratic care (greater corruptibility) can be that B_2 chooses to take a bribe. But then B_1 and the investor may prefer to limit the level of the price in order to restrict B_2's leverage for hold-up, thereby restricting the leakage from their surplus in the form of the bribe to B_2; and the lower price translates into greater domestic welfare.

Thus, our analysis reveals a mechanism through which the existence of bribery may be associated with greater domestic welfare. This mechanism is distinct from the grease hypothesis, and may be one of the factors underlying the results of empirical studies that in some cases have detected beneficial effects of corruption in heavily regulated economies.

More generally, we identify parameter ranges on which the relationship of corruptibility with domestic welfare is increasing, on which it is decreasing and on which it is nonmonotone. These results apply for variation in both bureaucratic care and the degree of centralization. The literature on centralization is contradictory, some studies showing a positive, and others a negative, relationship, depending on context. Our analysis emphasizes how the impact of (de)centralization depends on the values of the bureaucrats concerned. The results are straightforward for extreme (high or low) levels of bureaucratic care. But, otherwise, the precise level of care affects whether an increase in the degree of centralization results in greater or smaller domestic welfare. The details of these relationships also depend on the specifics of the outside option for B_2, that is, on the terms on which the threat of direct expropriation are made.

We have discussed briefly the potential effects of dropping some of our simplifying assumptions. Some other complications that we conjecture would not affect the general thrust of our results include the generalization to nonlinear utility functions, and introducing uncertainty with symmetric information, for example over costs and the value of the project output. We would still expect that, for some parameter ranges, bureaucrat B_1 and the investor would in effect collude against the interests of B_2; that complex relationships would hold between bureaucratic care and the degree of centralization on the one hand, and the incidence of bribery and level of welfare on the other; and that the effects of the degree of centralization would be mediated through the degree of bureaucratic care. A more fundamental change, that would require an extensive reformulation, would be to assume asymmetric information with regard to the investor's costs and the value of the project output.

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ENDNOTES

[1] The World Bank's Private Participation in Infrastructure Database contains information on more than 6400 projects dating from 1984. World Bank (2018) lists $43.5bn of current investment commitments.

[2] Specific cases of bribery in infrastructure provision are reported widely in the media. For example, according to *The Economist*, November 17, 2018, Odebrecht, a Brazilian construction firm, was charged with bribing officials in a dozen Latin American countries, including with regard to a $1.6bn contract to build a motorway in Colombia; while Reuters, August 7, 2020 (https://www.reuters.com/article/us-malaysia-politics-idUSKCN25307M) records that Malaysia is charging a former Finance Minister with seeking a bribe in connection with a $1.5bn infrastructure project.

[3] A more disaggregated approach to bribery is taken by Hakkala et al. (2008), who examine the relationship of FDI with measures of corruption in the receiving country. They find (i) that firms which invest in a country to sell there are affected negatively by corruption, and (ii) no effect of corruption on firms that invest in a country to export from it. They do not consider firms undertaking infrastructure investment, however.

[4] We consider the difference between the grease hypothesis and our analysis in Section 2.

[5] Our analysis builds on the framework developed by Bennett and Estrin (2006).

[6] Although not as widespread as investor-led renegotiation (which typically exploits private information), government-led renegotiation is nonetheless common. For example, Guasch et al. (2008) analyze 307 government-led renegotiations in Latin America. They note that in many cases government behavior is opportunistic, aiming to expropriate quasi-rents and sunk investments.

[7] The first bureaucrat may, for example, belong to a government department with an international orientation and have been involved in securing the investment. The second might have a more domestic focus with fiscal responsibilities, or might operate at a regional level.

[8] Hajzler and Rosborough (2016) note that over the period 1990–2014 there were 162 direct expropriations across 44 countries. This suggests that direct expropriation can be a credible threat.

[9] We consider the implications of greater government inefficiency near the end of the paper.

[10] For a detailed overview of the literature on corruption, see Rose-Ackerman and Palifka (2016).

[11] Note, however, that Carrasco (2010) obtains the opposite result in a different theoretical framework. In his model the agent has private information about effort and the impact of effort is uncertain. He finds that separation of two principals is more efficient than integration.

[12] We do not include bribe income in D. This may be interpreted as a value judgment, or it may be assumed to reflect the likelihood that bureaucrats will save and spend bribe income abroad, yielding little domestic benefit. It may also indicate that bureaucrats have expended resources in rent-seeking, up to the value of any bribes paid.

[13] Both bureaucrats are "corrupt" in the sense that they do not reject bribery on principle. Their corruptibility relates to the specific circumstances they each face in the model.

[14] We exclude the possibility that $\alpha = 1$ because the threat of direct expropriation would not then be credible. We also exclude $\alpha = 0$ because the model would then in effect reduce to one period ($t = 2$) for which the price agreed at $t = 1$ would be irrelevant.

[15] If (dropping Assumption 2) we had $P^H = C(P^H) + (1 + \gamma)W \leq K + W$, then any agreed level of P_1 would exceed P^H, so that hold-up would necessarily occur. The restriction that $P^H = C(P^H) + (1 + \gamma)W > K + W$ ensures that whether hold-up is a solution to the model is determined endogenously, through the deal struck by B_1 and the investor. If (dropping Assumption 3) we had $P^H \geq (1 + K + W)/2$, then, either instead of or in addition to a solution with hold-up, a solution without hold-up (where $P_1 = P = (1 + K + W)/2$) would obtain.

[16] As Hermalin and Katz (2009) note for a related bargaining problem with full information, one side might make a take-it-or-leave-it offer, demanding the entire surplus for itself. In our model a take-it-or-leave-it offer might be made by either side. We follow Hart (1995), who, in this situation, assumes that neither side has more bargaining power than the other, so that a standard Nash bargain will obtain.

[17] There is no case in which $u_1'(P) > 0$ but $\Pi'(P) < 0$.

[18] We noted above in connection with κ_2 how θ plays an independent role in the analysis, apart from as a constituent of κ. This independent role can also be seen in (22).

[19] Variation of $\{\eta, \theta\}$ also affects the value of P_{ii}, but the relationship is intractable.

[20] The potential for nonmonotone effects remains in this version of the model. Indeed, when, for intermediate centralization, the price P^H (which always lies below P_{ii}) obtains as part of a bargaining outcome this accentuates any upward price jump for κ below zero.

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SUPPORTING INFORMATION

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APPENDIX

A. PROOFS

Proof of Lemma 1. Let $P_1 = K + W$. Then under Assumption 2 we have $C(K + W) < K - \gamma W$ and so $K + W > C(K + W) + (1 + \gamma)W$. Therefore, expropriation is not a credible threat if $P_1 = K + W$. Under Assumption 3, $(1 + K + W)/2 > C([1 + K + W]/2) + (1 + \gamma)W$, so that expropriation is a credible threat if $P_1 = (1 + K + W)/2$. By Assumption 1, $C(P_1)$ is differentiable on $P_1 \in (K + W, (1 + K + W)/2)$ and therefore also continuous on this interval. Hence, by continuity, there exists a $P^H \in (K + W, [1 + K + W]/2)$ such that $P^H = C(P^H) + (1 + \gamma)W$.

Proof of Lemma 2. Substituting from (6), provision by the investor gives B_2 utility $u_2 = \theta b_1 + b_2 + (1 - \kappa)(1 - P_1 + T)$. The disagreement payoff to B_2 under direct expropriation is $\theta b_1 + \eta(1 + \theta)[1 - C(P_1) - (1 + \gamma)W]$. Add and subtract $C(P^H) + \alpha(P_1 - P^H)$ to rewrite the disagreement payoff as

$$\theta b_1 + (1-\kappa)\left[1-\left[C(P_1)-C\left(P^H\right)-\alpha\left(P_1-P^H\right)\right]-\alpha\left(P_1-P^H\right)-C\left(P^H\right)-(1+\gamma)W\right].$$

Note, first, that the final term, $-C(P^H) - (1 + \gamma)W$, is identically $-P^H$. Second, note that, given Assumption 1, the term $[C(P_1) - C(P^H) - \alpha(P_1 - P^H)]$ is independent of P_1. As this term is zero for $P_1 = P^H$ it is zero for all P_1. The disagreement payoff for B_2 therefore reduces to $\theta b_1 + (1 - \kappa)(1 - \alpha(P_1 - P^H) - P^H)$. The surplus for B_2 is therefore $b_2 + (1 - \kappa)[T - (1 - \alpha)(P_1 - P^H)]$. Using (1), provision by the investor gives a profit $\Pi = P_1 - T - K - W - b_1 - b_2$, while with direct expropriation $\Pi = C(P_1) - K - b_1$. Using the same substitutions as above this rewrites as $\Pi = \alpha(P_1 - P^H) + P^H - K - b_1 - (1 + \gamma)W$. The surplus for the investor is therefore $S_2^I(T, b_2) = (1-\alpha)\left(P_1-P^H\right)-W-T-b_2+(1+\gamma)W$. The sum of the surpluses is therefore $S_2(T) = -\kappa[T-(1-\alpha)(P_1-P^H)]+\gamma W$.

i. If $\kappa \leq 0$ the Nash bargaining solution solves

$$\frac{1}{2-\kappa} = \frac{S_2^I(T,0)}{S_2(T)}.$$

To see that $T > 0$ note that $T = T^*(P_1) > T^*\left(P^H\right) = \frac{\gamma W}{2} > 0$.

i. If $\kappa > 0$ the Nash bargaining solution solves

$$\frac{1}{2} = \frac{S_2^I(0, b_2)}{S_2(0)}.$$

To see that $b_2 > 0$ note that $b_2 = b_2^*(P_1) > b_2^*(P^H) = \frac{\gamma W}{2} > 0$.

Proof of Lemma 3. On $P \in [K + W, P^H]$ the Nash product has derivative (with respect to P) $2\left(\frac{1+K+W}{2} - P^H\right)(1-\kappa) > 0$. This same derivative holds also in the limit as $P \downarrow P^H$ when $\kappa \le 0$. It remains to consider the limit case $P \downarrow P^H$ when $\kappa > 0$. In this case, for $P \downarrow P^H$ we have $\lim_{P \downarrow P^H} b_2^* = 0$ and so the Nash product has derivative $(1-\kappa)(1-P^H)\left[1 - b_2^{*'}(P^H)\right] + (P^H - K - W)\left[\theta b_2^{*'}(P^H) - (1-\kappa)\right]$, where $b_2^{*'}(P^H) = (1-\alpha)(2-\kappa)/2$. This Nash product is minimized with respect to $b_2^{*'}(P^H)$ for $b_2^{*'}(P^H) \downarrow 1$, which occurs for $\kappa \downarrow 0$ and $\alpha \downarrow 0$. Thus, if the Nash product is nonnegative for $b_2^{*'}(P^H) \downarrow 1$ it is nonnegative for all feasible values of $b_2^{*'}(P^H)$. Setting $b_2^{*'}(P^H) \downarrow 1$ the Nash product reduces to $(P^H - K - W)(1-\theta) \ge 0$.

Proof of Lemma 4. (i) Suppose $\kappa \le 0$. Then $b_1^*(P) \gtrless 0 \Leftrightarrow P \gtrless 1 - \left(\frac{1-K-W}{2-\kappa}\right) = \hat{P} \in (K+W, 1)$. (ii) Now suppose $\kappa > 0$. Note that $b_1^*(K+W) < 0$. Then

$$b_1^*(1) \gtrless 0 \Leftrightarrow b_2^*(1) \lesseqgtr 1 - K - W \Leftrightarrow \kappa \gtrless 2 - \frac{2(1-K-W) - (1+\theta)\gamma W}{(1-\alpha)(1+\theta)(1-P^H)} = \kappa_c.$$

The condition in the lemma implies $\kappa_c < 0$. Hence, $\kappa > \kappa_c$ and so $b_1^*(1) > 0$. Then, by continuity, there exists a unique $\hat{P} \in (K+W, 1)$ such that $b_1^*(\hat{P}) = 0$.

Proof of Lemma 5. (i) If $\kappa > 0$ then $u_1'(P) \gtrless 0 \Leftrightarrow \theta b_2^{*'}(P) \gtrless 1 - \kappa$. As $b_2^{*'}(P) = (1-\alpha)(2-\kappa)/2$ it follows that

$$u_1'(P) \gtrless 0 \Leftrightarrow \kappa \gtrless 2\left[1 - \frac{1}{2 - \theta(1-\alpha)}\right].$$

If $\kappa \le 0$ then $u_1'(P) = -(1-\kappa) < 0$. So $u_1'(P) < 0$ for all $\kappa < \kappa_1$. (ii) If $\kappa > 0$ and $P > \hat{P}$ then the surplus is split equally between B_1 and the investor. Both parties then prefer price to be increased or decreased according to whether the surplus is increasing or decreasing in P: $u_1'(P) \gtrless 0 \Leftrightarrow \Pi'(P) \gtrless 0 \Leftrightarrow S_1'(P) \gtrless 0$.Using $S_1'(P) = \kappa - (1-\theta) b_2^{*'}(P)$ and $b_2^{*'}(P) = (1-\alpha)(2-\kappa)/2$ it follows that

$$u_1'(P) \gtrless 0 \Leftrightarrow \Pi'(P) \gtrless 0 \Leftrightarrow \kappa \gtrless 2\left[1 - \frac{2}{2 + (1-\theta)(1-\alpha)}\right].$$

Proof of Proposition 1. (i) Per Figure 2, for $\kappa > \kappa_1$ both B_1 and the investor prefer a higher price, so P is maximal. We now show that the Nash product is also increasing everywhere for $\kappa > \kappa_1 \in [\kappa_2, \kappa_1]$. For $P > \hat{P}$ both B_1 and the investor again prefer a higher price, so it remains to consider the interval $P \le \hat{P}$. The Nash product is increasing on this interval if $\Pi' u_1(\hat{P}) + u_1' \Pi(\hat{P}) \ge 0$. As $P = \hat{P} \Leftrightarrow \Pi(\hat{P}) = u_1(\hat{P})$ it holds that $\Pi' u_1(\hat{P}) + u_1' \Pi(\hat{P}) = (\Pi' + u_1') u_1(\hat{P})$. Next, note that $\Pi' + u_1' \gtrless 0 \Leftrightarrow \kappa \gtrless \kappa_2$. As $\kappa \ge \kappa_2$ we therefore have $(\Pi' + u_1') u_1(\hat{P}) \ge 0$, which completes the proof. (ii) We use a Taylor series expansion of $u_1(P)\Pi(P)$ around $P = (1 + K + W)/2$. For brevity, we write $u_1 = u_1([1+K+W]/2)$, $\Pi = \Pi([1+K+W]/2)$ we have

$$u_1(P)\Pi(P) = u_1\Pi + \left[\Pi' u_1 + u_1'\Pi\right]\left(P - \frac{1+K+W}{2}\right) + u_1'\Pi'\left(P - \frac{1+K+W}{2}\right)^2. \tag{A.1}$$

Differentiating in (A.1) w.r.t. P, and solving the first-order condition, we obtain

$$P=\frac{1+K+W}{2}-\frac{\Pi' u_1\left(\frac{1+K+W}{2}\right)+u_1'\Pi\left(\frac{1+K+W}{2}\right)}{2u_1'\Pi'}\equiv P_{ii}.$$

From the proof of part (i), $P_{ii}<\hat{P}$. To see that $P_{ii}>K+W$, note that this holds if $\Pi' u_1(K+W)+u_1'\Pi(K+W)>0$. This condition holds as $u_1'<0$ and $\Pi(K+W)<0$. (iii) The bargaining solution given in the proposition is the solution to the first-order condition in (19).

Proof of Lemma 6. We write $P_{ii}\equiv P_{ii}(\kappa)$. Then, solving $P_{ii}(0)=(1+K+W)/2$ for η, and determining the appropriate inequality by analysis of derivatives, gives that $P_{ii}(0)\gtrless(1+K+W)/2$ as

$$\eta\lesseqgtr\eta_c\equiv 1-\frac{P^H-K-W}{\alpha\left(1-P^H\right)+(2-\alpha)\left(P^H-K-W\right)}.$$

To see $\eta_c<1$ note that $\eta_c\uparrow 1$ as $P^H\downarrow K+W$. To see $\eta_c>1/2$ note that $\eta_c\downarrow 1/2$ as $\alpha\downarrow 0$.

Proof of Propositions 2A and 2B. If $\eta=1$ then $\kappa=-\theta\leq 0$. To prove the remaining parts, we have $\kappa\geq\kappa_2\Leftrightarrow f(\alpha,\theta,\eta)\equiv 4-[2+(1-\alpha)(1-\theta)][1+\eta(1+\theta)]\geq 0$. $f(\alpha,\theta,\eta)$ attains a global minimum at $\theta=(1-\alpha)^{-1}-(2\eta)^{-1}\equiv\dot{\theta}$. Solving $f\left(\alpha,\dot{\theta},\eta\right)=0$ gives the condition for η_1 in Proposition 2B. Whether $\kappa\geq\kappa_2$ at the boundary values of θ is therefore determined by the inequalities

$$f(\alpha,0,\eta)\gtrless 0\Leftrightarrow\eta\lesseqgtr\frac{1+\alpha}{3-\alpha};$$
$$f(\alpha,1,\eta)\gtrless 0\Leftrightarrow\eta\lesseqgtr\frac{1}{2}.$$

Which of these inequalities binds depends on a comparison between $(1+\alpha)/(3-\alpha)$ and $1/2$, given by

$$\frac{1+\alpha}{3-\alpha}\gtrless\frac{1}{2}\Leftrightarrow\alpha\gtrless\frac{1}{3}.$$

The minimum of the $\kappa=\kappa_2$ loci (at $\theta=\dot{\theta}$) is relevant only when $\dot{\theta}\in[0,1]$:

$$\dot{\theta}\in[0,1]\Leftrightarrow\eta\in\left[\frac{1-\alpha}{2},\frac{1-\alpha}{2\alpha}\right],$$

where

$$\frac{1-\alpha}{2}\gtrless\frac{1+\alpha}{3-\alpha}\Leftrightarrow\alpha\lesseqgtr 3-2\sqrt{2}.$$