The Choice Between Market Failures and Corruption

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Because government intervention transfers resources from one party to another, it creates room for corruption. As corruption often undermines the purpose of the intervention, governments will try to prevent it. They may create rents for bureaucrats, induce a misallocation of resources, and increase the size of the bureaucracy. Since preventing all corruption is excessively costly, second-best intervention may involve a certain fraction of bureaucrats accepting bribes. When corruption is harder to prevent, there may be both more bureaucrats and higher public-sector wages. Also, the optimal degree of government intervention may be nonmonotonic in the level of income. (*JEL* D23, H40)

Inefficiencies associated with government interventions in many developing and even advanced economies are well known (see for example, Deepak Lal [1985] on misallocation of resources; Ledivina V. Carino [1986] and Hernando De Soto [1989] on corruption; or John D. Donahue [1989] on rents to government employees). Taking the problems of government involvement seriously, many social scientists prefer to live with market failures rather than risk widespread government failures (e.g., Edward S. Mills, 1986). Others interpret the presence of government corruption as evidence that most politicians are intervening to further their career or wealth rather than correct market failures (e.g., William A. Niskanen, 1971; Andrei Shleifer and Robert W. Vishny, 1994). In contrast, another view points to a trade-off between government failures and market failures. This view is seldom formalized or developed, however, and we lack an understanding as to why government intervention designed to correct market failures also leads to corruption and inefficiencies.[1] As a consequence, without a theory of "government failure," we are often unable to determine whether a certain government intervention is justified when the distortions it brings are taken into account.

This paper develops a simple framework to analyze the links between government interventions and government failures. We start with the textbook model of government as a benevolent social planner intervening to correct market failures. To this, we add three basic assumptions:

1. Government intervention requires the use of agents ("bureaucrats" for short) to collect information, make decisions, and implement policies.[2]
2. These bureaucrats are self-interested, and by virtue of their superior information, hard to monitor perfectly.
3. There is some heterogeneity among bureaucrats.

These three assumptions imply that when the market failure in question is important, the op-

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[1] Susan Rose-Ackerman (1978 p. 9) also motivates her inquiry into corruption with a similar observation. She writes: "... corrupt incentives are the nearly inevitable consequence of *all* government attempts to control market forces ... ." However, she does not pursue this line to discuss the optimal mixture of market failure and corruption, which is the focus of our paper.

[2] See Maurice Crozier (1964), Guy B. Peters (1989), or James Q. Wilson (1989) on the role and duties of bureaucracies. These studies substantiate our assumption that it is not possible to have government intervention without a sizable bureaucracy and that bureaucrats will have an informational advantage over their "principal." For example, Peters (1989 p. 196) writes: "The first and perhaps most important resource of the bureaucracy is *information* and *expertise*."

timal allocation of resources will involve a certain degree of government intervention, accompanied by a large government bureaucracy, rents for public employees, misallocation of resources, and possibly, corruption. Paradoxically, we also find that when bureaucrats are corruptible, the optimal size of the government is *greater* than in the case where corruption is not possible. These government failures, however, are not proof that government intervention is socially harmful. Instead, they may indicate the unavoidable price of dealing with market failures.

To illustrate the main idea of the paper, consider what is perhaps the most standard example of government intervention: taxing pollution (or any other negative externality). A benevolent government would ideally tax pollution and ensure that all firms pollute less. But it is often costly to observe how much pollution a particular firm is causing and whether they took precautions. So the government employs bureaucrats to collect information and implement policies. The fact that the government needs to employ agents, who would otherwise be productive, increases the cost of intervention. More interestingly, it also introduces a principal–agent relation whereby bureaucrats transfer resources on the basis of information they have and the government (the principal) does not. This reasoning leads to our first basic result: because government intervention designed to correct market failures requires the use of bureaucrats to make decisions, it will create opportunities for these employees to be corrupt and demand bribes.

Corruption, by misdirecting subsidies or reducing tax revenues, undermines the purpose of government intervention. We therefore expect the government to institute mechanisms to prevent corruption. An important instrument in this effort is incentive payments (e.g., Gary S. Becker, 1968; Becker and George J. Stigler, 1974; Rose-Ackerman, 1978). Furthermore, when bureaucrats are credit constrained, these incentive payments will take the form of "efficiency wages." Public employees will receive monetary and nonpecuniary rents, which they will lose if caught taking bribes. Nevertheless, given some degree of heterogeneity among bureaucrats, it is often optimal not to pay the excessive rents required to prevent *all* corruption. As a result, government intervention leads both to a certain amount of corruption and to rents for government employees.

Our analysis yields a number of comparative static results which may be useful in assessing the trade-off between market failures and government failures. We find that when monitoring bureaucrats becomes more difficult, they should receive higher wages, and government intervention should become relatively rare. But if government intervention continues to be required despite the increased difficulty of monitoring, the number of bureaucrats and their wages should *increase,* very much as if the bureaucracy were expanding to seek additional rents. The intuition for this result is informative about the workings of our model. Government intervention has two instruments: the number of bureaucrats and their wages. When there are many bureaucrats, each firm is likely to be inspected, and a small fine on polluters is sufficient to discourage pollution. Because the fine is small, there is only a small bribe that the bureaucrat can extract. In contrast, with few bureaucrats, the fines need to be large and there is more room for corruption. When bureaucrats become harder to monitor, the optimal government intervention will use both instruments more intensively. That is, the government will hire more bureaucrats and pay higher wages.

Furthermore, the optimal degree of government intervention may be nonmonotonic in the per capita income level of the economy. An increase in output in a poor economy tends to increase the desirability of government intervention, but has the opposite effect in a rich country. The reason for the predicted decline in government intervention in rich countries is that the opportunity cost of government intervention is the withdrawal of agents from the productive sector. In richer economies, the productivity in the private sector is higher, so, the opportunity cost of government intervention is also greater. Unless the extent of market failures increases relatively rapidly with per capita income, the optimal size of government declines at some point. The nonmonotonic relation between income and government intervention in our model contrasts with some existing theories, such as the so called "Wagner's Law," which predict increasing government intervention over time. Although our model is extremely simple, this comparative static result may help us in analyzing the variations in the degree of government involvement across countries and over time.

Another result is that corruption should be observed as part of an optimal allocation when the market failure in question is important, and the fraction of "dishonest" bureaucrats (those who are harder to detect when taking bribes) is relatively low. This result may suggest that situations where the majority of bureaucrats are corrupt, as in some less developed countries (LDCs) are harder to rationalize as "optimal" government intervention than instances of more occasional corruption in the OECD.

Many other studies emphasize the costs of corruption (e.g., Robert Klitgaard, 1989; Shleifer and Vishny, 1993; Paulo Mauro, 1995). We depart from these papers by emphasizing the unavoidability of corruption (see also Rose-Ackerman, 1978). We argue instead that in many instances, markets malfunction and government intervention is necessary. Corruption associated with such interventions may therefore be the lesser of *two evils*. This is related to an argument made by Nathaniel Leff (1964), but there is a crucial difference. According to Leff (1964), and more recently DeSoto (1989), corruption is often unavoidable because governments distort the allocation of resources, and corruption is the way that the market bypasses the regulations. The optimal policy, in Leff's view, is therefore to eliminate government intervention. In our story, the market, not the government, is the culprit. The government intervenes to redress market failures, and corruption emerges as an unpleasant side effect of necessary intervention. Our work is also closely related to the principal–agent approach to law enforcement (e.g., Becker, 1968; Becker and Stigler, 1974; Rose-Ackerman, 1978; Dilip Mookherjee and I. P. L. Png, 1992, 1995; Abhijit Banerjee, 1997) and to the literature on optimal regulation under asymmetric information and regulatory capture (see Jean Jacques Laffont and Jean Tirole, 1993). In a related contribution, Banerjee (1997) considers a model where bureaucrats have superior information relative to the government wishing to allocate a limited set of goods to agents who are not the ones with the highest willingness to pay. Bureaucrats are corrupt and may even introduce red tape in order to increase the amount of bribes they can extract. However, in all of these papers, the approach is partial equilibrium, and the costs and benefits of government intervention are not analyzed together. In contrast, our general-equilibrium approach is important for many of our key results, including the finding that the number of bureaucrats and their wages should be higher when they are harder to monitor, and the *nonmonotonic* relation between per capita income and government intervention.

The plan of the paper is as follows. The next section outlines the basic environment and characterizes the optimal allocation in the absence of corruption constraints. Section II characterizes the optimal allocation when bureaucrats are corruptible. This section obtains most of the important results of this paper but because all bureaucrats are homogenous, there is no equilibrium corruption. Section III extends the analysis to the case of heterogenous bureaucrats and determines the conditions under which the optimal allocation will involve some of these bureaucrats accepting bribes. Section IV considers some extensions, and Section IV concludes.

I. The Basic Model

We consider a static economy consisting of a continuum of risk-neutral agents with mass 1. For now all agents are homogeneous. They can choose between two activities: they can become entrepreneurs, or if there is a government, they can become government employees (bureaucrats). Entrepreneurs also have two choices. They can choose one of two technologies: "bad" or "good." Both technologies generate output equal to y. However, their costs differ. The bad technology costs 0, whereas the good technology costs e where $0 < e < y$.

We choose the terminology "bad" and "good" because good technologies create a positive externality. Let n be the mass (fraction) of entrepreneurs in this economy and $x \leq n$ be the mass of entrepreneurs choosing the good technology. We assume that there is a positive nonpecuniary effect on the payoff of all agents equal to βx. Moreover, we have $\beta > e$ so that this externality is strong enough to outweigh the private costs. We also assume that the cost of choosing the good technology, e, is nonpecuniary. These assumptions simplify the analysis by making maximum taxes independent of technology choices, but do not affect our basic results.

A. *The Laissez-Faire Equilibrium and the First Best*

In the decentralized equilibrium, there is no government, so all agents become entrepreneurs, hence $n = 1$. The payoffs to the two activities are:

$$\pi_g = y + \beta \cdot x - e, \tag{1}$$

$$\pi_b = y + \beta \cdot x.$$

Therefore, $\pi_b > \pi_g$ for all x, and the unique equilibrium has $n = 1$ and $x = 0$.

Since $\beta > e$, the first best is given by $n = 1$ and $x = 1$: all agents become entrepreneurs and choose the good technology. However, this outcome is not sustainable as a decentralized equilibrium because, as in a standard prisoner's dilemma, each individual has a dominant strategy, which is to choose the bad technology. Essentially, entrepreneurs do not take into account the externalities they create on other agents.

B. *Optimal Regulation Without Corruption*

We now consider government intervention to regulate technology choice. Throughout the paper, we assume that the government intervenes to maximize social surplus. So there are no distributional concerns or rent seeking by the government itself. If technology choices of agents were publicly observable, the first best could be achieved. It is realistic, however, to assume that technology choices are not publicly observed. The government needs to employ some agents as bureaucrats to inspect entrepreneurs, and find out what technology is being used. We assume that one bureaucrat can inspect only one entrepreneur. This assumption is of no major importance, but the fact that regulation requires the employment of bureaucrats is crucial for our analysis.[3]

In this section, we ignore the corruption problem, and assume that bureaucrats always report truthfully. In the absence of further constraints, the optimal strategy for the government would be to have a trivial proportion of agents become bureaucrats, randomly inspect entrepreneurs, and impose infinite taxes/subsidies. This strategy would minimize the withdrawal of agents from the productive sector. However, in practice, there will be limited liability constraints limiting taxes, and a government budget constraint determining the amount that can be given away in subsidies. This is the first important role of the limited liability constraints in this economy.

We denote the tax that an entrepreneur with the bad technology has to pay by τ, and denote the subsidy that an entrepreneur with the good technology receives by s (both of these are imposed only if the entrepreneur is inspected). Note that we do not assume $s \geq 0$, so entrepreneurs with good technology may be taxed too. We denote the wage of a bureaucrat by w. Since before inspection, it is not known who has chosen bad technologies, inspection is random. Therefore, the probability that an entrepreneur is inspected is $p(n) = \max\{(1 - n)/n, 1\}$, which is the fraction of bureaucrats divided by the fraction of entrepreneurs, unless there are more bureaucrats than entrepreneurs.[4]

[3] Appendix B (available upon request) gives the analysis for the case in which each bureaucrat inspects θ entrepreneurs. The qualitative results are identical, and θ gives another measure of the efficacy of government intervention. In particular, as $\theta \to \infty$, government intervention is extremely effective, and all market failures can be prevented at minimal cost.

[4] Notice that in this environment, it is not possible to collects taxes without inspection. We discuss the case where the government can impose "poll taxes" without inspecting technology choices in Appendix C (available upon request). In this case, without corruption, the government raises a large tax revenue via poll taxes, and then sets a large subsidy, a large public-sector wage, and employs a very small fraction of agents to inspect technology choices. However, when bureaucrats are corruptible, similar results to those in the text apply. A high subsidy to good technology creates strong incentives for corruption, so only moderate subsidies can be set, and a sizable bureaucracy is necessary to inspect technology choices. In any case, we view the assumptions in the text, that taxation is costly, and that taxation and inspection can be carried out together, as plausible. Suppose, for example, that the bad technology in our model corresponds to misleading shareholders and creditors, and/or taking excessive financial risks. Then, inspectors who collect taxes can also determine whether a company has chosen the "bad" technology.

The exact timing of events is as follows:

1. The government announces the public wage, w, the tax τ, the subsidy s, and the maximum number of bureaucrats it will hire $(1 - n)$.
2. Agents choose their profession. If there are more applicants to the government sector than $1 - n$, then $1 - n$ of them are chosen randomly and the remainder enter the private sector.
3. Those who enter the private sector choose a technology. Their technology choice is not observed by any other agent at this stage.
4. Each bureaucrat randomly inspects one entrepreneur[5] and discovers whether he has chosen the good or the bad technology.
5. Each bureaucrat then reports on the technology choice of the entrepreneur he has inspected. If his report is "good," the entrepreneur receives the subsidy s. If the report is "bad," then the entrepreneur pays the tax τ.

As noted above, for now, all bureaucrats always report truthfully, hence there is no corruption. The government is utilitarian, and maximizes total net surplus:

$$SS = n \cdot y + (\beta - e) \cdot x \tag{2}$$

by choosing n, x, w, τ, and s, subject to four constraints, where recall that x is the mass of agents choosing the good technology.

First, there is a *limited liability constraint* which dictates that the government cannot tax more than the revenue of an entrepreneur:

$$\tau \leq y. \tag{3}$$

Second, choosing the good technology must yield a payoff as high as the bad technology. The expected payoff to the two technologies are: $\pi_g = y + \beta \cdot x - e + p(n) \cdot s$ and $\pi_b = y + \beta \cdot x - p(n) \cdot \tau$. It is straightforward to see that the optimal allocation would never have $n < 1/2$. Hence, we use $p(n) = (1 - n)/n$ as the probability of getting inspected for an entrepreneur, and then check whether $n \geq 1/2$. As a result, the second constraint, which we refer to as the *technology choice constraint,* $\pi_g \geq \pi_b$, takes the form

$$\tau + s \geq \frac{n}{1 - n} \cdot e. \tag{4}$$

This constraint ensures that all agents prefer to choose the good technology.

The government cannot force its citizens to become bureaucrats. The third condition, *the allocation of talent constraint,* therefore ensures that agents are willing to become bureaucrats rather than entrepreneurs. This requires $w + \beta \cdot x \geq \pi_g$, that is, the payoff to bureaucracy must be as large as the return to entrepreneurship. Or:

$$w \geq y - e + \frac{1 - n}{n} \cdot s. \tag{5}$$

Finally, we need the revenues of the government not to fall short of its expenses. The government will have a wage bill equal to $(1 - n) \cdot w$, and as long as $n \geq 1/2$, it will pay subsidies equal to $(1 - n) \cdot x/n \cdot s$ (since there will be $1 - n$ entrepreneurs inspected in total and a proportion x/n of them will have chosen the good technology). It will also collect taxes equal to $(1 - n) \cdot (1 - x/n) \cdot \tau$. *The government budget constraint* is therefore:

$$\left(1 - \frac{x}{n}\right) \cdot \tau \geq w + \frac{x}{n} \cdot s. \tag{6}$$

It is straightforward to see that the limited liability constraint (3) has to hold as an equality: otherwise, τ and n could be increased without violating (4), (5), or (6). The technology choice constraint, (4), also has to hold as an equality for the same reason. Then, from (3) and (4) we have $\tau = y$ and $s = n/(1 - n) \cdot e - y$. Substituting these into (5) now gives us a simplified form of the allocation of talent constraint: $w \geq y - (1 - n)/n \cdot y$, for $n \geq 1/2$. If this inequality did not hold, the public-sector

[5] There is no coordination issue here so an entrepreneur never gets inspected by two bureaucrats, and as long as $n > 1/2$, each bureaucrat inspects one entrepreneur. Introducing coordination problems does not change our results, though it complicates the expressions.

wage rate would be too low to attract agents, and we would have $n = 1$. Also, rearranging (6) and using (4), we obtain a more compact form of the government budget constraint as $w + x/(1 - n) \cdot e \leq y$. Combining these two inequalities, and noting that x, the mass of entrepreneurs choosing the good technology, cannot exceed n, we obtain the constraint set of the government as:

$$x \leq \min\left\{\frac{(1 - n)^2 \cdot y}{n \cdot e}, n\right\}. \tag{7}$$

The characterization of the optimal allocation is therefore given by the maximization of (2) subject to (7) and $n \geq 1/2$. This problem is represented diagrammatically in Figure 1. Only combinations of x and n in the triangular area are permissible. The objective function to be maximized, (2), is linear in n and x, thus the contours are straight lines. Since the constraint set is nonconvex, it is clear that an optimum must be either at $n = 1$ (with $x = 0$), or at $x = n$, i.e., at point E in the figure. Which of these will be preferred depends on the slope of the contours of (2).

If $n = 1$ and $x = 0$, then social surplus is $SS_{ng} = y$. Instead with $x = n$ in (7), we obtain a unique solution:

$$\hat{n} \equiv \frac{\sqrt{y}}{\sqrt{y} + \sqrt{e}}. \tag{8}$$

$\hat{n}$ lies between $1/2$ and 1 as required since $y > e$. Substituting (8) and $n = x$ into (2), we obtain the social surplus with optimal government regulation as: $SS_g = (y + \beta - e) \cdot (\sqrt{y}/(\sqrt{y} + \sqrt{e}))$. The comparison of SS_g with SS_{ng} leads to our first result (proof omitted).

PROPOSITION 1: *Suppose there is no corruption opportunity. Then if*

$$\beta > \sqrt{y \cdot e} + e \tag{9}$$

is satisfied, the optimal allocation of resources has $n = x = \hat{n}$ given by (8). Otherwise, the optimal allocation is laissez-faire ($n = 1$ and $x = 0$).

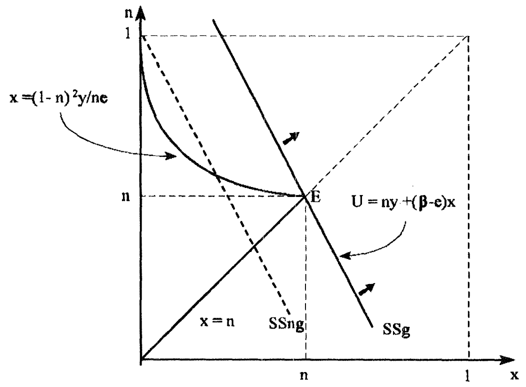

FIGURE 1. OPTIMAL GOVERNMENT INTERVENTION WITHOUT THE POTENTIAL OF CORRUPTION

Government regulation is costly as it withdraws agents from production to employ them in monitoring activities. It is therefore only worthwhile if the externality in question is sufficiently pronounced. In particular, since the cost of government intervention is the diversion of agents from production, the benefit of the intervention, β, needs to be sufficiently large as compared to y.

II. Optimal Regulation With Corruption

A. *Analysis*

We now combine two of our three basic ingredients: (i) the need to employ bureaucrats to make autonomous decisions or collect information, and (ii) corruptibility (while the third ingredient, heterogeneity, is left to the next section). A bureaucrat can exploit the informational advantage he has over his principal, the government. This can take either of two forms. First, upon meeting an entrepreneur who has chosen the good technology, a bureaucrat can threaten that unless he is bribed he will report the technology to be bad. Second, when he meets an entrepreneur with the bad technology, he can demand a bribe to report the project to be good. In both cases the maximum "surplus" that a bureaucrat can extract is $s + \tau$. We assume that in both cases the bureaucrat can get a proportion σ of this amount as bribe.

A corrupt bureaucrat will get caught with probability q. In this case, he suffers the most serious punishment subject to limited liability; he loses all his income.[6] Note that $1 - q$ is a measure of the informational advantage of bureaucrats. When $q = 0$, then corrupt bureaucrats are never caught. In contrast, if $q = 1$, corruption will be immediately detected. We can also observe the second important role of the limited liability constraint (recall its first role was to limit taxation): because all agents are risk neutral, a large punishment imposed on bureaucrats caught taking bribes would discourage corruption at no cost, and the allocation of Proposition 1 could be achieved. The limited liability constraint prevents this.

The timing of events of the previous section is now modified. In stage 5, each bureaucrat first decides whether to make a "collusion" offer to the entrepreneur with whom he is matched. If he decides not to demand bribes, he makes a truthful report, and the game ends as in the previous section. In case the bureaucrat demands a bribe, then his report depends on the entrepreneur's response. If the entrepreneur accepts this offer and pays the bribe, then, exactly at the same time, the bureaucrat makes the agreed report. If the entrepreneur rejects the collusion offer, the bureaucrat reports the project to be bad. Finally, there is a stage 6 in which bureaucrats' reports are inspected and those who made a false report are caught with probability q. All revenues from a bureaucrat who made a false report and from the corresponding entrepreneur are confiscated.[7]

Observe that we are not allowing complicated implementation schemes. Since the entrepreneur and the bureaucrat who have inspected him share a piece of information not observed by any other agent, they may both be asked to report it. Then, there will exist a Nash equilibrium in which there is truthful revelation. These kinds of implementation schemes would always solve corruption or collusion problems, but they are extremely difficult to administer, suffer from multiple equilibria, and are highly unrealistic. Hence, in this paper we ignore these implementation mechanisms. We also do not allow complaints by entrepreneurs. Such complaints could change the bargaining game between bureaucrats and entrepreneurs in the corruption stage, and would imply that bureaucrats would be able to extract less from entrepreneurs with the good technology without changing the essence of our results.[8] Finally, we allow bureaucrats to report that the technology is bad even when $n = x$. This can be justified by assuming that there is a small set of entrepreneurs who would always choose the bad technology, say, because they lack access to the good one.

Because all agents, in particular all bureaucrats, are homogenous, there will be a unique condition determining whether it pays to be corrupt. If honest, a bureaucrat obtains w. If corrupt, he loses everything with probability q, and with probability $1 - q$, he receives both the wage and a bribe $b = \sigma \cdot (\tau + s)$. Hence, if the "corruption constraint," the inequality

$$w \geq \frac{1-q}{q} \cdot \sigma \cdot (\tau + s) = \frac{1-q}{q} \cdot \frac{n}{1-n} \cdot \sigma \cdot e, \tag{10}$$

is violated, all bureaucrats would be corrupt [where the second term is obtained by substituting for $\tau + s$ using (4)]. In this case, all entrepreneurs receive $\sigma \cdot (\tau + s)$ irrespective of their technology choice, and the government intervention is unambiguously wasteful. So for government intervention to be desirable condition (10) has to hold. This observation also explains why corruption is harmful in this econ-

[6] We treat q as exogenous though it is possible to endogenize it, or even model the hierarchy of bureaucracy along the lines of Guillermo Calvo and Stanislaw Wellisz's (1979) analysis of hierarchies in efficiency wage models (see also Juan D. Carrillo, 1995; Rose-Ackerman, 1978). Since these extensions are not essential for our purpose, we will not pursue them here.

[7] Although a bureaucrat can falsify the technology choice of the entrepreneur, he can never falsify having met an entrepreneur.

[8] In particular, suppose that when dealing with an entrepreneur with a good technology, a bureaucrat can extract a fraction of σ_g of the surplus, whereas the same fraction is $\sigma_b > \sigma_g$ when negotiating with an entrepreneur with the bad technology. In the first two cases considered in Proposition 2, all entrepreneurs choose the good technology, so only σ_g would matter, but in the third case, where some entrepreneurs choose the bad technology, both σ_b and σ_g appear in the expressions, which makes the analysis more complicated, without affecting the main results.

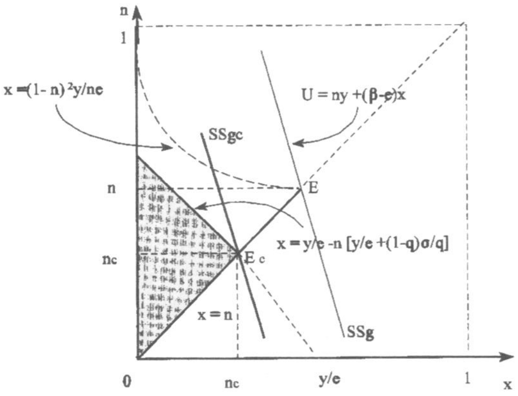

FIGURE 2. OPTIMAL GOVERNMENT INTERVENTION WITH POTENTIAL CORRUPTION

omy. The role of government intervention is to make *ex post* transfers conditional on technology choice so that *ex ante* decisions are affected. When bureaucrats are corrupt, transfers are unconditional and government intervention no longer affects *ex ante* choices.

In contrast, when (10) holds, no bureaucrat will demand bribes. Hence, we simply need to make sure that the corruption constraint, (10), and the other constraints on government policy, summarized by (7), are satisfied. Combining (10) with the simplified form of the government budget constraint, $w + x/(1 - n) = y$, gives the corruption constraint in the (x, n) space as:

$$(11) \qquad x \leq \frac{y}{e} - \left(\frac{y}{e} + \frac{1-q}{q} \cdot \sigma\right) \cdot n.$$

Diagrammatically, we add a line representing (11) to Figure 1 as an additional constraint and repeat the analysis. If (11) is less restrictive than (7), the public wage, set to attract agents into bureaucracy, would be high enough that no bureaucrat would want to accept bribes and the solution of the previous section applies.

The more interesting case, drawn in Figure 2, is when (11) is a more restrictive constraint than (7). In this case, to prevent corruption it is necessary to pay bureaucrats a wage above the minimum level that would attract them to the government sector, i.e., a *rent*. In Figure 2, this implies that the constraint set is now the smaller shaded triangle and the highest social surplus line would be reached at point E_c rather than at E as in Figure 1. We also need to check that $n \geq 1/2$, since all these equations are written assuming this condition to hold. Even though this constraint was never binding in the previous section, it may bind when bureaucrats are corruptible.

Optimal government intervention will therefore take one of the following three forms:[9]

(i) (11) is less restrictive than (7), so $n = x = \hat{n} > 1/2$ as given by (8);
(ii) (7) is less restrictive than (11), and $n = x = n_c > 1/2$ where n_c is given by imposing $n = x$ in (7):

$$(12) \qquad n_c \equiv \frac{y}{y + e + \dfrac{1-q}{q} \cdot \sigma \cdot e};$$

(iii) $n = 1/2$ and x is chosen so as to balance the government budget constraint, thus

$$(13) \qquad x = \max\left\{\frac{1}{2} \cdot \left(\frac{y}{e} - \frac{1-q}{q} \cdot \sigma\right);\ 0\right\}.$$

In this last case, government revenues fall short of supporting an allocation in which all entrepreneurs choose the good technology, and the only way of increasing revenues is to have some of the entrepreneurs choose the bad technology and pay the tax $\tau = y$. We have the following proposition (proof in the Appendix).

PROPOSITION 2: *Suppose that bureaucrats are corruptible. The optimal allocation is:*

1. *If* $y/e \geq [1 + \sigma \cdot (1 - q)/q]^2$ *and* $\beta > \sqrt{e} \cdot (\sqrt{y} + \sqrt{e})$, *then there is government intervention with* $n = x = \hat{n}$ *as given by (8).*
2. *If* $y/e \in (1 + \sigma \cdot (1 - q)/q; [1 + \sigma \cdot (1 - q)/q]^2)$ *and* $\beta > 2e + e \cdot \sigma \cdot (1 - q)/q$, *then the optimal allocation has government*

[9] Another possibility is to have a certain fraction of the bureaucrats corrupt, and reduce the required revenue by catching a fraction q of those. A by-product of our analysis in the next section will be to show that this is never preferred to the allocation derived here (see the proof of Proposition 3 in the Appendix).

intervention with $n = x = n_c$ as given by (12).

3. *If $y/e < 1 + \sigma \cdot (1 - q)/q$ and $\beta > e + y/[y/e - \sigma \cdot (1 - q)/q]$, then there is government intervention with $n = 1/2$, $x = 1/2\ [y/e - \sigma \cdot (1 - q)/q]$.*
4. *Otherwise, the optimal allocation is laissez-faire.*

B. *Discussion*

There are a number of results summarized in Proposition 2. First, if q is large enough or σ is sufficiently small, then corruption is easy to prevent, and the corruptibility of the bureaucrats is not important. This is because the wage used to attract agents to bureaucracy can also be used to discipline them, and the same trade-off as in the previous section applies. In contrast, if q is small or σ is large, then corruption is tempting for government employees. To prevent corruption, bureaucrats have to be paid a *rent.* As long as the market failure in question is serious enough (i.e., β high), it is worthwhile for the society to withdraw a large number of agents from the productive sector and pay them the required rent in order to correct the market failure (cases 2 and 3). An immediate implication is therefore that the potential for dishonesty among bureaucrats does not necessarily make government intervention counterproductive. Instead, it introduces equilibrium rents for these employees as part of the constrained optimal allocation.

Paradoxically, n_c as given by (12) is less than $\hat{n}$ as in (8). This implies that the introduction of the corruption constraint *increases* the optimal size of the bureaucracy. Intuitively, a larger bureaucracy is useful for two reasons. First and most important is the trade-off between the number of bureaucrats and their wages in preventing corruption. With many bureaucrats, corruption can be prevented with a low wage. This is because when entrepreneurs are sure to be inspected (e.g., $n = 1/2$), a low level of $\tau + s$ is sufficient to induce them to choose the good technology. When $\tau + s$ is small, there is only a small bribe that bureaucrats can extract, and so a low level of w is sufficient to prevent corruption. In contrast, when there are a few bureaucrats, a large level of $\tau + s$ is needed to induce entrepreneurs to choose the good technology, and this translates into an opportunity for large bribes. To prevent corruption now requires a high w. This trade-off implies that it is cheaper to satisfy the technology constraint of the entrepreneurs, (4), not only by increasing w, but also by having more bureaucrats (lower n) so as to reduce $\tau + s$ and the level of equilibrium bribes. In fact, it trivially follows from (4) that in this case $\tau + s$ is smaller than in Section I, subsection B. The second and related reason is that the corruption constraint forces public-sector wages to increase, and this requires higher government revenues, and more bureaucrats are needed to raise revenues.

Because $\hat{n} > n_c$, the social surplus with intervention, SS_c, is lower than SS_g, so government intervention is less desirable. Therefore, some market failures, which should have been corrected when bureaucrats were not corruptible, do not justify government intervention when bureaucratic corruption is taken into account.

Furthermore, n_c is decreasing in the bargaining power of bureaucrats, σ, and their informational advantage, $1 - q$. An increase in σ or a reduction in q will reduce the desirability of government intervention. Nevertheless, if the optimal allocation of resources still requires government intervention, we will observe higher wages for bureaucrats ($w \uparrow$) and a larger government ($n_c \downarrow$). At first, these patterns may look like a government sector diverting resources (rents) to itself by paying higher wages and hiring more people, very much as in the theories of "bureaucratic tyranny" (e.g., Niskanen, 1971). But, in our economy, it is also exactly the pattern that emerges when bureaucrats become harder to control (which could be because of changes in technology, bribe opportunities, or cultural reasons), and government intervention continues to be socially beneficial.

Finally, if y is sufficiently small, the government will have difficulty in raising enough tax revenue to pay the subsidies and the wages of bureaucrats. In this case, optimal government intervention has even more bureaucrats, $n = 1/2$, in an attempt to minimize bureaucratic wages by reducing bribes and maximize revenues. Moreover, if all entrepreneurs choose the good technology, tax revenues will again fall short, so the optimal allocation requires some of the entrepreneurs to choose the bad technology and act as a "tax base."[10] Therefore, government intervention is now less successful in two dimensions (as compared to the solution of the previous section): fewer agents are becoming entrepreneurs, and not all of them are choosing the good technology. Even though government intervention is now much less desirable, with a sufficiently serious market failure, it may still be preferred to laissez-faire.

Comparative statics with respect to y (or to y/e) are also interesting. Since y is the output produced by an entrepreneur, it naturally corresponds to per capita income in the economy: a higher level of y implies a richer economy. Figure 3 gives the cutoff level of β above which government intervention is optimal as a function of y/e (curve $\beta\beta$). The three different regimes of Proposition 2 can be seen in this diagram and a U shape emerges for the cutoff level. This cutoff level, $\beta\beta$, is decreasing in y for poor economies, then constant, and finally increasing. The intuitive reason for the downward-sloping part is that in poor economies, resources are limited, and the government budget constraint can only be satisfied by having some entrepreneurs use the bad technology (i.e., $x < n$) while being taxed heavily. Since the point of the intervention is to increase x, it becomes less desirable. In contrast, for rich economies the government budget constraint is not as restrictive, and the key factor is the opportunity cost of diverting productive individuals to bureaucracy. As y increases, this opportunity cost rises and government intervention becomes less desirable. Even though our model is simple and abstracts from many relevant considerations, this comparative static result emphasizes an effect that has not been pointed out in the previous literature.

The comparative static results in Figure 3, however, assume that the extent of the externality, β, remains constant as income increases. A more flexible formulation is to assume that

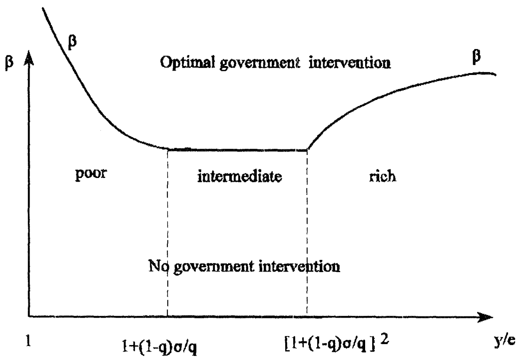

FIGURE 3. THE RELATION BETWEEN THE LEVEL OF INCOME AND GOVERNMENT INTERVENTION

$\beta = \beta_0 + \beta_1 \cdot y^{\beta_2}$, so that the importance of the externality also increases with income. It is straightforward to verify using the expressions in Proposition 2 that there will once again exist a cutoff $\beta_0^*(y)$ such that if $\beta_0 > \beta_0^*(y)$, government intervention is justified. If $\beta_2 \geq 1/2$ in the above formula, then the extent of market failures increase sufficiently rapidly with income that $\beta_0^*(y)$ is always decreasing in y. In this case, therefore, there should always be more intervention in richer societies, as claimed by the "Wagner's Law." In contrast, if $\beta_2 < 1/2$, then the comparative static results of Figure 3 continue to hold: the higher opportunity cost of withdrawing agents from the productive sector dominates at high levels of income, and the relation between income and optimal government intervention is nonmonotonic. Although growth of income may bring new areas for government intervention, for example, nuclear research or increased demand for government intervention in social problems related to demographic and sociological changes, it is plausible that the extent of many "externalities" increase less than proportionally with income. So our analysis suggests that in a number of areas, the higher opportunity cost of government intervention in rich economies may discourage government intervention.

Overall, therefore, our model suggests that an inverse U-shaped relation between per capita income and government intervention is possible. Such a nonmonotonic relation is consistent with some broad patterns in the data. Government intervention increased

[10] Since entrepreneurs are indifferent between the two technologies, i.e., $\pi_b = \pi_g = \beta x$, this is simply a mixed-strategy equilibrium.

starting from the nineteenth century (see, for example, Peter H. Lindert, 1989, 1994). An important aspect of government involvement was indeed an attempt to correct certain market failures. For example, investment in education for the masses, which stood at a very low levels, increased substantially after the intervention (see Franz Ringer, 1979). In contrast, the 1980's experienced a shift in political attitudes with politicians such as Thatcher, Reagan, and Mulroney, emphasizing costs of government and attempting to reduce the scope of government involvement.

Observe that so far the optimal allocation does not feature "equilibrium" corruption; either there is laissez-faire or all bureaucrats are honest. This is because bureaucrats are homogenous, and all corruption opportunities are the same. We will generalize this aspect in the next section.

III. Heterogeneity and Equilibrium Corruption

A. *Analysis*

We assume that once an agent becomes a bureaucrat, he discovers whether he is good at taking bribes or not.[11] Those who are good at taking bribes (the "dishonest") get caught with probability $\hat{q} \geq 0$, while those who are not proficient at corruption (the "honest") get caught with probability $q > \hat{q}$. The probability that an agent is good at taking bribes is m. In terms of the timing of events in Sections I and II, between stages 3 and 4, each bureaucrat discovers whether he is good at taking bribes or not, and then decides whether to demand a bribe. Exactly the same result would hold if bureaucrats had different "moral costs" of accepting bribes (as argued by Klitgaard, 1988), or alternatively, if some situations were more conducive to the detection of corruption. All we need is some heterogeneity in the "propensity" to accept (pay) bribes across bureaucrats (projects).

There are now three different candidate solutions. Either there is no government regulation, thus $n = 1$ and $x = 0$. Or there is no corruption and Proposition 2 from the previous section applies with $\hat{q}$ replacing q (and $n = x \geq 1/2$ or $n = 1/2$ and $x < 1/2$, in this case, $w \geq (1 - \hat{q}) \cdot \sigma \cdot (\tau + s)/\hat{q}$, so neither "honest" nor "dishonest" bureaucrats accept bribes). For future reference, let us refer to the social surplus of this allocation as S_{nc} (see Proposition 2). What we will show in this section is that there is a third possible solution which will feature equilibrium corruption: intervention with *partial corruption.*

Let us first characterize the optimal government regulation with partial corruption. This is an allocation in which there are sufficient bureaucratic rents so that "honest" bureaucrats do not take bribes, but the remaining fraction m, the "dishonest," do. Equation (4), the *technology choice constraint,* becomes:

$$\tau + s \geq \frac{n}{1-n} \cdot \frac{1}{1-m} e. \tag{14}$$

As before, an entrepreneur who chooses the good technology incurs the cost e, and receives the benefit when he obtains the subsidy. In Sections I and II, the probability of this even was $(1 - n)/n$. Now, with probability is $(1 - n) \cdot (1 - m)/n$, the entrepreneur is inspected and receives the subsidy. With probability $(1 - n) \cdot m/n$, there is inspection, but the bureaucrat is corrupt and extracts a bribe equal to $\sigma \cdot (\tau + s)$, and irrespective of his technology choice, the entrepreneur obtains the remaining $(1 - \sigma) \cdot (\tau + s)$, which gives (14) as the relevant technology choice constraint. As in the previous section, if a bureaucrat and an entrepreneur are caught exchanging bribes, the entrepreneur's revenue is confiscated irrespective of the technology choice.[12] Also again we have imposed $n \geq 1/2$ which will be checked later.

We also need to ensure that "honest" bureaucrats do not accept bribes, which, with a similar

[11] It is possible to assume that agents know whether or not they are good at corruption before they choose their profession. This would introduce some adverse selection features without affecting the general insights. See Timothy Besley and John McLaren (1993) for an analysis of this type of adverse selection.

[12] Without this assumption the government budget constraint below and the technology choice constraint, (14), would have to be slightly modified without affecting the results.

reasoning to above, we obtain the new partial-corruption constraint:

$$(15)\quad w \geq \frac{1-q}{q}\cdot(\tau+s) \geq \frac{1-q}{q}\cdot\frac{n}{1-n}\cdot\frac{\sigma}{1-m}\cdot e.$$

The budget constraint with partial corruption is different as well, because some of the corrupt bureaucrats are caught and their returns are confiscated:

$$(16)\quad (1-n)\cdot w + (1-n)\cdot(1-m)\cdot\frac{x}{n}\cdot s + (1-n)\cdot m\cdot(1-\hat{q})\cdot s \leq (1-n)\cdot m\cdot\hat{q}\cdot(w+\tau) + (1-n)\cdot(1-m)\cdot\left(1-\frac{x}{n}\right)\cdot\tau.$$

The government still pays w to all bureaucrats, then "honest" bureaucrats, fraction $1-m$, pay out a subsidy with probability x/n, and dishonest bureaucrats, except the proportion $\hat{q}$ who get caught, pay a subsidy with probability 1 (if the technology is bad, they claim it is good and take the subsidy). As for the revenues, a proportion $\hat{q}$ of the $m\cdot(1-n)$ dishonest bureaucrats are caught, their wages are not paid out, and full taxes are collected from all the entrepreneurs who conspired with the corrupt bureaucrats. Finally, the $(1-n)\cdot(1-m)$ honest bureaucrats find entrepreneurs with the bad technology with probability $1-x/n$, and this gives the last term.

Finally, the allocation of talent constraint becomes:

$$(17)\quad (1-m)\cdot w + m\cdot(1-\hat{q})\cdot[w+\sigma\cdot(\tau+s)] \geq y - \frac{1-n}{n}\cdot\tau + \frac{1-n}{n}\cdot m\cdot(1-\hat{q})\cdot(1-\sigma)\cdot(\tau+s).$$

This differs from (5) for two reasons. First, agents recognize that if they enter bureaucracy, with probability m, they will be good at taking bribes, and thus make more than w. And they also realize that by becoming an entrepreneur they will have to deal with corrupt bureaucrats, thus the third term is added to the right-hand side.

The characterization of optimal government intervention is more involved than before, and in order to simplify the algebra from now on we assume $\sigma = 1$; so entrepreneurs get taxed fully when they meet a corrupt bureaucrat. Then, combining the partial-corruption constraint, the budget constraint and the allocation of talent condition yields the constraint set for government intervention with *partial corruption* as:

$$(18)\quad x \leq \min\left\{n;\ (1-n)\cdot\frac{y}{e} - n\cdot\left[\frac{m}{1-m}\cdot(1-\hat{q}) + \frac{1-q}{q}\cdot\frac{1-m\cdot\hat{q}}{1-m}\right];\ \frac{(1-n)^2}{n}\cdot\frac{y}{e}\right\}$$

and $n \geq 1/2$. There are three terms in (18). The first one requires x to be less than n. The second ensures that the $1-m$ proportion of the bureaucrats who are "honest" do not accept bribes [cf., (15)]. The third one ensures that agents are willing to apply to bureaucracy [cf., (17)].

Let $A \equiv A(\hat{q}, m, q) \equiv m/(1-m)\cdot(1-\hat{q}) + (1-q)/q\cdot 1/(1-m)\cdot(1-m\cdot\hat{q})$. Then Proposition 3 follows (proof in the Appendix).

PROPOSITION 3: *Suppose that bureaucrats are corruptible and that a proportion $1-m$ get caught with probability q, and a proportion m get caught with probability $\hat{q} \in (0, q)$. Then there exists a unique $\bar{Q}(m, q) \in (0, q)$ such that:*

1. *When $\hat{q} < \bar{Q}(m, q)$, government intervention, whenever optimal, involves a fraction m of bureaucrats accepting bribes (i.e., partial corruption), and:*

(a) *If* $y/e \geq (1 + A)^2$ *and* $\beta > \sqrt{e} \cdot (\sqrt{y} + \sqrt{e})$, *then the optimal allocation has government intervention with* $n = x = \hat{n}$ *as given by (8).*
(b) If $y/e \in (1 + A; (1 + A)^2)$ *and* $\beta > 2e + A \cdot e$, *then the optimal allocation has government intervention with* $n = x = n_{pc}$ *as given by* $n_{pc} = (y/e)/[(y/e) + 1 + A]$.
(c) *If* $y/e < 1 + A$ *and* $\beta > e + [y/(y/e) - A]$, *then the optimal allocation has government intervention with* $n = 1/2$, $x = 1/2\ (y/e - A)$.
(d) *Otherwise the optimal allocation is laissez-faire.*

2. *When* $\hat{q} \geq \bar{Q}(m, q)$, *government intervention, whenever optimal, involves no corruption and the optimal allocation is as given in Proposition 2 with q substituted by* $\hat{q}$ *and* $\sigma = 1$.

B. *Discussion*

Proposition 3 gives a characterization of optimal intervention with heterogeneity among bureaucrats. It formalizes one of our claims in the introduction: for certain parameter values, it is optimal to have government intervention to deal with the market failure, but at the same time allow some of the government employees to be corrupt. Clearly, heterogeneity among bureaucrats is crucial for equilibrium corruption. In the previous section, where bureaucrats were homogenous, optimal government policy never involved corruption.[13] Intuitively, the market failure is serious enough and requires intervention. Nevertheless, preventing all corruption is excessively costly, so intervention with some corruption is the best option.

The technical intuition of this result can be easily seen in Figure 4. As the proposition suggests, the comparison between partial corruption and no corruption boils down to whether the constraint set under one regime is larger than the other. In this figure *HH* is the curve that would apply with "homogenous bureaucrats," each getting caught with probability q. Since a fraction m of bureaucrats can only be caught with probability $\hat{q} < q$, points along this line cannot be achieved. Instead, all corruption could be prevented by offering a high-enough wage to ensure that even bureaucrats with $\hat{q}$ do not accept bribes, and this gives the smaller triangle. Alternatively, the government could allow partial corruption, which gives the shaded triangle as the relevant constraint set. Since this shaded triangle is larger than the no-corruption triangle, partial corruption yields a larger choice set, and is therefore preferred to no corruption in this case.

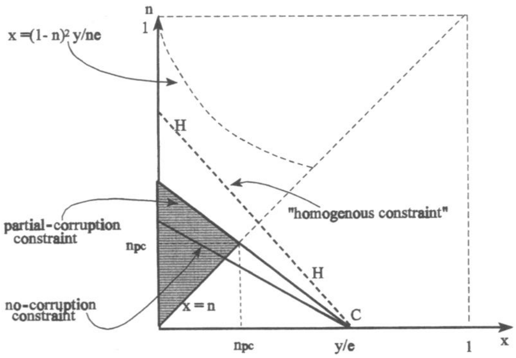

FIGURE 4. EQUILIBRIUM CORRUPTION WITH HETEROGENEOUS BUREAUCRATS

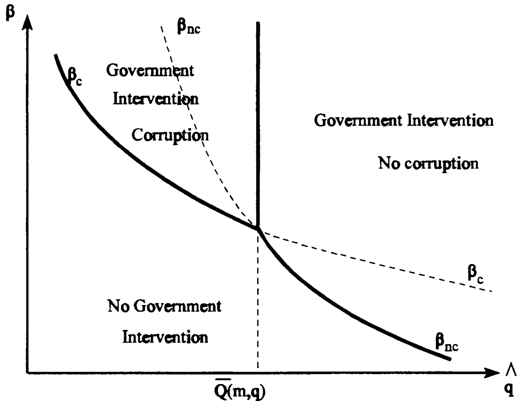

FIGURE 5. PATTERNS OF GOVERNMENT INTERVENTION

Figure 5 illustrates the optimal pattern of government intervention in the space $(\beta, \hat{q})$. The critical level for $\hat{q}$, $\bar{Q}(m, q)$, separates the two regimes of government intervention (with

[13] In other examples of corruption in the literature, heterogeneity is also important. For example, in Mookherjee and Png (1995) corruption may be optimal because eliminating all corruption would induce excessive enforcement effort from some law enforcers.

and without partial corruption). The cutoff levels of β in both regimes (β_c and β_{nc}) are decreasing functions of $\hat{q}$, because a less corruptible bureaucracy makes government intervention more desirable. The thick lower envelope of these two lines separates the regions of government intervention and no intervention, and is also decreasing.

Figure 5 also gives us a sense of when an optimal allocation with corruption is more likely to arise. The cutoff level in the corruption regime, β_c, is an increasing function of m and a decreasing function of q. This reflects again the fact that government intervention is more likely to be optimal when corruption is less of a problem. On the other hand, the cutoff line in the no-corruption regime, β_{nc}, depends only on $\hat{q}$. A reduction in m (or an increase in q) therefore only shifts down the cutoff line β_c. A downward shift of the curve β_c increases $\bar{Q}$ and enlarges the region where government intervention with partial corruption is optimal. Hence, a low m (i.e., relatively few "dishonest" bureaucrats) and a high value of q (i.e., "honest" bureaucrats being relatively easy to monitor) make partial corruption more desirable. These observations fit many instances of government intervention in the developed world where corruption exists, but is not the norm. For example, national defense is an important public good and there are instances of corruption in defense procurements in the OECD countries, but they appear to be relatively rare. In contrast, the corruption experiences of many LDCs may be at odds with this picture. In particular, it is difficult to make an argument that licensing private businesses in Lima as in the cases discussed by DeSoto (1989) or the widespread corruption in the Philippines during the reign of Marcos were designed to correct major market failures. In fact, the proportion of corrupt bureaucrats in many LDCs appears to be very high to fit our case of optimal partial corruption, which requires a low value of m. The model therefore suggests that it is easier to justify the instances of corruption in the advanced economies as costs of optimal government intervention, but much harder to do so for the LDCs.

Another interesting comparative static exercise would be to uncover the link between corruption and (relative) wages in the government sector (w). In our model, the correlation between government pay and corruption depends on which parameters differ across countries (or time periods). For example, suppose q increases. Then the partial-corruption regime becomes more desirable relative to no corruption. Also, since honest bureaucrats are easier to monitor, government wages can be reduced. Therefore, if the main difference between countries is due to differences in monitoring possibilities, we expect a *negative* relation between government pay and corruption. In contrast, suppose m increases: this will make government intervention with partial corruption less desirable, but as long as we stay in the regime where it is optimal to have government intervention, w will increase, the fraction of agents who are corrupt will increase, and the size of the bureaucracy $(1 - n)$ will also grow. Therefore, when countries differ with respect to the fraction of "dishonest" bureaucrats, we expect a *positive* relation between wages and corruption.

Finally, the comparative static results with respect to y are similar to those in the previous section. When $\hat{q} \geq \bar{Q}(m, q)$, Proposition 2 applies and we have the same results as before. When $\hat{q} < \bar{Q}(m, q)$, there is equilibrium corruption, but the extent of government intervention once again depends on how high y/e is relative to β and q. If y is small, the constraint on government intervention is government revenues, and an increase in y makes intervention more desirable. When y is high, the opportunity cost of withdrawing agents from the private sector becomes more important, and further increases in y make intervention less desirable (as long as β does not increase rapidly with y).

IV. Extensions

A. *Misallocation of Talent*

Another criticism of government intervention is that it distorts the allocation of other resources, for example talent. Our model implies that this may also be a feature of optimal government intervention. In the presence of rents in one sector, talent will be naturally misallocated (see Acemoglu and Verdier [1998] for a more detailed discussion of misallocation of talent). To formalize this, consider the model of Section II where all bureaucrats face the same probability of getting caught, q. However, assume that each agent has a cost c of entering entrepreneurship. c is the private information of an agent, and cannot be verified. Those with low c have a comparative advantage for entrepreneurship relative to bureaucracy. We assume that c has a distribution $F(c)$ in the population with support $[0, \bar{c}]$. We also assume that $\bar{c} < y - e$ so that the first best would still involve all agents choosing entrepreneurship. Now consider the configuration of parameters such that (7) is less restrictive than (11). We know from our previous analysis that in the absence of the costs, all agents wanted to enter bureaucracy. This will be true a fortiori when entering the private sector is costly. In other words, we will have:

$$w > y - c - \frac{1-n}{n} \cdot \tau$$

for all c. Since the government cannot condition its hiring on c (it is not observed), a random selection of applicants will be chosen for bureaucracy. Therefore, as long as some agents have a comparative advantage for private sector, the corruption constraint, whenever it is binding, will lead to some degree of misallocation of talent.

B. *Interior Solutions*

The optimal allocations in our analysis so far were corner solutions, $n = x$, $n = 1/2$, or $n = 1$ (and $x = 0$). This implies that changes in β never led to changes in x (unless they switched the economy from no intervention to the regime with government intervention).

To illustrate how some degree decreasing returns changes our results, we modify the externality from $\beta \cdot x$ to $\beta \cdot x^{\alpha}$ with $\alpha < 1$. Therefore, the externality from entrepreneurs using the good technology is always positive but exhibits decreasing returns. The analysis of the previous sections would carry over unchanged and the same constraint sets as in Figures 1, 2, and 4 will apply in the three cases we analyzed (respectively, without corruption constraint, with corruption constraint and homogenous bureaucrat, and with corruption constraint and heterogeneous constraints). However, instead of maximizing a linear function, we now have a concave function. Figure 6 draws the

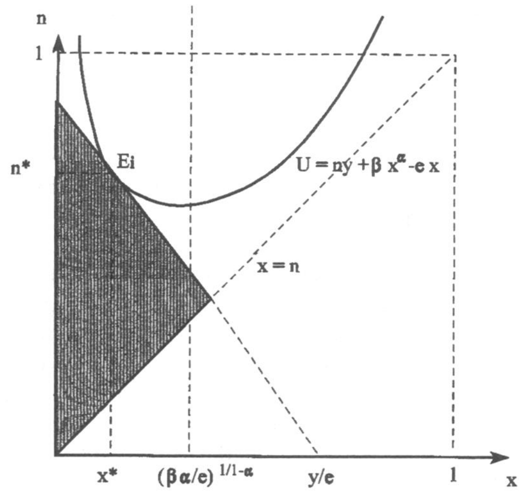

FIGURE 6. INTERIOR SOLUTIONS

diagrammatic form of the maximization problem with the corruption constraint and homogenous bureaucrats as in Section II. The diagram shows that if the objective function is sufficiently concave (α low enough), then an interior solution is possible. This interior solution would have the same features as the cases we discussed earlier. In particular, there will be rents for government employees, and this allocation would be preferred to no government regulation if the market failure it is trying to correct is sufficiently important (i.e., β high enough). It is straightforward to check that an increase in β would now lead to an increase in x, thus the more important is the externality, the larger is the fraction of people induced to choose the good technology. Moreover, the comparative static results of Section II continue to hold. For example, for given β, an increase in y at first makes government intervention more desirable as government revenues increase, but as further increases in y raises the opportunity cost of intervention, government regulation becomes less desirable.

V. Conclusion

Textbooks on public finance emphasize the role of the government in correcting market failures. In reality, we observe many government failures which may be hard to reconcile with the textbook view. We argue in this paper that as long as three plausible conditions are satisfied, optimal government intervention aimed at correcting important market failures will be associated precisely with these observed government failures. These three conditions are:

1. Government intervention requires "bureaucrats" to gather information and implement policies.
2. At least some of the agents who enter bureaucracy are corruptible, in the sense that they are willing to misrepresent their information at the right price.
3. There is some amount of heterogeneity among bureaucrats.

These three features imply that government intervention will create corruption opportunities, rents for public employees, and misallocation of resources. The possibility of corruption is likely to increase the size of government and public-sector wages, as compared to the case where corruption was not possible. And yet, these many faces of government failure do not necessarily imply that government intervention is harmful. They may arise because the government is trying to tax some activities while subsidizing others in order to deal with market failures.

Not all instances of government intervention are in line with this story. Our model predicts that government intervention with partial corruption is likely to be optimal only when corruption is relatively rare and the market failure it is trying to correct is relatively important. Many cases of corruption from developing countries do not fit this pattern. This suggests that even though corruption in LDCs may be "equilibrium," it is unlikely to be "optimal." Our analysis is clearly special because we assumed government policies to be optimally determined. Nevertheless, a simple theoretical framework of optimal government intervention may be the place to start in assessing the pros and cons of government intervention in different environments. Further research to analyze how "equilibrium" government policies and optimal government intervention interact would be useful.

Finally, an interesting and important issue that we have not discussed is the foundations of the distinction between bureaucratic corruption and corruption in the private sector. The conventional wisdom is that the former is much more harmful, but we are not aware of any formal analysis of this issue. This paper emphasized the role of government policy in modifying *ex post* returns and thus affecting *ex ante* behavior. Corruption prevents this useful role of government intervention. If private corruption has less scope for influencing *ex ante* behavior, it will be less harmful. Nevertheless, in many situations, corruption in the private sector may hinder contracting between agents and lead to similar inefficiencies. The analysis of these issues is also an obvious area for future research.

APPENDIX

PROOF OF PROPOSITION 2:

Suppose bureaucrats are corruptible and the government intervenes. We can characterize the total surplus as:

1. If $y/e \geq [1 + \sigma \cdot (1 - q)/q]^2$, (11) is less restrictive than (7), thus the solution is then $n = x = \hat{n} > 1/2$ and $SS_c = (y + \beta - e) \cdot \sqrt{y}/(\sqrt{y} + \sqrt{e})$.
2. If $y/e \in (1 + \sigma \cdot (1 - q)/q; [1 + \sigma \cdot (1 - q)/q]^2)$, then (11) is more restrictive than (7) and y is sufficiently high that all entrepreneurs choose the good technology: $n = x = n_c > 1/2$, $n_c < \hat{n}$ and $SS_c = [(y + \beta - e) \cdot y]/[y + e + e \cdot \sigma \cdot (1 - q)/q]$.
3. If $y/e < 1 + \sigma \cdot (1 - q)/q$, then (10) is more restrictive than (7) but y is low so that if all entrepreneurs choose the good technology, there will not be enough government revenue to pay the bureaucrats. Thus, we have $n = 1/2$, $x = \max\{1/2\,(y/e - \sigma \cdot (1 - q)/q),\ 0\}$ and $SS_c = 1/2\, y + 1/2\,(\beta - e) \cdot [y/e - \sigma \cdot (1 - q)/q]$.

If there is no intervention, total surplus is $SS_{ng} = y$. Comparing S_c in the three cases with y, we obtain Proposition 2.

PROOF OF PROPOSITION 3:

Suppose the government intervenes and wishes to allow partial corruption with the fraction m of bureaucrats who are "dishonest" and are accepting bribes. The optimal allocation is given as:

1. If $y/e < 1 + A$, then $n = ½$. In this case, the partial-corruption constraint is binding and the allocation of talent constraint is slack. The number of entrepreneurs choosing the good technology is: $x = \max\{½\,[y/e - A];\,0\}$. Social surplus is $SS_{pc} = ½y + ½(\beta - e)\cdot[y/e - A]$.
2. If $y/e \in (1 + A, (1 + A)^2)$, then the partial-corruption constraint is binding, the size of the private sector is:

$$\text{(A1)} \qquad n_{pc} = \frac{\frac{y}{e}}{\frac{y}{e} + 1 + A}$$

   and $x = n_{pc}$. We have social surplus: $SS_{pc} = [(y/e)\cdot(y + \beta - e)/(y/e + 1 + A)]$.
3. If $y/e > (1 + A)^2$, then the allocation constraint is binding and we have $n = x = \hat{n}$ as given by (8). $SS_{pc} = SS_g$ as in Section II, subsection B.

Now that we have the surplus from government intervention with partial corruption (SS_{pc}), we can compare this surplus to that from government intervention with no corruption (SS_{nc}), and to output with laissez-faire (SS_{ng}).

First, note that irrespective of parameter values, the social surplus of no intervention is always $SS_{ng} = y$. Second, comparing government intervention with no corruption (SS_{nc}) to intervention with partial corruption (SS_{pc}) is equivalent to comparing the constraints sets of these regimes in the space of (x, n). The feasible set of points (x, n), for intervention without corruption, Φ_{nc}, is given by:

$$\text{(A2)} \quad \Phi_{nc} = \left\{ \begin{array}{l} (x, n) \text{ such that } n \geq ½\text{; and} \\ x \leq \min\left\{(1-n)\cdot\frac{y}{e}\,\frac{1-\hat{q}}{\hat{q}}\cdot n;\ \frac{(1-n)^2\cdot y}{n\cdot e};\, n\right\} \end{array} \right\},$$

while the feasible set Φ_{pc} for intervention with corruption is:

$$\text{(A3)} \quad \Phi_{pc} = \left\{ \begin{array}{l} (x, n) \text{ such that } n \geq ½\text{; and} \\ x \leq \min\left\{(1-n)\cdot\frac{y}{e} - A(\hat{q}, m, q)\cdot n;\ \frac{(1-n)^2\cdot y}{n\cdot e};\, n\right\} \end{array} \right\}.$$

Comparing (A2) to (A3), it follows that $\Phi_{nc} \subseteq \Phi_{pc}$ (and therefore SS_{pc} is larger than SS_{nc}) if and only if: $A(\hat{q}, m, q) \leq (1 - \hat{q})/\hat{q}$. This condition is equivalent to:

$$\hat{q}\left(m + \frac{1-q}{q} - m\,\frac{\hat{q}}{q}\right) \leq (1-m)(1-\hat{q}).$$

The left-hand side of this inequality is continuously decreasing in $\hat{q} \in (0, q)$, from a maximum of $1 - m$ to $(1 - m)(1 - q)$. The right-hand side is a quadratic function, $B(\hat{q})$, and is increasing for $\hat{q} \in (0, \min\langle q, q/2 + (1 - q/2m)\rangle)$. Moreover, $B(0) = 0$, and $B(\min\langle q, q/2 + (1-q)/2m\rangle) \geq B(q) = 1 - q$. It therefore follows that there exists a unique $\bar{Q}(m, q) \in (0, \min\langle q, (q/2) + (1-q)/2m\rangle)$ such that, $B(\hat{q}) \leq (1 - m)\cdot(1 - \hat{q})$ if and only if $\hat{q} \leq, \bar{Q}(m, q)$. Hence, when $\hat{q}$ is smaller than this threshold, we have $A(\hat{q}, m, q) \leq (1 - \hat{q})/\hat{q}$, and government intervention with partial corruption will be preferred to government intervention with no corruption while when $\hat{q}$ is larger than $\bar{Q}(m, q)$, no corruption is preferred.[14]

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[14] This result also establishes our earlier claim that when all bureaucrats are homogenous, it is optimal not to allow any corruption.

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