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THE DYNAMICS OF CORRUPTION WITH THE RATCHET EFFECT

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Abstract

This paper provides a simple model of corruption dynamics with the ratchet effect. As in Shleifer and Vishny [1993], we consider the sale of government property (entry permit) by government officials as the prototype of corruption activities. In a dynamic version of the Shleifer-Vishny model, corrupt officials have *ex post* the incentive to price discriminate entrepreneurs based on the entry decisions made in an earlier period. We show that the inability of government officials to commit to future money demands induces the ratchet effect in that entrepreneurs have incentives to delay entry in order to receive a discount in the permit price later. The *ex post* opportunism erodes the official's extortion power and reduces his revenues from selling permits. Even though the dynamic setting leaves the corrupt official with less extortion power, we cannot rule out the possibility that the official's ability to apply dynamic discrimination decreases the intertemporal aggregate social welfare. We also explore the effect of the official's tenure stability on the extent of corruption. This allows us to identify circumstances under which the often observed practice of job rotation can help mitigate corruption.

Keywords: Corruption dynamics, ratchet effect, ex post opportunism, dynamic consistency

JEL Classification: D9, H2, K4, L1

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I. Introduction

This paper is concerned with the dynamics of corruption. We analyze a dynamic version of Shleifer and Vishny's [1993] model of corruption where the sale of government property (entry permit) by government officials is considered as the prototype of corruption activities.[1] In our two-period model of corruption, entrepreneurs are required to purchase a license from a corrupt official to open a shop. Our dynamic model departs from Shleifer and Vishny in that the official may require the renewal of the license at a fee in the second period.[2] Moreover, the corrupt official is allowed to induce more entry in the second period. In such a setting, corrupt officials have *ex post* the incentive to price discriminate entrepreneurs based on the entry decisions made in the earlier period. We show that the inability of government officials to commit to future demands entails the *ratchet effect* in that entrepreneurs have the incentive to delay entry into the market in order to receive a discount in the permit price later (Freixas, Guesnerie and Tirole, 1985; Laffont and Tirole, 1988).

The *ex post* opportunism erodes the official's monopoly power and reduces his overall revenues from selling permits. The effect of *ex post* opportunism on the aggregate social welfare, however, is ambiguous. In the second period, the official typically induces more entry compared to the commitment solution by giving a discount to new entrants. Thus, the second period welfare is higher when the official is unable to commit to future demands. The discount, however, provides incentives to delay entry for potential entrepreneurs, resulting in less entry in the first period compared to the commitment solution. As a result, the first period welfare is lower without commitment power. The overall effect on the aggregate social welfare thus depends on the relative magnitude of these two countervailing effects.

We also explore the effect of the official's tenure stability on the extent of corruption. The question here is whether the often observed practice of job rotation can help mitigate

[1] For the motivation of studying the dynamics of corruption, see Choi and Thum (1998), who provide many cases of corruption that fit the model.

[2] The repeated demands in corruption are well-documented. See, for instance, John T. Noonan's (1984) comprehensive study on bribe.

corruption. If a corrupt official is replaced, this will not only affect his own initial strategy, but the outcome will also depend on the new official's information structure. Whether job rotation is beneficial from a welfare point of view finally depends on whether the new (corrupt) official can distinguish in his extortion activities between established firms and new entrants.

Elsewhere in Choi and Thum (1998), we adopt the same type of two-period model to study corruption dynamics. However, our earlier paper is different from the current one in two important aspects. Firstly, these two papers employ different assumptions about the information structure the government official has in the second period about individual entrepreneurs. The earlier paper assumes that the entrepreneurs are *anonymous* in that the existing firms can disguise themselves as new entrants if any discounts are offered to new entrants, whereas the current paper considers the case of *identified* entrepreneurs. Thus, the official in Choi and Thum (1998) *cannot* price discriminate against the first period entrants in the second period. This implies that there is no ratchet effect; there are no incentives for the entrepreneurs to delay their entry to disguise as low types in order to elicit the discount later.

Secondly, Choi and Thum (1998) analyse a different type of *ex post* opportunism facing the government official. More specifically, there are sunk investments associated with the initial entry. We ask whether the government officials' *ex post* opportunism to demand more once entrepreneurs have made sunk investments entails further distortion in resource allocations. We initially show that the inability of government officials to commit to future demands does not distort entry decisions any further if the choice of technology is not a decision variable for the entrepreneurs. The government official can properly discount the initial demand in order to induce the appropriate amount of entry. If, however, the choice of technology is left to the entrepreneurs, the dynamic path of demand schedules will induce entrepreneurs to adopt an inefficient "fly-by-night" strategy. They will choose a technology with inefficiently low sunk cost components, which allows them to react more flexibly to future demands from corrupt officials. We characterise the equilibrium behaviour of the government officials and the entrepreneurs' technology choices. In particular, we show that there is no pure strategy equilibrium. Once entry decisions are made by entrepreneurs, the government officials' optimal strategy is to demand varying amounts of money. This provides a new interpretation of the arbitrariness that entrepreneurs often face in a corrupt environment;[3] uncertainty is simply an equilibrium property of repeated extortion.

Both of our papers build on the works by Shleifer and Vishny [1993] and Bliss and Di Tella [1997]. Shleifer and Vishny's main concern is to investigate how the harmful effects of corruption depend on "the industrial organization of corruption." They argue that when corruption activities are decentralised, the harmful effects of corruption are accentuated. As different agencies set their bribery demands independently in order to maximise their own revenue, they do not take the negative externalities on other agencies' revenues into account. Bliss and Di Tella [1997] investigate the relationship between market competition and corruption. They recognise that the extent of competition is not an exogenous parameter since corruption itself can affect the number of firms in a free-entry equilibrium through the endogenously determined level of graft. In a model where the level of corruption and the extent of entry are co-determined by what they call "deep competition" parameters, they show that there is no simple relationship between competition and corruption, thus questioning the validity of a commonly held belief that competitive pressures in the market can mitigate corruption. Our papers are concerned with *dynamic* aspects of corruption. We extend the analysis to a dynamic situation where the official who has previously collected the bribe comes back to demand more to explore implications of the official's ex post opportunism.

The remainder of the paper is organised in the following way. In Section II, we set up the basic model of corruption dynamics with the ratchet effect. We characterise the time-consistent demand schedule for the official and equilibrium entry dynamics for the entrepreneurs. The effect of the ratchet effect on the intertemporal aggregate welfare is also analysed. In Section III, we extend the basic model to explore the effect of the official's tenure stability on the extent of corruption. Section IV contains concluding remarks.

[3] See, e.g., Klitgaard (1990) for various accounts of this type of uncertainty for investors.

II. The Basic Model of Corruption Dynamics

We develop a two-period model of corruption dynamics. Consider a government official who has the power to issue licenses that allow entrepreneurs to open a shop.[4] The official sets the price of the license to maximise revenues from licensing.

Entrepreneurs are heterogeneous in their ability to generate (net) income in each period, denoted by v. Let us normalise the total population of entrepreneurs to unity. The distribution of abilities is given by the *inverse* cumulative distribution function $F(v)$ with continuous density $F' \leq 0$, that is, $F(v)$ denotes the proportion of entrepreneurs who can generate income *more* than v in each period. The type of entrepreneurs is private information to entrepreneurs. The government official knows only the distribution of types. However, once entry decisions have been made by entrepreneurs, the official can update his information on the types of entrepreneurs. In the second period, this updated information allows the official to price discriminate in his demands between those who have entered and those who have not in the first period. We explore the implications of this price discrimination for the entry dynamics of entrepreneurs.

II.1 The Static Problem

We first analyse a static problem as a benchmark. This preliminary analysis also helps us to develop notation. Let us assume that there are no operating costs for firms.[5] Then, if the official demands m for the license, the marginal type who is indifferent between entry and exit is given by $v = m$. Thus, the official solves:

(1) $$\max_{m} \; m \cdot F(m)$$

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[4] As pointed out by Stigler (1971), "[t]he state has one basic resource which in pure principle is not shared with even the mightiest of its citizens: the power to coerce." The state's monopoly on coercion can lead to the abuse of power when public officials have wide discretion and little accountability due to the lack of formal checks and balances [World Bank (1997)].

[5] This assumption is made without any loss of generality since we can interpret v as the income generated net of any operating cost.

This one-to-one relationship between the monetary demand and the marginal type allows us to use the marginal type v as the control variable for the government official, which turns out to be more convenient for later analysis:

(1)′ $\max_{v} \; v \cdot F(v)$

The first order condition for the marginal entrant *v*, which in turn determines the number of entrants $F(v)$, is given by:

(2) $F(v) + v \cdot F'(v) = 0$

We make the standard assumption that the distribution of types satisfies the monotone hazard rate condition, that is, $-F'/F$ is increasing:

(3) $-F''F + (F')^2 > 0$

This assumption ensures that the official's objective function is quasi-concave and the second order condition for the maximisation problem is satisfied:

(4) $2 \cdot F'(v) + v \cdot F''(v) < 0$.[6]

Let v^* as implicitly defined by (2) be the solution to the above problem, i.e.,

(5) $v^* = argmax \; v \cdot F(v)$.

Then, the marginal entrepreneur is v^* and the number of entrants is given by $F(v^*)$. The official demands $m^* = v^*$ for the license.

II.2 The Dynamic Problem with Commitment

We now consider a dynamic (two-period) problem where the official can come back to demand more in the second period. The timing is as follows. At the beginning of the first period, the

[6] Using the first order condition, we can rewrite the second order condition as $2 \cdot F'(v) - F''(v) \cdot F(v) / F'(v) < 0$. The second order condition holds if the distribution *F* satisfies the monotone hazard rate condition. This condition is a standard assumption in the incentive literature and is satisfied by most widely used distributions; see Fudenberg and Tirole [1991, p. 267].

official demands m_1 as a licensee fee for opening a business. Potential entrepreneurs know their own type (v) and decide whether or not to enter. In the second period, the official can demand more money. We assume that the entrepreneurs who entered in the first period are *identified*; the existing firms *cannot* disguise themselves as new entrants if any discounts are offered to new entrants.[7] This informational assumption implies that the official can charge different prices for the right to operate in the second period between existing (old) firms (m_2^o) and new entrants (m_2^n). The firms who entered in the first period decide whether to stay in the business by paying m_2^o or exit from the market. Those firms that did not enter in the first period can potentially enter the market in the second period by paying m_2^n (see *Figure 1*).

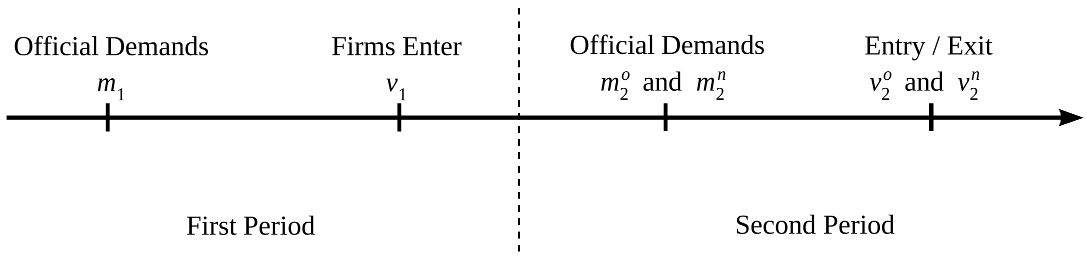

Figure 1. The Timing of the Repeated Extortion Game

The official cannot commit to m_2^o and m_2^n before entry occurs in the first period. The official *ex post* has the incentive to exploit those who entered in the first period since they have revealed that they are high type entrepreneurs. This updated information in the second period allows the official to price discriminate against the first-period entrants, charging them a higher price while setting a lower price for new entrants. In this setting, we ask how the official's *ex*

[7] The assumption of identified entrepreneurs is appropriate when corruption involves large corporations and/or face-to-face personal contacts. For example, consider the investment history of Gulf Oil Corporation in South Korea. In 1966, when Gulf had invested $200 million in South Korea, the incumbent party asked for a $1 million contribution to finance its election campaign. As John T. Noonan [1984, 638] notes, "[t]he request was accompanied by pressure which left little to the imagination." When another election was held four years later, S.K. Kim, a leader of the incumbent party, asked again for a 'campaign contribution' of $10 million. For smaller enterprises, it is usually not difficult to disguise themselves as new entrants; towards the corrupt official, they can simply install a front man and claim that the enterprise is a new entry. Such a disguise may be more difficult for large corporations as in the example of Gulf's FDI in Korea. For an analysis of corruption dynamics under the informational assumption of the anonymous case, see Choi and Thum (1998).

post opportunism to utilise his new information for price discrimination influences the entry behavior of entrepreneurs.

Before answering the question above, however, we first consider the counterfactual case where the official can *commit* to his future demand in the first period before the entry decisions are made. We establish that the optimum in the commitment case is essentially the replication of the static solution with the same number of firms in both periods.

Given m_1 and (m_2^o, m_2^n), the entry/exit behaviour in the second period can be characterised by the following cut-off rule. First period entrants will continue to stay in the market if and only if $v \geq m_2^o$. Potential new entrants will enter if and only if $v \geq m_2^n$. Thus, we can define two critical types, $\bar{v}_2^o (= m_2^o)$ and $\bar{v}_2^n (= m_2^n)$, for the first period entrants and new entrants respectively.[8] These two numbers characterise the entry/exit configuration in the second period. If any, the number of new entrants is given by $F(\bar{v}_2^n) - F(\bar{v}_1)$ and the number of exiting firms is given by $F(\bar{v}_1) - F(\bar{v}_2^o)$.

In the first period, entrepreneurs with type v will enter if the following two conditions are satisfied:

(IR) $(v - m_1) + \delta \max[v - m_2^o, 0] \geq 0$ and

(IC) $(v - m_1) + \delta \max[v - m_2^o, 0] \geq \delta (v - m_2^n)$

where δ ($\delta \leq 1$) is the discount factor. The first condition (IR) is the individual rationality condition. The second one (IC) is the incentive compatibility condition which states that entry in the first period is more profitable than delayed entry in the second period. It can be easily verified that if these two conditions are satisfied for type v, then they are also satisfied for any type $v' > v$. Thus, we can define a critical type $\bar{v}_1$ for the first period entrants. Note that $v_2^o \geq \bar{v}_1$ and $\bar{v}_2^n \leq \bar{v}_1$ by definition. We will say that there is exit in the second period if $\bar{v}_2^o > \bar{v}_1$ and there is new entry in the second period if $\bar{v}_2^n < \bar{v}_1$.

[8] The bar indicates that a variable refers to the commitment scenario.

Proposition 1. There is neither exit nor new entry in the second period, that is $\bar{v}_2^o = \bar{v}_2^n = \bar{v}_1$. Moreover, the number of entrants with commitment is the same as the one in the static model ($\bar{v}_1 = v^*$). Thus, the commitment solution replicates the static solution.

Proof. It can be easily verified that the IR constraint above is not binding.[9] As a result, we can ignore the IR constraint. The marginal type in the first period ($\bar{v}_1$) is that for which the IC constraint is binding and, thus is indifferent between entering in the first period and delayed entry. Using the fact that $\bar{v}_2^o = m_2^o$ and $\bar{v}_2^n = m_2^n$, we have the following relationship:

(6) $$m_1 = \bar{v}_1 - d(\bar{v}_1 - \bar{v}_2^n).$$

Thus, the government official's revenue as a function of the marginal types in each period can be written as

(7) $$\begin{aligned} R^C(\bar{v}_1, \bar{v}_2^o, \bar{v}_2^n) &= m_1 \cdot F(\bar{v}_1) + d \cdot \left\{ m_2^o F(\bar{v}_2^o) + m_2^n \left[F(\bar{v}_2^n) - F(\bar{v}_1) \right] \right\} \\ &= \left[\bar{v}_1 - d(\bar{v}_1 - \bar{v}_2^n) \right] \cdot F(\bar{v}_1) + d \cdot \left\{ \bar{v}_2^o F(\bar{v}_2^o) + \bar{v}_2^n \left[F(\bar{v}_2^n) - F(\bar{v}_1) \right] \right\} \\ &= (1-d)\bar{v}_1 \cdot F(\bar{v}_1) + d \cdot \bar{v}_2^o F(\bar{v}_2^o) + d\,\bar{v}_2^n F(\bar{v}_2^n). \end{aligned}$$

The revenue is maximised when $\bar{v}_1 = \bar{v}_2^o = \bar{v}_2^n = v^*$ [see Eq. (5)]. This implies that there is neither exit nor entry in the second period and the commitment solution replicates the static solution in terms of the extent of entry.

II.3 The Dynamic Problem without Commitment

Now let us analyse the case where the official *cannot* commit to the future level of demand before the entry decision is made. As in the case of commitment, the first period entry decision is characterised by a cut-off rule. Let us denote v_1 as the marginal type entrant in the first period when no commitment is possible. The official in the second period faces two sets of entrepreneurs; those who entered in the first period with $v \in [v_1, \infty]$ and those who have not

[9] Since $m_2^n (= \bar{v}_2^n) \leq \bar{v}_1$, the IR constraint is automatically satisfied if the IC constraint is satisfied.

entered with $v \in [0, v_1]$. As a result, the marginal type v_1 will serve as the state variable in the second period.

The optimal second period demands (m_2^o, m_2^n) can be determined by the marginal types (v_2^o, v_2^n). Once again, we will find it more convenient to treat (v_2^o, v_2^n) as the control variables. Since the official is assumed to be able to distinguish the existing entrepreneurs from potential new entrants, he solves two separate problems.

For potential new entrants, the maximisation problem for the official can be written as:

(8) $$\underset{v_2^n}{Max}\ [F(v_2^n) - F(v_1)] \cdot m_2^n = [F(v_2^n) - F(v_1)] \cdot v_2^n .$$

The demand for entry permit from the new entrants is represented by the "truncated demand function" $[F(v) - F(v_1)]$. Let $\Phi(v_1)$ maximise $[F(v) - F(v_1)]\ v$. That is, $\Phi(v_1)$ satisfies the following first order condition:

(9) $$F'(\Phi(v_1)) \cdot \Phi(v_1) + [F(\Phi(v_1)) - F(v_1)] = 0 .$$

Note that our assumption about the monotone hazard rate condition also implies that the "generalized hazard rate" $-F'(.)/[F(.) - F(v_1)]$ is increasing for all v_1, ensuring that the second order condition for the maximisation problem is satisfied and $\Phi(v_1)$ is well defined.[10] Given v_1, the optimal entry configuration for new entrants in the second period is thus:

(10) $$v_2^n = \Phi(v_1).$$

The indirect revenue function for the official from new entrants is given by

(11) $$p_2^n(v_1) = [F(\Phi(v_1)) - F(v_1)]\ \Phi(v_1).$$

For future reference, we observe that the total differentiation of (9) yields:

[10] Let $H(v) \equiv -F'(v)/[F(v) - F(v_1)]$. Then, $\text{sign}[H'(v)] = \text{sign}[\{-F''(v) \cdot F(v) + (F'(v))^2\} + F''(v) \cdot F(v_1)]$. From the monotone hazard rate condition [see (3)], we know that $\{-F''(v) \cdot F(v) + (F'(v))^2\} > 0$. There are two cases to consider. If $F''(v) > 0$, obviously $H'(v) > 0$. If $F''(v) < 0$, $\{-F''(v) \cdot F(v) + (F'(v))^2\} + F''(v) \cdot F(v_1)$ $= -F''(v) \cdot [F(v) - F(v_1)] + (F'(v))^2 > -F''(v) \cdot F(v) + (F'(v))^2 > 0$. Once again, $H'(v) > 0$.

(12) $\Phi'(v_1) = \frac{dv_2^n}{dv_1} = \frac{F'(v_1)}{F''(v_2^n)v_2^n + 2F'(v_2^n)} > 0.$[11]

Since $F(\infty) = 0$, we have $\Phi(\infty) = v^*$ [see Eq. (9)]. Thus, for any number of entrants in the first period, the marginal new entrant in the second period has a lower revenue than the marginal entrant in the case with commitment: $\Phi(v_1) < v^*$ for any v_1 . This implies that the total number of firms in the second period is larger than in the commitment scenario.

For the existing entrepreneurs, the official's maximisation problem is:

(13) $\underset{v_2^0}{Max}\ F(v_2^o)\cdot m_2^o \ = F(v_2^o)\cdot v_2^o$ subject to $v_2^o \geq v_1$.

Thus, the optimal entry configuration for the existing entrepreneurs is:

$v_2^o = \max\,[v_1, v^*]$.

The indirect revenue function for the official from existing entrepreneurs is given by

(14) $\pi_2^o(v_1) = \begin{cases} F(v_1)\cdot v_1 & \text{if } v_1 > v^* \\ F(v^*)\cdot v^* & \text{if } v_1 \leq v^* \end{cases}$

Proposition 2. In equilibrium without commitment, there is no exit in the second period, that is, $v_1 > v^*$ and thus $v_2^o = v_1$.

Proof. The official's overall revenue in present value can be written as:

(15) $R^{NC}(v_1) = F(v_1)\, m_1 + \delta[p_2^o(v_1) + p_2^n(v_1)]$.

Suppose $v_1 \leq v^*$. Then, the official's second-period optimal demand for the existing entrepreneurs is given by m_2^o $(= v_2^o = v^*) \geq v_1$. This implies that the marginal type v_1 does not get any surplus in the second period. Since the marginal type is indifferent between entering in the first period and delaying entry until the second period, we have the following relationship:

(16) $v_1 - m_1 = \delta[v_1 - \Phi(v_1)]$.

Substituting (11), (14) and (16) into (15) yields:

[11] To sign the expression, recall that the second order condition in (4) requires the denominator to be negative.

(17) $$R^{NC}(v_1) = F(v_1)\cdot\{v_1 - \delta\cdot[v_1 - \Phi(v_1)]\} + \delta\cdot\{F(v^*)\cdot v^* + [F(\Phi(v_1)) - F(v_1)]\cdot\Phi(v_1)\} =$$
$$= (1-\delta)\cdot F(v_1)\cdot v_1 + \delta\cdot F(v^*)\cdot v^* + \delta\cdot F(\Phi(v_1))\cdot\Phi(v_1).$$

When $v_1 \leq v^*$, $R^{NC}(v_1)$ is strictly increasing in v_1 since $F(v)\, v$ is quasiconcave with optimum at v^* and $\Phi(v_1) < v^*$ [$=\Phi(\infty)$] with $\Phi'(v_1) > 0$. Thus, any demand schedule that induces $v_1 \leq v^*$ cannot be optimal for the official. ■

The analysis above indicates that when the government official cannot commit to the second period demands, there is less entry in the first period and more entry in the second period in comparison to the commitment case (or the static case): $v_1 > v^*$ and $v_2 < v^*$. The reason for the low level of entry in the first period is the *ratchet effect* [Freixas, Guesnerie, and Tirole (1985)]. By entering in the first period, entrepreneurs reveal their ability to generate high incomes and consequently are subject to adverse "price discrimination" in the second period. Entrepreneurs thus deliberately delay their entry to take advantage of the lower license price offered to new entrants in the future.

As is standard in the time consistency literature the *ex post* flexibility, i.e. the official's ability to adjust his demands based on newly available information, actually hurts him in terms of revenues he can collect [see, for instance, Tirole (1988)]; the official's dynamic monopoly power is undermined by his own ability to price discriminate based on entry history. The loss of monopoly power, however, does not automatically translate into welfare gains in comparison to the commitment case. Compared to the commitment case, there is less entry in the first period ($v_1 > v^*$). The first period welfare thus is lower in the no commitment case. However, there are more entrants in the second period ($v_2 < v^*$); hence, second period welfare is higher in the no commitment case. The overall impacts of *ex post* flexibility on the intertemporal aggregate welfare depends on the relative magnitude of these two countervailing effects. To demonstrate the ambiguity of the welfare consequences, we consider two cases, linear and kinked demand for entry. For simplicity, we assume that δ=1.[12]

[12] The examples can easily be generalised for all $\delta \in [0,1]$.

Example 1. The Linear Demand Case

Suppose that the entrepreneur types are distributed uniformly on the unit interval $v \in [0,1]$, that is, $F(v) = 1 - v$. In this case, we can easily verify that $\Phi(v_1) = v_1/2$ and $\pi_2^n(v_1) = (v_1/2)^2$. The government official without commitment induces $v_1 = 3/5$ and $v_2 = 3/10$. The sum of welfare over the two periods is given by:

$$W = W_1 + W_2 = \int_{\frac{3}{5}}^{1} x dx + \int_{\frac{3}{10}}^{1} x dx = \frac{8}{25} + \frac{91}{200} = \frac{31}{40}.$$

In contrast, when the government official can commit to future demand, the marginal entrant is the same across periods with $v_1 = v_2 = 1/2$. The welfare with commitment power is given by:

$$\overline{W} = \overline{W}_1 + \overline{W}_2 = 2\int_{\frac{1}{2}}^{1} x dx = 3/4 \ (< W).$$

Thus, with a uniform distribution, social welfare increases as the government official loses dynamic monopoly power.

Example 2. The Kinked Demand Case

To demonstrate that the welfare effect of commitment is ambiguous, we simply introduce a kink in the demand for entry.[13] Suppose that the distribution function is given by

$$F(v) = \begin{cases} 1 - v/2 & \text{for } 0 \le v < 1/2 \\ 3/2 \cdot (1 - v) & \text{for } 1/2 \le v \le 1. \end{cases}$$

The example is illustrated in *Figure 2.* As it is more convenient to use the number of entrants as a choice variable in this example, the number of entrepreneurs who can generate income of at least v in each period is denoted on the horizontal axis. Let $n_1 = F(v_1)$ be the number of entrants in the first period. Then, given n_1, the government official's problem in the second period can be written as:

[13] This example is borrowed from Malueg and Solow (1989), who discuss the welfare implications of selling versus renting by a durable-goods monopolist.

$$\underset{n_2}{Max}\, R_2 = \begin{cases} (n_2 - n_1)\cdot\left[1 - \frac{2}{3}\cdot n_2\right] + n_1 \cdot v_1(n_1) & \text{for } n_2 \le \frac{3}{4} \\ (n_2 - n_1)\cdot\left[2\cdot(1 - n_2)\right] + n_1 \cdot v_1(n_1) & \text{for } n_2 > \frac{3}{4} \end{cases}$$

where n_2 is the total number of entrants in the second period and $v_1(n_1)$ is the marginal first-period entrant's willingness to pay [$v_1(n_1) = 1 - \frac{2}{3}\cdot n_1$ for $n_1 \le \frac{3}{4}$ and $v_1(n_1) = 2\cdot(1 - n_1)$ for for $n_1 > \frac{3}{4}$]. From the first-order condition we get:

$$n_2(n_1) = \begin{cases} ¾ & \text{for } n_1 \le ½ \\ ½ + ½\cdot \mathrm{n}_1 & \text{for } n_1 > ½. \end{cases}$$

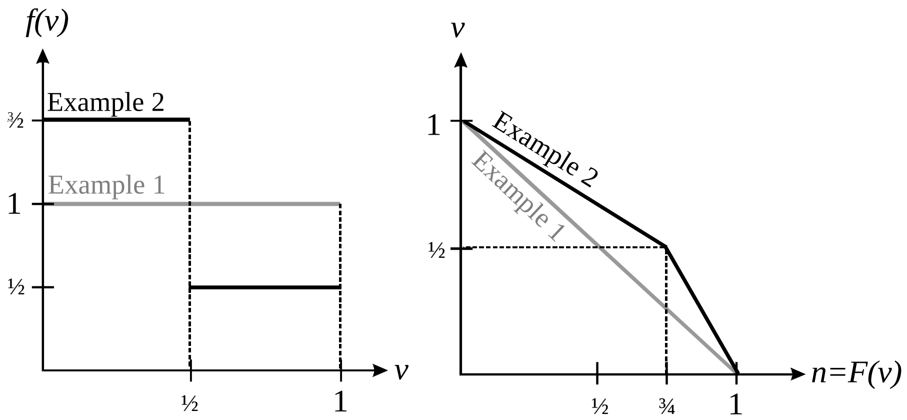

Figure 2. Linear and Kinked Demand for Entry

That is, with the kinked demand curve chosen here the government official induces second-period entry of at least ¾, which would be the number of entrants with commitment. The bribes charges from new entrants amount to

$$m_2(n_1) = \begin{cases} ½ & \text{for } n_1 \le ½ \\ 1 - n_1 & \text{for } n_1 > ½. \end{cases}$$

Now we can turn to the first period. With δ=1, Eq. (6) can be written as $m_1 = v_2^n = m_2$. The marginal entrant in the first period has to be indifferent whether to enter immediately or wait until the second period. If the bribery payments for new entrants are the same in both periods, the marginal entrant makes a profit of $v_1 - m_1$ in the first period and has to pay the entire second period revenue as a bribe. If he waits until the second period, he would just make the same profit of $v_1 - m_2$. The official's overall revenue can now be written as:

$$R^{NC}(n_1) = \begin{cases} ½ \cdot n_1 + {}^2\!/_3 \cdot n_1 + ½ \cdot (¾ - n_1) & \text{for } n_1 \leq ½ \\ (1 - n_1) \cdot n_1 + \left(1 - {}^2\!/_3 \cdot n_1\right) \cdot n_1 + (1 - n_1) \cdot \left(½ - ½ \cdot n_1\right) & \text{for } n_1 > ½. \end{cases}$$

The first-order condition yields:

$n_1 = ½$ and, therefore, $n_2 = ¾$.

In our simple example, it is not even necessary to calculate explicitly the welfare levels with and without commitment power of the corrupt official. Without commitment, the government allows half of the firms to enter in the first period and another quarter of the firms in the second period. With commitment, it is easy to see that it is optimal to have three quarters of the firms in for both periods. Hence, the number of firms is the same in the second period for both scenarios but is lower in the first period without commitment (½ instead of ¾). Thus, with the kinked demand function, social welfare decreases when the corrupt government official loses commitment power.

III. Job Rotation and the Dynamics of Corruption

One practice often observed in various organisations is job rotation.[14] This practice can be puzzling, since transferring individuals to new jobs sacrifices job-specific human capital (Ickes and Samuelson, 1987). One prominent explanation is that job transfers prevent corruption by ensuring that employees do not occupy a job long enough to reap the benefits of corrupt activities.[15] In this section, we investigate the implications of job rotation for the dynamics of corruption in our model.

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[14] Job rotation, for instance, is observed in planned enterprises in the former Soviet Union, the U.S. foreign service and military.

[15] Other explanations for job transfers include mitigating the ratchet effect, sorting employees into the jobs where they will be the most productive and allowing potential future managers to gain familiarity with various aspects of an organisation's operations. See Ickes and Samuelson (1987) for details.

Let us parameterise the frequency of job rotation by β, which is the probability that the official will *remain* in the same position in the second period. For the purpose of maximizing license revenue, β plays the role of a discount factor for the official. If there is a job transfer, the office is assumed to be occupied by another corrupt official. For simplicity, we ignore discounting by setting δ=1. We consider two scenarios depending on the information structure assumed for the new official. In the first scenario, the new official can distinguish between old and new firms, whereas he cannot in the second scenario.

III.1. First Period Entrants Identified by the New Official

This case analyses a situation where the new official enjoys the same information as the old official. It corresponds to a situation where the identities of entrants are publicly available. In this case, the change of power is irrelevant for the entrepreneurs while it affects directly the original corrupt official, who is transferred elsewhere. With this information structure, the second period demands will be independent of who is in power. Once again, it can be shown that the optimal strategy in the second period is to extract the whole surplus of the marginal type who entered in the first period without inducing any exit.[16] Thus, the marginal type in the first period is given by $v_1 - m_1 = v_1 - \Phi(v_1)$ with δ=1. Hence, we have $m_1 = \Phi(v_1)$.

The maximisation problem for the official in the first period is then:

$$(18) \qquad R^{NC}(v_1) = F(v_1)\, m_1 + \beta[p_2^o(v_1) + p_2^n(v_1)]$$
$$= F(v_1)\, \Phi(v_1) + \beta[p_2^o(v_1) + p_2^n(v_1)],$$

where $p_2^o(v_1) = F(v_1)\, v_1$ and $p_2^n(v_1) = [F(\Phi(v_1)) - F(v_1)]\, \Phi(v_1)$.

The first order condition is given by:

$$(19) \qquad F'(v_1)\, \Phi(v_1) + F(v_1)\, \Phi'(v_1) + \beta[p_2^{o\prime}(v_1) + p_2^{n\prime}(v_1)]=0.$$

Totally differentiating Eq. (19) with respect to v_1 and β yields:

[16] The reason is that the official in the first period never finds it optimal to induce entry level such that $v_1 \leq v^*$.

(20) $\quad [\text{s.o.c}]\, dv_1 + [\pi_2^o{}'(v_1) + \pi_2^n{}'(v_1)]\, d\beta = 0$,

where [s.o.c] denotes the second order condition for (18) and is negative. Thus, the sign of dv_1 / db is the same as the sign of $[\pi_2^o{}'(v_1) + \pi_2^n{}'(v_1)]$, which in general is ambiguous. The reason is that $p_2^o{}'(v_1) = F'(v_1)\, v_1 + F(v_1) < 0$ for $v_1 > v^*$, whereas $p_2^n{}'(v_1) = -\, F¢(v_1)\Phi(v_1) > 0$ by the envelope theorem. If $p_2^o{}'(v_1) + p_2^n{}'(v_1) = [F'(v_1)\, v_1 + F(v_1)] - F'(v_1)\Phi(v_1) > 0$ and thus $dv_1 / db > 0$, an increase in the frequency of job rotation (a lower β) induces more entrants in the first period. This in turn implies more entrants in the second period since there is a monotonic relationship between the number of entrants in the first period and in the second period ($\Phi'(v_1) > 0$). Such a condition, for instance, is satisfied for uniform distributions. If we assume that v is distributed uniformly on [0,1], it can be verified that $v_1 = (1 + 2\beta)/(2 + 3\beta)$, which is increasing in b. In such a case, the practice of job rotation can be justified as an instrument of reducing the harmful effects of corruption. If any job-specific human capital is involved, the optimal job design in an organisation requires that the probability of job rotation b be chosen to trade off the benefit of thwarting corruption against the loss of human capital.

III.2. First Period Entrants *Not* Identified by the New Official

This case analyses a situation where the new official has no information concerning the identities of entrants in the first period. It corresponds to a situation where the identities of entrants are not publicly available and thus price discrimination based on entry history is not possible for the new official. In this case, the change of power is also relevant for the entrepreneurs. When the new official comes in, he will solve the static optimisation problem and will charge v^*. Thus, the marginal type in the first period is given by:

$$v_1 - m_1 + (1 - \beta)(v_1 - v^*) = \beta[v_1 - \Phi(v_1)] + (1 - \beta)(v_1 - v^*).$$

The relationship between the first period monetary demand m_1 and the marginal type v_1 is $m_1 = (1 - \beta)\, v_1 + \beta\, \Phi(v_1)$. The maximisation problem for the official in the first period is then:

(21) $\quad R^{NC}(v_1) = F(v_1)\, m_1 + \beta[p_2^o(v_1) + p_2^n(v_1)] =$

$$= F(v_1)\,[(1-\beta)\,v_1 + \beta\,\Phi(v_1)] + \beta[F(v_1)\,v_1 + p_2^{\,n}(v_1)] =$$

$$= F(v_1)\,v_1 + \beta\,[F(v_1)\,\Phi(v_1) + p_2^{\,n}(v_1)],$$

where $p_2^{\,n}(v_1) = [F(\Phi(v_1)) - F(v_1)]\,\Phi(v_1)$. The first order condition is given by:

(22) $F'(v_1)\,v_1 + F(v_1) + \beta\,[F'(v_1)\,\Phi(v_1) + F(v_1)\,\Phi'(v_1) + p_2^{\,n}{}'(v_1)] = 0.$

Totally differentiating Eq. (19) with respect to v_1 and β yields:

(23) $[\text{s.o.c}]\,dv_1 + [F'(v_1)\,\Phi(v_1) + F(v_1)\,\Phi'(v_1) + p_2^{\,n}{}'(v_1)]\,db = 0,$

where [s.o.c] denotes the second order condition for (21) and is negative. Since $\pi_2^n(v_1) = -F'(v_1)\cdot\Phi(v_1)\,'(v_1)$ by the envelope theorem, we have $dv_1/db > 0$. In this case, an increase in the frequency of job rotation (a lower β) unambiguously induces more entrants in the first period. In the event of job rotation, however, the new official lacks the information to price discriminate in the second period. As a result, he will solve the static maximisation problem and will induce $F(v^*)$ entrants in the second period independent of entry configuration in the first period. In the second period, the number of entrants with a new official is less than the number of entrants in the event that the old official retains his job, $F(\Phi(v_1))$, for any v_1. The overall effect of job rotation on welfare is thus ambiguous. If the new official cannot identify who entered in the first period, the practice of job rotation, in a sense, mimics the outcome under commitment in that there is no price discrimination in the second period. We can conclude that if the intertemporal aggregate welfare is higher under the commitment regime, job rotation will be beneficial. In contrast, if the intertemporal aggregate welfare is higher under the no commitment regime, job rotation can be harmful.

In light of our earlier welfare result in Section II, we can conclude that job rotation is harmful in the uniform distribution case if the new official lacks the information concerning the identities of the first period entrants. Thus, we have a completely opposite result compared to the case where the new official can identify the first period entrants; there, job rotation was beneficial. These results suggest that the welfare consequences of job rotation in the dynamics of corruption hinge crucially on the information structure facing the new official.

IV. Concluding Remarks

In this paper, we analysed the dynamics of corruption when the official can identify which entrepreneurs have entered in the first period and can discriminate on the basis of entry history in the second period. We demonstrated that the entry dynamics are characterized by the ratchet effect in that entrepreneurs deliberately delay their entry to take advantage of a lower license price offered for new entrants in the future. We also analysed the effects of the ratchet effect on the intertemporal aggregate welfare. In addition, we explored the effect of the official's tenure stability on the extent of corruption. We identified circumstances under which the often observed practice of job rotation can help mitigate corruption.

We showed that the inability of government officials to commit to future demands erodes the official's extortion power and reduces his revenues from selling permits. This result has implications for the official's choice of information structure. Suppose that the official has some control over the information structure through his decision concerning whether or not to monitor individual entrepreneurs. Import licenses, for instance, can be made anonymous by granting entrepreneurs the right to resell them in the secondary market. Thus, a corrupt official may deliberately choose a way of extortion that does not allow himself to keep track of extorted entrepreneurs over time. Our result suggests that the "anonymous" information structure analysed in Choi and Thum (1998) may arise endogenously.

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