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Corruption, Fiscal Policy, and Growth: A Unified Approach

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Corruption, Fiscal Policy, and Growth: A Unified Approach

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Abstract
In this paper, we study the effects of bureaucratic corruption on fiscal policy and the subsequent impact on economic growth. Here corruption takes three forms: (i) it reduces the tax revenue raised from households, (ii) it inflates the volume of government spending, and (iii) it reduces the productivity of 'effective' government expenditure. The analysis distinguishes between the case where fiscal choices are determined exogenously to ensure a balanced budget and the case where the government optimally sets its policy instruments. Our policy experiments reveal that for both cases, corruption affects fiscal policy and growth in similar ways, in particular, through higher income tax and inflation rates, and a lower level of government spending. The findings from our unified framework could rationalise the diverse empirical evidence on the impact of corruption on economic growth in the literature.

Keywords: Corruption, economic growth, public expenditure and finances, passive and active fiscal policy.

JEL classification: D73, E60, O42.

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1. Introduction

Following on from the basic inquiry as to whether corruption is good or bad for growth,[1] a number of related questions on this topic have evolved over the years and evoked genuine interest among academics as well as policymakers. How can the impact of corruption via the expenditure and revenue sides of the government budget constraint be captured, and is this sizeable enough to influence the macroeconomy? How do governments design appropriate spending and tax policies to moderate the effects of such corruption? Do the economic outcomes differ significantly when governments take an active, rather than a passive, fiscal stance? In this paper, we attempt to provide some answers to these types of questions through a unified approach linking bureaucratic corruption,[2] fiscal policy and growth within an endogenous growth framework, where such issues have not been addressed together in the related literature.

In our paper, there is asymmetric information between the government and the public officials, a realistic feature of many developing countries, in particular. Within that set-up, corruption features in three distinct ways: On the expenditure side, there are two types of effects: first, corrupt officials inflate the size of the public spending, not for increasing the size of the national cake, but for their own pecuniary gain; secondly, although the amount of public spending is higher than warranted, the productivity arising out of such spending is considerably lower than it would otherwise have been.[3] On the revenue side, corruption in tax administration implies that not all tax revenues end up in

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[1] The efficiency or "speed money" hypothesis (see Leff (1964), Huntington (1968), Lui (1985), etc.) has largely been overturned in the literature by the inefficiency argument of corruption via rent-seeking activities, barriers to innovation, adoption of inefficient technologies, etc. (see, for example, Krueger (1974), Murphy *et al.* (1991), Acemoglu (1995), Ehrlich and Lui (1999), Hall and Jones (1999), Sarte (2000), and Svensson (2005)).

[2] Bureaucratic (or "petty") corruption occurs when bureaucrats running the administration are corrupt, as in this paper, and the government is benevolent; while with "grand" corruption, the government itself is corrupt. (See Rose-Ackerman (1999) for a distinction.) See also Ellis and Fender (2006), where the government and bureaucracy are comprised of self-interested agents who could be subsumed into one corrupt entity. There is a voluminous literature on the economic effects of bureaucratic corruption (see Bardhan (1997), Jain (2001), Aidt (2003), and Svensson (2005) for comprehensive reviews).

[3] Olson *et al*. (2000) attribute the cross-country differences in growth of total factor productivity (TFP) to differences in governance, but do not show any explicit theoretical link between (various forms of) corruption and growth as we do. In Del Monte and Papagni (2001), corruption does lower the quality of public infrastructure supplied to the private sector, but in their paper illegal behaviour manifests through bureaucrats providing the government with low quality goods at the same price as private markets and/or acquiring the same goods at a higher price.

government coffers, as some of it is embezzled by corrupt bureaucrats involved in tax collection. Although some of these aspects have been captured in previous empirical papers (see Mauro (1995), Tanzi and Davoodi (1997), among others), explicit analytical conditions have not been derived in the literature on the effects of corruption in public finances.

That corruption may impact independently on both the expenditure and revenue sides of the government's budget can be explained as follows: corruption can distort the composition of expenditures by shifting resources towards items where the possibility of inflating spending and obtaining more "commissions" is higher and also where there is greater scope for indulging in covert corruption, as alluded to by Shleifer and Vishny (1993). Corruption can also alter the manner by which revenues are generated, e.g., by shifting from tax to seigniorage revenues when part of the tax proceeds do not accrue to the government and is usurped, as suggested by other empirical evidence. Also Imam and Jacobs (2007), and Tanzi and Davoodi (1997, 2000) conclude that corruption reduces total tax revenues by reducing the revenues from almost all taxable sources (including incomes, profits, property, and capital gains). The implication is that, *ceteris paribus*, other means of raising income must be sought, and one of the most tempting of these is seigniorage. Significantly, it has been found that seigniorage is closely linked with inflation (see Cukierman *et al*. (1992)), and that inflation is positively related to the incidence of corruption (e.g., Al-Marhubi 2000), while seigniorage, itself, has a negative effect on growth (e.g., Adam and Bevan (2005); Bose *et al*. (2007)). Such observations provide the motivation for this paper, which explores the influence of various forms of bureaucratic corruption on public spending and finance, and the implications of these for growth and development.[4]

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[4] Although, in general, the two most common methods of financing the government budget – income taxation and seigniorage – are both considered distortionary in terms of growth, there is no consensus on the relative merits of tax versus money financing of public spending. For example, Palivos and Yip (1995) consider income-tax financing to be worse than seigniorage financing, whereas De Gregorio (1993) generally argues the opposite. Bose *et al*. (2007) link the optimal mode of financing to the levels of development, i.e., they find that for low-income (high-income) countries, financing expenditures with revenue generated by income taxation (seigniorage) is less distortionary for growth. In a similar vein, Holman and Neanidis (2006), in a small open economy model, find that the adverse growth effects of seigniorage are more prominent than those of income taxes for economies that are less financially developed. Miller and Russek (1997) find that a tax-financed increase in public spending in developing countries actually leads to higher growth, while that in developed countries lowers growth. None of these

It is important to note that the agents in our model hold money (in addition to capital) in their portfolio, and the portfolio allocation decision is made by financial intermediaries who act on behalf of agents. Following Diamond and Dybvig (1983) and Espinosa-Vega and Yip (1999, 2002), we consider a scenario in which individuals are subject to random relocation shocks that create a trade-off between investing in a productive, but illiquid, asset (capital) and a non-productive, but liquid, asset (money). Intermediaries, which receive deposits from individuals, optimize this trade-off by choosing a composition of portfolio that depends on the relative rates of return of the two assets. An increase in inflation, which reduces the return on money, causes a portfolio re-allocation away from capital investment (loans to firms) towards greater cash holdings in order to guarantee adequate provision of liquidity services for those agents who are forced to relocate. Against this background, we study the effects of corruption on growth and development.

As regards the role of public policy in our paper, we consider first the case of a benevolent government which passively adjusts its revenues/expenditures (to ensure a balanced budget) in response to corruption, and then that of a government which chooses its instruments optimally to maximize a social welfare function comprising of the lifetime utilities of all honest agents over generations.[5] We show that while the workings of the model are different in the two cases, their predictions are remarkably similar as to the choice of appropriate policy instruments and their respective growth effects, which implies that the issue of whether a government takes a passive or an active stance is actually not that critical.

In connection with the searching questions raised in the first paragraph, we find that in both cases corruption distorts growth by causing a lower level of government spending and higher rates of income tax and inflation. Interestingly, even though in our model corruption is generally harmful to the economy, there is a case where it may be beneficial for economic growth: this is when the government passively adjusts its level of

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papers, however, attribute corruption as a factor that affects the relative efficiency of seigniorage as against income taxation.

[5] Note that corruption at an individual level is undetectable in our model. However, as the overall distribution of corruption is known (and is, therefore, exogenously given in the aggregate), an optimizing government, which has to design a second-best fiscal policy, takes into account the welfare of all non-corrupt agents.

expenditure in response to corruption; here corruption gives rise to non-monotonic growth effects. So, clearly, the effect of corruption on growth, and the direction of change in seigniorage and income taxes that is triggered, depends on the types of corruption that exist, and the different channels that are activated as a consequence. Thus, our results could provide a rationale for the empirical findings of papers that report the conditional (or non-monotonic) effects of corruption on growth.

The rest of the paper is organized as follows. Section 2 presents the analytical model, and characterizes the balanced growth path of the economy. Section 3 analyses the effects of corruption on the key economic variables when a government allows an exogenous adjustment of its fiscal instruments to ensure a balanced budget. Section 4 captures the effects of corruption under an optimizing government. Finally, Section 5 contains a few concluding remarks.

2. The analytical model

Consider an overlapping generations economy in which there is an infinite sequence of two-period-lived agents. Each generation of agents is comprised by private citizens (or households) and public officials (or bureaucrats). Households work for firms in the production of output, whilst bureaucrats work for the government in the administration of public policy. All agents work only when young and consume only when old. Consumption is financed from savings with financial intermediaries that make optimal portfolio choices on behalf of agents by allocating their deposits between liquid and illiquid assets. This role of intermediaries is created by the existence of idiosyncratic relocation shocks which also motivate a demand for liquidity. This financial friction provides a link between the monetary and the real side of the economy.

The government generates revenue by taxing labour income and by printing money (seigniorage), and undertakes expenditures on public goods and services. Corruption takes shape in three different ways. Firstly, some bureaucrats appropriate tax revenues for themselves; secondly, some bureaucrats inflate the cost of public services; and thirdly, corruption reduces the efficiency of the public good in the production process. Finally, firms, of which there is a unit mass, conduct all of their business in perfectly competitive product and factor markets. The economy is described in more detail as follows.

2.1. Agents

There is a constant population (normalised to one) of two-period-lived agents belonging to overlapping generations of dynastic families. Agents are divided at birth into a fraction, μ, of households and a remaining fraction, 1-μ, of bureaucrats.[6] Both households and bureaucrats work only when young and consume only when old, deriving lifetime utility according to

$$U_t = -\frac{c_{t+1}^{-\sigma}}{\sigma}, \sigma > 0, \tag{1}$$

where c_{t+1} denotes old-age consumption.

All young agents are endowed with the same unit amount of labour which is supplied inelastically to a given occupation (private employment or public service) in return for the same labour income of w_t.[7] This income is deposited as savings with financial intermediaries. As in Espinosa-Vega and Yip (1999, 2002), we introduce some uncertainty into the model by assuming that a typical agent is born at a point in time in one particular location, where he resides in the first period of his life. In the second period, with probability q ($0 < q < 1$), this agent relocates to another location. The uncertainty of individuals about their future location is important for determining the composition of savings which can take two forms - a liquid, but unproductive, asset (money) and an illiquid, but productive, asset (capital). Although the return on capital is higher than that of money, there nevertheless exists some demand for cash as the latter is 'mobile' because of its liquidity and is therefore demanded by agents who relocate. We assume that these shocks are identically and independently distributed across agents who prefer to save through intermediaries, rather than by themselves, because doing so allows them to exploit the law of large numbers in eliminating individual risk. We study this in detail in our subsequent analysis.

[6] As in Blackburn *et al.* (2006) and Sarte (2000), we abstract from issues relating to occupational choice and assume that agents are differentiated at birth according to their abilities and skills.

[7] This has a similar interpretation to the allocation of talent condition as in Acemoglu and Verdier (2000), whereby the government is able to induce potential bureaucrats to take up public office by paying them salaries that they would earn elsewhere.

2.2. Firms

Households work for firms in the production of output. There is a unit mass of firms, each of which combines l_t units of labour with k_t units of capital to produce y_t units of output according to

$$y_t = Al_t^{\alpha} k_t^{\beta}[\xi(1-\chi\lambda)G_t]^{1-\beta}, \tag{2}$$

$(A > 0, \alpha, \beta \in (0,1))$, where G_t denotes productive public goods and services. We assume that expenditure on public goods and services is a fixed proportion of output, $G_t = \theta y_t, (\theta \in (0,1))$. The actual productivity of public goods and services, however, is less than what would have been in the absence of corruption. Specifically, as it is made clear in the next section, $\xi(1-\chi\lambda)$ is the "effective" productivity of public spending, with $\chi\lambda$ being the amount by which corruption reduces efficiency. This consideration is consistent with Bandeira *et al.* (2001) where corruption reduces the productivity of effective public investment.[8]

Given this, the firm maximises its profits by hiring labour at the real wage rate w_t and renting capital at the real interest rate r_t so as to satisfy the condition of perfect competition in factor markets. Observe that equilibrium in the labour market requires $l_t = \mu$, so that with the use of $G_t = \theta y_t$, equation (2) can be written as:

$$y_t = bk_t, \tag{2'}$$

where $b \equiv \left(A\mu^{\alpha}[\xi(1-\chi\lambda)\theta]^{1-\beta}\right)^{\frac{1}{\beta}} > 0$.

Using (2'), the equilibrium factor prices are shown to be

$$w_t = \frac{\alpha b}{\mu} k_t, \tag{3}$$

$$r_t = r = \beta b, \tag{4}$$

with equilibrium wages being proportional to the capital stock and the equilibrium interest rate being constant.

[8] Corruption has also been found to diminish the productivity of private capital and total factor productivity. The former effect is illustrated by Lambsdorff (2003) while the latter by Dar and AmirKhalkhali (2002).

2.3. Bureaucrats

Bureaucrats work for the government in the administration of public policy. Specifically, public officials are divided into those that work on revenue collection (v) and those that act in the procurement of the public good (1-v). This means that v(1-μ) bureaucrats collect revenues and (1-v)(1-μ) procure public goods. The revenues collected by the bureaucrats are represented by a fixed proportional tax rate, $\tau \in (0,1)$, the government levies on wage earnings, w_t. The public goods and services procured by the bureaucrats have a real value G_t and, as described above, contribute to the efficiency of the firm's output production. From the v(1-μ) bureaucrats that collect revenues, we assume that (1-η) are corrupt. We also assume that a fraction χ of the officials that procure the public good are also corrupt.[9]

The above imply that on the revenue side, collected tax revenues by each bureaucrat correspond to $\tau w_t / v(1-\mu)$. However, only the non-corrupt among the bureaucrats involved in revenue collection bring the tax proceeds to the government. Hence, *total* tax revenues provided to the government by all non-corrupt officials are described by $\eta \tau w_t$. As a result, tax revenues appropriated by corrupt officials are given by $(1-\eta)\tau w_t$. On the spending side, each official is responsible for the procurement of $\theta y_t /(1-v)(1-\mu)$ public goods, which corresponds to the amount each non-corrupt official procures. Each corrupt official, on the other hand, artificially inflates public spending to an amount equal to $\theta(1+\varepsilon) y_t /(1-v)(1-\mu)$, $\varepsilon > 0$. Here, ε represents the size by which spending is inflated due to corruption. Therefore, effective or total spending on public goods (g_t) is given by

$$g_t = (1+\chi\varepsilon)\theta y_t. \tag{5}$$

This means that actual spending on public goods increases due to corrupt practices as only θy_t of total public spending is utilised in the firms' production function. The

[9] The distinction between corruptible and non-corruptible bureaucrats may reflect differences in proficiencies at being corrupt or differences in moral attitudes towards being corrupt (e.g., Acemoglu and Verdier (2000) and Blackburn *et al*. (2006)). At a secondary level, we also make a distinction as to the number of corrupt officials on the two sides of the government budget constraint: $(1-\eta)v \neq \chi(1-v)$.

remaining amount of $\chi\varepsilon\theta y_t$ represents the illegal income (i.e., embezzlement) of corrupt bureaucrats. Such practices have been stressed empirically by Tanzi and Davoodi (1997) who show that corruption inflates public capital expenditure, as the scope for indulging in corrupt practices is much higher for this type of spending.

As mentioned in the previous section, corruption in our model also leads to a productivity loss, but only in the context of the procurement of public goods by corrupt bureaucrats. Specifically, we assume that each unit of the public good yields a productivity of ξ units when procured by (1-χ) non-corrupt bureaucrats, but only ξ(1-λ) units when this is procured by the χ corrupt bureaucrats. Therefore, the parameter $\lambda \in (0,1)$ captures the productivity loss of public spending due to corrupt practices. Incorporating this aspect, we find that total productivity generated from public goods is given by $\xi(1-\chi\lambda)$, as noted in the previous section. It is clear, therefore, that a higher value of λ, which represents more corruption, leads to lower productivity of public spending.

The importance of (a high level of) productivity with which physical and human capital are used in contributing to output per worker has been stressed by Hall and Jones (1999). They contend that social infrastructure – which comprises of the institutions and government policies that make up the economic environment within which economic agents operate – contributes to the success on each of these fronts. They mention thievery, expropriation and corruption among the sources of “diversion” of social infrastructure. Recently, Faruq et al. (2013) have provided estimates of the negative effect of corruption on firm productivity in Ghana, Kenya, and Tanzania: a one-standard-deviation increase in corruption reduces firm efficiency between 15%-20%, depending on whether the firm is input- or output-oriented. Likewise, in our set-up, government procurement of public goods could be interpreted as contributing to social infrastructure and firm productivity, with both being undermined in the presence of corruption.[10]

[10] In its various forms, corruption has been modeled as a phenomenon that occurs with certainty. One should not discount however that a part of corruption’s burden stems from its random nature--see Wei (1997).

2.4. Government

A benevolent government provides public services, g_t, that (partially) contribute to private productivity, as in Barro (1990). The government also pays bureaucrats' salaries, which, as already described, earn the same salaries as that of households, w_t. It follows then that the total real wage bill for the government is $(1-\mu)w_t$. The revenue side of the government's budget constraint comprises seigniorage and tax receipts. The first term on the left-hand-side of equation (6) denotes real revenue from money printing or seigniorage, while the second term gives the actual amount of tax revenue available to the government:

$$\frac{M_t - M_{t-1}}{P_t} + \eta\tau w_t = g_t + (1-\mu)w_t, \tag{6}$$

where from (5) we need to assume that $(1+\chi\varepsilon)\theta < 1$ so as to place an upper limit to government spending as a fraction of output.

In the analysis, we consider two different ways the government responds to corruption. First, we assume that the government allows for an exogenous adjustment of its fiscal instruments in order to ensure a balanced budget. We then consider the case where the government optimally chooses its instruments to maximize some social welfare function. The comparison between exogenous and endogenous fiscal policy adjustment gives us the opportunity to examine the extent by which the link between corruption and growth varies according to policy-making decisions.

2.5. Financial intermediaries

Financial intermediaries manage the savings of individuals and make portfolio allocation decisions in the interest of their depositors. The portfolio consists of money and capital, each of which has benefits and costs: money provides liquidity insurance for agents who are relocated, but does not pay any rate of interest; capital provides a rate of return for agents who do not relocate, but is unavailable to those who move. Individuals take the help of financial intermediaries – who are viewed as being formed as cooperatives from young households, as in Diamond and Dybvig (1983) – as the latter are able to exploit the law of large numbers and thereby to eliminate individual risk.[11] Let δ ($0 < \delta < 1$) be the fraction of deposits lent to firms (i.e. held in the form of capital), which implies that a (1-δ) fraction is held in the form of money. Also, let i_t (I_t) denote the gross real rate of return paid to depositors who move (do not move) location. Finally, the variable, $R_t (\equiv P_t / P_{t+1})$, which is the gross rate of deflation, denotes the real rate of return on money holdings, and is taken as given by the financial intermediaries.

It ought to be noted that for households, as well as for non-corrupt bureaucrats, labour income (w_t) is the only source of earnings. However, for corrupt public officials involved in revenue collection, $(1-\eta)\tau w_t$ is the amount appropriated illegally, while for the corrupt bureaucrats involved in public procurement, $\chi\varepsilon\theta y_t$ represents the amount embezzled. We assume that these corrupt officials manage to escape punishment either because their actions are undetectable and/or governments find it difficult to implement punishment strategies due to resource constraints (which is true especially in developing countries). We also assume that whatever is embezzled by such officials is saved via "non-standard" channels: in other words, the usual mode of saving via financial intermediaries described above only applies to the legal component of the income of corrupt officials (i.e., labour income), but not to the funds embezzled while undertaking revenue collection and public procurement. If that would have been the case, then the offenders would be exposed with certainty.

The optimisation problem facing financial intermediaries involves choosing δ_t, i_t and I_t, so as to maximise the expected utility of a representative depositor

$$V_t = -q\frac{[(1-\tau)w_t i_t]^{-\sigma}}{\sigma} - (1-q)\frac{[(1-\tau)w_t I_t]^{-\sigma}}{\sigma}, \tag{7}$$

subject to

$$qi_t = (1-\delta_t)R_t, \tag{8}$$

$$(1-q)I_t = \delta_t r. \tag{9}$$

[11] Instead of assuming that financial intermediaries operate as cooperatives drawn from households, one could consider such intermediaries as competing for the depositors, as in Bencivenga and Smith (1993). In that case, any (extra) economic profits that may accrue would be offered to depositors and therefore be competed away among the intermediaries, which in effect implies that competition leads to financial intermediaries acting in the best interests of depositors.

The financial intermediaries' portfolio problem is to maximise the expected welfare of a depositor who deposits his entire labour income with them; and this depositor faces a probability, q, of being relocated (thereby receiving i_t), and a probability, 1-q, of remaining in the same location (thereby receiving I_t). This is given by equation (7) above. The resource constraint in (8) conveys the information that the financial intermediaries are able to meet the liquidity needs of the depositors who do relocate using their real money holdings, while (9) shows that the intermediaries are able to make the requisite payment (out of their lending to producers of capital) to the fraction of depositors who do not relocate.

In equilibrium, it is necessary that cash is dominated by capital in terms of rate of return, that is, $r_t > R_t$. Otherwise, lending to firms is not the preferred option. At the same time, this condition requires financial intermediaries to hold currency for the sole reason of meeting the liquidity needs of relocated agents.

The solution of this problem yields the optimal share of deposits invested in capital to be

$$\delta_t = \frac{\left(\frac{q}{1-q}\right)\left(\frac{R_t}{r}\right)^{\frac{\sigma}{1+\sigma}}}{1+\left(\frac{q}{1-q}\right)\left(\frac{R_t}{r}\right)^{\frac{\sigma}{1+\sigma}}} \equiv \Delta(R_t)\,, \tag{10}$$

where $\Delta'(R_t) > 0$, implying that a decrease in R_t, the return on money, induces intermediaries to allocate a larger fraction of deposits towards cash holdings. This is because in the presence of higher inflation (i.e., lower R_t), intermediaries find it difficult to provide sufficient liquidity for agents who relocate, unless they hold more money. This income effect of a change in inflation implies that more money needs to be held and a smaller proportion of deposits can be allocated to productive capital.[12]

[12] This result is by now standard in studies that use this modeling framework. See Espinosa-Vega and Yip (1999, 2002).

2.6. Balanced growth equilibrium

Along the balanced growth equilibrium, which is unique and stable, all variables grow at the same rate. The growth rate is determined from the capital market equilibrium condition where the total demand for capital by firms, k_{t+1}, equals the total supply of capital by financial intermediaries, $w_t\delta_t$ (which equals the investment in capital made by the intermediaries out of the deposits accruing from all agents).

From $k_{t+1} = (1-\tau)w_t\delta_t$, we use equation (3) to obtain $k_{t+1}/k_t = (1-\tau)\alpha b\delta_t/\mu$, or

$$\gamma \equiv \frac{k_{t+1}}{k_t} = \frac{(1-\tau)\alpha b}{\mu}\Delta(R), \tag{11}$$

where γ is the economy's equilibrium growth rate. From eq. (11), it is clear that γ responds positively to R_t. This is because a higher return on money (captured by higher R_t) eases the liquidity constraint for financial intermediaries, thereby enabling agents' savings to be channelled towards capital, which spurs growth.

Denoting $m_t \equiv M_t/P_t$ as the real value of money balances, we can express the money market clearing condition as $m_t = (1-\tau)w_t(1-\delta_t)$, or using (3) and (10) obtain

$$m_t = \frac{(1-\tau)\alpha b}{\mu}[1-\Delta(R)]k_t. \tag{12}$$

An increase in R_t (lower inflation) implies that lower money holdings are required to satisfy the liquidity demands of households who relocate, and this is reflected in eq. (12).

Of course, in the steady-state, we have $\gamma \equiv k_{t+1}/k_t = m_{t+1}/m_t = y_{t+1}/y_t,$. Using $m_t = \gamma m_{t-1}$, the government revenue from seigniorage can be expressed as $(M_t - M_{t-1})/P_t = (\gamma - R)m_t/\gamma$. Then, combining equations (12) and (11) we obtain $(M_t - M_{t-1})/P_t = (\gamma - R)k_t[1-\Delta(R)]/\Delta(R)$.

Next, using the above expression for seigniorage, along with equations (2'), (5), and (13), we can rewrite the government budget constraint equation, (6), as

$$\left(\frac{\gamma - R}{b}\right)\left[\frac{1-\Delta(R)}{\Delta(R)}\right] + \eta\frac{\alpha}{\mu}\tau = (1+\chi\varepsilon)\theta + \frac{(1-\mu)\alpha}{\mu}. \tag{13}$$

The first term on the left-hand-side of the above expression denotes the seigniorage revenue of the government. This seigniorage revenue is the product of the (productivityadjusted) inflation tax rate and the (growth-adjusted) inflation tax base. The second term to the left of the equality is the tax revenue accruing to the government from the η-proportion of non-corrupt tax collectors. The first term to the right of the equality is the spending on procurement of public goods (which includes the inflating of public expenditures by corrupt bureaucrats), while the second term on the right-hand-side represents the salary payments made to bureaucrats, who comprise (1-μ)-proportion of the population.

As our task is to understand the effects of corruption (in its different forms) on economic growth, and given that growth and fiscal instruments are jointly determined through the government budget constraint, we need to consider the simultaneous system described by equations (11) and (13). Accordingly, we need to take the total derivatives of equations (11) and (13). Doing so, yields

$$d\gamma - \frac{(1-\tau)\alpha b}{\mu}\Delta' dR = -\frac{\alpha b}{\mu}\Delta d\tau + \frac{(1-\tau)\alpha\Delta}{\mu}\frac{\partial b}{\partial \chi}d\chi + \frac{(1-\tau)\alpha\Delta}{\mu}\frac{\partial b}{\partial \lambda}d\lambda . \tag{11}$$

$$\begin{aligned}\frac{1}{b}\frac{1-\Delta}{\Delta}d\gamma - \left[\frac{1-\Delta}{\Delta} + (\gamma - R)\frac{\Delta'}{\Delta^2}\right]\frac{1}{b}dR = -\frac{\eta\alpha}{\mu}d\tau - \frac{\alpha}{\mu}\tau d\eta + \left[\theta\varepsilon + (\gamma - R)\frac{1-\Delta}{\Delta}\frac{1}{b^2}\frac{\partial b}{\partial \chi}\right]d\chi \\ + (\gamma - R)\frac{1-\Delta}{\Delta}\frac{1}{b^2}\frac{\partial b}{\partial \lambda}d\lambda\end{aligned} . \tag{13'}$$

We now use equations (11') and (13') to perform a number of comparative statics exercises, highlighting the role of the different aspects of corruption on the revenue and expenditure sides of the government's budget, and eventually on growth. As already mentioned, the analysis distinguishes between the exogenous adjustment and the optimal choice of instruments by the government. These are described in the following sections, and enable us to obtain some interesting results.

3. Corruption and growth in the decentralized equilibrium

In this section, we examine the impact of the various forms of corruption (collection of tax revenue, procurement of public goods, and productivity of public goods) on growth by considering a passive stance by the government. That is, in response to corruption, the government is assumed to adjust its fiscal instruments to keep a balanced budget. To this effect, we examine independently the revenue generating and spending instruments. In particular, with regard to the creation of public revenue we examine three distinct cases: i) only seigniorage can vary, (ii) only the income tax rate can vary, (iii) both revenue sources are allowed to vary.

3.1. <u>Seigniorage as the single source of variation in government revenue</u>

Even though this may reflect an extreme case, the reliance of many countries (developing countries in particular) on seigniorage is a reality, often due to an inefficient tax system, making seigniorage a relatively inexpensive source of revenue (see Cukierman *et al.* (1992), De Gregorio (1993), Roubini and Sala-i-Martin (1995)). In our model, this case amounts to setting changes in the rate of income tax equal to zero, $d\tau = 0$, in equation (13')**.** This, in turn, implies that changes in seigniorage are used to match any changes in public spending (level effect), or compensate for any changes in tax revenue for a given level of government outlays (revenue composition effect).

Appendix **A(I)** illustrates how equations (11') and (13') look in matrix form under the above condition. It also shows how the gross rate of deflation (or inflation), R, and the rate of economic growth, γ, react to higher incidents of corruption as these materialise through the three different channels we consider. The results of these exercises take shape through the propositions below.

Proposition 1: *Given a path of public expenditure ($d\theta = 0$) and no fiscal consolidation ($d\tau = 0$), an increase in corruption related with the (i) collection of tax revenue, (ii) procurement of public goods, or (iii) productivity of public goods, increases the rate of inflation and decreases the steady-state growth rate.*

Part (i) of the proposition reflects a negative effect of corruption on growth through changes in the *composition* of public revenue toward more seigniorage. This finding is consistent with the empirical evidence provided by Blackburn *et al.* (2010) and the work of De Gregorio (1993). The former shows that a shift in the composition of public revenue toward more seigniorage at the expense of lower income taxes yields negative growth effects, while the latter highlights the role of an inefficient tax system which due to high tax collection costs produces high inflation rates and low economic growth. The incidence of tax collection costs across countries has been documented by Bird and Zolt (2005), who report that developed countries devote roughly one percent of tax revenues to cover the budgetary costs of tax collection. The costs of tax administration for developing countries, on the other hand, are substantially higher– almost three percent, according to Gallagher (2005). In our setup, the source of this inefficiency in tax administration arises out of corruption in the collection of public revenue.

Part (ii) of Proposition 1 corresponds to a negative effect of corruption on growth through changes in the *level* of public revenue toward more seigniorage – for a given amount of revenue collected through taxation – due to an increase in effective public spending. At the same time, corruption diminishes the productivity of public spending which has a direct negative effect on growth. This result is in line with the empirical evidence provided by Adam and Bevan (2005) and Bose *et al*. (2007), who illustrate that greater reliance on seigniorage as a means of financing public expenditure generates distortionary effects on growth.

This case represents an example of a situation where a particular type of corruption that operates on the expenditure side of the government budget constraint (manifested through a higher value of χ), affects the growth rate not only via inflated public spending, but also via shifts in revenues toward more seigniorage. Even though in both parts (i) and (ii) the outcome of higher corruption is lower economic growth, the difference is that in the former case the negative growth effect of a rise in seigniorage is a direct consequence of the fact that less tax revenues are generated (lower η). In the latter case, however, the growth effect (via higher χ) of higher seigniorage is indirect - strengthening the direct negative productivity effect on growth.

In addition, both (i) and (ii) imply that higher corruption induces higher inflation as the government relies more on seigniorage, a result empirically confirmed by Al-Marhubi (2000). Our contribution, therefore, lies in the fact that we identify two distinct channels via which corruption could lead to higher inflation: lower η (revenue side of the budget) or higher χ (expenditure side of the budget).

Part (iii) of Proposition 1 reflects the direct negative effect of corruption on growth via a decline in the productivity of public goods, and an indirect negative effect through changes in the *composition* of public revenue toward more seigniorage causing inflation to rise (decline in R) and the growth rate to fall. As regards the direct productivity effect, Salinas-Jimenez and Salinas-Jimenez (2007), by considering a sample of 22 OECD countries for the period 1980-2000, they show that corruption affects TFP growth, with economies that have lower levels of corruption recording, on average, faster growth rates. A similar result is obtained by Faruq et al. (2013) with regard to the adverse effect of corruption on the firm productivity of 900 African firms.

Here, too, the change in an expenditure-side parameter has an indirect effect on growth via the revenue side of the government budget constraint. Note that the link between higher corruption, higher inflation and lower growth remains as before; here, due to lower effective public spending (due to higher λ) being financed by seigniorage.

To offer some examples, and further confirm the findings outlined in Proposition 1, we conduct a series of numerical simulations. The goal is to illustrate the effects of corruption on the fiscal instruments and economic growth by setting plausible parameter values for the exogenous variables so as to generate realistic income tax and growth rates. Table 1 presents the benchmark values of the exogenous variables that determine the size of the endogenous variables. The values of the exogenous parameters are in line with the cited studies in the last column, while the corruption parameters reflect plausible values. As it concerns the endogenous variables, in the benchmark framework financial intermediaries hold only 14.5% of their deposits in the form of capital despite the much higher rate of return on this asset (26.5%) compared to money (3%). This result is sensible, however, given the relatively high relocation probability agents are facing (55%). The government uses 20% of national income toward public spending, while the income tax rate is determined at 26.8%. Finally, the economy grows at a rate of 4.26%.

Panel A of Table 2 shows how the endogenous variables of interest vary in response to changes in the corruption parameters when the inflation rate is the only fiscal instrument that is allowed to change. The main message, in line with Proposition 1, is that the inflation rate rises (lower R) and the equilibrium growth rate declines due to higher occurrence of corruption of any type (lower η, or higher χ or λ). So, in response to higher corruption, there needs to be a rise in seigniorage revenue via the inflation tax (in the absence of the income tax instrument) in order to satisfy the government budget constraint. The size of the change in the endogenous variables, however, varies across the types of corruption with both inflation and growth being most sensitive to corruption associated with the collection of public revenue, η.

3.2. Income tax as the single source of variation in government revenue

Although this too, is an extreme case, it is the limiting case of maintaining a very low rate of inflation. This is the experience of many developed countries, like the US and UK, and members of the European Union which have quite independent central banks with a commitment to maintain inflation within a specified target--as we know there is a strong positive relation between inflation and seigniorage (see Cukierman *et al.* (1992)). Very low reliance on the inflation-tax as a source of revenue could be expected from governments abandoning a regime of financial repression of the sort described by Roubini and Sala-i-Martin (1995).[13]

Within our model, this case corresponds to setting changes in the rate of inflation equal to zero in equation (13'). This, in turn, implies that any changes in spending are matched by changes in the tax rate. Using this condition, the new matrix form expression for the set of equations (11') and (13') appears in Appendix **A(II)**. This Appendix also presents the comparative static exercises as to the effect of the three types of corruption on the income tax and growth rates. Once again, we present the findings of these experiments in the form of the following Proposition.

Proposition 2: *Given a path of public expenditure ($d\theta = 0$) and a constant inflation rate ($dR = 0$), an increase in corruption related with the (i) collection of tax revenue, (ii) procurement of public goods, or (iii) productivity of public goods, increases the income tax rate and decreases the steady-state growth rate.*

Part (i) is a straightforward result stating that if corruption causes income tax revenue to drop, in the absence of an alternative method of raising revenue, the government has no other option but to increase the income tax rate in order to generate

[13] From a policy perspective, the World Bank (1989) has stressed the importance of reducing permanently the need for seigniorage revenues.

revenue to match the revenue lost due to corruption.[14] As a result, the increase in the rate of income tax leads to a lower growth rate by diminishing the after tax income available for investment purposes.

Part (ii) reflects an effect of corruption on growth through changes in both the *level* and the *productivity* of public spending. Intuitively, an increase in χ raises the size of government spending. At the same time, however, it decreases the productivity of output, b, and therefore the income tax base, which would have caused seigniorage revenue to rise (via a shift from income taxation). But given the constant inflation rate, the income tax rate has to rise in equilibrium to maintain the government budget constraint. Then, together with the fall in b, the growth rate falls.

As for part (iii) of Proposition 2, re-writing equation (13) as

$$(\gamma - R)\left[\frac{1-\Delta(R)}{\Delta(R)}\right] + \frac{\eta\alpha b}{\mu}\tau = (1+\chi\varepsilon)\theta b + \frac{(1-\mu)\alpha b}{\mu}, \tag{14}$$

shows that an increase in corruption associated with a lower output productivity of public goods, b, causes both the revenue and expenditure elements of the government budget to decline. It is unclear, however, which element of the budget will decrease by a greater extent. If the decline in expenditure falls below (exceeds) the drop in revenue, then given a fixed inflation rate, this will induce a higher (lower) income tax rate to ensure a balanced budget. Our calculations show that the tax rate is actually higher as a result of the rise in λ, which implies, therefore, that the decline in spending is lower than the reduction in revenue. This finding, then, is consistent with a direct negative effect of corruption on growth through a decline in the productivity (b) of the public good, and a complementary negative effect via a higher income tax rate (τ).

We assess numerically the findings of Proposition 2 by changing the values of the corruption parameters one at a time and by allowing only the income tax rate to vary. The results appear in Panel B of Table 2, where a higher tax rate and a lower growth rate result in response to higher corruption. So, in response to higher corruption, there needs to be a rise in tax revenue via the income tax instrument (in the absence of seigniorage

[14] De Gregorio (1993), in a model without corruption, shows that if the government is able to collect a smaller fraction of tax revenues (reflecting a more inefficient tax system), the tax rate has to increase when the rate of money creation is zero.

revenue) in order to satisfy the government budget constraint. This is true for any form of corruption, although the impact is, as in Proposition 1, greater in magnitude for corrupt tax collectors (lower η). Overall, the estimates in Panel B confirm Proposition 2.

3.3. Both seigniorage and income taxation as sources of variation in government revenue

As the above two classes of experiments, where governments are restricted in the use of a single revenue-generating mechanism, may lack realism, we now consider the effects of a joint use of both seigniorage and taxes as means of financing public outlays. This case simply amounts to the combination of the former two exercises. Combining Propositions 1 and 2, one can state the following:

Proposition 3: *Given a path of public expenditure ($d\theta = 0$), an increase in corruption related with the (i) collection of tax revenue, (ii) procurement of public goods, or (iii) productivity of public goods, increases both the inflation rate and the income tax rate, and decreases the steady-state growth rate.*

Comparing our results with studies linking tax systems with inflation and growth performance, we note that in De Gregorio (1993), a more inefficient tax system leads to a fall in the share of income tax revenues because the share of seigniorage increases, but the effect on the tax rate is ambiguous. The rate of growth of inflation increases, and the rate of growth of output falls unambiguously. Also, Roubini and Sala-i-Martin (1995) show that governments in countries with inefficient tax systems (high tax evasion) may optimally choose a high rate of money growth leading to high inflation rates, high seigniorage and low economic growth. As these papers do not explicitly deal with corruption, our study identifies a specific channel through which such inflation and growth effects could materialise from inefficient tax systems.

In addition, Proposition 3 may rationalize the empirical findings of Mendez and Sepulveda (2006), who show that the negative effect of corruption on growth is confined mainly to “free” countries. The idea is that in countries with more political rights, it is possible that corruption promotes some public investment that is otherwise thwarted by bureaucratic delays (see Huntington (1968) and De Soto (1990)), and also that it is worth allowing a small amount of corruption in the economy as the resources required for combating it are quite large (see Klitgaard (1988), and Acemoglu and Verdier (1998)). So, a small but positive level of corruption may be optimal for the economy. This result can also be compared with the theoretical and empirical results obtained by Bose *et al.* (2007) that in developed countries (with efficient tax collection systems), government spending financed by taxes retards growth more than if financed by seigniorage. Although that paper is not about corruption, its introduction offers a clear link between the findings of our study and the results reported there.

Overall, Proposition 3 implies that both of the government revenue-creation instruments have to rise due to corruption and that their subsequent effects on growth are negative, regardless of the type of corruption taking place. This is also the implication drawn from the numerical simulations in Panels A and B of Table 2. Thus, our framework suggests that corruption (of every type) influences a government's revenue instruments in the same direction while, at the same time, diminishes economic growth.

3.4. Adjustments in public expenditure

We now examine the case where the government keeps its sources of revenue constant (both the tax rate and rate of inflation) and allows only exogenous adjustments in spending. Thus, the effects of corruption are now transmitted through the expenditure side of the government budget constraint. Appendix **A(III)** illustrates how equations (11') and (13') look in matrix form under such a restriction. The impact of the different forms of corruption on the share of government expenditure (as fraction of GDP) and on economic growth, is summarized in the following proposition.

Proposition 4: *Given a constant income tax rate ($d\tau = 0$) and a constant inflation rate ($dR = 0$), an increase in corruption related with the (i) collection of tax revenue, (ii) procurement of public goods, or (iii) productivity of public goods, has an ambiguous effect on both the share of government expenditure and the steady-state growth rate.*

The intuition of these outcomes is best illustrated with the use of equation (14), and resembles the explanations given for Proposition 2(ii). Specifically, a decrease in η

decreases the revenue side in equation (14). The question now is: in which direction shall θ move to equilibrate the budget? Keeping in mind that output productivity, b, is positively influenced by changes in θ, we have a number of plausible outcomes. On the one hand, θ can increase, so that along with the increase in b, the expenditure side in equation (14) rises. But the rise in b will also increase the revenue side, so that if the rise in b exceeds the decline in η, a balanced budget is possible. Alternatively, θ can decline in response to a drop in η so that both sides of the budget will go down until a new equilibrium is achieved, assuming that the spending side will decrease by more. Moreover, the change in θ causes a change in the growth rate of output in the same direction through its impact on productivity. Thus, it is unclear in which way θ will adjust due to higher corruption on the collection of taxes, leading to ambiguous growth effects.

An increase in corruption related with the procurement of public goods, χ, leads to a decline in b so that the revenue side of equation (14) declines, while total expenditure may either fall or rise. If expenditures rise, then for a balanced budget, θ needs to drop, which will further reduce b. The double drop in b, due to the original increase in χ and the subsequent decreases in θ, diminishes the rate of growth. If, on the other hand, spending goes down by more than revenue, then for a balanced budget, θ will rise. This, in turn, will drive up both sides of the constraint. In this case, the offsetting effect of a higher χ and higher θ on productivity will have an ambiguous effect on growth. As before, this type of corruption also has unclear implications for the share of government spending and output growth.

Finally, an increase in λ, by decreasing output productivity, causes both sides of the budget to decline. But it is not identifiable which of the sides will decrease by more. If spending declines by more (less), then θ needs to rise (decline) to rebalance the budget. Once again, therefore, the impact of corruption is generally ambiguous. However, the general ambiguity of the effect of *all* types of corruption on both government spending and long-run growth can be identified as being related to a single variable: the size of public expenditure relative to the size of the economy, g/y. The following corollary illustrates this.

Corollary 4.1: *Given a constant income tax rate ($d\tau = 0$) and a constant inflation rate ($dR = 0$), if the share of government expenditure as a fraction of total economic activity is relatively large (small), an increase in corruption related with the (i) collection of tax revenue, (ii) procurement of public goods, or (iii) productivity of public goods, decreases (raises) both the share of public expenditure and the steady-state growth rate.*

The exact expression of the threshold value of government spending-to-output appears at the end of Appendix **A(III)**. If g/y is relatively large, a decrease in η which decreases the revenue side in equation (14), calls for a decline in θ so that both sides of the constraint decrease. Given that g/y is large, the expenditure side will decrease by a greater amount to catch up with the initial decline in revenue due to corruption, and, thus, equilibrate the budget. The drop in θ leads to a lower steady-state growth rate of output. In a similar way, with a large government size, increases in χ and λ require a decline in θ for a balanced budget to be retained, followed by lower output growth. The increase in χ decreases the revenue side of equation (14), while the large and increasing size of $(1+\chi\varepsilon)\theta$ leads to greater expenses, even with a lower b. To restore budget equilibrium, a downward adjustment of θ is needed. Finally, an increase in λ, even though causes both sides of the budget to decline, with a large government size, revenue declines by more. This, in turn, calls for lower θ.

Proposition 4 is put into the test with numerical simulations. Panel C of Table 2 illustrates the effects of corruption on the share of public spending and on economic growth, when public spending is the only fiscal instrument that is allowed to vary. The findings support Corollary 4.1 for the case where the share of public spending as fraction of total GDP is relatively large, in that both endogenous variables decline in response to corruption. . As in the previous propositions, the type of corruption that leads to greater declines in both θ and γ is that associated with corruption in the collection of tax proceeds.

In general, these findings support the presence of non-linear effects of corruption on growth with the sign of the impact being contingent on the size of the government: corruption in an environment with a small government improves growth, while in a large government impedes growth. Even though the mechanism of transmission of these effects focuses purely on public spending considerations, other studies have unveiled conditional effects of corruption on growth by focusing on political institutional quality (Mendez and Sepulveda (2006), Meon and Sekkat (2005), and Aidt *et al*. (2008)). Studying interaction effects between corruption and government size in growth regressions could, therefore, be a worthwhile task.

4. Corruption and growth with optimal (second-best) economic policy

In the previous analysis, the role of the government has been "passive" in response to corruption, in the sense that its fiscal choices were determined by adjusting either the revenue or the expenditure side to ensure a balanced budget. This means that the government has not been choosing its instruments optimally in a way as to maximize some social welfare function. In this section, we examine whether the results obtained thus far in linking the key fiscal variables, corruption, and growth are robust to an approach that allows for the government to be "active" in its choices of fiscal instruments.

In this section, we endogenize economic policy as reflected by the optimal choice of the three fiscal instruments: θ^*, τ^*, and R^*. We assume a benevolent government that plays a Stackelberg leader vis-à-vis the private sector. This corresponds to the situation where agents make consumption-investment decisions by taking fiscal policy variables as given and then the government chooses fiscal instruments taking the response functions of agents as given.[15] That is, the government maximizes the utility of the agents by considering its own budget and the market allocation as constraints, the latter being

[15] An alternative approach would be to solve for the first-best (command-optimum) equilibrium where the benevolent government chooses the fiscal policy variables and consumption-investment decision rules at the same time. Aside from the fact that this approach is less realistic (since a government is unlikely to have control over private investment and consumption decisions), it should also be noted that the key feature of our model is the existence of three different forms of corruption, which are exogenously given. Given that corruption is undetectable in our framework, a benevolent government has to choose its instruments appropriately while acknowledging that corruption does and will exist in equilibrium. In this context, the concept of an omniscient social planner that 'internalizes' corruption is difficult to fathom, and we therefore abstract from considerations of how a decentralized economy could replicate the social optimum (as, for example, could be studied when the services from public goods are affected by congestion), and focus on the government's second-best policy, which is termed the 'optimal' policy.

summarized by the growth rate equation (11). We assume commitment technologies on behalf of the government, so that decisions cannot be altered.[16]

To characterize the second-best equilibrium we use as objective of the benevolent government the sum of lifetime utilities of all agents over generations discounted by a factor ρ, $\rho \in (0,1)$, reflecting social time preference, expressed as[17]

$$\Omega \equiv \sum_{t=0}^{\infty} \rho^t U_t \, , \tag{15}$$

where U_t is the utility function given in equation (1). To ensure that Ω is bounded, we follow Barro (1990) in assuming $\rho < \gamma^{\sigma}$. Appendix B shows that the welfare criterion Ω corresponds to

$$\Omega = -\frac{(bk_{-1})^{-\sigma}}{\sigma(\gamma^{\sigma} - \rho)} \left[(1-\tau)\frac{\alpha}{\mu} \right]^{-\sigma} Y(R) \, , \tag{15'}$$

where the growth rate γ is described in equation (11) and[18]

$$Y(R) \equiv q^{1+\sigma}\left[R[1-\Delta(R)]\right]^{-\sigma} + (1-q)^{1+\sigma}\left[\beta b \Delta(R)\right]^{-\sigma} > 0 \, .$$

The term in square brackets of equation (15') represents the agents' income associated with legal practices, which is intermediated through financial corporations. This implies that social welfare depends only on the legal income of agents. The illegal income obtained through corrupt practices is not part of the government's welfare function because the government, even though it does not know a particular agent's type, knows the distribution of agents indulging in corrupt practices. In this way, the government abstracts entirely from the consideration of illegal income as part of its welfare function, revealing its aversion to illegitimate practices that allow corrupt bureaucrats to profit. Given the exogenous nature of corruption, however, the government has to choose its

[16] Recent applications of this problem can be found in Park and Philippopoulos (2002), Espinosa-Vega and Yip (1999, 2002), and Chen (2005).

[17] We follow the conventional practice of ignoring the initial old people's utility in the evaluation of social welfare.

[18] Tedious calculations reveal that $Y'(R) \equiv -\left[\sigma/(1+\sigma)R\right]\left\{\sigma\left[1-\Delta(R)\right]Y(R) + q^{1+\sigma}R^{-\sigma}\left[1-\Delta(R)\right]^{-\sigma}\right\} < 0$.

fiscal instruments while acknowledging the distortions imposed by the presence of corrupt practices in attaining the second-best.

Solving the benevolent government's optimization problem, which amounts to maximizing equation (15') subject to equations (11) and (13) with respect to the three fiscal policy instruments (θ*, τ*, R*), it is established that the welfare-maximizing fiscal structure is determined by

$$M_1(\tau^*, \theta^*, R^*; \sigma, A, \alpha, \beta, \xi, \mu, \varepsilon, q, \rho, \eta, \chi, \lambda) = 0, \tag{16}$$

$$M_2(\tau^*, \theta^*, R^*; \sigma, A, \alpha, \beta, \xi, \mu, \varepsilon, q, \rho, \eta, \chi, \lambda) = 0, \tag{17}$$

where the functions $M_1(.)$ and $M_2(.)$ are defined in Appendix B. These two functions, along with the government budget constraint, are used to solve for (θ*, τ*, R*). In general, these being higher order polynomials, it is not possible to solve for the optimal budget instruments explicitly. For this reason, we resort to numerical simulations to solve for θ*, τ*, R*, and in the process, also provide solutions to the rest of the endogenous variables – b, r, δ, and γ – with the use of equations (2'), (4), (10), and (11).

Using the values for the exogenous variables as listed earlier in Table 1, and choosing a value of 0.03 for the social welfare discount factor (ρ), Table 3 presents the estimated values for the endogenous variables. A notable observation is that the size of all these variables is greater compared to their counterparts in Table 1 obtained under the decentralized equilibrium. In particular, the government optimally taxes income at a rate of 78.39% and deflates prices at a gross rate of 2813%, with the combined collected revenue from income taxation and seigniorage being used to finance 28.09% of national income toward productive public spending. The extremely high value of R implies a very low rate of return on money holdings, inducing financial intermediaries to hold all of their deposits in the form of capital assets. The near-unitary value of δ, in turn, along with the higher value of the output productivity of private capital, b, gives rise to an economic growth rate γ of 11.5%, despite the higher income tax rate.

These findings suggest that the government in maximizing welfare optimally selects a very low inflation rate, thus yielding negative revenue from seigniorage that necessitates a very high income tax rate to sustain the financing of government expenditure. In essence, therefore, the government is trading off low inflation with high income taxes. This finding has been established in the literature by Espinosa-Vega and Yip (1999) and Holman and Neanidis (2006) in models without corruption, where both studies illustrate that in maximizing welfare a government finds it optimal to use income tax revenue to finance a deflation. Thus, from a welfare perspective, the optimal policy represents a contraction of the money supply with a simultaneous expansion of the income tax rate.

Given our interest (i) in the effects of corruption on the fiscal instruments and on economic growth, and (ii) on whether these effects differ when the government is 'active' compared to 'passive' in its choice of these instruments, Table 4 presents comparative statics exercises that resemble in spirit to those performed in Table 2. That is, we track the behaviour of the policy variables and of economic growth once we allow each of the corruption parameters to change one at a time. But, unlike Table 2, and in order to capture the second-best, now all policy instruments are allowed to adjust simultaneously from their benchmark values in response to changes in corruption.

The simulations support two main results. First, every type of corruption leads the government to optimally reduce both the level of productive spending and the rate of deflation, while, at the same time, raise the income tax rate. In each case, the combined effect of these adjustments causes a lower growth rate of output, γ. Second, changes in the optimal fiscal instruments move in the same direction as those obtained in Table 2, under the government's 'passive' policy. Furthermore, and as before, the most sizeable adjustments are in response to corruption associated with the collection of public revenue, η.

With regard to the first finding, the government by being constrained in running a balanced budget in each period adjusts all its fiscal instruments, so as to increase its revenue and simultaneously decrease its expenditure, when corruption takes place. In this way, it tries to smooth out the effect of each form of corruption on all its instruments by minimizing their distortion to welfare. At the same time, these adjustments lead to lower economic growth, as would be expected. For example, starting from an initial equilibrium, a decrease in η implies that a higher proportion of tax revenue is appropriated by corrupt bureaucrats, which forces the government to bring about a higher income tax rate and decrease both the optimal share of public expenditure and the optimal rate of return on holding money (i.e., higher inflation tax). These, in turn, lead to a decrease in both the growth rate and welfare.

The second main finding implies that a government that acts in such a way as to optimally choose its fiscal instruments in the presence of corruption leads to fiscal and economic changes that are in line with those under a government that adjusts its fiscal choices to run a balanced budget. Therefore, in connection with the growth and welfare effects of corruption, our findings show that it may not be critical whether the government takes a passive or an active stance in setting its fiscal variables, although one can identify the channels through which a government could attempt to mitigate the negative effects of corruption in each case.

5. Conclusion

This paper studied, via a unified analytical framework, the effects of corruption on an economy's growth rate, and on the policy instruments (income tax rate, inflation rate, and size of government spending) that are employed when bureaucratic corruption takes three forms: it reduces the tax revenues that are raised from households, inflates the volume of government spending, and reduces the productivity of effective government expenditure. Moreover, our analysis has distinguished between the case where fiscal choices are effectively determined exogenously through the balanced budget constraint, and the case where the government sets its instruments in an optimal manner to achieve the second-best policy outcome.

The effects of corruption on fiscal policy variables as well as growth are intuitive. Corruption diminishes growth by resulting in higher income tax and inflation rates, and a lower level of government spending. Importantly, these transmission effects are valid under both a passive and an active stance by the government. The only exception is the case where the government passively adjusts its level of expenditure in response to corruption, whence corruption may have a positive growth effect via a rise in the level of its spending. This result, however, depends on the size of the government, which needs to be relatively small to start with. If, on the other hand, the government is relatively large, corruption has a distorting growth effect. The nature of all these effects has not hitherto been explored in the literature. Moreover, our analysis - by combining the literature on corruption in public spending and finances with that on fiscal policy and growth - has established some results that could rationalise some of the findings in the earlier literature in the area.

Our research could be extended in different directions. One line of enquiry, which is outside the scope of the current exercise, would be to endogenize corruption by allowing a feedback effect from growth to corrupt activities. Indeed, some studies (Paldam (2002), Blackburn *et al.* (2006)) have suggested mechanisms via which such feedback is plausible. Such analysis would determine an equilibrium level of corruption and examine whether growth has different effects on the rewards to honesty and to corruption. Another area in which our research could be conducted would be to empirically estimate the effects of the different types of corruption in public expenditure and revenue on growth. This would supplement the work of Blackburn *et al.* (2010) on corruption on the revenue side of the government budget constraint. A third direction in which our research could be extended is to study the case where bond financing (rather than money financing) of deficits – along with tax financing – is considered feasible. This would be an interesting exercise in the context of the Stability and Growth Pact, which assigns upper limits to deficits and debt for EMU members, and virtually rules out seigniorage.

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Appendices

A(I).

Under the assumptions of $d\theta = 0$ and $d\tau = 0$, the matrix form expression of equations (11') and (13') is

$$\begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} d\gamma \\ dR \end{bmatrix} = \begin{bmatrix} a_{13} & a_{14} & a_{15} \\ a_{23} & a_{24} & a_{25} \end{bmatrix} \begin{bmatrix} d\eta \\ d\chi \\ d\lambda \end{bmatrix}, \tag{A1}$$

where $a_{11} = 1 > 0$, $a_{12} = -\frac{(1-\tau)\alpha b}{\mu}\Delta^{'} < 0$, $a_{13} = 0$, $a_{14} = \frac{(1-\tau)\alpha\Delta}{\mu}\frac{\partial b}{\partial\chi} < 0$, $a_{15} = \frac{(1-\tau)\alpha\Delta}{\mu}\frac{\partial b}{\partial\lambda} < 0$, $a_{21} = \frac{1}{b}\frac{1-\Delta}{\Delta} > 0$, $a_{22} = -\left[\frac{1-\Delta}{\Delta} + (\gamma - R)\frac{\Delta'}{\Delta^2}\right]\frac{1}{b} < 0$, $a_{23} = -\frac{\alpha}{\mu}\tau < 0$, $a_{24} = \left(\theta\varepsilon + (\gamma - R)\frac{1-\Delta}{\Delta}\frac{1}{b^2}\frac{\partial b}{\partial\chi}\right)$, and $a_{25} = (\gamma - R)\frac{1-\Delta}{\Delta}\frac{1}{b^2}\frac{\partial b}{\partial\lambda} < 0$.

In obtaining the signs of a_{14}, a_{15}, a_{24}, and a_{25}, we have used the expression of b from the output per capita equation (2'), from where it can be shown that $\partial b/\partial\chi < 0$ and $\partial b/\partial\lambda < 0$.

Using equation (A1), we can derive the inflation and growth effects of a change in corruption related with the collection of tax revenues; that is, of a lower η. These are

$$\frac{dR}{d\eta} = \frac{a_{11}a_{23} - a_{21}a_{13}}{Det}, \tag{A2}$$

$$\frac{d\gamma}{d\eta} = \frac{a_{13}a_{22} - a_{23}a_{12}}{Det}, \tag{A3}$$

where 'Det' is the determinant, for which the expression is provided in equation (A9) below.

Using equation (A1) again, we can derive the inflation and growth effects of a change in corruption related with the procurement of public goods; that is, of a higher χ. These are

$$\frac{dR}{d\chi} = \frac{a_{11}a_{24} - a_{21}a_{14}}{Det}, \tag{A4}$$

$$\frac{d\gamma}{d\chi} = \frac{a_{14}a_{22} - a_{24}a_{12}}{Det}, \tag{A5}$$

Finally, using equation (A1) we can derive the inflation and growth effects of a change in corruption related with the productivity of public goods; that is, of a higher λ, as

$$\frac{dR}{d\lambda} = \frac{a_{11}a_{25} - a_{21}a_{15}}{Det}, \tag{A6}$$

$$\frac{d\gamma}{d\lambda} = \frac{a_{15}a_{22} - a_{25}a_{12}}{Det}, \tag{A7}$$

In equations (A2)-(A7) the determinant is given by

$$Det = a_{11}a_{22} - a_{21}a_{12} = -\left[\frac{1-\Delta}{\Delta} + (\gamma - R)\frac{\Delta'}{\Delta^2} - \frac{1-\Delta}{\Delta}\frac{\Delta'}{\Delta}\gamma\right]\frac{1}{b}.$$

Using equation (10), we find

$$\Delta' = \frac{\Delta}{R}\frac{\sigma}{1+\sigma}\frac{1}{1+\left(\frac{q}{1-q}\right)\left(\frac{R}{r}\right)^{\frac{\sigma}{1+\sigma}}} > 0. \tag{A8}$$

So, the determinant becomes

$$Det = -\frac{1}{b}\frac{1}{\Delta}\frac{1}{1+\sigma}\frac{1+\sigma\Delta\frac{\gamma}{R}}{1+\left(\frac{q}{1-q}\right)\left(\frac{R}{r}\right)^{\frac{\sigma}{1+\sigma}}} < 0. \tag{A9}$$

Using equation (A9) along with the expressions for a_{ij} defined above into the pairs of equations (A2)-(A3), (A4)-(A5), and (A6)-(A7) respectively, we obtain that $dR/d\eta > 0$, $d\gamma/d\eta > 0$, $dR/d\chi < 0$, $d\gamma/d\chi < 0$, $dR/d\lambda < 0$, and $d\gamma/d\lambda < 0$, which form the basis for Proposition 1.

A(II).

Under the assumptions of $d\theta = 0$ and $dR = 0$, the new matrix form expression for the set of equations (11') and (13') now is

$$\begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}\begin{bmatrix} d\gamma \\ d\tau \end{bmatrix} = \begin{bmatrix} b_{13} & b_{14} & b_{15} \\ b_{23} & b_{24} & b_{25} \end{bmatrix}\begin{bmatrix} d\eta \\ d\chi \\ d\lambda \end{bmatrix}, \tag{A10}$$

where $b_{ij} = a_{ij}$ except for $b_{12} = \frac{\alpha b}{\mu}\Delta > 0$ and $b_{22} = \frac{\eta\alpha}{\mu} > 0$.

Using equation (A10), we can derive the income tax rate and growth effects of a change in corruption related with the collection of tax revenues; that is, of a lower η. These are

$$\frac{d\tau}{d\eta} = \frac{b_{11}b_{23} - b_{21}b_{13}}{DET}, \tag{A11}$$

$$\frac{d\gamma}{d\eta} = \frac{b_{13}b_{22} - b_{23}b_{12}}{DET}, \tag{A12}$$

where 'DET' is the determinant, for which the expression is provided in equation (A17) below.

Using equation (A10) again, we can derive the income tax rate and growth effects of a change in corruption related with the procurement of public goods; that is, of a higher χ. These are

$$\frac{d\tau}{d\chi} = \frac{b_{11}b_{24} - b_{21}b_{14}}{DET}, \tag{A13}$$

$$\frac{d\gamma}{d\chi} = \frac{b_{14}b_{22} - b_{24}b_{12}}{DET}, \tag{A14}$$

Finally, using equation (A10) we can derive the income tax rate and growth effects of a change in corruption related with the productivity of public goods; that is, of a higher λ, as

$$\frac{d\tau}{d\lambda} = \frac{b_{11}b_{25} - b_{21}b_{15}}{DET}, \tag{A15}$$

$$\frac{d\gamma}{d\lambda} = \frac{b_{15}b_{22} - b_{25}b_{12}}{DET}, \tag{A16}$$

In equations (A11)-(A16) the determinant is given by[19]

$$DET = b_{11}b_{22} - b_{21}b_{12} = b_{22} = \eta + \Delta - 1 > 0\,. \tag{A17}$$

Using equation (A17) along with the expressions for b_{ij} defined above into the pairs of equations (A11)-(A12), (A13)-(A14), and (A15)-(A16) respectively, we obtain that $d\tau / d\eta < 0$, $d\gamma / d\eta > 0$, $d\tau / d\chi > 0$, $d\gamma / d\chi < 0$, $d\tau / d\lambda > 0$, and $d\gamma / d\lambda < 0$, which form the basis for Proposition 2.

A(III).

Using the restrictions that $d\tau = 0$ and $dR = 0$, the new matrix form expression for the set of equations (11') and (13') now is

$$\begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix} \begin{bmatrix} d\gamma \\ d\theta \end{bmatrix} = \begin{bmatrix} c_{13} & c_{14} & c_{15} \\ c_{23} & c_{24} & c_{25} \end{bmatrix} \begin{bmatrix} d\eta \\ d\chi \\ d\lambda \end{bmatrix}, \tag{A23}$$

[19] The positive sign of the determinant is proved in Appendix B below.

where $c_{ij} = a_{ij}$ except for $c_{12} = -\frac{(1-\tau)\alpha\Delta}{\mu}\frac{\partial b}{\partial \theta} < 0$ and $c_{22} = -\left((\gamma - R)\frac{1-\Delta}{\Delta}\frac{1}{b^2}\frac{\partial b}{\partial \theta} + 1 + \chi\varepsilon\right) < 0$.

Using equation (A23), we can derive the effects of a change in corruption associated with the collection of tax revenues (a lower η) on government expenditure and growth. These are

$$\frac{d\theta}{d\eta} = \frac{c_{11}c_{23} - c_{21}c_{13}}{Det'}, \tag{A24}$$

$$\frac{d\gamma}{d\eta} = \frac{c_{13}c_{22} - c_{23}c_{12}}{Det'}, \tag{A25}$$

where 'Det'' is the determinant, for which the expression is provided in equation (A30) below.

Using equation (A23) again, we can derive the effects of a change in corruption associated with the procurement of public goods (a higher χ) on government expenditure and growth. These are

$$\frac{d\theta}{d\chi} = \frac{c_{11}c_{24} - c_{21}c_{14}}{Det'}, \tag{A26}$$

$$\frac{d\gamma}{d\chi} = \frac{c_{14}c_{22} - c_{24}c_{12}}{Det'}, \tag{A27}$$

Finally, using equation (A23) we can derive the effects of a change in corruption associated with the productivity of public goods (a higher λ) on government expenditure and growth. These are

$$\frac{d\theta}{d\lambda} = \frac{c_{11}c_{25} - c_{21}c_{15}}{Det'}, \tag{A28}$$

$$\frac{d\gamma}{d\lambda} = \frac{c_{15}c_{22} - c_{25}c_{12}}{Det'}, \tag{A29}$$

In equations (A24)-(A29) the determinant is given by

$$Det' = c_{11}c_{22} - c_{21}c_{12} = R\frac{1-\Delta}{\Delta}\frac{1}{b^2}\frac{\partial b}{\partial \theta} - (1 + \chi\varepsilon). \tag{A30}$$

Multiplying and dividing through equation (A30) by θ, and using equations (2') and (5), yields

$$Det' = \frac{1}{\theta}\left[\frac{R}{b}\frac{1-\Delta}{\Delta}\frac{1-\beta}{\beta} - \frac{g}{y}\right], \tag{A31}$$

the sign of which is in general ambiguous. The sign depends on the relative size of total spending on public goods and services (as a fraction of GDP). If this ratio is large, then *Det'* < 0 and the effects captured by equations (A24)-(A29) can be assigned the following signs: $d\theta / d\eta > 0$, $d\gamma / d\eta > 0$, $d\theta / d\chi < 0$, $d\gamma / d\chi < 0$, $d\theta / d\lambda < 0$, and $d\gamma / d\lambda < 0$. If *g/y* is relatively small, the opposite effects take shape. These findings form the basis for Corollary 4.1.

B.

Our economy is populated by two types of agents, households and bureaucrats, of which bureaucrats are divided into those that oversee the collection of tax revenue and those that deal with the procurement of the public good. In these two classes of bureaucrats, there are in place both honest and corrupt public officials. This description of the structure of our economy shows that there is no such thing as one representative agent. Therefore, when the benevolent government is deriving the welfare criterion, *Ω* in equation (15), it takes into account the discounted lifetime utility of *all* agents. Given that utility is solely based on consumption during the second period of the agents' lives, the appropriate measure of welfare is a function of the total level of consumption in the economy during the agents' lifetime.

The income of households and the legal income of bureaucrats are saved with the financial intermediaries, while the illegal income of bureaucrats is saved "under the mattress." This means that only the income saved through banks is subject to an uncertain rate of return conditional on the probability of the agent's relocation. The illegal income, on the other hand, carries no rate of return. This latter income is represented by the total amount appropriated by corrupt bureaucrats: $(1-\mu)[(1-\eta)\tau w_t + \chi\varepsilon\theta y_t]$. This illegal income, however, is not included in the government's social welfare function given that the government knows the proportion of corrupt bureaucrats, and thus the size of their income. In other words, the government considers in its welfare function only consumption that arises from income that is legal.

From equations (15), (1), and (7), the benevolent government maximizes

$$\Omega \equiv \sum_{t=0}^{\infty} \rho^t U_t \,, \tag{B1}$$

where

$$U_t = -q\frac{[(1-\tau)w_t i_t]^{-\sigma}}{\sigma} - (1-q)\frac{[(1-\tau)w_t I_t]^{-\sigma}}{\sigma}, \tag{B2}$$

subject to the economic growth rate equation (11) and the government budget constraint equation (13), which we re-write both here for convenience

$$\gamma = \frac{(1-\tau)\alpha b}{\mu}\Delta(R), \tag{B3}$$

$$\left(\frac{\gamma - R}{b}\right)\left[\frac{1-\Delta(R)}{\Delta(R)}\right] + \eta\frac{\alpha}{\mu}\tau = (1+\chi\varepsilon)\theta + \frac{(1-\mu)\alpha}{\mu}. \tag{B4}$$

Using equations (2'), (3), (4), (8), and (9) into equation (B2), the latter becomes

$$U_t = -\frac{1}{\sigma}\left\{ q\left[(1-\tau)\frac{\alpha}{\mu}\frac{R}{q}[1-\Delta(R)]\right]^{-\sigma} + (1-q)\left[(1-\tau)\frac{\alpha}{\mu}\frac{\beta b}{1-q}\Delta(R)\right]^{-\sigma}\right\}(bk_t)^{-\sigma},$$

or,

$$U_t = -\frac{1}{\sigma}\left\{\left[(1-\tau)\frac{\alpha}{\mu}\right]^{-\sigma} Y(R)\right\}(bk_t)^{-\sigma}, \tag{B2'}$$

where

$$Y(R) \equiv q^{1+\sigma}\left[R[1-\Delta(R)]\right]^{-\sigma} + (1-q)^{1+\sigma}\left[\beta b\Delta(R)\right]^{-\sigma} > 0.$$

Using equation (B2') and the growth rate equation (B3), some algebra reveals that equation (B1) becomes equation (15'), or

$$\Omega = -\frac{(bk_{-1})^{-\sigma}}{\sigma(\gamma^{\sigma} - \rho)}\left\{\left[(1-\tau)\frac{\alpha}{\mu}\right]^{-\sigma} Y(R)\right\}. \tag{B5}$$

Solving for the benevolent government's optimization problem, which amounts to maximizing equation (B5) subject to equations (B3) and (B4) with respect to the three fiscal policy instruments (θ, τ, and R), the optimality conditions are given respectively by

$$\Omega\sigma\left(\frac{1}{1-\tau}\right)\left(\frac{2\gamma^{\sigma} - \rho}{\gamma^{\sigma} - \rho}\right) + \lambda\left(\frac{\alpha}{\mu}\right)[1-\Delta(R) - \eta] = 0, \tag{B6}$$

$$\begin{aligned} &-\Omega\sigma\left(\frac{1-\beta}{\beta}\right)\left(\frac{1}{\theta}\right)\left[\frac{2\gamma^{\sigma} - \rho}{\gamma^{\sigma} - \rho} + \frac{(1-q)^{1+\sigma}[\beta b\Delta(R)]^{-\sigma}}{Y(R)}\right] + \\ &\lambda\left\{-\left(\frac{R}{b}\right)\left[\frac{1-\Delta(R)}{\Delta(R)}\right]\left(\frac{1-\beta}{\beta}\right)\left(\frac{1}{\theta}\right) + (1+\chi\varepsilon)\right\} = 0, \text{ and}\end{aligned} \tag{B7}$$

$$\Omega\left[-\frac{\sigma\gamma^{\sigma}}{\gamma^{\sigma}-\rho}\frac{\Delta'(R)}{\Delta(R)}+\frac{Y'(R)}{Y(R)}\right]-\lambda\left(\frac{1}{b}\right)\left\{\frac{-\gamma\Delta'(R)\Delta(R)-[1-\Delta(R)]\Delta(R)+R\Delta'(R)}{[\Delta(R)]^{2}}\right\}=0\,, \quad \text{(B8)}$$

where λ is the Lagrange multiplier associated with the government budget constraint and $\Delta'(R)$ and $Y'(R)$ are as defined in the text.[20]

Next, combining equations (B6) and (B7), and simplifying, yields

$$\left(\frac{2\gamma^{\sigma}-\rho}{\gamma^{\sigma}-\rho}\right)\left\{\left(\frac{1-\beta}{\beta}\right)\left[\left(\frac{R}{b}\right)\left[\frac{1-\Delta(R)}{\Delta(R)}\right]-\left(\frac{\alpha}{\mu}\right)(1-\tau)[1-\Delta(R)-\eta]\right]-(1+\chi\varepsilon)\theta\right\}=$$
$$\left(\frac{1-\beta}{\beta}\right)\left[\frac{(1-q)^{1+\sigma}[\beta b\Delta(R)]^{-\sigma}}{Y(R)}\right]\left(\frac{\alpha}{\mu}\right)(1-\tau)[1-\Delta(R)-\eta], \quad \text{(B9)}$$

while combining equations (B6) and (B8), yields

$$\left(\frac{\sigma}{1+\sigma}\right)\left[\frac{1-\Delta(R)}{R}\right]\left\{(\gamma^{\sigma}-\rho)[\gamma\sigma\Delta(R)+R]+\gamma^{\sigma}R+\sigma\gamma^{\sigma+1}(1-\eta)\right\}=$$
$$\frac{Y'(R)}{Y(R)}\gamma[1-\Delta(R)-\eta](\gamma^{\sigma}-\rho)\,. \quad \text{(B10)}$$

These two reduced optimality conditions, which define the two implicit functions $M_1(.)$ and $M_2(.)$ in the text, along with the government budget constraint (13), are used to solve for the three (second-best) optimal fiscal instruments, θ^*, τ^*, and R^*. These expressions, however, are highly non-linear, and as a result explicit solutions for the optimal fiscal instruments, and of the effects of corruption, cannot be obtained. For this reason, we rely on numerical simulations, as discussed in the text.

[20] Given the restriction $\rho<\gamma^{\sigma}$, equation (B6) implies that $(1-\Delta-\eta)<0$. This, in turn, proves the positive sign of the determinant identified in equation (A17) in Appendix (AII) above.

Table 1
Benchmark Parameters

Exogenous variables	Value	Definition	Source
σ	10	$\sigma = \frac{1}{IES} - 1$, where IES is the intertemporal elasticity of substitution.	Bose et al. (2007)
A	2	Firm's total factor productivity	Bose et al. (2007)
α	0.67	Elasticity of output with respect to labour	Bose et al. (2007)
β	0.55	Elasticity of output with respect to private capital	Baxter and King (1993)
ξ	0.7	Public goods productivity in firm's output	Baxter and King (1993)
q	0.55	Probability of agent relocation in second period of life	Bose et al. (2007)
ρ	0.03	Social welfare discount factor	Holman and Neanidis (2006)
μ	0.8	Share of households in economy	Author's calculations based on the share of private sector employment to total employment for 66 countries, average over years 2009 and 2010; Employment Statistics, ILO.
ε	0.025	Size of public spending inflated due to corruption	Author's set value
Corruption variables			
η	0.95	Proportion of non-corrupt bureaucrats in charge of public revenue collection	
χ	0.25	Proportion of corrupt bureaucrats in charge of public good procurement	
λ	0.5	Productivity loss of public spending due to bureaucrat corrupt practices	
Endogenous variables			
r	0.2652	Real rate of return on capital holdings (MPK)	
b	0.4821	Linear output productivity of private capital	
δ	0.1442	Fraction of bank deposits lent to firms	
R	0.03	Real rate of return on money holdings	
τ	0.2683	Income (wage) tax rate	
θ	0.2	Proportion of output toward public goods expenditure	
γ	0.0426	Equilibrium growth rate of output per capita	

Table 2
Comparative Statics Exercises of Passive Government Policy

	θ	τ	R	γ
Benchmark values	0.2	0.2683	0.03	0.0426
Panel A: Proposition 1				
η: 0.95 → 0.9	0.2	0.2683	*0.0268*	*0.0390*
χ: 0.25 → 0.3	0.2	0.2683	*0.0292*	*0.0415*
λ: 0.5 → 0.55	0.2	0.2683	*0.0296*	*0.0421*
Panel B: Proposition 2				
η: 0.95 → 0.9	0.2	*0.5715*	0.03	*0.0249*
χ: 0.25 → 0.3	0.2	*0.3014*	0.03	*0.0404*
λ: 0.5 → 0.55	0.2	*0.2834*	0.03	*0.0416*
Panel C: Proposition 4				
η: 0.95 → 0.9	*0.1798*	0.2683	0.03	*0.0417*
χ: 0.25 → 0.3	*0.1953*	0.2683	0.03	*0.0422*
λ: 0.5 → 0.55	*0.1979*	0.2683	0.03	*0.0424*

Note: Values in *Italics* represent the endogenous variables allowed to change in response to higher corruption.

Table 3
Values of Endogenous Variables under Active Government Policy

Endogenous variables	Value	Definition
r	0.3501	Real rate of return on capital holdings (MPK)
b	0.6366	Linear output productivity of private capital
δ	0.9999	Fraction of bank deposits lent to firms
R^*	28.13	Real rate of return on money holdings
τ^*	0.7839	Income (wage) tax rate
θ^*	0.2809	Proportion of output toward public goods expenditure
γ	0.1152	Equilibrium growth rate of output per capita

Table 4
Comparative Statics Exercises of Active Government Policy

	θ^*	τ^*	R^*	γ
Benchmark values	0.2809	0.7839	28.13	0.1152
Corruption type				
η: 0.95 → 0.9	*0.2621*	*0.9968*	*12.46*	*0.0016*
χ: 0.25 → 0.3	*0.2805*	*0.7980*	*24.45*	*0.1050*
λ: 0.5 → 0.55	*0.2809*	*0.7915*	*26.11*	*0.1098*

Note: Values in *Italics* represent the endogenous variables allowed to change in response to higher corruption.