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The Effects of Corruption and Seigniorage on
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The Effects of Corruption and Seigniorage on Growth and Inflation

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Abstract

In the last two decades, cases of corruption have been unveiled in different countries, raising public awareness and reinforcing a trend in which society expects more from their leaders. Our objective in this paper is to examine the effects of corruption and seigniorage on inflation and growth rates. The model used in this article is an extension of the model used by Huang and Wei (2006). We find interesting results and one of them is that, under some conditions, corruption has a positive impact on the growth rate.

JEL classification: D73, E52, E58, E62.

Keywords: Corruption; Fiscal Policy; Growth; Monetary Policy; Seigniorage.

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1. Introduction

Corruption is capturing a lot of attention around the world. It is one particular feature that is prevalent in developing economies. However, developed countries are not immune to this problem, even though it is less common than in many developing countries. Corruption encompasses different meanings such as bribery, the sale of public property by government officials, kickbacks in public procurement, and misuse of government funds (Reinikka and Svensson, 2005). In our paper, we define corruption as the abuse of public office for private gain (Jain, 2001).

Following on from the basic inquiry as to whether corruption is detrimental or beneficial for the economy, a number of related questions on this topic have evoked genuine interest among economists. How can corruption impact on growth? What are the effects of corruption on inflation? If we consider the empirical studies that focus on the relationship between corruption and growth, it is surprising to find out that they offer mixed results (see Leff, 1964; Mauro, 1995; Aidt et al., 2008; among others). On the other hand, it is found that the relationship between corruption and inflation is positive in the literature (Al-Marhubi, 2000; Haider et al., 2011). In this paper, we attempt to provide some answers to the previous questions.

We will develop a theoretical model in which the government gets public financing through tax revenues and printing money (seigniorage). The private sector pays a tax rate but only a portion of it will be used for public spending. There is less corruption when the portion is higher. The concept of seigniorage is known as printing new money and defined as the value of real resources acquired by the government through its power of sovereignty on its monopoly of printing money (Begg et al., 1994). The reliance of many developing countries on seigniorage is a reality, often due to an inefficient tax system. Hence, seigniorage revenues are on average higher in developing countries than in industrial countries since these last countries have governments which are able to finance their expenditures through taxes or debt (Cukierman et al., 1992; Aisen and Veiga, 2008). Cukierman et al. (1992) try to explain theoretically and empirically that there are differences across countries on the importance of seigniorage relative to other sources of government revenue. They use a probit model in a sample of 79 countries to determine the likelihood of an incumbent government to remain in power. Their empirical exercise notes that countries with a more unstable and polarised political system are positively associated with seigniorage. Aisen and Veiga (2008) rely upon the theoretical literature and a dataset covering around 100 countries. They want to investigate the main economic, political and institutional determinants of seigniorage. They find that greater political instability leads to higher seigniorage levels, confirming previous results by

Cukierman et al. (1992) and Click (1998).

In this paper, we will present a theoretical model that attempts to explain the relationship between corruption, seigniorage, economic growth and inflation. Our main interest is to examine how corruption and seigniorage affect growth and inflation. To this end, we will extend the framework developed by Huang and Wei (2006) to study corruption, seigniorage, growth and inflation. In contrast to them, the present paper considers a model in a broader sense since we allow different preferences among the authorities and we study the effects of corruption with different degrees of seigniorage.

In connection with the question about corruption and growth, we find that the effect of corruption on growth is mixed. Thus, our results could provide a rationale for the empirical findings that report the effects of corruption on growth. Interestingly, we find that the effects of corruption and seigniorage on inflation are also ambiguous. Huang and Wei (2006) find the same results about corruption, growth and inflation as us in a theoretical model. However, our results are more general given the broader model we develop.

The remainder of the paper is organised as follows. Section 2 surveys the related literature on the linkage between corruption, seigniorage, economic growth and inflation. Section 3 describes our model. Section 4 discusses the effects of corruption and seigniorage. Section 5 presents the numerical cases. Section 6 concludes.

2. Literature Review

This section surveys the theoretical and empirical literature on the effects of corruption and seigniorage on some economic variables such as growth, inflation and tax revenues.

Firstly, we review the empirical literature and the first aspect which we discuss is the connection between corruption and economic growth. The relationship between them has been a major concern in the last two decades. The empirical literature indicates that this relationship is ambiguous. Economists' reflections have been divided between those who find that corruption produces prejudicial effects on economic performance and those who see that corruption could accelerate economic growth.

The negative relationship between corruption and growth has been identified in numerous empirical studies (for instance, Mauro, 1995; Del Monte and Papagni, 2001; Aidt et al., 2008; Farooq et al., 2013).¹ On the basis of cross-country data of 67 countries around the world, Mauro (1995) focuses on the relationship between corruption and the per capita GDP growth rate. The indices for corruption, drawn from Business International, reflect the analysts' perspectives on risk and efficiency factors, and they may be taken to represent investors'

¹Mo (2001), Paul (2010) and Ibraheem et al. (2013) also report this result.

assessments of conditions in the country in question. He finds a significant negative effect of corruption on economic growth. Del Monte and Papagni (2001) use data on time series of the Italian case to estimate the effect of corruption on the growth rate of per-employee GDP. They represent corruption as the number of crimes against the public administration per million employees. Their results show that higher corruption has a significant negative effect on economic growth in 20 Italian regions. Aidt et al. (2008) perform an econometric analysis with a sample of 70 countries drawn from all five continents in order to study the effects of corruption on growth in the real GDP per capita. They use two measures of corruption, the corruption perception index constructed by Transparency International and the control of corruption through the World Bank's database. Their empirical findings show that corruption reduces the economic growth in countries with high quality institutions, but in countries with low quality institutions corruption has no impact on growth. Farooq et al. (2013) investigate the impact of corruption on the real GDP per capita in Pakistan. The data about corruption is based on the corruption perception index collected from Transparency International as Aidt et al. (2008). They find that corruption impedes economic growth.

By contrast, other researchers have found that corruption may be beneficial (Leff, 1964; Rock and Bonnett, 2004; Méon and Weill, 2010; Dreher and Gassebner, 2013).² The most popular justification of the beneficial effects of corruption rely on the so-called "grease the wheels" hypothesis. This hypothesis argues that corruption could be beneficial in a second best world because of the distortions caused by bad functioning institutions. A poor bureaucracy constitutes an impediment to investment that some "speed" or "grease" money may help circumvent. Thus, the intuition is that corruption may act as a trouble-saving device and raise efficiency, investment, and eventually, growth. Hence, corruption may positively contribute to growth because it compensates the consequences of a poor bureaucracy and bad policies. A very interesting link between corruption and economic growth was discovered by Leff (1964). His work notes that corruption leaves positive impacts on economic growth. Rock and Bonnett (2004) investigate the relationship between corruption and the real GDP per capita in cross-country regressions. They use four corruption data sets which are the Business International corruption index, the Transparency International corruption index, the World Bank corruption index and the Political Risk Service corruption index over four different time periods. The empirical exercise exposes that corruption significantly promotes growth in the large East Asian newly industrialising economies. Méon and Weill (2010) test whether corruption may be efficient for economic growth for a panel of 69 countries, both developed and developing economies. They focus on the corruption index provided by the

²Other authors point out this result such as Vial and Hanoteau (2010) and Dzhumashev (2014), among others.

World Bank and Transparency International. They find evidence that the presence of corruption has a positive effect on economic growth in countries where institutions are extremely ineffective. Dreher and Gassebner (2013) study the impact of corruption on economic growth for 43 countries around the world. They employ two different datasets of corruption provided by Transparency International and the World Bank as Méon and Weill (2010). Their empirical analysis shows that corruption is beneficial in highly regulated economies.³

The second aspect that we review on the corruption literature is the relationship between corruption and inflation. The empirical evidence says that, in terms of inflation, the impact of corruption is positive. Thus, Al-Marhubi (2000), Abed and Davoodi (2000) and Haider et al. (2011) conclude that corruption leads to higher inflation.⁴ In this sense, there is an interesting work from Al-Marhubi (2000) which analyses the relationship between corruption and inflation on cross-country data consisting of 41 developed and developing countries. He uses alternative indicators of corruption which are from Transparency International and Mauro's (1995) work. Besides, he measures inflation as the logarithm of the average annual percentage change in the GDP deflator. His result notes that the impact of corruption on inflation is significantly positive. Abed and Davoodi (2000) study the effect of corruption as a symptom of weakness for panel and cross-sectional data in 25 transition economies. The role of corruption is drawn from six surveys of perception of corruption. They specify inflation as a function of the choice of the exchange rate regime, fiscal balance, structural reform indices and a dummy variable representing trade disruptions. They also find a positive impact of corruption on inflation in some transition countries. The paper of Haider et al. (2011) presents a theoretical model that captures some important features of Pakistan's economy. Their study focuses on analysing the consequences of bureaucratic corruption on inflation. Besides, they carry out a computational model in order to confirm the implications of their theoretical model. The inflation rate is based on the consumer price index and the index of corruption is taken from Barro (1991) and the International Country Risk Guide database. Their results indicate that lower corruption is associated with lower inflation in democratic regimes.

Moreover, another aspect that we study is the relationship between corruption and tax revenues. It has been found that tax revenues are negatively related to the incidence of corruption (Ghura, 1998; Mokhtari and Grafova, 2007; Ajaz and Ahmad, 2010).⁵ Hence, they conclude that poorer institutional quality leads to a fall of tax revenues. Ghura (1998) studies the determinants of tax revenue by focusing on the impact of economy and corruption

³His data on regulation is taken from the World Bank's Doing Business Database and the Economic Freedom Index developed by the Fraser Institute.

⁴These findings are consistent with Smith-Hillman (2007) and Rahmani and Yousefi (2009).

⁵Tanzi and Davoodi (1997) and Gupta (2007) obtain similar results.

for 39 sub-Saharan African countries. The index of corruption used in his study is taken from the International Country Risk Guide. He finds strong evidence that an increase in the level of corruption lowers the tax revenue-GDP ratio. Mokhtari and Grafova (2007) provide theory and evidence on the problem of corruption in the Russian Federation. They consider corruption as the number of tax inspection employees per capita. Their empirical findings indicate that corruption plays a significant role in reducing tax collection in Russia. Ajaz and Ahmad (2010) analyse the effect of institutional and structural variable on tax revenues in 25 developing countries. Data on total tax revenues and corruption are taken from the World Development Indicator and the International Country Risk Guide, respectively. Their study concludes that corruption has a negative and significant effect on tax revenues.

Finally, we examine the relationship between seigniorage and growth. Empirical evidence shows a negative relationship between them (Holman and Neanidis, 2006; Bose et al., 2007; among others). Holman and Neanidis (2006) study the growth and welfare effects of alternative modes of government finance within a small open economy. They find, in a calibration study, that seigniorage finance has stronger negative implications for growth over income-tax finance in countries with less-developed financial markets. The contribution of Bose et al. (2007) lies in identifying the best way to finance public expenditures using a panel of 21 Organisation for Economic Cooperation and Development countries and 40 developing countries. The seigniorage measure is drawn from the International Financial Statistics. Their results indicate that the growth effect is large and significantly negative in developing countries. However, the same coefficient is found to be insignificant for developed countries. Adam and Bevan (2005) analyse the relationship between fiscal deficits and growth for a panel of 45 developing countries. Seigniorage is defined as the sum of inflation tax and the real growth of base money. By contrast, they show that seigniorage-financing appears to be significantly growth-enhancing below the threshold of 1.25% of GDP.

Table 1 summarises the previous empirical findings which have been found in this literature between corruption, seigniorage, growth and inflation.

	Corruption		Seigniorage	
	<i>Positive</i>	<i>Negative</i>	<i>Positive</i>	<i>Negative</i>
Economic	Leff (1964)	Mauro (1995)	Adam and Bevan (2005)	Holman and Neanidis (2006)
Growth	Rock and Bonnett (2004) Méon and Weill (2010) Dreher and Gassebner (2013)	Del Monte and Papagni (2001) Aidt et al. (2008) Farooq et al. (2013)		Bose et al. (2007)
Inflation	Al-Marhubi (2000) Abad and Davoodi (2000) Haider et al. (2011)	-	-	-

Table 1. Empirical literature concerning about the relationship between corruption, seigniorage, growth and inflation.

Secondly, other authors, like Huang and Wei (2006), Hefeker (2010), Faure (2011) and

Dimakou (2013), have studied the effect of corruption using theoretical models. Huang and Wei (2006) examine the effects of institutional quality on inflation targeting and exchange rate fixing. They further study the implications for the design of several other monetary frameworks, including a currency board, dollarisation and a Rogoff-type conservative central banker. The government finances its spending through taxes and seigniorage revenue. Corruption is assumed to cause a leakage of tax revenue. Huang and Wei (2006) find a threshold of institutional quality that determines whether inflation and the tax rate are higher or lower when corruption increases. Another finding of their paper is that the presence of a Laffer curve effect on seigniorage revenue likely lowers inflation and raises the tax rate. However, in some cases it may raise both inflation and tax rates. Hefeker (2010) investigates the relation between corruption in a country and its monetary regime. He uses an extension of Huang and Wei (2006). Unlike them, he assumes that the government also benefits from some exogenous income stream and allows for different degrees of seigniorage. Further, in contrast to Huang and Wei (2006), Hefeker supposes corruption as an absolute sum that can even be larger than tax revenue. He finds that, in a country with low inflation, a credibly fixed exchange rate can reduce corruption and improve the fiscal system. Besides, a high tax revenue leads government to allow more corruption and vice-versa. Finally, lower seigniorage implies higher taxes and can have negative output effects. Faure (2011) provides a new insight into the lack of incentive from authorities to curtail corruption. He assumes corruption as Huang and Wei (2006). The government's sources are seigniorage revenue, tax revenue and new debt issue. The main finding is that corruption can make a country better off if its government is unable to make binding commitments and assigns a larger weight to output than to inflation stabilisation. Hence, corruption can enhance welfare by mitigating the inflation bias of discretionary monetary policy and with excessive debt. Dimakou (2013) analyses the interactions among investment decisions in monetary institutions and in fiscal capacity. In addition, she focuses on the comparative statics of the incentives to fight corruption. Her study also builds on Huang and Wei's framework (2006) allowing for borrowing and systematically assessing the incentives to improve economic institutions. She finds that the investment decisions are strategic complementarities. Moreover, she identifies a set of structural determinants that affect the decisions of the government to enhance economic institutions. The papers that we have stated previously have assumed complete seigniorage in order to analyse the effect of corruption, with the exception of Hefeker's (2010) paper.

3. The Model

The model we use is an extension of the models used by Alesina and Tabellini (1987) and Huang and Wei (2006). We assume a modified Lucas supply function in which the level of output, x_t , depends positively on unexpected inflation and a supply shock, $\pi_t - \pi_t^e$ and ε_t , respectively. Besides, ε_t is independently and identically distributed with mean zero and variance σ_ε^2 . Output depends negatively on the tax rate, τ_t . All variables are expressed in logarithms. To be more precise, output is given by:

$$x_t = \pi_t - \pi_t^e - \tau_t + \varepsilon_t. \quad (3.1)$$

The model includes two policies, fiscal and monetary policy. Fiscal policy is controlled by the government and monetary policy is controlled by the central bank. Concretely, the government chooses the tax rate and the central bank selects the inflation rate. Moreover, as shocks can play an important role during crises (Alesina and Stella, 2010), we will study their effects on equilibrium values. We also assume that there could be corruption in the government, as in Huang and Wei (2006), so that the model can cover important aspects of many developing and transition economies where institutional quality is poor. Following Huang and Wei (2006), the private sector pays a tax rate in the amount of τ_t , but only a portion of it, ϕ , will be used for public spending. In contrast to Huang and Wei (2006), we allow the authorities to have different preferences on controlling inflation and stabilising output and public spending. Besides, we allow different degrees of seigniorage. Hence, the government's public spending function is described by:

$$g_t = \phi\tau_t + k\pi_t, \quad (3.2)$$

where g_t denotes the ratio of public expenditures over output, and $0 < \phi < 1$ and $0 < k < 1$. Hence, there are two sources of finance: tax and seigniorage revenue. On the one hand, $\phi\tau_t$ represents the tax revenue where ϕ indicates the degree of institutional quality: when $\phi = 1$ there is no corruption, and when $\phi = 0$ the collection system collapses as there is full corruption. On the other hand, $k\pi_t$ measures the seigniorage revenue where k represents the degree of seigniorage.

The timing of events is such that shocks occur after expectations are set. Then, the government and central bank choose the tax and inflation rates, respectively. The government and central bank aim at stabilising inflation, output and public spending. In the following objective functions, the target levels for inflation and output are normalised to zero and the target level for public spending is denoted by \bar{g} . Thus, the government and central bank optimise the following loss functions expressed in terms of inflation, output and public

spending:

$$L_G = \frac{1}{2} \sum_{t=0}^T \theta_G^t \left(\pi_t^2 + \delta_G x_t^2 + \gamma_G (g_t - \bar{g})^2 \right), \quad (3.3)$$

where $\delta_G, \gamma_G > 0$, $0 < \theta_G < 1$ and $\bar{g} \geq 0$, and

$$L_{CB} = \frac{1}{2} \sum_{t=0}^T \theta_{CB}^t \left(\pi_t^2 + \delta_{CB} x_t^2 + \gamma_{CB} (g_t - \bar{g})^2 \right), \quad (3.4)$$

where $\delta_{CB} > 0$, $\gamma_{CB} \geq 0$ and $0 < \theta_{CB} < 1$.⁶

The parameters δ_i and γ_i ($i = G, CB$) represent the relative weights on output and public spending stabilisation with respect to inflation for each authority. In the literature, there does not seem to be an agreement about the values of the weights in the loss functions. Alesina and Tabellini (1987) argue that the two policymakers can differ in the weights attributed to output and public spending relative to inflation. As these authors point out, an independent central bank is not subject to elections and, in most industrial countries, it enjoys various degrees of independence from the fiscal authority. Hence, we assume that the relative weights of both authorities are different ($\delta_G \neq \delta_{CB}$ and $\gamma_G \neq \gamma_{CB}$). Moreover, following Dixit and Lambertini (2003), we assume that fiscal and monetary authorities assign identical goals.

Substituting (3.1) and (3.2) into (3.3) and (3.4), we obtain the following loss functions

$$L_G = \frac{1}{2} \sum_{t=0}^T \theta_G^t \left(\pi_t^2 + \delta_G (\pi_t - \pi_t^e - \tau_t + \varepsilon_t)^2 + \gamma_G (\phi \tau_t + k \pi_t - \bar{g})^2 \right) \text{ and} \quad (3.5)$$

$$L_{CB} = \frac{1}{2} \sum_{t=0}^T \theta_{CB}^t \left(\pi_t^2 + \delta_{CB} (\pi_t - \pi_t^e - \tau_t + \varepsilon_t)^2 + \gamma_{CB} (\phi \tau_t + k \pi_t - \bar{g})^2 \right). \quad (3.6)$$

The equilibrium is obtained by minimising the government's and central bank's loss functions, (3.5) and (3.6), with respect to tax and inflation, respectively. Hence, the corresponding optimisation problems are:

$$\begin{aligned} & \min_{\tau_t} L_G \text{ and} \\ & \min_{\pi_t} L_{CB}. \end{aligned}$$

Considering π_t^e constant in the problem, the first order conditions are given by:

$$\frac{\partial L_G}{\partial \tau_t} = -\delta_G (\pi_t - \pi_t^e - \tau_t + \varepsilon_t) + \phi \gamma_G (\phi \tau_t + k \pi_t - \bar{g}) = 0 \text{ and}$$

$$\frac{\partial L_{CB}}{\partial \pi_t} = \pi_t + \delta_{CB} (\pi_t - \pi_t^e - \tau_t + \varepsilon_t) + k \gamma_{CB} (\phi \tau_t + k \pi_t - \bar{g}) = 0.$$

Hence, it follows that

⁶The variables θ_G and θ_{CB} represent the discount factors for the government and central bank, respectively.

$$\tau_t = \frac{(\delta_G - \phi k \gamma_G) \pi_t - \delta_G (\pi_t^e - \varepsilon_t) + \phi \gamma_G \bar{g}}{\delta_G + \phi^2 \gamma_G} \text{ and} \quad (3.7)$$

$$\pi_t = \frac{\delta_{CB} (\pi_t^e + \tau_t - \varepsilon_t) - k \gamma_{CB} (\phi \tau_t - \bar{g})}{1 + \delta_{CB} + k^2 \gamma_{CB}}. \quad (3.8)$$

Plugging (3.7) into (3.8) yields

$$\pi_t = \frac{(\bar{g} + \phi (\pi_t^e - \varepsilon_t)) \eta}{\phi^2 + \alpha_G + (\phi + k) \eta}, \quad (3.9)$$

where $\eta = \phi \delta_{CB} + k \alpha_G \gamma_{CB}$ and $\alpha_G = \frac{\delta_G}{\gamma_G}$. The weight that the government attributes to output relative to public spending is denoted by α_G . Taking expectations of Expression (3.9) and solving for π_t^e , we get

$$\pi_t^e = \frac{\eta}{\phi^2 + \alpha_G + k \eta} \bar{g}.$$

Hence, after some algebra, we derive the following expressions for the tax and inflation rates in equilibrium:

$$\tau_t = \frac{\phi}{\phi^2 + \alpha_G + k \eta} \bar{g} + \frac{\alpha_G + k \eta}{\phi^2 + \alpha_G + (\phi + k) \eta} \varepsilon_t \text{ and} \quad (3.10)$$

$$\pi_t = \frac{\eta}{\phi^2 + \alpha_G + k \eta} \bar{g} - \phi \frac{\eta}{\phi^2 + \alpha_G + (\phi + k) \eta} \varepsilon_t. \quad (3.11)$$

The optimal tax and inflation are composed of two parts: a structural part (first term) and the reaction to shocks (second term). On the one hand, the higher is the public spending target, the higher taxes and inflation rates are set. An increase in the spending target requires more seigniorage and tax financing. On the other hand, taxes and inflation move in opposite directions in response to shocks. Concretely, the tax rate depends positively on shocks, whereas the inflation rate depends negatively on shocks. Given that output increases with a positive supply shock, the central bank has less incentive to inflate and the government raises the tax rate.

Moreover,⁷ it follows that public spending and output deviations are,

$$\bar{g} - g_t = \frac{\alpha_G}{\eta} \pi_t \text{ and} \quad (3.12)$$

$$0 - x_t = \frac{\phi}{\eta} \pi_t. \quad (3.13)$$

which are increasing in inflation, meaning that higher inflation induces more public spending and output deviations. In particular, the higher the need to finance the public spending (i.e. an increase in \bar{g}) gives rise to an increase in these deviations. In addition, from (3.12) and (3.13), it follows that the average levels of public spending and output fall short of their targets, showing the trade-off the fiscal authority faces between spending and output.

⁷Notice that Expressions (3.12) and (3.13) make sense when $\eta \neq 0$.

4. Comparative Statics

In the next two subsections we will present some comparative static results obtained from the equilibrium. In particular, we analyse the effects of corruption and seigniorage on the expected levels of growth and inflation rates. In order to analyse how expected output varies with corruption and seigniorage, it suffices to study how the expected tax rate varies with them since $E(x_t) = -E(\tau_t)$. Hence, taking expectations in Expressions (3.10) and (3.11), it follows that

$$E(\tau_t) = \frac{\phi}{\phi^2 + \alpha_G + k\eta} \bar{g} \text{ and} \quad (4.1)$$

$$E(\pi_t) = \frac{\eta}{\phi^2 + \alpha_G + k\eta} \bar{g}. \quad (4.2)$$

4.1. Institutional Quality

Differentiating Expressions (4.1) and (4.2) with respect to the degree of institutional quality, it can be shown that

$$\frac{\partial}{\partial \phi} E(\tau_t) = -\frac{\phi^2 - \alpha_G - k^2 \alpha_G \gamma_{CB}}{(\phi^2 + \alpha_G + k\eta)^2} \bar{g} \text{ and}$$

$$\frac{\partial}{\partial \phi} E(\pi_t) = -\frac{(\phi^2 - \alpha_G) \delta_{CB} + 2\phi k \alpha_G \gamma_{CB}}{(\phi^2 + \alpha_G + k\eta)^2} \bar{g}.$$

Therefore, we get

$$\frac{\partial}{\partial \phi} E(\tau_t) > 0 \leftrightarrow \phi < \bar{\phi}_\tau \text{ and} \quad (4.3)$$

$$\frac{\partial}{\partial \phi} E(\pi_t) > 0 \leftrightarrow \phi < \bar{\phi}_\pi, \quad (4.4)$$

where $\bar{\phi}_\tau = \sqrt{\alpha_G(k^2 \gamma_{CB} + 1)}$ and $\bar{\phi}_\pi = \alpha_G \left(\sqrt{\frac{k^2 \gamma_{CB}^2}{\delta_{CB}^2} + \frac{1}{\alpha_G}} - \frac{k \gamma_{CB}}{\delta_{CB}} \right)$.

From Expression (4.3), it follows that for poor levels of institutional quality ($\phi < \bar{\phi}_\tau$), the optimal response to an increase in corruption (a decrease in ϕ) would be to lower the tax rate (in expected terms). Thus, in this case the growth rate of output increases with corruption. Once a moderate level of institutional quality is achieved ($\phi > \bar{\phi}_\tau$), the tax rate increases and hence, the growth rate decreases. In terms of inflation, Expression (4.4) indicates that for poor levels of institutional quality ($\phi < \bar{\phi}_\pi$), an increase in corruption decreases the expected inflation rate. At sufficient levels of institutional quality ($\phi > \bar{\phi}_\pi$), the optimal response to an increase in corruption is to raise the expected inflation rate.

Next, we discuss in detail how a reduction in the degree of institutional quality affects the behaviour of both authorities. When institutional quality gets worse, *ceteris paribus*, the

fiscal authority has incentives to increase the tax rate in order to compensate the reduction in public spending financing. However, the increase in the tax rate negatively affects the output rate. When $\phi < \bar{\phi}_\tau$ ($\phi > \bar{\phi}_\tau$) the cost of increasing the tax rate overcomes (does not overcome) the corresponding benefit and, consequently, the government prefers to reduce (rise) its tax rate. In particular, note that if the fiscal authority is more concerned about the output objective than the public spending objective ($\alpha_G > 1$), then $\bar{\phi}_\tau > 1$, and thus, $\frac{\partial}{\partial \phi} E(\tau_t) > 0$, for all $0 \leq \phi \leq 1$. Consequently, we can conclude that in this case, corruption always favours the growth rate.

From the point of view of the central bank, a decrease in the degree of institutional quality will create more incentives to inflate due to the reduction in tax revenues (public spending effect).⁸ However, the central bank will also react to the change in the tax rate (output effect): if the government rises the tax rate due to an increase in the level of corruption, the central bank has more incentives to inflate in order to raise output and be closer to its target, and vice-versa. Notice that, when the expected tax rate decreases in ϕ (a reduction in ϕ induces an increase in $E(\tau_t)$, and thus, $\frac{\partial}{\partial \phi} E(\tau_t) < 0$), the previous two effects move in the same direction, so we can conclude that, in this case, the central bank has more incentives to inflate when the level of corruption increases. By contrast, when the expected tax rate increases in ϕ (a reduction in ϕ induces a decrease in $E(\tau_t)$, and thus, $\frac{\partial}{\partial \phi} E(\tau_t) > 0$), the previous two effects work in opposite ways. When the output effect dominates, the expected inflation rate will increase in ϕ . Further, when α_G is high enough and $\frac{k\gamma_{CB}}{\delta_{CB}}$ is low enough, then $\bar{\phi}_\pi > 1$. Therefore, we can conclude that, in this case, the expected inflation rate always decreases with a reduction in the degree of institutional quality, i.e., $\frac{\partial}{\partial \phi} E(\pi_t) > 0$.

Finally, the following figure illustrates the effect of corruption on the average levels of growth and inflation:⁹

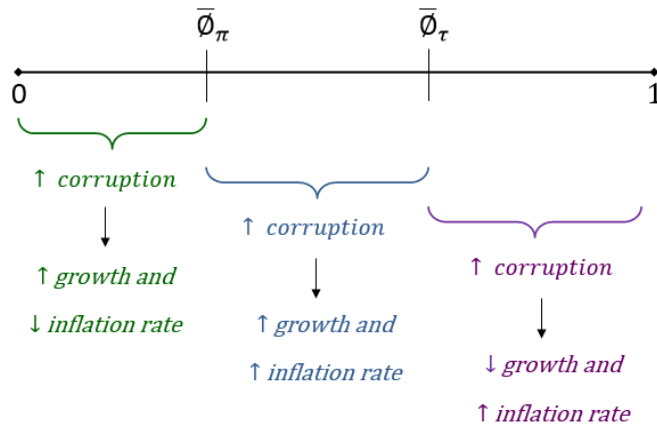


Fig.1. Relationship between the expected growth, the expected inflation rate and corruption.

⁸ A decrease in ϕ yields a reduction in $\phi E(\tau_t)$. This result is in accordance with the empirical evidence provided by Ghura (1998), Mokhtari and Grafova (2007) and Ajaz and Ahmad (2010).

⁹Remember that $E(x_t) = -E(\tau_t)$.

From Fig. 1, we can see that we obtain the following relationship between the two previous threshold values of ϕ : $\bar{\phi}_\tau > \bar{\phi}_\pi$. In particular, notice that this inequality indicates that when the expected inflation rate decreases due to a reduce in the degree of institutional quality, corruption has a positive effect on the growth rate. The existing literature points out that corruption leads to higher inflation. Looking at Fig. 1, this would indicate that $\phi > \bar{\phi}_\pi$. Notice that in this area, corruption can enhance or damage growth. This is in line with the mixed results found related to the effect of corruption on growth in the empirical literature (see Leff, 1964; Mauro, 1995; Méon and Weill, 2010; Farooq et al., 2013; among others).

4.2. Seigniorage

In this subsection, we will now look at the effects of seigniorage on the equilibrium values of tax and inflation rates. Using the Expressions of taxes and inflation given in (4.1) and (4.2), respectively, we obtain

$$\begin{aligned}\frac{\partial}{\partial k} E(\tau_t) &= -\phi \frac{\phi \delta_{CB} + 2k \alpha_G \gamma_{CB}}{(\phi^2 + \alpha_G + k\eta)^2} \bar{g} \text{ and} \\ \frac{\partial}{\partial k} E(\pi_t) &= \frac{(\phi^2 + \alpha_G) \alpha_G \gamma_{CB} - \eta^2}{(\phi^2 + \alpha_G + k\eta)^2} \bar{g}.\end{aligned}$$

Hence,

$$\frac{\partial}{\partial k} E(\tau_t) < 0 \text{ and}$$

$$\frac{\partial}{\partial k} E(\pi_t) < 0 \text{ if and only if } k > k_1,$$

$$\text{where } k_1 = \frac{\sqrt{(\phi^2 + \alpha_G) \alpha_G \gamma_{CB} - \phi \delta_{CB}}}{\alpha_G \gamma_{CB}}.$$

Given that seigniorage as a source of revenue tends to be smaller as the monetary and fiscal institutions of a country become more sophisticated, we will study the effects of a reduction in seigniorage. When the degree of seigniorage decreases, the total revenue through inflation decreases ($\frac{\partial}{\partial k} E(k\pi_t) > 0$). This implies that the fiscal authority has more incentives to increase its tax rate ($\frac{\partial}{\partial k} E(\tau_t) < 0$). Here, in expected terms, seigniorage damages economic growth. In turn, this has two effects on the behaviour of the central bank: on the one hand, taking into account the objective of output, the increase in tax rate increases the incentives to inflate; on the other hand, given the objective of public spending, the increase in tax rate decreases the incentives to inflate. Notice that the reduction in seigniorage revenue leads to an increase in expected tax and inflation rates whenever the central bank prioritises the stabilisation of output over public spending ($\frac{\delta_{CB}}{\gamma_{CB}}$ is high enough). However, when $\frac{\delta_{CB}}{\gamma_{CB}}$ is low enough, the opposite could be true.

5. Numerical Cases

In this section, we will visualise the theoretical results stated in Subsections 4.1 and 4.2. To this end, we will replicate the relationship identified in the theoretical model between corruption, seigniorage, growth and inflation (in expected terms).

The parameters of the model are depicted in Table 2. The relative weight on the output gap deviation for the government has been observed in several studies. Jensen (2002) and Tillmann (2008) set $\delta_G = 0.25$. Walsh (2003) varies δ_G until 1 and Dimakou (2013) until 1.2. Following Dimakou (2013), we will set $\delta_G = 0.75$ and $\gamma_G = 1.2$ as the mean values of Dimakou's (2013) ranges. Moreover, following Alesina and Tabellini (1987), we will assume that $\delta_G > \delta_{CB}$ and $\gamma_G > \gamma_{CB}$ since the government does not assign a greater weight to inflation relative to output and public spending than the central bank. Further, we will assume that $\delta_{CB} > \gamma_{CB}$ since some authors point out that the central bank is not worried about stabilising the public spending (Debelle and Fischer, 1964; Beetsma and Bovenberg, 2001; Hefeker, 2010). Hence, we will assume that $\delta_{CB} = 0.65$ and $\gamma_{CB} = 0.15$. Moreover, the degrees of institutional quality and seigniorage degrees are set to vary within its full range, $0 < \phi < 1$ and $0 < k < 1$, respectively. These degrees explore the impact on the optimal growth and inflation rates. Finally, we will set the value of the government spending target, $\bar{g} = 0.28$, extracted also from the mean range of Dimakou (2013).

Our analysis includes four sets of comparative static exercises divided into two subsections, corruption and seigniorage. In each subsection, we simulate for growth and inflation. First, we compare the optimal growth and inflation for different levels of corruption and second, we analyse the optimal growth and inflation under different levels of seigniorage.

Parameter		Value
δ_G	Government's weight on output gap relative to inflation	0.75
γ_G	Government's weight on public spending gap relative to inflation	1.2
δ_{CB}	Central bank's weight on output gap relative to inflation	0.65
γ_{CB}	Central bank's weight on public spending gap relative to inflation	0.15
ϕ	Institutional quality (lower value means higher corruption)	0.10-0.90
k	Seigniorage	0.002-0.8
\bar{g}	Public spending target	0.28

Table 2. Parameters values.

5.1. Corruption

We start off presenting our two first specifications where we compare two cases in which the only difference lies on the degree of seigniorage. In one case (red line), we assume that $k = 0.8$

and in the other case (blue line) $k = 0.002$,¹⁰ while growth or inflation vary for different institutional quality parameters. The high seigniorage simulation case would attempt to represent developing countries (red line). By contrast, the simulation of low seigniorage case is focused on developed economies (blue line).¹¹

Growth and Institutional Quality

Fig. 2 depicts the optimal growth for two different seigniorage degrees at different levels of corruption. We can see that higher corruption enhances growth until $\phi = 0.83$ for developing countries (red line) and $\phi = 0.79$ for developed countries (blue line). Hence, in that case, our results are in line with the point of view that corruption may be beneficial for growth as Leff (1964), Rock and Bonnett (2004) and Méon and Weill (2010), among others. However, at the point where $\phi > 0.83$ for developing countries (red line) and $\phi > 0.79$ for developed countries (blue line), higher corruption damages growth as empirical evidence by Mauro (1995), Aidt et al. (2008) and Farooq et al. (2013). Note that more cases may be found where higher corruption promotes growth in developing countries since their threshold (0.83) is higher than in developed countries (0.79).

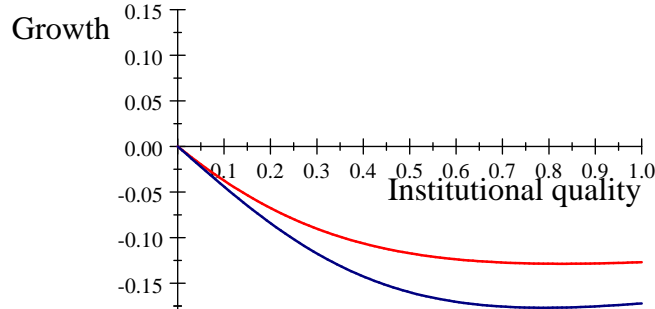


Fig.2. When $\delta_G=0.75$, $\gamma_G=1.2$, $\delta_{CB}=0.65$, $\gamma_{CB}=0.15$ and $\bar{g}=0.28$.

Inflation and Institutional Quality

Fig. 3 illustrates that a higher corruption level decreases inflation until $\phi = 0.68$ for developing countries and $\phi = 0.79$ for developed economies, and thus, $\frac{\partial}{\partial \phi} E(\pi_t) > 0$. Above these thresholds ($\phi > 0.68$ for developing countries and $\phi > 0.79$ for developed countries), more corruption leads to an increase in inflation, $\frac{\partial}{\partial \phi} E(\pi_t) < 0$, as Al-Marhubi (2000), Abed and Davoodi (2000) and Haider et al. (2011). Identifying the developed and developing countries by the two seigniorage levels, for high values of corruption, the first set of countries appears to be more sensitive to changes in corruption than the second one. Further, the threshold for developed countries (0.79) is higher than for developing countries (0.68). Hence,

¹⁰Following Gros (2004), we will represent seigniorage for developed countries less than one quarter of 1 per cent.

¹¹Remember that institutional quality is inversely related to corruption.

there are more cases where higher degrees of corruption reduce the inflation rate in developed countries than in developing countries.

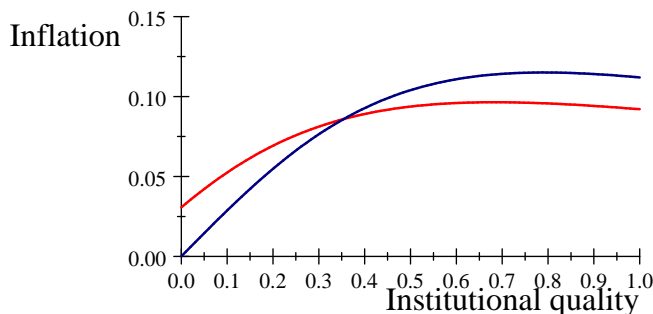


Fig.3. When $\delta_G=0.75$, $\gamma_G=1.2$, $\delta_{CB}=0.65$, $\gamma_{CB}=0.15$ and $\bar{g}=0.28$.

5.2. Seigniorage

In the two following specifications, we focus on the impact of seigniorage changes on growth and inflation in which the only difference lies on the levels of corruption. In the red line, the economy suffers from a very high level of bureaucratic corruption, $\phi = 0.10$. In contrast, the blue line represents an economy with high institutional quality, $\phi = 0.90$.

Growth and Seigniorage

Fig. 4 verifies the previous theoretical result between seigniorage and growth, $\frac{\partial}{\partial k} E(x_t) > 0$. Hence, higher degrees of seigniorage enhance growth for both levels of corruption.

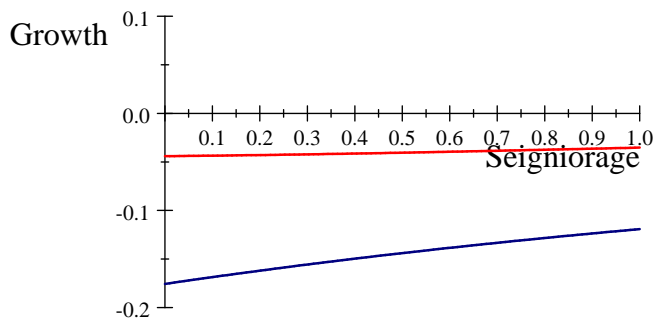


Fig.4. When $\delta_G=0.75$, $\gamma_G=1.2$, $\delta_{CB}=0.65$, $\gamma_{CB}=0.15$ and $\bar{g}=0.28$.

Inflation and Seigniorage

Finally, we analyse the effects of different degrees of seigniorage on inflation. Fig. 5 reveals that for countries with low institutional quality (red line), higher degrees of seigniorage increase inflation. In that case, $k_1 = 1.91$ and hence, $\frac{\partial}{\partial k} E(\pi_t) > 0$.¹² However, for countries with high institutional quality, the blue line shows that higher degrees of seigniorage reduce the inflation rate since, in that case, $k_1 = -2.33$ and thus, $\frac{\partial}{\partial k} E(\pi_t) < 0$.

¹²See Subsection 4.2.

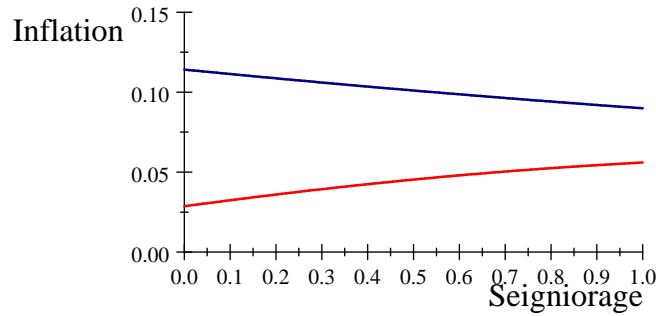


Fig.5. When $\delta_G=0.75$, $\gamma_G=1.2$, $\delta_{CB}=0.65$, $\gamma_{CB}=0.15$ and $\bar{g}=0.28$.

6. Conclusions

There is now a broad consensus that the quality of governance plays a vital role not only in developing economies but also in developed economies. The literature about corruption has given the impression that the world is divided in two types of people: the ‘sanders’ and the ‘greasers’. The ‘sanders’ consider that corruption is detrimental to development, while the ‘greasers’ think that corruption may enhance development.

Our theoretical approach has focused on the relationship between corruption, seigniorage, growth and inflation rates. This paper concludes that the effects of corruption on economic growth and inflation rates are not straightforward. Hence, our results are in line with Mauro (1995), Del Monte and Papagni (2001) and Farooq et al. (2013) who consider that corruption damages growth and with Leff (1964), Méon and Weill (2010) and Dreher and Gassebner (2013) who believe that corruption may be beneficial for economic growth. Moreover, the impact of the degree of seigniorage on the inflation rate is also not straightforward. In some cases, seigniorage increases the inflation rate and in other circumstances, seigniorage decreases the inflation rate. Besides, we find that seigniorage enhances growth. We have given the economic intuitions for all the results found in this paper.

In addition, we have performed a set of comparative static exercises employing numerical simulations. In all our numerical simulations, we can confirm our previous results obtained in the theoretical model.

Several extensions are left for future research. A first one is to develop the model in a Stackelberg game with the government as the leader. It may be more realistic since monetary policy can be adjusted more quickly than fiscal policy. A second one is to explore the results when we include the cost in fighting corruption in a dynamic model. Finally, a third one is to consider that the government can get finance through public debt with a two period dynamic environment.

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