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Anastasia Litina and Theodore Palivos

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Department of Economics, University of Macedonia, 156 Egnatia str, 540 06
Thessaloniki, Greece, Fax: + 30 (0) 2310 891292
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Explicating Corruption and Tax Evasion: Reflections on Greek Tragedy*

Anastasia Litina†
Department of Economics
University of Ioannina
Ioannina, Greece

Theodore Palivos
Department of Economics
University of Macedonia
Salonica, Greece

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Abstract

Do developed countries experience extensive corruption and if so how should they treat it? Evidence from countries in which tax evasion and various forms of corruption coexist and interact (e.g. Greece) indicates that the answer is positive. We address this problem by constructing an overlapping generations model comprising two distinct groups of agents, citizens and politicians. Citizens decide the fraction of their income that they report to the tax authorities. Politicians decide the fraction of the public budget that they peculate. In such a context, multiple self-fulfilling equilibria can emerge: a “good” (“bad”) equilibrium with low (high) corruption and high (low) level of spending on education. It is shown that standard deterrence policies (e.g., fines) cannot eliminate multiplicity. Interestingly, whenever corruption may corrupt, policies that impose a strong moral cost on tax evaders and corrupt politicians can lead to a unique equilibrium.

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†Corresponding author: Department of Economics, University of Ioannina, University Campus, GR-451 10, Ioannina, Greece, Tel.+30-26510-05957
1 Introduction

Corruption is hardly a new phenomenon. It was analyzed extensively more than two thousand years ago by Kautilya, an Indian statesman and philosopher, and is still prevalent in a number of countries both developing and developed. Today the World Bank characterizes corruption as "one of the most important obstacles to promote sustainable economic growth and poverty reduction." which explains why the Bank has supported more than 600 anti-corruption programs since 1996. The role of the state has a prominent position in most definitions of corruption, which defines it as a particular and rather "perverted" state-society relationship. Another important and rather old problem, that comes naturally when one considers taxes is that of tax evasion. Both issues, corruption and tax evasion, can have detrimental effects on government finances, growth and wealth distribution.

There is a significant strand of literature, that relates the level of corruption with the stage of economic development. Sarte (2000) suggests that corruption hinders growth by impeding the entry of firms in the formal sector. Blackburn et al (2006) suggest that corruption and development are jointly determined in a model where development is deterred due to loss of resources that could be allocated in productive activities whereas the stage of development determines how corrupt agents choose to be. In a richer context, Blackburn and Forgues-Puccio (2007) predict that corruption and development are negatively related, in a model where corruption in public policy hurts the poor more severely. These results accord well with empirical evidence (see, e.g., Mauro 1995; Ades and Di Tella 1997; Keefer and Knack 1997; Treissman 2000) that predict a negative relationship between corruption and growth with the causality running both ways.

Crucially, this literature suggests that in high stages of development the incidence of corruption diminishes, which is the case for most developed countries. Evidence though suggests that corruption and tax evasion may by highly persistent in a number of developed economies as well. There seems to be little disagreement to the claim that the current Greek tragedy is a play that involves both of these issues. In fact, as two Greek economists have written in a recent article

We contend that a crucial factor in this respect, and which has been steadily eroding the foundations of Greek society and will impact on the resolution of

\[1\text{http://go.worldbank.org/D51GCA82B0} \]
the current fiscal crisis, is the interdependence between the tax burden, public
good provision, tax compliance . . . The rise of budget deficits during the last
three decades reflect in addition to outright corruption, the increasing inability
of the public sector to deliver on the public goods and services that the higher-
tax citizens . . . have every right to expect in return. This has created a further
“legitimization” of tax evasion . . . (Moutos and Tsitsikas 2010, pp. 173)

Indeed, political corruption, evidenced by a series of scandals, together with massive tax
evasion and low quality of public services have been the case in Greece for the last three
decades, which currently ranks 78th among 178 countries with a corruption score 3.5/10 in
CPI index! Similar evidence can be found for other developed countries such as Portugal
(6/10), Israel and Spain (6.1/10).

Our aim is to account for these facts that cannot be accounted for in models with
path dependencies. Analytically, the paper attempts to analyze these two social issues,
corruption and tax evasion, jointly, motivated by the following empirical facts. First,
existing evidence suggests that there is a positive correlation between corruption and tax
evasion. The two of them often coexist and reinforce each other either directly through
bribery or without the presence of any causal relation just through a rise in the size of the
shadow economy (De Soto 1990²; Amudnsen 1999; Barreto and Alm 2003). Moreover,
there seems to be a negative correlation between any of these two phenomena and spending
on publicly provided goods, such as education and health (see, e.g., Mauro 1995, 1998³;
Gupta, Davoodi and Rosa 1998; Tanzi and Davoodi 1997). Both of these problems appear
to be highly persistent and difficult to eradicate.

We attempt to account for these facts via the use of a model appropriate to study
the interrelation between corruption and tax evasion. More specifically, we construct an
economy that comprises two distinct groups of agents, private citizens and politicians.
Citizens decide how much of their income to report to the tax authorities, taking into
account the exogenously given probability of inspection and the size of the delinquent
tax penalty. A certain fraction of tax revenue is supposed to be spent for the public
provision of a good. For the sake of concreteness we take this good to be education,
but it could also be fire protection, health, etc. Politicians, on the other hand, have

²In an extensive empirical study on the size of underground economy in 69 countries, De Soto concludes
that corruption, rather than tax rates, is the main determinant of the size of the underground economy.
³Mauro reports that a decrease in corruption (1.5 unit in the BI index) could increase spending on
education up to 0.6%.
the opportunity to peculate a certain fraction of the public funds that are earmarked for public education. Crucially, each agent cares not only about her own consumption but also about the quantity/quality of education that is provided to her offspring.

In such a context, strategic complementarities may arise that lead to multiple self-fulfilling equilibria. The existence of multiple equilibria can help us understand why countries with similar background experience are characterized by different levels of corruption and tax evasion. It can also provide some insights as to why these two phenomena are so difficult to eradicate. We examine the use of standard deterrence policies (e.g., fines) as means to fight corruption and tax evasion as well as a device to select an equilibrium. We show that in this context such policies may not be as effective as expected. This result seems plausible, when it comes to developed countries that experience high corruption levels, in which deterrence systems are rather progressive compared to developing countries and yet ineffective in the fight against corruption.

Next we modify the model to analyze the issue within a richer environment. Specifically we introduce social stigma directly in the utility of agents, following the relevant literature (see, e.g., Moffit 1983; Gordon 1989; Besley and Coate 1992, for welfare stigma; Kim 2003, for a social stigma related to tax evasion). We assume that those who commit unlawful actions and get caught have to face a moral (stigma) cost. If this cost is sufficiently high the multiplicity of equilibria is eliminated and the indeterminacy is dissolved.

Examining the role of moral costs in the society is motivated by a couple of empirical facts. Graetz and Wilde (1985) and Skinner and Slemrod (1985) have empirically estimated the compliance rates of various countries and have found them significantly higher than expected, taking into account low auditing probabilities and fines. Moreover experimental studies have indicated that some people never evade or they evade less that expected to (Alm et al, 1992). These odd observations were accounted for by resorting in among others, to social norms and moral considerations. This literature directly introduces stigma or moral costs into agents’ utility (see, Moffit 1983; Gordon 1989, Besley and Coate 1992; Kim 2003). Interestingly when it comes to Greece, evidence from World Values Survey (WVS) data indicates that a high rate of citizens (37.5%) seems to believe that the “almost all compatriots cheat on taxes” as well as that it is to some extend

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4Note that our model analyzes political and not fiscal corruption, whose correlation with tax evasion may be rather obvious.
justifiable cheating on taxes”. These observations highlight that there seems to be a role for moral considerations for the "Greek Tragedy" or to be precise there seems to be a role for the lack of tax morale in Greece.

The result that the corruption of one agent may be a strategic complement for another is reminiscent of the argument that corruption seems to be contagious, or as Andvig and Moene (1990) put it "corruption may corrupt". Empirically, there seems to exist an interdependence between agents' behavior. Whenever they feel that other people are corrupt or that their burden is not fair compared to others, they choose to become more corrupt as well. Laffont (1975), Bordignon (1993) and Pommerehne et al (1994) attempt to account for fairness issues in tax evasion models by introducing the Kantian notion of fairness summarized as individuals considering it fair to pay as much as they would wish the other individuals (or politicians) to pay. Spicer and Becker (1980) and Fortin et al (2007) conducted lab experiments and found that taxpayers tend to evade more taxes if they believe that their tax burden is not fair.

The remainder of this paper is organized as follows. Section 2 introduces the benchmark model that poses the problem and describes the emergence of multiple equilibria and the effects of corruption in a society without deterrence policies. Section 3 introduces standard enforcement policies and analyzes the causes responsible for their limited effectiveness in the fight against corruption. Section 4 describes the functioning of a moral-based society and clarifies why imposing an ethical cost on corrupt activities effectively deters corruption. Section 5 summarizes the results and draws conclusions. There is also an Appendix, which considers various extensions of the model.

2 The benchmark model

2.1 The economy

Consider an overlapping generations economy where individuals live for two periods. The population size remains constant and is normalized to unity. In the first period of life, all agents are identical. They enter the public education system and acquire human capital according to the learning technology

\[ h_t = vH_{t-1} + AE_{t-1}, \]  

(1)
where \( t = 0, 1, 2 \ldots \) indexes time and \( h_t \) denotes the level of human capital of an individual born in period \( t - 1 \); this level of human capital is formed in period \( t - 1 \), but it is put to use in period \( t \). Moreover, \( H_{t-1} \) is the average stock of human capital at time \( t - 1 \) and \( E_{t-1} \) denotes public spending on education. The human capital accumulation process described by equation (1) shares common features with several papers in the literature; see, among others, De Gregorio and Kim (2000), Ceroni (2001), Palivos and Varvarigos (2011). Accordingly, a young agent, who was born in period \( t - 1 \), can pick up a fraction \( v \in [0, 1] \) of the existing (average) level of human capital \( H_{t-1} \) without any cost, simply by observing what the previous generation does.\(^5\) The enhancement of an agent’s human capital even further is possible only with the use of resources. In this paper, we consider only public education and hence the level of public spending enters the learning technology. The parameter \( A > 0 \) measures the efficiency of the public education system. Finally, the specific functional form in equation (1) is used purely for convenience; it allows us to derive analytical expressions.

For simplicity, we assume that agents do not consume in the first period, or that their consumption is included in the consumption of their parents. Instead, agents derive utility from consumption in the second period of their life and from their offspring’s level of human capital. The latter is meant to capture the idea that parents care about their offspring’s future prospects and social status (both being enhanced through more advanced knowledge and/or increased income). Formally, individuals born in period \( t - 1 \) wish to maximize the following utility function:

\[
u_t = c_t (h_{t+1})^\beta, \quad \beta \in (0, 1],\]

where \( c_t \) and \( h_{t+1} \) stand for the levels of consumption when old and offspring’s human capital, respectively. The parameter \( \beta \) measures the strength of the altruistic motive.\(^6\) Note that the presence of the offspring’s human capital level in parental utility function results in an agent’s vested interest in public education.

At the end of a cohort’s first period of life, a small number of agents emerge via a random process and become politicians. This group forms the central government, while the rest of the population remain private citizens. For simplicity, we assume that the

\(^5\)The term \( 1 - v \) can be taken to capture the depreciation rate of the stock of knowledge.

\(^6\)Variations of this utility function abound in the literature; see, for example, Glomm (1997) and Ceroni (2001).
number of politicians is equal to one. When necessary, we use the subscripts \(c\) and \(p\) to denote variables that are related to citizens and the politician, respectively.

**Citizens**

In the second period of their life, private citizens assume production of a single consumption good. Using the appropriate normalization of units, we assume that the wage rate per unit of human capital is equal to unity and hence each old citizen’s income is equal to the (common) level of human capital \(h_t\).\(^7\) This income is taxed at the rate \(\tau\), which is assumed to be exogenous and time invariant. Nevertheless, citizens have the opportunity to tax evade. In particular, we let \(z_t\) denote the fraction of their income that they declare to the tax authorities, leading to an amount \(\tau z_t h_t\) that is paid as income tax.

Following, among others, Cowell (1990) and Chen (2003), we assume that tax evasion involves a transaction cost, which, in general, increases along with the extend of tax evasion, the level of income and the level of honesty of the politician. This cost can be perceived as an effort to conceal tax evasion, e.g. hiring a tax practitioner (Andreoni et al, 1998). More specifically, we assume that the transaction cost of tax evasion equals
\[
S(1 - z_t)h_t \quad \text{where} \quad S = s(1 - z_t)\mu_t \quad (s > 0)
\]
and denotes the per unit cost imposed by the overall level of corruption as perceived by the citizens, multiplied by the actual level of evasion \((1 - z_t)h_t\) (see, Chen 2003, pp. 384-385). As explained in detail below, \(\mu_t\) denotes the proportion of the education budget that is actually spent on education; that is, \(1 - \mu_t\) is the percentage of the education budget that is embezzled by the politician. In the benchmark model there are no penalties imposed on tax evaders. In other words, by paying the transaction cost, agents are able to conceal tax evasion fully.\(^8\)

**Politician**

The politician receives a payment (net of taxes) from the government budget. In addition, he has the option to embezzle public funds.\(^9\) More specifically, he decides what fraction \(1 - \mu_t\) of tax revenue to embezzle. In the benchmark model, there is no fine imposed on the politician, even after he has been found guilty of embezzlement. A more realistic version is examined in the next section. Still, given the politician’s vested interest in public education, \(1 - \mu\) may not be equal to unity (see below).

\(^7\)Since all agents have the same level of human capital, we omit the subscript \(i = c, p\) from the level of human capital \(h_t\).

\(^8\)A more realistic version, where fines are imposed on tax evaders, is analyzed in the next section.

\(^9\)Since most politicians are males, we use the masculine gender to refer to the politician and the feminine to refer to citizens.
**Spending on Education**

The total tax revenue collected within a period $t$ is $R_t = z_t \tau H_t$, where $z$ denotes the average value of $z$. A constant fraction $1 - \phi$ of this revenue is earmarked for public sector wages; that is, the politician’s net income is equal to $(1 - \phi)R_t = (1 - \phi)z_t \tau H_t$. The remaining amount $\phi z_t \tau H_t$ is to be spent on public education. Nevertheless, the politician peculates a fraction $1 - \mu_t$ of this sum. Hence, the actual amount spent on education $E_t$ is

$$E_t = \mu_t \phi z_t \tau H_t. \quad (3)$$

Evidently, individual optimization decisions regarding $z_t$ and $\mu_t$ affect total spending on education and consequently the human capital of generation $t$.

### 2.2 Individual optimization

**Citizens**

As mentioned above, in period $t$ each citizen’s gross income is $h_t$. A fraction $z_t$ of this is declared to the tax authorities and an amount $\tau z_t h_t$ is paid as income tax. In addition, an amount $s\mu_t (1 - z_t)^2 h_t$ is paid as a transaction cost, to conceal tax evasion. Hence, each citizen’s disposable income is

$$(1 - \tau) z_t h_t + (1 - z_t) h_t - s\mu_t (1 - z_t)^2 h_t = [(1 - z_t \tau) - s\mu_t (1 - z_t)^2] h_t.$$

The individual optimization problem solved by a citizen born in period $t - 1$ is given by

$$\max_{c_{ct}, z_t} c_{ct} h_{t+1}^{\beta}, \quad (4)$$

subject to

$$c_{ct} = [(1 - z_t \tau) - s\mu_t (1 - z_t)^2] h_t, \quad (5)$$

$$c_{ct} \geq 0, \quad 1 \geq z_t \geq 0,$$

taking $H_t$, $E_t$, and hence $h_{t+1}$, and $\mu_t$ as given.

Maximization yields the citizens’ best response function:

$$z_t = f(\mu_t) = \begin{cases} 
0 & \text{if } \tau \geq 2s\mu \\
1 - \frac{\tau}{2s\mu} & \text{if } \tau < 2s\mu.
\end{cases} \quad (6)$$
Inspection of equation (6) reveals that a corner solution \( z_t = 0 \) will emerge if the tax rate \( \tau \) is higher than the marginal transaction cost \( 2s\mu_t \) or, equivalently, if the politician’s level of honesty \( \mu_t \) is below \( \tau/2s \). Note that the corner \( z_t = 1 \) is never feasible for \( \tau > 0 \) and finite \( s \). Therefore the citizen always finds it optimal to evade a part of her revenue\(^{10}\). Moreover, whenever an interior solution, i.e., \( 0 < z_t < 1 \), emerges, the tax evasion rate \((1 - z_t)\) is positively affected by the size of the tax rate \( \tau \) and negatively by the cost parameter \( (s) \) and, more importantly, the politician’s level of honesty \( (\mu_t) \). Hence, an increase in the politician’s tendency to peculate public funds makes citizens more prone to tax evasion. In other words, the politician’s embezzlement rate is a \textit{strategic} complement for citizens’ tax evasion rate, meaning that \( z_t \) is an increasing function of \( \mu_t \).

\textit{The Politician}

The politician’s optimization problem is

\[
\max_{c_{pt}, \mu_t} c_{pt} h_{t+1}^\beta, 
\]

subject to

\[
c_{pt} = (1 - \mu_t \phi) \overline{z}_t \tau H_t, 
\]

\[
c_{pt} \geq 0, \ 1 \geq \mu_t \geq 0, 
\]

and equations (1) and (3), taking \( \overline{z} \) and \( H_t \) as given.

Straightforward maximization yields the politician’s best response function

\[
\mu_t = g(\overline{z}) = \begin{cases} 
0 & \text{if } \beta A \overline{z}_t \tau \leq v \\
\frac{\beta A \overline{z}_t - v}{A z_t \phi (1+\beta)} & \text{if } A \overline{z}_t \tau [\beta - \phi (1+\beta)] \leq v < \beta A \overline{z}_t \tau \\
1 & \text{if } v < A \overline{z}_t \tau [\beta - \phi (1+\beta)]. 
\end{cases} 
\]

Inspection of equation (9) reveals that a corner solution \( \mu_t = 0 (\mu_t = 1) \) will emerge, if the rate of human capital transferred freely to the next generation, \( v \), is sufficiently high (low). Capturing a large (small) percentage of the existing human capital freely implies that the politician, as a parent, has a weak (strong) incentive to invest in education and thus peculates all (none of) the public education funds. Whenever an interior solution emerges, the embezzlement rate \((1 - \mu_t)\) is negatively affected by the efficiency of the

\(^{10}\)Note that this result hinges upon the hypothesis that all agents are corruptible. Had we assumed that some agents are inherently honest would not qualitatively change our results.
education system \((A)\), the tax rate \((\tau)\) and the degree of altruism \((\beta)\). On the other hand, the embezzlement rate is negatively affected by the percentage of the tax revenue that is earmarked for politicians’ wages \((1 - \phi)\). In fact, if \(\phi > \beta/(1 + \beta)\), then the embezzlement rate is never zero. This accords well with empirical evidence on the negative relationship between corruption and wages (Haque and Sahay 1996).

Finally, an increase in the citizens’ average tax evasion rate, \((1 - \overline{z}_t)\), increases the politician’s embezzlement rate. Put differently, the private citizens’ action is a strategic complement for the politician, meaning that \(\mu_t\) is an increasing function of \(\overline{z}_t\).

2.3 Equilibrium

The situation at hand is a coordination game in which there are strategic complementarities. Games of strategic complementarity (see, for example, Cooper and John, 1988 and Vives, 2005) are those in which the best response of any player, is increasing in the actions of the rival; this is the case here for \(\overline{z}_t\) and \(\mu_t\). Strategic complementarity is a necessary condition for the existence of multiple equilibria in symmetric coordination games. The occurring equilibria are not driven by fundamentals. Instead, they are self-fulfilling and critically depend on the expectations of one group concerning the behavior of the other. Nevertheless, the game that we analyze here is not a symmetric game. Moreover the choice space is bounded and this necessitates the consideration of corner solutions. In fact, as we show below, this game does not share certain properties of symmetric games with strategic complementarities. Consider first the following definition of the equilibrium:

**Definition 1.** A Nash equilibrium in this economy consists of sequences \(\{c_{it}\}_{t=0}^\infty\), \(\{z_t\}_{t=0}^\infty\), \(\{\mu_t\}_{t=0}^\infty\), \(\{h_t\}_{t=0}^\infty\), \(\{H_t\}_{t=0}^\infty\), \(\{E_t\}_{t=0}^\infty\), \(i = c, p\), such that, given an initial average stock of human capital \(H_{-1} > 0\), in every period \(t = 0, 1, 2, \ldots\),

1. Private citizens choose \(z_t\) to maximize their utility, taking \(\mu_t\), \(H_t\) and \(E_t\) as given.

2. The politician chooses \(\mu_t\) to maximize his utility, taking \(\overline{z}_t\) and \(H_t\) as given.

3. The labor and output markets clear.

4. \(H_t = h_t\) and \(\overline{z}_t = z_t\) \(\forall t\).

5. The sequences \(\{h_t\}_{t=0}^\infty\), \(\{E_t\}_{t=0}^\infty\), and \(\{c_{it}\}_{t=0}^\infty\), are determined according to (1), (3), (5), and (8).
The optimization problem of each agent is well defined since the utility function is strictly concave and the budget constraint is either convex or linear with respect to the relevant decision variable, $z_t$ or $\mu_t$. In Proposition 1 below, we prove the existence of a pair $(z_t, \mu_t)$ that satisfies Definition 1 in every period. Given the existence of the equilibrium pair $(z_t, \mu_t)$, we can easily establish the equilibrium values of the remaining variables, following Definition 1.

**Proposition 1.** An equilibrium pair $(z_t, \mu_t)$ exists.

*Proof:* We must establish the existence of a pair $(z_t, \mu_t)$ that satisfies equations (6) and (9) simultaneously, after $\tau = z$ is imposed in (9). For an arbitrary time period $t$, let $z_t = f(\mu_t)$ denote the solution to each citizen’s problem, as described by equation (6); for each value of the embezzlement rate $\mu_t$ there exists a unique value of the evasion rate $z_t$. Similarly, let $\mu_t = g(z_t)$ denote the solution to the politician’s problem, as described by equation (9). Note that both of these functions are continuous (see equations (6) and (9)). Thus, the composite function $g \circ f$ from $[0,1]$ to $[0,1]$ is continuous and, by Brower’s fixed point theorem, has a fixed point. □

We call an equilibrium interior (corner) if it lies in the interior (on the boundary) of the unit square. Propositions 2 and 3 establish sufficient conditions for the existence of a unique and multiple equilibria, respectively.

**Proposition 2.** Uniqueness of Equilibria

a) If $v = 0$ then $(z_t, \mu_t) = (1 - \frac{\tau \phi(1+\beta)}{2s\beta}, \frac{\beta}{\phi(1+\beta)})$ is the only equilibrium. b) If $s = 0$, then $(z_t, \mu_t) = (0, 0)$ is the only equilibrium. c) If $v \geq \beta A \tau$ or $\tau \geq 2s$, then $(z_t, \mu_t) = (0, 0)$ is the only equilibrium.

*Proof:* a) If $v = 0$, then simple substitution in equation (9) shows that the politician’s optimal response is independent of the citizens’ actions. More specifically, $\mu_t = \beta/\phi(1+\beta)$. Substituting this value in (6), yields $z_t = 1 - \frac{\phi(1+\beta)}{2s\beta}$. b) Similarly, if $s = 0$, then each citizen’s best response is independent of the politician’s action. Indeed, substituting $s = 0$, equation (6) yields $z_t = 0$. The equilibrium value of $\mu_t = 0$ follows then from equation (9). c) If $v \geq \beta A \tau$, then the politician’s best response function coincides with the side of the unit square that lies on the vertical axis (see Figure 1, where the best response functions are indicated by bold lines). The only common point then with the citizens’ best response function is $(0, 0)$. Similarly, if $\tau \geq 2s$ then the citizens’ best response function coincides with the side of the unit square that lies on the horizontal axis. Hence,
the only common point with the politician’s best response is \((0,0)\). ■

If \(v = 0\) then each new generation born in period \(t\) will not acquire any human capital unless both \(z_t > 0\) and \(\mu_t > 0\) hold. Thus, the politician commits to a certain strategy regardless of what the citizens do.\(^{11}\) Since this is the case citizens find it optimal not to evade all of their income and therefore an interior solution emerges.

On the contrary if there is no transaction cost \((s = 0)\), then citizens tax evade their entire income, i.e., \(z_t = 0\), regardless of the politician’s action. In this case the corner \((0,0)\) emerges. Similarly, if \(v\) is high enough and hence each new generation acquires a substantial level of human capital freely, then the politician peculates the entire amount \((\mu = 0)\). Anticipating that, the citizens set \(z = 0\). Note that, for a given value of \(v\), the condition specified in part (c) of Proposition 2 can also be expressed in terms of the tax

\(^{11}\)In Appendix A2, we show that, in a more general version of the model, strategic complementarity and multiple equilibria can arise even if \(v=0\).
rate \( (\tau) \). For example, if \( \tau \) is too low, then spending on education will be low no matter how honest the politician is. In this case the politician does not have any incentive to behave honestly and hence the only equilibrium is \((0, 0)\). This finding is consistent with the positive correlation between corruption, tax evasion and spending on education across countries (De Soto 1989; Mauro 1995; Tanzi and Davoodi 1997) as well as with the literature that suggests reciprocity in tax evasion associated with the extend of provision of public goods (see, Sugden 1984; Bordignon 1993). Nevertheless, it offers a different direction of causality as described in Corollary 1.

**Corollary 1.** Spending on education is not low because of high of levels of corruption and tax evasion; instead, corruption and tax evasion are at high levels because the commitment for education spending is low.

Similarly, if the tax rate is high enough then the citizens tax evade all their income. This leads again to \((0, 0)\) as the only equilibrium. Finally, note that, by analyzing the quadratic equation that results from the combination of (6) and (9), it is straightforward, but tedious, to find additional conditions, which ensure that that the two best response functions intersect only at \((0, 0)\), or that they intersect again outside the unit square.

**Proposition 3. Multiplicity of equilibria**

a) If \( v > 0 \) and \( s > 0 \) then multiple equilibria may always arise. The occurring equilibria can either be one corner and two interior or one interior and two corner equilibria depending on parameter values. b) If \( v > 0 \), then \((z_t, \mu_t) = (0, 0)\) is always an equilibrium. c) If \( (2s - \tau)/2s > v/[A\tau(\beta - \phi(1 + \beta)] > 0\), then there exist one interior and two corner equilibria

**Proof:** a) The proof follows immediately from equations (6) and (9). b) Notice that if \( v > 0 \), then the point \((0, 0)\) satisfies both equations (6) and (9). c) The proof follows immediately from Figure 2b and equations (6) and (9).

Figure 2 shows two possible configurations where multiple equilibria arise. Besides the origin, there are two equilibria, which are indicated by the letters A and B. In Figure 2a there two interior equilibria and one corner, whereas in Figure 2b there are two corner and one interior equilibrium.

Again, by analyzing the quadratic equation that results from the combination of (6) and (9), it is straightforward but cumbersome to find sufficient conditions for the existence of the second interior equilibrium.
of two interior equilibria or one interior and two corner.

The stability of the equilibria can be characterized using best-reply dynamics; namely, a Nash equilibrium is said to be stable if, starting from any point in its neighborhood, the adjustment process in which players take turns myopically playing a best response to each other’s current strategies converges to the equilibrium (see, e.g., Henriques 1990). Using this approach, we can infer that stability requires that the best response function of the citizen is flatter than that of the politician. Hence, whenever there exist three equilibria, (0, 0) and either one interior and one more corner or two interior, the equilibrium that lies in the middle is unstable, while the other two are stable. In sum, there are at most two stable equilibria: (0, 0) and the high action equilibrium, where there exists low corruption and low tax evasion. Consider next the following numerical example.

**Example 1.** Let $A = 25$, $\phi = \tau = 0.3$, $v = 0.03$, $\beta = 0.1$, $s = 0.8$. Then there will be one corner equilibrium $(\mu_1, z_1) = (0, 0)$ and two interior $(\mu_2, z_2) = (0.219, 0.145)$, and $(\mu_3, z_3) = (0.259, 0.277)$. The middle equilibrium is unstable while the other two are stable. The utility level of each citizen and the politician in the corner equilibrium and the high action equilibrium, respectively, will be $(u_{1c}, u_{1p}) = (0.704, 0)$ and $(u_{3c}, u_{3p}) = (0.685, 0.065)$.

Example 1 serves to show, among others, that in contrast, for example, to Cooper and John (1988), if there are two stable equilibria, then, in general, they cannot be ranked in terms of the welfare that they yield. This is attributed to the fact that the game is non-symmetric. The politician is better off at the low corruption and low tax evasion equilibrium $(\mu_3, z_3)$ than under the full corruption and complete tax evasion $(0, 0)$; the reason is of course that his salary and the amount that he peculates are both a fraction of the tax revenue. Nevertheless, in this particular example, the citizens prefer the first equilibrium, where there is full corruption and complete tax evasion. In general, which equilibrium they prefer depends on the relative strength of two conflicting effects: on the one hand, high tax evasion increases citizen’s consumption level, but on the other, it (and the accompanying high corruption) decreases spending on education and hence future levels of human capital.

**Proposition 4.** If the highest equilibrium $(\mu^*, z^*)$ is an interior point, then

$$
\frac{d\mu^*}{dt} > 0 \quad \text{and} \quad \frac{d\mu^*}{dj} < 0 \\
\frac{ds^*}{dt} > 0 \quad \text{and} \quad \frac{ds^*}{dj} < 0
$$

where $i = s, A, \beta$ and $j = \phi, v$. 

14
The effects of a change in the tax rate $\tau$ are ambiguous.

Proof: These results follow directly after differentiating (6) and (9).

The intuition behind these results is straightforward. For example, an increase in $s$ raises the cost of tax evasion and hence $z^*$. Given the strategic complementarity, $\mu^*$ increases as well. An increase in $A$, on the other hand, raises the efficiency of public education and hence $\mu^*$. The effect on $z^*$ follows again from the strategic complementarity of the two actions. Finally, an increase in the tax rate has ambiguous effects, because, on the one hand, it raises the incentives for tax evasion but, on the other, it decreases the incentives for embezzlement as well as increases spending on education and thus the human capital of the next generation.

Corollary 2. If $v > 0$ then changes in the policy instruments, i.e., changes in $\tau$, $s$ or $\phi$, cannot eliminate the high corruption equilibrium $(0,0)$.

Proof: This follows trivially from Proposition 3(b), where it is shown that if $v > 0$ then $(0,0)$ is always an equilibrium. ■

As long as some of the knowledge is transferred freely to the new generations, then the politician may peculate all the public funds. Anticipating that, citizens may declare zero income.

Overall, it is interesting to note that in a context where corruption may corrupt, multiple self-fulfilling equilibria may arise that cannot be eliminated via the use of policy. Contrary to the models with path-dependencies that account for corruption in less developed countries, we explain how corruption may persist even in developed countries. Malpractice and illegal behavior by one group may reinforce malpractice and illegal behavior by the other group and vice versa. As a result, even countries at a high stage of development can find themselves trapped in a high-corruption, high evasion equilibrium. Following we enrich the benchmark model to examine whether standard policies are effective in eliminating endemic corruption.

3 Enforcement policy

Whenever agents get involved in illegal activities, they are faced with some uncertainty. In this particular case, citizens are faced with a certain probability of being audited. If they are audited, then their true income is revealed and they are punished with a fine
proportional to the evaded tax, as in Yitzhaki (1974). In terms of modelling, there is a fine appropriate for each punishment, so long as moral issues are not considered (Andreoni, 1998).

There are many ways to introduce policy. In this section we introduce uncertainty through standard deterrence policies. We assume either exogenous auditing probabilities and fines or endogenous auditing probabilities. Revenue from fines can be either spent on public education or not. In the case of politicians we could either assume that they pay a penalty or that they are thrown out of office. In all these cases fines are imposed on citizens’ evaded tax following Yitzhaki (1974) and on politicians embezzled income.

Interestingly, despite the fact that the good equilibrium is being improved under the deterrence scheme, we find that enforcement policies are not effective in eliminating multiple equilibria. More significantly our results are robust in all the different formulations. Following we examine the case of exogenous auditing probabilities and fines whereas in the appendix we present some extensions of the model.

To keep the analysis simple, in the main text, we assume exogenous auditing probabilities and fines. More specifically, let $p$ denote the expected penalty rate, i.e., $p$ equals the probability of being audited times the penalty rate. Then, the budget constraint of each citizen is

$$c_{ct} = [(1 - z_t) - s\mu_t(1 - z_t)^2 - p\tau(1 - z_t)]h_t.$$  

(10)

According to equation (10), each citizen’s consumption is equal to her disposable income, after having evaded taxes at a rate $(1 - z_t)$, minus the transaction cost $s\mu_t(1 - z_t)^2h_t$ and the expected penalty $p\tau(1 - z_t)h_t$. As it is common in the literature, e.g., Chen (2003), we assume that the tax evasion gamble is better than fair, i.e., $1 \geq p$.

Similarly, the politician, if found to have embezzled public funds, pays a fine that is proportional to the embezzled amount. We let $q$ denote the expected punishment rate. Hence, the politician’s budget constraint is

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12 Imposing fines on evaded income, following Allingham and Sandmo (1972), leads to qualitatively similar results.
13 In Appendix A3 we attempt to endogenize the auditing probabilities.
14 The case where the opposite holds is of little interest, since tax evasion would never take place. The assumption that the evasion gamble is better than fair, is empirically supported; see, for example, Skinner and Slemrod (1985).
15 In Appendix A1 we analyze an extreme case of penalty, where a corrupt politician has zero consumption (he is thrown out of office). As we show, our results remain qualitatively the same.
\[ c_{pt} = (1 - \mu_t \phi)z_t r H_t - q(1 - \mu_t)\phi z_t r H_t. \]  

Equation (11) sets the consumption of a politician, \( c_{pt} \), equal to his salary plus the embezzled amount of public funds minus the expected fine. As is the case with citizens, the embezzlement gamble is assumed to be better than fair, i.e., \( 1 \geq q \).

The law of motion of human capital is still given by (1) and \( E_t \) is again given by (3).\(^{16}\)

### 3.1 Individual optimization

**Citizens**

The individual optimization problem solved by each citizen at time \( t \) is that of maximizing (4) subject to (10) and the non-negativity constraints, taking \( H_t, E_t, \) and hence \( h_{t+1} \), and \( \mu_t \) as given. To simplify the algebra, in the remainder of the paper we assume that \( \beta = 1 \). Maximization yields

\[ z_t = f(\mu_t) = \begin{cases} 
0 & \text{if } \tau \geq \frac{2q\mu_t}{1-p} \\
1 - \frac{(1-p)\tau}{2q\mu_t} & \text{if } \tau < \frac{2q\mu_t}{1-p}.
\end{cases} \]  

(12)

As in the benchmark model, the politicians’ embezzlement rate is a strategic complement for citizens’ tax evasion rate, meaning that \( z_t \) is an increasing function of \( \mu_t \). While the properties of the reaction function are similar to the those of the benchmark model, evidently when we compare the interior solution with the one in the benchmark model, we observe that for the same value of \( \mu_t \), the evasion rate is lower.

**The Politician**

The politician maximizes (7) subject to (11), the non-negativity constraints and equations (1) and (3), taking \( \tau_t \) and \( H_t \) as given. Maximization yields

\[ \mu_t = g(\tau_t) = \begin{cases} 
0 & \text{if } A\tau z_t(1 - \phi q) \leq (1 - q)v \\
\frac{A\tau z_t(1 - \phi q) - v(1 - q)}{2A\tau z_t(1 - q)} & \text{if } A\tau z_t(1 - 2\phi + \phi q) \leq (1 - q)v < A\tau z_t(1 - \phi q) \\
1 & \text{if } (1 - q)v < A\tau z_t(1 - 2\phi + \phi q).
\end{cases} \]  

(13)

\(^{16}\)In Appendix A2, we analyze the case where the revenue from the fines imposed on tax dodgers and corrupt politicians is spent on public education. Once again, our results remain essentially unaltered.
Simple differentiation shows that \( \frac{d\mu_t}{dz_t} > 0 \) and hence private citizens’ action is a strategic complement for the politician. Similarly to the citizen reaction function, while the properties of the reaction function are similar to the those of the benchmark model, when we compare the interior solution with the one in the benchmark model, we observe that for the same value of \( z_t \), the embezzlement rate is lower.

### 3.2 Equilibrium

The definition of equilibrium remains basically the same as that in Definition 1. Also, following exactly the same steps as in Proposition 1 we can show the existence of an equilibrium in this version of the model as well. For a wide range of parameter values there exist three equilibria, one corner and two interior or one interior and two corner. The stability of the equilibria is the same as in the benchmark model, namely the lowest (full tax evasion and full corruption) and the highest (low tax evasion and low corruption) equilibria are stable, whereas the intermediate equilibrium is unstable. Crucially while deterrence policies are successful in reducing corruption and tax evasion in the low corruption equilibrium still though the multiplicity persists.

The intuition behind this result lies in that deterrence policies can affect agents’ decision with respect to their own budget constraint since they simply render evasion or embezzlement more costly. Still though they fail to treat the problem arising due to presence of strategic interactions. No matter how high a fine or an auditing probability is\(^{17}\), whenever agents observe other agents being corrupt, they always find it optimal to be corrupt as well.

**Corollary 3.** Deterrence policies a) Are effective in treating each problem (tax evasion-embezzlement) separately and b) If \( v > 0 \), then changes in the policy instruments, i.e., changes in \( p, q, s, \tau \) or \( \phi \), cannot eliminate the high corruption equilibrium.

**Proof:** a) If in the model with exogenous auditing probabilities and fines we set \( v = 0 \), which eliminates strategic interactions, then we obtain a unique equilibrium \((z_t^F, \mu_t^F) = (1 - \frac{2\gamma(1-q\theta)(1-p)}{2s(1-q\theta)}; \frac{1-\phi d}{2o(1-q\theta)})\). When compared to the benchmark solution \((z_t^B, \mu_t^B) = (1 - \frac{2\gamma}{2s}; \frac{1}{2\theta})\) it is evident that \((z_t^F, \mu_t^F) > (z_t^B, \mu_t^B)\). b) If \( v > 0 \)\(^{18}\), then the point \((0,0)\) satisfies

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\(^{17}\)It could be suggested that since the government knows the amount of tax revenue and since all taxpayers are identical, it could easily observe that all taxpayers evade and thus set \( p = 1 \). To justify a probability of detection lower than unity we could either introduce a fraction of honest taxpayers (which would unnecessarily complicate our results) or assume that \( p \) denotes the probability that the true evasion rate is revealed (Andreoni et al, 1998).

\(^{18}\)As stated earlier in more general versions of the model strategic interactions and multiple equilibria
4 Norms, Morals and Values

The notion of morals is not new in the literature and has been widely used in various contexts. For example, Moffit (1983) and Besley and Coate (1992) analyze the case where there is a moral stigma for people who participate in welfare programs. In the tax evasion literature the notion was first introduced by Allingham and Sandmo (1972). Recently, Kim (2003) has analyzed the case where society views tax evasion as an ignominious behavior and places a social stigma upon agents that are disclosed as tax evaders.

To increase peer pressure on tax evaders, governments often make publicly available the tax filling reports or publicize cases of tax evasion. For example, in Sweden, Norway and Finland personal income tax fillings are publicly available (see Lenter et al 2003).\textsuperscript{19} In California, on the other hand, the names of the top 250 delinquent taxpayers are published on the internet annually.\textsuperscript{20} Also, the U.S. Attorney office in the district where a case is prosecuted “normally issues a press release when a tax evader is indicted, once he or she is convicted, and again when the evader is sentenced” (Gray, 1999). In New Zealand the Commissioner of Inland Revenue regularly releases the “Tax Evaders Gazette,” which lists those taxpayers, individuals and companies, who have been prosecuted, had penal tax or shortfall penalties imposed for evading their taxation obligations (see Lenter et al., 2003). Several other countries follow similar practices.\textsuperscript{21}

Also, taking into account that in most countries audits are not very extensive, e.g., the average audit rate for individual tax returns in the US is less that 1% (McCaffery and Slemrod, 2004), the rate of tax compliance is estimated to be rather high.\textsuperscript{22} Most models cannot account for these high rates unless they introduce some form of moral considerations (e.g., Bordignon, 1993; Erard and Feinstein, 1994; Sandmo, 2005).

Following, Kim (2003) among others, we postulate that when law-breaking agents hold even when $v = 0$.\textsuperscript{19} In fact, in Norway tax fillings are available on the Internet for both individuals and corporations.\textsuperscript{20} http://www.ftb.ca.gov/individuals/txdhqxt.shtml.\textsuperscript{21} Interestingly, the Hellenic Data Protection Authority, an independent authority in charge of the protection of data privacy in Greece, has recently ruled against the publication of the names of individual delinquent taxpayers.\textsuperscript{22} Rates of tax evasion in most western developed countries are estimated around 5%-25% of potential tax revenue (Feige, 1989; Pyle, 1989; Thomas, 1992). In developing countries, tax evasion rates are higher (Tanzi and Shome, 1994).
are traced, they suffer a disutility from being revealed as cheaters. To keep the analysis
simple we assume that there are no fines for tax dodgers and corrupt politicians. We seek
to examine whether coordination can be achieved if suitable values are inculcated upon
agents.

Citizens

Each citizen’s utility function is now modified as follows:

$$\max_{c_t, z_t} c_t^h h_{t+1} - \gamma H_t (1 - z_t) \tau h_t. \tag{14}$$

The last term in (14) captures the expected size of the moral cost if the citizens gets caught.
This term depends positively on the total tax that the delinquent evaded, \((1 - z_t) \tau h_t\).
Analytically, the expected marginal cost of breaking the law is \(\gamma H_t\). The parameter \(\gamma > 0\)
is of special interest because it measures the expected punishment that the society inflicts
upon law-breaking activities. It is influenced by the level of moral values in the society,
i.e., the society’s sensitivity to tax evasion, as well as the probability of being caught.\(^23\)

Furthermore, we assume that the expected marginal moral cost depends on the average
level of human capital, \(H_t\). There is a technical reason behind this assumption. Without
this, as the levels of human capital and income grow over time, the expected marginal
benefit from breaking the law increases, whereas the expected marginal cost remains
constant. As a result, after a certain level of human capital, the expected marginal
benefit outweighs the marginal cost and the moral cost becomes irrelevant. Nevertheless,
we think that this may not be an inappropriate assumption, since different societies may
judge the same unlawful act in a different manner. For example, poor societies may be
more tolerant towards tax evasion and not view it as unethical. In any case, even if we
drop this assumption, our results below still hold for low levels of human capital, or if the
level of human capital remains constant over time.

A citizen maximizes (14) subject to (5) and the non-negativity constraints, taking \(\mu_t, E_t\)
and \(H_t\) as given. The citizens’ best response function is now far more complicated.
It is given in an implicit form in Appendix A4. Moreover, the nature of the interaction
between citizens and the politician is not clear any more. Specifically, for low values of
\(\gamma\), we have that \(dz_t / d\mu_t\) is unambiguously positive as before, i.e., the politician’s action

\(^{23}\) We implicitly assume that the moral cost is an intrinsic cost (Benabou and Tirole 2003; Gordon 1989)
not associated with other groups’ evasion. In an extension of the model we have associated individual
cost with other groups’ behavior (following the rational we adopted for the transaction cost) and found
qualitatively similar results.
is definitely a strategic complement for the citizens (the threshold value of $\gamma$ is given in Appendix A4). Nevertheless, for high value of $\gamma$, when the effect of moral cost is strong, the politician’s action may become a strategic complement for citizens.

The Politician

The politician’s optimization problem at time $t$ is now given by

$$\max_{c^p_t, \mu_t} c^p_t h_{t+1} - \gamma H_t (1 - \mu_t) \phi \tau \overline{z_t} H_t,$$

subject to the budget constraint (8), the standard non-negativity constraints and equations (1) and (3), taking $\overline{z_t}$ and $H_t$ as given. The moral cost term in (15) is completely analogous to the one introduced above in citizens’ utility (equation 14). First, it depends positively on the size of the fraud $(1 - \mu_t) \tau \phi \overline{z_t} H_t$. Second, the expected marginal cost $\gamma H_t$ depends positively on the average human capital. Finally, for simplicity, we assume that the value of $\gamma$ is the same with that in the citizens’ problem.

Maximization yields the solution

$$\mu_t = g(\overline{z_t}) = \begin{cases} 
0 & \text{if } A \tau \overline{z_t} \leq v - \gamma \\
\frac{A \tau \overline{z_t} + v - \gamma}{2A \tau \overline{z_t}} & \text{if } A \tau \overline{z_t} (1 - 2\phi) \leq v - \gamma < A \tau \overline{z_t} \\
1 & \text{if } v - \gamma < A \tau \overline{z_t} (1 - 2\phi).
\end{cases}$$

(16)

Notice that for values of $\gamma$ below $v$, $d\mu_t/d\overline{z_t} > 0$ as before. Nevertheless, for values of $\gamma$ above $v$, $d\mu_t/d\overline{z_t} < 0$, namely, the citizens’ action is a strategic substitute for the politician. This means that if the stigma cost for following an unlawful action is high enough, then the politician does not wish any more to respond positively to the action of the citizens; instead he attempts to improve the situation by choosing to be more honest.

The definition of equilibrium is similar to that in the previous versions. Notice that if we set $\gamma = 0$, then this version collapses to the benchmark model. More generally, for sufficiently small values of $\gamma$ we get the same results as in the benchmark model. For sufficiently high values of $\gamma$, however, the action of the politician may be a strategic substitute for the citizens and vice versa. We illustrate this case in the following example.

Example 2. Let $A = 2$, $\phi = 0.7$, $\tau = 0.4$, $v = 0.04$, $s = 0.8$, and $\gamma = 0.1$. Then the best response functions have the properties shown in Figure 3. Moreover, there exists a unique interior equilibrium: $(\mu^*, \overline{z^*}) = (0.782, 0.790)$. 

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Figure 3. Equilibrium in a stigma-based society
We can conclude that a stigma cost is possible to eliminate the multiplicity of equilibria. Contrary to simple deterrence policies, a stigma cost that is high enough alters agents’ behavior, since each agent’s action may now be a strategic substitute, instead of a strategic complement, to other agents.\textsuperscript{24}

As mentioned above, the parameter $\gamma$, which enters in the expected marginal moral cost, depends on two terms: the level of moral values in the society and the probability of being caught. The first is the result of education, anti-corruption campaigns and public exhortation, while the second is a policy instrument. Nevertheless, both of these factors are crucial for the effectiveness of social stigma and one cannot work without the other.

A critique on our results would be that we exogenously assume that agents suffer from moral costs if they get caught cheating. This would be true taking into account that the establishment of internal moral costs, if feasible, is a long-term solution, since it requires a change in agents’ attitudes and tastes. However our purpose is to examine the effectiveness of various policies on the deterrence of corruption assuming they are successfully implemented. Whether a policy will be successfully implemented or not depends on many factors that cannot be easily accounted for in a model, nor even for standard policies such as fines and auditing probabilities. We have therefore followed the standard morals literature (see, Moffit 1983; Gordon 1989; Besley and Coate 1992; Kim 2003) and assumed that if an agent is audited and exposed as an evader (embezzler) she suffers from an internal moral cost. Interestingly we found that in the presence of a sufficiently high cost we can eliminate multiplicity of equilibria. The mechanism behind our results is breaking the "social coordination" effect and rendering the strategies of the players strategic substitutes. Strategic substitutability implies that it is too costly for agents to follow the other agents’ actions.

5 Summary and Conclusions

We have analyzed the issues of political corruption and tax evasion in the context of a simple economy with a publicly provided good, which for the sake of concreteness we assumed it to be education. We have shown that strategic complementarities may arise

\textsuperscript{24}Note that this simplifying formulation aims at highlighting the role of stigmatizing offenders when implementing anti-corruption policies. Evidently if a deterrence policy involves both a pecuniary and a non-pecuniary (stigma) cost, then we would obtain qualitatively similar results. Specifically we could still eliminate multiplicity but this would be the outcome of the stigmatizing effect of the policy.
among agents, which lead to the existence of two stable equilibria. One of these equilibria, is characterized by high rates of corruption and tax evasion and a low level of public spending on education and the other by low rates of corruption and tax evasion and high level of public education spending. These results are robust to various extensions of the basic model.

We showed first that standard deterrence policies, i.e., changes in the probabilities of being caught or in the penalty rates, are not able to eliminate the multiplicity of equilibria. Next we analyzed the issue of social coordination in the presence of a moral cost imposed on law-breaking agents. We showed that such a cost if strong enough, can eliminate the multiplicity of equilibria. Nevertheless, we think that in practice the establishment of such a cost is extremely difficult. Hence, these results can explain the persistence of corruption and tax evasion and the difficulty that often honest leaders face when trying to eradicate them.

We believe that our framework can admit a number of interesting extensions. For instance, we think that the next logical step is to allow for the coexistence of public and private education. In such a framework, people have the option of sending their children to a public school, in which case they have a vested interest in public education, or they can send them to a private school, in which case they pay the tuition bill. Such a decision will indubitably have an impact on their behavior, as tax payers or politicians, towards government finances.
A Appendix

A.1 An Alternative Punishment Scheme for the Politician

In this appendix we analyze an alternative punishment scheme for the politician, namely, if the politician is caught to have peculated public funds, then he is thrown out of office and receives zero consumption. More specifically, the utility function of the politician is now

\[(1-q)(c_{pt}h_{t+1}), \tag{A.1}\]

where \(c_{pt}\) is given by (8). Maximizing (A.1) subject to (8) and the non-negativity constraints, taking is \(z_t\) and \(H_t\) as given, leads to the same best response function as in the benchmark model (equation 9).

Each citizen’s problem is the same as the one analyzed in Section 3 and hence her best response function is again given by equation (12).

Obviously, the results in this case are very similar to the ones obtained in the benchmark model as well as in the model with fines (Section 3). For a wide range of parameter values there exist three equilibria. Moreover, if \(v > 0\), then changes in the policy parameters, e.g., \(p, q, \tau,\) and \(\phi\), cannot eliminate the high corruption equilibrium.

A.2 Revenue from Fines Go to Public Education

In the main text we assume that the revenue from fines on tax dodgers and the politician is neutralized. In this Appendix, we analyze the case where this revenue is used to finance public education. Accordingly, equation (3), which gives the level of spending on public education, changes to

\[E_t = \mu_t \phi \tau \bar{z} H_t + p \tau (1 - \bar{z}) H_t + q (1 - \mu_t) \phi \tau \bar{z} H_t, \tag{A.2}\]

where \(p\tau(1 - \bar{z})H_t\) and \(q(1 - \mu_t)\phi\tau\bar{z}H_t\) represent the expected revenue from fines imposed on tax evaders and the politician, respectively.

Each citizen’s problem does not change and her best response is again given by equation (12). Following the same steps as in Section 3, we find the politician’s best response to be
Simple differentiation shows that \( \frac{d\mu_t}{dz_t} \) is positive and hence private citizens’ action is a strategic complement for the politician. Once again, for a wide range of parameter values there exist three equilibria, one corner and two interior or one interior and two corner. These equilibria have the same stability properties as in the benchmark model, namely the lowest (high tax evasion and high corruption) and the highest (low tax evasion and low corruption) equilibria are stable, whereas the intermediate equilibrium is unstable.

Note however that, in contrast to the other versions of the model, in this case strategic complementarity and multiple equilibria can arise even if \( v \), the rate of human capital transferred freely to the next generation, is zero. The reason behind this result is that, even if \( z_t \) or \( \mu_t \) is zero, there will still be some acquisition of human capital financed by the fines on tax evaders and corrupt politicians. Moreover, there does not exist a policy that can eliminate multiplicity. More specifically, since the point \((0, 0)\) satisfies both equations (12) and (A.3), changes in the policy parameters, e.g., \( p, q, \tau, \) and \( \phi \), cannot eliminate the high corruption equilibrium.

### A.3 Endogenous Probabilities

Next we make an attempt to endogenize the probabilities that agents face. More specifically, we assume that citizens choose the percentage of their income that they report to the tax authorities and face a probability of being audited equal to \( q_{ct} \). If audited, their true income is revealed and they pay a penalty \( \pi \) on evaded income tax. The politician, on the other hand, peculates an amount \( \mu_t \) of the tax revenue earmarked for public education. Nevertheless, there is a technical relation \( q_{pt} = \alpha \mu_t \) between the embezzlement rate and the probability to be caught, i.e., the more the politician peculates, the more likely he will get caught; \( \alpha \in (0, 1) \) is an institutional parameter (Allingham and Sandmo, 1972). For simplicity, we assume, that if the politician gets caught having peculated funds, then he is thrown out of office and consumes nothing. Moreover, in equilibrium \( q_c = q_{pt} = q \), that is, the probability of being caught is the same for all agents, or the law is applied equally

\[
\mu_t = g(z_t) = \begin{cases} 
0 & \text{if } \tau Az(1 + p - 2q) \leq v + \tau pA \\
\frac{Az|z_t|z_t(1+p)-p-2q}{2\phi\tau z_t(1-q)} & \text{if } \tau Az(1 + p - 2\phi) \leq v + \tau pA < \tau Az(1 + p - 2q) \\
1 & \text{if } v + \tau pA < \tau Az(1 + p - 2\phi) \) 
\end{cases}
\] (A.3)
to all. The human capital accumulation and the expenditure on public education are still given by (1) and (3).

Citizens face essentially the same problem as in Section 3 and their best response function is

$$z_t = f(q_t) = \begin{cases} 0 & \text{if } \tau \geq \frac{2s\tau}{\alpha(1-q_t^\pi)} \\ 1 - \frac{\alpha(1-q_t^\pi)\tau}{2s\tau} & \text{if } \tau < \frac{2s\tau}{\alpha(1-q_t^\pi)} \end{cases} \quad (A.4)$$

Simple differentiation yields $dz_t/dq_t > 0$.

The politician’s problem can be represented as one where he chooses $c_{pt}$ and $q_{pt}$ to maximize

$$\max_{c_{pt}, q_{pt}} (1 - q_{pt})(c_{pt}h_{t+1}), \quad (A.5)$$

subject to (8), the non-negativity constraints, and equations (1) and (3), taking $z_t$ and $H_t$ as given. This leads to the following best response function

$$q_t = \begin{cases} 0 & \text{if } z_t \leq \frac{v(\alpha+\phi)}{\tau A\phi} \\ g(z_t) & \text{if } \frac{v(\alpha+\phi)}{\tau A\phi} < z_t \end{cases} \quad (A.6)$$

where

$$z_t = g^{-1}(q_t) = \frac{\alpha v}{\tau A\phi} \frac{\alpha - 2q\phi + \phi}{3q^2\phi - 2q(\alpha + \phi) + \alpha}.$$ 

For a wide range of parameter values there exist three equilibria, the origin and two internal. For example if $A = 2$, $\tau = 0.4$, $\alpha = s = 0.9$, $v = 0.04$, $\phi = 0.7$, $\pi = 1.01$, then the three equilibria $(q, z)$ are $(0, 0)$, $(0.184, 0.113)$ and $(0.337, 0.609)$. Importantly, changes in $\pi$, $\tau$, and $\phi$ cannot eliminate the multiplicity of equilibria.

This extension is more interesting since it endogenizes policy and answers to the question concerning who will enforce policy and for what reason. Evidently the presence of strategic interactions and the "fear" that citizens will respond to politicians’ embezzlement with higher evasion is a sufficient reason to enforce positive auditing probabilities. However as was the case in the benchmark model, not even endogenous policy can eliminate multiple equilibria since it does not resolve the problem that arises due to strategic complementarity.
A.4 Results Regarding the Case of Stigma

Citizens

Maximizing (14) subject to (5) and the non-negativity constraints, taking $\mu_t$, $E_t$ and $H_t$ as given, yields that the part of the best response function that lies strictly between zero and one is given by the positive root of the quadratic equation in $z_t$

$$2sA\phi\tau\mu_t^2z_t^2 + (A\phi\tau^2 - 2sA\phi\tau\mu_t + 2sv)\mu_t z_t + \tau v - 2sv\mu_t - \gamma \tau = 0.$$  \hfill (A.7)

Tedious calculations show that if

$$\gamma < \frac{(A\phi\tau)^2(2s\mu_t - \tau^2) + 4sv(A\phi\tau^2 - A\phi sv\tau\mu_t - sv)}{8A\phi s\tau^2},$$

the politician’s action is unambiguously a strategic complement for the citizens, i.e., $dz_t/d\mu_t > 0$. 

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References


