Explicating Corruption and Tax Evasion: Reflections on Greek Tragedy

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Abstract

We construct an overlapping generations model comprising two distinct groups of agents, citizens and politicians. Each agent derives utility from her own consumption level and the human capital of her offspring. Private citizens choose the proportion of their income that they declare to the tax authorities to balance a trade-off between their consumption and spending on public education. Similarly, politicians choose the proportion of the public education budget that they peculate to balance a similar trade-off. In such a context, two self-fulfilling stable equilibria can emerge, one with high corruption, high tax evasion and low spending on education and one with low corruption, low tax evasion and high spending on education. This accords well with existing empirical evidence. Next we analyze the possibility of selecting an equilibrium via the use of standard deterrence policies (e.g., fines) and show that such policies are not always effective. Finally, we also explore the same issues in the presence of a social stigma towards law-breaking agents and show that the multiplicity of equilibria is eliminated and corruption and tax evasion are effectively reduced.

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PRELIMINARY AND INCOMPLETE

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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, who also suggested ways to deal with it. Today the World Bank characterizes corruption as "one of the most important obstacles to promote sustainable economic growth and poverty reduction."

That is why the Bank has supported more than 600 anti-corruption programs since 1996. An equally old but distinct phenomenon is tax evasion. This too can have detrimental effects on government finances, growth and wealth distribution.

This paper attempts to analyze these two social issues jointly and to focus on the following two aspects. The first is how the overall level of corruption affects the provision of public goods, focusing mainly on public education. The second aspect is how the various forms of corruption prevalent in each society interact with each other thereby raising the overall level of corruption.

Our analysis is motivated by the following empirical facts. First, existing evidence suggests a negative relation between corruption and spending on education (see, for example, Tanzi and Davoodi, 1997, and Mauro, 1998).

Second, 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. Spicer and Becker (1980) and Fortin, Lacroix and Villeval (2006) conducted lab experiments and found that taxpayers tend to evade more taxes if they believe that their tax burden is not fair. Scholtz and Lubell (1998) have conducted a survey study and have found that the higher the trust in government the lower the likelihood of non-compliance.

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

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1http://go.worldbank.org/D51GCA82B0
2Mauro reports that a decrease in corruption (1.5 unit in the BI index) could increase spending on education up to 0.6%.
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 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.

In such a context, there can be strategic complementarities 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.

Next we modify the model to analyze the issue within a richer environment. 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. Extending the standard literature we assume that such a policy has a twofold effect. On the one hand there is a pecuniary effect, imposed by fines while on the other hand there is a non-pecuniary effect for offenders.

The choice of a non-pecuniary effect is also motivated by empirical evidence that suggests that while audits are not very extensive (according to McCaffery and Slemrod, 2004, the average audit rate for individual tax returns in the US is less than 1%), the rate of tax compliance is estimated to be rather high. Rates of tax evasion in most western developed countries are estimated around 5%-25% of potential tax revenue (Feige, 1989; Pyle, 1989; Thomas, 1992) while for developing countries higher rates may emerge (Tanzi and Shome, 1994). Most models cannot account for these high rates unless they introduce some from of moral sentiments (e.g. Erard and Feinstein, 1994).

Specifically we introduce social stigma directly in the utility of agents, following the relevant literature (e.g., Moffit, 1983, and Besley and Coate, 1992, for welfare stigma, and Kim (2003) for a social stigma related to tax evasion). As in Kim (2003), we assume that the society stigmatizes those who commit unlawful actions and get caught. Contrary to findings in the previous literature, we find that the presence of a social stigma can eliminate the multiplicity of equilibria and dissolve the indeterminacy.

The remainder of this paper is organized as follows. Section 2 presents the benchmark model, which helps us pose the questions. Section 3 investigates the conditions that lead to the emergence of multiple equilibria. Section 4 introduces standard enforcement
policies in a stigma-based society and analyzes their limits and strengths in the fight against corruption and tax evasion. Section 5 describes the functioning of a stigma-based society without deterrence policies and shows that the presence of an additional cost on unlawful activities can be effective for deterrence of corruption. Section 6 concludes the paper.

2. The benchmark model

2.1. The economy

Consider an overlapping generations economy where two individuals\textsuperscript{3} live for two periods. In the first period of life, both agents are identical. They enter the public education system and acquire human capital according to the learning technology

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

where \( t = 0, 1, 2 \ldots \) indexes time and \( h_t \) denotes the level of human capital of an individual born at (the end of) period \( t - 1 \), which will be 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. This human capital accumulation process shares common features with several papers in the literature; see, among others, De Gregorio and Kim (2000) and Ceroni (2001). Accordingly, a young agent, who is 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.\textsuperscript{4} 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.

\textsuperscript{3}To simplify our analysis we assume two agents. In a continuum of agents free riding may occur, however since decisions on educational spending in several countries (REFERENCE) take place at a local level, this effect is minimized. We could model this decision using a parameter \( \Psi \) indicating the size of the economy. For values of \( \Psi \) less than infinity we always have interior solutions. (REFERENCE)

Empirically, Pommerehne and Weck-Hannemann (1996) and Frey (1997b) have found that tax evasion in Swiss cantons were referenda are employed on budgetary issues is lower than in purely parliamentary cantons.

Moreover Alm, McCleland and Schulze (1992) and Alm, Jackson and McKee (1992), report that the introduction of a public good in exchange for the taxes paid increases compliance rates, thereby indicating that people do not fully free-ride on the public good since they can perceive the impact of their actions on it.

\textsuperscript{4}The term \( 1 - v \) can be taken to capture the depreciation rate of the stock of knowledge.
Finally, the specific functional form in equation (2.1) is used purely for convenience; it allows us to derive analytical expressions.

For simplicity, we assume that the two 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:

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

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.\(^5\) 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, one of the two individuals becomes a politician via a random process, while the other remains a private citizen. When necessary, we use the subscripts \( c \) and \( p \) to denote variables that are related to citizens and politicians, respectively.

**Citizen**

In the second period of their life, the private citizen assumes production of a single consumption good. Using the appropriate normalization of units, we assume that the individual’s output and income \( y_{ct} \) equals the level of human capital\(^6\)

\[
    y_{ct} = h_t.
\]

The citizen’s income is taxed at the rate \( \tau \), which is assumed to be exogenous and time invariant. Nevertheless, the citizen decides upon what fraction \( z_t \) of her income to declare to the tax authority. In the benchmark model the citizen’s declaration is never audited by the authorities; consequently, tax evasion does not involve any risk. Still, given the citizen’s vested interest in public education, \( z \) may not be equal to 0 (see below).

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\(^5\) Variations of this utility function abound in the literature; see, for example, Glomm (1997) and Ceroni (2001).

\(^6\) Since all agents have the same level of human capital we omit the subscript \( i = c, p \) from the level of human capital \( h_t \).
Politicians

The politicians receives a payment (net of taxes) from the government budget. In addition she has the option to embezzle public funds. More specifically, she decides what fraction 1 − \(\mu_t\) of tax revenue to embezzle. In the benchmark model, the politicians is never investigated and hence peculation does not involve any risk. Still, given the politician’s vested interest in public education, 1 − \(\mu\) may not be equal to 1 (see also below).

Spending on Education

The total tax revenue collected within a period \(t\) is \(R_t = z_t \tau h_t\). A constant fraction 1 − \(\phi\) of this is earmarked for public sector wages (politician’s net income) \(W_t = (1 − \phi)R_t = (1 − \phi)z_t \tau h_t\). 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

\[
E_t = \mu_t \phi z_t \tau h_t.
\]

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

2.2. Individual optimization

Citizen

As mentioned above, in period \(t\) an adult 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. Hence, each adult citizen’s disposable income is \((1 − \tau)z_t h_t + (1 − z_t)h_t = (1 − z_t \tau)h_t\). The individual optimization problem solved by each citizen born in period \(t − 1\) is

\[
\max_{c_{ct}, z_t} \quad c_{ct} h_{t+1}^\beta,
\]

subject to

\[
c_{ct} = (1 − z_t \tau)h_t, \tag{2.6}
\]

\[
c_{ct} \geq 0, \quad 1 \geq z_t \geq 0,
\]

and equations (2.1) and (2.4), taking \(\mu_t\) and \(H_t\) as given.

Maximization yields the citizens’ best response function:

\[
z_t = f(\mu_t) = \begin{cases} 
0 & \text{if } \beta A\mu_t \phi \leq v \\
\frac{\beta A\mu_t \phi - v}{\lambda \mu_t \phi (1 + \beta)} & \text{if } A\mu_t \phi[\beta - \tau(1 + \beta)] \leq v < \beta A\mu_t \phi \\
1 & \text{if } v < A\mu_t \phi[\beta - \tau(1 + \beta)].
\end{cases}
\]
Inspection of equation (2.7) reveals that a corner solution \( z_t = 0 \) (\( z_t = 1 \)) 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 parents have a weak (strong) incentive to invest in education and thus declare none (all) of their income to the tax authorities. Whenever an interior solution emerges, the tax evasion rate \( (1 - z_t) \) is negatively affected by the efficiency of the education system \( (A) \), the percentage of the tax revenue that becomes public salaries \( (\phi) \) and the degree of altruism \( (\beta) \). On the other hand, the tax evasion rate is positively affected by the size of the tax rate \( \tau \). In fact, if \( \tau > \beta/(1 + \beta) \), then the tax evasion rate is never zero. Finally, if \( v > 0 \), then an increase in the politicians embezzlement rate, \( (1 - \mu_t) \), increases the citizens’ tax evasion rate. In other words, the politicians’ embezzlement rate is a strategic complement for citizens’ tax evasion rate, meaning that \( z_t \) is an increasing function of \( \mu_t \). Put differently, an increase in the politicians’ tendency to peculate public funds makes citizen more prone to tax evasion.

**Politician**

The individual optimization problem solved by each politician born at time \( t - 1 \) is

\[
\max_{c_{pt}, \mu_t} c_{pt} h_{t+1}^\beta, \tag{2.8}
\]

subject to

\[
c_{pt} = (1 - \mu_t) (\tau z_t H_t), \tag{2.9}
\]

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

and equations (2.1) and (2.4), taking \( z_t \) and \( H_t \) as given.

Straightforward maximization yields the politicians’ best response function \( \mu_t = g(z_t) \)

\[
\mu_t = g(z_t) = \begin{cases} 
0 & \text{if } \beta A z_t \tau \leq v \\
\frac{\beta A z_t \tau - v}{A z_t \phi (1 + \beta)} & \text{if } A z_t \tau [\beta - \phi (1 + \beta)] \leq v < \beta A z_t \tau \\
1 & \text{if } v < A z_t \tau [\beta - \phi (1 + \beta)].
\end{cases} \tag{2.10}
\]

This best response function has properties analogous to those of the private citizens’ best response. In particular, the corner solutions of full or no corruption \( (\mu_t = 0 \text{ and } \mu_t = 1, \text{ respectively}) \) emerge if \( v \) is sufficiently high or sufficiently low. Moreover, \( \mu_t \) is increasing in \( A, \tau \) and \( \beta \) and decreasing in \( v \) and \( \phi \). If the percentage \( 1 - \phi \) of tax revenue that
The situation at hand is a coordination game in which there are strategic complementarities (see, for example, Cooper and John, 1988, Vives, 2005). Games of strategic complementarity are those in which the best response of any player is increasing in the actions of the rival; this is the case here for $z_t$ 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 expectation of one group concerning the behavior of the other. Nevertheless, the game that we analyze here is not a symmetric game unless $\phi = \tau$, which is a rather restrictive assumption. 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 many of the properties of games with strategic complementarities.

Consider first the following definition of equilibrium:

**Definition 1.** A Nash equilibrium in this economy consists of sequences $\{c_{it}\}_{t=0}^{\infty}$, $\{z_t\}_{t=0}^{\infty}$, $\{\mu_t\}_{t=0}^{\infty}$, $\{y_{ct}\}_{t=0}^{\infty}$, $\{h_t\}_{t=0}^{\infty}$, $\{H_t\}_{t=0}^{\infty}$, $\{E_t\}_{t=0}^{\infty}$, $i = c, p$, 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 $\mu_t$ as given.

2. Politicians choose $\mu_t$ to maximize their utility, taking $z_t$ as given.

3. The sequences $\{h_t\}_{t=0}^{\infty}$, $\{y_{ct}\}_{t=0}^{\infty}$, $\{E_t\}_{t=0}^{\infty}$, and $\{c_{it}\}_{t=0}^{\infty}$, are determined according to (2.1), (2.3), (2.4), (2.6), and (2.9).

4. $h_t = H_t$.

Each group’s individual optimization problem is well defined since its utility function is strictly concave and the budget constraint 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 (2.7) and (2.10) simultaneously. For an arbitrary time period \(t\), let \(z_t = f(\mu_t)\) denote the solution to each citizen’s problem, as described by equation (2.7); 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 each politician’s problem, as described by equation (2.10). Note that both of these functions are continuous (see equations (2.7) and (2.10)). 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. Let \(f_1\) and \(g_1\) denote the strictly monotonic parts of \(f\) and \(g\) (see equations (2.7) and (2.10)). Any interior equilibrium value of \(\mu\), if it exists, will be a solution to the equation

\[
f_1(\mu_t) = \frac{\beta A \mu_t \phi - v}{A \mu_t \phi \tau (1 + \beta)} = g_1^{-1}(\mu_t) = \frac{v}{A \tau [\beta - \phi (1 + \beta) \mu_t]},
\]

which simplifies to the (quadratic) equation

\[
A \phi^2 (1 + \beta) \mu_t^2 - A \phi \beta \mu_t + v = 0.
\]  (3.1)

This equation has real roots if and only if its discriminant is non-negative, that is, \(A \beta^2 / 4 (1 + \beta) \geq v\). Let also the roots of this equation, if they exist, be denoted by \(\xi_1\) and \(\xi_2\), where

\[
\xi_1 = \frac{A \beta - \sqrt{A [A \beta^2 - 4 (1 + \beta) v]}}{2 A \phi (1 + \beta)}, \quad \xi_2 = \frac{A \beta + \sqrt{A [A \beta^2 - 4 (1 + \beta) v]}}{2 A \phi (1 + \beta)}.
\]  (3.2)

The corresponding values for \(z\) are

\[
\omega_1 = \frac{\phi}{\tau} \xi_1, \quad \omega_2 = \frac{\phi}{\tau} \xi_2.
\]  (3.3)

Propositions 2 and 3 establish sufficient conditions for the existence of a unique and multiple equilibria, respectively.
Proposition 2. a) If \( v = 0 \), then the equilibrium is unique. b) If \( v > 0 \), then \((z_t, \mu_t) = (0, 0)\) is always an equilibrium. c) If \( v \geq \beta A \max\{\tau, \phi\} \), then \((z_t, \mu_t) = (0, 0)\) is the only equilibrium. d) If \( v > \frac{A\beta^2}{4(1 + \beta)} \), then \((z_t, \mu_t) = (0, 0)\) is the only equilibrium. e) If \( \frac{A\beta^2}{4(1 + \beta)} \geq v \) and \( \xi_1 \geq \max(1, \tau/\phi) \), then \((z_t, \mu_t) = (0, 0)\) is the only equilibrium.

Proof: a) If \( v = 0 \), then simple substitution in equations (2.7) and (2.10) shows that each group’s optimal response is independent of the other group’s action. More specifically,
\[
z_t = \frac{\beta}{\tau(1 + \beta)} \quad \text{and} \quad \mu_t = \frac{\beta}{\phi(1 + \beta)} \quad \forall t.
\]
b) Notice that if \( v > 0 \), then the point \((0, 0)\) satisfies both equations (2.7) and (2.10). c) If \( v \geq \beta A \max\{\tau, \phi\} \), then the two best response functions coincide with two adjacent sides of the unit square and the only common point is \((0, 0)\) (see Figure 1a, where the best response functions are indicated by bold lines). d) If \( v > \frac{A\beta^2}{4(1 + \beta)} \) then equation (3.1) does not have any real roots, meaning that the strictly monotonic parts of the two best response functions, \( f_1 \) and \( g_1 \), do not intersect (see Figure 1b). e) If \( \frac{A\beta^2}{4(1 + \beta)} \geq v \) and \( \xi_1 > \max(1, \tau/\phi) \), then \( f_1 \) and \( g_1 \) intersect outside of the unit square (see Figure 1c).

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, each group commits to a certain strategy regardless of what the other group does. Also, if \( v \) is high enough and hence each new generation acquires a substantial level of human capital freely, then one cannot preclude among others the case where one group sets its decision variable (i.e., the tax evasion rate or the embezzlement rate) equal to 1 independently of what the other group does. Note that, for a given value of \( v \), the conditions specified in Proposition 2 can also be expressed in terms of the tax rate (\( \tau \)) and the proportion of the tax revenue (\( \phi \)) that is earmarked for education. For example, if \( \tau \) and \( \phi \) are too low, then spending on education will be low no matter how honest agents are. In this case agents do not have any incentive to behave honestly, and the only feasible equilibrium is \((0, 0)\). This finding is consistent with the positive correlation between corruption and tax evasion across countries. Nevertheless, but it offers a different direction of causality. 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.

Proposition 3. a) If \( A[\beta - \phi(1+\beta)] \min\{\tau, \phi\} > v > 0 \), then there exist one interior and two corner equilibria. b) If \( A\beta^2/4(1 + \beta) > v > 0 \), \( \xi_2 \geq \max(1, \tau/\phi) \) and \( \xi_1 \leq \min(1, \tau/\phi) \),
Figure 3.1: (0,0) is the only equilibrium
then there exist one interior and two corner equilibria. c) If \( A\beta^2/4(1 + \beta) > v > 0 \), and \( \xi_2 < \min 1, \tau/\phi \), then there exist one corner and two interior equilibria

**Proof:** a) Given \( v > 0 \), \((0,0)\) is one (corner) equilibrium. A sufficient condition for the existence of one interior equilibrium is the following inequality \( g_1^{-1}(1) < \min \{ f_1(1), 1 \} \). To see why let \( \mu_0 \equiv v/\beta A \). Note that if \( A[\beta - \phi(1 + \beta)]\min \{ \tau, \phi \} > v \), then \( A\beta\phi > v \) and \( \mu_0 < 1 \). Next notice that \( f_1(\mu_0) = 0 < g_1^{-1}(\mu_0) \). Given the restriction posed above both functions are continuous; hence, if \( g_1^{-1}(1) < f_1(1) \) then \( f_1 \) must cut \( g_1^{-1} \) from below at an interior point \((z, \mu) < (1,1)\). Figure 2a illustrates the case where \( f_1(1) > 1 \). The inequality \( g_1^{-1}(1) < 1 \) leads to \( A[\beta - \phi(1 + \beta)]\tau > v \), whereas the inequality \( g_1^{-1}(1) < f(1) \) leads to \( A[\beta - \phi(1 + \beta)]\phi > v \). Since \( f_1 \) is concave and \( g_1^{-1} \) convex, the two curves will intersect at one more point outside the unit square. Hence, there is one more corner equilibrium.

b) One corner equilibrium is \((0,0)\). When the specified conditions are met then equation (3.1) has two real roots; one of them (and the corresponding value of \( z \)) lies inside and the other outside the unit square (see again Figure 2a). c) Again, one corner equilibrium is \((0,0)\). When the specified conditions are met then equation (3.1) has two real roots; both of them (and the corresponding values of \( z \)) lie within the unit square (see Figure 2b).

Obviously, other configurations, besides those described in Figures 1 and 2, are possible, but they are omitted to save space. Also, 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, for example, 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, when ever 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 \((z^*, \mu^*)\) where

\[
z^* = \min \{ 1, \xi_2 \}, \mu^* = \min \left\{ 1, \frac{\phi}{\tau} \xi_2 \right\}.
\]

**Corollary 1.** If the highest equilibrium \((z^*, \mu^*)\) is an interior point, then

\[
\frac{dz^*}{dv} < 0, \quad \frac{dz^*}{d\tau} < 0, \quad \frac{dz^*}{dA} > 0, \quad \frac{d\mu^*}{dv} < 0, \quad \frac{d\mu^*}{d\phi} < 0, \quad \frac{d\mu^*}{dA} > 0.
\]
Figure 3.2: Multiple Nash Equilibria

(a) Two corner equilibria

(b) Two interior equilibria
Proof: This follows directly after differentiating $\xi_2$ and $\omega_2$, given in (3.2) and (3.3), respectively.

**Corollary 2.** If $v > 0$, then none of the policies available to a policy maker in the benchmark model, i.e., changes in $\tau$ or $\phi$, can eliminate the high corruption equilibrium $(0, 0)$.

*Proof:* This follows trivially from Proposition 2(b), where it is shown that if $v > 0$ then $(0, 0)$ is always an equilibrium.

Finally, note 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 can be demonstrated easily by looking at the case where there are two corner equilibria $(0, 0)$ and $(1, 1)$. The politicians are better off under the zero corruption and no tax evasion equilibrium $(0, 0)$ than under the full corruption and complete tax evasion $(1, 1)$; the reason is of course that their salary and the amount that they peculate are both a fraction of the tax revenue. Nevertheless, the citizens prefer the first (second) equilibrium if

\[
(1 - \tau) \left(1 + \frac{A\phi v}{v}\right)^\beta - 1
\]

is negative (positive). The reason behind this ambiguity is the existence of two effects on welfare: 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.

**4. Enforcement policy**

Whenever agents get involved in illegal activities, they are faced with some uncertainty. The probability to get caught and the severity of the punishment depend on the extend of the underlying corruption and the effectiveness of the tax administration. In terms of modelling, there is a fine appropriate for each punishment, so long as moral issues are not considered (Andreoni et al., 1998).

In this section we introduce uncertainty through standard deterrence policies. To keep the model tractable we assume exogenous auditing probabilities and fines. Following Yitzhaki (1974), we assume that, once caught, citizens pay fines that are proportional to
the evaded tax. Similarly, politicians who are found to have embezzled public funds must pay fines that are proportional to the embezzled amount.

Additionally we analyze the effects of implementing policies in an environment that stigmatizes people who break the law. The notion of stigma is not new in the economic literature. Moffit (1983) and Besley and Coate (1992) analyze the case of 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. Following this literature, we postulate that an individual experiences a disutility if he is investigated and exposed as a cheater. Overall each implemented policy bears two kinds of cost for offenders; a pecuniary cost imposed by the appropriate fine and a non pecuniary cost due to stigmatization of the offender.

The results we obtain are mixed and depend both on the strengths of the stigma motive and on the fines, that define the strategic interactions in the behavior of agents. In the presence of strategic complementarity multiple equilibria may arise, that can be eliminated via the appropriate policy. When revenue from fines finance the public good, deterrence policies are effective in eliminating the high corruption equilibrium but do not necessarily reduce corruption in the low corruption equilibrium. On the contrary, whenever revenue from fines do not finance the public good, the policy is effective but only due to stigma considerations.

In this richer setting strategic substitutability may as well occur, in which case a unique stable equilibrium occurs. Finally we may have both interactions, i.e one agent viewing the strategy of the other as strategic complement while the latter viewing the strategy of the former as strategic substitute in which case uniqueness can be obtained only if the occurring equilibrium is stable.

4.1. Revenue from fines financing the provision of public education

Citizens earn a taxable income \( h_{t+1} \) and decide how much income to declare to the tax authorities. Now they face an exogenous probability \( p \) of being investigated and caught. In case they get caught, their true income is revealed and they are punished with a fine.

\footnote{Imposing fines on evaded income, following Allingham and Sandmo (1972), leads to qualitatively similar results.}
π (π > τ) proportional to the evaded tax.

Similarly, politicians embezzle a part of the tax revenue earmarked for public education \((1 - \mu)\varphi z_{t+1} \tau H_{t+1}\), and they are faced with an exogenous probability \(q\) of being caught, in which case they are punished with a rate \(\theta \ (\theta > 1)\) of the embezzled income.

Apart from the pecuniary cost of the punishment, being caught involves a non-pecuniary cost, i.e. stigmatization for breaking the law. Therefore the effect of standard deterrence policies is two-fold, thus implying that offenders have to bear not only the relevant fine but also the social cost associated with being punished. Agents’ utility is modified as follows:

\[
u_{it} = c_{it} h_{it+1} - g(H_t)F_i\]

For analytical convenience we set \(\beta = 1\). The last term \(g(H_t)F_i\) captures the expected size of the stigma cost suffered by the agent. This depends positively on the magnitude of the fraud \(F\), i.e. on the amount of money that the tax delinquent evaded or the politician embezzled. Nevertheless, 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. Similarly, less-educated societies that may not understand the intricacies of governance may be more tolerant towards political corruption. To capture these possibilities we hypothesize that the society’s sensitivity for unlawful acts depends on the average level of human capital: this is captured by the term \(g(H_t)\). To simplify the algebra we make two assumptions: a) the size of the fraud \(F\) enters linearly in the stigma cost function and b) the expected marginal cost from breaking the law is \(g(H_t) = \gamma H_t\) where \(\gamma > 0\). We would like to emphasize that our main results do not hinge on these assumptions. In fact we could easily assume that \(g'(\cdot) = 0\) without altering our results in any significant way.

The law of motion of human capital is given by

\[
h_{t+1} = AE_t(\mu_t, z_t) + vH_t\quad (4.1)\]

where \(E_t = z_t \mu_t \varphi \tau H_t + p r \pi (1 - z_t) H_t + q \theta (1 - \mu_t) \varphi z_t \tau H_t\). Notice that the revenue from the fines imposed on corrupt citizens, \(\tau \pi (1 - z_t) H_t\), and on corrupt politicians, \(\theta (1 - \mu_t) \varphi z_t \tau H_t\), is supplementing the revenue earmarked for public education. Agents in the economy are aware of that and observe their human capital stock growing faster whenever corruption is effectively treated.
4.1.1. Individual optimization

A citizen maximizes

\[
\max_{c_{zt}} c_{zt}h_{t+1} - \gamma H_t(1 - z_t)\tau h_t \tag{4.2}
\]

s.t. \[ c_{zt}^c = (1 - z_t\tau)h_t - \rho\tau(1 - z_t)h_t \tag{4.3} \]

Citizens budget constraint (eq. (4.3)) denotes that consumption equals his disposable income after having evaded taxes to a rate \((1 - z_{t+1})\), minus \(\rho\tau(1 - z)h_{t+1}\), in case he gets caught evading. The tax evasion gamble is assumed to be better than fair, i.e. \(1 \geq \rho\tau^8\).

For concavity to hold \(\beta < 1\) and \(-\varphi\mu_{t+1} + \rho\tau - \varphi q\theta (1 - \mu_{t+1}) < 0\).

Maximization yields the solution:

\[
z_t = f(\mu_t) = \begin{cases} 0 & \text{if } \Omega_1 < 0 \\ \frac{\gamma p + A[\rho\pi(-\tau + \rho\pi\tau - 1)(1 - \rho\pi\tau)(-\varphi\mu_{t+1} + \rho\pi - \varphi q\theta(1 - \mu_{t+1})) + v(\rho\pi - 1)]}{2A(\rho\pi - 1)[-\varphi\mu_{t+1} + \rho\pi - \varphi q\theta(1 - \mu_{t+1})]} & \text{if } \Omega_2 > \Omega_1 > 0 \\ 1 & \text{if } \Omega_2 < \Omega_1 \end{cases} \tag{4.4}
\]

where

\[
\Omega_1 = \gamma p + A[\rho\pi(-\tau + \rho\pi\tau - 1) - (1 - \rho\pi\tau)(-\varphi\mu_{t+1} + \rho\pi - \varphi q\theta(1 - \mu_{t+1})) + v(\rho\pi - 1)]
\]

and

\[
\Omega_1 = 2A\tau(\rho\pi - 1)[-\varphi\mu_{t+1} + \rho\pi - \varphi q\theta(1 - \mu_{t+1})].
\]

**Politicians**

The individual optimization problem solved by each politician at time \(t + 1\) is given by

\[
\max_{c_{zt}} c_{pt}h_{t+1} - \gamma H_t(1 - \mu_t)\varphi z_t\tau h_t \tag{4.5}
\]

s.t. \[ c_{zt}^p = (1 - \mu_t\varphi)z_t\tau h_t - q\theta(1 - \mu_t)\varphi z_t\tau h_t \tag{4.6} \]

Equation (4.6) is the budget constraint of the politician whose consumption, \(c_{t+1}^p\), is financed by his wage plus the rate of money he embezzles, minus a fine \(\theta\) imposed on the embezzled amount \((1 - \mu_{t+1})\varphi z_{t+1}\tau h_{t+1}\) in case he gets caught with probability \(q\). As was

\[8\] The case where the opposite hold is of little interest, since in this case tax evasion would never take place. The assumption that the evasion gamble is better than fair, is empirically supported (i.e. Skinner and Slemrod, 1985).
the case with the citizen, the embezzlement gamble is assumed to be better than fair, i.e. 
\[ 1 \geq \theta q, \] while concavity always holds.

Maximization yields the solution

\[
\mu_{t+1} = \begin{cases} 
0 & \text{if } \Omega_3 < 0 \\
\frac{\gamma q - (1 - q\theta)(Ap\pi\tau(1 - z_{t+1}) + v - A\tau z_{t+1} + 2A\varphi q\theta z_{t+1}\tau)}{2A\varphi\tau(q\theta - 1)^2 z_{t+1}} & \text{if } \Omega_4 > \Omega_3 > 0 \\
\frac{1}{1} & \text{if } \Omega_4 < \Omega_3 
\end{cases}
\]  
(4.7)

where

\[
\Omega_3 = \gamma q - (1 - q\theta)(Ap\pi\tau(1 - z_{t+1}) + v - A\tau z_{t+1} + 2A\varphi q\theta z_{t+1}\tau)
\]
and

\[
\Omega_4 = 2A\varphi\tau(q\theta - 1)^2 z_{t+1}.
\]

4.1.2. Equilibria

The definition of equilibrium remains basically the same as 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. Whether multiple equilibria or a unique equilibrium emerges depends on parameter values and the same holds for stability of the equilibria. To analyze all this cases we will examine the various forms of strategic interactions that may occur.

Case 1A: \(dz_t/d\mu_t > 0\) and \(d\mu_t/dz_t > 0\)

For Case 1 to hold the following two conditions must be satisfied:

\[
\gamma < \frac{(Ap\pi\tau + v)(1 - p\pi)}{p} \text{ and } \gamma < \frac{(Ap\pi\tau + v)(1 - q\theta)}{q}
\]  
(4.8)

In this case 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 (high tax evasion and high corruption) and the highest (low tax evasion and low corruption) equilibria are stable, whereas the intermediate equilibrium is unstable.

Two crucial points should be made, that differentiate this version from the benchmark case. First, strategic complementarity and multiple equilibria can arise even if \(v\), the rate of human capital transferred freely to the next generation, is zero. The intuition behind
this result is that the externality captured previously by $v$ is now introduced via the revenue from fines that directly finance public education; that is even if $z_t$ or $\mu_t$ are zero, there will still be some acquisition of human capital financed by the fines on tax evaders and corrupt politicians. Also note that the high tax evasion rate $1 - z_t$ is not necessarily equal to 1, or equivalently $z_t$ is not necessarily equal to 0. This is due to the fact that there is now a source for education spending that is independent of the behavior of the politicians, namely the revenue from fines on tax evaders. Thus, the high tax evasion and high corruption equilibrium is not necessarily the $(0, 0)$ point, as was the case in Figure 2; it could instead be anywhere within the $[0, 1]$ interval on the $z_t$ axis.

Similarly for $\gamma$, if we set $\gamma = 0$ or both $\gamma = v = 0$, multiple equilibria still occurs.

![Figure 4.1: The high corruption (O) equilibrium is eliminated](image)

Second, a sufficiently low expected penalty rate for citizens accompanied by a bounded penalty rate for politicians can eliminate the high corruption and high tax evasion equilibrium. This is shown in Figure (4.1). Suppose that the best response functions are given by the solid lines in which case there are two stable equilibria, $O$ and $B$. If the best response functions are shifted to the ones represented by the dashed lines, then there will be only one equilibrium, which is stable and characterized by low tax evasion (high value of $z$) and low corruption (high value of $\mu$). In Figure (4.1) this is represented by point...
C. Let $f_1$ and $g_1$ denote the strictly monotonic part of the best response function of the citizen and the politician, respectively. Since $f_1$ is concave and $g_1$ is convex a sufficient condition for the elimination of the equilibrium $O$ in Figure (4.1) is

$$f_1(0) > g^{-1}(0) > 0,$$

or using equations (4.4), (4.7) and condition (4.8),

$$\gamma > \frac{A(-\varphi q \theta + p\pi (1 + \tau - 2p\pi \tau + \varphi q \theta \tau)) + v(1 - p\pi)}{p}.$$

This inequality can hold even for $\gamma = 0$, just by setting an appropriate fine, i.e. deterrence policies can be effective even when agents bear no stigma associated with being punished. The role of stigma in this case is to increase the strength of the intrinsic motive.

**Proposition 6** The conditions

$$\frac{(Ap\pi \tau + v)(1 - p\pi)}{p} > \gamma > \Omega_5$$

and

$$\frac{(Ap\pi \tau + v)(1 - q\theta)}{q} > \gamma > \Omega_5$$

where $\Omega_5 = \frac{A(-\varphi q \theta + p\pi (1 + \tau - 2p\pi \tau + \varphi q \theta \tau) + v(1 - p\pi)}{p}$ are necessary for the elimination of the high corruption equilibrium.

**Proof:** The left hand sides of both inequalities are the direct outcome of the strategic complementarity assumption. The right hand side of the inequalities follows immediately from eq. (4.4), by setting $\mu = 0$ (recall that since strategic complementarity is assumed, then a lower $\mu$ implies a lower $z$) and solving for $\gamma$.  

Interestingly the effect of policy on corruption is not clear and can either be positive or negative depending on parameter values. This result may at first seem counter-intuitive however it is not surprising when taking into account that whenever agents are being punished, a positive externality on the aggregate human capital occurs. Therefore agents are punished in terms of consumption, still though they are benefited with respect to their
human capital. In terms of being stigmatized the stronger extrinsic incentive to truthful reporting does not reduce the intrinsic incentive to behave honestly.

**Case 2A:** \( \frac{dz_t}{d\mu_t} < 0 \) and \( \frac{d\mu_t}{dz_t} > 0 \)

When Case 2A holds, citizens behavior denotes strategic substitutability with respect to \( \mu \), while politicians behavior denotes strategic complementarity with respect to \( z \). The following condition must be satisfied:

\[
\frac{(Ap\pi\tau + v)(1 - q\theta)}{q} > \frac{(Ap\pi\tau + v)(1 - p\pi)}{p}
\]  
(4.9)

Condition (4.9) implies that for a sufficiently high fine \( \pi \) or probability to get caught, \( p \), higher than \( q \) and \( \theta \), citizens may find it too costly to increase their evasion in accordance with politicians embezzlement and instead behave in a more honest manner and reduce their evasion rate.

For parameter values satisfying the above condition, interesting results arise with respect to equilibria and stability. In Figure (4.2) we observe that a unique stable equilibrium arises, where the familiar adjustment process end with an oscillatory convergence. In Figure (4.3) no stable equilibrium exists. Which of the two outcomes prevails depends on the relative slopes of the two reaction functions.

![Figure 4.2: Unique Stable Equilibrium](image-url)
Case 3A: $dz_t/d\mu_t > 0$ and $d\mu_t/dz_t < 0$

For Case 3A to hold the following condition must hold

$$\frac{(Ap\pi + v)(1-q\theta)}{q} < \gamma < \frac{(Ap\pi + v)(1-p\pi)}{p}$$ (4.10)

which is satisfied for a sufficiently high $q$ and/or $\theta$. The dynamics are similar to those in Case 3A

Case 4A: $dz_t/d\mu_t < 0$ and $d\mu_t/dz_t < 0$

In this last case both inequalities set in Case 1A must hold with the reverse sign, i.e.

$$\gamma > \frac{(Ap\pi + v)(1-p\pi)}{p} \text{ and } \gamma > \frac{(Ap\pi + v)(1-q\theta)}{q}$$ (4.11)

Both strategies are strategic substitutes and the two descending reaction functions cross only once. The occurring equilibrium is globally stable (see Figure 4.4).

4.1.3. Non-Stigmatizing Policy

We will examine the extreme case were the implemented policy does not bear any non-pecuniary cost to agents in the model, i.e. we will set $\gamma = 0$. Setting different values in
Figure 4.4: Strategic Substitutes and Unique Equilibrium
\( \gamma \) or even setting it null is a plausible hypothesis since different implementation involves different levels of stigmatization. For instance, strict enforcement of the law often involves high stigma costs whereas loose enforcement of the law actually reduces the stigma costs since it is indicative of tolerance towards corrupt behavior\(^9\).

Setting \( \gamma = 0 \) it is evident that only Case 1 can hold. Therefore both strategies are strategic complements and multiple equilibria can arise. The properties of the occurring equilibria are exactly the same as in the case with \( \gamma > 0 \) i.e. there are three equilibria of which the two are stable (the lowest and the highest). Multiplicity can occur, even when setting \( v = 0 \) however it can be eliminated for a sufficiently low expected penalty rate for citizens accompanied by a bounded rate for politicians. Using equations (4.4), (4.7), condition (4.8) and setting \( \gamma = 0 \) we obtain:

\[
\frac{(1 - p\pi \tau)}{2(1 - p\pi)} - \frac{Ap\pi + v}{2A[-p\pi + \phi q\theta]} > \frac{A\tau p\pi + v}{A - 2A\phi q\theta + Ap\pi} \geq 0. \tag{4.12}
\]

This condition always holds if, for example, \( v = 0, p\pi = 0 \) and \( q\theta < \beta /(1 + \beta)\phi \). Proposition 4 derives necessary conditions for the high corruption equilibrium to be eliminated.

**Proposition 4.** The conditions

\[
p\pi < \frac{Aq\theta \phi - v}{2A} \quad \text{and} \quad \frac{1}{\phi} \max \left\{ p\pi, \frac{v}{A} \right\} < q\theta < \frac{1 + p\pi}{2\phi}
\]

are necessary for the elimination of the high corruption equilibrium.

**Proof:** The condition regarding \( p\pi \) follows immediately from the left-hand-side part of (4.12). The conditions regarding \( q\theta \) follow from the combination of the right-hand-side inequality of (4.12), \( p\pi > 0 \) and the assumption that the citizens’ objection function is concave with respect to \( z \), or \( \phi \mu_i - p\pi + \phi q\theta (1 - \mu_i) > 0 \ \forall \mu_i \) and hence \( -p\pi + \phi q\theta > 0 \).

Notice from Proposition 4 that \( q\theta > p\pi/\phi > p\pi \); in other words, the inspection rate on the politicians should be greater than that on the citizens. Apparently there is some asymmetry in the treatment of citizens and politicians.

\(^9\)We could multiply an indicator of enforcement, \( e \), to the probability of being caught i.e. \( p\pi e \) or \( q\theta e \), and associate low values of \( e \) with zero values of \( \gamma \), to make our point more transparent. However this would complicate the notation without gaining more intuition.
4.2. Revenue from fines not financing the provision of public education

Next we analyze the case where the revenue from fines imposed on tax evaders and corrupt politicians is not used to finance activities that affect any of the two group of agents. The law of motion for human capital is still given by (2.1), where now

\[ E_t = \mu_t \phi z_t H_t. \]  

**Citizens**

Private citizens maximize (4.2) subject to (4.3), \( c_{ct} \geq 0, \ 1 \geq z_t \geq 0, \) and equations (2.1) and (4.13), taking \( \mu_t \) and \( H_t \) as given. The solution is:

\[ z_t = f(\mu_t) = \begin{cases} 
0 & \text{if } A(1 - p\pi\tau)\mu_t \phi + \gamma p < v(1 - p\pi) \\
\frac{A(1 - p\pi\tau)\mu_t \phi - v(1 - p\pi) + \gamma p}{2A(1 - p\pi)\tau \mu_t \phi} & \text{if } 0 < A(1 - p\pi\tau)\mu_t \phi - v(1 - p\pi) + \gamma p < 2A(1 - p\pi)\tau \mu_t \phi \\
1 & \text{if } A(1 - p\pi\tau)\mu_t \phi - v(1 - p\pi) + \gamma p > 2A(1 - p\pi)\tau \mu_t \phi
\end{cases} \]  

**Politicians**

Politicians maximize (4.5) subject to (4.6), \( c_{ct} \geq 0, \ 1 \geq \mu_t \geq 0, \) and equations (2.1) and (4.13), taking \( z_t \) and \( H_t \) as given. The solution is:

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

The existence, multiplicity and stability of equilibria can be shown following the same steps as before., namely we have to distinguish four cases based on strategic interactions.

*Case 1B:* \( dz_t/d\mu_t > 0 \) and \( d\mu_t/dz_t > 0 \)

For Case 1B to hold the following two conditions must be satisfied:

\[ \gamma < \frac{v(1 - p\pi)}{p} \text{ and } \gamma < \frac{v(1 - q\theta)}{q} \]  

In this case for a wide range of parameters 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 and the model with fines that finance the public good, 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.

A first difference between this version and the one where revenue from fines are directed towards public education is with regard to the role of \( v \) and \( \gamma \). As in the benchmark model but in contrast to the case where fines go to education if \( v = \gamma = 0 \) then there is a unique equilibrium with positive compliance levels.

A second difference is with regard to the effect of fines on tax evasion and corruption; namely, here increases in expected penalty rates deter tax evasion and corruption, \( dz_t/dp > 0 \) and \( d\mu_t/dq > 0 \). This result is expected since the imposition of fines does not affect agents in any positive manner and hence it is at their best interest to behave honestly.

The last and perhaps most significant observation is that this policy eliminates multiplicity, still though this effect is entirely attributed to the effect of stigma on agents not on fines per se. To put it differently:

**Proposition 5.** If \( v > 0 \) and \( \gamma > 0 \), then changes in the policy parameters \( p, q, \tau, \phi \), can eliminate the high corruption equilibrium, still though this effect could not occur if the policy involved no stigma cost, i.e. if \( \gamma = 0 \). The conditions

\[
\gamma < \frac{v(1-p\tau)}{p}
\]

and

\[
\gamma < \frac{v(1-q\theta)}{q}
\]

are necessary for the elimination of the high corruption equilibrium.

*Proof:* Both inequalities are the direct outcome of the strategic complementarity assumption and the same inequalities occur when setting \( \mu = 0 \) (recall that since strategic complementarity is assumed, then a lower \( \mu \) implies a lower \( z \)) and solving for \( \gamma \).

**Case 2B:** \( dz_t/d\mu_t < 0 \) and \( d\mu_t/dz_t > 0 \)

For Case 2B to hold the following condition must be satisfied:

\[
\frac{v(1-q\theta)}{q} > \gamma > \frac{v(1-p\tau)}{p}
\]

(4.17)
which implies that for a sufficiently high fine \( \pi \) or probability to get caught, \( p \), citizens manifest strategic substitutability. Similarly to Case 2A oscillatory convergence or divergence may occur.

**Case 3B:** \( \frac{d z_t}{d \mu_t} > 0 \) and \( \frac{d \mu_t}{d z_t} < 0 \)

For Case 3 to hold the following condition must hold

\[
\frac{v(1-q\theta)}{q} < \gamma < \frac{v(1-p\pi)}{p}
\]

(4.18)

which is satisfied for a sufficiently high \( q \) and/or \( \theta \). Similarly to Case 2A oscillatory convergence or divergence may occur.

**Case 4B:** \( \frac{d z_t}{d \mu_t} < 0 \) and \( \frac{d \mu_t}{d z_t} < 0 \)

In this last case both inequalities set in Case 1B must hold with the reverse sign, i.e.

\[
\gamma > \frac{v(1-p\pi)}{p} \quad \text{and} \quad \gamma > \frac{v(1-q\theta)}{q}
\]

(4.19)

A unique equilibrium occurs which is globally stable.

**Effects of tax rate on tax evasion**

As far as the effect of an increase in tax on tax evasion is concerned, we find that the relationship that describes it is given by:

\[
\frac{dz}{d\tau} = \frac{\partial z}{\partial \tau} + \frac{\partial z}{\partial \mu} \frac{\partial \mu}{\partial \tau} = \frac{(\gamma p - v(1-p\pi))(\gamma q - v(1-q\theta))(2A\mu^2\varphi\tau + v)}{4A^2\varphi^2\mu^2(p\pi - 1)(q\theta - 1)z}
\]

(4.20)

Evidently the effect of a variation of the tax rate on tax evasion, crucially depends on whether \( z \) and \( \mu \) are strategic substitutes or complements. In Case 1B and 4B, we contradict the unintuitive result found by Yitzhaki (1974) and find that an increase in tax rate increases tax evasion. On the other hand, in Cases 2B and 3B, we find that the income effect prevails and increases in the tax rate decrease tax evasion.
4.2.1. Non-Stigmatizing Policy

As we did in the previous chapter we examine the extreme case were $\gamma = 0$ where only Cases 1A and 1B can hold. Therefore both strategies are strategic complements and multiple equilibria can arise. The properties of the occurring equilibria are similar to the case were $\gamma > 0$ i.e. there are three equilibria of which the two are stable (the lowest and the highest). Multiplicity can occur, even when setting $v = 0$ however. The crucial difference now is that when $\gamma = 0$ no policy is effective in eliminating multiple equilibria, i.e. no fine or auditing probability can enforce agents to coordinate to the good equilibrium.

**Proposition 5.** If $v > 0$ and $\gamma = 0$ then changes in the policy parameters $p, q, \tau, \phi$, cannot eliminate the high corruption equilibrium.

*Proof:* If $v > 0$ and $\gamma = 0$ then the point $(0,0)$ satisfies both equations (4.14) and (4.15).

A direct implication of this result would be that in an economy with imperfect enforcement and thus with no stigmatization of the offenders, the policy in which revenue from fines is earmarked for education could deter corruption to some extend whereas in the alternative case, policy would be totally ineffective.

5. Stigma

In this section we will assume away deterrence policies and we will analyze the effects of implementing policies that involve only non-pecuniary costs. More specifically we will assume that $\pi = 0$, i.e. when evaders get caught they do not pay any fines. Such a policy could involve anti-corruption campaigns, publicizing incomes as in some Nordic countries, etc. (REFERENCE).

5.1. Individual optimization

*Citizens*

A citizen maximizes

$$\max_{ct, zi} c_{t+1} h_{t+1} - \gamma (1 - z_t) \tau h_t$$
subject to (2.6), (2.1) and (2.4), taking $\mu_t$ and $H_t$ as given. Maximization yields

$$z_t = f(\mu_t) = \begin{cases} 
0 & \text{if } A\mu_t \phi \leq v - \gamma \\
\frac{A\mu_t \phi + \gamma - v}{2A\mu_t \phi \tau} & \text{if } A\mu_t \phi (1 - 2\tau) \leq v - \gamma \leq A\mu_t \phi \\
1 & \text{if } v - \gamma < A\mu_t \phi (1 - 2\tau). 
\end{cases} \tag{5.1}$$

Analyzing the properties of the citizen’s best response function is straightforward. In particular, note that the politician’s action is a strategic complement (substitute) for citizen’s tax evasion depending on whether the effect of stigma is stronger (weaker) than the effect of the externality in the human capital accumulation process, that is $\gamma > v$ ($\gamma < v$). In addition, as expected, the higher the stigma coefficient $\gamma$, the higher the amount of income declared to the tax authorities.

**Politicians**

A politician maximizes

$$\max_{c_{pt+1}, \mu_t} c_{pt} h_{t+1} - \gamma (1 - \mu_t) \phi \tau z_t h_t$$

subject (2.1), (2.4) and (2.9), taking $\mu_t$ and $H_t$ as given. This leads to

$$\mu_t = g(z_t) = \begin{cases} 
0 & \text{if } A_z \tau \leq v - \gamma \\
\frac{A_z \tau + \gamma - v}{2A_z \phi \tau} & \text{if } A_z \tau (1 - 2\phi) \leq v - \gamma < A_z \tau \\
1 & \text{if } v - \gamma < A_z \tau (1 - 2\phi). 
\end{cases} \tag{5.2}$$

which has properties analogous to $z_t$.

**5.2. Equilibrium**

The definition of equilibrium is similar to that in the previous versions. The existence of an equilibrium can be shown following similar steps. Also, notice that if we set $\gamma = 0$ then this version collapses to the benchmark model. More generally, we get the same results as in the benchmark model if $\gamma \leq v$. Thus, we only analyze the case where $\gamma > v$. Consider,

**Proposition 6.** If $\gamma > v$ then the equilibrium is unique.

**Proof:** Based on (5.1) and (5.2) there are four cases to consider. We show that the equilibrium is unique in each one of them: a) if $\gamma > \max\{v + A\phi (2\tau - 1), v, v + A\tau (2\phi - 1)\}$, then there is a unique equilibrium $(z^*_t, \mu^*_t) = (1, 1)$. b) If $\gamma > \max\{v + A\phi (2\tau - 1), v\}$ and
\( \gamma < v + A\tau(2\phi - 1) \) then \((z^*_t, \mu^*_t) = (1, (A\tau + \gamma - v)/2A\phi \tau)\). c) If \( \gamma > \max\{v + A\tau(2\phi - 1), v\} \) and \( \gamma < v + A\phi(2\tau - 1) \) then \((z^*_t, \mu^*_t) = ((A\phi + \gamma - v)/2A\phi \tau, 1)\). d) If \( \gamma < v + A\tau(2\phi - 1) \) and \( \gamma < v + A\phi(2\tau - 1) \) then any interior equilibrium will be a solution to the equation 
\[ f_1(z_t) = g_1^{-1}(z_t), \]

or
\[ \frac{A\mu_t \phi + \gamma - v}{2A\mu_t \phi \tau} = \frac{\gamma - v}{A\tau(2\phi \mu_t - 1)}, \]

or a root to the equation 
\[ 2A\phi^2 \mu_t - A\phi \mu_t - (\gamma - v) = 0. \]

This equation has two roots
\[ \mu_{1t} = \frac{A - \sqrt{A[A + 8(\gamma - v)]}}{4A\phi} \quad \text{and} \quad \mu_{2t} = \frac{A + \sqrt{A[A + 8(\gamma - v)]}}{4A\phi}, \]

the first of which is negative and the second is positive. Also, \( \forall \mu_t \gtrless \mu_{2t}, 2A\phi^2 \mu_t - A\phi \mu_t - (\gamma - v) \gtrless 0 \).

In other words, \( \forall \mu_t \gtrless \mu_{2t}, f_1(z_t) \gtrless g_1^{-1}(z_t) \). Hence the functions \( f(z_t) \) and \( g^{-1}(z_t) \) intersect only once.

In each of the first three cases in Proposition 6 there is a corner equilibrium. One or both best response functions are straight lines. Illustration of Case d is similar to the one in Figure (4.4). We can conclude that a stigma cost eliminates the multiplicity of equilibria. Contrary to 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 the actions of all other agents. More specifically, if the stigma cost for following an unlawful action is high enough, then each group does not wish any more to respond positively to the action of the other group; instead, they attempt to improve the situation by choosing to be more honest.

6. Conclusions

Both corruption and tax evasion constitute widespread problems with detrimental effects. A point of this paper is that they are often interrelated and reinforce each other. Moreover, reducing the size of corruption and tax evasion in modern societies is not easy. Standard deterrence policies, such as frequent audits and fines, are not always effective and a policy maker must carefully consider how to implement them. Besides these enforcement policies, additional measures, such as anti-corruption and anti-tax evasion campaigns, can be particularly helpful, if they manage to raise the cost that society imposes on law-breaking citizens.

\( ^{10} \)Of course, the root \( \mu_{2t} \) and the corresponding value of \( z_t \) constitute an interior solution if they are both less than one.
References


