Crime and Uncertain Punishment in Transition Economies*

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Abstract

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We consider a continuum of agents in a transition country where the transfer of property rights has occurred. The transition is in progress and the nature of the government’s future policies is unknown to the agents. Agents believe that the present government can evolve into one of two types: a traditional democratic government that supplies law enforcement and infrastructure leading to positive firm growth, or a corrupt government that may or may not provide law enforcement, does not provide a climate for firm growth, and may be confiscatory. Each agent owns one firm, and we define an illegal action (crime) as the diversion of funds from this firm into the agent’s pocket. Each agent decides how much to steal, understanding that the amount he steals, and the government that will be in place, will affect the taxes he pays. Agents further believe that the objective that each possible government wishes to achieve depends on, or is limited by, the taxes it collects. Since both the agents’ decisions and the tax revenue depend on the probability of each government type coming into existence, we endogenize the calculation of this probability. Using it, we determine the percentage of agents who steal, and investigate the relationship between the level of crime and uncertain political structure.

JEL Classifications: K42, P14, P26

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1. Introduction

Between 1990 and 2008, 37 incumbents were replaced in a total of 47 elections in 8 Central Eastern European countries.\(^1\) These electoral changes often resulted in governments pursuing different social and economic policies than their predecessors. Evidence that economic policy changes have an impact on business decision makers can be found in the BEEPS II data base. Turning to the broader group of 26 economies in transition covered in this study, hundreds of respondents from each of these countries were asked many questions, including the following: How great an obstacle to the operation and growth of your business is economic policy uncertainty? In 22 of those countries, more than 50 per cent of the respondents stated that economic policy uncertainty was either a moderate or a major obstacle to the operation and growth of their business.\(^2\) How would an economic agent within one of these economies in transition have dealt with the economic policy uncertainty? Would this uncertainty have induced acts by these agents that would have undermined or impeded the development of stable market-oriented democracies? In this paper, we attempt to answer these questions by investigating the degree to which uncertainty concerning governmental policy induces criminal acts on the part of agents in economies in transition. In our model we explore the resulting level of crime and how this level changes with agents’ uncertainty concerning government policy.

We consider a continuum of agents in a country in an early stage of transition from a planned to a market economy and suppose the transfer of property rights, once held by the state, has already occurred. However, the transition is still in progress, and

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\(^1\)See Kornai (2006) for a list of governmental turnovers in these countries between 1990 and 2004. He found 30 such instances. Using the same methodology and countries and extending the time period to 2008, we found 37 instances in which incumbents were replaced. The current financial/economic crisis is bound to increase that number.

\(^2\)See BEEPS II Interactive Dataset, EBRD–World Bank, 2002. The question can be found under the heading Governance and Anti-Corruption. We excluded Turkey from the panel of countries, leaving the 26 economies in transition.
the nature of the government’s future policies is unknown to the agents. In particular, we assume that the agents believe that, due to a variety of reasons, the present government may become either a traditional democratic government or a corrupt government. We let each agent own one firm, and define an illegal action (crime) as the diversion of funds from this firm into the agent’s pocket.³ We assume that each agent has all the information needed to characterize the two possible forms that the government may become when deciding how much to steal from his firm. Each agent must furthermore know the probability that the government will be democratic or corrupt in order to complete the decision of how much to steal. With this probability, individual decisions are made and collectively a level of crime results. We endogenize this probability as follows. For each possible form of government that each agent considers, he understands that different levels of crime will produce different amounts of tax revenue. Thus, tax revenue that the agents believe the government would collect depends on the probability of each form of government occurring. The interaction between tax revenue and agents’ decisions determines the probability that the government will become democratic and the level of crime induced. We then investigate how the level of crime would change as the policies of both the democratic and corrupt governments change.

In the context of the literature on the rule of law in transition economies, almost all of the studies relating the form of government to the decision of an agent to steal utilize a common approach: A particular type of government is assumed and each agent optimizes his choice knowing this governmental form. Then another type of government is postulated by the modeler, and the agent once again optimizes. A comparison of the agents’ decisions are then analyzed. In these studies, no assumption is made that the agent himself is aware of the various forms that the government

³We use crime for thefts perpetrated by agents, reserving the word corruption for certain acts of government.
might take. Examples of such studies include Polishchuk and Savvateev (2004), Sonin (2003), and Katz and Owen (2009). Other studies that assume the impact of a specific form of government are Grossman (1995) and Alexeev, Janeba and Osborne (2004). They both consider "mafias" that are independent of the government and compete with the state for entrepreneurial rents in a setting where the form of the government is fixed and known to the agents. The same is true of Dixit (2004), which suggests a principal-agent model to capture the intent of a government to induce efficiency in society. An exception to this approach is offered in Hoff and Stiglitz (2004), which allows agents to face the uncertainty of two forms of government. There, the endogenization of the probability of occurrence of these governments is based on a consistency requirement among the agents, and not on the awareness of agents of the types of governments that might ensue. This approach leads to multiple solutions for the level of crime, making comparative statics awkward.

We contribute to the literature on the rule of law in transition in several ways. First, by allowing the agents to consider the uncertain future form of the government while also allowing them to presume that the government's form will depend on tax revenue, we are able to endogenize the probability of the government becoming one form or the other. Our endogenization takes into account the agents' perceptions of the impact of their decisions on the form of government, as well as the agents' perceptions of the reaction of the government to the agents' decisions. Second, as a result of our method of endogenizing the probability of the government's form, a unique solution, that is, a unique level of crime, is induced. By determining the level of crime, we establish a connection between perceived corruption in government and the level of crime of the agents. Third, as the solution is unique, we are able to consider the change in the level of crime induced by changes in parameters defining each of the government types. In addition to adding to this literature, we also contribute to the literature on the role of institutions in transition (for example, Djankov and
Murrell (2002), McMillan (2002) and Bevan and Estrin (2004)), and to that stressing, more generally, that different economic outcomes are to be expected from different institutional arrangements (for example, Shleifer and Vishny (1998) and Acemoglu, Johnson and Robinson (2001, 2002, 2003)). Our work shows that considering different institutional arrangements without allowing agents to be themselves aware of these different possibilities may cause some important implications to be missed.

We present our model in Section 2, deriving its properties and investigating some comparative statics. In Section 3, some further implications of the model are investigated through examples. Section 4 contains a discussion of our results and concluding remarks.

2. The Model

We consider a transition economy with a government and a continuum of risk neutral, von Neumann-Morgenstern expected utility maximizing agents. We assume each agent has already acquired property rights over a firm, whose value at the outset is normalized to one. The agent’s problem is to decide whether to steal from his firm, that is, what proportion \( \tau, \tau \in [0, 1] \), of the firm’s value to divert to himself. Should the agent elect to steal \( \tau \), he incurs expenses \( \frac{c \tau^2}{2} \). Agents differ only by the parameter \( c \). We assume that the continuum of agents is characterized by the continuous distribution \( H(c) \), where \( H(c) \) is strictly increasing on \( c \in [0, 1] \) with density \( h(c) \). The mean of this distribution is denoted by \( \bar{c} \). The agent’s decision concerning how law abiding to be is made independently by each agent. All agents share the same information except for the individual \( c \) value, which is known only privately.

The difficulty for the agents in deciding how much to steal hinges on the fact that the agents do not know the form the government will take, and consequently do not know the economic and punitive impacts of their choices. We limit the government’s
form to one of two possibilities: a traditional democratic government that supplies law enforcement, as well as infrastructure, leading to positive firm growth (G1), or alternatively, a corrupt government about which the agents are uncertain as to the degree of law enforcement, as well as the degree of confiscatory behavior, and in which firms do not grow (G2).

The characterizations of the two possible government forms are assumed to be known to each agent, and are summarized as follows.

G1: 1. G1 strictly enforces the rule of law and supplies a transparent fiscal policy.
   2. Honest agents are taxed at the rate $t \in [0, 1]$.
   3. Infrastructure is improved at the rate $r > 0$.
   4. All thieves are caught.
   5. Stolen funds are taxed at the punitive rate $(t + \delta) \in [0, 1]$.

G2: 1. G2 does not strictly enforce the rule of law and its fiscal policy is uncertain.
   2. Honest agents are taxed at the rate $t \in [0, 1]$.
   3. Infrastructure is not improved, i.e., $r = 0$.
   4. Thieves are caught with probability $\lambda \in [0, 1]$.
   5a. If caught, the entire firm of the thief is taxed at the rate $b \in [0, 1]$.
   5b. If not caught, the thief keeps the stolen funds and the part of the firm remaining is taxed at the rate of $t$ with probability $p$ and at the rate $t + \Delta$, $(t + \Delta) \in [0, 1]$, with probability $(1 - p)$.

In order for each agent to decide how much of his firm to appropriate, he must know the probability of the government becoming G1 or G2. We let $\pi, \pi \in [0, 1]$, be the probability that the government form will be G1.

We now establish the level of crime in the society that results from the agents’ uncertainty regarding the government’s form assuming $\pi$ is known. We begin by deriving the optimal decision for each agent under this assumption. Referring to a particular agent by his cost parameter $c$, agent $c$’s decision can be summarized by the
decision tree in Figure 2.1. The end-branch values are given by
\[ A = (1 - t)(1 + r) - \delta \tau (1 + r) - \frac{\tau \alpha^2}{2}, \]
\[ B = 1 - b - \frac{\tau \alpha^2}{2}, \]
\[ C = \tau + (1 - \tau)(1 - t) - \frac{\tau \alpha^2}{2}, \]
\[ D = \tau + (1 - \tau)(1 - t - \Delta) - \frac{\tau \alpha^2}{2}. \]

Our first proposition establishes \( \tau_c(\pi) \), the optimal proportion of the firm that agent \( c \) chooses to appropriate given the value of \( \pi \). We define \( v(\pi) = (1 - \lambda)\bar{t} - \pi[(1 - \lambda)\bar{t} + (1 + r)\delta] \), where \( \bar{t} = t + (1 - p)\Delta \) is the expected tax rate under \( G2 \).

**Proposition 1.** Given \( \pi \), agent \( c \) maximizes his expected utility by choosing to appropriate \( \tau_c(\pi) \) percent of his firm, where

\[
\tau_c(\pi) = \begin{cases} 
1 & \text{if } v(\pi) \geq c \\
\frac{v(\pi)}{c} & \text{if } 0 < v(\pi) < c \\
0 & \text{if } v(\pi) \leq 0
\end{cases}.
\]

**Proof.** See Appendix.
From P1, it follows that all agents would choose to be honest if \( v(\pi) \leq 0 \). Examining \( v(\pi) \), we see that this condition would hold if \( \pi \delta (1 + r) \) were larger than \((1 - \pi)(1 - \lambda)\tilde{r}\). This inequality would occur if \( \pi, \delta \) or \( r \) were large or if \( \lambda \) were large. Thus, if agents believe the probability of G1 occurring is large, or perceive G1 as guaranteeing a heavy penalty for breaking the law, or as producing a good environment, an honest society would follow. It would also follow if, in G2, there were a high probability of catching thieves. Conversely, if \( \pi \) were small, some level of crime would result. The condition that \( v(\pi) > 0 \) would hold if \( \pi \delta (1 + r) \) were less than \((1 - \pi)(1 - \lambda)\tilde{r}\), that is, if agents expected the economy of G1 to grow moderately, or expected the punitive tax rate to be not too large. Since \((1 - \lambda)\tilde{r} \leq 1\), it follows that \( v(\pi) \leq 1 \). So, unless both \( \lambda = 0 \) and \( \tilde{r} = 1 \), when \( v(\pi) > 0 \) there will be \( c \) values below \( v(\pi) \) and the corresponding agents represent the proportion of agents who steal heavily from their firms. Furthermore, there will be \( c \) values greater than \( v(\pi) \) and the agents corresponding to these \( c \) values represent the proportion that steal moderately from their firms. In any event, when \( v(\pi) > 0 \), all agents will steal to varying degrees.

Given the value of \( \pi \), we define the level of crime, \( K(\pi \mid \gamma) \), as the proportion of agents who steal at least \( \gamma \) percent of their firms. Recall that \( c \) has distribution function \( H(c) \).

**Proposition 2.** Given \( \pi \) and \( 0 < \gamma \leq 1 \), then

\[
K(\pi \mid \gamma) = \begin{cases} 
0 & \text{if } v(\pi) \leq 0 \\
H\left(\frac{v(\pi)}{\gamma}\right) & \text{if } 0 < v(\pi) < \gamma \\
1 & \text{if } v(\pi) \geq \gamma
\end{cases}
\]

**Proof.** See Appendix.

Since \( K(\pi \mid \gamma) \) depends on \( \pi \) through the function \( v(\pi) \), we can write it as \( K(v(\pi) \mid \gamma) \). Thus, through the function \( v(\pi) \), the value of \( \pi \) has an impact on individual appropriation as well as on the level of crime in society. This, in turn, has an impact
on the tax revenue collected by the government. We assume that agents believe that
the form that the government will take depends on the tax revenue that that form
produces. We use this assumption to endogenize the value of \( \pi \).

In thinking about the tax revenue that would be produced by the alternative
forms of government, we assume that agents believe that the government evaluates
tax revenue based on the average agent (that is, the average value of \( c \)), whom we
denoted by \( \bar{c} \). Given \( \pi \), we can then define the tax revenue that the agents’ perceive
that G1 would receive when the average agent is \( \bar{c} \) as \( R(G1 \mid \pi, \bar{c}) \). Similarly, given
\( \pi \), we define the tax revenue that the agents’ perceive that G2 would receive when
the average agent is \( \bar{c} \) as \( R(G2 \mid \pi, \bar{c}) \). We let \( f(\pi) = \frac{R(G1 \mid \pi, \bar{c})}{R(G1 \mid \pi, \bar{c}) + R(G2 \mid \pi, \bar{c})} \) represent the
proportion of revenue the agents’ perceive as going to G1 corresponding to the average
agent \( \bar{c} \). We now assume that the agents believe that the higher the possible revenues
going to one type of government, the higher the likelihood that that government
will come into existence. Specifically, we assume that agents will choose \( \pi = f(\pi) \). We next evaluate \( f(\pi) \), show that the equation \( \pi = f(\pi) \) has a unique
solution \( \pi^* \), and examine some of the properties of \( \pi^* \).

**Proposition 3.** \( f(\pi) = \left\{ \begin{array}{ll}
\frac{(1+r)(t+\delta)}{(1+r)(t+\delta) + \lambda} & \text{if } 0 \leq \pi \leq \pi_0 \
\frac{(1+r)(t+\frac{1}{\delta} + \frac{\delta}{\lambda})}{(1+r)(t+\frac{1}{\delta} + \frac{\delta}{\lambda}) + \lambda b + (1-\lambda)(1-\frac{\delta}{\lambda})\pi} & \text{if } \pi_0 < \pi < \pi_1 \
\frac{(1+r)t}{(1+r)t + \lambda b + (1-\lambda)\pi} & \text{if } \pi_1 \leq \pi \leq 1
\end{array} \right. \)

where \( \pi_0 = \max\{0, \frac{(1-\lambda)\pi - \pi}{(1-\lambda)\delta + (1+r)\delta}\} \) and \( \pi_1 = \left[ \frac{(1-\lambda)\pi}{(1-\lambda)\delta + (1+r)\delta} \right] \)

**Proof.** See Appendix.

We denote the constant value of \( f(\pi) \) when \( 0 \leq \pi \leq \pi_0 \) as \( f(\pi_0) \). Similarly, the
constant value of \( f(\pi) \) when \( \pi_1 \leq \pi \leq 1 \) is denoted by \( f(\pi_1) \).

Examination of the \( v(\pi) \) function shows that \( v(\pi_0) = \bar{c} \) so that for \( 0 \leq \pi \leq \pi_0 \),
\( v(\pi) \geq \bar{c} \) and, from P1, for the average agent \( \tau^*_\pi = 1 \). Thus, agents believe that from
the government’s perspective, tax revenue is constant in the interval \( 0 \leq \pi \leq \pi_0 \) at
this highest level of crime. Similarly, since \( v(\pi_1) = 0 \) for \( \pi_1 \leq \pi \leq 1 \), \( v(\pi) \leq 0 \) and therefore \( \tau^*_c = 0 \). Again by P1, no crime will occur, and for all \( \pi \) in this interval taxes remain the same.

**Proposition 4.** \( \pi = f(\pi) \) has a unique solution \( \pi^* \in [0, 1] \).

**Proof.** See Appendix.

Having established the unique \( \pi^* \) allows us to evaluate the optimal appropriation of agent \( c \) as \( \tau_c(\pi^*) \). For convenience, we denote this as \( \tau^*_c \). Similarly, the crime level resulting from the optimal choices of the agents is denoted by \( K(v^* | \gamma) \) where \( v^* = v(\pi^*) \).

We next investigate the relationships among \( \pi^* \), \( \tau^*_c \), and the tax revenue. Since \( \tau^*_c \) is determined by \( v^* \) (see P1), we write the next proposition in terms of \( v^* \). This focus on \( v^* \) is useful below when we consider the crime level.

**Proposition 5.** a. Any one of the following three inequalities implies the other two:
\[
\pi_0 \geq f(\pi_0), \ 0 \leq \pi^* \leq \pi_0, \ v^* \geq \overline{c}.
\]

b. Any one of the following three inequalities implies the other two:
\[
\pi_1 > f(\pi_1) \text{ and } \pi_0 < f(\pi_0), \ \pi_0 < \pi^* < \pi_1, \ 0 < v^* < \overline{c}.
\]

c. Any one of the following three inequalities implies the other two:
\[
\pi_1 \leq f(\pi_1), \ \pi_1 \leq \pi^* \leq 1, \ v^* \leq 0.
\]

**Proof.** See Appendix.

P5 establishes the importance of the values \( \pi_0 \) and \( \pi_1 \) in locating \( \pi^* \). Furthermore it establishes the location of \( \pi^* \) and the size of \( v^* \) compared to \( \overline{c} \). Recalling P1, we see that the size of \( v^* \) relative to \( \overline{c} \) will have different repercussions on different agents. This follows since agent \( c \) needs to know the relationship between \( v^* \) and \( c \), not \( \overline{c} \), in order to determine \( \tau^*_c \). These comments lead to the next proposition.
Proposition 6. a. If \( \pi_1 \leq \pi^* \leq 1 \), then all agents choose to be honest.

b. If \( 0 \leq \pi^* < \pi_1 \), then all agents steal from their firms and the proportion that steals more than \( \gamma \) depends on \( \bar{c} \).

Proof. See Appendix.

We now shift our attention to the crime level \( K(v^* | \gamma) \). Since this function depends on \( \pi^* \) through \( v^* \), we next show how \( v^* \) is explicitly determined.

Proposition 7. Let \( \bar{c} \geq \gamma \).

a. If \( \pi_0 \geq f(\pi_0) \), then \( v^* = (1 - \lambda)\bar{t} - f(\pi_0)\bar{t} + (1 + r)\delta \) and \( K(v^* | \gamma) = H(\frac{v^*}{\gamma}) \).

b. If \( \pi_1 \leq f(\pi_1) \), then \( v^* = (1 - \lambda)\bar{t} - f(\pi_1)(1 - \lambda)\bar{t} + (1 + r)\delta \) and \( K(v^* | \gamma) = 0 \).

c. If neither condition of parts a and b holds, then \( v^* \) is the unique solution in the unit interval of the function \( g_2 v^2 - g_1 v + g_0 = 0 \) where \( g_2 = (1 - \lambda)\bar{t} - (1 + r)\delta \), \( g_1 = (1 + r)\bar{c}t + \bar{c}[\lambda b + (1 - \lambda)\bar{t}] + (1 - \lambda)^2\bar{t}^2 + \delta^2(1 + r)^2 \), and \( g_0 = \bar{c}(1 - \lambda)\bar{t}[\lambda b + (1 - \lambda)\bar{t}] - \bar{c}\delta t(1 + r)^2 \) and \( K(v^* | \gamma) = H(\frac{v^*}{\gamma}) \).

Proof. See Appendix.

Since \( v^* \) depends on the parameters that describe the perceived behavior of G1 and G2, we next investigate how \( K(v^* | \gamma) \) changes as specific parameters change. The governmental parameters are \( \delta, r, b, \lambda \) and \( \bar{t} \). When focusing on a specific parameter \( \theta \), we write \( K(v^* | \gamma) \) as \( K(\theta | \gamma) \). Since a change in \( \bar{c} \) enters the model in a different way by altering the distribution \( H(c) \), it will be handled separately by an example below.

Before proceeding, we note the following. When case b of P7 holds, \( K(\theta | \gamma) \) is constant. Thus, infinitesimal changes in any parameter \( \theta \) will not change \( K(\theta | \gamma) \). The remaining cases, a and c, need closer scrutiny. In case c, \( K(\theta | \gamma) = H(\frac{v^*}{\gamma}) \) is a differentiable function of \( v^* \) since \( H(c) \) is continuous with density \( h(c) \). It follows that
\[
\frac{\partial K(\theta | \gamma)}{\partial \theta} = \frac{1}{\gamma} h\left(\frac{v^*}{\gamma}\right) \frac{\partial v^*}{\partial \theta}.
\]
Thus, the sign of \(\frac{\partial K(\theta | \gamma)}{\partial \theta}\) is the same as that of \(\frac{\partial v^*}{\partial \theta}\). We address this case next.

**Proposition 8.** Let \(0 < v^* < \gamma \leq \bar{\gamma}\). Then the sign of \(\frac{\partial v^*}{\partial \theta}\) is the same as the sign of \(g_{2\theta}v^2 - g_{1\theta}v^* + g_{0\theta}\) where \(g_{i\theta}, i = 0, 1, 2\), are the partial derivatives with respect to \(\theta\) given in Proposition 7.

**Proof.** See Appendix.

**Proposition 9.** Let \(0 < v^* < \gamma \leq \bar{\gamma}\). Then

a. \(K(\theta | \gamma)\) decreases as \(\theta = r\) or \(\delta\) increases.

b. \(K(\theta | \gamma)\) increases as \(\theta = b\) or \(\tilde{t}\) increases.

c. If \((1 - \lambda) \leq \frac{\tilde{t}}{t}[1 - \frac{b - \tilde{t}}{b}]\), \(K(\theta | \gamma)\) decreases as \(\theta = \lambda\) increases.

**Proof.** See Appendix.

The case when \(v^* \geq \bar{\gamma}\) (P7a), produces similar results as in P9. This can be seen by directly differentiating the \(v^*\) function given in part a with respect to the various parameters.

It is not surprising that the promise of an improvement in G1’s economy, i.e., an increase in \(r\), would cause more agents to wish to take advantage of this opportunity. But, if these agents believe that G1 would be the government form, then any stealing would be punished. Thus, to take advantage of the improved economic climate, the amount of stealing would have to be reduced. Similarly, an increase in the punitive rate \(\delta\) would impose a heavier cost on every thief in G1 since each thief would be caught. This, in turn, would dissuade some from stealing and reduce the overall level of crime. Part b of P9 yields an often noted result that links crime to corruption. If we interpret \(b\) as a bribe that the government extracts from criminals wishing to avoid punishment, then an increase in this type of corruption would cause, rather than deter, an increase in crime. Similarly, if G2 were to increase the tax rate \(\tilde{t}\), an
increase in the level of crime would occur. Part c of P9 shows the complexity of the factors that could cause an increase or decrease in the level of crime. In particular, the change in the level of crime due to a change in $\lambda$ cannot be predicted without imposing restrictions on other parameters. The interactions between these parameters, as well as the non-linearities inherent in the model, prevent simple predictions from being made. We illustrate this below by example. In P9 we assumed that $0 < v^* < \gamma \leq \bar{c}$. However, the case where $\bar{c} < v^* \leq \gamma$ can be shown to yield similar results.

3. Examples

In order to illustrate some additional features of the model and the level of crime associated with the parameters, we start with a baseline model of the two possible forms that the agents believe the government might take. For this baseline model, we compute the resulting level of crime. Afterwards, we alter some of the parameter values of the baseline model to illustrate some of the comparative statics established in our propositions. We also include additional results.

We assume that the distribution of agents is given by $H(c) = c \in [0, 1]$, implying that $\bar{c} = .5$.

3.1. Baseline model.

Assumptions about G1 and G2 are as follows.

G1: 1. G1 strictly enforces the rule of law and supplies a transparent fiscal policy.
   2. Honest agents are taxed at rate $t = .3$.
   3. Infrastructure is improved at the rate $r = .2$.
   4. All thieves are caught.
   5. Stolen funds are taxed at the punitive rate $(t + \delta) = .5$.

G2: 1. G2 does not strictly enforce the rule of law and its fiscal policy is uncertain.
2. Honest agents are taxed at the rate \( t = .3 \).

3. Infrastructure is not improved, i.e., \( r = 0 \).

4. Thieves are caught with probability \( \lambda = .5 \).

5a. If caught, the entire firm of the thief is taxed at the rate \( b = .6 \).

5b. If not caught, the thief keeps the stolen funds and the part of the firm remaining is taxed at the rate of \( t = .3 \) with probability \( p = .5 \) and at the rate \( t + \Delta = .7 \) with probability \( .5 \), i.e., \( \tilde{t} = .5 \).

Using these values, it follows that \( \pi_0 = 0 \) and \( \pi_1 = .5102 \). From P5, \( f(\pi_1) = .3956 \) and \( \pi^* \in (0, \pi_1) \). Since, from P7, \( v^* \) satisfies \( g_2 v^*^2 - g_1 v^* + g_0 = 0 \), we can solve this equation explicitly. This yields \( \pi^* = .4182 \) and \( v^* = .0451 \). Based on P7, the proportions of agents stealing more than 15\%, 25\% and 50\% of their firms in this benchmark case are \( K(.0451 \mid .15) = .30 \), \( K(.0451 \mid .25) = .18 \), and \( K(.0451 \mid .50) = .09 \), respectively. When there are as many high cost as low cost agents, moderate crime flourishes and there is a notable number of large crimes.

3.2. Comparative statics in the examples.

Turning to comparative statics, we note that increasing \( r, \delta, b \) or \( \tilde{t} \) results in an unambiguous change in the proportion of agents who steal from their firms as seen in P9. On the other hand, the impact of a change in \( \lambda \) is more complicated. We now illustrate part c of P9. We increase the value of \( \lambda \) from .5 to .6. We must check two conditions to illustrate part c. First, we must check whether \( \pi_0 \leq \pi^* \leq \pi_1 \) for \( \lambda = .6 \), and second, whether \( 1 - .6 \leq \frac{\tilde{t}}{\tilde{t}}[1 - \frac{b - \tilde{t}}{\tilde{t}}] \). The second condition is easily verified since the right-hand-side of the inequality equals .8. To check the first condition, we must resolve the problem for \( \lambda = .6 \). Re-solving, we have \( \pi^* = .395 \), \( v^* = .026 \), \( \pi_0 = 0 \), \( \pi_1 = .455 \) and \( f(\pi_1) = .39 \). The first condition is satisfied and we illustrate part c by computing the levels of crime. It follows from \( v^* = .026 \) that \( K(\lambda \mid .15) = .17 \), \( K(\lambda \mid .25) = .10 \), and \( K(\lambda \mid .50) = .05 \). As predicted by P9, each of these values is smaller
than its counterpart in the benchmark case: $K(\lambda \mid .15) = .30$, $K(\lambda \mid .25) = .18$, and $K(\lambda \mid .50) = .09$.

Based on the remark before P8, $\bar{c}$ could not be included in P9 so we next present an example that varies from the original illustration by changing the distribution of $c$. Let $H(c) = c^2$ for $c \in [0,1]$. Thus, $\tau = 2/3$. Reworking the illustration (setting $\lambda = .5$ again), we have $\pi^* = .4144$ and $v^* = .0469$. Here, the proportions of agents stealing more than 15%, 25% and 50% of their firms are $K(c \mid .15) = .10$, $K(c \mid .25) = .035$, and $K(c \mid .50) = .009$, respectively. Moderate crime is much lower and large crimes have been substantially reduced compared with the benchmark case.

We consider one final variation of our basic illustration that was not handled by P9, that is, the change in the basic tax rate $t$ shared by both governments. Reworking our illustration after setting $t = .5$, we have $\pi^* = .5046$ and $v^* = .0523$. Here, the proportions of agents stealing more than 15%, 25% and 50% of their firms are $K(t \mid .15) = .35$, $K(t \mid .25) = .21$, and $K(t \mid .50) = .10$. Compared to the benchmark case $K(t \mid .15) = .30$, $K(t \mid .25) = .18$, and $K(t \mid .50) = .09$, we see that the increase in the basic tax rate by G1 causes the level of crime to rise.

4. Discussion and Conclusions

Our model was chosen to explore the impact of an evolving government on the level of crime. Facing the uncertainty of the direction the government would take, agents decided how much to steal from their firms. In order to make these decisions, we assumed that the agents in this society presumed that the government’s ultimate form would be based on the level of tax revenue that that form would generate. Our results were based on the agents beliefs, and did not depend on whether the actual government had a criterion different from that assumed by the agents. Since crime would alter tax revenue, and the agents’ decisions to steal had to be made before
the government’s form was known, the probability that the government would take a particular form was determined endogenously. Having fixed the ultimate form of the government to be one of two kinds, each with known structure to the agents, we derived the ensuing level of crime. This established the connection between the level of crime and the uncertain evolving form that the government could take. We then considered the impact that changes in the characteristics of the two potential governments forms would have on the level of crime. This development was based on a number of assumptions that we now discuss.

Five key assumptions were made in our development: (1) that there were two possible future forms of government, (2) that agents believed that the realized form of government would be influenced by the taxes that that government would receive, (3) that agents believed that each government would evaluate its potential tax revenues based on an average agent, (4) the method of endogenizing \( \pi \), and (5) that the distribution of the agents’ costs of stealing, \( H(c) \), would be known to the government, as least in so far as it permitted the the government to calculate the average cost. We comment on these in turn.

It is clearly a simplification to assume that only two forms of government can arise and that each of the characteristics of these would be entirely known to the agents. Dropping all or part of this assumption would lead to complexities that would add to the degree of uncertainty that agents would face, thus exaggerating the results we found. Assuming that the implied tax revenue is instrumental in the ensuing form of government is a particularly strong assumption since it does not take into account the political or personal motivations of those that might form the next government. However, this simplification allowed us to carry through the analysis of our model. The robustness of our result will depend on how far afield our assumption is from reality. We assumed that agents believed that each possible government would calculate its future tax revenues based on those paid by the average agent \( (\bar{c}) \), and we
assumed that individual agents knew the behavior of the average agent. It is possible that each potential government could be thought of as computing the actual total tax revenues paid by all agents but it would be difficult to assume that each agent would have this information. Thus, again, this assumption was made for tractability of the model. Given the previous assumption, it seemed reasonable to assume that each agent would choose the probability that a specific form of government would come into being as a function of the anticipated tax revenues of that form of government. Our assumption that \( \pi \) is proportional to the anticipated tax revenue of \( G1 \) is a simplification of this requirement, but one that again allowed us to develop our model. Assuming \( H(c) \) to be known is a surrogate for assuming knowledge about the inclination toward crime of that society at the outset of the decision process, i.e., the initial conditions of such a propensity. It is clear that different countries would have different initial conditions and, in our model, the assumption enables agents to this into account this measure of lawlessness before making their decisions. Implicit in this is that, ceteris paribus, different countries with different initial conditions would have different levels of crime, a point that has been empirically noted many times.

While agents in western mixed market economies may be uncertain about a future government’s economic and/or social policies, we believe that this uncertainty is particularly acute in transition economies. It is in the latter that governments changed and continue to change without a firm grounding in established legal or judiciary traditions, without codes of regulation and without a consensus against self-dealing transactions. In the immediate aftermath of the collapse of communism, a new rule of law had to be established to replace the legal structures that were part of the discredited states. Agents anticipating this development had to contend with a legacy of government distrust. In this paper we investigated one consequence of this distrust.
5. Appendix

Proof of P1.

We first establish the expected utility of agent $c$ if he steals $\tau$. From the text, 
$E(G1) = (1 + r)(1 - t) - \tau \delta (1 + r) - \frac{cr^2}{2}$. Also, $E(G2) = 1 - \lambda b - (1 - \lambda)(1 - \tau)\bar{t} - \frac{cr^2}{2}$.
Finally, the expected utility of agent $c$ is $\pi E(G1) + (1 - \pi) E(G2)$ which after some collection of terms becomes $\pi (1 - t)(1 + r) + (1 - \pi)[1 - (\lambda b + (1 - \lambda)\bar{t})] + \tau[(1 - \pi)(1 - \lambda)\bar{t} - \pi \delta (1 + r)] - \frac{cr^2}{2}$. Maximizing this expression over $\tau$ for $0 \leq \tau \leq 1$ yields

$$
\tau_c(\pi) = \begin{cases} 
1 & \text{for } v(\pi) \geq c \\
\frac{v(\pi)}{c} & \text{for } 0 < v(\pi) < c \\
0 & \text{for } v(\pi) \leq 0 
\end{cases}
$$

where $v(\pi) = (1 - \lambda)\bar{t} - \pi[(1 - \lambda)\bar{t} + (1 + r)\delta]$. ♣

Proof of P2.

Assume $\pi$ is given. If $v(\pi) \leq 0$, from P1 no agent steals and thus $K(\pi \mid \gamma) = 0$, If $0 < v(\pi) < \gamma$, then agent $c$ will steal at least $\gamma$ if $c \leq \frac{v(\pi)}{\gamma}$. Thus, from the definition of $H(c)$, it follows that $K(\pi \mid \gamma) = H(\frac{v(\pi)}{\gamma})$. Finally, if $v(\pi) \geq \gamma$, then every value of $c$ will satisfy $\frac{v(\pi)}{c} \geq \gamma$ so $K(\pi \mid \gamma) = 1$. ♣

Proof of P3.

It follows from the definition of $v(\pi)$ that $v(\pi) \geq c$ if $0 \leq \pi \leq \frac{(1-\lambda)\bar{t} - c}{(1-\lambda)\bar{t} + (1+r)\delta}$, $0 < v(\pi) < c$ if $\frac{(1-\lambda)\bar{t} - c}{(1-\lambda)\bar{t} + (1+r)\delta} < \pi < \frac{(1-\lambda)\bar{t}}{(1-\lambda)\bar{t} + (1+r)\delta}$, and $v(\pi) \leq 0$ if $\frac{(1-\lambda)\bar{t}}{(1-\lambda)\bar{t} + (1+r)\delta} \leq \pi \leq 1$. Thus, for agent $c$, and using P1, we have

$$
\tau_c(\pi) = \begin{cases} 
1 & \text{if } 0 \leq \pi \leq \pi_0 \\
\frac{v(\pi)}{c} & \text{if } \pi_0 < \pi < \pi_1 \\
0 & \text{if } \pi_1 \leq \pi \leq 1 
\end{cases}
$$

where $\pi_0 = \max[0, \frac{(1-\lambda)\bar{t} - \pi}{(1-\lambda)\bar{t} + (1+r)\delta}]$ and $\pi_1 = \frac{(1-\lambda)\bar{t}}{(1-\lambda)\bar{t} + (1+r)\delta}$. 19
The government’s expected revenue corresponds to the tax revenue that results from the average agent’s optimum choice, i.e., \( \tau_\pi(\pi) \). Thus, \( R(G1 \mid \pi, \tau) = (1 + r)(t + \tau_\pi(\pi)\delta) \), i.e., the tax \( t \) on the final value of the firm plus the additional tax on the stolen part of the firm. Also, \( R(G2 \mid \pi, \tau) = \lambda b + (1 - \lambda)(1 - \tau_\pi(\pi))\bar{f} \), i.e., the government gets the "bribe" with probability \( \lambda \) and, with the remaining probability gets the taxes on the part of the firm not stolen at the expected tax rate \( \bar{f} \). It follows that \( f(\pi) = \frac{R(G1|\pi, \tau)}{R(G1|\pi, \tau) + R(G2|\pi, \tau)} = \frac{(1+r)(t+\tau_\pi(\pi)\delta)}{(1+r)(t+\tau_\pi(\pi)\delta) + \lambda b + (1-\lambda)(1-\tau_\pi(\pi))\bar{f}}. \) Finally, substituting the value of \( \tau_\pi(\pi) \) from above yields the result.

**Proof of P4.**

Examination of \( f(\pi) \) in P3 shows that it is continuous and non-increasing for \( 0 \leq \pi \leq 1 \). Furthermore, by construction, \( 0 < f(\pi) < 1 \). Thus, the function \( \pi - f(\pi) \) is a continuous, increasing function that is negative at \( \pi = 0 \) and positive at \( \pi = 1 \). Thus, it crosses the axis at a unique value, \( \pi^* \).

**Proof of P5.**

We will prove part b only since the proofs of parts a and c are similar. Let \( \pi_0 < f(\pi_0) \) and \( \pi_1 > f(\pi_1) \). Since \( \pi - f(\pi) \) is a continuous increasing function of \( \pi \), it follows that \( \pi - f(\pi) = 0 \) once in the interval \( (\pi_0, \pi_1) \), i.e., \( \pi_0 < \pi^* < \pi_1 \). Let \( \pi_0 < \pi^* < \pi_1 \). Then \( \pi - f(\pi) \) has a root in \( (\pi_0, \pi_1) \) and since \( \pi - f(\pi) \) is increasing, it follows that \( \pi_0 < f(\pi_0) \) and \( \pi_1 > f(\pi_1) \). So \( \pi_0 < f(\pi_0) \) and \( \pi_1 > f(\pi_1) \) if and only if \( \pi_0 < \pi^* < \pi_1 \). From the definitions of \( v^*, \pi_0, \) and \( \pi_1 \), it follows that we can write \( v^* - \bar{c} = d(\pi_0 - \pi^*) \) and \( v^* = d(\pi_1 - \pi^*) \) where \( d = (1-\lambda)\bar{f} + (1+r)\delta > 0 \). Thus, \( v^* < \bar{c} \) if and only if \( \pi^* > \pi_0 \) and \( v^* > 0 \) if and only if \( \pi^* < \pi_1 \). Therefore, \( \pi_0 < \pi^* < \pi_1 \) if and only if \( 0 < v^* < \bar{c} \).

**Proof of P6.**

From P5, \( \pi_1 \leq \pi \leq 1 \) implies that \( v^* \leq 0 \). From P1 this implies that \( \tau^*_c = 0 \) for all \( c \) so part a follows. Also, from P5, we have that for any \( \pi^* \in [0, \pi_1) \), \( v^* > 0 \). From P1, it follows that \( \tau^*_c > 0 \) for all \( c \) and part b follows.
Proof of P7.

a. If $\pi_0 \geq f(\pi_0)$, then by P5, $0 \leq \pi^* \leq \pi_0$ and $f(\pi) = f(\pi_0)$ over this interval. Therefore $\pi^* = f(\pi_0)$ and by definition $v^* = (1 - \lambda)\bar{t} - f(\pi_0) [(1 - \lambda)\bar{t} + (1 + r)\delta]$. Also by P5, in this interval $v^* \geq \gamma \geq 0$. Thus, $K(v^* | \gamma) = H(\frac{\pi^*}{\gamma})$.

b. If $\pi_1 \leq f(\pi_1)$, then by P5, $v^* \leq 0$ and by P1, $\tau_c^* = 0$ for all $c$. Thus, $K(v^* | \gamma) = 0$.

c. If $\pi_1 > f(\pi_1)$ and $\pi_0 < f(\pi_0)$, then from P3 it follows that $\pi^*$ satisfies $\pi^* = \frac{(1+r)(t+\frac{v^*}{\gamma})}{(1+r)(t+\frac{v^*}{\gamma}) + \lambda b + (1-\lambda)(1-\frac{v^*}{\gamma})}$. Since $v^* = (1 - \lambda)\bar{t} - \pi^* [(1 - \lambda)\bar{t} + (1 + r)\delta]$, $\pi^*$ can be written as $\frac{(1-\lambda)(1-\gamma)\bar{t} - v^*}{(1-\lambda)(1-\gamma)\bar{t} + (1+\gamma)\delta}$, making the previous equation a function of $v^*$. Multiplying through by the denominator of the right-hand-side and rearranging terms yields a quadratic equation in $v^*$, i.e., $g_2 v^2 - g_1 v^* + g_0$, where the functions $g_i$, $i = 0, 1, 2$, are given in the proposition. Since $\tau_c^* > 0$ on this interval, $K(v^* | \gamma) = H(\frac{v^*}{\gamma})$.

Proof of P8.

Implicit differentiation of the polynomial of part c of P7 shows that $v_\gamma^* = \frac{\partial v^*}{\partial \gamma}$ must satisfy $(g_1 - 2g_2 v^*) v_\gamma^* = g_2 v^* - g_1 v^* + g_0$. It remains to show that $g_1 - 2g_2 v^* > 0$. Note

\[
g_1 - 2g_2 v^* = (1 + r)\bar{t} + [\bar{t} + (1 - \lambda)\bar{t}] + (1 - \lambda)\bar{t}^2 + \delta^2 [(1 + r)^2 - 2v^* [(1 - \lambda)\bar{t} - (1 + r)\delta]] \\
\geq \tau (1 - \lambda)\bar{t} - v^* (1 - \lambda)\bar{t} + (1 - \lambda)\bar{t}^2 - v^* (1 - \lambda)\bar{t} \\
= (1 - \lambda)\bar{t}[\gamma - v^* + \bar{t} - v^*].
\]

It follows that $g_1 - 2g_2 v^* > 0$ since $v^* < (1 - \lambda)\bar{t} \leq \bar{t}$ and $v^* < \gamma$, thus the proposition follows.

Proof of P9.

Part a. Evaluating $g_2 v^* + g_1 v^* + g_0$ for $\theta = r$ yields $-\delta v^* - v^*[\bar{t}\gamma + 2\delta^2 (1 +$
Similarly, evaluating this expression for \( \theta = \delta \) yields the same sign.

Part b. When \( \theta = b \), the expression becomes \( v^*[v\lambda] + \bar{c}(1-\lambda)\bar{\ell}\lambda = \bar{c}\lambda[(1-\lambda)\bar{\ell} - v^*] > 0 \).

Now let \( \theta = \bar{\ell} \). Evaluating \( g_{2\theta}v^* - g_{1\theta}v^* + g_{0\theta} \) for \( \theta = \bar{\ell} \), yields \( v^* (1-\lambda) - v^*[v(1-\lambda) + 2(1-\lambda)^2\bar{\ell} + \bar{c}(1-\lambda)\lambda b + (1-\lambda)\bar{\ell} + \bar{c}(1-\lambda)^2\bar{\ell}] \)

\[
= (1-\lambda)\{v^*(v^* - \bar{c}) - 2(1-\lambda)\bar{\ell}(v^* - \bar{c}) + \bar{c}\lambda b\}
= (1-\lambda)\{(v^* - \bar{c})[v^* - 2(1-\lambda)\bar{\ell}] + \bar{c}\lambda b\} > 0 \text{ since } v^* < \bar{c} \text{ and } v^* < 2(1-\lambda)\bar{\ell}.

Part c. Evaluating \( g_{2\theta}v^* - g_{1\theta}v^* + g_{0\theta} \) for \( \theta = \lambda \) yields \( -\bar{\ell}v^* - v^*[v^*(b - \bar{\ell}) - 2(1-\lambda)\bar{\ell}^2] + \bar{c}(b - \bar{\ell})(1-\lambda)\bar{\ell} - \bar{\ell}\bar{\ell}[\lambda b + (1-\lambda)\bar{\ell}] \)

\[
= \bar{\ell}v^*[(1-\lambda)\bar{\ell} - v^*] + \bar{c}(b - \bar{\ell})[(1-\lambda)\bar{\ell} - v^*] + (1-\lambda)\bar{\ell}^2 v^* - \bar{\ell}\bar{\ell}[\lambda b + (1-\lambda)\bar{\ell}] .
\]

Remembering that \( v^* = (1-\lambda)\bar{\ell} - \pi^*[(1-\lambda)\bar{\ell} + (1+r)\delta] \) and the definition of \( \pi_1 \) given in P2, the sign of the last expression is unchanged when we divide through by \( [(1-\lambda)\bar{\ell} + (1+r)\delta] \) and it becomes \( \bar{\ell}v^*\pi^* + \bar{c}(b - \bar{\ell})\pi^* + [(1-\lambda)\bar{\ell}^2(\pi_1 - \pi^*) - \bar{\ell}\bar{\ell}\pi_1 - \frac{\bar{\ell}\bar{\ell}\lambda b}{(1-\lambda)\bar{\ell} + (1+r)\delta}] . \) Combining terms we have \( \bar{\ell}v^*[v^* - (1-\lambda)\bar{\ell}] + \bar{c}(b - \bar{\ell})\pi^* + [(1-\lambda)\bar{\ell}^2 - \bar{\ell}\bar{\ell}]\pi_1 - \frac{\bar{\ell}\bar{\ell}\lambda b}{(1-\lambda)\bar{\ell} + (1+r)\delta} . \) This expression is non-positive if \( \bar{\ell}(b - \bar{\ell})\pi^* + [(1-\lambda)\bar{\ell}^2 - \bar{\ell}\bar{\ell}]\pi_1 \leq 0 \) or if \( (1-\lambda) \leq \frac{\bar{\ell}}{\bar{\ell}}[1 - \frac{b - \bar{\ell}}{\bar{\ell}}] . \) The last inequality would hold if \( (1-\lambda) \leq \frac{\bar{\ell}}{\bar{\ell}}[1 - \frac{b - \bar{\ell}}{\bar{\ell}}] . \) ♦
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6. References


EBRD-World Bank Business Environment and Enterprise Performance Survey


