IHS Economics Series
Working Paper 238
May 2009

Do "Clean Hands" Ensure Healthy Growth?: Theory and Practice in the Battle Against Corruption

Raffaella Coppier
Mauro Costantini
Gustavo Piga

Institut für Höhere Studien
Institute for Advanced Studies
Vienna

Impressum

Author(s):
Raffaella Coppier, Mauro Costantini, Gustavo Piga

Title:
Do "Clean Hands" Ensure Healthy Growth?: Theory and Practice in the Battle Against Corruption

ISSN: Unspecified

2009 Institut für Höhere Studien - Institute for Advanced Studies (IHS)
Josefstädter Straße 39, A-1080 Wien
E-Mail: office@ihs.ac.at
Web: www.ihs.ac.at

All IHS Working Papers are available online: http://irihs.ihs.ac.at/view/ihs_series/
This paper is available for download without charge at:
https://irihs.ihs.ac.at/id/eprint/1917/

238

Reihe Ökonomie

Economics Series

Do "Clean Hands" Ensure Healthy Growth?

Theory and Practice in the Battle Against Corruption

Raffaella Coppier, Mauro Costantini, Gustavo Piga

238

Reihe Ökonomie

Economics Series

Do "Clean Hands" Ensure Healthy Growth?

Theory and Practice in the Battle Against Corruption

Raffaella Coppier, Mauro Costantini, Gustavo Piga

May 2009

Institut für Höhere Studien (IHS), Wien
Institute for Advanced Studies, Vienna

Contact:

Raffaella Coppier
Department of Economic and Financial Institutions
University of Macerata
Piaggia della Torre, 8
62100 Macerata (MC), Italy
email: raffaellacoppier@unimc.it

Mauro Costantini
Department of Economics
University of Vienna
Brünner Straße 72
1210 Vienna, Austria
☎: +43/1/4277-37478
email: mauro.costantini@univie.ac.at

Gustavo Piga
Department of Economics and Institutions
University of Rome Tor Vergata
Via Columbia 2
00133 Roma, Italy
email: gustavo.piga@uniroma2.it

Founded in 1963 by two prominent Austrians living in exile – the sociologist Paul F. Lazarsfeld and the economist Oskar Morgenstern – with the financial support from the Ford Foundation, the Austrian Federal Ministry of Education and the City of Vienna, the Institute for Advanced Studies (IHS) is the first institution for postgraduate education and research in economics and the social sciences in Austria. The **Economics Series** presents research done at the Department of Economics and Finance and aims to share "work in progress" in a timely way before formal publication. As usual, authors bear full responsibility for the content of their contributions.

Das Institut für Höhere Studien (IHS) wurde im Jahr 1963 von zwei prominenten Exilösterreichern – dem Soziologen Paul F. Lazarsfeld und dem Ökonomen Oskar Morgenstern – mit Hilfe der Ford-Stiftung, des Österreichischen Bundesministeriums für Unterricht und der Stadt Wien gegründet und ist somit die erste nachuniversitäre Lehr- und Forschungsstätte für die Sozial- und Wirtschafts-wissenschaften in Österreich. Die **Reihe Ökonomie** bietet Einblick in die Forschungsarbeit der Abteilung für Ökonomie und Finanzwirtschaft und verfolgt das Ziel, abteilungsinterne Diskussionsbeiträge einer breiteren fachinternen Öffentlichkeit zugänglich zu machen. Die inhaltliche Verantwortung für die veröffentlichten Beiträge liegt bei den Autoren und Autorinnen.

Abstract

This paper analyzes the existing relationship between economic growth and the monitoring of corruption and examines the possible outcome of the implementation of a State reform in order to weed out corruption. Growth is always higher when monitoring is high and therefore corruption eradicated. But growth declines when monitoring against corruption is not too high, say intermediate, so much that it makes an equilibrium with corruption and little monitoring a more growth-enhancing solution. It is also stressed that when reforms to combat corruption appear to be implausible, they tend to curb most productive investments. The model is estimated using a dynamic panel data approach for Italy. Italy has been plagued by corruption and in the late 80s and early 90s several scandals erupted which led to the well-known "Clean Hands" (Mani pulite) inquiries. Empirical results support the theoretical model.

Keywords

Corruption, growth, reform, panel data

JEL Classification

C33, D73, K42

Comments

The authors would like to thank Francesco Busato, Luca De Benedictis, Gianni De Fraia, Pietro Reichlin, Maria Cristina Rossi, and seminar participants at the Department of Economic Sciences at the University of Rome \La Sapienza" and at the Department of Economic and Financial Institutions at the University of Macerata for their very helpful suggestions. We would also like to thank Christopher John Norris. A special thanks to Francesco Nucci. The usual disclaimer applies.

Contents

1 Introduction

During the last thirty years economists from various fields have contributed to the analysis of corruption. The first paper that received widespread attention was published in 1975 (Rose-Ackerman, 1975). Since then many works have appeared in the economic literature and much attention has been paid to the relationship between corruption and economic growth. There are several ways in which corruption may reduce economic growth. Corruption can act as a tax and thus lower incentives to invest. Corruption could cause talented people to engage in rent-seeking rather than productive activities. Corruption may distort the composition of government expenditure as corrupt politicians could be expected to invest in large non-productive projects from which considerable bribes can be exacted more easily than from productive activities. Recent empirical analysis has also provided evidence of the negative effects of corruption on economic growth (for an excellent survey see Abed and Gupta, 2002). Only in some cases, it has been argued that the economic benefits of corruption outweigh its cost. According to Huntington (1968) *"[i]n terms of economic growth, the only thing worse than a society with a rigid, over-centralized dishonest bureaucracy, is one with a rigid, over-centralized, honest bureaucracy".*

In this paper, we develop a theoretical endogenous growth model which incorporates corruption. In our model, the social loss of corruption stems from the fact that entrepreneurs must bribe a bureaucrat in order to invest, and consequently devote fewer resources to the accumulation of capital. Therefore in our model corruption has a negative effect on private investment. Other models share our framework. Ehrlich and Lui (1999) claim that individuals have an incentive to compete over the privilege of becoming bureaucrats (the so-called investment in political capital) since they obtain economic rents through corruption. This investment in political capital consumes economic resources which could otherwise be used for production or investment in human capital. In Del Monte and Papagni (2001), corruption arises when bureaucrats manage public resources to produce public goods and services. Corruption reduces the quality of public infrastructure resulting in a negative effect on economic growth. Barreto (2000) presents a simple neoclassical endogenous growth model where the public sector's monopolistic position is explicitly considered. His findings indicate that a corruption equilibrium is characterized by lower growth rates compared to the ideal situation in which public goods are provided competitively. He also shows that if the public sector is subject to significant bureaucratic red-tape, all of the agents within the economy may prefer the corruption equilibrium, as corruption can bypass bureaucratic obstacles.

The novel feature of our paper is a study of the impact of monitoring of corruption on economic growth. In our theoretical model we derive a non-linear relationship between the level of monitoring and economic growth, as well as between corruption and economic growth. At low monitoring levels the economy experiences widespread corruption and medium growth rates; at intermediate monitoring levels no corruption occurs, but low growth rates are recorded; whereas at high monitoring levels no corruption occurs and high growth rates are recorded. With reference to this non-linear relationship, we then consider the effect of a reform aimed at weeding out corruption. When a reform is announced, economic agents define an expected probability regarding its permanence in time. If agents underestimate the probability of monitoring by the State, the effect of such a reform could be to lead the economy to an unintended equilibrium with low growth. The non-linear relationship between growth and monitoring is finally investigated empirically over the period 1980-2003 in Italy. In order to study this relationship new measures of monitoring are used. Our empirical evidence supports the conclusions of the model.

The paper is organized as follows: section 2 studies the relationship between the level of monitoring, corruption, and economic growth. In addition, a possible outcome of a State reform to curb corruption in terms of growth is examined. In section 3, empirical implications from the theoretical model are evaluated. Section 4 concludes.

2 Theoretical Model

Let us consider an economy producing a single homogeneous good y. Firms manufacture y with one input, capital, using one of two technologies with constant returns to scale: the modern sector technology and the one of the traditional sector. Each entrepreneur is assumed to have the same quantity of capital k. The product may be either manufactured for consumption purposes or for investment purposes. The modern sector technology is $y = a_M k$. The entrepreneurs in the modern sector must obtain a licence from the government to access the technology. In order to obtain such a licence, an entrepreneur must submit a project to a bureaucrat and this act involves an implementation cost of sk.[1] The entrepreneur may access the traditional sector without any licence being issued. In this case the output is $y = a_T k$. From this point onwards, it is assumed that $(a_M - s) > a_T > 0$, i.e. that the modern sector is more profitable than the traditional sector. In this economy there are three types of players: the State, bureaucrats and entrepreneurs. There is a continuum of bureaucrats and entrepreneurs, and their number is normalized to 1. Economic agents are risk-neutral. While entrepreneurs may invest their total capital in the modern sector or in the traditional one, bureaucrats cannot invest in the production activity, earning a fixed

[1] The cost of the project submission to the bureaucrat is a function of the investment. The underlying assumption is that, as the size of the investment grows, the cost for the entrepreneur's bureaucratic practices also grows.

salary w. It is assumed that no arbitrage is possible between the public and the private sector allowing bureaucrats to become entrepreneurs, even if their salary w is lower than the entrepreneur's net return.[2] Bureaucrats are corruptible, in the sense that they pursue their own interest, and not necessarily the one of the State. Bureaucrats are open to bribery as they issue the licence required to access the modern sector technology to the entrepreneurs submitting a project. The State controls the bureaucrats in such a way that they have a probability q (monitoring level) of being detected if they undertake a corrupt transaction.

In this model, the bureaucrat may decide not to ask for a bribe and to issue the licence to those entrepreneurs who submit a project, or else to ask for a bribe (represented by b) in exchange for the licence. Since $(a_M - s) > a_T$, the entrepreneur might find it worthwhile to offer a bribe to the corrupt bureaucrat with a view to obtaining the necessary licence to access the modern sector. The bureaucrat is assumed to have both monopolistic power (i.e. after having submitted the project, the entrepreneur cannot turn to any other bureaucrat to obtain the licence) and discretional power over granting the licence (i.e. the bureaucrat may refuse to issue the licence without being required to provide any explanation). If the bureaucrat is detected while performing a corrupt transaction, he incurs a cost (either monetary, moral, or criminal) equal to mk, where $m > 0$; the entrepreneur, if detected, incurs a cost (either monetary, moral, or criminal) equal to ck, where $c > 0$, but he is refunded the cost of the bribe paid to the bureaucrat[3].

2.1 Game Description

In the following, we refer to the entrepreneur payoff by using the superscript (E) and to the bureaucrat payoff by using the superscript (B). These represent the first and the second element of the payoff vector $\underline{\eta}_i, i = 1, 2, 3, 4$ respectively. Consider the following three-period game:

Stage 1. At stage one of the game, the entrepreneur decides in which sector to operate, i.e. whether to invest his capital in the modern or in the traditional sector. Such a decision is tantamount to the decision of whether to submit the project to the bureaucrat, considering that a licence is needed to invest in the modern sector. Project submission does not automatically result in the bureaucrat issuing a licence, as he may refuse to grant the licence unless a bribe b is paid. If the entrepreneur decides not to submit the project (preferring to invest in the traditional sector instead) the game ends and then the payoff

[2] This may be assumed since although individuals in the population (bureaucrats) have a job, they have no access to capital markets, and therefore may not become entrepreneurs.

[3] See Rose-Ackerman (1999) for details regarding the assumption of a non-constant punishment function.

vector is given by:

$$\underline{\eta}_1 = (a_T k, w) \tag{1}$$

If the entrepreneur decides to submit the project, he asks the bureaucrat to issue the licence. In this case the game continues to stage two.

Stage 2. At this stage the bureaucrat, on facing an entrepreneur who has submitted a project incurring a cost sk, may decide to issue the licence without asking for a bribe ($b = 0$).[4] In this case the game ends and the payoff vector is given by:

$$\underline{\eta}_2 = (a_M k - sk, w) \tag{2}$$

Alternatively, if he demands the payment of a bribe ($b > 0$) from the entrepreneur before he agrees to issue the licence, the game continues to stage three.

Stage 3. At stage three the entrepreneur must decide whether to pay a bribe or not. Should he decide to negotiate the payment of a bribe with the bureaucrat, the two parties will find the bribe corresponding to the Nash solution to a bargaining game (b^{NB}). If the entrepreneur decides not to negotiate with the bureaucrat, the latter will refuse to issue the licence; thus the game ends with the bureaucrat receiving his salary and the entrepreneur, after having been denied the licence, will be left with no other option but to invest in the traditional sector. In this case the game ends and the corresponding payoff vector is given by:

$$\underline{\eta}_3 = (a_T k - sk, w) \tag{3}$$

If the entrepreneur decides to pay the bribe, the expected payoffs will depend on the probability q with which the bureaucrat and the entrepreneur are monitored. In this case, the expected payoff vector is given by:

$$\underline{\eta}_4 = \big((a_M - s)k - qck - b^{NB}(1-q), w - qmk + b^{NB}(1-q)\big) \tag{4}$$

It should be noted that by construction $\underline{\eta}_2$ is preferred to $\underline{\eta}_3$ by both agents, and therefore the bureaucrat will never ask for a bribe which he knows that the entrepreneur would turn down.

[4] If agents are indifferent about whether to ask for a bribe or not, they will prefer to be honest.

2.2 The Solution to the Game

The model described in the previous section well reflects the pervasive uncertainty which is typically experienced by entrepreneurs when dealing with the Public Administration. The game may be solved by starting from the last stage using backward induction, determining the bribe b^{NB} (which is the Nash solution to a bargaining game). The bribe b^{NB} is the outcome of a negotiation between the bureaucrat and the entrepreneur (see Appendix A1 for the proof).

Proposition 2.1. *Let $q \neq 1$.*[5] *Then there is a unique non negative bribe (b^{NB}), as the Nash solution to a bargaining game, given by:*

$$b^{NB} = \mu \left[\frac{(a_M - a_T)k}{(1-q)} - \frac{q(c-m)k}{(1-q)} \right]. \tag{5}$$

where $\mu \equiv \frac{\alpha}{\alpha+\omega}$ is the share of the surplus that goes to the bureaucrat, and α and ω are parameters that can be interpreted as the bargaining strength measures of the bureaucrat and the entrepreneur respectively.

Let us assume, without loss of generality, that the entrepreneur and the bureaucrat share the surplus on an equal basis. Thus we have a standard Nash case, when $\alpha = \omega = 1$ and the entrepreneur and the bureaucrat receive equal shares. Hence the bribe is equal to:

$$b^{NB} = \frac{1}{2} \left[\frac{(a_M - a_T)k}{(1-q)} - \frac{q(c-m)k}{(1-q)} \right]. \tag{6}$$

2.2.1 Static equilibrium

The game is solved by means of backward induction starting from the last stage and the solution is formalized by the following proposition (see Appendix A2). We here focus on the case where parameters allow the greatest number of equilibria depending on the level of monitoring by the State[6].

Proposition 2.2. *Define $q_2 = \frac{(a_M-a_T)}{(c+m)} - \frac{2s}{(c+m)}$ and $q_1 = \frac{(a_M-a_T)}{(c+m)}$ with $q_1 > q_2$. Then, if $q_2 \geq 0$, $q_1 \leq 1$ and $(c+m) > 2s$:*

(a) If $q \in [0, q_2]$ then the equilibrium payoff vector is:

$$\underline{\eta}_4 = \left(\frac{(a_M + a_T)k}{2} - sk - \frac{q(c+m)k}{2}, w + \frac{(a_M - a_T)k}{2} - \frac{q(c+m)k}{2} \right) \tag{7}$$

*this is the payoff vector connected to equilibrium **C** (see below);*

[5] If $q = 1$ this stage of the game is never reached.

[6] In the Appendix A3 we show the results under all parameter conditions.

(b) if $q_2 < q < q_1$ the equilibrium payoff vector is:

$$\underline{\eta}_1 = (a_T k, w) \tag{8}$$

*this is the payoff vector connected to equilibrium **B** (see below);*

(c) If $q \in [q_1, 1]$ the equilibrium payoff vector is:

$$\underline{\eta}_2 = ((a_M - s)k, w) \tag{9}$$

*this is the payoff vector connected to equilibrium **A** (see below).*

The previous proposition shows that, depending on the parameter values, one of the three perfect Nash equilibria is obtained in the subgames:

- Equilibrium **C**: corruption and high output. When $0 \leq q \leq q_2$, i.e. if the monitoring level is low enough, the entrepreneur will enter the modern sector and will be asked to pay a bribe by the bureaucrat. Monitoring intensity is so low that the difference in gross profits, $(a_M - a_T)k$, between the modern and the traditional sector is high enough to outweigh a (relatively low) expected cost of corruption and the cost of the project.

- Equilibrium **B**: no corruption and low output. When $q_2 < q < q_1$, i.e. if the monitoring level is intermediate, the entrepreneur will not enter the modern sector and therefore will not ask for a licence. Monitoring intensity is not low enough for the entrepreneur to justify paying for the cost of the project along with the additional expected cost of paying a bribe. The difference in gross profits between modern and traditional sector does not compensate for the expected cost of corruption plus the cost of the project. Furthermore, monitoring intensity is not of a high enough level to deter the bureaucrat from asking a bribe in case the entrepreneur were to pay the cost of the project.

- Equilibrium **A**: no corruption and high output. When $q \geq q_1$, i.e. if the monitoring level is high enough, the level of monitoring intensity by the State is so high that the entrepreneur would turn down a request for a bribe even after having paid the (sunk) cost of submitting a project. Realising this fact, the bureaucrat will refrain from asking for a bribe to issue the licence. Thus the entrepreneur will enter the modern sector and will not be asked for a bribe by the bureaucrat.

Notice that in equilibrium **B** there is no corruption but low output compared to equilibrium **C** where corruption is at its highest, but output is higher. Should a State wish to lead the economy towards one of these three viable equilibria by employing a certain level of monitoring, it would realise that equilibria **A** and **C** imply a greater output than equilibrium **B**. Equilibria

A and **C** allow the same output to be obtained, even though they are considerably different from one another in terms of level of corruption (which is greatest in **C** and nonexistent in **A**).
From a static perspective, the equilibrium **A** is better than equilibrium **C** which implies the same output of equilibrium **A** but is characterized by widespread corruption, entailing higher cost, summarized by parameters c and m. **A** is also better than **B**, while **B** and **C** cannot be ranked a priori.

2.2.2 Dynamic equilibrium

Following the work of Del Monte and Papagni (2007), we expand the game perspective in order to examine the dynamic consequences of corruption on economic growth and hence on investment. Satisfaction is derived from consumption according to a simple constant elasticity utility function:

$$U = \frac{C^{1-\sigma} - 1}{1 - \sigma}$$

Each entrepreneur maximizes utility over an infinite period of time subject to a budget constraint. This problem is formalized as:

$$\max_{c \in \Re^+} \int_0^\infty e^{-\rho t} U(C) dt$$

sub

$$\overset{\bullet}{k} = \eta_i^E - C$$

where C is consumption, ρ is the discount rate over time, η_i^E is the entrepreneur's payoff.
Since η_i^E is different in each of the three equilibria, the problem is solved for each of the three cases. In the equilibrium with corruption (equilibrium **C**), the entrepreneur's payoff is:

$$\eta_4^E = \left[\frac{(a_M + a_T)k}{2} - sk - \frac{q(c+m)k}{2} \right]$$

thus the constraint is:

$$\overset{\bullet}{k} = \left[\frac{(a_M + a_T)k}{2} - sk - \frac{q(c+m)k}{2} \right] - C$$

The Hamiltonian function is:

$$H = e^{-\rho t} \frac{C^{1-\sigma} - 1}{1 - \sigma} + \lambda \left[\frac{(a_M + a_T)k}{2} - sk - \frac{q(c+m)k}{2} - C \right]$$

where λ is a costate variable. Optimization provides the following first-order conditions:

$$e^{-\rho t} C^{-\sigma} - \lambda = 0 \tag{10}$$

and

$$\overset{\bullet}{\lambda} = -\lambda \left[\frac{(a_M + a_T)}{2} - s - \frac{q(c+m)}{2} \right] \tag{11}$$

By differentiating the first condition (10) with respect to time and substituting it into the second condition (11), the consumption growth rate is obtained:

$$\gamma_C^C = \frac{1}{\sigma} \left[\frac{(a_M + a_T)}{2} - s - \frac{q(c+m)}{2} - \rho \right]$$

In equilibrium **A**, the entrepreneur's payoff is:

$$\eta_2^E = a_M k - sk$$

In this case, optimization provides the first-order conditions that allow the corresponding consumption growth rate to be obtained:

$$\gamma_A^C = \frac{1}{\sigma} [a_M - s - \rho]$$

In equilibrium **B**, the entrepreneur's payoff is:

$$\eta_1^E = a_T k$$

and the corresponding consumption growth rate is:

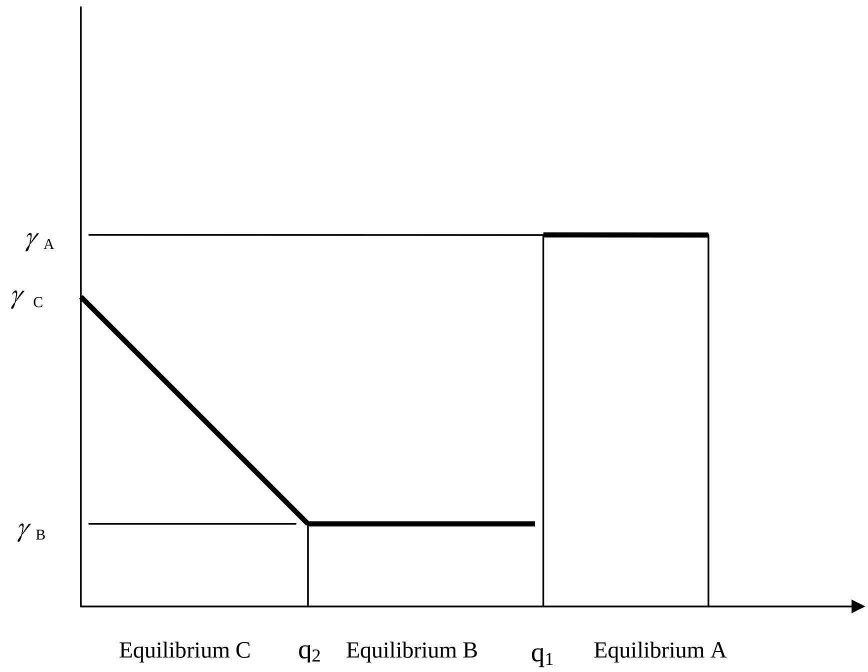
$$\gamma_B^C = \frac{1}{\sigma} [a_T - \rho]$$

It should be noted that:

$$\gamma_A^C > \gamma_C^C > \gamma_B^C$$

i.e. the equilibrium **A** (no corruption, high-level monitoring) has the highest consumption growth rate; in equilibrium **C** (pervasive corruption, low monitoring) the consumption growth rate is intermediate; and finally in equilibrium **B** (no corruption, intermediate monitoring level) the entrepreneur invests in the traditional sector, with low profits, low accumulation of capital and a low growth rate. Furthermore, it can be shown that capital and income also have the same growth rate as consumption. Therefore, of the three equilibria, from a dynamic viewpoint, equilibrium **A** is the most conducive to economic growth. This is shown in Figure 1 in terms of monitoring level and growth rate: equilibrium **A** (high-level monitoring without corruption) produces the highest growth rate since the entrepreneurs, who are investing in the modern sector without paying bribes, are able to generate greater accumulation of capital; in equilibrium **C** the growth rate is intermediate since although the entrepreneur manages to invest in the modern sector, he must pay bribes in order to do so and ends up accumulating less; finally in equilibrium **B** the entrepreneur invests in the

Figure 1: Monitoring and Growth rate.



traditional sector, with low revenues and low accumulation of capital. Thus a non-linear U-shaped relationship between the monitoring of corruption and economic growth is obtained which shall be tested empirically in the next section.

Before doing that, notice that a farsighted State, with long-term objectives, will be encouraged to implement a reform to weed out corruption by leading the economy from equilibrium **C** to equilibrium **A**, by means of increasing the level of monitoring q. While this is true also for the static context of the previous section, it should be noted the added advantage that arises in a dynamic context; not only do the costs of corruption decline, but also investment, consumption and output are higher when the State raises the monitoring intensity to a sufficiently high level. Let us thus assume that:

a) The economy is at an equilibrium characterized by widespread corruption, i.e. at equilibrium **C**, where q^* is the current monitoring level with $0 \leq q^* \leq q_2$;

b) The State announces that a higher monitoring level will be implemented, and one by which the probability of being monitored while performing a corrupt transaction increases from q^* to q_1, with $0 \leq q^* \leq q_2$. Hence we assume that the economy initially has a high level of corruption and economic growth is at an intermediate level, and that the State announces a reform designed to increase growth and eradicate corruption (to achieve equilibrium **A**). Since q_1 is the minimum monitoring level required for the economy to achieve equilibrium **A**, the State will raise the probability of being monitored to q_1.

We assume that agents will formulate expectations regarding whether or not the reform will last over time. Economic agents are assumed to estimate that there is a given probability $(1-\pi)$ that monitoring will revert to the previous level q^*. It is further assumed that the State is unaware of this belief held by economic agents. When a reform is announced, economic agents evaluate the probability of being detected (q^e), weighted according to their assessment of whether or not the reform will last over time. The probability expected by the operators is q^e with $q^e < q_1$ and equal to $q^e = q_1\pi + q^*(1-\pi)$. In this case, even if the State intends to increase monitoring to steer the economy to equilibrium **A**, operators will expect a lower value of monitoring, q^e. If this value is such that:

$$\frac{(a_M - a_T) - 2s}{(c+m)} < q^e < \frac{(a_M - a_T)}{(c+m)}$$

the economy ends up at equilibrium **B**. In terms of economic growth this outcome is not only worse than equilibrium **A** to which the State aspires to, but is also worse than the baseline equilibrium **C**. In fact, equilibrium **B** is characterized by a growth rate lower than not only of equilibrium **A**, but also of equilibrium **C**.

Although the reform was intended to foster growth by eradicating corruption, due to its lack of credibility it induces entrepreneurs to invest in the traditional sector rather than in the more innovative modern sector. Thus the level of economic growth was higher before the reform, when corruption was prevalent. This feature of the model reflects the oft-heard argument that "corruption greases the wheels of growth", but also qualifies it. Only if the State lacks complete control of the monitoring technology can such prescription apply. A credible, appropriate reform will always foster growth by curbing corruption.

3 Empirical Analysis

The relatively recent Italian nationwide *Mani Pulite* ("Clean Hands") scandal, in conjunction with judicial authorities implementing greater levels of monitoring as a consequence, drastically affected Italy's economic environment. This Italian experience lends itself naturally to verify the impact of the announcement and implementation of a "monitoring reform" on corruption and growth.[7] This section aims to empirically investigate the relationship between the level of monitoring of corruption and economic growth in Italy. The non-linear character of the relationship between monitoring level and the growth rate of income is formalized by using an empirical specification reflecting a parabolic relation between these two variables. The theoretical model is tested using new measures of monitoring.[8]

3.1 Data

The empirical analysis is based on annual data from Italian regions over the period 1980-2003. With the exception of monitoring and human capital variables, the annual data are drawn from the Prometeia Regional Accounting data-set (courtesy of ISAE). The data relating to monitoring are selected from ISTAT and the Ministero dell'Economia e delle Finanze, and data regarding human capital are drawn from the Costantini-Destefanis (2009) data-set. Appendix B provides a detailed description of the variables and their sources. The descriptive statistics of the variables are found in

[7] *Mani pulite* (Italian for "Clean Hands") was a nationwide Italian judicial investigation into political corruption, held in the 1990s. As Della Porta and Vannucci (1999) said "In Italy the history of corruption does not begin (let alone end) on February 17, 1992 (the official date that Clean Hands began). What starts at that point are the extraordinary events of public exposure of corruption, a scandal affecting the highest levels of the political and economic system, causing the most serious political crisis of the Italian Republic". The corruption system that is uncovered by these investigations is usually referred to as Tangentopoli, or "bribesville".

[8] In recent years several authors have investigated the causes and consequences of corruption in Italy (Del Monte and Papagni, 2001; Golden and Picci, 2005; Del Monte and Papagni, 2007)

Appendix C.
As regards the monitoring variable, three different measures are provided with a view to studying the effects of monitoring on economic growth. The first is based on the number of corruption crimes and is denoted as M_1. The second and the third measures use the number of pertinent judges and policemen as proxies to indicate how much of the State resources are allocated to fighting corruption related crimes. These two measures are denoted as M_2 and M_3. The first measure (M_1) is the ratio between the number of corruption crimes detected and the estimated total number of corruption crimes (see Appendix D). This is an *ex-post* variable since it only considers the results of State control activity. Therefore this index expresses the effectiveness of the monitoring activity, i.e. the monitoring which leads to the corrupt bureaucrat being successfully charged. The second and third measures are based respectively on the number of judges assigned to penal law cases (M_2) and on the number of policemen employed in the investigation of corruption related crimes (M_3). Incentives for corruption increase as the probability of being caught and punished decreases and this probability is positively dependent on the actions of judges and policemen. These two proxies are of an *ex-ante* nature, since they allow us to assess the level of monitoring implemented by the State.

3.2 Estimation Methods

The specification of the basic estimated equation corresponds to a reduced form so as to evaluate the implications of the theoretical model. Following the work of Levine and Renelt (1992), a degree of convergence on the most appropriate empirical specification for modeling growth has occurred (see Temple, 1999). Our base specification is fundamentally a "Levine-Renelt" one with the addition of the monitoring variable. We differ in that since our estimating model is dynamic rather than static (see Greenaway et al., 1998, 2002) and the growth rate is included as a regressor (lagged by one period). This specification has an obvious intuitive appeal in that it models growth in a dynamic context. However, when a lagged dependent variable is included in the regression, a correlation between the error term and this variables may be found. To provide consistent estimates, an instrumental variable procedure is adopted (see discussion on the GMM system estimator below). The regression equation is:

$$g_{y_{it}} = \beta_1 g_{y_{it-1}} + \beta_2 lny_{it-1} + \beta_3 ln(monitor_{it-1}) + \beta_4 (ln(monitor_{it-1}))^2 + \\ + \beta_5 inv_{it} + \beta_6 conpa_{it} + \beta_7 h_{it} + e_{it}, \quad (12)$$

where $g_{y_{it}}$ is the growth rate of the per capita income at 2000 constant prices, $g_{y_{it-1}}$ is the lagged growth rate of the per-capita income, lny_{it-1} is the logarithm of lagged value of the per capita income level, $ln(monitor_{it-1})$

is the log monitoring level delayed by one period, $(ln(monitor_{it-1}))^2$ is the square of the logarithm of the monitoring variable lagged by one period, inv_{it} is the share of investment in GDP, $conpa_{it}$ is public consumption over GDP and h_{it} is the stock of human capital.[9] The term e_{it} represents the error term, which is assumed to be IID. The index i refers to the cross-section dimension (regions) and the index t to the time dimension. The share of investment over GDP and the level of public consumption over GDP are important control variables.[10] The "monitoring" variable is included in the equation with a delay of one period for two reasons: firstly, because changes in the monitoring level are very likely to require some time before they influence the agents' decisions;[11] and secondly, any distortions due to simultaneity, resulting from the possible endogeneity of the "monitoring" variable, need to be mitigated, since a higher growth rate may result in more tax revenue and therefore more resources being allocated to monitoring activity.

Equation (12) is estimated using a GMM system estimator proposed by Arellano and Bond (1991) and Blundell and Bond (1998). The first step of the estimation procedure is to ensure that the model is either specified with fixed effects or with random effects. In our case, the fixed effect model has been preferred as the Hausman test results suggest (35.32, p-value 0.00).

In the dynamic panel, the OLS estimator is biased and inconsistent, even though the error term is not serially correlated (see Hsiao, 2003). The LSDV (least square dummy variable) model with a lagged dependent variable generates biased estimates when the time dimension of the panel is small (see Nickell, 1981), while when the time dimension is large (up to 30 observations), a corrected LSDV estimator seems to work better with respect to the OLS, IV and GMM estimators, with the GMM estimators as a second best solution (see Judson and Owen, 1999). However, the correction for LSDV derived by Bun and Kiviet (2003) for balanced panels only works with exogenous explanatory variables. For this reason equation (12) was estimated with a system of GMM estimators developed by Arellano and Bond (1991) and Blundell and Bond (1998). A finite sample correction for the two-step covariance matrix derived by Windmeijer (2005) is used in the estimation of the equation (12). This correction makes the robust two-step procedure more efficient than the one-step procedure, especially for system GMM. The estimation results are summarized in the next section.

[9] Details of data-set construction are found in Costantini and Destefanis (2009).

[10] See Barro (1991) and Levine and Renelt (1992).

[11] Del Monte and Papagni (2001) use two lags for the corruption variable in the economic growth regression equation for Italian regions.

3.3 Results

The estimation results are reported in Table 1. For all equations, the instruments used are "y_{it}", "$g_{y_{it}}$", $monitor$, $monitor^2$, Inv and conpa lagged for two periods. Furthermore two period dummies are used as instruments in all regressions as they are related to the monitoring variable. Dummy1 relates to the 90s decade and includes the entry into force of law n. 86 (26th of April, 1990) which substantially modified the provisions of the penal code with regard to corruption. Dummy2 takes account of the beginning of the "Clean hands" investigation (1992).

The estimated regression coefficients of the square of the logarithm of the monitoring variables are all positive (see Table 1). This confirms the existence of a parabola-shaped relationship with the concavity upwards as predicted by the theoretical model. The estimated coefficients are also statistically significant. As regards, interpreting the effect of the square of the logarithm of the monitoring variable on economic growth, since the coefficient of the logarithm of the monitoring is negative and the coefficient of the square of the logarithm of monitoring is positive, this equation implies that at low values of monitoring additional monitoring units have a negative effect on the dependent variable. At some point, the effect becomes positive, and the quadratic shape indicates that the impact of monitoring on growth is increasing as the monitoring itself increases. The sign of the parameter β_1 is positive in all cases, signifying a positive correlation between the lagged delayed growth rate and the income growth rate at time t. The associated t-statistics are also significant.

The coefficient on the lny_{it} is used to test the convergence hypothesis.[12] A negative sign denotes conditional convergence of growth rates. In our estimation, the sign of the parameter β_2 is negative in all cases and varies from -0.123 to -0.165. These estimated coefficients are also statistically significant. As regards the investment/GDP ratio (Inv) variable, the estimated coefficients are all positive and statistically significant. The values of these coefficients vary from 0.143 to 0.165. These results would seem to be in line with the literature concerning growth models (see e.g. Levine and Renelt, 1992) and similar findings are also found in other studies of Italian regions (see Auteri and Costantini, 2004). With respect to the public consumption variable, positive coefficients are found in all cases. The estimated coefficient values vary from 0.188 to 0.247 and are all statistically significant. Del Monte and Papagni (2007) found similar results, although their evidence of a positive impact of public consumption on economic growth is weaker. As regards the human capital variable, a positive and statistically significant effect on economic growth is also found. The level of education has a crucial impact on growth as it determines the economy's

[12] Jones and Manuelli (1990) and Kelly (1992) are early examples of endogenous growth models compatible with $\beta - convergence$.

capacity to (i) carry out technological innovation and, most importantly for less developed regions, (ii) adopt and efficiently utilize technology from richer regions which is the case in Italy.
In order to assess the validity of all the results, two diagnostic tests were performed: The Hansen test of the over identifying restrictions and the Arellano-Bond test for AR(1) and AR(2) autocorrelation in the first-difference residuals. As regards the Hansen test, the chi-squared statistics values for M_1, M_2 and M_3 regressions are 17.18, 16.98 and 16.67 respectively. The associated p-values are 0.900, 0.921 and 0.913. With regard to the z-statistics of the Arellano-Bond test, the following results for M_1, M_2 and M_3 regressions are found: 0.270, 0.210 and 0.450. The associated p-values are 0.743, 0.790 and 0.685. Test results support the validity of the instruments used in the estimation.

4 Conclusions

In this paper, a new theoretical model of the link between monitoring of corruption and growth is developed. The model highlights the non-linear relationship between the level of State monitoring and economic growth. The economy would clearly benefit should corruption be completely eradicated as a result of State reforms and greater controls. However, should the State fail to successfully convince agents about the effectiveness of such reforms, the level of corruption may be reduced, but economic growth could also suffer due to a consequential lack of investment. Thus a State wishing to introduce a reform to reduce corruption and improve economic growth should consider this non-linear nature of the corruption-economic growth relationship. The relationship is investigated using regional data for Italy over the period 1980-2003. The empirical results support the predictions of the model.

Table 1: Growth and Monitoring in panel data. 1980-2003

Dependent variable: $g_{y_{it}}$			
Variables	M_1	M_2	M_3
$g_{y_{i,t-1}}$	0.310	0.354	0.231
	$(3.02)^{**}$	$(2.47)^{**}$	$(2.51)^{**}$
$\ln(y_{i,t-1})$	-0.102	-0.104	-0.121
	$(2.33)^{**}$	$(2.40)^{**}$	$(2.35)^{**}$
$\ln(monitor_{i,t-1})$	-0.039	-0.032	-0.039
	$(2.89)^{**}$	$(2.28)^{**}$	$(2.89)^{**}$
$(ln(monitor_{i,t-1}))^2$	0.022	0.023	0.016
	$(3.29)^{*}$	$(2.27)^{**}$	$(2.29)^{**}$
Inv	0.143	0.165	0.154
	$(2.95)^{**}$	$(2.91)^{**}$	$(2.64)^{**}$
conpa	0.247	0.202	0.188
	$(1.86)^{*}$	$(2.32)^{**}$	$(1.83)^{*}$
h_{it}	0.042	0.056	0.048
	$(3.42)^{**}$	$(2.18)^{**}$	$(2.31)^{*}$
constant	0.378	0.362	0.328
	(1.61)	$(3.16)^{**}$	(1.54)
Hansen test: χ^2	17.18	16.98	16.67
p-values	0.900	0.921	0.913
z-statistics	0.270	0.210	0.450
p-values	0.743	0.790	0.685
No. of observations	475	457	457

Notes : *i)* t-statistics are in parenthesis; *ii)* * and ** denote 5% and 10% significant results, respectively. *iii)* z-statistics indicates Arellano-Bond test for second order autocorrelation in the first-difference residuals.

References

[1] Abed, G.T., Gupta, S., 2002. Governance, Corruption and Economic Performance, International Monetary Fund, Washington, DC.

[2] Arellano, M., Bond, S., 1991. Some Test of Specification for Panel Data: Monte Carlo Evidence and Application to Employment Equations. The Review of Economic Studies. 58, 277-297.

[3] Auteri, M., Costantini, M., 2004. Fiscal Policy and Economic Growth: the Case of Italian Regions. The Review of Regional Studies. 34, 72-93.

[4] Barreto, R., 2000. Endogenous Corruption in a Neoclassical Growth Model. European Economic Review. 44, 35-60.

[5] Barro, R.J., 1991. Economic Growth in a Cross Section of Countries. Quarterly Journal of Economics. 106, 407-444.

[6] Blundell, R., Bond S., 1998. Initial Conditions and Moment Restrictions in Dynamic Panel Data Models. Journal of Econometrics. 87, 115-43.

[7] Bun, M.J.G., Kiviet, J.F., 2003. On the Diminishing Returns of Higher Order Terms in Asymptotic Expansions of Bias. Economics Letters. 79,145-152.

[8] Costantini, M., Destefanis, S., 2009. Cointegration Analysis for Cross-sectionally Dependent Panels. The Case of Regional Production Functions. Economic Modelling. 26, 320-327.

[9] Della Porta, D.,Vannucci, A., 1999. Un Paese anormale. Come la classe politica ha perso l'occasione di Mani Pulite, Edizioni Laterza.

[10] Del Monte, A.,Papagni, E., 2001. Public Expenditure, Corruption and Economic Growth. European Journal of Political Economy. 17, 1-16.

[11] Del Monte, A., Papagni, E., 2007. The Determinants of Corruption in Italy: Regional Panel Data Analysis. European Journal of Political Economy. 23, 379-396.

[12] Ehrlich, I., Lui, F.T., 1999. Bureaucratic Corruption and Endogenous Economic Growth. Journal of Political Economy. 107, 6, 270-293.

[13] Golden M., Picci, L., 2005. Proposal for a New Measure of Corruption, Illustrated with the Italian Data. Economics & Politics. 1, 37-75.

[14] Greenaway, D., Morgan, W., Wright, P., 1998. Trade Reform, Adjustment and Growth: What Does the Evidence Tell Us? Economic Journal. 108, 1547-1561.

[15] Greenaway, D., Morgan, W., Wright, P., 2002. Trade Liberalisation and Growth in Developing Countries. Journal of Development Economics. 67, 229-244.

[16] Hsiao, C., 2003. Analysis of Panel Data, Cambridge, UK, 2nd Edition Cambridge University Press.

[17] Huntington, S. P.,1968. Political Order in Changing Societies, New Haven: Yale University Press.

[18] ISTAT, "Annuario Statistico e Giudiziario", various years

[19] ISTAT, "Conti Economici Nazionali", various years

[20] ISTAT, "Conti Economici Regionali", various years

[21] ISTAT, "Opere Pubbliche", various years

[22] Jones, L., Manuelli, R., 1990. A Convex Model of Equilibrium Growth: Theory and Policy Implications. Journal of Political Economy. 98, 5, 1008-1038.

[23] Judson, R.A., Owen, A.L., 1999. Estimating Dynamic Panel Data Models: a Guide for Macroeconomists. Economics Letters. 65, 9-15.

[24] Kelly, M., 1992. On Endogenous Growth with Productivity Shocks. Journal of Monetary Economics. 30, 1, 47-56.

[25] Levine, R., Renelt, D., 1992. A Sensitive Analysis of Cross – Country Growth Regression. American Economic Review. 82, 942-963.

[26] McMillan, J., 1991, Dango: Japans Price-fixing Conspiracies. Economics and Politics 3, 201218.

[27] Nickell, S., 1981. Biases in Dynamic Models with Fixed Effects. Econometrica. 49, 1417-1426.

[28] Porter, R.H., Zona, J.D., 1993. Detection of Bid Rigging in Procurement Auctions. Journal of Political Economy. 101, 518–538.

[29] Rose - Ackerman, S.,1975. The Economics of Corruption. Journal of Public Economics. 4, 187-203.

[30] Rose - Ackerman, S.,1999. Corruption and Government, Cambridge, UK, Cambridge University Press.

[31] Temple, J.,1999. The New Growth Evidence. Journal of Economic Literature. 37, 112-156.

[32] Windmeijer, F., 2005. A Finite Sample Correction for the Variance of Linear Two-step GMM Estimators. Journal of Econometrics. 126, 25-51.

Appendix A

A1: The Nash Bargaining bribe b^{NB}

Let $\underline{\phi}_{\Delta} = \phi_{\Delta}^{(E)}, \phi_{\Delta}^{(B)}$ be the vector of the differences in the payoffs between the case of agreement and disagreement regarding the bribe between the the entrepreneur and the bureaucrat. In accordance with generalized Nash bargaining theory, the division between two agents will solve:

$$\max_{b \in \Re+} [\phi_{\Delta}^{(E)}]^{\omega} \cdot [\phi_{\Delta}^{(B)}]^{\alpha} \tag{13}$$

in formula

$$\max_{b \in \Re+} [(a_M - a_T)k - ckq - (1-q)b]^{\omega} \, [(1-q)b - qkm]^{\alpha} \tag{14}$$

which is the maximum of the product between the elements of $\underline{\phi}_{\Delta}$ and where $[(a_T k - sk), w]$ is the point of disagreement, i.e. the payoffs that the entrepreneur and the bureaucrat would obtain respectively if they failed to reach an agreement. The parameters ω and α can be interpreted as measures of bargaining strength. It is now easy to check that the bureaucrat gets a share $\mu = \frac{\alpha}{\alpha+\omega}$ of the surplus τ, i.e. the bribe is $b^{NB} = \mu\tau$. More generally μ reflects the distribution of bargaining strength between the two agents.
Then the bribe b^{NB} is an asymmetric (or generalized) Nash bargaining solution and is given by:

$$b^{NB} = \mu \left[\frac{(a_M - a_T)k}{(1-q)} - \frac{q(c-m)k}{(1-q)} \right] \tag{15}$$

which is the unique equilibrium bribe in the last subgame, $\forall q \neq 1$.

A2: Solution to the static game

The static game is solved using backward induction, which enables the equilibria to be obtained.
Proof of Proposition 2.2.

Proof. Backward induction method.

(3) At stage three the entrepreneur negotiates the bribe if, and only if,

$$\eta_4^{(E)} > \eta_3^{(E)} \Rightarrow (a_T k - sk) < \frac{(a_M + a_T)k}{2} - sk - \frac{q(c+m)k}{2}$$

that is if the entrepreneur negotiates the bribe his payoff is greater than his payoff if he refuses. That is verified $\forall q < \frac{(a_M - a_T)}{(c+m)} = q_1$.

Notice that in order to have an admissible probability set, q must belong to $[0,1]$. It should be noted that q_1 is greater than one by assumption.
Furthermore, from now on we assume that $q_1 < 1$, i.e. the difference in returns between the two sectors must not be greater than the expected cost of corruption; consequently the presence of the probability q determines the entrepreneur's choice of whether to enter into the transaction. Then if $q < q_1$ the entrepreneur negotiates the bribe, otherwise if $q \geq q_1$ he refuses the bribe.[13]

(2) Ascending the decision-making tree, at stage two the bureaucrat decides whether or not to ask for a bribe.

• Let $q \geq q_1$ then the bureaucrat knows that the entrepreneur will not accept any bribe. Should he decide not to ask for a bribe, his payoff will be w, whereas should he decide to ask for a bribe, he knows there is no room for negotiation, and therefore he will refuse to grant the licence to the entrepreneur, who will be forced to invest in the traditional sector. In this case the bureaucrat's payoff will be w. Thus the bureaucrat's payoff is the same as if he decides to ask for a bribe equal to zero. As noted, in this case of equal payoffs, it may be assumed that the bureaucrat will prefer to be "honest", and thus not to ask for a bribe.

• Let $q < q_1$ then the bureaucrat knows that if he asks for a bribe then the entrepreneur will start a negotiation and the final bribe will be b^{NB}. Then, at stage two the bureaucrat asks for a bribe if and only if the bureaucrat's payoff on asking for a bribe is greater than his payoff if he doesn't.

$$\eta_4^{(B)} > \eta_2^{(B)} \Rightarrow$$
$$w + \frac{(a_M - a_T)k}{2} - \frac{q(c+m)k}{2} > w$$

that holds $\forall q < q_1$. Thus we can conclude that if $q < q_1$ then the bureaucrat asks for a bribe that the entrepreneur accepts.

(1) At stage one the entrepreneur has to decide whether to present the project.

• Let $q \geq q_1$ then the entrepreneur knows that if he presents a project no bribe will be asked. Should he decide not to submit the project, his payoff will be equal to $a_T k$, whereas if he decides to submit his project, his payoff will be equal to $a_M k - sk$. Therefore he will present the project if and only if

$$\eta_2^{(E)} > \eta_1^{(E)} \Rightarrow a_M k - sk > a_T$$

[13] Otherwise if $q_1 \geq 1$ then the entrepreneur will always negotiate the bribe. See appendix A3 for details.

The previous inequality is always verified by hypothesis.

• Let $q < q_1$ then the entrepreneur knows that the bureaucrat will ask for the bribe that he will accept. Should he decide not to submit the project, his payoff will be $a_T k$, whereas should he decide to submit the project and to pay the bribe to the bureaucrat, his payoff will be $\frac{(a_M - a_T)k}{2} - sk - \frac{q(c+m)k}{2}$.

Thus the entrepreneur decides to submit the project if and only if

$$\eta_4^E \geq \eta_1^E \Rightarrow$$

$$\frac{(a_M - a_T)k}{2} - sk - \frac{q(c+m)k}{2} \geq a_T k$$

which is verified if and only if

$$q \leq \frac{(a_M - a_T) - 2s}{(c+m)} = q_2.$$

Because $q_2 < q_1$ and since we assumed that $q_1 \leq 1$, then $q_2 \leq 1$. From now on we assume that $q_2 > 0$, i.e. half of the surplus (as the difference than the returns of the two productivity sectors) must be greater then the project cost[14].

□

[14]For the other cases see Appendix A3.

A3: Equilibria under all parameter conditions

If $(c+m) > 2s$ we obtain the following five cases depending on parameter conditions:

Table 2: Equilibria $(c+m) \geq 2s$

Parameter conditions	**Equilibria**
$q_2 < 0 \Leftrightarrow (a_M - a_T) < 2s$ and $q_1 \leq 1 \Leftrightarrow (a_M - a_T) \leq (c+m)$ $\Rightarrow (a_M - a_T) < 2s$	**Equilibria B and A**
$q_2 < 0 \Leftrightarrow (a_M - a_T) < 2s$ and $q_1 > 1 \Leftrightarrow (a_M - a_T) > (c+m)$ $\Rightarrow (a_M - a_T) > (c+m)$ and $(a_M - a_T) < 2s$	**Not applicable**
$q_2 \geq 0 \Leftrightarrow (a_M - a_T) \geq 2s$ and $q_1 \leq 1 \Leftrightarrow (a_M - a_T) \leq (c+m)$ $\Rightarrow 2s \leq (a_M - a_T) \leq (c+m)$	**Proposition 2.2.** **Equilibria C, B and A**
$1 > q_2 \geq 0 \Rightarrow 2s \leq (a_M - a_T) < (c+m) + 2s$ and $q_1 > 1 \Rightarrow (a_M - a_T) > (c+m)$ $\Rightarrow (c+m) < (a_M - a_T) < (c+m) + 2s$	**Equilibria C and B**
$q_2 > 1 \Leftrightarrow (a_M - a_T) > (c+m) + 2s$ and $q_1 > 1 \Leftrightarrow (a_M - a_T) > (c+m)$ $\Rightarrow (a_M - a_T) > (c+m) + 2s$	**Equilibrium C**

Table 3: Equilibria $(c+m) < 2s$

Parameter conditions	Equilibria
$q_2 < 0 \Leftrightarrow (a_M - a_T) < 2s$ and $q_1 \leq 1 \Leftrightarrow (a_M - a_T) \leq (c+m)$ $\Rightarrow (a_M - a_T) \leq (c+m)$	**Equilibria B and A**
$q_2 < 0 \Leftrightarrow (a_M - a_T) < 2s$ and $q_1 > 1 \Leftrightarrow (a_M - a_T) > (c+m)$ $\Rightarrow 2s > (a_M - a_T) > c+m$	**Equilibrium B**
$q_2 \geq 0 \Leftrightarrow (a_M - a_T) \geq 2s$ and $q_1 \leq 1 \Leftrightarrow (a_M - a_T) \leq (c+m)$ $\Rightarrow (a_M - a_T) \geq 2s$ and $(a_M - a_T) \leq (c+m)$	**Not applicable**
$1 > q_2 \geq 0 \Leftrightarrow 2s \leq (a_M - a_T) < (c+m) + 2s$ and $q_1 > 1 \Leftrightarrow (a_M - a_T) > (c+m)$ $\Rightarrow 2s \leq (a_M - a_T) < (c+m) + 2s$	**Equilibria C and B**
$q_2 > 1 \Leftrightarrow (a_M - a_T) > (c+m) + 2s$ and $q_1 > 1 \Leftrightarrow (a_M - a_T) > (c+m)$ $\Rightarrow (a_M - a_T) > (c+m) + 2s$	**Equilibrium C**

Appendix B

Table 4: Data and Sources

GDP at market prices 2000	1980-2003: PROMETEIA
Gross Fixed Investment at 2000 prices	1980-2003: PROMETEIA
Corruption Level	1980-2003: ISTAT "Annuario Statistico e Giudiziario" various years
Criminal Judges	1980-2003: Ministero dell'Economia e delle Finanze "Dipendenti delle Amministrazioni Statali" various issues
Police Forces	1980-2003: Ministero del Tesoro "Dipendenti delle Amministrazioni Statali" various issues
Population	1980-2003: PROMETEIA
Public Infrastructures Spending at 2000 prices	1980-2003: PROMETEIA
Public consumption at 2000 prices	1980-2003: PROMETEIA
Human Capital	1980-2003: Costantini and Destefanis (2008)

Notes: *i)* The legal statistics of ISTAT are one of the main sources for region-based corruption analysis. Corruption crimes fall into two classes of crimes considered by Istat. The first class includes crimes by public officials considered by the criminal code (arts. "314" and "322") and referred to as embezzlement of public funds or misappropriation (art. "324"); the second class concerns private interests in official deeds. The data considered in this study refer to the total number of crimes classified by ISTAT with classification numbers from "286" to "294", namely: "286" Embezzlement of public funds "287" Embezzlement by drawing profit from another's error "288" Misappropriation to the damage of private individuals "289" Extortion "290" Corruption for official deeds "291" Corruption for deeds contrary to official duties "292" Corruption of a party in charge of a public service "293" Corruptor's liability "294" Incitement to corruption; *ii)* Police forces data include: Arma dei Carabinieri (paramilitary police) and Polizia di Stato (state police) (see "Conto Annuale", "Dipendenti delle amministrazioni statali", codice "9", Ministero del Tesoro); *iii*: Judges data include several categories (see codice "12").

Appendix C

Table 5: Descriptive statistics

Variables	N Obs.	Mean	Min	Max	Std.Dev.
GDP (*growth rate*)	479	4.4	-9.6	5.6	0.559
M_1	478	2.230	0.967	3.204	0.336
M_2	460	5.446	0.693	7.577	1.155
M_3	460	8.448	5.575	10.822	1.010
Investment/GDP	480	0.228	0.142	0.448	0.056
Public Consumption/GDP	480	0.248	0.129	0.396	0.067
Human Capital	480	7.224	4.498	9.144	1.060

Notes: The growth rate of real per capita GDP is expressed in percentages. With reference to public consumption and investment, the unit of measurement used is millions of Euro at 2000 constant prices. M_1, M_2 and M_3 indicate the three measures of monitoring.

Appendix D

We consider the ratio between the number of detected corruption crimes and the estimated total number of corruption crimes. The number of reported corruption crimes is both a function of the corruption level, and a function of the level of prevention in place to reduce the phenomenon. The probability of being detected q, may be estimated by the ratio between detected corruption crimes, C_o, and the estimated total number of corruption crimes, C_e :

$$q = \frac{C_o}{C_e} \tag{16}$$

Most econometric studies find that corruption is a function of several variables (the legal system, government intervention, probability of being detected, etc.). Therefore we can define the estimated total number of corruption crimes:

$$C_e = A * IP * q^{\gamma} \tag{17}$$

where IP is public infrastructure spending, q is the probability of being detected and the constant A represents all the other variables that affect corruption. The rationale for focusing on public infrastructure spending is that activities surrounding public works construction are the classic locus of illegal monetary activities between public officials, both elected and appointed, and businesses. Although corruption occurs in settings other than public works contracting, the process of public works contracting is, because of inherent informational asymmetries, especially vulnerable, as substantial empirical and theoretical literatures suggest (see McMillan, 1991;

Porter and Zona, 1993)[15]. We assume that q is a non linear function of the monitoring level:

$$q = Monitoring^{\alpha} \tag{18}$$

By substituting (17) and (18) in (16), we have:

$$Monitoring^{\alpha} = \frac{C_o}{A * IP * Monitoring^{\alpha\gamma}} \Rightarrow \tag{19}$$

$$\frac{C_o}{IP} = A * Monitoring^{\alpha(\gamma+1)} \tag{20}$$

Taking logs, equation (20) written as follows:

$$log\frac{C_o}{IP} = logA + \alpha(\gamma + 1)logMonitoring \tag{21}$$

Then we use $log\frac{C_o}{IP}$ as a proxy for the dynamic of $logMonitoring$:

$$logmonitor = log\frac{\text{detected corruption crimes}}{\text{public infrastracture spending}}$$

[15]A study of press reports of Italian corruption during the twentieth century (through 1986) finds that only 17 percent of cases of corruption reported in the press concerned public works contracting. Larger percentages were reported for building permits (28 percent) and public services (20 percent) (see Golden and Picci, 2005).

Authors: Raffaella Coppier, Mauro Costantini, Gustavo Piga

Title: Do "Clean Hands" Ensure Healthy Growth? Theory and Practice in the Battle Against Corruption

Reihe Ökonomie / Economics Series 238

ISSN: 1605-7996

ISSN: 1605-7996