On the Cyclical Properties of Corruption and Turnover

Francisco J. Espinosa (NYU)

April 2015

Abstract

In this paper I study the relation between political corruption and turnover, on the one hand, and the business cycle, on the other. As a first step in this direction, I propose a particular channel (the "golden goose effect", as Niehaus and Sukhatankar (2013) call it) through which the amount of current and expected future aggregate resources affect these two political variables: an increase in the expected future corruption opportunities leads to more cautious behavior today by the incumbents, and therefore less political turnover. If the trend component of (log) output is linear in time, the cyclical component is the only determinant of the behavior of politicians. Broadly speaking, corruption (measured as the percentage of total current resources grabbed by politicians) is procyclical. I present some first attempts to bring these implications to the data, and the partial results would seem to provide some support for the idea that unexpected high income today, that will most likely vanish in the near future, triggers corruption and political turnover in the short run.

1 Introduction

In this paper I study the relation between political corruption and turnover, on the one hand, and the business cycle, on the other. More precisely, I analyze how the business cycle affects the incentives of politicians to extract rents and therefore how it also affects the probability of replacement of the incumbent (political turnover). As a first step in this direction, I propose a particular channel through which the unexpected innovations of output, and the expectations about future aggregate resources, affect these two political variables. My analysis will, however, abstract from the possible feedback that corruption may have on the performance of the economy, and from any other constraints to rent extraction that democratic institutions may impose on politicians. The only punishment that politicians face in the model economy is the threat of replacement by the citizens, which will be endogenously determined.

Corruption has received a lot of both theoretical and empirical attention by economists at least since the seminal work of Susan Rose-Ackerman (1975). The biggest difficulty in testing the predictions of the theory is in the availability of the data: corruption is inherently hard to measure in a precise way since, as in any other illegal activity, violators try to keep it secret. However, some measures based on the perception of the degree of corruption (as seen by risk analysts and businessmen) have allowed researchers to have some idea about what variables are (and are not) correlated with corruption[1]. Some stilyzed facts have thus emerged from such analyses, which are

[1] The empirical literature is summarized in Triesman (2000).

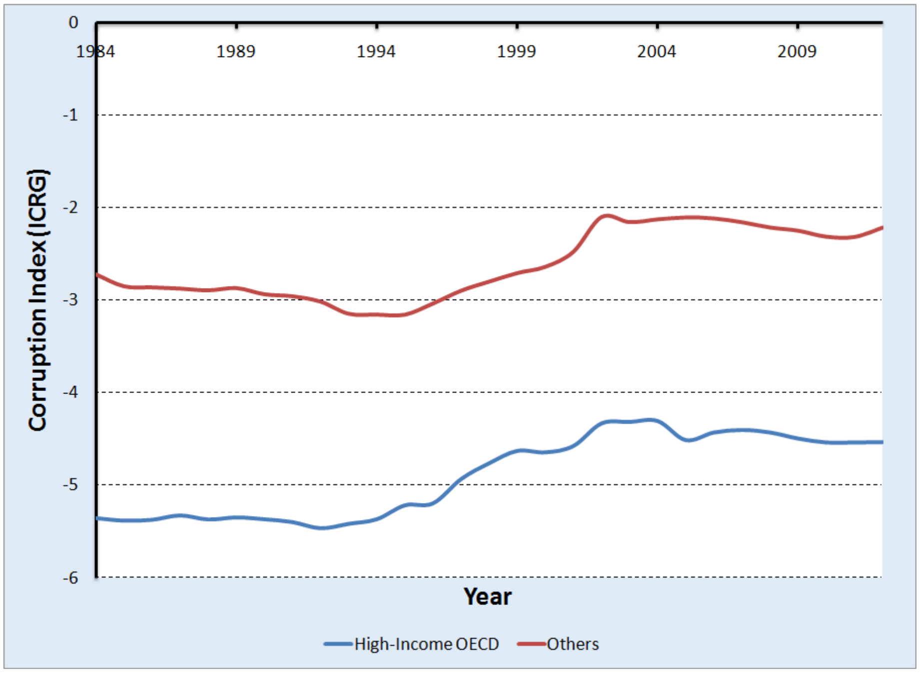


Figure 1: Figure 1. Corruption in high-income OECD and others.

in almost all of the cases of a cross-sectional nature. The empirical fact that is most closely related to my study is the (often) negative correlation between real income per capita and corruption, as Figure 1, replicated from Besley (2006), shows. The figure depicts the time series of the simple average of one of these perception indexes (the one from the International Country Risk Guide (ICRG)), over the period 1984 – 2012, for two groups: high-income OECD countries, and the rest[2]. As it is clear from the picture, corruption in the set of less developed countries is systematically higher than in the other group. Furthermore, real GDP per capita has usually a negative sign in the OLS cross national regressions that try to explain the corruption index variable. For example, in Persson and Tabellini (2003), in each of a set of five different OLS regressions of corruption on several explanatory variables, real GDP per capita maintains always a negative sign, and it is always significant at the 1% level.[3] However, the direction of causation is hard to be determined. More developed economies usually exhibit higher degree of property rights, stronger rule of law, a freer press and a more educated population, all of them being variables that help in reducing corruption. To the best of my knowledge, none of these studies tried to analyze what are the effects of a *change in current output* on *current corruption*, everything else kept constant. This is precisely what I aim to do in this paper, both at the theoretical and empirical level, and it is slightly different

[2] High-income OECD countries are: Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK, and USA.

[3] This being said, some other studies find ambigous effects of GDP per capita, changing both sign and statistical significance when running different regressions. See, for example, Ades and Di Tella (1997).

than asking what causes corruption to be higher in one place than another (which is essentially a question of cross-sectional nature).

The benchmark model economy I will analyze consists of two mandates, of one period each. In the first period, a self-interested incumbent whose degree of corruptibility is unknown to the voters, decides how to split the current aggregate resources between consumption for the citizens and rents for himself. After this decision is made and publicly observed, elections are held, and the incumbent may be replaced with a new one, whose degree of corruptibility would be again uncertain for the voters. The economy then moves to the next period, and since elections will not be held by the end of this second mandate, whoever is the incumbent has full discretion on the allocation of the second-period aggregate resources and there are no reputational concerns. The game then ends.

In this very simple framework, the driving forces behind corruption and turnover will be: (a) current output and the expectations of future aggregate resources, which together will give a measure of the incumbent's "temptation" of grabbing rents in the first period,.and (b) the voters' ignorance about the degree of corruptibility of the politician in power, which in equilibrium can be partially of fully revealed.

The equilibrium behavior of politicians and voters in the benchmark model economy will yield three basic empirical implications: if the conomy is experiencing a transitory boom (recession), (1) corruption increases (decreases), (2) the probability of turnover increases (decreases), and (3) the expected corruption in the following period decreases (increases)[4]. When I then consider an extension of the benchmark model economy to allow for multiperiod incumbency, a stylized result about the behavior of corruption within a mandate is added: corruption and turnover are completely history dependent, and in particular they depend *positively* on all realizations of the cyclical component of output up to the current period. Finally, the model suggests that corruption is weakly increasing within a mandate, but this might strongly depend on the perfect monitoring assumption I impose. In my last step, I take these results to the data, and I find partial support for them. In particular, the cyclical component of output seems to have a positive effect on corruption, as suggested by the model.

2 Related Literature

On the theoretical side, one of the main assumption in this paper is the self-interest of politicians, which is not new at all: this assumption is the pillar of the Public Choice literature which has its roots in the work of Buchanan and Tullock (1962). Since then, almost all the political economy literature has adopted this view[5] (if consumers and firms are considered to be self-interested agents, why wouldn't politicians?).

This line of research has payed big attention to the agency problem between the government and the citizens. The agency problem comes basically from the fact that voters (the principals) delegate certain power to the government (the agent) that belong to them as the sovereing, and given that politicians are self-interested, the rulers' incentives might not be aligned with those of the citizens. The agency problem thus shows up in the picture: once in office, politicians enjoy some discretion in making decisions that directly or indirectly affect those who voted them. Since, differently from what happens in the standard principal-agent setting, voters and politicians cannot sign contracts

[4] In Appendix B I show that these results do not heavily depend on the finiteness of the time horizon.

[5] Persson and Tabellini (2000) summarizes the classic problems in public choice and their results.

determining payments, the voters rather rely on the power of the election rules: they choose these rules in order to provide candidates with incentives. This is called electoral accountability, and has its roots in the work by Barro (1973) and Ferejohn (1986) . The features of politicians' self-interest and discretion in office ("lack of commitment") makes this paper belong to this old tradition.

Leaving the above features aside, the paper that is theoretically closest to mine is Acemoglu et al. (2008) . They consider a Neoclassical Growth model where the allocation of resources is decided by a politician who faces lack of commitment. Their timing of the stage game similar to mine, but they have a richer structure on the side of the citizen-voters: in their paper, voters supply labor before the incumbent decides how to allocate aggregate resources between personal rents for himself, consumption for the citizens, and investment. Everything is publicly observable, as in my model, and at the end of each period citizens decide whether to keep or to replace the incumbent. However, all politicians are identical, so this is the key difference of this paper with respect to theirs. Also, they focus their attention on the characterization and analysis of the "best sustainable Subgame Perfect Equilibrium". In my model, the finiteness of the time horizon, together with an equilibrium refinement I impose, allows the equilibrium I study to be unique. Finally, one of the properties of the equilibrium analyzed in Acemoglu et al. is that the initial politician is kept forever in power, because politicians are all identical and citizens want to provide the incumbent with incentives (for not grabbing "too much") in an efficient way. Therefore there is no turnover, and the model is not suitable for studying the behavior across time of this political variable.

As I said in the Introduction, very little is known about the cyclical behavior of corruption in a given (*i.e.*, fixed) institutional environment. Empirical studies about corruption have essentially focused on the cross-sectional effect of a higher GDP per capita, without differentiating the effects of the predictable and unpredictable components, that is, trend and cycle, respectively. Moreover, the effect of GDP per capita in these studies is often ambiguous once other economic and socio-political variables are taken into account. This is clear in, for example, the work of Ades and Di Tella (1999). In fact, in page 991 they write: "[...] the cyclical character of corruption remains an open question." This ambiguous relation may be due to the fact that we would expect not only GDP to have an effect on corruption, but also the other way around. In a seminal paper, Mauro (1995) found that corruption has a negative effect on investment and therefore growth, providing evidence in favor of the "corruption as sand in the machine" argument (as opposed to the "oil in the machine" argument).

In a recent paper, Gokcekus and Suzuki (2011) present, to the best of my knowledge, the only empirical study about the effect of transitory income on corruption. They study a panel of 39 countries over the period $1995-2007$ and find that a higher transitory income leads to an increase in corruption. However, the corruption index they use in their study is not very suitable for time-series analysis (see Lambsdorff (2008)), and the way they capture an increase in transitory income does not clearly map to the business cycle component we are used to see in the business cycle literature. Finally, they measure "permanent income" of country i as the average across time of $GDP_{i,t}/GDP_{ave,t}$ (where $GDP_{ave,t}$ is the cross-sectional average of per capita GDP at time t) They find that an increase in this variable reduces corruption, while in my paper a perfectly persistent increase in the permanent income has not effect on corruption.

In a microeconometric study, Niehaus and Sukhatankar (2013) , analyze what they call the "golden goose effect", which is the same phenomenon that in my model economy makes politicians grab less when a higher income is expected to come in the future: an increase in the expected future corruption opportunities leads to more cautious behavior today, "the agents want to preserve the goose that lays the golden eggs". They study the case of the Indian National Rural

Employment Guarantee Scheme (NREGS). On May 1*st* 2007, an exogenous increase in daily wage was implemented in the state of Orissa, and as a control group they considered the neighboring state of Andhra Pradesh, where the policy was not implemented but after some time. Corruption was measured by the level of over-reporting days of work by the officials, who are those in charge of running the projects for which the villagers are employed. Theoretically, the effect of the wage increase is ambiguous: an increase in wages increases the incentives of the officials to overreport days of work (after the implementation of the wage policy), which is a price effect, but if the change is *permanent* the golden goose effect kicks in. In order to successfully separate the the golden goose effect from the price effect, they considered projects where compensation was based on piece rates rather than daily wages. (The policy did not affect piece-rate works but only after August 16*th*, 2007, a month and a half after the study period ends.) Theory predicts that the wage increase should (*i*) reduce theft from piece-rate projects, and (*ii*) differentially reduce corruption in villages with more daily-wage projects *upcoming*. They found evidence that (1) prices do matter, since when statutory daily wages increased, officials report more fictitious work on wage projects, and (2) there was a golden goose effects: theft on piece-rate projects in Orissa declined after the shock, both in absolute terms and relative to neighboring Andhra Pradesh, and both daily-wage overreporting and piece-rate theft fell differentially (the former significantly) in villages that subsequently executed a higher share of daily-wage projects.

The main differences between Niehaus and Sukhatankar and this paper is that (1) I consider in a more careful way how punishments are implemented on the corrupt agents (this is endogenously determined in my model, whereas it is exogenously given in theirs) and (2) I study whether such a golden goose effect may hold at the aggregate level of the economy and the political sphere. More importantly, NS have a reduced form for "turnover" given by a function that determines the probability of being caught which depends positively on the gap between labor hired and labor reported by the official. Since I consider an equilibrium concept that demands for sequential rationality, a probability of re-election between 0 and 1 could be consistent with this in an environment where all politicians are identical and the voters are always indifferent between re-electing or replacing the incumbent. This equilibrium in mixed strategies is not very appealing: it would require a big amount of coordination among the voters, and it is in principle not very credible that voters always pick randomly among the candidates. Furthermore, any probability function would be consistent with equilibrium behavior, so: which one should be choose? In this paper I get a golden goose effect and at the same time voters always play pure strategies in a way that maximizes their continuation value. I obtain this by allowing politicians to be heterogeneous along a dimension which voters care about.

With respect to turnover and the reputational concerns of the incumbents, Besley and Case (1995) study the behavior of U.S. governors from 1950 to 1986 and provide empirical support for the reputation-building model: they find that governors that face term limits and therefore cannot be re-elected behave systematically and significantly different than those who can. In particular, they find that state sales and income taxes, together with total government expenditures per capita are higher in the last mandates. Governments facing term limits care less about keeping taxes and expenditures down. Finally, Krause and Méndez (2009) , study how changes in the perceived level of government corruption affects the total amount of votes obtained by an incumbent, which is extremely close to my goal in this paper. They find that higher output *growth* and lower inflation increase the incumbent's support, so good economic performance is rewarded, but at the same time corruption is punished. This could undermine the results I am after, since these findings would suggest that a higher economic cycle would lead to a higher probability of re-election, whereas in my model the only effect of a higher cyclical component of output is on corruption, which increases and it therefore makes the probability of turnover to go up. However, they do not actually consider whether incumbent *wins* re-election or not, since the dependent variable in thei regressions is the *gain* in the share of votes received by the incumbent party with respect to the previous election.

The rest of the paper is organized as follows. Section 3 presents the benchmark model economy, the equilibrium refinement I use, and the comparative statics of the unique equilibrium, which leads to the empirical implications of the model. Section 4 extends the benchmark economy to allow for multiperiod incumbency and stochastic output. The effect of the cyclical component of output become clearer there. Section 5 presents the empirical strategy, comments on the data and the reasons to use the datasets I employ in the empirical analysis. Its final subsection presents the tests I conducted so far. Section 6 (partially) concludes. Appendix A, presents the major proofs; finally, Appendix B considers an infinite-horizon economy to show that the major results of the benchmark economy do not heavily depend on the finiteness of the time horizon.

3 The Benchmark Model Economy

3.1 Environment

I consider a two-period endowment economy populated by a voter and a set of heterogeneous politicians. At every period t there is a total endowment $A_t \geq 0$ which, for now, I assume to be deterministic. All players in this economy are expected discounted utility maximizers.

The voter lives for the two periods, and his preferences for current consuption, c, are represented by the per-period utility function $u(c) = c$. This functional form is assumed for simplicty. His discount factor is $\beta \in (0,1)$, but this parameter will not play any role whatsoever.

Politicians differ in their degree of selfishness or corruptibility. This is captured by the variable $\theta \in \Theta = [0,1]$, the politician's "type", which is private information and it is distributed according to a cumulative distribution function G with full support, which is common knowledge. That is, the population of politicians is characterized by G, and this is common knowledge. $G's$ pdf exists, and it is denoted by g.

A $\theta-$type politician's preferences for rents, x, are represented by the per-period utility function

$$v(x, A, \theta) = \theta x - \frac{1}{2A}x^2, \tag{1}$$

where A is total current output. Politicians have a common discount factor $\delta \in (0,1)$. Since v has a very particular functional form, I want to spend some lines on this. The first term, "θx", says that politicians like rents, but they do it in an heterogeneous way. This is how θ represents the degree of corruptibility of a certain politician. The second term, "$-\frac{1}{2A}x^2$", says that there is a cost from grabbing, which captures institutional contraints to corruption or effort spent in illegal activities. In this way, grabbing is increasingly costly, but the bigger the cake (total available resources, A), the lower the marginal cost from rent-extraction. This utility representation says that a $\theta-$type politician has an ideal amount of rents, $x^b(A,\theta) = \theta A$, which will be called "bliss-point" throughout the paper. $x^b(A,\theta)$ globally maximizes $v(x, A, \theta)$.[6] Even if there are other sets of assumptions that

[6] Another (perhaps more natural) assumption that yields the same result is the following. Suppose a politician's type is now $\psi \in [0,1]$, and the $\psi-$type politician has per-period utility function $\psi\widetilde{v}(x) + (1-\psi)\widetilde{u}(c)$, where $\widetilde{u}(c)$ is

would lead to this bliss-point result (see footnote 6), the assumed functional form for v turns out to be extremely tractable. For example, it will give certainty equivalence.

Notice that the utility function can be also written in the following way:

$$v(x, A, \theta) = \frac{1}{2}\theta^2 A - \frac{1}{2A}(x - \theta A)^2 . \tag{2}$$

We can see that the specification I consider contains a standard loss component which increases as the distance between x and the ideal point increaes as well. The component that is independent of x, $\frac{1}{2}\theta^2 A$, is very important for the main result of my paper: the golden goose effect. The value of the incumbent from being re-elected depends positively on the expected value of A even in the case where the incumbent will be able to choose his ideal point in the second period (in which case the loss component is equal to 0).

The allocation of aggregate resources is delegated to politicians. At every period t there is only one politician in power, the incumbent. The restrictions the incumbent faces when deciding how to allocate resources at period t are $A_t \geq x_t + c_t$ and $c_t \geq 0$. In short, $x_t \in [0, A_t]$.

The game that politicians and the voter play is as follows. First, nature draws a politician (*i.e.*, a type θ) from the distribution G. This determines the identity of incumbent in period $t = 1$, and this is not oberved by the voter. Then, the incumbent decides how to allocate A_1 between consumption for the voter, c_1, and rents for himself, x_1. After this decision is publicly oberved (perfect monitoring), the voter decides whether to re-elect the incumbent or to replace him with a new one, $r \in \{0, 1\}$, where $r = 1$ denotes re-election. To replace the incumbent means to draw again from the distribution G. After the re-election decision, period $t = 2$ starts. The politicians in power decides how to allocate A_2 between c_2 and x_2, and the game ends.[7] The following picture

the voter's per-period utility function, which is now strictly concave and satisfies the Inada condition $\lim_{c\to 0} \widetilde{u}'(c) = \infty$. The same assumptions are imposed on $\widetilde{v}(x)$. If the incumbent solves

$$\max_{x,c} \left\{ \begin{array}{c} \psi \widetilde{v}(x) + (1-\psi)\widetilde{u}(c) \\ s.t. : x + c \leq A \end{array} \right\}$$

then the solution to this problem, x^*, is in the interior of $[0, A]$ and it is strictly increasing in ψ. For example, with $v = u = \ln$ we have $x^* = \psi A$.

[7] Elections in this economy can be thought to be as follows. Elections are held before the beginning of period $t = 1$. Two candidates are available, and they are ex-ante identical (i.e., voters have priors given by G for the type of both politicians). Because of lack of commitment both on the side of politicians (they enjoy full discretion when in power) and on the side of the voters (voters cannot ex-ante commit to a re-election/replacement decision), electoral campaings are cheap-talk. That is, there cannot be truthful report by the politicians. Therefore, the outcome of the elections is, to the eyes of the voters, a random draw from G. The idea is similar for the elections held before the beginning of period 2 : the incumbent runs for re-election agains an opponent, whose type is again unknown. The fact that there is full discretion and no reputational cencerns in the second mandate, would make the opponent always report in such a way that he would look preferable over the incumbent. Therefore, electoral campaings are again pure cheap-talk.

summarizes the timing and the strategies of this game.

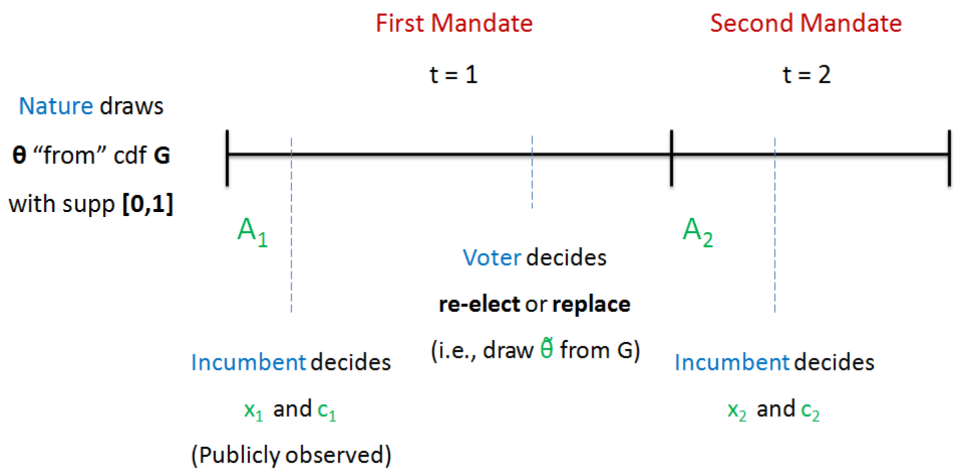


Figure 2. Timeline for the benchmark model economy.

3.2 Equilibrium

I will study Perfect Bayesian Equilibra (PBE) of this economy, but imposing some particular restrictions on the voter's beliefs when off-equilibrium events occur. This will employ a slight variation on the Intuitive Criterion (Cho and Kreps, 1987).

We may think of an equilibrium in this economy as consisting of three objects:

1. *Rent functions for politicians:* two maps from types to levels of rents in the corresponding feasible set, $x_t^* : \Theta \to [0, A_t]\,,\ t = 1, 2$;

2. *Voter's posterior beliefs:* a map from all conceivable levels of rents in period 1 to posterior beliefs held by the voter; and

3. *Re-election decision by the voter:* a map from all conceivable levels of rents in period 1 to the re-election/replacement decision, $r\,(x_1) \in \{0, 1\}$[8];

such that:

a strategies are sequentially rational given beliefs, and

b beliefs are consistent given strategies.

Consistency of beliefs in (b) says that the voter has to update his priors, given by G, according to the observed x_1 and what he expects each type θ to play in equilibrium (that is, given strategy x_1^*). We know the PBE concept imposes very specific restrictions on beliefs only for those levels of rents that are expected to be played in equilibrium by the politicians: in these cases, beliefs must

[8] I focus on pure strategies only, and furthermore I impose $r = 1$ whenever the voter is indifferent.

be updated according to Bayes' rule. However, for levels of rents that are not played in equilibrium, beliefs can be made arbitrary according to the PBE concept, and a multiplicity of equilibria thus arises in this economy. Before proceeding to the particular equilibrium refinement I will use, I briefly present some preliminary results (that hold before applying the refinement) and illustrate the reasons behind the multiplicity.

3.2.1 Some Preliminary Results

Let us go backwards. In period $t = 2$, whoever is in power will play his bliss-point, so $x_2^*(\theta) = \theta A_2$ $\forall \theta \in [0,1]$. Given this, after having observed x_1, the voter decides to re-elect the incumbent $(r(x_1) = 1)$ if, and only if,

$$E[\theta | x_1] \leq E[\theta] =: \overline{\theta}. \tag{3}$$

Since the voter is "linear", he cares only about minimizing the expected degree of corruption in period $t = 2$, $\frac{x_2}{A_2}$, which given $x_2^*(\theta)$ is equal to θ $\forall \theta \in [0,1]$. If the voter replaces the incumbent and therefore draws a new type from G, the expected degree of corruption is simply given by $\overline{\theta}$, and if the voter re-elects the incumbent, it is given by his the expected type given the information the incumbent has given to the voter by playing x_1, $E[\theta | x_1]$. Finally, given $r(x_1)$, $x_1^*(\theta)$ has to satisfy the following Incentive Compatibility constraint:

$$\theta \in \arg \max_{\theta' \in [0,1]} v\left(x_1^*\left(\theta'\right), A_1, \theta\right) + \delta \cdot r\left(x_1^*\left(\theta'\right)\right) \cdot v\left(x_2^*\left(\theta\right), A_2, \theta\right). \tag{4}$$

From the above condition we can see the following useful

Result 3.1. *If a $\theta-$type incumbent is to be replaced, and therefore $r(x_1^*(\theta)) = 0$, it has to be the case that $x_1^*(\theta)$ globally maximizes $v(x_1^*(\theta), A_1, \theta)$, so $x_1^*(\theta) = x^b(A_1, \theta) = \theta A_1$.*

If type $\theta = \overline{\theta}$ tells the voter his identity, and the voter can trust him, then the voter is just indifferent between re-electing and replacing him. Any type $\theta \in \left[0, \overline{\theta}\right)$ makes the voter strictly prefer to re-elect the incumbent, and I will call these types in $\left[0, \overline{\theta}\right]$ the "good types" throughout the paper. Finally, the voter would like to replace all types in $\left(\overline{\theta}, 1\right]$, the "bad types".

Remark 3.2 (Certainty Equivalence)**.** *Notice that the IC constraint is linear in A_2 since $v(x_2^*(\theta), A_2, \theta) = \theta^2 \frac{A_2}{2}$. Therefore, if A_2 is stochastic, we just replace A_2 by $E_1[A_2]$. This certainty equivalence allows A_2 to be more generally interpreted as the expectations about future output from period $1'$s point of view. This will be important in the following section, where I extend the model to allow for stochastic output.*

The following results can make us be somehow optimistic:

Lemma 3.3 (Good types)**.** *In any equilibrium, all types in $\left[0, \overline{\theta}\right]$ are re-elected.*

Proof. If some good type θ is not re-elected in equilibrium, he has to be playing his bliss-point, $x_1^*(\theta) = \theta A_1$. Furthermore, no other type would be playing this level of rents since he would be replaced, and then he would be strictly better-off by playing his own bliss-point. Therefore, $x_1^*(\theta)$ perfectly reveals the incumbent's type, θ, and the voter now wants to re-elect him. ∎

Lemma 3.4 (The Incurruptible)**.** *In any equilibrium, type $\theta = 0$ plays $x_1 = 0$.*

Proof. The maximum amount of utility that type $\theta = 0$ can get is 0. Playing anything different in period $t = 1$ gives strictly negative utility, so he would deviate if $x_1^*(0) \neq 0$. ■

However, not everything is good news. The following result says that we cannot expect all politicians to be "honest".

Proposition 3.5. *A fully separating equilibrium in $t = 1$ does not exist.*

Proof. Suppose a fully separating equilibrium is played by the politicians in period $t = 1$. Therefore, strategy x_1^* perfectly reveals each politician's type. The voter re-elects all the good types and replaces all the bad ones. This means that the bad types must be playing their corresponding bliss-points. Furthermore, this means that the good types grab levels of rents in the interval $\left[0, x^b\left(\overline{\theta}\right)\right]$, since otherwise they would be seen as a bad type and they would be replaced. Now, any level in this interval *that is played in equilibrium* must be played by the type whose bliss-point coincides with such level, since he would otherwise deviate. This, together with the fact that all good types play differently, means that all the good types are also grabbing their corresponding ideal amounts of rent. So, $x_1^*(\theta) = \theta A_1$ for all types. But now type $\overline{\theta} + \varepsilon$ (with $\varepsilon > 0$ and small) wants to mimic type $\overline{\theta}$, since he is willing to sacrifice a small amount of rents today in order to be re-elected and then extract his ideal amount in $t = 2$. ■

I now state the first equilibrium result, for the case when $\frac{A_1}{A_2}$ is low enough.

Proposition 3.6 (Equilibrium when $\frac{A_1}{A_2} \leq \delta$.)**.** *If $\frac{A_1}{A_2} \leq \delta$, $x_1^*(\theta) = 0$ $\forall \theta \in [0, 1]$. All types are therefore re-elected by the voter.*

Proof. Suppose the voter re-elects if, and only if, $x_1 = 0$. If type $\theta > 0$ grabs his ideal amount in $t = 1$, θA_1, he gets a total payoff of $v\left(x_1^b(\theta), A_1, \theta\right) = \theta^2 \frac{A_1}{2}$. If he plays as prescribed by the equilibrium, he obtains a total payoff of $\delta v\left(x_2^b(\theta), A_2, \theta\right) = \delta\theta^2 \frac{A_2}{2}$. Then, if $A_1 \leq \delta A_2$, he does not deviate. Finally, when the voter observes $x_1 = 0$, $E[\theta | x_1] = \overline{\theta}$, and therefore he re-elects the incumbent. ■

When $\frac{A_1}{A_2} > \delta$, the temptation to grab for the bad types is too strong, and therefore some will mimic good types just as before, but now some others will not. In particular, suppose $x_1^*(\theta)$ is as follows:

$$x_1^*(\theta) = \begin{cases} \theta_l A_1 & if\ \theta \in [\theta_l, \theta_h] \\ \\ \theta A_1 & if\ \theta \notin [\theta_l, \theta_h] \end{cases}, \tag{5}$$

where θ_l is "some" type. Since the types in $[\theta_l, \theta_h]$ are pooling together, is has to be the case that they are being re-elected in equilibrium, so it has to be true that

$$E[\theta | \theta \in [\theta_l, \theta_h]] \leq \overline{\theta}. \tag{6}$$

So $\theta_l < \overline{\theta}$ (he is a good type) and $\theta_h > \overline{\theta}$ (he is a bad type). θ_h is given by the indifference condition for this bad type (playing $\theta_l A_1$ and being re-elected vs playing $\theta_h A_1$ and being replaced):

$$\theta_h \theta_l A_1 - \frac{1}{2}\theta_l^2 A_1 + \delta\theta_h^2 \frac{A_2}{2} = \theta_h^2 \frac{A_1}{2}, \tag{7}$$

or

$$\theta_h\left(\frac{A_2}{A_1}, \theta_l\right) := \theta_l \frac{\sqrt{A_1}}{\sqrt{A_1} - \sqrt{\delta A_2}}. \tag{8}$$

Therefore, for this to be an equilibrium (in the PBE sense) we only need θ_l to satisfy $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] \leq \overline{\theta}$. But there can be several goos types "θ_l" that satisfy this condition (each of them pooled together with its corresponding θ_h). This is were the multiplicity comes from. The Figure 3 graphically summarizes this situation.

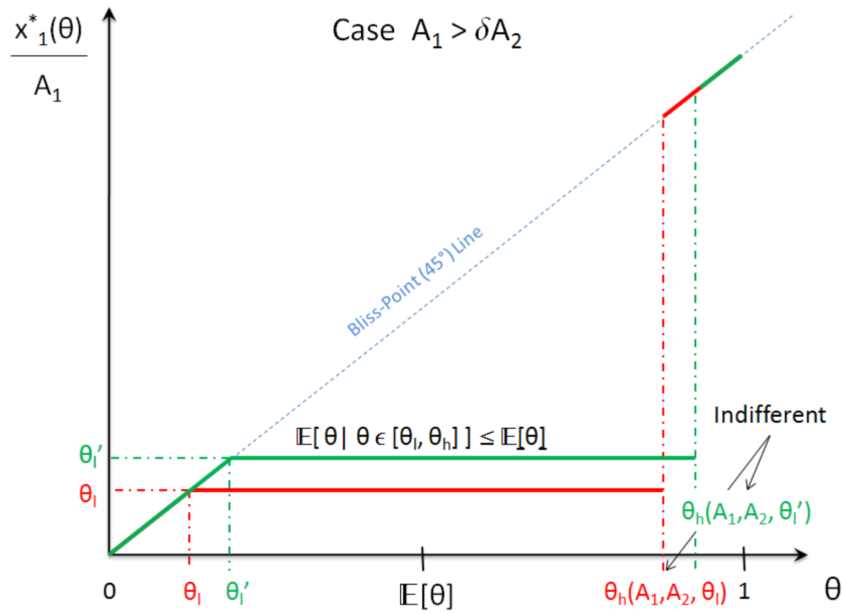


Figure 3. Multiplicity of equilibria in the case $\frac{A_1}{A_2} > \delta$.

3.2.2 Equilibrium Refinement and Its Survivor

Notice that, in equilibrium, so far, we have always some amount of pooling in $t = 1$. In particular, some of the good types pool together with some of the bad types. In view of the Good types Lemma, why are these good types not grabbing their bliss-points if they would be always re-elected? It has to be the case that the voter's beliefs for this off-equilibrium messages are such that voter replaces the incumbent. If I restrict attention to PBE, this is allowed, and the multiplicity I just illustrated must be admitted. I therefore consider a variation on the Cho-Kreps Intuitive Criterion, which consists in the following:

1. Consider some off-equilibrium message $m^o \in [0, A_1] \setminus x_1^* (\Theta)$.

2. Submit each type $\theta \in [0, 1]$ to the followin test: check whether θ is better-off by playing as prescribed by the equilibrium even if he gets re-elected by deviating and playing m^o. If he is, rule him out.

   Let $\Theta^o (m^o) \subset \Theta$ be the closure of the set of types that weren't ruled out.

3. I restrict posterior beliefs after observing m^o to satisfy

$$g'(\theta|m^o) = \begin{cases} \frac{g(\theta)}{G(\Theta^o(m^o))} & if\ \theta \in \Theta^o(m^o) \\ 0 & if\ \theta \notin \Theta^o(m^o) \end{cases}. \tag{9}$$

4. Check whether the voter decides to re-elect or replace when beliefs are given by Step 3.

5. If the voter re-elects for some m^o, then the equilibrium does not survive the refinement.

   If the voter replaces the incumbent for all off-equilibrium messages, the equilibrium survives the refinement.

The variation on the original Intuitive Criterion is given by the particular restriction on beliefs imposed in Step 3. The Intuitive Criterion in this economy would be basically given by the same procedure, but skipping this Step, since this Criterion does not impose *any* restriction on posteriors other than having support in $\Theta^o(m^o)$. Now,

Proposition 3.7. *The only equilibrium given by* (5) *and* (6) *that survives to the refinement is the one where* $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] = \overline{\theta}$. *Furthermore, there exists a unique* θ_l *that satisfies this condition.*

Proof. Appendix *A*. ∎

The appealing property of the refinement is given by the above proposition: it yields a unique equilibrium. Furthermore, the survivor satisfies $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] = \overline{\theta}$, as I just stated, and this pins θ_l down. This allows me to do comparative statics which I couldn't do with multiple equilibria.

Before proceeding to the comparative statics, I summarize the equilibria of this model economy when beliefs satisfy the proposed refinement:

Theorem 3.8 (Equilibria)**.** *Given the proposed refinement on PBE, the unique equilibrium in this economy is as follows:*

1. *In* $t = 2$, *all types take their bliss-points:* $x_2^*(\theta) = \theta A_2$;

2. *After observing* x_1, *the voter re-elects the incumbent iff* $E[\theta|x_1] \leq \overline{\theta}$.

3. *In* $t = 1$,

   (a) *if* $\frac{A_1}{A_2} \leq \delta$, $x_1^*(\theta) = 0\ \forall \theta \in [0, 1]$, *and all politicians are re-elected, and*

   (b) *if* $\frac{A_1}{A_2} > \delta$,

$$x_1^*(\theta) = \begin{cases} \theta_l A_1 & if\ \theta \in [\theta_l, \theta_h] \\ \theta A_1 & if\ \theta \notin [\theta_l, \theta_h] \end{cases}, \tag{10}$$

   where (θ_l, θ_h) *satisfy*

$$\theta_h = \theta_l \frac{\sqrt{A_1}}{\sqrt{A_1} - \sqrt{\delta A_2}}, \tag{11}$$

and

$$E[\theta|\theta \in [\theta_l, \theta_h]] = \overline{\theta}; \qquad (12)$$

type θ is re-elected if, and only if, $\theta \in [0, \theta_h]$.

Proof. Appendix *A*. ■

I close this section with the following Corollary, which says that we cannot escape from having "bad politicians":

Corollary 3.9 (Bad types curse). *There are always some bad types re-elected.*

3.3 Comparative Statics

Figure 4 depicts $x_1^*(\theta)$, as stated in the Theorem, in two different circumstances: one where $\frac{A_1}{A_2} \leq \delta$, and one where the opposite is true.

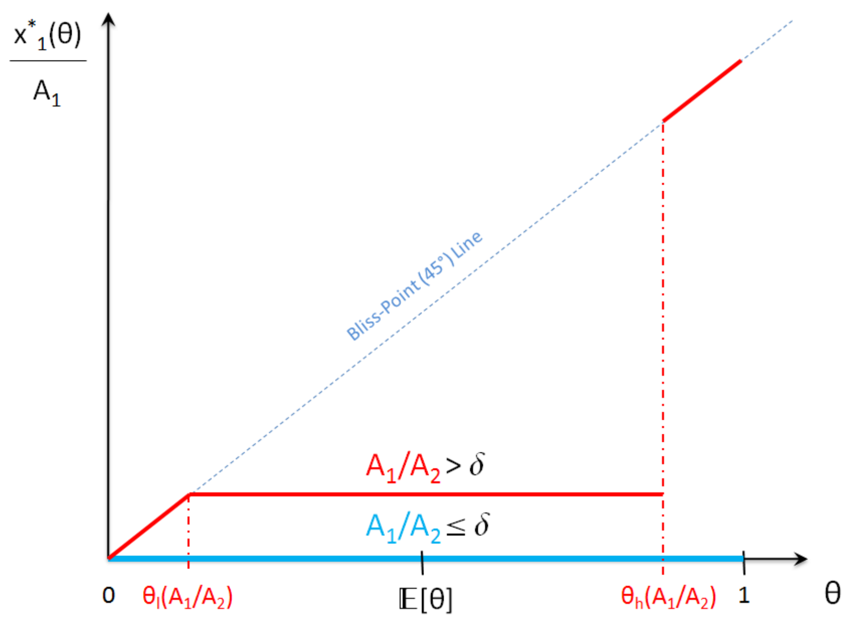


Figure 4. Equilibrium for two cases.

As stated previously, the shape that $\frac{x_1^*(\theta)}{A_1}$ takes (either "flat" or "piecewise") depends only on the ratio $\frac{A_1}{A_2}$. Now, if we consider a initial situation where $\frac{A_1}{A_2} > \delta$ (the red function in Figure 4), what happens as $\frac{A_1}{A_2}$ increases? As $\frac{A_1}{A_2}$ becomes bigger, the temptation of the bad types becomes stronger. Therefore, if we keep θ_l unaltered, θ_h, who was originally indifferent, now prefers to grab his bliss-point, reveal himself, and get replaced. The new θ_h' (the new high type that is now indifferent between mimicking the old θ_l and taking his bliss-point) should now be smaller, but this would yield $E\left[\theta|\theta \in \left[\theta_l, \theta_h'\right]\right] < \overline{\theta}$, and therefore we must "compensate" the voter, making him again indifferent. This means θ_l' has to increase. Figure 5 summarizes this effect of an increase in $\frac{A_1}{A_2}$ on $x_1^*(\theta)$.

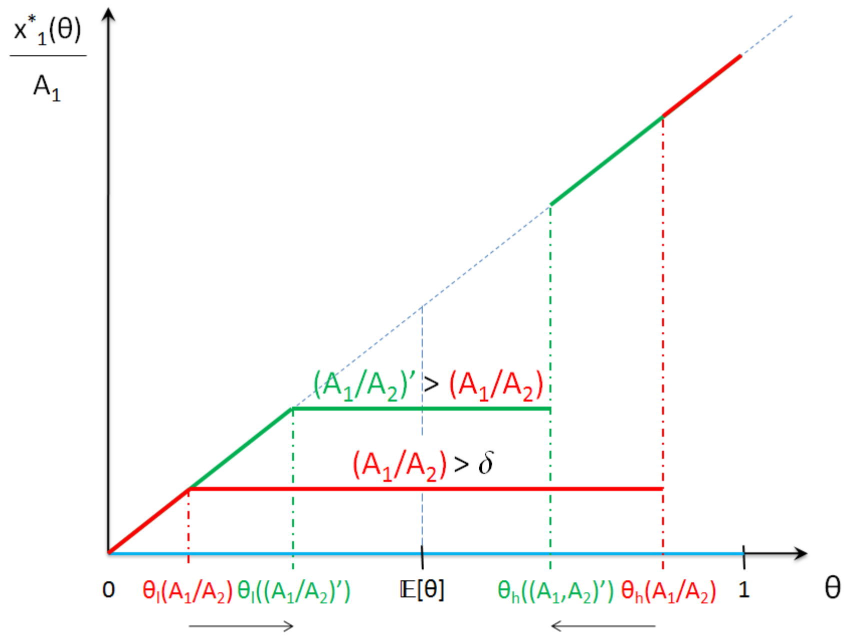


Figure 5. The equilibrium effect of an increase in $A_1/A_2 > \delta$.

As the Figure 5 shows, the pooling range shrinks (the formal proof is provided in Appendix *A*), and the fraction of output grabbed by the pooling types increases. As $\frac{A_1}{A_2} \downarrow \delta$, the piecewise function $\frac{x_1^*(\theta)}{A_1}$ approaches the blue line, which is the equilibrium for all the cases where $\frac{A_1}{A_2} \leq \delta$. An interesting feature of this equilibrium is about the limiting economy: as $\frac{A_1}{A_2} \to \infty$, $\frac{x_1^*(\theta)}{A_1}$ converges to the 45° line, which would be a fully separating equilibrium, which we already know it doesn't exist. That is, equilibrium $\frac{x_1^*(\theta)}{A_1}$ converges to a function that is not an equilibrium.

Of course the other side of the coin is given by changes in δ, since the equilibrium actually depends on the ratio $\frac{A_1}{\delta A_2}$. An increase (decrease) in δ in equivalent to a decrease (increase) in $\frac{A_1}{A_2}$.

3.3.1 Interpretation and Empirical Implications

When an economy is experiencing a transitory boom, we may think of $\frac{A_1}{A_2}$ as being large. The more corruptible or selfish politicians will take this opportunity to grab as much as they ideally want, since it is not worth trying to fool the voter in order to survive to the next mandate, since output there is expected to be "low". On the other hand, if the economy is currently in a recession, and it is expected to recover whithin the following mandate, even the very corrupted politicians will find worth waiting to the next period, so they would fool the voters by behaving as good types and extracting little amounts of rents.

To be more precise, let's call "corruption" the following variable: $E_\theta\left[\frac{x_1^*(\theta)}{A_1}\right]$. This is the expected degree of corruption in the economy before nature draws a type from G (*i.e.*, before "elections"), for a given A_1. This would be represented by the area below the $\frac{x_1^*(\theta)}{A_1}$ in Figure 5, but with "weights" for each type θ given by the pdf $g(\theta)$. Notice then that an increase from $\frac{A_1}{A_2}$ to $\left(\frac{A_1}{A_2}\right)'$ makes this variable to go up unambigously when $\left(\frac{A_1}{A_2}\right)' > \delta$, and it makes it remain the same when $\left(\frac{A_1}{A_2}\right)' \leq \delta$, so corruption is weakly increasing in $\frac{A_1}{A_2}$.

Also, let us call "turnover" the following variable: $1 - G(\theta_h)$. This is the probability of a type being in the range of bad types that reveal themselves by grabbing their bliss-points in $t = 1$. A higher $\frac{A_1}{A_2}$ forces (weakly) more revelation from the bad types (θ_h decreases as we informally saw), and therefore it triggers a higher probability of turnover.

Finally, a higher $\frac{A_1}{A_2}$ allows the voter to get rid of some very bad types by triggering more revelation, who in the second mandate would grab more than the average, $\overline{\theta}$, and therefore even if a higher $\frac{A_1}{A_2}$ yields more corruption in the first mandate, it lowers corruption in the second mandate. Formally,

$$E_0\left[\frac{x_2^*(\theta)}{A_2}\right] = \int_0^{\theta_h} \theta dG(\theta) + \int_{\theta_h}^1 \overline{\theta} dG(\theta), \tag{13}$$

and

$$\frac{\partial}{\partial(A_1/A_2)} E\left[\frac{x_2^*(\theta)}{A_2}\right] = \frac{\partial\theta_h}{\partial(A_1/A_2)} \cdot \left(\theta_h - \overline{\theta}\right) \cdot g(\theta_h) < 0, \tag{14}$$

where E_0 is the expectation computed before the very first draw from G, for a given (A_1, A_2).

It is natural to ask how strongly do these results depend on the finiteness of the time-horizon or, more precisely, to the fact that in the second mandate, since the game ends after that, all politicians grab their corresponding bliss-points. In Appendix B I show that these results still hold in an inifite-horizon economy with term limits.

The empirical implications stated so far are summarized in what follows:

Summary 3.10. *An increase in* $\frac{A_1}{A_2}$ *(or, equivalently, a decrease in* δ*)*

- *(Weakly) Increases corruption in* $t = 1$;
- *(Weakly) Increases turnover;*
- *(Weakly) Decreases corruption in* $t = 2$.

However, what should we expect to see in the data if, for example, mandates are 4 years long and a president or prime minister is in the 2^{nd} year of the term? How should corruption in this period respond to changes in current output and/or in expected future output? This is the motivation that leads us to the following extension to the benchmark model economy I have analyzed so far.

4 Multiperiod Incumbency with Stochastic Ouput

4.1 Environment

In this section I deal with a four-period economy. Periods 1 and 2 constitute the first mandate of the incumbent. Elections are held at the end of the second period, and the second manate runs from period 3 to period 4. Also, I allow for stochastic output. In particular, I assume the following process for A_t :

$$\ln A_t = T_t + \varepsilon_t, \tag{15}$$

where T_t is the trend component, which I assume to be given by

$$T_t = \ln(1+\gamma) + T_{t-1}, \tag{16}$$

and the cyclical component ε_t follows an $AR(1)$ process:

$$\varepsilon_t = \rho\varepsilon_{t-1} + \eta_t, \tag{17}$$

with $\rho \in (0,1)$ and $\eta_t \sim^{iid} N\left(0, \sigma^2\right)$. The timing is summarized in the Figure 6.

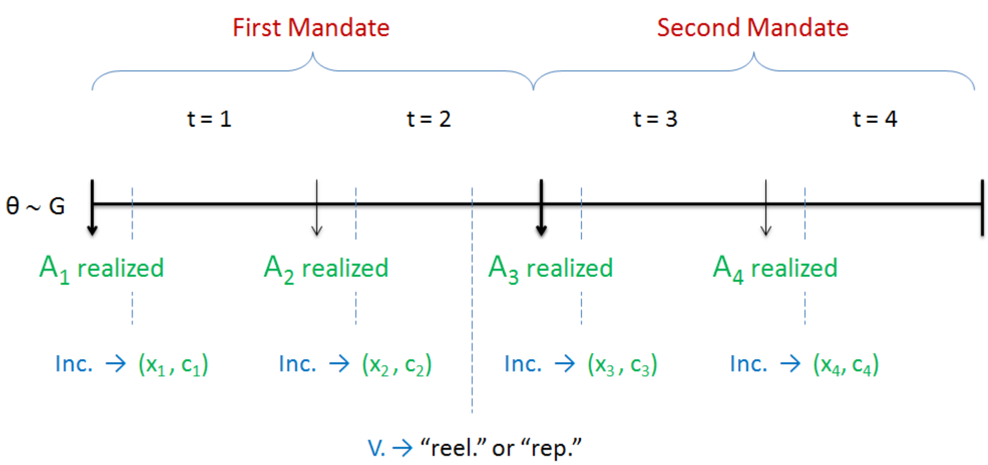


Figure 6. Timing of the game in the multiperiod incumbency model with stochastic output.

A_t is realized at the beginning of period t, and this is publicly observed. The incumbent then decides how to allocate this amount of aggregate resources (this decision is again publicly observed). If $t=2$, after this decision is made by the incumbent, the voter decides whether to re-elect or to replace him. If $t \neq 2$, after the allocation decision the economy just moves to the next period $t+1$.

4.2 Equilibrium

In the multiperiod incumbency economy with stochastic output, the equilibrium is as follows:

- in periods 3 and 4, whoever is in power will take his bliss-point, so $\frac{x_t^*(\theta)}{A_t} = \theta\ \forall\theta \in [0,1]$, $t = 3, 4$;
- the voter re-elects the incumbent after observing $h^2 = \{(A_1, x_1), (A_2, x_2)\}$, $r\left(h^2\right) = 1$, if, and only if, $E\left[\theta | h^2\right] \leq \bar{\theta}$; and
- in periods 1 and 2, $\frac{x_1^*(\theta)}{A_1}$ and $\frac{x_2^*(\theta)}{A_2}$ are as in Figures 7 and 8.

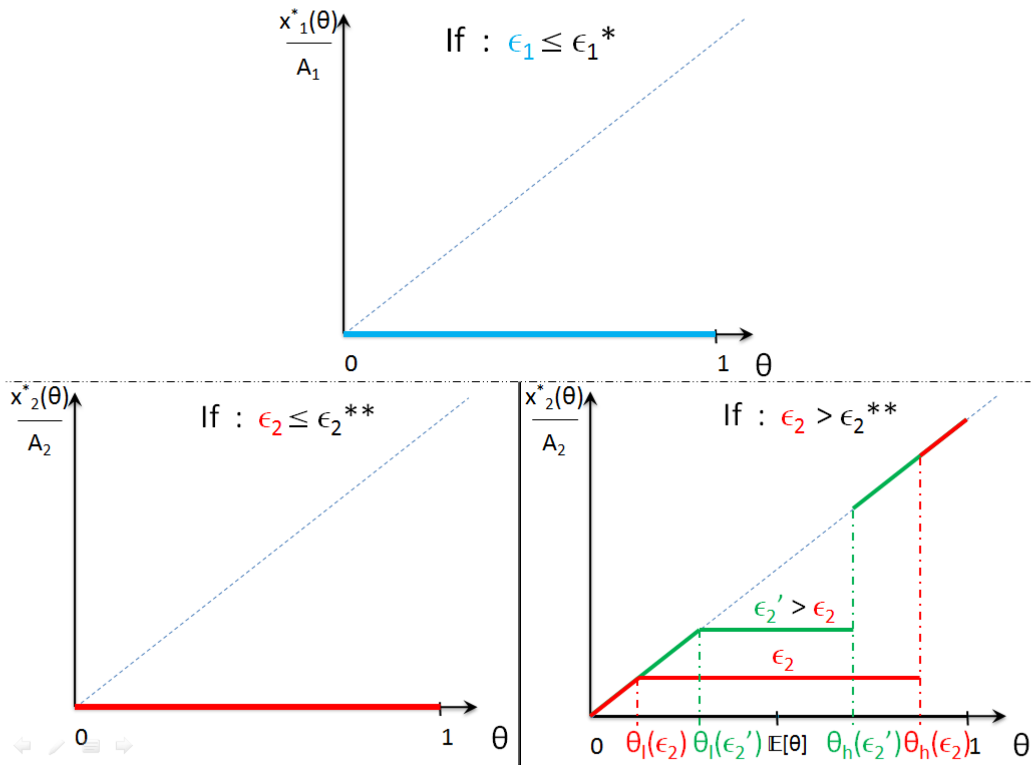


Figure 7. Equilibrium strategies $x_1^*(\theta)$ and $x_2^*(\theta)$ in the case $\varepsilon_1 \leq \varepsilon_1^{**}$.

and

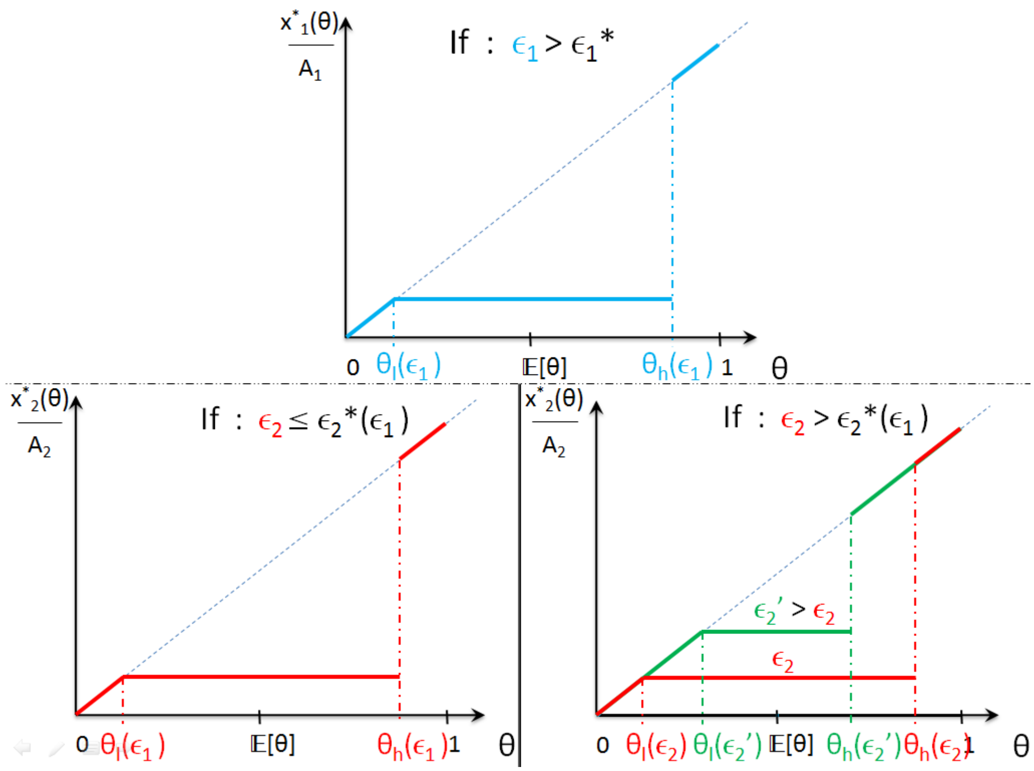


Figure 8. Equilibrium strategies $x_1^*(\theta)$ and $x_2^*(\theta)$ in the case $\varepsilon_1 > \varepsilon_1^{**}$.

The formal details of the equilibria are given in Appendix A.

The most interesting feature of the equilibria of this economy is that the degrees of corruption in the first mandate, $\frac{x_1}{A_1}$ and $\frac{x_2}{A_2}$, depend *only* on the cyclical components of the output. The trend plays no role whatsoever, but this is due to the fact that T_t was assumed to be linear in t, and therefore an increase in T_t translates into an equal increase in the future trends, T_{t+k} for $k \geq 1$. In short, and in general, the effects of both ε and T affect corruption in the first mandate (and, therefore, turnover) depending on how persistent these changes are.

When the cycle in $t = 1$ is low enough, $\varepsilon_1 \leq \varepsilon_1^{**}$ (where ε_1^{**} is a threshold defined in Appendix A), it is worth waiting at least till period 2 and not to reveal the bad types' identities. When the cycle is again low enough, $\varepsilon_2 \leq \varepsilon_2^{**}$ (where ε_2^{**} is again another threshold defined in Appendix A), the same reasoning applies. However, if $\varepsilon_2 > \varepsilon_2^{**}$, some bad types start grabbing. Moreover, the higher the level of the cycle, the higher the amount of revelation by the bad types. Since the cyclical component is not perfectly persistent ($\rho < 1$), the bad politicians take advantage of this good opportunity that will partially vanish in the near future.

When $\varepsilon_1 > \varepsilon_1^{**}$, temptation in $t = 1$ is already too strong, so there is some revelation right from the very beginning. However, if $\varepsilon_2 < \varepsilon_2^*(\varepsilon_1)$, there is no change in the degree of corruption:

the reputation "built" by the incumbent in period 1 cannot be "reversed", that is, the incumbent cannot convince the voter to be a type lower than the one he proved to "be" in the first period. There is no point in reducing the degree of corruption. When $\varepsilon_2 > \varepsilon_2^* (\varepsilon_1)$, the same old reasoning applies, and the amount of revelation is higher than in the first period.

Notice then that for a given ε_2, the degree of corruption could be quite different depending on what happened in the first period. There is full history dependence. For example, the set of levels of ε_2 in the lower-left panel of Figure 7 is fully contained in the set of levels of ε_2 in the lower-left panel of Figure 8. In the first case, where the realization of ε_1 was low, the degree of corruption in $t = 2$ is lower than in its "counterpart" from Figure 8, where the level of ε_1 was high. Therefore, the degree of corruption in $t = 2$ depends positively on the realization of ε_1, and it also depends positively on the realization of current ε_2.

Finally, notice that, for a given type θ, corruption is weakly increasing throughout the first mandate. This is because reputation cannot be "undone", so this result seems to strongly depend on the assumption of perfect monitoring.

4.3 Empirical Implications

This extension of the benchmark model economy added some empirical implications for the cyclical behavior of corruption *within* a mandate. I now summarize the empirical implications that I try to test with the data in the following section.

Summary 4.1 (Empirical Implications)**.** *Considering the results from the multiperiod incumbency economy with stochastic output, we have that*

1. ***Corruption within a mandate:***

   - *Pro-cyclicality: Corruption in* t, $E_\theta \left[\frac{x_t^*(\theta)}{A_t} \right]$, *weakly increases with cycle* ε_t, *but it also weakly increases with all previous realizations of* ε *of the current mandate.*
   - *Tenure: For a given type* θ, *corruption weakly increases with tenure of incumbent in the current mandate.*
   - *Mandate Length: A longer mandate (represented as a lower* δ *in the model economy) increases corruption.*

2. ***Turnover:***

   - *Pro-cyclicality: Turnover increases with the sequence of realizations of the cyclical component,* ε.
   - *Mandate Length: A longer mandate (represented as a lower* δ *in the model economy) increases turnover.*

3. ***Corruption between mandates:***

   - *A higher sequence of realization of the cyclical components in the first mandate increases turnover and therefore decreases corruption in the second mandate.*

There are other testable implications of the model that weren't stated. These relate to the rate of growth, γ, the volatility of the cyclical component, σ^2, and the persistence of the shocks, ρ.

A higher rate of growth is equivalent to a higher δ, and therefore this reduces corruption (it is worth "surviving"). The effect of σ is less clear, since in the equations that determine the thresholds ε_1^{**}, ε_2^{**} and $\varepsilon_2^{*}(\varepsilon_1)$ plays the same role as δ and γ, but it also affects the probability that ε falls in the different ranges that determine what's the equilibrium to be played. This can be seen in a more clear way in the case of the benchmark model economy (with output following the process in $(15)-(17)$). Condition $\frac{A_1}{A_2} \leq \delta$ becomes

$$\varepsilon_1 \leq \varepsilon_1^* := \frac{\ln\left[\delta\left(1+\gamma\right)\right]}{\left(1-\rho\right)} + \frac{\sigma^2}{2\left(1-\rho\right)}. \tag{18}$$

So a higher σ would seem to reduce corruption by increasing the threshold ε_1^* below which $x_1^*(\theta) = 0$ $\forall \theta \in [0,1]$. However,

$$\Pr\left(\varepsilon_t \leq \varepsilon_t^*\right) = \Phi\left(\sqrt{\frac{1+\rho}{1-\rho}}\left(\frac{1}{\sigma}\ln\left[\delta\left(1+\gamma\right)\right] + \frac{\sigma}{2}\right)\right), \tag{19}$$

where Φ is the cdf of a standard normal random variable. By calling Z the argument in $\Phi(\cdot)$, we have that

$$\frac{\partial Z}{\partial \sigma} > 0 \Leftrightarrow \sigma^2 > 2\ln\left[\delta\left(1+\gamma\right)\right]. \tag{20}$$

More volatile economies are more likely to have low corruption in the first mandates provided they are already sufficiently volatile.

Finally, even if the effect of ρ on the degree of corruption is ambiguous for the same reason as σ, the persistence of corruption within a mandate follows very closely that of output according to the model.

The dependence of corruption on the entire history of realizations of the cyclical component can be captured, or broadly stated, as a dependence on lagged levels of corruption. In this sense, we could say that corruption in t depends positively on both ε_t and corruption in $t-1$. In the same way, turnover should depend positively on the last realization of ε before elections and the degree of corruption up to that moment.

5 Empirical Strategy and Data (preliminary and incomplete)

The goal is to test the main empirical implications of the model economies studied in the previous sections. In particular, I want to test that (1) corruption and turnover depend positively on the magnitude of the cyclical component of output and corruption in the previous year (if the incumbent is not in his first year), (2) corruption in the second mandate decreases with the first mandate's realizations of the cyclical component, and (3) longer mandates lead to higher corruption. For now, I will present partial results for point (1).

I use a corruption index constructed by the Political Risk Service Group (PRS), the ICRG Index (from "International Country Risk Guide"). It covers an (unbalanced) panel of 146 countries over the period $1984-2014$ (a total of 3893 observations). The index goes from 0 (very corrupt) to 6 (perfectly clean). I rescaled by (-1) in order to interpret a higher index as an increase in corruption. Some remarks about this variable are in order. It measures corruption in the public sphere as perceived by the PRS. The source is therefore only one. This is very different than in the case of other, very much used, corruption perception index, Transparency International's (TI) CPI. The CPI is computed by averaging the reports of several different sources, which are never less than 3. Also, TI reports the standard deviations of the reports for each country and each year, which could be used in order to weight the different results in regressions like the one I want to run. However, the CPI is not suitable for time-series analysis, as explained by Lambsdorff (2008). This is because the main purpose of the CPI is to give a rank of countries in term of corruption for a given year. However, the ranking of a country may change from one year to the other only because the sample of countries changed, and not because the degree of corruption in that country suffered any relevant, significant variation. Another measure of corruption used for the case of the American States (which would be in principle better because the heterogeneity I would be dealing with would be smaller than in the cross-country analysis I perform) is the number of execution for public corruption in a given state in a given year. However, this would be a measure more of the performance of the judiciary system and of the effectiveness enforcement policies rather than a measure of effective corruption.

The political variables come from three different datasets: the Database of Political Institutions (DPI, 2012) from the World Bank; Polity IV, and POLCON 2012 (Henisz, 2012). From these datasets I can check, among several other things, for every country and for every year, whether the economy is a democracy or an autocracy, what is the current tenure in office of the chief executive, how many years left in office he has, and whether he can be re-elected or not. These databases also provide information about the quality of the judiciary, the competitiveness of elections both at the executive and at the legistlative level, and several other political variables that I plan to use as controls.

For the economic variables I use the data from the Penn World Tables (verion 8.0). For each country, I compute the log of real GDP per capita in dollars, and I compute the linear and cyclical components:

$$y_{i,t} = \beta_{i,0} + \beta_{i,1} \cdot t + \varepsilon_{i,t}, \tag{21}$$

where $\varepsilon_{i,t}$ and $y_{i,t} - \varepsilon_{i,t}$ are the cyclical and trend component of log-real GDP per capita, $y_{i,t}$, respectively.

The first goal is to estimate

$$Corrup_{i,t} = \alpha_0 + \alpha_1 \varepsilon_{i,t} + \alpha_2 (y_{i,t} - \varepsilon_{i,t}) + \alpha_3 X_{it} + \eta_{it}, \tag{22}$$

where $Corrup_{it}$ is our measure of the degree of corruption for country i in period t, and X_{it} is a vector where I include socio-economic and political controls, as well as time and entity fixed-effects. The theory developed previously suggest that $\alpha_1 > 0$, and $\alpha_2 = 0$.

Figure 9 is the scatter plot of the (rescaled) corruption index and real GDP per capita[9]. We can see that in this simple analysis there is a negative relationship between the level of (average) real income and corruption. The slope of the linear fit is -0.52 and it has a p-value of 0 (robust standard errors were computed). This result is similar to the one previously discussed in Figure 1 (see Section 1), which repeatedly appears in the previous literature.

[9] There are 589 observations that have data for corruption but do not have data on GDP, and 1058 cases were the opposite is true. The scatter plot contains a total of 3304 observations.

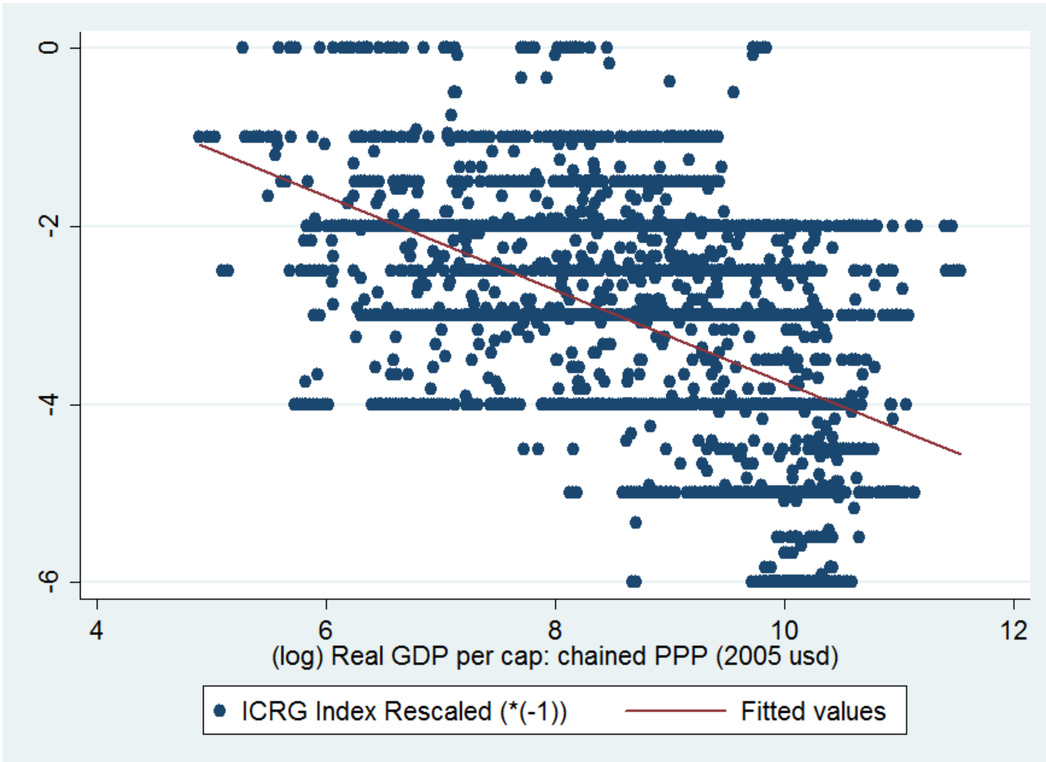


Figure 9.

The picture could be a result of the effect of institutions on both real per capita GDP and corruption. In fact, if we control for entity and time fixed-effects the sign of the relation is reversed, as the following table shows:

OLS Regression with entity and time fixed-effects

Dependent variable:	ICRG Corruption Index			
	Coef.	Robust Std. Err.	t	p-value
Real GDP per capita	0.1704	0.0585	2.92	0.004
Num. obs.:	3304		R^2 :	0.7818

If we allow for clustered standard errors, and restrict attention to "regular" cases (countries that are not in wars, are not colonies and have internal self-government), the result is the following:

OLS Regression with entity and time fixed-effects

Dependent variable:	ICRG Corruption Index			
	Coef.	Clustered Std. Err.	t	p-value
Real GDP per capita	.4947037	.1622456	3.05	0.003
Num. obs.:	2273		Clusters:	109

5.1 Corruption Regressions

The Table below shows some of the coefficients from regression (22)[10]. I control for entity and time fixed-effects, and compute robust (clustered by entity) standard errors. I restricted attention to regular cases where the country i at time t is democratic, is not in period of transitions to another system, it is not in interregnum or anarchy, and it is not under interruption of the (democratic) system. Also, I considered only those cases where the Chief Executive (CE) can be re-elected.

Dep. Var.:	Corruption Index (ICRG)	
	Coef.	p-value
Cycle RGDP per cap.	0.5583	0.043
Linear Trend	0.6985	0.103
Tenure CE	0.0157	0.054
Years Left (current mandate)	-0.0196	0.036

As we can see, the coefficient on the cyclical component is positive and significant at the 5% level, and the trend component is not significant. These results go in the direction that the theory suggests, and they hold for various specifications of the empirical model. Also, a higher tenure of the CE leads to higher corruption as, again, in our theoretical model.

Years left was intended to capture different values of δ, but this variable is almost the other side of the coin of "Tenure CE". This variable is actually not a good measure od δ, since as time goes by this variable moves, whereas δ is a parameter. The way I will try to deal with this is to consider the inverse of the length of the mandate of the CE.

When running regressions for cases where CE cannot be re-elected the effect of cycle on corruption completely disapears. (However, there are much fewer cases where this is true: these regressions contain a number of around 250 observations).

The results are so far suggestive. However, I still have to deal with the potential problem of reverse causation. In order to do this, I will consider the cycle of the prices of exports and imports (or terms of trade) as instruments for the cycle of output.

[10] A total of 29 control variables where included. Appendix C explains the entire regression and its variables in detail.

5.2 Turnover Regression

The dependent variable in the following Table is "Turnover Party$_t$" which is equal to 1 if t is the last period in office of the CE's party (that is, the party will not be in power in $t+1$)[11], and 0 otherwise. I do not take into account whether the change in party was due to elections or not.

I run a logit with entity and time fixed-effects. Standard errors are those coming from the Observed Information Matrix (OIM). Again, only some coefficients are shown in the Table below (see Appendix C for more details).

Dep. Var.:	Turnover Party			
	Coef.	p-value	Coef.	p-value
Cycle RGDP per cap.	-2.0861	0.037	-6.4514	0.001
Linear Trend	-1.5624	0.202	-1.6271	0.156
Corruption$(t-1)$	0.5396	0.002	–	–
Cycle$(t-1)$	–	–	5.5615	0.003
Tenure Party	0.2584	0.000	0.2639	0.000
(Tenure Party)^2	-0.0037	0.000	-0.0039	0.000
Party Age	-0.007	0.163	-0.0074	0.122

The first two columns display the results from a regression that includes the degree of corruption in $t-1$ on the right-hand side of the regression, whereas in the last two columns this variable is replaced by the lagged cyclical component of output. In both cases, the trend component of output has no effect on turnover, as suggested by our theory. However, the current cyclical component has a negative coefficient and it is strongly significant (this is a result that still holds when changing the control variables). This is contrary to the predictions of the model. Whereas, by the previous empirical results, it seems true that corruption increases with the cycle, there might be other variables which voters care about that could be positively correlated with a higher cycle (e.g., the incumbent's ability or some policies implemented by him).

Notice, however, that the coefficients on lagged corruption and lagged cycle are both positive and strongly significant. This is a result consistent with the theory's predictions. One interpretation could be the following. Corruption is procyclical, and voters do punish corruption (not in a retrospective sense, though), but voters also care about some other dimensions of the politicians which may not be perfectly correlated with their degree of corruptibility. Let's think for example about ability, which could be positively correlated with the cycle. It could be costly for the incumbent to reveal this other variable, for example because it requires some effort, and because of discounting the incumbent would be more prone to exert a bigger effort in the final stage of the mandate.

6 Final Comments (so far)

In this paper I have analyzed how the business cycle affects the incentives of politicians to extract rents and therefore how it also affects the probability of replacement of the incumbent (political turnover). As a first step in this direction, I proposed a particular channel through which the unexpected innovations of output, and the expectations about future aggregate resources, affect

[11] This includes changes of the party in power but also significant changes in the "original" party.

this two political variables. This is the "golden goose effect", as Niehaus and Sukhatankar (2013) call it: an increase in the expected future corruption opportunities (given by a low realization of the shock today, which it is expected to recover in the future) leads to more cautious behavior today, and less turnover. "The agents want to preserve the goose that lays the golden eggs". My analysis, however, abstracted from the possible feedback that corruption may have on the performance of the economy, and from any other constraints to rent extraction that democratic institutions may impose on politicians.

Unlike previous studies on the determinants of corruption, I decomposed real GDP per capita into its trend and cyclical component, and theoretically considered their effect on corruption and turnover separately. To the best of my knowledge, this is one of the first attempts in doing this so far.

The equilibrium behavior of politicians and voters in the benchmark model economy gave three basic empirical implications: if the conomy is experiencing a transitory boom (recession), (1) corruption increases (decreases), (2) the probability of turnover increases (decreases), and (3) the expected corruption in the following period decreases (increases). Also, corruption is completely history dependent within a given mandate, and in particular it depends positively on all realizations of the cyclical component of output up to the current period.

I presented some first attempts to bring this implications to the data, and the partial results would seem to provide some support for the idea that unexpected high incomes today, that will most likely vanish in the near future, triggers corruption in the short run. However, in the case of turnover, the empirical analysis suggests that there may be some aspects of the incumbent (other than his degree of corruptability) which voters care about (in a good way) that are positively correlated with the cycle.

References

[1] Acemoglu, D., M. Golosov, and A. Tsyvinski (2008) : "Political Economy of Mechanisms," *Econometrica*, 76, 619 – 641.

[2] Ades, A., and R. Di Tella (1997) :."National Champions and Corruption: Some Unpleasant Interventionist Arithmetic," *The Economic Journal*, 107, 1023 – 1042.

[3] Ades, A., and R. Di Tella (1999) :."Rents, competition and corruption," *American Economic Review*, 89, 982 – 993.

[4] Banks, J. S., and R. K. Sundaram (1993) : "Moral Hazard and Adverse Selection in a Model of Repeated Elections," in *Political Economy: Institutions, Information Competition, and Representation* (W. Barnett, et al., Eds.), Cambridge Univ. Press, Cambridge, UK.

[5] Banks, J. S., and R. K. Sundaram (1998) : "Optimal Retention in Agency Problems," *Journal of Economic Theory*, 82, 293 – 323.

[6] Barro, R. (1973) : "The Control of Politicians: An Economic Model," *Public Choice*, 14, 19–42.

[7] Besley, T. (2006) : *Principled Agents? The Political Economy of Good Government*. Oxford University Press.

[8] Besley, T. and A. Case (1995) : "Does Electoral Accountability Affect Economic Policy Choices? Evidence from Gubernatorial Term Limits." *The Quarterly Journal of Economics*, 110 (3) , 769 − 798.

[9] Buchanan, J. M., and G. Tullock (1962) : *The Calculus of Consent: Logical Foundations of Constitutional Democracy,* Ann Arbor: University of Michigan Press.

[10] Ferejohn, J. (1986) : "Incumbent Performance and Electoral Control," *Public Choice*, 50, 5−25.

[11] Gokcekus, O., and Y. Suzuki (2011) : "Business Cycle and Corruption," Economic Letters, 111, 138 − 140.

[12] Krause, S., and F. Méndez (2009) : "Corruption and Elections: An Empirical Study for a Cross-Section of Countries." *Economics & Politics*, 21 (2) , 179 − 200.

[13] Lambsdorff, J. (2008) :.*The Institutional Economics of Corruption and Reform: Theory, Evidence, and Policy.* Cambridge University Press, Cambridge, UK.

[14] Mauro, P. (1995) : "Corruption and Growth," *The Quarterly Journal of Economics*, 110 (3) , 681 − 712.

[15] Myerson, R. (1981) : "Optimal Auction Design," *Mathematics of Operations Research*, 6, 58 − 73.

[16] Myerson, R. (1982) : "Optimal Coordination Mechanisms in Generalized Principal-Agent Problems," *Journal of Mathematical Economics*, 10, 67 − 81.

[17] Niehaus, P., and S. Sukhtankar (2013) : "Corruption Dynamics: The Golden Goose Effect," *AEJ: Policy*, 5 (4) , 230 − 269.

[18] Persson, T., and G. Tabellini (2000) : *Political Economics: Explaining Economic Policy.* Cambridge, MA: MIT Press.

[19] Persson, T., and G. Tabellini (2003) : *The Economic Effects of Constitutions.* Cambridge, MA: MIT Press.

[20] Rogoff, K. (1990) : "Equilibrium Political Budget Cycles," *American Economic Review*, 80, 21 − 36.

[21] Rogoff, K., and A. Sibert (1988) : "Elections and Macroeconomic Policy Cycles," *Review of Economic Studies*, 55, 1 − 16.

[22] Rose-Ackerman, S. (1975) : "The Economics of Corruption," *Journal of Public Economics*, 4 (2) , 187 − 203.

[23] Reed, W. R. (1994) : "A Retrospective Voting Model with Heterogeneous Politicians," *Economics and Politics*, 6, 39 − 58.

[24] Reed, W. R., and J. Cho (1998) : "A Comparison of Prospective and Retrospective Voting with Heterogeneous Politicians," *Public Choice*, 96, 93 − 116.

[25] Treisman, D. (2000) :."The Causes of Corruption: a Cross National Study," *Journal of Public Economics*, 76, 399 − 457.

7 Appendix A

Proposition 7.1. *The only equilibrium given by* (5) *and* (6) *that survives to the refinement is the one where* $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] = \overline{\theta}$. *Furthermore, there exists a unique* θ_l *that satisfies this condition.*

Proof. Consider the case where $A_1 > \delta A_2$ and $x_1^*(\theta)$ is as in (5). Furthermore, suppose (6) holds with strict inequality and consider the off-equilibrium level of rents $x_1^o = (\theta_l + \gamma) A_1$ with $\gamma > 0$ and small (this is type $(\theta_l + \gamma)'s$ bliss-point). Notice that all the good types in $\left[0, \theta_l + \frac{\gamma}{2}\right]$ would never play this x_1^o, so they are ruled out. Also, we have that all those types above $\theta_h + \varepsilon$ would never play x_1^o either, where

$$\varepsilon = \gamma \frac{\sqrt{A_1}}{\sqrt{A_1} - \sqrt{\delta A_2}}. \tag{23}$$

So, in this case

$$\Theta^o(\theta_l + \gamma) = \left[\theta_l + \frac{\gamma}{2}, \theta_h + \varepsilon\right]. \tag{24}$$

Now, applying Step 3, since $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] < \overline{\theta}$, we have that for $\gamma > 0$ sufficiently small,

$$E\left[\theta|\theta \in \Theta^o(\theta_l + \gamma)\right] \leq \overline{\theta}, \tag{25}$$

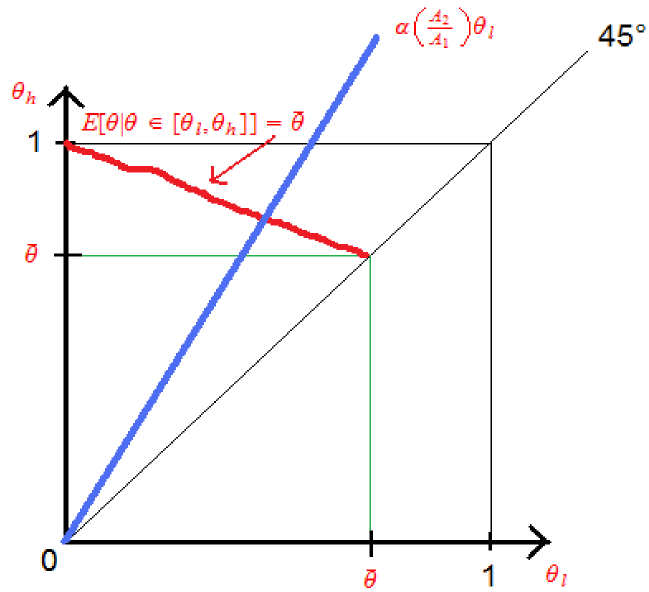
and therefore after observing x_1^o the voter would re-elect the incumbent, and therefore type $\theta_l + \gamma$ (among others) would deviate.

Under the same reasoning, if $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] = \overline{\theta}$ and we consider any off-equilibrium message $\widetilde{x}_1^o$, for any $\gamma > 0$ we would have

$$E\left[\theta|\theta \in \Theta^o(\widetilde{x}_1^o)\right] > \overline{\theta}, \tag{26}$$

and the voter replaces the incumbent after observing $\widetilde{x}_1^o$. Therefore this equilibrium survives the refinement.

To see that there is a unique θ_l that satisfies $E\left[\theta|\theta \in \left[\theta_l, \theta_h\left(\frac{A_2}{A_1}, \theta_l\right)\right]\right] = \overline{\theta}$, recall that this equation comes from two separate conditions: $E\left[\theta|\theta \in [\theta_l, \theta_h]\right] = \overline{\theta}$ and $\theta_h = \alpha\left(\frac{A_2}{A_1}\right)\theta_l$, where $\alpha\left(\frac{A_2}{A_1}\right) := \frac{\sqrt{A_1}}{\sqrt{A_1} - \sqrt{\delta A_2}}$. So, for a given θ_l, we have a unique θ_h that satisfies $\theta_h = \alpha\left(\frac{A_2}{A_1}\right)\theta_l$, and it strictly increases with θ_l. Also, for a given $\theta_l \in \left[0, \overline{\theta}\right]$, there is a unique $\theta_h \in \left[\overline{\theta}, 1\right]$ that satisfies $E\left[\theta|\theta \in [\theta_l, \theta_h]\right] = \overline{\theta}$, and it is decreasing in θ_l. Moreover, at $\theta_l = 0$, $\alpha\left(\frac{A_2}{A_1}\right)\theta_l = 0$, whereas $E\left[\theta|\theta \in [0, \theta_h]\right] = \overline{\theta}$ yields $\theta_h = 1$. Finally, when $\theta_l = \overline{\theta}$, $\alpha\left(\frac{A_2}{A_1}\right)\theta_l > \overline{\theta}$, and $E\left[\theta|\theta \in [0, \theta_h]\right] = \overline{\theta}$ yields $\theta_h = \overline{\theta}$. Therefore, there exists a unique (θ_l, θ_h) that satisfy both equations. The following picture represents graphically what I just said.



■

Proof. I show that the pooling equilbrium in the cases where $A_1 \leq \delta A_2$ survives the equilibrium refinement and it is the unique equilibrium.

Any $x_1 > 0$ is an off-equilibrium level of rents. Let θ^* be the type whose bliss-point coincides with x_1. If the incumbent were to be re-elected after sending this message, all types in $\left[\frac{\theta^*}{2}, 1\right]$ would prefer to play x_1 over grabbing 0, so $\Theta^o(x_1) = \left[\frac{\theta^*}{2}, 1\right]$ and therefore $E[\theta|\Theta^o(x_1)] > \overline{\theta}$, which makes the voter replace the incumbent.

Is there any other equilibrium in the cases where $A_1 \leq \delta A_2$? As we know from before, all bad types should be re-elected (otherwise they would be willing to mimic type 0). This means every bad types is pooling together with some good types.

Notice that in $x_1^*\left(\left[0, \overline{\theta}\right]\right) \cap \left[0, \overline{\theta} A_1\right]$ (that is, those levels of rents in $\left[0, \overline{\theta} A_1\right]$ which are played by the good types) there can be at most one level of rents that is played by more than one good type: if there are two (or more) of them, then the bad types would strictly prefer to take the highest one over all the others, and therefore these other pooling levels are only being played by good types; however, if these types deviate and play their bliss-points, the voter should re-elect them according to the equilibrium refinement ($\Theta^o \subset \left[0, \overline{\theta}\right]$ since all bad types can be ruled out).

We know that $x_1^*(0) = 0$, and the IC constraint for the types in $[0, \varepsilon]$ with $\varepsilon > 0$ and small says that either $x_1^*(\theta) = x_1^b(\theta)$ or $x_1^*(\theta) = 0$ for all these good types. Let us first consider the second case.

Notice that, if $\lim_{\gamma \downarrow 0} x_1^*(\varepsilon + \gamma) \neq 0 = x_1^*(\varepsilon)$, so there is a jump at $\theta = \varepsilon$, then $x_1^*(\varepsilon + \gamma)$ has to go above the bliss-point line for any $\gamma > 0$ and small, otherwise $\theta = \varepsilon$ would prefer to imitate $\theta = \varepsilon + \gamma$. More precisely, $\theta = \varepsilon$ hast to be indifferent between playing $x_1^*(\varepsilon) = 0$ and

$\lim_{\gamma\downarrow 0} x_1^*(\varepsilon+\gamma)$, so $x_1^*(\varepsilon)=0$ and $\lim_{\gamma\downarrow 0} x_1^*(\varepsilon+\gamma)$ have to be equidistant from the bliss-point line:

$$\lim_{\gamma\downarrow 0} x_1^*(\varepsilon+\gamma)=2\varepsilon. \tag{27}$$

Furthermore, $x_1^*(\varepsilon+\gamma)$ has to be constant for all $\gamma\in(0,\overline{\gamma})$ for some $\overline{\gamma}>0$: if it is decreasing, $\theta=\varepsilon$ prefers to imitate $\theta=\varepsilon+\frac{\overline{\gamma}}{2}$ because $x_1^*\left(\varepsilon+\frac{\overline{\gamma}}{2}\right)$ is closer to $\varepsilon' s$ bliss-point; if it is increasing, $\theta=\varepsilon+\frac{\overline{\gamma}}{2}$ would mimic ε. Moreover, x_1^* must continue to be flat untill it crosses the bliss-point line, and the next "jump" (upwards) it can exhibit (at $\theta=\varepsilon+\overline{\gamma}$) has to satisfy that $\theta=\varepsilon+\overline{\gamma}$ is indifferent between playing $\lim_{\gamma\uparrow\overline{\gamma}} x_1^*(\varepsilon+\gamma)$ and $\lim_{\gamma\downarrow\overline{\gamma}} x_1^*(\varepsilon+\gamma)$. After this, x_1^* has to be flat because of the same reasoning as before, and so on. So we have that in the range $\left[0,\overline{\theta}\right]$, $x_1^*(\theta)$ must be a weakly increasing step function, with image $\{y_1=0,y_2,\ldots,y_N\}$. However, remember that only one of these $y's$ can be in the interval $\left[0,\overline{\theta}A_1\right]$. Therefore, $y_n>\overline{\theta}A_1$ for all $n\in\{2,\ldots,N\}$. But then, all the good types would choose to grab $y^*=\min_{n\geq 1} y_n$, since all the others are further away from their bliss-points. So the image of $x_1^*(\theta)$ for $\theta\in\left[0,\overline{\theta}\right]$ can only be $\{y_1=0,y_2\}$ with $y_2>\overline{\theta}$. Furthermore, in order to prevent *all* the bad types to prefer y_2 over $y_1=0$, it must be true that

$$y_2>2\overline{\theta}. \tag{28}$$

Since $y_2=2\varepsilon$, this means

$$\varepsilon>\overline{\theta}, \tag{29}$$

which is a contradiction.

Let us now consider the case where $x_1^*(\theta)=x_1^b(\theta)$ for all θ in $[0,\varepsilon]$ with $\varepsilon>0$ and small. This will be very similar to the previous case, with the difference that the first degree $\left(\frac{x}{A}\right)$ of pooling is at $\varepsilon>0$. The IC of the good types will tell that at $\theta=\varepsilon$, $x_1^*(\theta)$ will exhibit a kink, being flat to the right of ε (this comes from the IC constraint of type $\theta=\varepsilon$). Then, the next jump will occur at some θ_1 still in the good range, but this new degree of pooling have to go above $\overline{\theta}$ since otherwise there is no point for the very low types to be pooling at the lower level ε (all bad types would prefer to mimic θ_1). So the indifference condition of θ_l says that

$$\theta_1=\frac{y_2+\varepsilon}{2}, \tag{30}$$

where y_2 is the highest degree of pooling. For not all the bad types to prefer ε over y_2, we need at least type $\overline{\theta}$ to prefer ε, so

$$y_2>2\overline{\theta}-\varepsilon, \tag{31}$$

but this implies that

$$\theta_1>\overline{\theta}, \tag{32}$$

which is a contradiction.

Then, $x_1^*(\theta)=0\ \forall\theta\in[0,1]$ is the only equilibrium for the case $A_1\leq\delta A_2$ that survives the equilibrium refinement.

Finally, I show that the semi separating equilibrium stated in the Theorem, for the cases where $A_1>\delta A_2$, if the only kind of equilibrium.

A pure pooling equilibrium cannot exists. $x_1^*(0)=0$ requires the level of pooling to be 0, and $\theta=1$ now prefers to deviate and grab his bliss-point in $t=1$.

So, equilibrium has to be semi-separating. Could all the bad types survive? No, the analysis would be the same as in the cases just explored when $A_1 \leq \delta A_2$. Some bad types must be replaced. This means these types grab their bliss-points in $t = 1$.

Coul all the bad types be replaced? If this is the case they all take their bliss-points, and for the range $\left[0, \overline{\theta}\right]$, $x_1^*(\theta)$ would look like this:

$$x_1^*(\theta) = \begin{cases} \theta A_1 & \theta \in [0, \theta_l] \\ \theta_l A_1 & \theta \in \left[\theta_l, \overline{\theta}\right] \end{cases}, \tag{33}$$

where $\theta_l \in \left[0, \overline{\theta}\right)$ must satisfy type $\overline{\theta}'s$ indifference condition:

$$\overline{\theta} = \theta_l \frac{\sqrt{A_1}}{\sqrt{A_1} - \sqrt{\delta A_2}}. \tag{34}$$

But then notice that $E\left[\theta | \theta \in \left[\theta_l, \overline{\theta}\right]\right] < \overline{\theta}$, and therefore this will not survive the equilibrium refinement. So, not all types are re-elected, and not all bad types are replaces.

Notice that if some bad type θ is replaced, he prefers to grab today, and therefore all types above him will also prefer to grab today. Let us call θ_h the inf of this set of bad types. Above θ_h, they are all being replaced, below θ_h, they are all being re-elected, so they are pooling together with some good types. The same previous reasoning will tell us that there cannot be more than one level of pooling for the good types, so there can be at most one. If there is none, all bad types who are pooling will pool with type $\overline{\theta}$, and the voter will not re-elect the incumbent after observing $\overline{\theta}'s$ level of rents. But then there has to be only one level of pooling, and all bad types that survive are pooling at this level, so this is the equilibrium stated in the Theorem. ∎

Proof. I prove that $\frac{\partial \theta_l}{\partial (A_1/A_2)} > 0$ and $\frac{\partial \theta_h}{\partial (A_1/A_2)} < 0$. We know the pair (θ_l, θ_h) is determined by the following system of equations:

$$\begin{aligned} E\left[\theta | \theta \in [\theta_l, \theta_h]\right] &= \overline{\theta}, \\ \theta_h &= \theta_l \frac{\sqrt{A_1}}{\sqrt{A_1} - \sqrt{\delta A_2}}. \end{aligned} \tag{35}$$

By taking derivatives in the second one we obtain

$$\frac{\partial \theta_h}{\partial (A_1/A_2)} = \frac{\partial \theta_l}{\partial (A_1/A_2)} \frac{\sqrt{\frac{A_1}{A_2}}}{\sqrt{\frac{A_1}{A_2}} - \sqrt{\delta}} - \theta_l \frac{\sqrt{\delta}}{2\sqrt{\frac{A_1}{A_2}}} \frac{1}{\sqrt{\frac{A_1}{A_2}} - \sqrt{\delta}}. \tag{36}$$

And from the first one,

$$\frac{\partial \theta_h}{\partial (A_1/A_2)} \left(\theta_h - \overline{\theta}\right) g(\theta_h) = \frac{\partial \theta_l}{\partial (A_1/A_2)} \left(\theta_l - \overline{\theta}\right) g(\theta_l). \tag{37}$$

So,

$$\frac{\partial \theta_l}{\partial (A_1/A_2)} = \frac{\sqrt{\delta}}{2\frac{A_1}{A_2}} \frac{\theta_h \left(\theta_h - \overline{\theta}\right) g(\theta_h)}{\left(\overline{\theta} - \theta_l\right) g(\theta_l) + \frac{\theta_h}{\theta_l} \left(\theta_h - \overline{\theta}\right) g(\theta_h)} > 0, \tag{38}$$

and

$$\frac{\partial\theta_h}{\partial\left(A_1/A_2\right)}=-\frac{\sqrt{\delta}}{2\frac{A_1}{A_2}}\frac{\theta_h\left(\overline{\theta}-\theta_l\right)g\left(\theta_l\right)}{\left(\overline{\theta}-\theta_l\right)g\left(\theta_l\right)+\frac{\theta_h}{\theta_l}\left(\theta_h-\overline{\theta}\right)g\left(\theta_h\right)}<0. \tag{39}$$

■

Proof. Here I show that the equilibria in the multiperiod economy with stochastic output are as stated in Section 4.

Let's suppose that in period $t=1$ politicians play the semi-separating equilibrium ($x_1^*\left(\theta\right)$ is the usual piecewise kind of function). Then, some of those in $\left[\theta_{1l},\theta_{1h}\right]$ are "bad" politicians trying to fool the voter. In the second period, for some levels of (realized) A_2, this same kind of equilibrium could be played. Notice that the non-existence of a fully separating equilibrium still holds in period $t=2$. So, for those in $\left[\theta_{1l},\theta_{1h}\right]$, it cannot be the case that all the bad ones choose their bliss point. In the second period we should have types in $\left[\theta_l\left(A_2\right),\theta_h\left(A_2\right)\right]$ pooling together.

Let $\overline{\theta}_{2h}:=\sup_{A_2}\theta_h\left(A_2\right)$. It cannot be the case that $\theta_{1h}>\overline{\theta}_{2h}$, since there would be no point of pooling in $t=1$ for those in $\left(\overline{\theta}_{2h},\theta_{1h}\right)$. Also, if $\theta_{1h}<\overline{\theta}_{2h}$, types in $\left(\theta_{1h},\overline{\theta}_{2h}\right)$ had already revealed themselves in $t=1$, so in $t=2$ it doesn't make sense not to grab their bliss-point to them. So we must have $\theta_{1h}=\overline{\theta}_{2h}$.

Now let $\underline{\theta}_{2l}:=\inf_{A_2}\theta_l\left(A_2\right)$. If $\theta_{1l}<\underline{\theta}_{2l}$, all types in $\left(\theta_{1l},\underline{\theta}_{2l}\right)$ must be pooling only because choosing their bliss-points is off-path, and therefore they are threatened by beliefs. But they cannot be ruled out if their bliss-points are observed, so our off-path beliefs have to put positive mass on them, and therefore tomorrow they can play their equilibrium action (namely, their bliss-points), and be re-elected. This is a profitable deviation, so $\theta_{1l}\geq\underline{\theta}_{2l}$. If $\theta_{1l}>\underline{\theta}_{2l}$, types in $\left(\underline{\theta}_{2l},\theta_{1l}\right)$ in period 2 are pooling (in some states), but they have already revealed themselves, so there is no point in pooling. So $\theta_{1l}=\underline{\theta}_{2l}$.

The result is therefore that $\left[\theta_l\left(A_2\right),\theta_h\left(A_2\right)\right]\subset\left[\theta_{1l},\theta_{1h}\right]\ \forall A_2$.

Let $\mathcal{A}_2\left(\theta_{1h}\right):=\left\{A_2:\theta_{1h}\in\left[\theta_l\left(A_2\right),\theta_h\left(A_2\right)\right]\right\}$ (the set of states in period 2 for which θ_{1h} pools again). The indifference condition for θ_{1h} at $t=1$ is:

$$\begin{aligned}\frac{\theta_{1h}^2}{2}\left(A_1+\delta E_1\left[A_2\right]\right) &= \left(\theta_{1h}\theta_{1l}-\frac{\theta_{1l}^2}{2}\right)A_1\\ &+\int_{\mathcal{A}_2\left(\theta_{1h}\right)}\left\{\left(\theta_{1h}\theta_l\left(A_2\right)-\frac{\theta_l\left(A_2\right)^2}{2}\right)\delta A_2+\frac{\theta_{1h}^2}{2}\delta^2E_2\left[A_3+\delta A_4\right]\right\}f\left(A_2|A_1\right)dA_2\\ &+\int_{\mathcal{A}_2^c\left(\theta_{1h}\right)}\frac{\theta_{1h}^2}{2}\delta A_2 f\left(A_2|A_1\right)dA_2.\end{aligned} \tag{40}$$

Also, in period $t=2$, θ_{1h} must prefer to pool at every $A_2\in\mathcal{A}_2\left(\theta_{1h}\right)$ rather than grabbing his bliss-point and not being re-elected:

$$\left(\theta_{1h}\theta_l\left(A_2\right)-\frac{\theta_l\left(A_2\right)^2}{2}\right)\frac{A_2}{2}+\frac{\theta_{1h}^2}{4}\delta E_2\left[A_3+\delta A_4\right]\geq\frac{\theta_{1h}^2}{4}A_2,\forall A_2\in\mathcal{A}_2\left(\theta_{1h}\right). \tag{41}$$

If the indifference condition is satisfied, then the above set of inequalities implies

$$\frac{\theta_{1h}^2}{2}\geq\theta_{1h}\theta_{1l}-\frac{\theta_{1l}^2}{2}, \tag{42}$$

which is always true.

Furthremore, suppose there is a subset $\mathcal{A}_2^{\#}(\theta_{1h}) \subset \mathcal{A}_2(\theta_{1h})$ of positive measure such that, $A_2 \in \mathcal{A}_2^{\#}(\theta_{1h})$ if, and only if,

$$\left(\theta_{1h}\theta_l(A_2) - \frac{\theta_l(A_2)^2}{2}\right)\frac{A_2}{2} + \frac{\theta_{1h}^2}{4}\delta E_2[A_3 + \delta A_4] < \frac{\theta_{1h}^2}{4}A_2. \tag{43}$$

Then, the indifference condition, together with the above set of strict inequalities, imply that

$$\begin{aligned}&(\theta_{1h} - \theta_{1l})^2 \frac{A_1}{4} \\ < &\int_{\mathcal{A}_2^{-\#}(\theta_{1h})} \left\{\left(\theta_{1h}\theta_l(A_2) - \frac{\theta_l(A_2)^2}{2}\right)\frac{\delta A_2}{2} + \frac{\theta_{1h}^2}{4}\delta^2 E_2[A_3 + \delta A_4]\right\} f(A_2|A_1)\, dA_2 - \int_{\mathcal{A}_2^{-\#}(\theta_{1h})} \frac{\theta_{1h}^2}{4}\delta A_2 f(A_2|A_1)\, d(A\end{aligned}$$

where $\mathcal{A}_2^{-\#}(\theta_{1h}) := \mathcal{A}_2(\theta_{1h}) \backslash \mathcal{A}_2^{\#}(\theta_{1h})$. Since $(\theta_{1h} - \theta_{1l})^2 \frac{A_1}{2} > 0$, this further implies that

$$\int_{\mathcal{A}_2^{-\#}(\theta_{1h})} \left\{\left(\theta_{1h}\theta_l(A_2) - \frac{\theta_l(A_2)^2}{2}\right)\frac{\delta A_2}{2} + \frac{\theta_{1h}^2}{4}\delta^2 E_2[A_3 + \delta A_4]\right\} f(A_2|A_1)\, dA_2 > \int_{\mathcal{A}_2^{-\#}(\theta_{1h})} \frac{\theta_{1h}^2}{4}\delta A_2 f(A_2|A_1)\, dA_2, \tag{45}$$

but this contradicts the fact that for all $A_2 \in \mathcal{A}_2^{-\#}(\theta_{1h})$ we have

$$\left(\theta_{1h}\theta_l(A_2) - \frac{\theta_l(A_2)^2}{2}\right)\frac{A_2}{2} + \frac{\theta_{1h}^2}{4}\delta E_2[A_3 + \delta A_4] \geq \frac{\theta_{1h}^2}{4}A_2. \tag{46}$$

So, the output levels in $t = 2$ for which θ_{1h} will pool again are those that satisfy

$$\left(\theta_{1h}\theta_l(A_2) - \frac{\theta_l(A_2)^2}{2}\right)\frac{A_2}{2} + \frac{\theta_{1h}^2}{4}\delta E_2[A_3 + \delta A_4] \geq \frac{\theta_{1h}^2}{4}A_2, \tag{47}$$

or

$$\theta_{1h}^2 \delta E_2[A_3 + \delta A_4] \geq (\theta_{1h} - \theta_l(A_2))^2 A_2. \tag{48}$$

For all these $A_2's$, $\theta_h(A_2) = \theta_{1h}$. What about $\theta_l(A_2)$? The variation on the intuitive criterion together with risk neutrality require that $\theta_l(A_2) = \theta_l$ for all these cases (the different $A_2's$ create different conditional distributions for A_3 and A_4, but the indifference condition does not depend on these distributions at all because of risk-neutrality. Without it, the lower bound $\theta_l(A_2)$ would move with A_2 even in these cases, keeping the voter always indifferent). Then, whenever θ_{1h} is pooling in $t = 2$, he is pooling with θ_{1l}, this means that the indifference condition in $t = 1$ is now

$$(\theta_{1h} - \theta_{1l})^2 \left(A_1 + \delta \int_{\mathcal{A}_2(\theta_{1h})} A_2 f(A_2|A_1)\, dA_2\right) = \theta_{1h}^2 \delta^2 \int_{\mathcal{A}_2(\theta_{1h})} E_2[A_3 + \delta A_4] f(A_2|A_1)\, dA_2, \tag{49}$$

so

$$\theta_{1h} = \theta_{1l} \frac{\sqrt{A_1 + \delta \widetilde{A}_2}}{\sqrt{\left(A_1 + \delta \widetilde{A}_2\right)} - \sqrt{\delta^2 \widetilde{E}_2[A_3 + \delta A_4]}}, \tag{50}$$

where

$$\widetilde{A}_2 \quad : \quad = \int_{\mathcal{A}_2(\theta_{1h})} A_2 f\left(A_2|A_1\right) dA_2, \tag{51}$$

$$\widetilde{E}_2\left[A_3+\delta A_4\right] \quad : \quad = \int_{\mathcal{A}_2(\theta_{1h})} E_2\left[A_3+\delta A_4\right] f\left(A_2|A_1\right) dA_2. \tag{52}$$

Notice this is a fixed-point problem since, for example, $\widetilde{A}_2$ depends on the values of θ_{1h} and θ_{1l} that make inequality (48) true. If we now plug this value of θ_{1h} into (48) we obtain that for all $A_2 \in \mathcal{A}_2\left(\theta_{1h}\right)$ the following inequality must be true:

$$\frac{\delta A_2}{E_2\left[A_3+\delta A_4|A_2\right]} \leq \frac{A_1+\delta \widetilde{A}_2}{\widetilde{E}\left[A_3+\delta A_4\right]}. \tag{53}$$

The right-hand side doesn't depend on A_2, while the left-hand side does. For cases when an increase in A_2 leads to increases in future ourputs but the persistence of the shock (ρ) is less than 1, we will have that LHS increases with A_2, and therefore, $\mathcal{A}_2\left(\theta_{1h}\right)=\left[0, A_2^*\right]$ with

$$\frac{\delta A_2^*}{E_2\left[A_3+\delta A_4|A_2^*\right]} \equiv \frac{A_1+\delta \widetilde{A}_2}{\widetilde{E}\left[A_3+\delta A_4\right]}, \tag{54}$$

or

$$\frac{\delta A_2^*}{E_2\left[A_3+\delta A_4|A_2^*\right]} \equiv \frac{A_1+\delta \int_0^{A_2^*} A_2 f\left(A_2|A_1\right) dA_2}{\int_0^{A_2^*} E_2\left[A_3+\delta A_4|A_2\right] f\left(A_2|A_1\right) dA_2}. \tag{55}$$

Notice A_2^* is a function of A_1. Now, θ_{1h} can be rewritten as

$$\theta_{1h}=\theta_{1l} \frac{\sqrt{A_2^*}}{\sqrt{A_2^*}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2^*\right]}}. \tag{56}$$

When $A_2>A_2^*$, then the set $\left[\theta_l\left(A_2\right), \theta_h\left(A_2\right)\right]$ starts shrinking. $\theta_h\left(A_2\right)$ will be always defined by the indifference condition

$$\theta_h\left(A_2\right)^2 \delta E_2\left[A_3+\delta A_4\right] \equiv\left(\theta_h\left(A_2\right)-\theta_l\left(A_2\right)\right)^2 A_2, \tag{57}$$

so

$$\theta_h\left(A_2\right)=\theta_l\left(A_2\right) \frac{\sqrt{A_2}}{\sqrt{A_2}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2\right]}}, \tag{58}$$

where the voter's indifference condition

$$E\left[\theta|\theta \in\left[\theta_l\left(A_2\right), \theta_h\left(A_2\right)\right]\right]=E[\theta], \tag{59}$$

entirely pins the equilibrium down. Again, if the increase in A_2 translates into a reduced increase in future outputs, then $\frac{\sqrt{A_2}}{\sqrt{A_2}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2\right]}}$ decreases with A_2, and therefore $\theta_l\left(A_2\right)$ increases (if it decreased then $\theta_h\left(A_2\right)$ would also decrease the interval moves entirely to the left and couldn't match the indifference condition of the voter) and $\theta_h\left(A_2\right)$ decreases.

Notice that the necessary condition for the hybrid equilibrium to be played in $t=1$ is now

$$A_1+\delta\int_0^{A_2^*}A_2 f\left(A_2|A_1\right)dA_2\geq\delta^2\int_0^{A_2^*}E_2\left[A_3+\delta A_4|A_2\right]f\left(A_2|A_1\right)dA_2, \tag{60}$$

What happens when the above condition is not satisfied? Can we still have a pooling equilibrium with $x_1(\theta)=0\ \forall\theta$? If the answer is yes, then in $t=2$ the voter's beliefs are equal to their priors. Then, in $t=2$ we can again have pooling at 0 or the hybrid equilibrium if A_2 is too tempting for the "bad" types (i.e., too high). Notice that, if

$$\delta E_2\left[A_3+\delta A_4|A_2\right]>A_2, \tag{61}$$

then $\theta=1$ prefers to mimick $\theta=0$ and survive rather than grabbing his BP today, so for these A_2' we will have pooling at 0 again. Then, for higher $A_2's$, RHS grows at a rate of 1, whereas LHS grows slowlier. Therefore, for $A_2\in[0,A_2^{**}]$ we will have the pooling at 0 in $t=2$, provided there was pooling at 0 in $t=1$, where

$$\delta E_2\left[A_3+\delta A_4|A_2^{**}\right]\equiv A_2^{**}. \tag{62}$$

If $A_2>A_2^{**}$ (so $A_2>\delta E_2\left[A_3+\delta A_4|A_2\right]$) then $\theta=1$ doesn't want to mimick $\theta=0$ and we might have again an hybrid kind of equilibrium. So, the type that is indifferent between grabbing today and pooling with some $\theta_l\left(A_2\right)$ is given by

$$\theta_h\left(A_2\right)^2\delta E_2\left[A_3+\delta A_4\right]\equiv\left(\theta_h\left(A_2\right)-\theta_l\left(A_2\right)\right)^2A_2, \tag{63}$$

or

$$\theta_h\left(A_2\right)=\theta_l\left(A_2\right)\frac{\sqrt{A_2}}{\sqrt{A_2}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2\right]}}. \tag{64}$$

where $E\left[\theta|\theta\in\left[\theta_l\left(A_2\right),\theta_h\left(A_2\right)\right]\right]=E\left[\theta\right].$

In order to verify that we do have pooling at $t=1$, now that we know how poiticians could behave in $t=2$, we have to make sure that everyone wants to mimick $\theta=0$ in $t=1$. It is necessary and sufficient that $\theta=1$ wants to do it. So, the IC condition is

$$A_1+\delta\int_0^{A_2^{**}}A_2 f\left(A_2|A_1\right)dA_2\leq\delta^2\int_0^{A_2^{**}}E_2\left[A_3+\delta A_4|A_2\right]f\left(A_2|A_1\right)dA_2. \tag{65}$$

Notice that A_2^{**} does not depend on A_1, therefore, there is a level of A_1, A_1^{**}, such that, if $A_1\in[0,A_1^{**}]$, then the above condition is met. This level is defined by

$$A_1^{**}+\delta\int_0^{A_2^{**}}A_2 f\left(A_2|A_1^{**}\right)dA_2\equiv\delta^2\int_0^{A_2^{**}}E_2\left[A_3+\delta A_4|A_2\right]f\left(A_2|A_1^{**}\right)dA_2. \tag{66}$$

When A_1 is above this threshold, the pooling equilibrium cannot be sustained, and the hybrid kind of equilibrium is played instead. Notice that, when $A_1=A_1^{**}$, $A_2^*\left(A_1\right)=A_2^{**}$, since

$$\frac{A_2^{**}}{\delta E_2\left[A_3+\delta A_4|A_2^{**}\right]}\equiv 1, \tag{67}$$

and

$$\frac{A_2^*(A_1)}{E_2[A_3+\delta A_4|A_2^*(A_1)]} \equiv \frac{A_1+\delta\int_0^{A_2^*(A_1)} A_2 f(A_2|A_1)\,dA_2}{\delta\int_0^{A_2^*(A_1)} E_2[A_3+\delta A_4|A_2]\,f(A_2|A_1)\,dA_2}. \tag{68}$$

This is provided uniqueness: if A_1^{**}, then A_2^{**} solves the equation that determines $A_2^*(A_1)$, and therefore $A_2^*(A_1)=A_2^{**}$ is the unique solution to such equation.

With the specific process for output that I assumed, everything depends on the magnitude of the cyclical components at each point in time. Recall

$$\ln A_t = \ln A_0 + t\ln(1+\gamma)+\varepsilon_t, \tag{69}$$

where $\varepsilon_t=\rho\varepsilon_{t-1}+\eta_t$ with $\rho\in(0,1)$ and $\eta_t \sim^{iid} N(0,\sigma^2)$. This says that, for $k\geq 1$, $\ln A_{t+k}|t\sim N\left(\mu_{t+k|t},\sigma^2_{t+k|t}\right)$, where

$$\mu_{t+k|t}=T_{t+k}+\rho^k(\ln A_t - T_t), \tag{70}$$

and

$$\sigma^2_{t+k|t}=\sigma^2\sum_{i=0}^{k-1}\rho^{2i}=\sigma^2\frac{1-\rho^{2k}}{1-\rho^2}. \tag{71}$$

This leads to

$$\begin{aligned} E_t[A_{t+k}] &= A_t^{\rho^k}\exp\left[T_{t+k}-\rho^k T_t\right]\exp\left[\frac{\sigma^2}{2}\frac{1-\rho^{2k}}{1-\rho^2}\right] \\ &= A_t^{\rho^k}\cdot A_0^{1-\rho^k}\cdot(1+\gamma)^k\cdot(1+\gamma)^{t\cdot(1-\rho^k)}\cdot\exp\left[\frac{\sigma^2}{2}\frac{1-\rho^{2k}}{1-\rho^2}\right], k\geq 1. \end{aligned} \tag{72}$$

Now we want to find the thresholds that determine what type of equilibrium is played at every stage of the game.

Recall we had

$$\delta E_2[A_3+\delta A_4|A_2^{**}]\equiv A_2^{**}. \tag{73}$$

Therefore, this equation, from $t=1$ point of view, takes now the following form:

$$A_{t+1}^{\rho}\cdot A_0^{1-\rho}\cdot(1+\gamma)\cdot(1+\gamma)^{(t+1)\cdot(1-\rho)}\cdot\exp\left[\frac{\sigma^2}{2}\right]+\delta A_{t+1}^{\rho^2}\cdot A_0^{1-\rho^2}\cdot(1+\gamma)^2\cdot(1+\gamma)^{(t+1)\cdot(1-\rho^2)}\cdot\exp\left[\frac{\sigma^2}{2}\left(1+\rho^2\right)\right]=\frac{A_{t+1}}{\delta}. \tag{74}$$

Redefine the unknown as

$$a_{t+1}:=\frac{A_{t+1}}{A_0(1+\gamma)^{t+1}}=\exp[\varepsilon_{t+1}], \tag{75}$$

then

$$a_{t+1}^{\rho}\cdot[\delta(1+\gamma)]\cdot\exp\left[\frac{\sigma^2}{2}\right]+a_{t+1}^{\rho^2}\cdot[\delta(1+\gamma)]^2\cdot\exp\left[\frac{\sigma^2}{2}\left(1+\rho^2\right)\right]=a_{t+1}. \tag{76}$$

Notice a_{t+1}^{**} depends only on parameters only, and it is invariant with t, so $a_{t+1}^{**}=a^{**}$, and

$$A_{t+1}^{**}=a^{**}\cdot A_0(1+\gamma)^{t+1}. \tag{77}$$

Now, let's analyze the equation that determines $A_2^*(A_1)$, or $A_{t+1}^*(A_t)$. The equation was

$$\frac{A_{t+1}}{E_{t+1}\left[A_{t+2}+\delta A_{t+3}|A_{t+1}\right]}=\frac{A_t+\delta\int_0^{A_{t+1}}\widetilde{A}_{t+1}f\left(\widetilde{A}_{t+1}|A_t\right)d\widetilde{A}_{t+1}}{\delta\int_0^{A_{t+1}}E_{t+1}\left[A_{t+2}+\delta A_{t+3}|\widetilde{A}_{t+1}\right]f\left(\widetilde{A}_{t+1}|A_t\right)d\widetilde{A}_{t+1}}, \tag{78}$$

which now becomes

$$\frac{a_{t+1}}{a_{t+1}^{\rho}+a_{t+1}^{\rho^2}\cdot\delta\left(1+\gamma\right)\cdot\exp\left[\frac{\sigma^2}{2}\rho^2\right]}=\frac{\frac{a_t}{1+\gamma}+\delta\int_0^{a_{t+1}}A\left[\frac{1}{\sqrt{2\pi}\sigma A}\exp\left(-\frac{1}{2}\frac{[\ln(A)-\rho\ln(a_t)]^2}{\sigma^2}\right)\right]dA}{\delta\int_0^{a_{t+1}}\left[A^{\rho}+A^{\rho^2}\cdot\delta\left(1+\gamma\right)\cdot\exp\left[\frac{\sigma^2}{2}\rho^2\right]\right]\left[\frac{1}{\sqrt{2\pi}\sigma A}\exp\left(-\frac{1}{2}\frac{[\ln(A)-\rho\ln(a_t)]^2}{\sigma^2}\right)\right]dA}, \tag{79}$$

which again does not depend on t, but only on parameters and $a_t := \frac{A_t}{A_0(1+\gamma)^t}$. So, the solution is

$$A_{t+1}^*(A_t)=a_{t+1}^*A_0\left(1+\gamma\right)^{t+1}. \tag{80}$$

Finally, we need to determine A_1^*, given by

$$A_1^{**}+\delta\int_0^{A_2^{**}}A_2f\left(A_2|A_1^*\right)dA_2\equiv\delta^2\int_0^{A_2^{**}}E_2\left[A_3+\delta A_4|A_2\right]f\left(A_2|A_1^{**}\right)dA_2. \tag{81}$$

Again, we rewrite this as follows:

$$\frac{a_t}{(1+\gamma)}+\int_0^{a^{**}}\left[\delta A-\delta^2\left(1+\gamma\right)\cdot\exp\left[\frac{\sigma^2}{2}\right]\left[A^{\rho}+\delta A^{\rho^2}\cdot\left(1+\gamma\right)\cdot\exp\left[\frac{\sigma^2\rho^2}{2}\right]\right]\right]\cdot\left[\frac{1}{\sqrt{2\pi}\sigma A}\exp\left(-\frac{1}{2}\frac{\left[\ln A-\rho\ln a_t\right]^2}{\sigma^2}\right)\right]dA \tag{82}$$

So, we can see that a_t^{**} does not depend on t, so solution is a^{**} and therefore

$$A_t^{**}=x^{**}A_0\left(1+\gamma\right)^t. \tag{83}$$

Semi-separating values. Here I show that the semi-separating thresholds θ_l and θ_h are also determined only by the cyclical components of output.

In the case where $\varepsilon_1\leq\varepsilon_1^{**}=\ln\left(a_1^{**}\right)$, we had that, in $t=2$,

$$\theta_h\left(A_2\right)=\theta_l\left(A_2\right)\frac{\sqrt{A_2}}{\sqrt{A_2}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2\right]}}, \tag{84}$$

but

$$\begin{aligned}\delta\frac{E_2\left[A_3+\delta A_4|A_2\right]}{A_2} &= a_2^{\rho-1}\cdot\delta\left(1+\gamma\right)\cdot\exp\left[\frac{\sigma^2}{2}\right]\\ &\quad+a_2^{\rho^2-1}\cdot\left[\delta\left(1+\gamma\right)\right]^2\cdot\exp\left[\frac{\sigma^2}{2}\left(1+\rho^2\right)\right].\end{aligned} \tag{85}$$

Furthermore, condition $E\left[\theta|\theta\in\left[\theta_h,\theta_l\right]\right]=\overline{\theta}$ doesn't depend on output, so $\theta_l\left(A_2\right)$ and $\theta_h\left(A_2\right)$ are really a function of only $a_2=\exp\left[\varepsilon_2\right]$.

In the case where $\varepsilon_1>\varepsilon_1^{**}$,

$$\theta_{1h}=\theta_{1l}\frac{\sqrt{A_2^*}}{\sqrt{A_2^*}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2^*\right]}}, \tag{86}$$

where

$$\frac{\delta A_2^*}{E_2\left[A_3+\delta A_4|A_2^*\right]} \equiv \frac{A_1+\delta\int_0^{A_2^*} A_2 f\left(A_2|A_1\right)dA_2}{\int_0^{A_2^*} E_2\left[A_3+\delta A_4|A_2\right] f\left(A_2|A_1\right)dA_2}. \tag{87}$$

But again

$$\begin{aligned}\frac{\delta E_2\left[A_3+\delta A_4|A_2^*\right]}{A_2^*} &= \left(a_2^*\left(a_1\right)\right)^{\rho-1}\cdot\delta\left(1+\gamma\right)\cdot\exp\left[\frac{\sigma^2}{2}\right] \\ &\quad+\left(a_2^*\left(a_1\right)\right)^{\rho^2-1}\cdot\left[\delta\left(1+\gamma\right)\right]^2\cdot\exp\left[\frac{\sigma^2}{2}\left(1+\rho^2\right)\right],\end{aligned} \tag{88}$$

and therefore $\theta_l\left(A_1\right)$ and $\theta_h\left(A_1\right)$ are really a function of only $a_1=\exp\left[\varepsilon_1\right]$. Finally, when $A_2 > A_2^*\left(A_1\right)$ (or $\varepsilon_2>\varepsilon_2^*\left(\varepsilon_1\right)$), we again have

$$\theta_h\left(A_2\right)=\theta_l\left(A_2\right)\frac{\sqrt{A_2}}{\sqrt{A_2}-\sqrt{\delta E_2\left[A_3+\delta A_4|A_2\right]}}, \tag{89}$$

which we just showed that depends on ε_2 only. ∎

8 Appendix B

In this section I consider an infinite-horizon economy with term limits and show that the basic empirical implication of the benchmark could still hold.

Time is discrete and runs forever. The economy is populated by a set of heterogeneous politicians, just as before, and a sequence of voters that live for two periods. More precisely, at every period t there are two voters: a young one and an old one. At the end of every period t, voters decide whether to re-elect or to replace the incumbent. Since the old voter is completely indifferent (because he will abandon the economy at the end of the current period) I assume only the young voter takes the re-election decision.

Politicians cannot be in office for more than 2 consecutive mandates, so there are term limits. As before, when a politician either is replaced with a new one or finishes his second mandate in office, he cannot be ever elected again (that is, there is "no recall").

The information structure and the elections procedure are the usual: every time an incumbent is replaced, a new one is drawn from the distribution G, and the type of the incumbent is his own private information. The timing of the events within period t is also maintained. Output is stochastic.

Let $x_{mt}^*\left(\theta\right)$ be the equilibrium period-t strategy of type θ in his m^{th} term in office, with $m=1,2$.

In any period t, if the incumbent is in his second term in office, he will grab his bliss-point, so $x_{2t}^*\left(\theta\right)=\theta A_t\ \forall\theta\in\left[0,1\right], \forall t$.

If $A_t\leq\delta E_t\left[A_{t+1}\right], x_{1t}^*\left(\theta\right)=0\ \forall\theta\in\left[0,1\right], \forall t$, which is the same pooling equilibrium as in the benchmark case, and reason is the same: all the bad types are willing to mimic $\theta=0$ in order to get re-elected.

If $A_t>\delta E_t\left[A_{t+1}\right]$, we have that, $\forall t$

$$x_{1t}^*\left(\theta\right)=\begin{cases}\theta_l A_t & if\ \theta\in\left[\theta_l,\theta_h\right] \\ \theta A_t & if\ \theta\notin\left[\theta_l,\theta_h\right]\end{cases}, \tag{90}$$

where

$$\theta_h = \theta_l \frac{\sqrt{A_t}}{\sqrt{A_t} - \sqrt{\delta E_t [A_{t+1}]}}. \tag{91}$$

This is again the same result as before.

However, the difference now is the re-election strategy of the voter. After observing x_{1t} the voter still computes $E[\theta|x_{1t}]$, which is the degree of corruption in the next period if the incumbent is re-elected, but now the outside option is not necessarily $\overline{\theta}$, since replacing the incumbent means to draw a new type from G that will play according to $x^*_{1t+1}(\theta)$ as given in (90) when $A_{t+1} > \delta E_{t+1}[A_{t+2}]$ and it will be $x^*_{1t+1}(\theta) = 0$ $\forall\theta$ when the opposite is true.

Let $v^*_t := E_t\left[\frac{x^*_{1t+1}(\theta)}{A_{t+1}}\right]$, which is now the correct expected degree of corruption in the next period if the voter replaces the incumbent, where the expectation is computed with respect to both θ and A_{t+1}, given the information in period t. So, now the condition that pins θ_l down is

$$v^*_t = E[\theta|\theta \in [\theta_l, \theta_h]]. \tag{92}$$

The above equation implies $v^*_t \in [0, \overline{\theta}]$ (otherwise, as $\theta_l \downarrow 0$, θ_h would go above 1). In the most general case, the above condition can be re-writeen (after some manipulation) as

$$v^*_t(A_t) = \int_{A^*_{t+1}}^{\infty} \left[\overline{\theta} + \left[\theta_l(A_{t+1}) - v^*_{t+1}(A_{t+1})\right]\pi(A_{t+1})\right] f(A_{t+1}|A_t)\, dA_{t+1}, \tag{93}$$

where $\pi(A_{t+1}) = G(\theta_h(A_{t+1})) - G(\theta_l(A_{t+1}))$ is the probability of pooling in the next period, and A^*_t is defined by $A^*_t \equiv \delta E_t[A_{t+1}|A^*_t]$ $\forall t$.[12]

Now, for a *given* function $\theta_l(A_t)$, standard dynamic programming arguments guarantee that a unique solution to the above Bellman equation exists (in particular, Blackwell's conditions are satisfied). Moreover, *given* a function $v^*_t(A_t)$, a unique solution $\theta_l(A_t)$ to (92) exists. Finally, notice that if $v^*_{t+1}(A_{t+1}) \in [0, \overline{\theta}]$, then $v^*_t(A_t) \in [0, \overline{\theta}(1 - p_t(A_t))] \subset [0, \overline{\theta}]$, where $p_t(A_t) := \Pr\{A_{t+1} > A^*_{t+1}|A_t\}$. Therefore, the Contraction Mapping Theorem will ensure that $v^* \in [0, \overline{\theta}]$ as we originally required.

Notice that now the threshold degree of expected corruption following re-election, $v^*_t(A_t)$, depends on A_t. This is different than in the benchmark economy. The reason is that if today's output is, for example, "high", the chances of A_{t+1} being also "high" are quite big because of persistence, and therefore the expected degree of corruption in the next period is higher. However, this is now always the case, since the degree of corruption in the next period is also determined by $v^*_{t+1}(A_{t+1})$. A higher $v^*_{t+1}(A_{t+1})$ "allows" for higher corruption, and therefore our previous reasoning applies.

Now, let us consider the case where $f(A_{t+1}|A_t)$ does not depend on A_t, so output is i.i.d. (up to normalization by the trend component). That would mean to take $\rho = 0$ in $(15) - (17)$. Then, $A^*_t \equiv \delta E_t[A_{t+1}|A^*_t]$ becomes

$$\eta^*_t \equiv \ln[\delta(1+\gamma)] + \frac{1}{2}\sigma^2, \forall t. \tag{94}$$

So, everytime the cyclical component $\varepsilon_t = \eta_t$ is below η^*, the pooling equilibrium with $x^*_{1t}(\theta) = 0$ $\forall\theta$ will be played in the first mandates; and when $\eta_t > \eta^*$, we have the same old semi-separating

[12] I am implicitly assuming that the process for A_t is such that $A_t \geq \delta E_t[A_{t+1}|A_t]$ if, and only if, $A_t \geq A^*_t$. This is effectively the case if, for example, output follows the process stated in $(15) - (17)$, where $E_t[A_{t+1}|A_t] = A^{\rho}_t \xi$, and ξ is some positive constant, and $\rho \in [0, 1)$.

equilibrium. Now the Bellman equation (93) becomes

$$v^*(A_t) = \int_{a^*}^{\infty} \left[\overline{\theta} + [\theta_l(a) - v^*(A_{t+1})]\,\pi(a)\right] \frac{1}{\sqrt{2\pi}\sigma a} \exp\left[-\frac{1}{2}\frac{(\ln a)^2}{\sigma^2}\right] da, \tag{95}$$

where $a = \exp[\eta]$, and therefore $a^* = \exp[\eta^*]$. As we can see, $v_t^*(A_t)$ does not depend on A_t anymore, so it is constant for every period t and every level of output A_t. Furthremore,

$$\theta_h(a) = \theta_l(a) \frac{\sqrt{a}}{\sqrt{a} - \sqrt{\delta(1+\gamma)\exp\left[\frac{\sigma^2}{2}\right]}}, \tag{96}$$

and

$$v^* = E[\theta|\theta \in [\theta_l, \theta_h]]. \tag{97}$$

So the equilibrium again entirely depends on the cyclical component, and in the same way as in the benchmark model economy.

9 Appendix C

The results presented in in Section 5.1 come from regressing the ICRG corruption index on the cyclical and trend component of output, as in (22), and the following list control variables:

`pop`: Population, in millions. PWT 8.0.

`autoc`: Degree of autocracy. Goes from 1 to 10. PolityIV.

`democ`: Degree of democracy. Goes from 1 to 10. PolityIV.

`yrsoffc`: How many years has the chief executive been in office? DPI 2012.

`yrcurnt`: Years left in current term. Only full years are counted. DPI 2012.

`prtyin`: Party of chief executive has been how long in office. DPI 2012.

`execage`: Age of party since formation under "this" name. DPI 2012.

`allhouse`: Does party of executive control all houses? 1 if yes, 0 otherwise. DPI 2012.

`totalseats`: Total seats in the legislature (lower house). Appointed and elected seats. DPI 2012.

`herfgov`: $\sum_{i=1}^{n} \alpha_i^2$ where α_i is share of seats of party i (party i belongs to the goverment). DPI 2012.

`herfopp`: Same as `herfgov` but for parties in the opposition. DPI 2012.

`govfrac`: Probability that two deputies picked at random from among the government parties will be of different parties. DPI 2012.

`oppfrac`: Probability that two deputies picked at random from among the opposition parties will be of different parties. DPI 2012.

`frac`: Probability that two deputies picked at random will be of different parties. DPI 2012.

`sh_seats_gov`: % of seats held by government parties. DPI 2012.

`partyage`: Average age of parties (1st gov party, 2nd gov party, and 1st opposition party). DPI 2012.

`liec`: legistlative index of electoral competitiveness. DPI 2012.

`eiec`: executive index of electoral competitiveness. DPI 2012.

`stabs`: % of veto players who drop from the government in any given year. PolityIV.

pol_ri: Political Rights Rating. Freedom House.

civil_li: Civil Liberties Rating. Freedom House.

polconiii: measures the feasibility of policy change (the extent to which a change in the preferences of any one actor may lead to a change in government policy). (Political constraints.) Polcon.

polconv: adds judiciary and sub-federal entities to polconiii. Polcon.

j: existence of an independent judiciary. 1 if yes, 0 otherwise. Polcon.

legfralower: Legislative fractionalization is approximately the probability that two random draws from the lower (upper) legislative chamber will be from the same party. Polcon.

partycountlower: Number of parties in the lower house. Polcon.

parcomp: The Competitiveness of Participation: The competitiveness of participation refers to the extent to which alternative preferences for policy and leadership can be pursued in the political arena. Political competition implies a significant degree of civil interaction.

polcomp: Degree of political competition.

xconst: Constraints to executive. Goes from 1 (unlimited authority) to 7 (accountability groups have effective authority equal to or greater than the executive in most areas of activity).

openness: trade as % of GDP. PWT 8.0.

csh_ci: Private Consumption and Investment as % of GDP. PWT 8.0.

csh_g: Public Consumption as % of GDP. PWT 8.0.

i.year: Year dummies.

Entity fixed effects were also included and the robust (clustered) stadard errors were computed.

The observations were subject to (1) data availability, (2) the Chief Executive could serve additional term(s) following the current one when there were formal restraints on an executive's term (only limits on immediate reelection count), and (3) variable polityfrompolity was non-negative (it goes from -10 (stonrgly autocratic) to 10 (strongly democratic)).

The list of controls in the regression from Section 5.2 was the following one:

polityfrompolity
prtyin
prtyin^2
execage
allhouse
totalseats
herfgov
govfrac
sh_seats_gov
partyage
liec
eiec
stabs
pol_ri
civil_li
polconiii
polconv
j

```
legfralower
parcomp
polcomp
xconst
csh_ci
i.year
```

The observations were subject to (1) data availability, (2) the Chief Executive could serve additional term(s) following the current one when there were formal restraints on an executive's term (only limits on immediate reelection count), and (3) variable `polityfrompolity` was non-negative.