Corruption and Political Turnover over the Business Cycle: Theory and Evidence*

Francisco Espinosa†

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Abstract

I study how GDP shocks affect corruption and political turnover, both from a theoretical and an empirical perspective. The theoretical setting presumes politicians are heterogeneous and privately informed about their degree of corruptibility. They face exogenous shocks to GDP, which affect appropriable government revenues. The political incentives to appropriate these rents systematically vary with such shocks, which affects the endogenous re-election/replacement decisions of voters. I predict that transitory output shocks that lie above trend represent a good opportunity to grab rents today — current gains increase relative to expected continuation values. Therefore, corruption is predicted to be pro-cyclical, as is subsequent political turnover. This has the further implication that booms in current mandates decrease corruption in future mandates, because voters eliminate the more corrupt incumbents. I test these three predictions using an annual panel of countries over 1985–2011. I find evidence in support of the theory. Moreover, these cyclical properties are stronger for more democratic countries, suggesting electoral accountability is indeed the bridge that links corruption to business cycles.

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† New York University, Department of Economics. Email: francisco.espinosa@nyu.edu.
1 Introduction

I study, both theoretically and empirically, how corruption and political turnover respond to output shocks. In the theory I set up, politicians are heterogeneous and privately informed about their degree of corruptibility — or their eagerness to seize rents. Their incentives to appropriate such rents will depend on output shocks, and their decisions will, in turn, affect the endogenous re-election/replacement decision of voters. Every politician must face the trade-off between engaging in corruption — with high attendant current payoffs — and a future in which he is removed from office as a consequence of his actions. This trade-off between current and continuation values is resolved in favor of the present, when current shocks to output (and government revenue) are high relative to trend.

Therefore, my main theoretical prediction is that corruption is pro-cyclical: Transitory booms in output, which are most likely to vanish in the near future, represent a good opportunity to grab current rents. Furthermore, changes in the trend component of output (or, in other words, perfectly persistent shocks to output) shouldn’t affect corruption, and economies with higher rates of growth should exhibit less corruption.\footnote{So at least part of the negative relationship between corruption and growth rates — see, for example, Campos et al. (2010) and Ugur (2014) — is likely running from growth to corruption rather than the other way around.} In turn, this pro-cyclicality of corruption causes political turnover to be pro-cyclical as well: The higher the peaks, the larger the number of bad politicians who reveal their true colors to the voters, so that turnover should increase. Finally, the theory also predicts corruption in future mandates should be lower if the current mandate exhibits a peaking of the business cycle. In that case, the current mandate should entail more corruption, followed by higher turnover of politician types whose actions have been revealed them to be corrupt. The theory makes these three predictions, which I propose to investigate empirically.

Three assumptions in the theory deliver the pro-cyclicality of corruption: the voter’s incomplete information about the incumbent’s type, the imperfect persistence of output booms, and the incumbent’s reputational concerns. To combine these three aspects in a comprehensive yet tractable way, I construct a dynamic signaling model in which politician types are revealed to a greater or lesser degree depending on the magnitude of the business cycle, with the largest degree of pooling occurring at the troughs and the maximal separation occurring at the peaks. The resulting dynamics then track the path of corruption, subsequent turnover, as well as the dips in corruption following a period of particularly high turnover.

As a methodological comment, the signaling game I consider features a multiplicity
of equilibria, which I deal with by *invoking* a simple variation of the Intuitive Criterion (Cho & Kreps 1987). This variation turns out to be a suitable adaptation of the Perfect Sequential Equilibrium concept (Grossman & Perry 1986) to my model. The resulting unique equilibrium allows me to derive clear empirical predictions of the model.\(^2\)

I take the three predictions of the model to an annual panel of countries over the period 1985–2011. I find evidence in support of the theory: Corruption is strongly and robustly pro–cyclical, corrupt behavior triggers turnover, and turnover lowers subsequent corruption.

To study the pro–cyclicality of corruption, I regress indices of corruption on cyclical components of GDP extracted from time trends. I do so directly and also by using international oil–price cycles (interacted with country dummies, or, alternatively, with country–specific historical shares of oil imports relative to GDP) to instrument for within–country cyclical components. Significant existing variations in the levels of democracy, electoral competitiveness, and other measures of the incumbent’s prospects for re–election offer good ways to test for the existence of the mechanism that, in the model, relates corruption to the business cycle. In particular, I find the effect of output cycles on corruption disappears when incumbents cannot be (immediately) re–elected, and it increases with the level of democracy. That is, greater electoral accountability implies a higher elasticity of corruption with respect to output fluctuations.

For turnover, I construct four variables that indicate whether the incumbent government is replaced. Specifically, I consider chief executive and party turnover and, in each case, I either restrict attention to election years or I consider the unrestricted sample. Lagged corruption has a strong and positive effect on turnover in any case, which in turn decreases future corruption. This result suggests that, provided corruption is pro–cyclical, business cycles positively but indirectly affect turnover. However, at the same time, good economic performance is most likely rewarded at the polls, so output booms should have a negative, direct effect on turnover as well. The net effect will ultimately depend on the way the voters value each dimension and how voters’ preferences are aggregated. I control for these two opposite effects by controlling for average growth on the one hand and maximum business cycle peaks on the other. The first index is a natural measure of overall economic performance, whereas I argue and show the second, proxies for the degree of corruption. Indeed, I find that party turnover decreases with good economic

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\(^2\)I first consider a simple two–period model. In section 3.4, I extend the model to an infinite–horizon economy and fully characterize an equilibrium that exhibits the same features of the unique equilibrium of the two–period economy.
performance, and it increases with maximum business cycle peaks. Importantly, the effect of the peaks on turnover is substantially weakened once I control for the effect of lagged corruption on turnover, suggesting the peak-to-turnover connection travels via increased corruption following higher peaks.

Finally, regarding the effect on future corruption, I consider different measures of the change in corruption between mandates, and I evaluate the effect of turnover on these variables. Regardless of which measure of change in corruption I use, and for any of the four turnover variables, I find turnover has a negative (and, most of the time, significant) effect on corruption growth. Once again, the effect is stronger in more democratic economies. To be sure, however, a competing theory of “learning to be corrupt” could also explain this empirical finding. However, I also show that maximum business cycle peaks from previous mandates have a negative effect on corruption in current mandates.

The paper is organized as follows. I begin with a broad review of the literature (section 2). In section 3, I introduce the baseline model and study its mechanics. Like many signaling models, our model leads to a multiplicity of equilibria, and I show how that multiplicity vanishes in the face of a natural refinement. The unique survivor to the refinement is then subjected to a comparative statics analysis, which leads to the main predictions of the model. In section 4, I empirically evaluate these theoretical implications. section 5 concludes. An Appendix contains both additional theoretical and empirical discussion, including a full description of every variable used in the empirical section.

2 Related Literature

As for the empirical analysis, this paper intersects, in broad terms, with different strands of the political economy literature studying corruption and turnover, which can be grouped into two: (a) the relationship between corruption and development and GDP, and (b) the effects of corruption and economic performance on turnover and politicians’ support. In both, the empirical work can differ depending on whether the analysis is performed by using aggregate international corruption–perception indexes (as in this paper) or more detailed micro data, with differences both in the generality and in the interpretation of the results—especially regarding the identification of the direction of causality.

Not surprisingly, cross-sectional, international analyses on the determinants of corruption find it to be negatively related to almost any measure of higher development.\textsuperscript{3} For

\textsuperscript{3}See Treisman (2007) and Lambsdorff (2008) for two comprehensive surveys of the first decade of this
example, Lederman, Loayza & Soares (2005) find that lower corruption is associated with a stronger degree of democracy, political stability, and freedom of the press. In addition to these results, Treisman (2000) finds less corruption in countries with a longer exposure to democracy and a more educated population. As for economic variables, in a seminal paper, Mauro (1995) finds corruption has a negative effect on investment and therefore growth. Corruption has also been shown to have a negative impact on human capital, as measured by average years of schooling (Mo 2001), the quality of public investment (Tanzi & Davoodi 1997), the quality of public health care provision and child mortality (Davoodi, Gupta & Tiongson 2000), and FDI (Wei 2000b, a, Lambsdorff & Cornelius 2015). (Notice that all these variables are just different types of investment.) As for causality, Treisman (2000, 2007) finds evidence suggesting a higher degree of development causes lower corruption. Along this same line of reasoning, the literature usually finds corruption to be negatively associated with GDP (e.g., Persson & Tabellini 2003),⁴ which is usually used to control for the overall degree of development of a country. Figure 1, replicated from Besley (2006), exhibits the time series of the Political Risk Service (PRS) corruption index (ICRG) over the period 1985–2011. Countries are divided into two groups: high-income OECD countries and the rest⁵. Average corruption in the set of less developed countries is systematically higher. Needless to say, the direction of causation is hard to determine. I contribute to this literature by suggesting business cycles are an important determinant of the degree of corruption in a country at a point in time. My findings may at first appear as contrary to the stylized fact summarized in Figure 1. However, the two results can be reconciled once we distinguish between the long run (Figure 1) and the short run (this paper). Even though richer countries exhibit less corruption, corruption should not necessarily be counter–cyclical in the short run for a given institutional environment. In fact, even though in my panel regressions I find a positive correlation between business cycles and corruption, the same dataset exhibits a cross–sectional negative correlation between corruption and real GDP per capita.

The literature on the cross-national analysis of corruption also finds evidence suggesting electoral accountability is one of the key channels linking corruption and development. Lederman, Loayza & Soares (2005) identify three main characteristics: political competition, the existence of checks and balances, and transparency of the system. Recent

⁴For an exception, see Ades & Di Tella (1997).

⁵High-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, the UK, and the USA.
microeconomic studies support these findings. Ferraz & Finan (2011) find re-election incentives have a strong detrimental effect on corruption. In line with the discussion in Glaeser & Goldin (2006), Avis, Ferraz & Finan (2018) provide evidence that judicial accountability is another important determinant of corruption. Campante & Do (2014) show local governments in isolated US capital cities are less accountable and exhibit greater levels of corruption. On the one hand, the empirical findings in this paper coincide with the literature: When the analyses include control variables related to the characteristics identified by Lederman, Loayza & Soares (2005), these variables show signs in accordance with the literature. On the other hand, however, I also find that when accountability and the degree of democracy are strong, the elasticity of corruption with respect to business cycles is larger.

Regarding the effects of corruption on turnover, the evidence is mixed. Ferraz & Finan (2008) show that voters in Brazilian municipalities punish corrupt politicians when information about corruption practices is publicized. In a cross-national analysis, Krause & Méndez (2009) find that higher output growth and lower inflation increase the incumbent’s support at the same time that corruption is punished at the polls. Peters & Welch

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6See Olken & Pande (2012) for a review of this literature.
(1980) study the electoral impact of corruption charges on candidates in contest for the US House of Representatives, and find that even though corrupt candidates suffer a loss in votes, they are often re-elected. Chang & Golden (2004) find similar results in their study of the re-election probability of Italian congressmen. On the other hand, the literature on economic voting (see Lewis-Beck & Stegmaier (2013) for a complete survey) finds that good economic performance is rewarded and bad economic performance is punished. This paper contributes to these literatures by showing that higher corruption leads to an increase in the probability of both chief executive and party turnover, at the same time that good economic performance is rewarded. More importantly, I provide evidence showing that business cycles have a positive, indirect effect on turnover working through corruption, as predicted by the model.

Three empirical regularities in this paper are, to the best of my knowledge, new to the literature. The first one is the counter-cyclicality of future corruption, working through the pro-cyclicality of turnover, as predicted by the model. The second finding is that, at the cross-national level, corruption is a strikingly stable function of the log of output volatility, as measured by the standard deviation of the business cycle component of log real GDP per capita. This result is not an unambiguous result in the theory I set up, and I only perform a basic empirical analysis about it because it is not the main focus of the paper. The same is true for the third empirical regularity, namely, the fact that across countries, corruption increases with the length of mandates.

To the best of my knowledge, the study closest to an analysis of the relationship between aggregate corruption and business cycle fluctuations is Gokcekus & Suzuki (2011). 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. The way they capture an increase in transitory income does not clearly map to a business cycle component, however. Their measure of transitory income for country $i$ at period $t$ is $y_{i,t} - \bar{y}_i$, where $y_{i,t} := GDP_{i,t}/\overline{GDP}_t$, $\bar{y}_i := \sum_t y_{i,t}$, and $\overline{GDP}_t := \sum_i GDP_{i,t}$. In this way, the measure of a country’s booms is contaminated by other countries’ performance. Thus, it is difficult to interpret this variable as effectively affecting the incentives of the agents living in country $i$. Think of the case in which country $i$ exhibited a constant rate of growth over the entire period and the rest of the countries had a more erratic performance. The authors’ measure of a country’s level of corruption in period $t$ is $\text{corr}_{i,t}/\text{corr}_t$, which suffers from a problem similar to the one of their measure of transitory income. Finally, as I explain in more detail in section 4.1, the corruption index they use is not suitable for year-to-year comparisons within a country.
The pro-cyclicality of corruption found in this paper is similar to the findings in Niehaus & Sukhtankar (2013). They study the Indian National Rural Employment Guarantee Scheme (NREGS) and analyze in great detail the effects of an exogenous increase in daily wages on the amount of days of work overreported by implementing officials, who administer labor budgets. They find that (1) prices matter: When statutory daily wages increased, officials reported more fictitious work on wage projects; and (2) Official’s mis-reporting involved a “golden goose effect”: Theft on piece-rate projects (which were not affected by the wage increase) declined after the shock, and both daily-wage overreporting and piece-rate theft fell differentially (the former significantly) in villages with a higher share of upcoming pre-scheduled daily-wage projects. Officials, who can be punished for misconduct, wanted to preserve “the goose that lays the golden eggs.” Three essential differences exist between the empirical findings in Niehaus & Sukhtankar (2013) and in this paper. First, they differ regarding the context in which the results are valid. Niehaus & Sukhtankar (2013) show that at the individual level, corrupt behavior is in line with standard economic principles from incentive theory (Olken & Pande 2012). My interest, instead, is in on aggregate corrupt behavior in the political system and how it interacts with the punishment power of voters through electoral accountability. Second, I analyze whether the results hold across countries, and in which class of countries the effects are stronger. Finally, I evaluate whether the aggregate behavior of the economy, as measured by the business cycles, is a valid measure of politicians’ dynamic incentives to engage in corruption.

From a theoretical standpoint, the main forces behind the pro-cyclicality of corruption are shared with Alesina, Campante & Tabellini (2008) and Aidt & Dutta (2008), who analyze political-agency models with moral hazard. Because all politicians are ex-ante identical, voters are always indifferent between re-electing and replacing the incumbent government. Due to this indeterminacy, these type of models typically study equilibria where, at the beginning of the period, the voters announce performance standards (e.g., a utility threshold) such that they commit to re-elect the incumbent government only if performance is above the announced level, as if voting were retrospective. In such equilibria, no turnover occurs (as in Acemoglu, Golosov & Tsyvinski 2008, as well), because if it did, incentives to the incumbent government would be inefficiently provided. Finally, in equilibrium, positive and impersistent output shocks must induce an increase in corruption: These shocks increase total appropriable resources, so the incumbent’s temptations increase; if these shocks are observable to the voters (which is the case in Alesina, Campante & Tabellini 2008, Aidt & Dutta 2008), the voters realize they must loosen the
re–election standards in order to keep the incentive compatibility of the politician. All in all, total rents must increase.\footnote{In Alesina, Campante & Tabellini (2008), the pro–cyclicality of rents is only true in one specification of the model, in which total rents (i.e., total corruption) are bounded above by an exogenous function that is assumed to be increasing in output. In an alternative specification in which this bound does not depend on output but on the stock of debt, output shocks do not affect current rents.}

With the model studied in this paper, I consider problems of adverse selection and not moral hazard. Everything except the incumbent’s type is observable to the voter. Therefore turnover to occurs along the equilibrium path, and I can derive meaningful empirical predictions about the relationship between output shocks and turnover. The response of turnover further implies post–turnover corruption will change with these shocks, and this is then another prediction unique to this paper. Finally, regarding the relation between current corruption and current output shocks, my main prediction concerns the pro–cyclicality of the degree of corruption and not the level. To my best knowledge, in Alesina, Campante & Tabellini (2008) and Aidt & Dutta (2008), nothing guarantees corruption as a fraction of total resources increases (furthermore, see footnote 7).

\section{The Model Economy}

\subsection{Environment}

I consider a political–agency model\footnote{Following Alt & Lassen (2003), “corruption is a general problem of agency.”} (Besley 2006) with adverse selection and no moral hazard. The model economy is similar in spirit to the one in Acemoglu, Golosov & Tsyvinski (2008). The goal is to study the way in which corruption incentives vary with output shocks, and how this in turn affects political turnover. I therefore consider a simple two–period economy, to later show in section 3.4 that the main empirical implications still hold in an infinite–horizon setting. The economy is populated by a single voter\footnote{The fact that a single voter exists is unimportant. On the one hand, one can think of corruption as a valence issue, on which voters’ preferences are not very heterogeneous. On the other hand, in the one-dimensional game analyzed in this paper, if the economy contained more than one voter, majority rule would yield the outcome the median voter most prefers.} and a set of heterogeneous politicians, and the path of aggregate output is exogenously determined. All agents in this economy are expected discounted utility maximizers.

The voter lives for two periods, and her preferences for current consumption, $c \geq 0$, are represented by the per–period utility function $u(c) = c$.\footnote{Voters’ utility is linear also in Aidt & Dutta (2008) and Brollo, Nannicini, Perotti & Tabellini (2013).} Her discount factor is $\beta \in (0, 1)$ (in this two–period model, this parameter will not play a role).
Politicians differ in their degree of corruptibility, \( \theta \in \Theta = [0, 1] \), which is private information. The distribution function of types, \( G \), is common knowledge. Its pdf exists and is denoted by \( g \). Its support is \( \Theta = [0, 1] \). Politicians have preferences over rents, \( x \geq 0 \), and the voter’s consumption, \( c \), represented by the per–period utility function \( \tilde{v}(x, c, \theta) \), which is assumed to be homogeneous of degree one in its first two arguments, \( x \) and \( c \). The politicians’ common discount factor is \( \delta \in (0, 1) \).

In period \( t \), the allocation of aggregate resources, \( A_t \in A_t \subset \mathbb{R}_+ \), is delegated to the period–\( t \) incumbent politician, and it must satisfy the feasibility constraint \( x_t + c_t \leq A_t \), with \( c_t, x_t \geq 0 \). In short, the incumbent must choose \( x_t \in [0, A_t] \). Assume further that no savings technology exists, and the voter consumes whatever the incumbent has left on the table; therefore, \( x_t + c_t = A_t \ \forall t \). Finally, I also assume \( A_t \) is uncorrelated with the incumbent’s type. In particular, I first consider a deterministic path for output. Then, after a certainty equivalence result is evidenced, I consider a more general stochastic process, to study the equilibrium effects of output shocks in a sharper way.

The timing of the game is as follows. At the beginning of period \( t = 1 \), nature draws a type \( \theta \) from distribution \( G \), and only the incumbent observes this draw. Output is also realized at this point, but unlike the incumbent’s identity, output is publicly observed. The incumbent politician then decides how to allocate \( A_1 \) between \( x_1 \) and \( c_1 \), and period–1 payoffs are realized. After observing the allocation decision, the voter updates her beliefs on the incumbent’s type and decides whether to re–elect him or replace him with a fresh new draw from the same pool, \( G \). I denote the voter’s action by \( r \in [0, 1] \), where \( r = 1 \) indicates certain re–election. If the incumbent is replaced, he receives a continuation value of 0. The economy then moves on to period \( t = 2 \). The new level of output is realized and the politician in power — either the re–elected one or the newly drawn — decides on how to allocate \( A_2 \). Period–2 payoffs are realized and the game ends.

In the empirical analyses of section 4 I will look at the degree of corruption and political turnover. I informally define their model counterparts here, and I determine their equilibrium expressions in section 3.2.2.

**Definition 1 (Corruption).** The ex–post period–\( t \) degree of corruption, \( \chi_t \), is defined as total corruption relative to total available resources, \( \chi_t := \frac{x_t}{A_t} \in [0, 1] \). The period–\( t \) degree of corruption, \( C_t \), is defined as the (unconditional) expected ex–post period–\( t \) degree of corruption, \( C_t := E_0[\chi_t] \).

The definition of turnover is analogous:

**Definition 2 (Turnover).** Turnover, \( \tau \), is defined as the ex–ante probability that the
period–1 incumbent will be replaced, \( \tau = E_0 [r] \).

In equilibrium, the degree of corruption will depend on the incumbent’s type, which is unobservable, so our focus in the empirical analysis will be on the (unconditional) expected degree of corruption, where \( E_0 [\cdot] \) is computed before the incumbent’s type is realized, but after the realization of period–\( t \) output. The same reasoning applies to the case of turnover. These two measures are the limit average of the (corruption, turnover) observations for a given (and observable) output path as this two–period economy is observed infinitely many times over time periods or across countries (or both). Thus, the variables defined in Definitions 1 and 2 are the natural theoretical counterparts of the variables I analyze in section 4 with an international panel dataset: The corruption–perception index that I use measures corruption as captured from statements such as “high government officials are likely to demand special payments” or “illegal payments are generally expected throughout lower levels of government” (emphasis added); therefore, it is arguably a measure of the degree of corruption and not the level.

### 3.1.1 Politicians’ Preferences

\( \bar{\nu}(x, c, \theta) \) is assumed to be homogeneous of degree one in its first two arguments, \( x \) and \( c \). This assumption, together with the feasibility constraint \( x + c = A \), allows us to write

\[
\bar{\nu}(x, c, \theta) = A \bar{\nu}(\chi, 1 - \chi, \theta),
\]

where \( \chi := \frac{x}{A} \), as in Definition 1. The above expression says at least two important things. The first is that our forward-looking politicians will only care about the first moment of output. This is a certainty equivalence property. The second important aspect is that as long as the ratio of current and expected future output stays constant, the politician shouldn’t react to changes in the output path or to output shocks. That is, if both current and future expected output are scaled up or down by the same proportion, the allocation decision of the incumbent shouldn’t be affected. Therefore, the persistence of current output shocks is crucial: If output shocks are expected to last forever (i.e., they are perfectly persistent), corruption and turnover shouldn’t change. However, if output shocks are imperfectly persistent, as business cycles are, this reasoning no longer holds.

Define \( v(\chi, \theta) := \bar{\nu}(\chi, 1 - \chi, \theta) \). I impose the following conditions:

**Assumption 1** (Politician’s utility function). Let \( v(\chi, \theta) := \bar{\nu}(\chi, 1 - \chi, \theta) \forall \chi \in [0, 1], \forall \theta \in \Theta. v \) is assumed to satisfy
i. (Normalization.) $v(0, \theta) = 0 \forall \theta \in \Theta$;

ii. (Single–Peakedness.) $v_{\chi}(\chi, \theta) > 0 \forall \chi < \theta$, $v_{\chi}(\theta, \theta) = 0$, $v_{\chi}(\chi, \theta) < 0 \forall \chi > \theta$, $\forall \theta \in \Theta$;

iii. (Single–Crossing.) $v_{\chi\theta}(\chi, \theta) > 0 \forall \theta \in \Theta, \forall \chi \in [0, 1]$;

iv. (Distance.) Let $\chi \in [0, 1]$ and $\theta \in \Theta$. $\frac{v_{\chi}(\chi, \theta)}{v_{\chi}(\theta, \theta)}$ is strictly decreasing in $\theta$ when $\theta > \chi$, and it is strictly increasing in $\theta$ when $\theta < \chi$.

Assumption 1.i says that zero rents lead to zero utility for any type of politician. This assumption is a mere normalization. Assumption 1.ii indicates a type-$\theta$ politician has an ideal degree of corruption, which is equal to its type (the latter being, again, a normalization). That is, a type-$\theta$ politician would, myopically, like to steal a fraction $\theta$ of total resources. This is the way in which $\theta$ measures the degree of corruptibility. The underlying assumption here is that, reputational concerns aside, different politicians have different costs and benefits from appropriating public resources. The costs could be coming from a lower welfare of the incumbent’s constituency (which he directly cares about), ethics, shame, the probability of going to jail or the existence of institutional constraints on corrupt activities, effort spent in illegal activities or opportunity costs, having to share rents with bureaucrats, and so on.\(^{11}\) They must not be interpreted, however, as costs associated with electoral defeat, because this will be endogenously determined in the model. In short, politicians differ in the marginal benefits and/or costs coming from appropriating public resources, and as a result, leaving electoral accountability aside, they would exhibit different degrees of corruption. $\chi^b(\theta) := \theta$ will be called type–$\theta$’s bliss point.\(^{12}\)

The bliss point function will have great power in the characterization of the equilibria. For example, if the voter, for some given $A_1$ at $t = 1$, always (i.e., for any $\chi \in [0, 1]$) replaces or always re–elects the incumbent, each type’s best response will be to play $\chi^b(\theta)$; but this would perfectly reveal the identity of the incumbent to the voter, who now will be unwilling to always replace or always re–elect the incumbent.

Assumption 1.iii is a standard single–crossing property. Assumption 1.iv says the utility from grabbing a fraction $\chi$ of total appropriable resources relative to the politician’s maximum possible utility, which is the one derived from taking his bliss point, decreases

\(^{11}\)Alesina, Campante & Tabellini (2008), for example, assume there exists a maximum level of resources that the government can appropriate without ending up in jail.

\(^{12}\)In Aidt & Dutta (2008), an incumbent politician who can sell a unit mass licenses for production has an ideal (i.e., monopoly) quantity of licenses which is independent of the realization of output.
as the politician’s bliss points are further away from $\chi$. That is, more corrupt politicians, that is, those with higher $\theta$, suffer a bigger opportunity cost from grabbing a given fraction $\chi$. This assumption therefore imposes a notion of *distance* between actual rents and a politician’s bliss point.

### 3.1.2 Output

Even though I start analyzing this model economy for a given output path (i.e., $A_1$ and $A_2$ fixed), the certainty equivalence property of the model, discussed in the previous section, allows us to consider $A_2$ more generally as $E_{t=1} [A_2]$, the expected value of output in period $t = 2$ given the information in period $t = 1$. In section 3.3, where I derive the predictions of the model, I assume output follows the following stochastic process:

$$\ln A_t = T_t + \varepsilon_t,$$

where $T_t$ and $\varepsilon_t$ are the trend and cyclical component of period $t$ (log) output, respectively, which evolve over time as follows:

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

and

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

with $\rho \in [0, 1)$, $\gamma \in \mathbb{R}$, $\eta_t \sim \text{iid } N (0, \sigma^2_\eta)$, $\nu_t \sim \text{iid } N (0, \sigma^2_\nu)$, and $\eta_t$ and $\nu_t$ uncorrelated. The fundamental difference between the trend and the cycle is in their persistence. Shocks to the trend are perfectly persistent, whereas shocks to the cycle are imperfectly persistent because $\rho < 1$. As a secondary point, the trend component exhibits a drift, so $\gamma$ is the expected rate of growth in this economy, whereas the cycle exhibits no drift and eventually reverts to its mean, which is 0.

Notice that in this specification, to precisely compute the expected value of future output, both the politicians and the voter need to know the current realizations of $T_t$ and $\varepsilon_t$. Observing their sum, that is, the current value of output, is not enough. In this case, I therefore assume that both the trend and the cycle are observed by all players in this economy.
3.2 Equilibrium

I start by considering Perfect Bayesian Equilibria (PBE). Because, as is very well known, multiplicity of PBE may arise due to “unreasonable” off-equilibrium beliefs (of the voter, in this case), I later impose a simple equilibrium refinement based on the Intuitive Criterion (Cho & Kreps 1987). The procedure to which I subject off-equilibrium beliefs is a suitable adaptation of the Perfect Sequential Equilibrium concept (Grossman & Perry 1986) to this model. The equilibrium refinement will yield a unique equilibrium.

Following the PBE concept, one may think of an equilibrium in this economy as consisting of three objects:

1. **Politicians’ behavior strategies (degree of corruption):** two maps, one for each period, going from the sets of types, to degrees of corruption, \( \chi^*_t : \Theta \rightarrow [0,1], t = 1, 2; \)

2. **Voter’s posterior beliefs:** a map from all conceivable degrees of corruption in period \( t = 1, \chi_1 \in [0,1] \), to a probability distribution over \( \Theta \); and

3. **Voter’s behavior strategy (re-election):** a map from all conceivable degrees of corruption in period \( t = 1 \) to the re-election decision, \( r^* : [0,1] \rightarrow \{0,1\}, \)

such that

a. strategies are sequentially rational given beliefs, and

b. beliefs are consistent given strategies.

As shown in points 1 and 3 above, I restrict attention to pure strategies. The fact that the voter plays pure strategies is not restrictive in this setting, because if the voter randomizes between re-election and replacement after observing some degree of corruption \( \chi_1 \) in period \( t = 1 \), she can make at most one type indifferent between playing \( \chi_1 \) and facing the lottery and playing the bliss point and being replaced. Moreover, I assume that whenever the voter is indifferent, she re-elects the incumbent. This latter assumption, in turn, is crucial for the existence of equilibria.

3.2.1 Preliminaries: Perfect Bayesian Equilibria

In period \( t = 2 \), the politician in power will play his bliss point: \( \chi^*_2 (\theta) = \theta \forall \theta \in \Theta \). Thus, after having observed \( \chi_1 \), the voter decides to re-elect the incumbent if (and, modulo
indifference, only if) \[\text{[from now on, “if(f)”]} E [(1 - \theta) A_2 | \chi_1] \leq E [(1 - \theta) A_2]. \] Because \(A_2\) is independent of \(\theta\) (even in the stochastic case), this condition is equivalent to

\[E [\theta | \chi_1] \leq E [\theta] =: \theta^*. \] (4)

Because the voter is “linear,” and future output is independent of the politician’s degree of corruptibility, she only cares about minimizing the expected degree of corruption in period \(t = 2\), \(C_2 = E [\chi_2^* (\theta)]\) (recall Definition 1). If the voter replaces the incumbent, the expected degree of corruption is given by \(E[\theta]\). If the voter re–elects the incumbent, it is given by his expected type given the information the incumbent has provided to the voter by playing \(\chi_1\), \(E [\theta | \chi_1]\). For interpretation purposes and future reference, classifying types according to their position relative to \(\theta^* := E [\theta]\), the voter’s indifference threshold, is useful. In this way, let \(\theta \in [0, \theta^*]\) be called a “good” type, in contrast to the “bad” types who live in the interval on the other side of \(\theta^*, (\theta^*, 1]\). The partition is not whimsical: Condition (4) tells us that voter would ideally like to keep any good politician, and replace all the bad ones.

Finally, given equilibrium strategies, \(\chi_1^* (\theta)\) must satisfy the following incentive compatibility constraint:

\[\chi_1^* (\theta) \in \arg \max_{\chi \in [0,1]} A_1 v (\chi, \theta) + \delta \cdot r^* (\chi) \cdot A_2 v (\theta, \theta). \] (5)

Notice that, as anticipated in section 3.1.1, the politician’s best response to \(r^* (\cdot)\) will depend on the ratio \(a := \frac{A_1}{A_2}\) and not on the values of \(A_1\) and \(A_2\) separately (as long as \(r^* (\cdot)\) doesn’t change). This incentive compatibility constraint by itself already yields a useful result:

**Lemma 1.** In any equilibrium, if type \(\theta\) is to be replaced after playing \(\chi_1^* (\theta)\), it must be that \(\chi_1^* (\theta) = \chi^b (\theta) = \theta\). That is, \(r^* (\chi_1^* (\theta)) = 0 \Rightarrow \chi_1^* (\theta) = \theta, \forall \theta \in \Theta.\)

**Proof.** See Appendix A.

Lemma 1 states that if the incumbent politician is supposed to play \(\chi_1^* (\theta)\) in equilibrium, and this decision leads to sure replacement, he must be playing his bliss point. If not, deviating to \(\chi^b (\theta)\) would be profitable because doing so maximizes current utility and \(r^* (\chi^b (\theta)) \geq 0\). Two important corollaries follow. First, if some type is not playing his bliss point, he is re–elected in equilibrium. Second, an equilibrium degree of corruption that leads to sure replacement could only be played by the type whose bliss point coincides with such a point. These results already suggest a taxonomy of types according
to their equilibrium behavior: types who play their bliss point and are re-elected; types who play their bliss points but are voted out; and types who — in order to get re-elected — do not play their bliss points. How does this taxonomy relates to the “good” and “bad” types classification? Keep reading.

Applying the PBE concept provides the following results, which help narrow down the equilibria of the model:

(a). Full revelation can never happen in period $t = 1$: $\chi^*_1(\theta)$ is not injective in $\theta$; however,

(b). (i) $\chi^*_1(\theta)$ is a weakly increasing function of $\theta$ such that (ii) every type is either playing his bliss point or playing a pooling degree of corruption;

(c). In any equilibrium, all the good types $\theta \in [0, \theta^*]$ are re-elected;

(d). There always exists at least one good type who does not play his bliss point in period $t = 1$.

See Appendix A for the formal proofs.

Result (a) determines full revelation is impossible in period $t = 1$. Some degree of “cheating” will always occur. Most of the time the cheating will be reasonable: The bad types pool together with the good types in order to get re-elected. At other times, cheating doesn’t make sense: Good types can be pooling together at degrees of corruption that are not played by any bad type. These good types are being threatened by off-equilibrium, unreasonable beliefs. Note, however, that this result does not imply the voter is unable to perfectly discriminate between good and bad types. It can be the case that for some good type $\theta > 0$, all types below $\theta$ may play their bliss point and get re-elected, all types in $[\theta, \theta^*]$ pool together at $\chi_1 = \chi^b(\theta)$ and get re-elected, and all the bad politicians grab their bliss points and are voted out. This scenario constitutes an equilibrium as long as type $\theta^*$ is indifferent between playing $\chi^b(\theta)$ and being re-elected, and playing his bliss point and being replaced, and the voter replaces the incumbent if she observes $\chi_1 \in (\theta, \theta^*)$. Thus, we see that multiplicity of equilibria is pervasive and unavoidable — the “choice” of such a type $\theta$ is practically unrestricted —, due to the lack of discipline one imposes on off-equilibrium beliefs.

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13 This classification is analogous to the one identified by Duggan (2000).
14 By Assumption 1.iv, if $\theta^*$ is indeed indifferent, all the good, pooling types below him will strictly prefer $\chi^b(\theta)$ to their bliss points, because their loss from the latter is smaller than the loss of type $\theta^*$ (see Lemma 8 in Appendix A for a formal proof).
Result (b.i) indicates that the higher the degree of corruptibility of the incumbent politician, the higher the equilibrium degree of corruption. But because, by Result (a), \( \chi^*_1(\theta) \) cannot be strictly increasing in \( \theta \), it must be weakly so. To understand the meaning of Result (b.ii), consider a type who is not playing his bliss point. He must then be playing another degree of corruption that keeps him in office (Lemma 1). But this degree of corruption certainly corresponds to the bliss point of some other type who would therefore prefer it to any other option because it leads to sure retention. Finally, the fact that these two types are playing the same action makes all intermediate types between them play this same degree of corruption, because \( \chi^*_1(\theta) \) is increasing by Result (b.i).

To understand Result (c), notice that if a good type is not re-elected, Lemma 1 determines he must play his bliss point. Furthermore, he must be the only type who plays such a degree of corruption. But then his action perfectly reveals his type to the voter, who now wants to keep him in office. This result is somehow good news: The less corrupt politicians are always (i.e., in any PBE) re-elected. However, even if all good types are re-elected, it comes at a cost. As Result (d) indicates, some good types pay the cost of the voter’s incomplete information. If this weren’t the case, and all the good politicians played their corresponding bliss points, many bad types close enough to \( \theta^* \) would be tempted to mimic the good type \( \theta^* \), who is re-elected as any other good type (Result (c)). But then playing \( \chi_1 = \theta^* \) wouldn’t really lead to re-election, because the voter’s posterior beliefs now would push her to vote the incumbent out after observing \( \chi_1 = \theta^* \) because, in this case, \( E[\theta|\chi_1 = \theta^*] > \theta^* \) (recall condition (4)).

Despite the multiplicity discussed in the context of Result (a), the PBE concept yields a unique equilibrium when \( A_1 \) is sufficiently lower than \( A_2 \) — for example, a macroeconomic recession:

**Proposition 1.** If \( A_1 \leq \delta A_2 \), all types play \( \chi^*_1(\theta) = 0 \) in period \( t = 1 \) and the voter re-elects the incumbent if(f) \( \chi_1 = 0 \).

**Proof.** If \( A_1 \leq \delta A_2 \), the reward for waiting, as measured by \( \delta A_2 \), is greater than the temptation to grab today, as measured by \( A_1 \). First, note that in such cases, no type \( \theta \) can ever be replaced in equilibrium. If he were, he would play his bliss point \( \chi^b(\theta) = \theta \) by Lemma 1. However, whenever \( \delta A_2 \geq A_1 \), this type prefers to mimic type \( \theta = 0 \), who always plays \( \chi_1 = 0 \) (see Appendix A) and always gets re-elected (Result (c)). To see this, consider type \( \theta \) and compare his utility when he plays \( \chi_1 = \theta \) with \( r^*(\theta) = 0 \) against \( \chi_1 = 0 \) with \( r^*(0) = 1 \). Because \( v(0, \theta) \geq 0 \ \forall \theta \in \Theta \) (Assumption 1.i) and \( A_1 \leq \delta A_2 \), we...
have that \( \forall \theta \in \Theta, \)
\[
A_1 v (0, \theta) + (\delta A_2 - A_1) v (\theta, \theta) > 0,
\]
or
\[
A_1 v (0, \theta) + \delta A_2 v (\theta, \theta) > A_1 v (\theta, \theta).
\]

So this type strictly prefers to deviate and mimic type \( \theta = 0 \). Then, when \( A_1 \leq \delta A_2 \), all types must be re-elected in equilibrium. In particular, type \( \theta = 1 \) must be re-elected, so he must play a pooling degree of corruption, \( \chi^p \), after which the voter is willing to re-elect.

Suppose \( \chi^p > 0 \). Notice that the voter’s optimality condition in (4) and the fact that \( \chi^*_1 (\theta) \) is increasing (Result (b.i)) together determine \( \chi^p \) must be played by (almost) all types other than \( \theta = 0 \) (who always plays \( \chi_1 = 0 \)). But then we can see that, by the single-peakedness of \( v (\chi, \cdot) \), a type \( \theta' > 0 \) exists close enough to \( \theta = 0 \) such that \( \theta' \) is indifferent between mimicking \( \theta = 0 \) and playing \( \chi^p \). But then all types in \( (0, \theta') \) strictly prefer to mimic \( \theta = 0 \), which violates the requirement that \( E [\theta | \chi^p] \leq \theta^* \). Therefore, \( \chi^*_1 (\theta) = 0 \) \( \forall \theta \in \Theta \). In this case, \( E [\theta | \chi^p] = \theta^* \), and the voter is indifferent between retaining and replacing. Finally, it must be the case that the voter replaces the incumbent politician for any degree of corruption other than \( \chi_1 = 0 \); otherwise, the types whose bliss points coincide with these other degrees of corruption, which lead to retention, would deviate.

It is now evident that multiplicity of equilibria can only arise when \( A_1 > \delta A_2 \). In such cases, the current temptation to grab is too strong, and some bad types will start to give in. Figure 2 shows some possible classes of equilibrium (behavior) strategies of the politicians in period \( t = 1, \chi^*_1 (\theta) \). Notice that in all panels except panel (a), good types are pooling together with other good types, and with good types only. If more than one such set of good, pooling types exists (as in panels (b) and (c)), these equilibria would be ruled out every time any strategic meaning is given to off-equilibrium messages. So, for example, the Intuitive Criterion would take care of these cases. The reason is that for any off-equilibrium message \( \chi^o \) that coincides with the bliss point of a good type \( \theta \) in the “leftmost” set of good, pooling types, no bad politician exists who would send message \( \chi^o \) to the voter, even if he were treated in the best possible way (i.e., re-elected). The bad politicians prefer to play the action prescribed by the equilibrium. Therefore, these off-equilibrium messages could have been sent only by good types. By recognizing this fact, the voter should be willing to re-elect the incumbent, and the equilibrium would fall apart.

Panels (a) and (c), however, cannot be ruled out by standard equilibrium refinements such as the Intuitive Criterion. The reason is that for any off-equilibrium message \( \chi^o \),
there always exists a set of bad types who could have sent this message if they were consequently re-elected. Then the voter should place some weight on these bad types if she observes such an off-equilibrium message, $\chi^o$, and how the voter would optimally respond to $\chi^o$ in this case is unclear. I now define the strategies depicted in panels (a) and (c) of Figure 2 and the associated equilibria.

**Definition 3.** The politicians’ (behavior) strategy is called separating-pooling-separating (SPS) if it is of the following form:

$$
\chi_1^*(\theta) = \begin{cases} 
\theta_l & \text{if } \theta \in [\theta_l, \theta_h] \\
\theta & \text{if } \theta \notin [\theta_l, \theta_h]
\end{cases}
$$

\text{(6)}
for some pair \((\theta_l, \theta_h) \in \Theta^2\) such that \(0 \leq \theta_l \leq \theta_h \leq 1\). A PBE is called an SPS equilibrium if the politicians play an SPS (behavior) strategy in every period.

Notice the strategy \(\chi(\theta) = \theta \forall \theta \in \Theta\) is included by considering \(\theta_l = \theta_h\). In an SPS equilibrium, all types in the interval \([\theta_l, \theta_h]\) are pooling together at \(\theta_l\)’s bliss point. All other types (those to the left of \(\theta_l\) and to the right of \(\theta_h\)) are playing their preferred degree of corruption.

**Proposition 2.** Let \(a := \frac{A_1}{\delta A_2}\). If \(a > 1\), a continuum of SPS equilibria exists. In each of them, \(\chi_2^*(\theta) = \theta \forall \theta \in \Theta\), and in period \(t = 1\), \(\chi_1^*(\theta)\) is characterized by a pair \((\theta_l, \theta_h) \in \Theta^2\) satisfying \(\theta_l < \theta_h\),

\[
E[\theta|\theta \in [\theta_l, \theta_h]] \leq \theta^*;
\]

and

\[
av(\theta_l, \theta_h) + v(\theta_h, \theta_h) = av(\theta_h, \theta_h).
\]

The voter re-elects if\(f\) \(\chi_1 \leq \theta_l\).

**Proof.** We already know \(\chi_2^*(\theta) = \theta \forall \theta \in \Theta\), and this is an SPS strategy. In period \(t = 1\), some types reveal their true intentions to the voter. The good ones are re-elected and the bad ones are replaced. Also, no type in the interval \([\theta_l, \theta_h]\) is playing his bliss point; therefore, all types in this interval must be re-elected in equilibrium (Lemma 1). Then it must be the case that the voter re-elects if\(f\) \(\chi_1 \leq \theta_l\). Therefore, (7) must be satisfied, and for any off-equilibrium action we make the voter believe this message is coming from type \(\theta = 1\) with probability 1. (7) further implies \(\theta_l < \theta^*\) (\(\theta_l\) is a good type).

At the same time, \(\theta_h\) must be a bad type. If he weren’t, he would like to deviate and imitate type \(\theta_h + \varepsilon\), with \(\varepsilon > 0\) and sufficiently small such that \(\theta_h + \varepsilon \leq \theta^*\): This type is a good type and is therefore kept in office (Result (c)), and at the same time, he is playing his bliss point, which is very close to \(\theta_h\)’s. That is, \(\theta_l < \theta^* < \theta_h\). Given \(\theta_l\), type \(\theta_h\) must be indifferent between mimicking \(\theta_l\) and being re-elected, and playing his bliss point and leaving office, which is (8). Finally, all the bad types above \(\theta_h\) strictly prefer their bliss points over \(\theta_l\), and the types \(\theta \in (\theta_l, \theta_h)\) strictly prefer \(\theta_l\) to their bliss points (see Lemma 8.iv in Appendix A for the proof). We can conclude this strategy profile and beliefs constitute a PBE.

To prove multiplicity, we have that, given \(\theta_l\), type \(\theta_h\) satisfying (8) increases with \(\theta_l\) (see Lemma 8.ii in Appendix A for the proof). Then, \(E[\theta|\theta \in [\theta_l, \theta_h]]\) increases with \(\theta_l\) and it is clear that a multiplicity of equilibria exists, each equilibrium being characterized by a value of \(\theta_l\).
3.2.2 A Refinement for PBE

As argued earlier, standard equilibrium refinements do not have any firepower in this model. I consider a variation on the Intuitive Criterion (Cho & Kreps 1987), which consists of applying the following

**Refinement Steps:**

1. Consider a PBE and some off-equilibrium message $\chi^o \in [0, 1] \backslash \chi^*_1(\Theta)$.

2. Submit each type $\theta \in \Theta$ to the following test: Check whether $\theta$ is better off by playing as prescribed by the equilibrium even if he gets re-elected after deviating and playing $\chi^o$. If he is better off, rule him out. Define $\Theta^o(\chi^o) \subset \Theta$ to be the closure of the set of types that are not ruled out.
3. When $\chi^o$ is observed, restrict posterior beliefs to satisfy

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

4. Check whether the voter decides to re-elect or replace when beliefs are given by (9).

5. If the voter re-elects for some $\chi^o$, 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. This simple procedure turns out to be equivalent to applying the more complex concept of Perfect Sequential Equilibrium (PSE, Grossman & Perry 1986). The reason is that, in this setting, the PSE fixed-point problem involving off-equilibrium beliefs is easily solved because (a) only one action by the voter means “to treat the incumbent in the best possible way” (re-election), and (b) this is true regardless of the incumbent’s type. Convergence of the fixed-point problem in the PSE concept is achieved in one step in this setting.

This equilibrium refinement yields a unique equilibrium.\(^{16}\)

**Proposition 3.** For each $a = \frac{A_1}{A_2}$, a unique equilibrium exists that survives the equilibrium refinement characterized by Refinement Steps 1 – 5. If $a \leq 1$, this equilibrium is the one identified by Proposition 1. If $a > 1$, it is the unique SPS equilibrium, as defined in Proposition 2, such that

$$E[\theta|\theta \in [\theta_l, \theta_h(\theta_l)]] = \theta^*.\quad (10)$$

**Proof.** See Appendix A.\hfill \blacksquare

\(^{15}\)For applying the PSE concept in a sender–receiver signaling game, one must specify an action that the receiver will follow for every possible message and every possible belief. Then, a PSE is constituted by sequentially rational strategies (in the usual sense) and credible beliefs, where credibility means that, after observing any message $m$, the receiver believes $m$ is sent by a type in a set $K$ such that, given the consequent best response of the receiver, those types benefiting (relative to equilibrium) from sending $m$ are all the types in $K$, and no one else. Finally, even if message $m$ is off the equilibrium path, the receiver’s beliefs after observing $m$ are obtained by applying Bayes’ rule on the prior given that the sender type is in the set $K$.

\(^{16}\)The unique equilibrium obtained with the equilibrium refinement belongs to the class of equilibria identified by Duggan (2000).
Before analyzing the empirical predictions of the model in the following section, I formally define the measures of corruption and turnover in this economy, following Definitions 1 and 2 in section 3.1. In light of the results in Proposition 3, all types $\theta > \theta_h$ are replaced, so turnover is
\[
\tau := E_\theta [r] = 1 - G(\theta_h) .
\]

For the degree of corruption,
\[
C_1 := E_\theta [\chi_1^*(\theta)] = \int_0^{\theta_l} \theta g(\theta) d\theta + \int_{\theta_l}^{\theta_h} \theta_1 g(\theta) d\theta + \int_{\theta_h}^{1} \theta g(\theta) d\theta , \quad \text{and}
\]
\[
C_2 := E_\theta [\chi_2^*(\theta)] = \int_0^{\theta_h} \theta g(\theta) d\theta + \int_{\theta_h}^{1} \theta^* g(\theta) d\theta .
\]

When $\delta A_2 \geq A_1$, these expressions should be evaluated at $\theta_h = 1$ and $\theta_l = 0$.

### 3.3 Comparative Statics and Predictions of the Model

In this section, I evaluate the way in which the endogenous variables of interest, corruption and turnover, vary with the exogenous variables and parameters of the model. Note that the unique equilibrium is completely summarized by $\theta_l$ and $\theta_h$, as seen from Proposition 3, and it depends only on $a = \frac{A_1}{\delta A_2}$.

**Proposition 4.** If $a < 1$, changes in $a$ have no effect on the degree of corruption or turnover. If $a \geq 1$, when $a$ increases, $\theta_h$ decreases strictly and $\theta_l$ increases strictly, so (i) the degree of corruption in period $t = 1$, $C_1$, increases, (ii) turnover, $\tau$, increases, and (iii) the degree of corruption in period $t = 2$, $C_2$, decreases.

**Proof.** See Appendix A. 

### 3.3.1 Changes in the Output Path

When $a = \frac{A_1}{\delta A_2} \leq 1$, or $\frac{A_1}{A_2} \leq \delta$, the degree of corruption is zero, as is turnover. Changes in the output ratio do not affect either of them, as long as $\frac{A_1}{A_2}$ stays below $\delta$.

Now consider the cases in which $a > 1$, or $\frac{A_1}{A_2} > \delta$. As $\frac{A_1}{A_2}$ gets bigger, the bad types are tempted to grab more today. If we momentarily fix $\theta_l$, type $\theta_h$ now prefers to take his bliss point and to be voted out, as opposed to catering to the voter by playing $\chi_1 = \theta_l$ and being re–elected. The new value of $\theta_h$ is smaller with higher $\frac{A_1}{A_2}$. However, this decrease in $\theta_h$ would yield $E[\theta|\theta \in [\theta_l, \theta_h]] < \theta^*$, so $\theta_l$ must increase in order to keep the voter indifferent. All in all, the interval of pooling types shrinks, and more revelation occurs on
either side of the interval. The effect on the expected degree of corruption in period \( t = 1 \), \( C_1 \), is clear: More types are now playing their bliss points, and the degree of corruption of the pooling types, \( \theta_l \), is also higher. The degree of corruption \( C_1 \) increases. Turnover increases as well, because the set \( (\theta_h, 1] \) expands. Figure 4 depicts these changes in the period–1 degree of corruption and turnover triggered by an increase in \( \frac{A_1}{A_2} \). The degree of corruption in period \( t = 1 \) is represented by the area below the colored lines (with weights for each type \( \theta \) given by the pdf \( g \)), whereas turnover is measured by the interval \( [\theta_h, 1] \).

As \( \frac{A_1}{A_2} \downarrow \delta \), so \( a \downarrow 1 \), the piece-wise function \( \chi^*_1(\theta) \) approaches the blue line, which is the equilibrium degree of corruption when \( a \leq 1 \). For point (iii) in Proposition 4, we have that as \( \frac{A_1}{A_2} \) increases, the voter can eliminate more of the most corrupt politicians, because more of them reveal their type. These types, in the second mandate, steal more than the average incumbent \( \theta^* \) — the voter’s outside option — thus making \( C_2 \) decrease.

**Figure 4: Comparative Statics: An Increase in \( A_1/A_2 \)**

\[ a = \frac{A_t}{\delta E[A_{t+1}|A_t]} = \frac{e^{(1-\rho)\varepsilon_t}}{\delta (1 + \gamma) e^{-\frac{\sigma^2 + \sigma^2}{2}}} . \]  

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**Output Shocks.** Now I assume output follows the stochastic process presented in section 3.1.2. In this case, we have that
The following are the main predictions of the model, which I test against the data in section 4.

**Predictions 1.**  

i. *(Cycle.)* A positive business cycle shock increases the current degree of corruption and political turnover, and it decreases corruption in future mandates: The current degree of corruption and political turnover are pro–cyclical, whereas future corruption is counter–cyclical.

ii. *(Trend.)* Neither corruption nor turnover depend on the value of the trend component of output, $T_t$.

A higher realization of the business cycle component, $\varepsilon_t$, increases $A_1 A_2$, because the effect of this boom vanishes over time ($\rho < 1$). The mean–reverting process of the cyclical component tells the politicians that a current macroeconomic expansion is an opportunity that won’t last forever, so they’d better grab it today. The current degree of corruption increases, turnover increases, and the next mandate’s degree of corruption decreases.

When the process for output is given by (1)-(3), the equilibrium does not depend on the level of the trend component, $T_t$, because shocks to $T_t$ are perfectly persistent, and therefore they translate into a permanent increase in aggregate resources. $A_1 A_2$ does not change. In short, the fundamental difference between the two types of income shocks in terms of their effects on corruption and turnover lies in the difference in their persistence. Notice that if I set $\rho = 1$, so shocks to $\varepsilon$ are perfectly persistent, $\varepsilon$ disappears from the expression in (11).

Notice the model also predicts that a higher long–run rate of growth of the economy, $\gamma$, decreases current corruption and turnover: On average, *ceteris paribus*, it is always better to wait. This model predicts a negative relationship between growth and corruption, but this time running from rates to corruption rather than vice versa (as in, for example, Mauro 1995). An analogous result can be found in Aidt & Dutta (2008).

The effect of a higher output volatility, $\sigma = \sigma^2 + \sigma^2_T$, is ambiguous in the following sense. Given a value of $\varepsilon_1$, a higher $\sigma$ decreases corruption because the expected value of future output is increasing in $\sigma$. However, the probability distribution of $\varepsilon_1$ varies with $\sigma$, and therefore the effect of a higher output volatility on expected corruption before $\varepsilon_1$ is realized is ambiguous. One easy way to see this ambiguity is to compare $\sigma = \infty$ against $\sigma = 0$. In the first case, the equilibrium degree of corruption is either 0 when $\varepsilon_1 = -\infty$ and the “pure” pooling equilibrium is played — or $\theta^*$ — when $\varepsilon_1 = \infty$ and the hybrid

\[ \text{If } \ln(z) \text{ is normally distributed with mean } \mu \text{ and variance } \sigma^2, \text{ then } E[z] = e^{\mu + \frac{\sigma^2}{2}}. \]
equilibrium converges to an equilibrium where every type grabs his bliss point. Both have the same probability. The expected degree of corruption when $\sigma = \infty$ is therefore equal to $\frac{1}{2}\theta^*$. In the second case, when $\sigma = 0$, $\varepsilon_1$ is equal to $\rho\varepsilon_0$ with probability 1. If $\varepsilon_1 = \rho\varepsilon_0$ implies $\frac{A_1}{A_2} \leq \delta$, corruption is zero, and it is therefore smaller than in the $\sigma = \infty$ case. However, if $\varepsilon_1 = \rho\varepsilon_0$ implies $\frac{A_1}{A_2} > \delta$, the hybrid equilibrium is played, and the degree of corruption can be smaller or greater than $\frac{1}{2}\theta^*$. In section 4.6, I evaluate the relationship between corruption and output volatility in the data. I find that, across countries, the average degree of corruption is a strikingly stable function of (the log of) output volatility.

### 3.3.2 Changes in $\delta$ and $\theta^*$

An increase in $\delta$ is equivalent to a decrease in $\frac{A_1}{A_2}$: It decreases corruption, decreases turnover, and increases future corruption. A higher value of $\delta$ can be interpreted as a shorter term. That is, the model predicts that economies with shorter mandates should exhibit a lower degree of corruption and lower turnover. I submit this prediction to simple empirical scrutiny in section 4.6.

Finally, a change in $\theta^*$, interpretable as a change in the voter’s outside option (rather than a change in the current distribution of types), makes both $\theta_l$ and $\theta_h$ increase. Therefore, turnover decreases, increasing the degree of corruption in the second period. However, the effect on the period–1 degree of corruption is ambiguous: When $\theta_l$ increases to $\theta_l'$, all types in $[\theta_l, \theta_h]$ now play $\theta_l'$, which increases corruption. However, at the same time, type $\theta_h$ shifts to the right as well, so the type who was playing his bliss point $\theta_h$ now pools together with the types in $[\theta_l, \theta_h]$, who consume $\theta_l < \theta_h$. The specific distribution of types $G$ determines the net effect. (See Appendix A for the proof.)

### 3.4 An Infinite–Horizon Economy

In this section, to show the main empirical predictions still hold in an infinite–horizon environment, I consider an extension of the baseline model in which time runs forever.

At every period $t$, the economy is still populated by one voter and one incumbent. The voter lives forever and her per-period utility function is $u(c_t) = c_t$. Her discount factor is $\beta \in (0, 1)$. The incumbent is characterized by his type, $\theta \in \Theta = [0, 1]$, which determines its degree of corruptibility. For simplicity, I assume $v(\chi, \theta) = \theta\chi - \frac{1}{2}\chi^2$. The politician’s discount factor is $\delta \in (0, 1)$. The distribution function of types, $G_0$, is common knowledge, and it is constant over time. Its pdf exists, and it is denoted by $g_0$. Its support is $\Theta = [0, 1]$. 
Output in every period is exogenously determined. As before, we can think of output in this economy as exhibiting a trend component, $T$, and a cyclical component, $\varepsilon$. For simplicity, I assume the cyclical component of output is iid across periods, which will make the outside option of the voter constant in a Markovian environment, as it is in the benchmark model. Furthermore, given I have already shown the irrelevance of the level of the trend, $T$, on corruption and turnover, I consider the detrended economy, in which the only shocks to output are given by business cycles. Given this assumption, discount factors $\delta$ and $\beta$ should now be interpreted as already taking into account the expectations of average growth in the economy.

The timing of the stage game is the same as before. At the beginning of each period $t$, one and only one incumbent is in office. The voter’s beliefs about the incumbent’s type are generically denoted by $g$, which is a pdf over $\Theta = [0, 1]$. First, $\varepsilon_t$ is realized according to a cdf $F$ whose pdf $f$ exists. The realization of this output shock is publicly observed. Then the incumbent decides how to allocate $\varepsilon_t$ between rents, $x_t$, and consumption for the voter, $c_t$. That is, $x_t + c_t \leq \varepsilon_t$. The allocation decision is perfectly observed by the voter, who now updates her prior on the incumbent’s type and decides whether to re-elect him or to replace him with a fresh new draw from the pool of politicians $G_0$. If the incumbent is replaced, he receives a continuation value of 0. The economy then moves on to the following period, $t + 1$. I assume the incumbent can be retained indefinitely by the voter (i.e., no term limits exist). However, at the beginning of each period, the politician is exogenously replaced by a fresh new draw from the stationary pool with probability $\lambda \in (0, 1)$. The voter observes this exogenous replacement episode.

### 3.4.1 Equilibrium Concept and Strategies

I analyze Markov Perfect Bayesian Equilibria (MPBE) of this model economy. Once again, multiplicity of equilibria may arise just because of “unreasonable” off-equilibrium beliefs. I therefore impose the same equilibrium refinement as in the benchmark model.

Let $S = (\varepsilon, g) \in \Sigma := \mathbb{R}_+ \times \Delta([0,1])$ be the vector that describes the state of the economy at a given point in time, where $\varepsilon$ is the current realization of the cyclical component of output, $g$ is the pdf over $\Theta = [0, 1]$ that characterizes the voter’s beliefs at a generic information set, and $\Delta([0,1])$ is the set of probability distributions over the interval $[0, 1]$.

The (behavior) strategies of the players in this game are as follows: First, given $S$, the incumbent chooses $\chi$, the fraction of output that he keeps for himself, so $\chi : \Theta \times \Sigma \to [0, 1]$. Having observed $(\varepsilon, \chi)$ and given beginning-of-period beliefs $g$, the voter must make a
re–election/replacement decision, so \( r : \Sigma \times [0, 1] \to \{0, 1\} \), with \( r = 1 \) indicating retention.

Let \( Z (S, \chi) := \left\{ \tilde{\theta} \in \Theta : g (\tilde{\theta}) \neq 0 \text{ and } \chi^* (\tilde{\theta}, S) = \chi \right\} \subset \Theta \) be the set of politician types “alive” (according to \( g \)) at state \( S \) and playing \( \chi \) in equilibrium.

**Definition 4.** A Markov Perfect Bayesian Equilibrium (MPBE) in this economy consists of politicians’ (behavior) strategies \( \chi^* : \Theta \times \Sigma \to [0, 1] \), the voter’s re–election/replacement decision \( r^* : \Sigma \times [0, 1] \to \{0, 1\} \), and a belief system \( \mu^* : \Sigma \times [0, 1] \to \Delta ([0, 1]) \) such that

1. Given \( r^* \), \( \chi^* (\theta, S) \) maximizes the type–\( \theta \) incumbent’s expected discounted utility at state \( S \), \( \forall \theta \in \Theta, \forall S \in \Sigma \);

2. Given \( \chi^* \) and \( \mu^* \), \( r^* (S, \chi) \) maximizes the voter’s expected discounted utility at state \( S \) after having observed \( \chi \), \( \forall S \in \Sigma, \forall \chi \in [0, 1] \), where expected discounted utility is computed with probabilities over types according to \( \mu^* \);

3. The belief system \( \mu^* \) is consistent with equilibrium strategies in the sense that, given \( \chi^* \), \( \forall S \in \Sigma, \forall \chi \in [0, 1] \) such that \( Z (S, \chi) \neq \emptyset \),

\[
\mu^* (\theta, S, \chi) = \left\{ \begin{array}{ll}
g (\theta) & \forall \theta \in Z (S, \chi) \\
\int_{\theta \in Z (S, \chi)} g (\theta) d\theta & \forall \theta \in \Theta \setminus Z (S, \chi)
\end{array} \right.
\]

If \( Z (S, \chi) \) is a singleton, so \( Z (S, \chi) = \left\{ \tilde{\theta} \right\} \) for some \( \tilde{\theta} \in \Theta \), then \( \mu^* \) is degenerate at \( \tilde{\theta} \).

4. The state evolves as follows:

   (a) \( \varepsilon \) is iid and distributed according to pdf \( f \);

   (b) Beliefs evolve according to \( \mu^* \): \( \forall \theta \in \Theta, \forall S \in \Sigma, \forall \chi \in [0, 1] \),

\[
g' (\theta|S, \chi) = \mu^* (\theta, S, \chi).
\]

### 3.4.2 Value Functions

**Voter.** Let the state at the beginning of the current period be \( S = (\varepsilon, \tilde{\gamma}) \). After observing \( \chi \in [0, 1] \), and given equilibrium strategies \( \chi^* \), the voter updates her beliefs on the incumbent’s type via Bayes’ rule whenever possible. Let \( g \) be the voter’s posterior beliefs resulting from this updating process. Notice then that, because the voter is an expected
discounted utility maximizer, all that matters for her best response in a MPBE is $g$, because it indicates the likelihood with which each type $\theta$ will be in office if re-elected. Finally, the realization of the cycle in the current period, $\varepsilon$, doesn’t affect the future, since this random variable is iid. Thus, let us call $V (g)$ the value function of the voter when end-of-period beliefs are given by $g$. Also, let $V_0 := V (g_0)$ be the value from replacing the incumbent, which is also the value that the voter obtains when the incumbent is exogenously removed from office. Then we have the following Bellman equations:

$$V (g) = \max \left\{ V_0, \int_0^1 \varepsilon' (1 - \chi^* (\theta, \varepsilon', g)) g (\theta) d\theta f (\varepsilon') d\varepsilon' + \beta (1 - \lambda) \int_0^1 V \left( g' (\varepsilon', g, \chi^* (\theta, \varepsilon', g)) \right) g (\theta) d\theta f (\varepsilon') d\varepsilon' + \beta \lambda V_0 \right\}$$

and

$$V_0 = \int_0^1 \varepsilon' (1 - \chi^* (\theta, \varepsilon', g_0)) g_0 (\theta) d\theta f (\varepsilon') d\varepsilon' + \beta (1 - \lambda) \int_0^1 V \left( g' (\varepsilon', g_0, \chi^* (\theta, \varepsilon', g_0)) \right) g_0 (\theta) d\theta f (\varepsilon') d\varepsilon' + \beta \lambda V_0.$$

The value function in (12) says that when holding beliefs $g$, the voter chooses the maximum between replacing the incumbent, which gives continuation value $V_0$, and re-electing the incumbent. The value from re-election is equal to expected consumption in the next period, which for a given type $\theta$ and a given $\varepsilon'$ is equal to $\varepsilon' \cdot (1 - \chi^* (\theta, \varepsilon', g))$, plus the discounted continuation value: With probability $\lambda$, the incumbent is exogenously replaced and the voter obtains $\beta V_0$, and with probability $(1 - \lambda)$, the voter obtains $\beta E [V \left( g' (\varepsilon', g, \chi^* (\theta, \varepsilon', g)) \right)]$, where expectations are computed with respect to $\varepsilon'$. The continuation value $V_0$ in (13) follows an analogous reasoning, but this time the voter cannot decide, and expectations with respect to the incumbent’s type are computed according to $g_0$.

**Politicians.** Consider a type-$\theta$ politician who is in power in state $S = (\varepsilon, g)$. His value function satisfies the following Bellman equation:

$$P (\theta, \varepsilon, g) = \max_{\chi \in [0,1]} \varepsilon v (\chi, \theta) + \delta (1 - \lambda) r (\varepsilon, g, \chi) \int P (\theta, \varepsilon', g' (\varepsilon', g, \chi)) f (\varepsilon') d\varepsilon'$$

Notice the chosen degree of corruption, $\chi$, affects not only current utility and the probability of re-election, as in the two-period model, but also the incumbent’s beliefs $g'$, and therefore the future state of the economy.
3.4.3 Conjecture of an MPBE

I conjecture that a particular MPBE exists that closely resembles the unique SPS equilibrium identified in Proposition 3 but is adapted to the infinite–horizon environment.

The particular MPBE that I consider is characterized by two functions \( \theta_l(\varepsilon) : \mathbb{R} \rightarrow [0, \theta^*] \) and \( \theta_h(\varepsilon) : \mathbb{R} \rightarrow [\theta^*, 1] \). \( \theta_l(\varepsilon) \) is increasing, whereas \( \theta_h(\varepsilon) \) is decreasing in \( \varepsilon \). \( \theta^* \in [0, 1] \) is the limit of both \( \theta_l(\varepsilon) \) and \( \theta_h(\varepsilon) \) as \( \varepsilon \rightarrow \infty \). Also, \( \varepsilon_0 \) exists such that \( \theta_l(\varepsilon_0) = 0 \) and \( \theta_h(\varepsilon_0) = 1 \) \( \forall \varepsilon \leq \varepsilon_0 \). The two functions are strictly monotonic in \( \varepsilon \) for \( \varepsilon > \varepsilon_0 \). Determining the way in which these functions affect equilibrium play is now necessary. I first do so heuristically.

Recall the definition of an SPS behavior strategy for the politicians (Definition 3). The conjecture is that, in their first term, politicians behave qualitatively in the same way they did in the unique equilibrium of the benchmark model. Then the role of \( \theta_l \) and \( \theta_h \) is the same as before. The difference, however, is in the following mandates.

Panel (a) in Figure 5 shows the way in which the behavior strategy \( \chi^*(\theta, \varepsilon, g_0) \) changes with \( \varepsilon \). Again, this is the same as in the first period of the two–period economy. However, this time \( \theta^* \) is not the voter’s threshold type (for now) but the limit of the functions \( \theta_l(\varepsilon) \) and \( \theta_h(\varepsilon) \) as \( \varepsilon \rightarrow \infty \). Now suppose the realization of \( \varepsilon \) is \( \varepsilon' \) such that \( \chi^*(\theta, \varepsilon', g_0) \) is the green curve in panel (a). If the incumbent is of type \( \theta < \theta_l(\varepsilon') \), he reveals his type, and assuming he is a good type (which the voter decides), he is kept in office forever, playing his bliss point, until he is exogenously replaced by a new incumbent. If the type is \( \theta > \theta_h(\varepsilon') \), the interpretation is that he is a bad type and is therefore immediately replaced by the voter. Now assume \( \theta \in [\theta_l(\varepsilon'), \theta_h(\varepsilon')] \). The incumbent pools at \( \chi = \theta_l(\varepsilon') \) and is re–elected (Lemma 1 still holds). Also, by our equilibrium refinement, the claim is that the voter is indifferent between replacing and retaining the incumbent when she observes \( (\varepsilon, \chi) = (\varepsilon', \theta_l(\varepsilon')) \) when beliefs are given by \( g_0 \). How does this incumbent play in his second mandate? The conjecture is that if the new realization of \( \varepsilon \) is below \( \varepsilon' \), as in panel (b), an incumbent of type \( \theta \in [\theta_l(\varepsilon'), \theta_h(\varepsilon')] \) plays \( \theta_l(\varepsilon') \). He just “stays there.” The reason is that playing \( \chi \) lower than this is pointless. There was a reason to play a lower degree of corruption in the first mandate, because the incumbent could “look like” a more honest type by doing so (given the right value of \( \varepsilon \)), but now the incumbent has already revealed to the voter that his type is in the interval \( [\theta_l(\varepsilon'), \theta_h(\varepsilon')] \). However, if the realization is \( \varepsilon'' > \varepsilon' \), as in panel (c), the incumbent starts playing in the same way he would have played in the first mandate. And the reasoning applies going forward: 

\[18\] This result comes from perfect monitoring.
Theorem 1. In this economy, an MPBE exists that, along the equilibrium path, is characterized by \( \theta_l(\varepsilon) : \mathbb{R} \to [0, \theta^*] \) and \( \theta_h(\varepsilon) : \mathbb{R} \to [\theta^*, 1] \) such that

i. \( \theta^* \in [0, 1] \) is the limit of both \( \theta_l(\varepsilon) \) and \( \theta_h(\varepsilon) \) as \( \varepsilon \to \infty \);
ii. \( \theta_l(\varepsilon_0) = 0 \) and \( \theta_h(\varepsilon_0) = 1 \) \( \forall \varepsilon \leq \varepsilon_0 \) for some \( \varepsilon_0 \in \mathbb{R} \);

iii. \( \theta_l(\varepsilon) \) is strictly increasing and \( \theta_h(\varepsilon) \) is strictly decreasing for all \( \varepsilon > \varepsilon_0 \).

Then the equilibrium play along the equilibrium path is as follows:

a. (Politicians’s behavior strategies.) At state \( S = (\varepsilon, g) \), where \( g \) has support \( [\theta_l(\tilde{\varepsilon}), \theta_h(\tilde{\varepsilon})] \) for some \( \tilde{\varepsilon} \in \mathbb{R} \),

\[
\chi^*(\theta, \varepsilon, g) = \begin{cases} 
\theta_l(\tilde{\varepsilon}) & \text{if } \varepsilon \leq \tilde{\varepsilon} \\
\theta_l(\varepsilon) & \text{if } \varepsilon \in (\tilde{\varepsilon}, \theta_l^{-1}(\theta)) \\
\theta & \text{if } \varepsilon > \theta_l^{-1}(\theta)
\end{cases}
\]

for all \( \theta \in [\theta_l(\tilde{\varepsilon}), \theta^*] \), whereas

\[
\chi^*(\theta, \varepsilon, g) = \begin{cases} 
\theta_l(\tilde{\varepsilon}) & \text{if } \varepsilon \leq \tilde{\varepsilon} \\
\theta_l(\varepsilon) & \text{if } \varepsilon \in (\tilde{\varepsilon}, \theta_l^{-1}(\theta)) \\
\theta & \text{if } \varepsilon > \theta_l^{-1}(\theta)
\end{cases}
\]

for all \( \theta \in (\theta^*, \theta_h(\tilde{\varepsilon})] \). When beliefs \( g \) are degenerate at some type \( \tilde{\theta} \), \( \chi^*(\tilde{\theta}, \varepsilon, g) = \tilde{\theta} \) \( \forall \varepsilon \in \mathbb{R}, \forall \tilde{\theta} \in [0, 1] \).

b. (Beliefs.) Along the equilibrium path, the voter’s end-of-period beliefs will be either degenerate or will have support \( [\theta_l(\tilde{\varepsilon}), \theta_h(\tilde{\varepsilon})] \) for some \( \tilde{\varepsilon} \in \mathbb{R} \).

c. (Voter’s behavior strategy.) At state \( S = (\varepsilon, g) \), where \( g \) has support \( [\theta_l(\tilde{\varepsilon}), \theta_h(\tilde{\varepsilon})] \) for some \( \tilde{\varepsilon} \in \mathbb{R} \), the voter re–elects the incumbent if\( (f) \chi \leq \theta_l(\varepsilon) \). If \( g \) is degenerate at some type \( \tilde{\theta} \), the voter re–elects the incumbent if\( (f) \chi \leq \theta^* \).

Then we have the following:

**Proposition 5.** The pair of functions \( (\theta_l(\varepsilon), \theta_h(\varepsilon)) \) that characterizes the conjectured MPBE are characterized by the following set of requirements:

1. (Initial conditions.) \( \theta_l(\varepsilon_0) = 0 \) and \( \theta_h(\varepsilon_0) = 1 \), where \( \varepsilon_0 \) is the unique solution to

\[
\varepsilon = \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F(\varepsilon)} \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon';
\]
2. (Politician’s indifference.)

\[ \theta_h (\varepsilon) = h (\varepsilon) \theta_l (\varepsilon), \]

where

\[ h (\varepsilon) := \left(1 - \sqrt{\frac{\delta (1 - \lambda) E [\varepsilon']}{(1 - \delta (1 - \lambda) F (\varepsilon)) \cdot \varepsilon + \delta (1 - \lambda) F (\varepsilon) \cdot E [\varepsilon'|\varepsilon' \leq \varepsilon]} \right)^{-1}. \]

3. (Voter’s indifference.)

\[ \theta^*_{\text{rep}} E [\varepsilon'] \Pi' (\varepsilon) = \theta_l' (\varepsilon) \Pi (\varepsilon) \cdot \int_\varepsilon^\varepsilon' f (\varepsilon') d\varepsilon' + \theta_l (\varepsilon) \Pi' (\varepsilon) \cdot \int_{-\infty}^\varepsilon f (\varepsilon') d\varepsilon' + \int_{-\infty}^\varepsilon f (\varepsilon') d\varepsilon' + \theta_l (\varepsilon) \Pi (\varepsilon) \cdot \int_0^\varepsilon f (\varepsilon') d\varepsilon' \]

where \( \Pi (\varepsilon) := G_0 (\theta_h (\varepsilon)) - G_0 (\theta_l (\varepsilon)) \) is the probability of pooling when output shock is \( \varepsilon \), and

\[ \theta^*_{\text{rep}} = \frac{\int_{\varepsilon_0}^\infty \left[ \int_0^1 \varepsilon' \chi^* (\theta, \varepsilon', g_0 (\theta) d\theta \right] f (\varepsilon') d\varepsilon' + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \int_{\varepsilon_0}^\infty \int_0^{\theta_l (\varepsilon')} g_0 (\theta) d\theta f (\varepsilon') d\varepsilon' \]}{E [\varepsilon'] \left(1 + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} \int_{\varepsilon_0}^\infty \int_0^{\theta_l (\varepsilon')} g_0 (\theta) d\theta f (\varepsilon') d\varepsilon' \right)^{-1}}, \]

is the voter’s indifference threshold;

4. (Transversality condition.) \( \lim_{\varepsilon \to \infty} \varepsilon f (\varepsilon) \frac{\Pi (\varepsilon)}{\Pi' (\varepsilon)} = 0. \)

5. (Equilibrium consistency.) \( \lim_{\varepsilon \to \infty} \theta_l (\varepsilon) = \theta^*_{\text{rep}}. \)

**Proof.** See Appendix B.

Finally, the following Proposition states that the main empirical implications of the benchmark model are not a particular feature of the finiteness of the horizon.

**Proposition 6.** A pair of functions \((\theta_l (\varepsilon), \theta_h (\varepsilon))\) that satisfies the list of requirements 1—5 in Proposition 5 features \( \theta'_l (\varepsilon) > 0 \) and \( \theta'_h (\varepsilon) < 0 \) \( \forall \varepsilon > \varepsilon_0 \). Then the conjectured MPBE exhibits

i. pro–cyclical corruption;

ii. pro–cyclical turnover;
iii. counter–cyclical future corruption.

Proof. See Appendix B.

4 Empirical Evaluation of the Model

The main goal now is to test for the fundamental empirical implications of the model economy, namely, the pro–cyclicality of both current corruption and turnover, and the counter–cyclicality of future corruption. At the end of the section, I also show that, at the cross-national level, higher corruption is associated with longer mandates (which the model predicts) and with greater output volatility (which the model doesn’t necessarily predict).

4.1 Main Variables of Interest and Measurement

The main variables of interest are the degree of corruption, political turnover, and the business cycle.

Corruption. For the corruption variable, I use a corruption index constructed by the Political Risk Service Group (PRS), which is used as a component of their International Country Risk Guide index (ICRG). It measures corruption within the political system of a country, as captured by statements such as “high government officials are likely to demand special payments” or “illegal payments are generally expected throughout lower levels of government” (emphasis added), which is why I consider it an accurate empirical counterpart of the degree of corruption in the model. The ICRG covers, beginning in 1982, an (unbalanced) panel of 146 countries at a monthly frequency. The index goes from 0 (very corrupt) to 6 (perfectly clean). I linearly transform this index so that a higher value is interpreted as higher corruption. For each country, to convert the data to an annual frequency, I compute the simple annual average of the monthly scores.

I choose to use this index over another, very common measure of corruption, Transparency International’s (TI) Corruption Perceptions Index (CPI). The reason is that, in order to test for the implication of my model, I need a good measure of the evolution of corruption over time within a given country, because I want to link it to a variable that is of a time–series nature, namely, the business cycle. As Thompson & Shah (2005) and many others argue, the CPI is not well suited for such a task, for three main reasons.

\[ ^{19}\text{See, for example, Schwindt-Bayer & Tavits (2016), Lancaster & Montinola (2001), and Rohwer} \]
First, the index is computed by averaging the (standardized) reports of several different sources. It is a “poll of polls.” The problem with this methodology is that the sources vary across countries and over time, depending on availability and reliability. Therefore, because corruption is a multidimensional phenomenon and is not uniquely defined, different sources may rate corruption according to different criteria. In this way, changes in the CPI score of a country from one year to another may be due to the fact that the country was rated by different sources over time. Second, the CPI has suffered many methodological changes since it was first launched in 1995. These modifications are primarily associated with the criteria for selecting sources (e.g., surveys vs. analyses performed by country experts), the minimum number of sources required for a country, and the way the different sources are aggregated. These methodological revisions may also cause noise in the behavior of the index over time that is hard to control for. Third, the CPI corresponding to year $t$ might contain data from up to year $t-2$. These is done to smooth the data coming from surveys. However, this smoothing effect could lead to an inaccurate measurement of the size of the most recent changes in corruption, which is particularly important for the analysis I perform because it may affect the short–term behavior of the corruption variable. In short, the CPI is a good tool for cross–sectional analysis but, as determined by Lambsdorff (2002) in TI’s methodological notes, “year–to–year comparisons of a country’s score do not only result from a changing perception of a country’s performance but also from a changing sample and methodology. [...] However, to the extent that changes can be traced back to a change in the results from individual sources, trends can cautiously be identified.” The ICRG is indeed one of these sources. Furthermore, according Schwindt-Bayer & Tavits (2016), the ICRG offers the most complete time series for the largest number of countries and is comparable across time. Moreover, the methodological notes of the PRS state that its methodology is designed “to ensure consistency, both between countries and over time” (emphasis added).

Another measure of corruption is the number of federal prosecutions and the number of public officials convicted for public corruption in US states (see, e.g., Meier & Holbrook 1992, Goel & Nelson 1998). First, this measure could be more one of the effectiveness of the judiciary system or enforcement policies rather than a measure of corruption (see, e.g., Boylan & Long 2003, Alt & Lassen 2003). Second, as noted by Campante & Do (2014), this measure is very noisy in terms of its year–on–year fluctuations, which is particularly

(2009). Transparency International itself warns the public about the use of the CPI for time–series analysis: “Comparisons to last year’s index [...] can be misleading because of methodological changes between years.” For more on this issue, see Lambsdorff (2002, 2008).
important for my analysis.

**Turnover.** The political variables come from four different datasets: the Database of Political Institutions (DPI, 2012), from the World Bank (Beck, Clarke, Groff, Keefer & Walsh 2001); Polity IV (Marshall, Gurr & Jaggers 2014); Polcon 2012 (Henisz 2000, 2015); and Archigos 4.1 (Goemans, Gleditsch & Chiozza 2009). From the DPI and Archigos,20 I construct four turnover variables. The first one, \( trnvr \), tracks the chief executive (CE) spell. It takes a value of 1 in those cases in which the CE was replaced, and a value of 0 if the incumbent government was re-elected (see Appendix C for the details of this procedure). The variable takes no value in those country–year cases in which the CE was not replaced and no elections were held. The second measure of turnover, \( trnvr_e \), equals \( trnvr \) but only for the country–year cases in which elections were held. Finally, the other two measures are \( trnvr_p \) and \( trnvr_p.e \), which are analogous to \( trnvr \) and \( trnvr_e \), respectively, but for the case of party turnover. In any case, I omit those cases in which the CE’s term in office came to an end due to natural death or illness, because these cases do not qualify as proper political turnover.

**Business Cycle.** Output data are taken from the Penn World Table 8.0 (PWT8). By considering the process for output assumed in (1)-(3), and invoking the rational expectations hypothesis (REH), for the baseline empirical specifications I take, for each country \( i \), the log of real GDP per capita, \( y \), and decompose it as follows:

\[
y_{i,t} = \beta_{i,0} + \beta_{i,1} \cdot t + \varepsilon_{i,t},
\]

(14)

where \( \varepsilon_{i,t} \) and \( y_{i,t} - \varepsilon_{i,t} \) are thus the cyclical and trend components of \( y_{i,t} \), respectively. \( \varepsilon_{i,t} \) is the main explanatory variable of interest. Its values result from the residuals of an ordinary least squares (OLS) estimation of (14) for each country. PWT8 provides several alternatives of output data. I consider output–side real GDP in 2005 US\$, \( RGDP^o \), which is constructed by using prices that are constant across countries and over time. In robustness checks, I also consider real GDP at constant national prices in 2005 US\$, \( RGDP^{NA} \), constructed from national accounts growth–rate data for each country.21

I also consider two alternative measures of business cycles, which depart from the REH and resemble more a story of adaptive expectations and learning (see Evans & Honkapohja 2001). In the first case, agents are assumed to look up to \( k \) periods back and compute the average rate of growth of output between periods \( t - k \) and \( t - 1 \). Then they expect

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20Complementary sources were consulted in particular cases.
21For a detailed description of the Penn World Table and the variables therein, see Feenstra, Inklaar & Timmer (2015).
output to growth at this exact rate from period $t - 1$ to period $t$. That is, expected output $Y^e$ in period $t$ and country $i$ is

$$Y^e_{i,t,k} = Y_{i,t-1} \cdot \left( \frac{Y_{i,t-1}}{Y_{i,t-k}} \right)^{\frac{1}{k-1}}. \quad (15)$$

In this way, the trend component of output for country $i$ at period $t$ under this first alternative specification is

$$y_{i,t,k}^{tr1} := \ln \left( Y^e_{i,t,k} \right), \quad (16)$$

and the cyclical component is therefore

$$\varepsilon_{i,t,k}^{alt1} := y_{i,t} - y_{i,t,k}^{tr1}. \quad (17)$$

The second alternative consists of assuming, once again, that agents look backwards, but this time they estimate equation (14) by OLS for the period $t - k$ to $t - 1$. Let $\hat{\beta}_{i,0,t,k}$ and $\hat{\beta}_{i,1,t,k}$ be the OLS estimates of $\beta_{i,0}$ and $\beta_{i,1}$ in (14), respectively. Then the trend component of output for country $i$ at period $t$ is

$$y_{i,t,k}^{tr2} := \hat{\beta}_{i,0,t,k} + \hat{\beta}_{i,1,t,k} \cdot t; \quad (18)$$

therefore, the cycle is

$$\varepsilon_{i,t,k}^{alt2} := y_{i,t} - y_{i,t,k}^{tr2}. \quad (19)$$

Notice that all three alternatives are equivalent if log output is linear in time. In this sense, these different specifications of expectation calculation shouldn’t result in significant differences in the estimation of business cycles in developed economies, which one can think as being close to a steady state in terms of growth. However, for the case of developing countries, each procedure could lead to substantially different quantitative results.

Finally, to control for potential problems of endogeneity, that is, effects going from corruption to the business cycle, in alternative specifications of the empirical model, the output cycle is instrumented or replaced by different variables related to the oil sector, which will be specified and explained as I go along.
4.2 Conditioning Variables

The implications of the model economy rely fundamentally on the possibility that the government can be rewarded for good behavior. Thus, in the empirical analysis, I pay particular attention to democratic environments, where the accountability mechanisms are strong enough and the public can effectively hold the government accountable for bad (or good) performance.\textsuperscript{22} I make use of five conditioning variables in different instances of my empirical analysis.

The first three conditioning variables (all of them from Polity IV) ensure the environment is sufficiently democratic with respect to the election of the government. The variable polity2 measures the degree of plural, institutionalized democracy for each country–year pair. The score ranges from $-10$ (hereditary monarchy) to 10 (consolidated democracy). In this way, by conditioning observations according to the polity2 score, I can consider groups of country–year pairs that are more or less democratic. My baseline empirical specification requires the polity2 score to be strictly greater than zero. The second variable is xrcomp. It measures the level of competitiveness of executive recruitment, with a score ranging from 0 to 3. The higher the score, the more competitive the recruitment process. The third variable is xrreg, with a score from 1 to 3 for the degree of regulation of CE recruitment. The higher this value, the stronger the institutionalized procedures to transfer executive power.\textsuperscript{23}

The following two conditioning variables (from DPI) guarantee the existence of stronger re–election or reputational incentives. finittrm is a dummy variable that indicates whether a constitutional limit is in place on the number of years the executive can serve before new elections must be called. Examples of finittrm = 0 are communist countries or countries under a dictatorship. Finally, multpl is a dummy variable that takes a value of 1 when formal restraints are in place on an executive’s term (in this case, finittrm equals 1) but s/he can serve additional term(s) following the current one (and also when a term limit is not explicitly stated). Only limits on immediate reelection count, so a value of 0 shouldn’t be interpreted as non–existence of reputational motives, because the CE could in principle run again after the following immediate mandate.

Finally, I exclude observations corresponding to colonies (even when they have an in-

\textsuperscript{22}This doesn’t imply that autocratic regimes should not exhibit pro–cyclical corruption, because electoral accountability is not the only mechanism available to get rid of bad rulers. However, because autocracies have no regularized contest for public office, the claim is that the elasticity of corruption with respect to the business cycles should be, if anything, smaller than in democracies.

\textsuperscript{23}For a detailed description of the variables in the Polity IV dataset, see Marshall, Gurr & Jaggers (2014).
ternal self-government), Soviet Republics while they were part of the USSR, and countries in the midst of civil war or a political crisis.

4.3 Corruption Analysis

4.3.1 Control Variables

Regarding control variables for corruption, Lederman, Loayza & Soares (2005) identify three main variables that determine the strength of the linkage between electoral accountability and corruption: political competition, the existence of checks and balances, and transparency of the system. I therefore include as controls those variables, available in the datasets, that are indicative of either the degree of effective monitoring, the punishment power of the electorate, or the degree of the executive’s discretion.

$oppfrac$ (from DPI) is a measure of the fractionalization of the opposition. An increase in this variable in principle embodies two effects on corruption that go in the same direction. On the one hand, when $oppfrac$ increases, effective monitoring and accountability of the executive inside the government structure could be weaker, which would increase corruption. On the other hand, the public faces a weak and fractionalized alternative to the incumbent government. If this weakens the reputational motives for good behavior, corruption would once again increase. $polcomp$ (from Polity IV) indicates the degree of political competition. A higher degree of political competition could be interpreted, in terms of the model, as a lower discount factor of the politician. Therefore, it should reduce the incentives for good behavior. Corruption should therefore increase with $polcomp$. Political competition, however, is found to have ambiguous effects on corruption (Schleiter & Voznaya 2014). The variable $allhouse$ (from DPI) is in spirit similar to $polcomp$ regarding its effects on corruption of the CE or her/his party, because it indicates whether the government party controls all relevant houses. A “yes” is indicative of great political power and low political competition. This variable is expected to be positively associated with corruption.

$j$ (from Polcon) is a dummy variable indicating the existence of an independent judiciary. Glaeser & Goldin (2006) argue that a big part of the reduction in corruption in the US in the 1870-1920 period was due to the existence of an independent judiciary that successfully prosecuted corrupt officials. Avis, Ferraz & Finan (2018) provide evidence that judicial accountability decreases corruption. Thus, the coefficient on this variable is expected to be negative. Another variable related to the constraints faced by the CE is $xconst$ (from Polity IV), which measures the extent of institutionalized constraints on the
decision-making powers of the CE. The score ranges from 1 (unlimited authority) to 7 (executive parity or subordination). The presumption here is that weaker checks and balances could be associated with a more corrupt environment, as determined by Lederman, Loayza & Soares (2005). A variable similar to $x_{const}$ is $checks$ (from DPI). It measures the effective checks and balances in a system. However, $checks$ is a measure of overall check and balances in a country, whereas $x_{const}$ tracks the constraints faced by the CE.

Finally, $share_{gov}$ measures public support for the government. If the observation corresponds to a presidential system, it is equal to the president’s share of votes in the first round of elections; otherwise, it is equal to the total number of seats held by all government parties over the number of total seats.

4.3.2 Empirical Analysis on Corruption and the Business Cycle

The main estimating equation for corruption is

$$Corr_{i,t} = \alpha_1 \varepsilon_{i,t} + \alpha_2 (y_{i,t} - \varepsilon_{i,t}) + X_{it} \beta + \theta_t + \gamma_i + \eta_{it},$$

(20)

where $i$ indexes countries and $t$ indexes years. $Corr_{i,t}$ is the value of the corruption index, and $\varepsilon_{i,t}$ is the cyclical component of output, obtained from OLS estimation of (14) for each country $i$. The model suggests $\alpha_1 > 0$ and $\alpha_2 = 0$.

$X_{it}$ is the vector of controls presented in section 4.3.1. This vector $X_{it}$ also includes DPI’s variable $yrsoffc$, which tracks CE tenure in office. Table 1 reports descriptive statistics of the variables used in estimating (20). The sample is restricted to the period 1985–2011 and to observations that correspond to democratic environments ($polity2 > 0$) where elections are competitive and regulated ($xcomp.xreg \geq 2$) and the duration of the mandate is not indeterminate ($finirrtm = 1$). However, I do not always condition the sample on the values of all four variables in every estimation: My baseline case will consider observations where $polity2 > 0$, but no restrictions on the other three variables are imposed. $\theta_t$ and $\gamma_i$ in (20) are time and entity fixed effects, respectively. The use of fixed effects is motivated by the fact that unobserved characteristics of each country might correlate with the control variables I include, because more general institutional and/or cultural factors might relate these variables together. Year fixed effects are included to account for overall global changes in corruption. $\eta_{it}$ is the error term.

Basic Estimations. Table 2 presents the baseline results from estimation of the empirical model in (20). All regressions include entity and time fixed effects, and standard errors are always robust against heteroskedasticity and clustered at the country level.
## Table 1: Descriptive Statistics 1985-2011 - Corruption Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corruption</td>
<td>0.431</td>
<td>0.231</td>
<td>0</td>
<td>1</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>0.200</td>
<td>0</td>
<td>0.793</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.115</td>
<td>0.063</td>
<td>0.836</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>Output Cycle</td>
<td>-0.001</td>
<td>0.074</td>
<td>-0.375</td>
<td>0.391</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>0.042</td>
<td>-0.146</td>
<td>0.246</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.071</td>
<td>-0.357</td>
<td>0.329</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>Output Trend</td>
<td>9.027</td>
<td>1.214</td>
<td>5.180</td>
<td>11.116</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>1.311</td>
<td>5.261</td>
<td>10.808</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.169</td>
<td>8.422</td>
<td>9.629</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>yrsoffc</td>
<td>4.151</td>
<td>3.552</td>
<td>1</td>
<td>30</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>3.116</td>
<td>1.5</td>
<td>26.5</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>2.709</td>
<td>-6.849</td>
<td>21.251</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>yrcurnt</td>
<td>1.892</td>
<td>1.365</td>
<td>0</td>
<td>6</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>0.596</td>
<td>1</td>
<td>5.5</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>1.305</td>
<td>-1.524</td>
<td>5.162</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>oppfrac</td>
<td>0.479</td>
<td>0.253</td>
<td>0</td>
<td>1</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>0.195</td>
<td>0.006</td>
<td>0.938</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.171</td>
<td>-0.206</td>
<td>1.359</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>polcomp</td>
<td>8.946</td>
<td>1.298</td>
<td>2</td>
<td>10</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>1.273</td>
<td>4.8</td>
<td>10</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.711</td>
<td>2.470</td>
<td>10.826</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>j</td>
<td>0.614</td>
<td>0.487</td>
<td>0</td>
<td>1</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>0.439</td>
<td>0</td>
<td>1</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.256</td>
<td>-0.338</td>
<td>1.534</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>checks</td>
<td>3.793</td>
<td>1.581</td>
<td>1</td>
<td>18</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>1.056</td>
<td>1</td>
<td>8.519</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>1.155</td>
<td>-1.725</td>
<td>14.293</td>
<td></td>
<td>T = 19.56</td>
</tr>
<tr>
<td>xconst</td>
<td>6.340</td>
<td>0.965</td>
<td>3</td>
<td>7</td>
<td>N = 1858</td>
</tr>
<tr>
<td>Between</td>
<td>0.995</td>
<td>3</td>
<td>7</td>
<td></td>
<td>n = 95</td>
</tr>
<tr>
<td>Within</td>
<td>0.442</td>
<td>2.749</td>
<td>8.032</td>
<td></td>
<td>T = 19.56</td>
</tr>
</tbody>
</table>

Notes: N = number of observations; n = number of panels; T = average number of observations per panel. Only observations satisfying $polity2 > 0$, $xcomp$, $xreg \geq 2$, $finirrtn = 1$, and with no missing data for all variables were included. Variables $x_{it}$ (for overall statistics) are decomposed into a between, $\bar{x}_i$, and within, $x_{it} - \bar{x}_i + \bar{x}$. 


## Table 2: Corruption and the Business Cycle: Basic Results

<table>
<thead>
<tr>
<th>Dependent Variable: Corruption ICRG (transformed)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output Cycle</strong></td>
<td>0.036</td>
<td>0.044</td>
<td>0.078**</td>
<td>0.076**</td>
<td>0.100***</td>
<td>0.104**</td>
<td>0.052</td>
<td>0.094**</td>
</tr>
<tr>
<td>(0.039)</td>
<td>(0.040)</td>
<td>(0.039)</td>
<td>(0.037)</td>
<td>(0.033)</td>
<td>(0.039)</td>
<td>(0.071)</td>
<td>(0.038)</td>
<td></td>
</tr>
<tr>
<td><strong>Output Trend</strong></td>
<td>0.078</td>
<td>0.080</td>
<td>0.074</td>
<td>0.089</td>
<td>0.091</td>
<td>0.058</td>
<td>0.069</td>
<td>0.043</td>
</tr>
<tr>
<td>(0.048)</td>
<td>(0.049)</td>
<td>(0.063)</td>
<td>(0.060)</td>
<td>(0.060)</td>
<td>(0.069)</td>
<td>(0.086)</td>
<td>(0.054)</td>
<td></td>
</tr>
<tr>
<td><strong>yrsoffe</strong></td>
<td>0.001</td>
<td>0.002**</td>
<td>0.002**</td>
<td>0.002*</td>
<td>0.002*</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>opfrac</strong></td>
<td>0.012</td>
<td>0.060**</td>
<td>0.057**</td>
<td>0.030</td>
<td>0.047</td>
<td>0.024</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.027)</td>
<td>(0.025)</td>
<td>(0.025)</td>
<td>(0.026)</td>
<td>(0.064)</td>
<td>(0.023)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>polcomp</strong></td>
<td>0.008</td>
<td>0.013</td>
<td>0.013</td>
<td>0.022***</td>
<td>-0.031</td>
<td>0.024***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.010)</td>
<td>(0.008)</td>
<td>(0.021)</td>
<td>(0.006)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>xconst</strong></td>
<td>-0.025**</td>
<td>-0.017</td>
<td>-0.018</td>
<td>-0.014</td>
<td>-0.013</td>
<td>-0.010</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.012)</td>
<td>(0.013)</td>
<td>(0.013)</td>
<td>(0.014)</td>
<td>(0.016)</td>
<td>(0.011)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>j</strong></td>
<td>-0.042*</td>
<td>-0.044*</td>
<td>-0.045**</td>
<td>-0.027</td>
<td>-0.139***</td>
<td>-0.023</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.023)</td>
<td>(0.022)</td>
<td>(0.022)</td>
<td>(0.023)</td>
<td>(0.043)</td>
<td>(0.018)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>checks</strong></td>
<td>-0.001</td>
<td>-0.000</td>
<td>-0.001</td>
<td>-0.002</td>
<td>0.004</td>
<td>-0.002</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.012)</td>
<td>(0.003)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>allhouse</strong></td>
<td>-0.011</td>
<td>-0.017</td>
<td>-0.018</td>
<td>-0.006</td>
<td>-0.059</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.015)</td>
<td>(0.014)</td>
<td>(0.014)</td>
<td>(0.013)</td>
<td>(0.037)</td>
<td>(0.011)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>share.gov</strong></td>
<td>0.003</td>
<td>0.038</td>
<td>0.034</td>
<td>0.010</td>
<td>0.073</td>
<td>-0.005</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(0.044)</td>
<td>(0.034)</td>
<td>(0.034)</td>
<td>(0.043)</td>
<td>(0.064)</td>
<td>(0.035)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Observations are at the country and year level. A higher value of the dependent variable indicates higher corruption. All regressions include country and time fixed effects. Columns (3)-(8) condition on observations with polity2 > 0. Columns (5)-(8) condition on observation with higher scores of democracy, meaning xreg.xcomp ≥ 2, and finittrm = 1. Column (6) further imposes that multpl = 1, which indicates that the CE can serve additional, immediate terms, whereas column (7) considers observations with multpl = 0. Column (8) omits influential variables from column (6) according to Cook’s criterion. Robust standard errors, clustered by country, in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.
Columns (1) and (2) exhibit the estimates of a standard OLS regression that included every observation in the sample (having non-missing data for all explanatory variables). Neither cycle nor trend seem to have an effect on corruption, regardless of whether our control variables are included (column (2)) or not (column (1)). Estimations in columns (3) and (4) are restricted to observations featuring a polity2 score strictly greater than zero. Column (4) includes the vector of control variables $X_{it}$, whereas column (3) does not. In any case, the output cycle is significant and positively related to corruption, as predicted by the model. Moreover, the output trend remains insignificant, again in accordance with the theory. The magnitude of the two coefficients differs only slightly, but the one on the cycle is different from zero at the 5% level in any case and its magnitude doesn’t change with the inclusion of the control variables. Column (5) considers the set of observations from column (4), but additionally imposes stronger requirements on the degree of democracy: $xcomp, xrrreg \geq 2$, and $finrrtm = 1$. The coefficient on the cycle of output is still positive, and is significant at the 1% level. Importantly, its magnitude is now bigger, suggesting the elasticity of corruption with respect to the business cycle increases with the level of democracy, as indicated by the theory. Columns (6) and (7) consider the sample from column (5) but consider different sets of observations according to the value of multpl, because the hope is to see a stronger effect in those cases in which the CE can serve immediate additional terms (as in Ferraz & Finan 2011). The results are once again in line with the predictions of the model: countries where the CE faces weaker reputational concerns ($multpl = 0$, indicating immediate re-election cannot occur), the effect of the cycle on corruption is weaker. In this case, it actually completely disappears, whereas the effect when $multpl = 1$ is even stronger than the one in column (5). Some observations in the set considered in column (6) might be driving these empirical results, so that when the sample is smaller, their effect on the estimates becomes stronger. For this reason, column (7) considers the observations in column (5) and applies Cook’s criterion to omit influential observations. The effect of the cycle on corruption is still positive, significant at the 5% level, and different in magnitude from the one of the trend, which is statistically zero. As for the control variables, the existence of an independent judiciary seems to always decrease corruption, and usually in a strong way. However, one cannot rule out that a higher level of corruption decreases the probability of an independent judiciary. The other two variables closely related to $j$, namely, $xconst$ and checks, also have the expected negative sign (except for checks in column (7)). The fractionalization of the political opposition also has the expected sign, and in some cases, it is significant. The relation of corruption with the degree of political competition, which in the literature is ambiguous,
is positive and in some cases significant (see column (8)). Finally, the variable tenure of the incumbent is positively correlated with corruption. The equilibrium conjectured in section 3.4 features this property as well: Corruption is increasing with the tenure of the politician in power. However, we cannot distinguish the mechanisms proposed in this paper from a competing story of learning, where politicians learn how to be corrupt over time. I also discuss this issue in section 4.4.4, where I evaluate whether turnover decreases, on average, future corruption.

**Democracies vs. Autocracies.** In Table 3, I evaluate whether the effect of the output cycle on corruption is stronger in more democratic environments. As discussed previously, the theory suggests it should. In the odd-numbered columns, I restrict the sample to those cases in which the polity2 score is above some threshold, which increases with the column number, whereas in the even-numbered columns, I perform the analysis with the remaining observations. 0 is the most common cut-off in the political economy literature (Epstein, Bates, Goldstone, Kristensen & O’Halloran 2006, Persson & Tabellini 2008, 2009). A cut-off of 5 is standard for full democracies (Fearon 2008, Marshall, Gurr & Jaggers 2014). I also further consider a threshold of 8 (as in Nunn, Qian & Wen 2018). The coefficient on the output cycle is positive and significant in all odd-numbered columns, and both its effect on corruption and its significance increase with the level of democracy. Also, its magnitude increases relative to the coefficient on the output trend. In the even-numbered columns, the business cycle is irrelevant in explaining corruption. These results suggest, once again, that electoral accountability is the bridge that links corruption to business cycles.

**Alternative Measures of Business Cycles.** As anticipated in section 4.1, I consider alternative measures of business cycles as a robustness check. Table 4 exhibits the estimates. In all of the estimations, the only requirement I impose is that polity2 > 0, which is my benchmark case. In column (1), I insist on the rational expectation hypothesis, but this time, real GDP per capita is measured differently, that is, as real GDP at constant 2005 national prices (in millions of 2005 US$). The results are unchanged: The output cycle is still significant in explaining corruption, at a 5% level, and its coefficient is still around 0.1. In columns (2) and (3), I consider the case in which agents form their expectations according to (15)-(17), whereas columns (4) and (5) consider the model in (18)-(19). Recall that agents are assumed to look k periods back in order to form their expectations. Columns (2) and (4) consider k = 5, and columns (3) and (5) consider k = 10.\textsuperscript{24} Even though the new measures of output cycles are still positively correlated

\textsuperscript{24}It might be argued that periods of 5 or 10 years are not long enough to compute trends. However,
Table 3: Corruption and the Business Cycle: Democracies vs. Autocracies

<table>
<thead>
<tr>
<th>Dependent Variable: Corruption ICRG (transformed)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output Cycle</td>
<td>0.076**</td>
<td>0.018</td>
<td>0.111***</td>
<td>0.018</td>
<td>0.120**</td>
<td>0.009</td>
</tr>
<tr>
<td></td>
<td>(0.037)</td>
<td>(0.087)</td>
<td>(0.036)</td>
<td>(0.064)</td>
<td>(0.051)</td>
<td>(0.049)</td>
</tr>
<tr>
<td>Output Trend</td>
<td>0.089</td>
<td>-0.060</td>
<td>0.075</td>
<td>0.045</td>
<td>0.023</td>
<td>0.078</td>
</tr>
<tr>
<td></td>
<td>(0.060)</td>
<td>(0.057)</td>
<td>(0.064)</td>
<td>(0.066)</td>
<td>(0.104)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>yrsoffc</td>
<td>0.002**</td>
<td>-0.006***</td>
<td>0.002*</td>
<td>-0.003*</td>
<td>0.001</td>
<td>0.001</td>
</tr>
<tr>
<td></td>
<td>(0.001)</td>
<td>(0.002)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
<td>(0.001)</td>
</tr>
<tr>
<td>oppfrac</td>
<td>0.060**</td>
<td>-0.078</td>
<td>0.052*</td>
<td>-0.055</td>
<td>0.043</td>
<td>-0.019</td>
</tr>
<tr>
<td></td>
<td>(0.025)</td>
<td>(0.049)</td>
<td>(0.026)</td>
<td>(0.040)</td>
<td>(0.039)</td>
<td>(0.037)</td>
</tr>
<tr>
<td>polcomp</td>
<td>0.013</td>
<td>0.015</td>
<td>-0.003</td>
<td>0.015</td>
<td>0.060</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.012)</td>
<td>(0.009)</td>
<td>(0.011)</td>
<td>(0.045)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>xconst</td>
<td>-0.017</td>
<td>-0.067**</td>
<td>-0.002</td>
<td>-0.059**</td>
<td>-0.096***</td>
<td>-0.025*</td>
</tr>
<tr>
<td></td>
<td>(0.013)</td>
<td>(0.032)</td>
<td>(0.013)</td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>j</td>
<td>-0.044*</td>
<td>-0.058</td>
<td>-0.051*</td>
<td>-0.042**</td>
<td>-0.034</td>
<td>-0.041*</td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.092)</td>
<td>(0.026)</td>
<td>(0.019)</td>
<td>(0.047)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>checks</td>
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<td>-0.008</td>
<td>-0.001</td>
<td>-0.006</td>
<td>-0.003</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.019)</td>
<td>(0.003)</td>
<td>(0.012)</td>
<td>(0.003)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>allhouse</td>
<td>-0.017</td>
<td>0.044</td>
<td>-0.023</td>
<td>0.041</td>
<td>-0.024</td>
<td>0.008</td>
</tr>
<tr>
<td></td>
<td>(0.014)</td>
<td>(0.042)</td>
<td>(0.014)</td>
<td>(0.040)</td>
<td>(0.019)</td>
<td>(0.024)</td>
</tr>
<tr>
<td>share_gov</td>
<td>0.038</td>
<td>-0.286***</td>
<td>0.024</td>
<td>-0.152</td>
<td>-0.022</td>
<td>-0.020</td>
</tr>
<tr>
<td></td>
<td>(0.034)</td>
<td>(0.079)</td>
<td>(0.033)</td>
<td>(0.093)</td>
<td>(0.046)</td>
<td>(0.065)</td>
</tr>
<tr>
<td><em>polity2 score</em></td>
<td>&gt; 0</td>
<td>≤ 0</td>
<td>&gt; 5</td>
<td>≤ 5</td>
<td>&gt; 8</td>
<td>≤ 8</td>
</tr>
<tr>
<td>N</td>
<td>1841</td>
<td>352</td>
<td>1627</td>
<td>566</td>
<td>1023</td>
<td>1170</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.854</td>
<td>0.817</td>
<td>0.857</td>
<td>0.800</td>
<td>0.706</td>
<td>0.731</td>
</tr>
</tbody>
</table>

Notes: Observations are at the country and year level. A higher value of the dependent variable indicates higher corruption. polity2 ranges from -10 (hereditary monarchy) to 10 (consolidated democracy). All regressions include country and time fixed effects. Robust standard errors, clustered by country, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. 
with corruption and are significant at 5% level, the results from these estimations differ from the benchmark in that the trend now also has a positive effect on corruption. This finding is not surprising, however: We are now letting the trend “absorb” part of the benchmark measure of the business cycle. However, note that, in any case, the cyclical component has a bigger coefficient than the trend component, indicating that unexpected shocks have the strongest effect on corruption.

**Endogeneity.** Even if we believe that changes in corruption can affect business cycles in the short run, we would expect these effects to be negative. So far, I showed that output cycles are strongly and positively associated with corruption. That is, corruption is pro-cyclical. However, in Table 5, I test this hypothesis by either replacing output cycles with other measures of real business cycles, or by applying instrumental variable (IV) procedures. In any case, I require that polity2 > 0, as usual. Also, all control variables in vector Xit are included in each estimation. Before discussing the results in Table 5, I first define εwtit as the residual resulting from OLS estimation of (14), where yt is now replaced by ln (ptwti), where ptwti is the price of West Texas Intermediate (WTI) crude oil, adjusted by world inflation, so that it is expressed in 2011 US dollars. I call this variable “oil cycle.” Then the trend is defined as the difference between observed log price and εwtit, ln (ptwti) − εwtit. Column (1) of Table 5 exhibits the OLS estimates of regressing the corruption index on the interactions of the oil cycle and trend with each country’s average oil reserves during the period 1980-2012, whenever information is available.25 As the results show, oil cycles have a positive and significant effect on corruption at the 1% level. I chose not to use this variable as an instrument for the output cycle because we are dealing with countries that have oil reserves, and therefore oil prices wouldn’t satisfy the exclusion restriction that instruments must satisfy. The exclusion restriction would be violated because changes in oil prices can affect corruption even if output per capita remains unchanged. Think for example on government’s revenues. Furthermore, in many “oil countries,” the government owns or controls firms in the oil sector, and changes in the price of the product would affect corruption directly. To consider an instrument for the oil countries, I consider the change in proven oil reserves. That is, if country i at time t has a total of Oi,t barrels in proven oil reserves, my instrument for the business cycle variable for country i at time t is Oi,t − Oi,t−1.26 First, positive changes in oil reserves

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25The data was obtained from the International Energy Statistics of the U.S. Energy Information Administration (www.eia.gov)

26Vicente (2010) finds that oil discovery in Sao Tome and Principe caused an increase in a measure of perceived corruption constructed from tailored surveys.
Table 4: Corruption and the Business Cycle: Alternative Measures of Business Cycles

<table>
<thead>
<tr>
<th></th>
<th>Dependent Variable: Corruption ICRG (transformed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
</tr>
<tr>
<td>Cycle (CON), REH</td>
<td>0.131**</td>
</tr>
<tr>
<td></td>
<td>(0.059)</td>
</tr>
<tr>
<td>Trend (CON), REH</td>
<td>-0.015</td>
</tr>
<tr>
<td></td>
<td>(0.066)</td>
</tr>
<tr>
<td>$\varepsilon_{i,t,k}^{alt1}$ with $k = 5$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$y_{i,t,k}^{tr1}$ with $k = 5$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{i,t,k}^{alt1}$ with $k = 10$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$y_{i,t,k}^{tr1}$ with $k = 10$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{i,t,k}^{alt2}$ with $k = 5$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$y_{i,t,k}^{tr2}$ with $k = 5$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$\varepsilon_{i,t,k}^{alt2}$ with $k = 10$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$y_{i,t,k}^{tr2}$ with $k = 10$</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>$N$</td>
<td>1841</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.854</td>
</tr>
</tbody>
</table>

Notes: Observations are at the country and year level. Only observations with polity2 > 0 are considered. A higher value of the dependent variable indicates higher corruption. Output CON is real GDP at constant 2005 national prices (in millions of 2005 US$). RES stands for Rational Expectations Hypothesis. See section 4 for the definitions of trend variables $y_{i,t,k}^{tr1}$ and $y_{i,t,k}^{tr2}$ and business cycle components $\varepsilon_{i,t,k}^{alt1}$ and $\varepsilon_{i,t,k}^{alt2}$. All regressions include country and time fixed effects. All standard controls were included but omitted from the table for the sake of expositional clarity. Robust standard errors, clustered by country, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. 

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are stochastic. Second, I assume that when the change occurs, the probability of a new discovery is not affected. See Figure 6. Column (2) shows the estimates of a two-stage least squares (2SLS) regression, using the change in oil reserves as an instrument for the output cycle in the first stage. The results show the instrument is valid in explaining the potentially endogenous variable (panel B), and in turn the predicted cycle shows a positive and significant coefficient in the second stage (panel A). Notice, however, the number of observations in columns (1) and (2), with a number of 20 groups, or countries, in each case.

**Figure 6:** Evolution of Proven Oil Reserves for Selected Countries.

![Graph showing evolution of proven oil reserves for selected countries](image)

Even though the literature has reached no strong consensus regarding the effects of oil on business cycles (see, e.g., Rebelo 2005), in columns (3) and (4), I use the estimated oil cycles to instrument for within-country cyclical components of GDP. I restrict attention to those countries that, on average, were net importers of oil during the period 1980-2012. For each of these countries, I compute, for each year, net imports of oil27 over GDP. I then compute the average of these import shares over time for each country. The result of this procedure is the variable I interact with the oil cycle in the first stage of column (3). The coefficient reported in the table corresponds to the marginal effect of the oil cycle.

27I consider oil as corresponding to product codes 2709 and 2710 of the Harmonized System. The data were obtained from UN Comtrade || International Trade Statistics Database.
Finally, in the first stage in column (4), again restricting attention to net importers of oil, I interact the oil cycle with country fixed effects, a procedure followed by Angrist & Krueger (1991). The result is a strongly significant coefficient in the first stage. However, this approach may suffer from a weak-instruments problem, which would result in a bias of the estimates.

4.4 Turnover Analysis

The empirical results from the previous section indicate that greater values of the cyclical component of output are indeed associated with a higher degree of corruption. In this way, an economic boom has a positive, indirect effect on turnover working through corruption. However, as discussed in section 2, we would also expect it to have a negative, direct effect on turnover, because the public might (at least partially) attribute the good performance of the economy to the incumbent government. The ultimate goal in this section is therefore to evaluate whether the first effect exists. Notice that in a multiperiod incumbency version of the model economy, keeping the perfect monitoring assumption, once a bad politician has revealed himself in period \( t \), grabbing less than his bliss point from period \( t + 1 \) onwards would be pointless, regardless of what happens with the cycle. In this sense, if revelation occurs in period \( t \), the degree of corruption would thereafter remain constant. With this intuition in mind, to separate the two opposite effects that economic booms and recession might have on political turnover in the data, I replace the measure of the business cycle, \( \varepsilon \), with the maximum value that this variable took within the CE’s most recent term in office (called “peak”). I measure economic performance by the average rate of growth of real GDP per capita within the term. In this way, we expect peaks to have a positive effect on turnover, whereas growth should have a negative effect. Figure 7 is a scatter plot of all (peak, performance) pairs in the sample. As the figure shows, peaks and performance are uncorrelated across the sample.\(^{28}\)

4.4.1 Control Variables

In the regressions on turnover, I use the same control variables as in the case of corruption. In addition to including the tenure of the CE, I also include the tenure of the government party, \( \text{prtyin} \) (from DPI). Also, based on the literature on economic voting (for a complete survey, see Lewis-Beck & Stegmaier 2013), I include the change in inflation within the CE’s

\(^{28}\)Their correlation is \(-0.0013\) with a p-value of 0.97.
Table 5: Corruption and the Business Cycle: Endogeneity

<table>
<thead>
<tr>
<th>Dependent Variable: Corruption ICRG (transformed)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panel A. Two-Stage Least Square</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price of Oil Cycle × Average Oil Reserves</td>
<td>0.025***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price of Oil Trend × Average Oil Reserves</td>
<td>0.024</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.341)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Cycle</td>
<td>0.903**</td>
<td>1.356*</td>
<td>0.200**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.438)</td>
<td>(0.752)</td>
<td>(0.089)</td>
<td></td>
</tr>
<tr>
<td>Panel B. First Stage for Output Cycle</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Change in Oil Reserves</td>
<td>0.694**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.272)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price of Oil Cycle × Oil Net Imports over GDP</td>
<td>0.076**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.036)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price of Oil Cycle × Country Fixed-Effects</td>
<td></td>
<td>−0.797***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.036)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>364</td>
<td>363</td>
<td>1180</td>
<td>1324</td>
</tr>
<tr>
<td>Groups</td>
<td>20</td>
<td>20</td>
<td>72</td>
<td>61</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.910</td>
<td>0.317</td>
<td>0.232</td>
<td>0.504</td>
</tr>
</tbody>
</table>

Notes: Observations are at the country and year level. A higher value of Corr indicates higher corruption. Observation are restricted to those with polity2 > 0. All regressions include country and time fixed effects. All standard controls are included in each specification. The cycle of oil prices (adjusted by world inflation) was estimated from linear detrending of its log, as in (14) for the case of output. Column (1) exhibits OLS estimate of corruption on the cycle and trend of the price of oil, interacted with average oil reserves by country. Columns (2)-(4) perform IV estimation. The instrumented variable in each case is the cyclical component of output. Column (3) considers as instrument the change over time in oil reserves. Columns (3) and (4) consider oil-importing countries, and the proposed instruments are: the cycle of the price of oil, interacted with the average fraction of net imports of oil over GDP for a country; and the cycle of the price of oil, interacted with the country fixed effects. Marginal effects of the cycle of the price of oil are presented. Robust standard errors, clustered by country, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. 

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Figure 7: Business Cycle Peaks and Overall Economic Performance within Mandates

most recent term.\textsuperscript{29} This variable is interacted with the inflation rate at the beginning of the corresponding term. Although the literature on economic voting finds unemployment to be an important determinant of the vote function, I do not include this variable due to the limited availability of the data in an already small sample.\textsuperscript{30} I also include real GDP per capita to account for the overall degree of development of a country. Regarding political variables, I include the Executive Index of Electoral Competitiveness, $eiec$ (from DPI). This index goes from 1 to 7, with higher values indicating a higher degree of competition in the election of the CE. Finally, I include an index on political rights, $pol_{ri}$ (from The Freedom House), which ranges from 1 (fully free) to 7 (not free) and is compounded by other scores on the competitiveness and fairness of elections, political pluralism and participation, and the functioning of the government.

Table 6 reports the descriptive statistics. Similar to the case of corruption, the sample is restricted to the period 1985–2011 and to observations that correspond to demo-

\textsuperscript{29}If the term started in period $t$ and ended in period $t + k$, the change in inflation assigned to this mandate is $\pi_{t+k} - \pi_{t-1}$, where $\pi$ is the annual inflation rate measured by the GDP deflator.

\textsuperscript{30}The sample contains 1,063 observations for turnover, which goes down to 848 when conditioning on observations that correspond to election years. The number becomes even smaller when taking into account data availability of control variables.
ocratic environments \((polity^2 > 0)\), and the duration of the mandate is not indeterminate \((\text{finittrm} = 1)\).

4.4.2 Empirical Analysis on Turnover and Corruption

Before evaluating whether output booms have an indirect, positive effect on turnover working through corruption, I first analyze whether corruption has a positive effect on turnover. To do so, I estimate the equation

\[
\tau_{i,t} = \alpha_1 \text{Corr}_{i,t-1} + \alpha_2 \text{perform}_{i,t} + X_{it-1} \beta + Z_{it} \Delta + \theta_t + \gamma_i + \eta_{it}, \tag{21}
\]

where \(\tau_{i,t}\) indicates turnover in country \(i\) at period \(t\), as explained in section 4.4; \(\text{Corr}_{i,t-1}\) and \(\text{perform}_{i,t}\) are the degree of corruption in period \(t-1\) and the average rate of growth of real GDP per capita over the term, respectively; \(X_{it-1}\) is a vector of lagged controls; \(Z_{it}\) is a vector of contemporaneous control variables; and \(\theta_i\) and \(\gamma_i\) are time and country fixed effects, respectively.

Table 7 reports the marginal effects of corruption and performance on turnover for linear probability (LPM) and probit models in panels A and B, respectively. The models are estimated for all four measures of turnover (CE and party turnover, conditioning on election years and not). In all cases, I restrict the sample to observations with \(\text{finittrm}(t-1) = 1\), meaning all considered terms were finite. Additionally, in columns (5)-(8), I restrict attention to those cases in which the economy was sufficiently democratic in the year before, so \(\text{polity}^2(t-1) > 0\). In the cases of CE turnover, I additionally require that \(\text{multpl}(t-1) = 1\). Robust standard errors, clustered by country, are computed in all cases.

In the LPM, lagged corruption is positively and strongly associated with turnover. In the case of CE turnover, the coefficient ranges from 0.762 to almost 1. Considering the overall standard deviation of of lagged corruption, which is 0.236 (see Table 6), this implies an increase in one standard deviation in corruption — equivalent to the difference in average corruption between, for example, Egypt and Chile — is associated with an increase in the probability of CE turnover of 18 to 23 percentage points. In the case

\[31\] For a term going from period \(t\) to period \(t+k\), \(\text{perform}_{t+k} = \left(\frac{y_{t+k}}{y_{t-1}}\right)^{\frac{1}{k+1}}\), where \(y\) is real GDP per capita.

\[32\] These variables are openness, polri, polcomp, ciec, xconst, share.gov, allhouse, and oppfrac.

\[33\] These variables are the change in the inflation rate over the term and initial inflation (inflation rate in the year before the first year of the mandate), their interaction, yrsoffc, partyin, and real GDP per capita.
Table 6: Descriptive Statistics 1985-2011 - Turnover Regressions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Min</th>
<th>Max</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>tnrvt(t)</td>
<td>0.648</td>
<td>0.478</td>
<td>0</td>
<td>1</td>
<td>N = 599</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>Between</td>
<td>Within</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.289</td>
<td>0.412</td>
<td>−0.269</td>
<td>1.481</td>
<td>T = 5.30</td>
</tr>
<tr>
<td>tnrvtωt(t)</td>
<td>0.627</td>
<td>0.484</td>
<td>0</td>
<td>1</td>
<td>N = 526</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>Between</td>
<td>Within</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.316</td>
<td>0.411</td>
<td>−0.273</td>
<td>1.461</td>
<td>T = 4.92</td>
</tr>
<tr>
<td>tnrvπt(t)</td>
<td>0.451</td>
<td>0.498</td>
<td>0</td>
<td>1</td>
<td>N = 599</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>Between</td>
<td>Within</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.288</td>
<td>0.434</td>
<td>−0.406</td>
<td>1.308</td>
<td>T = 5.30</td>
</tr>
<tr>
<td>tnrvπωt(t)</td>
<td>0.464</td>
<td>0.499</td>
<td>0</td>
<td>1</td>
<td>N = 526</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>Between</td>
<td>Within</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.305</td>
<td>0.431</td>
<td>−0.393</td>
<td>1.297</td>
<td>T = 4.92</td>
</tr>
<tr>
<td>Corr (t−1)</td>
<td>0.398</td>
<td>0.236</td>
<td>0</td>
<td>1</td>
<td>N = 529</td>
</tr>
<tr>
<td></td>
<td>Overall</td>
<td>Between</td>
<td>Within</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.199</td>
<td>0.115</td>
<td>0.049</td>
<td>0.798</td>
<td>T = 5.45</td>
</tr>
<tr>
<td>Peak(t)</td>
<td>0.034</td>
<td>0.095</td>
<td>−0.350</td>
<td>0.490</td>
<td>N = 564</td>
</tr>
<tr>
<td></td>
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<td>Between</td>
<td>Within</td>
<td></td>
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</tr>
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<td>0.066</td>
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<tr>
<td>Perf(t)</td>
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<td>Within</td>
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<td>0.914</td>
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<td>Within</td>
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<td></td>
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<td>Between</td>
<td>Within</td>
<td></td>
<td></td>
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<td></td>
<td>185.724</td>
<td>497.085</td>
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<td>1727.388</td>
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<tr>
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<td>1.170</td>
<td>1.170</td>
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<td>Within</td>
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</tr>
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<td>Within</td>
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</tr>
<tr>
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<td>Within</td>
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<tr>
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<td>share_gov(t−1)</td>
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<td>5.232</td>
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<td>Within</td>
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<td>Within</td>
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<td>Within</td>
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<td>1.290</td>
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<td>T = 5.24</td>
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</table>

Notes: N = number of observations; n = number of panels; T = average number of observations per panel. Only observations satisfying finittrm(t−1) = 1 and polty2(t−1) > 0, and with no missing data for tnrvt were included. Variables xit (for overall statistics) are decomposed into a between, , and within, , , and , where is the annual inflation rate measured by the GDP deflator; and , where is real GDP per capita.
<table>
<thead>
<tr>
<th>Dep. Var.:</th>
<th>trnvr</th>
<th>trnvr_p</th>
<th>trnvr_e</th>
<th>trnvr_p_e</th>
<th>trnvr</th>
<th>trnvr_p</th>
<th>trnvr_e</th>
<th>trnvr_p_e</th>
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<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
<td>(7)</td>
<td>(8)</td>
</tr>
<tr>
<td>Lag Corr.</td>
<td>0.762***</td>
<td>0.706***</td>
<td>0.902***</td>
<td>0.716***</td>
<td>0.864***</td>
<td>0.596***</td>
<td>0.969***</td>
<td>0.503***</td>
</tr>
<tr>
<td></td>
<td>(0.247)</td>
<td>(0.196)</td>
<td>(0.264)</td>
<td>(0.222)</td>
<td>(0.279)</td>
<td>(0.223)</td>
<td>(0.340)</td>
<td>(0.234)</td>
</tr>
<tr>
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<td>(0.667)</td>
<td>(0.628)</td>
<td>(0.757)</td>
<td>(0.879)</td>
<td>(0.779)</td>
<td>(0.862)</td>
<td>(0.879)</td>
<td>(1.064)</td>
</tr>
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<td>0.400</td>
<td>0.446</td>
<td>0.427</td>
<td>0.383</td>
<td>0.393</td>
<td>0.421</td>
<td>0.427</td>
</tr>
</tbody>
</table>

**Panel A. Linear Probability Model**

| Lag Corr. | 0.782*** | 0.785*** | 0.963*** | 0.832*** | 0.976*** | 0.604**  | 1.064*** | 0.578**   |
|           | (0.249) | (0.248) | (0.277) | (0.256)   | (0.285) | (0.240) | (0.314) | (0.231)   |
|           | (0.884) | (0.849) | (1.018) | (1.130)   | (0.892) | (1.084) | (1.212) | (1.436)   |
|           |         |         |         |           |         |         |         |           |
| N         | 418    | 465     | 338     | 392       | 347    | 411     | 303     | 361       |
| Pseudo R² | 0.321  | 0.291   | 0.362   | 0.311     | 0.308  | 0.292   | 0.348   | 0.337     |

**Panel B. Probit Model**

Notes: Observations are at the country and year level. A higher value of Corr indicates higher corruption. trnvr and trnvr_e correspond to CE turnover. trnvr_p and trnvr_p_e correspond to party turnover. Suffix _e stands for “only election years considered.” Perform is the average rate of growth of real GDP per capita within a term. Columns (5)-(8) condition country-year observations which are democratic in t-1, meaning polity2(t-1) > 0. finittrm(t-1) = 1 in all columns. In the cases of trnvr and trnvr_e, it was additionally required that multpl(t-1) = 1. All regressions include country and time fixed effects. Additional controls included in all regressions (all lagged): real GDP per capita; change in inflation within the term, initial inflation and their interaction; openness; political rights score; polcomp; competitiveness of executive elections; xconst; share_gov; CE tenure; allhouse; oppfrac. In Probit regressions marginal effects are presented. Robust standard errors, clustered by country, in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.
of party turnover the coefficient ranges from 0.503 to 0.716, meaning a one standard
deviation increase in corruption is associated with an increase in the probability of party
turnover of 12 to 17 percentage points. The marginal effect of economic performance on
turnover is always negative, as expected, and statistically significant except in the cases
of democracies when we do not condition on election years.

The effects of corruption on turnover are essentially identical in the case of the probit
estimation. Notice the number of observations drops, due to the perfect explanatory
power of the country fixed effects in some cases.\footnote{This happens when the turnover variable always takes the same value (either 0 or 1).} Performance is now always statistically
significant and its marginal effects are always greater (in absolute value) than the LPM
counterparts.

Interestingly, in both models, the effects of corruption on CE turnover are stronger
when conditioning on observations with a higher degree of democracy, the result is reversed
when looking at party turnover.

\subsection*{4.4.3 Empirical Analysis on Turnover and the Business Cycle}

As explained earlier, to evaluate whether economic booms have a positive, indirect effect
on turnover, I estimate the model in (21) but replace the corruption variable with the
cycle peak within the CE mandate.\footnote{For a term going from \( t \) to period \( t + k \), \( \text{peak}_{t+k} = \max \{ \varepsilon_r \}_{r=t}^{t+k} \), where \( \varepsilon \) is the output cycle (see equation (14)).} Thus, the main estimating equation for turnover is

\[
\tau_{i,t} = \alpha_1 \text{peak}_{i,t} + \alpha_2 \text{perform}_{i,t} + X_{i,t-1} \beta + Z_{i,t} \Delta + \theta_t + \gamma_i + \eta_{it}.
\]  (22)

Tables 8 and 9 show the results for the cases of party turnover. The model failed in
the cases of CE turnover — similar to what Table 10 shows.\footnote{The fact that the model failed to explain CE turnover shouldn’t be discouraging, because party
turnover is a better measure of the phenomenon I analyze. The reason is that from the available databases,
one cannot discern whether the CE ran for re-election and was voted-out or s/he didn’t run. Even though
the fact that the incumbent did not run for re-election contains valuable information, these two events
are not equivalent. Furthermore, CE behavior indeed affects the public’s support to the party. Chong,
De La O Torres, Karlan & Wantchekon (2012) provide experimental evidence that information about
corruption not only decreases incumbent support, but also erodes voters’ identification with the party of
the corrupt incumbent.} Odd–numbered columns consider “unrestricted” party turnover, whereas even–numbered columns consider election
years only. As we move to the right, each pair of columns restricts attention to observations
that are above an increasing score of democracy (\( \text{polity2}(t-1) > 0, \geq 5 \) and \( \geq 7 \)).\footnote{Unlike in the case of corruption, the upper threshold is 7 and not 8; otherwise, the sample would be
too small, and the probit model would have convergence problems, due to the presence of country fixed
55} Each
### Table 8: Turnover and Business Cycles - Probit Model

<table>
<thead>
<tr>
<th>Dep. Var.:</th>
<th>trnvr_p</th>
<th>trnvr_p.e</th>
<th>trnvr_p</th>
<th>trnvr_p.e</th>
<th>trnvr_p</th>
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<td>(6)</td>
</tr>
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<td>&gt; 0</td>
<td>&gt; 0</td>
<td>≥ 5</td>
<td>≥ 5</td>
<td>≥ 7</td>
<td>≥ 7</td>
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<td>0.619*</td>
<td>0.913**</td>
<td>1.143***</td>
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<td>(0.374)</td>
<td>(0.370)</td>
<td>(0.392)</td>
<td>(0.414)</td>
<td>(0.453)</td>
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<td>−2.583***</td>
<td>−2.003*</td>
<td>−2.807**</td>
<td>−3.840***</td>
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<td>0.272</td>
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<td>0.789*</td>
<td>0.944**</td>
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<td>(0.421)</td>
<td>(0.427)</td>
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<td>0.588**</td>
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<td>0.661***</td>
<td>0.526**</td>
<td>0.750***</td>
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<td>(0.239)</td>
<td>(0.243)</td>
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<td>0.338</td>
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</table>

Notes: Marginal effects are reported. Observations are at the country and year level. trnvr_p and trnvr_p.e correspond to party turnover. For trnvr_p.e, only election years considered. Cycle Peak within Term is the maximum value of the output cycle within the previous term. Perform. is the average rate of growth of real GDP per capita within a term. All regressions condition on $finittrm = 1$ and include country and time fixed effects. Additional controls included in all regressions (all lagged): real GDP per capita; change in inflation within the term, initial inflation and their interaction; openness; political rights score; polcomp; competitiveness of executive elections; xconst; share.gov; CE tenure; allhouse; oppfrac. Robust standard errors, clustered by country, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. 
table contains an upper and a lower panel that correspond to different empirical models. In the upper panels, the tables show the results from estimation of the model in (22), whereas in the lower panels, \( \text{Corr}_{i,t-1} \) is included as an explanatory variable.

I first turn to analyzing the results in Table 9. Peaks have a positive effect on party turnover, whereas good economic performance is rewarded with a lower probability of turnover. The effect of peaks on turnover is stronger as the degree of democracy increases, which is consistent with the results in Table 3, where the effect of the business cycle on corruption is stronger as the democracy threshold increases. Also, generally, the effect of peaks on turnover is stronger in election years, except for the highest levels of democracy. Finally, the way in which the public rewards the incumbent party for good economic performance is also stronger in election years, but its relationship with the degree of democracy doesn’t seem to be monotonic. In adding the value of corruption in the previous year, we can see this variable is still always positively and strongly associated with turnover. Importantly, “unrestricted” party turnover stops being significant in the cases of columns (1) and (3). In any other case, even though peaks do not become statistically zero, their coefficients always lose significance and decrease in their magnitude with respect to their counterparts in the upper panel. The same phenomenon occurs in the case of the LPM in Table 8, except this time the peaks are not always significantly associated with party turnover. These results indeed suggest an indirect, negative effect of business cycles on turnover running through corruption. Of course the pro- or counter-cyclicality of turnover will depend on the weights with which citizens average over corruption and economic performance, and the way the electoral process aggregates their individual preferences.

4.4.4 Turnover and Changes in Corruption Between Mandates

In this section, I take a first step to empirically evaluate the third important prediction of my model: since a higher degree of corruption leads to a higher probability of political turnover, we should, on average, see a decrease in corruption after the incumbent government is voted out.

I compute two variables that measure the changes in corruption: \( \Delta \text{Corr}_{i,t} := \text{Corr}_{i,t+1} - \text{Corr}_{i,t-1} \) and \( P_{i,t} := 1 \{ \text{AvCorr}_{i,t+1,t+2} > \text{AvCorr}_{i,t-1,t-2} \} \), where \( \text{AvCorr}_{i,t,t'} = \frac{1}{2} (\text{Corr}_{i,t} + \text{Corr}_{i,t'}) \) and \( 1 \{ \cdot \} \) is the indicator function. In this way, \( P_{i,t} \) is equal to 1 if average corruption in the two years following \( t \) is greater than average corruption in the two years before \( t \), and
Table 9: Turnover and Business Cycles - Linear Probability Model

<table>
<thead>
<tr>
<th>Dep. Var.:</th>
<th>trnvr_p</th>
<th>trnvr_p_e</th>
<th>trnvr_p</th>
<th>trnvr_p_e</th>
<th>trnvr_p</th>
<th>trnvr_p_e</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
<td>(5)</td>
<td>(6)</td>
</tr>
<tr>
<td>polity2 score</td>
<td>&gt; 0</td>
<td>&gt; 0</td>
<td>≥ 5</td>
<td>≥ 5</td>
<td>≥ 7</td>
<td>≥ 7</td>
</tr>
<tr>
<td>Peak</td>
<td>0.257 (0.342)</td>
<td>0.478 (0.344)</td>
<td>0.286 (0.356)</td>
<td>0.560 (0.360)</td>
<td>0.818** (0.410)</td>
<td>0.945** (0.437)</td>
</tr>
<tr>
<td>Perform</td>
<td>−1.132 (0.842)</td>
<td>−1.984** (1.001)</td>
<td>−1.497 (0.910)</td>
<td>−2.274** (1.094)</td>
<td>−2.493** (1.071)</td>
<td>−3.664*** (1.313)</td>
</tr>
<tr>
<td></td>
<td>502</td>
<td>443</td>
<td>480</td>
<td>426</td>
<td>406</td>
<td>367</td>
</tr>
<tr>
<td>Groups</td>
<td>97</td>
<td>92</td>
<td>93</td>
<td>90</td>
<td>79</td>
<td>76</td>
</tr>
<tr>
<td>R²</td>
<td>0.372</td>
<td>0.416</td>
<td>0.369</td>
<td>0.406</td>
<td>0.308</td>
<td>0.420</td>
</tr>
<tr>
<td>Peak</td>
<td>0.246 (0.357)</td>
<td>0.423 (0.363)</td>
<td>0.264 (0.377)</td>
<td>0.471 (0.390)</td>
<td>0.653 (0.433)</td>
<td>0.747 (0.477)</td>
</tr>
<tr>
<td>Lag Corr</td>
<td>0.615*** (0.224)</td>
<td>0.527** (0.231)</td>
<td>0.495** (0.213)</td>
<td>0.532** (0.232)</td>
<td>0.457* (0.235)</td>
<td>0.527** (0.246)</td>
</tr>
<tr>
<td>Perform</td>
<td>−1.353 (0.839)</td>
<td>−2.385** (1.030)</td>
<td>−1.706* (0.898)</td>
<td>−2.671** (1.126)</td>
<td>−2.175** (1.054)</td>
<td>−3.340** (1.348)</td>
</tr>
<tr>
<td></td>
<td>470</td>
<td>417</td>
<td>450</td>
<td>402</td>
<td>391</td>
<td>354</td>
</tr>
<tr>
<td>Groups</td>
<td>88</td>
<td>83</td>
<td>85</td>
<td>81</td>
<td>74</td>
<td>71</td>
</tr>
<tr>
<td>R²</td>
<td>0.393</td>
<td>0.428</td>
<td>0.389</td>
<td>0.420</td>
<td>0.381</td>
<td>0.423</td>
</tr>
</tbody>
</table>

Notes: Observations are at the country and year level. trnvr_p and trnvr_p_e correspond to party turnover. For trnvr_p_e, only election years considered. Cycle Peak within Term is the maximum value of the output cycle within the previous term. Perform. is the average rate of growth of real GDP per capita within a term. All regressions condition on finitrn = 1 and include country and time fixed effects. Additional controls included in all regressions (all lagged): real GDP per capita; change in inflation within the term, initial inflation and their interaction; openness; political rights score; polcomp; competitiveness of executive elections; xconst; share_gov; CE tenure; allhouse; oppfrac. Robust standard errors, clustered by country, in parentheses. Significance levels: * p < 0.10, ** p < 0.05, *** p < 0.01.
0 otherwise. I then estimate, first,

$$\Delta \text{Corr}_{i,t} = \varsigma \tau_{i,t} + \Delta \tilde{X}_{it}\beta + \theta_{t} + \gamma_{i} + \eta_{it}, \quad \text{(23)}$$

where $$\Delta \tilde{X}_{it} := \tilde{X}_{i,t+1} - \tilde{X}_{i,t-1}$$ and $$\tilde{X}_{it}$$ is the set of explanatory variables in the corruption regressions, including the output cycle. Finally, I estimate

$$P_{i,t} = \varsigma \tau_{i,t} + \hat{\Delta} \tilde{X}_{it}\beta + \theta_{t} + \gamma_{i} + \eta_{it}, \quad \text{(24)}$$

where $$\hat{\Delta} \tilde{X}_{it} := \text{Av}_{i,t+1,t+2} - \text{Av}_{i,t-1,t-2}$$ and $$\tilde{X}_{it}$$ is the same set of explanatory variables as in (23).

The results are shown in Table 10. The estimations include all four measures of turnover. Panel A exhibits the results of OLS estimation of the model in equation (23), whereas panels B and C show the estimates of the model in equation (24) for LPM and probit estimation techniques, respectively. Columns (5)-(8) condition the estimations on sufficiently democratic observations ($$\text{ polit2}_{i,t-1} > 0$$, and $$\text{ finittrm}_{i,t-1} = 1$$ and furthermore $$\text{ multpl}_{i,t-1} = 1$$ in the cases of CE turnover). In all cases, the coefficient on turnover is negative, indicating turnover is associated with lower future corruption relative to current corruption. The strongest effects are related to party turnover, and the impact is larger in the cases of more democratic countries (columns (5)-(8)). Notice, however, this analysis cannot distinguish between the validity of the predictions of this paper and a competing theory or hypothesis of “learning” (how to appropriate public resources), which is reasonably valid. In the following section, I analyze the counter-cyclicality of future corruption, directly regressing corruption on current and previous output shocks.

### 4.5 Future Corruption and the Business Cycle

Now I explore if corruption in a mandate responds counter-cyclically to output shocks in the previous mandate. I depart from a “mandate-a-average” version of the corruption regression in (20):

$$\overline{\text{Corr}}_{i,m} = \alpha_{1}\text{peak}_{i,m} + \overline{X}_{im}\beta + \theta_{t} + \gamma_{i} + \eta_{it}, \quad \text{(25)}$$

where subscript $$m$$ indicates the unit of observation is a country-mandate, rather than a country-year, as in (20), and the upper bar denotes the average value of the variable within mandate $$m$$ in country $$i$$. Notice that, for a given year $$t$$, I have observations
<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
<th>(6)</th>
<th>(7)</th>
<th>(8)</th>
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<tr>
<td><strong>Panel A.</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td><strong>Dependent Variable:</strong></td>
<td>$\Delta$Corr($t$) := Corr($t+1$) - Corr($t-1$)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$trnvr(t)$</td>
<td>-0.019$^*$</td>
<td>-0.019$^*$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.011)</td>
<td>(0.011)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$trnvr_p(t)$</td>
<td>-0.020$^*$</td>
<td></td>
<td>-0.014</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.010)</td>
<td></td>
<td>(0.010)</td>
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</tr>
<tr>
<td>$trnvr_e(t)$</td>
<td></td>
<td>-0.027$^*$</td>
<td></td>
<td>-0.026$^*$</td>
<td></td>
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<tr>
<td></td>
<td>(0.011)</td>
<td>(0.011)</td>
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<td>(0.011)</td>
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</tr>
<tr>
<td>$trnvr_p_e(t)$</td>
<td></td>
<td>-0.015</td>
<td></td>
<td>-0.011</td>
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<tr>
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<td>(0.011)</td>
<td>(0.011)</td>
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<td>(0.011)</td>
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<tr>
<td><strong>Panel B.</strong></td>
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<td></td>
</tr>
<tr>
<td><strong>Dependent Variable:</strong></td>
<td>$P(t)$ := 1{AvCorr($t+1,t+2$) &gt; AvCorr($t-1,t-2$)}. Linear Probability Model</td>
<td></td>
<td></td>
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<tr>
<td>$trnvr(t)$</td>
<td>-0.053</td>
<td></td>
<td>-0.063</td>
<td></td>
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<tr>
<td></td>
<td>(0.049)</td>
<td></td>
<td>(0.047)</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>$trnvr_p(t)$</td>
<td></td>
<td>-0.103$^*$</td>
<td></td>
<td>-0.110$^*$</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(0.044)</td>
<td>(0.046)</td>
<td></td>
<td>(0.046)</td>
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<td></td>
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<tr>
<td>$trnvr_e(t)$</td>
<td></td>
<td></td>
<td>-0.065</td>
<td></td>
<td>-0.093$^*$</td>
<td></td>
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<tr>
<td></td>
<td>(0.057)</td>
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<td>(0.054)</td>
<td></td>
<td>(0.054)</td>
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<tr>
<td>$trnvr_p_e(t)$</td>
<td></td>
<td>-0.104$^*$</td>
<td></td>
<td>-0.119$^*$</td>
<td></td>
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<tr>
<td></td>
<td>(0.050)</td>
<td>(0.052)</td>
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<td>(0.052)</td>
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<tr>
<td><strong>Panel C.</strong></td>
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<tr>
<td><strong>Dependent Variable:</strong></td>
<td>$P(t)$ := 1{AvCorr($t+1,t+2$) &gt; AvCorr($t-1,t-2$)}. Probit</td>
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<td></td>
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<tr>
<td>$trnvr(t)$</td>
<td>-0.061</td>
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<td>-0.083</td>
<td></td>
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<tr>
<td></td>
<td>(0.057)</td>
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<td>(0.052)</td>
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<tr>
<td>$trnvr_p(t)$</td>
<td></td>
<td>-0.142$^{***}$</td>
<td></td>
<td>-0.148$^{***}$</td>
<td></td>
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<tr>
<td></td>
<td>(0.051)</td>
<td>(0.053)</td>
<td></td>
<td>(0.053)</td>
<td></td>
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</tr>
<tr>
<td>$trnvr_e(t)$</td>
<td></td>
<td></td>
<td>-0.073</td>
<td></td>
<td>-0.124$^*$</td>
<td></td>
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<tr>
<td></td>
<td>(0.064)</td>
<td></td>
<td>(0.059)</td>
<td></td>
<td>(0.059)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$trnvr_p_e(t)$</td>
<td></td>
<td></td>
<td></td>
<td>-0.134$^*$</td>
<td></td>
<td>-0.154$^*$</td>
<td></td>
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</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.059)</td>
<td></td>
<td>(0.063)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes: Observations are at the country and year level. 1\{\} is the indicator function. A higher value of Corr indicates higher corruption. $trnvr$ and $trnvr_e$ correspond to Chief Executive turnover. $trnvr_p$ and $trnvr_p_e$ correspond to party turnover. Suffix _$e$ stands for “only election years considered.” Columns (5)-(8) condition on democratic country-year observations, meaning $polity2(t-1) > 0$ and $finittrm(t-1) = 1$. In the cases of $trnvr$ and $trnvr_e$, it was additionally required that $multpl(t-1) = 1$. All regressions include country and time fixed effects. Marginal effects for Probit. Robust standard errors, clustered by country, in parentheses. Significance levels: $^*$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$. 

Democratic | No | No | No | Yes | Yes | Yes | Yes | Yes | Yes
only for those countries that experienced a re-election/replacement episode in year $t$. Therefore, for such countries, $\overline{Corr}_{i,m}$ is the average value of $Corr$ during the mandate that has just came to an end, and the same applies for the vector of control variables $X$. $peak_{i,m}$ is the maximum value of the business cycles during this same mandate, as in the turnover analysis in section 4.4. While still controlling for country and year fixed effects, the model predicts that we should see $\alpha_1 > 0$ (as argued in the previous section when analyzing turnover). After this first estimation, I add the value of $peak$ in the previous mandate; that is, I estimate

$$\overline{Corr}_{i,m} = \alpha_1 peak_{i,m} + \alpha_2 peak_{i,m-1} + \overline{X}_{im} \beta + \theta_t + \gamma_i + \eta_{it}. \quad (26)$$

The theory predicts that, on average, we should see less corruption in mandate $m$ if the realization of the business cycle was larger in mandate $m-1$. That is, the theory predicts $\alpha_2 < 0$.

Figure 8 shows the scatter plot of $peak_{i,m}$ against $peak_{i,m-1}$ across the entire sample. We can see these two variables are positively correlated. Their correlation is 0.2 with a p-value of 0.

**Figure 8:** Maximum Business–Cycle Peaks in Current and Previous Mandates
As a robustness check, I also estimate these two equations but by taking the maximum values of the variables rather than their means (as with business cycles). That is, I estimate

\[ MC_{\text{corr}}_{i,m} = \alpha_1 \text{peak}_{i,m} + M \mathbf{X}_{im} \beta + \theta_t + \gamma_i + \eta_t \tag{27} \]

and

\[ MC_{\text{corr}}_{i,m} = \alpha_1 \text{peak}_{i,m} + \alpha_2 \text{peak}_{i,m-1} + M \mathbf{X}_{im} \beta + \theta_t + \gamma_i + \eta_t, \tag{28} \]

where the prefix \( M \) indicates we are considering the maximum value of the variable for the mandate under consideration. Table 11 shows the results of OLS estimations of (25)-(28). Columns (1)–(4) consider \( \text{Corr}_{i,m} \) as the dependent variable. Column (1) includes only \( \text{peak}_{i,m} \), and the sample was not restricted to democratic countries. \( \text{peak}_{i,m} \) has no significant effect on average corruption, although the coefficient is positive. Column (2) adds \( \text{peak}_{i,m-1} \). Its coefficient is not significantly different from zero, but it is positive. Columns (3) and (4) consider only those countries for which the polity2 score at the beginning of the mandate under consideration was strictly greater than zero. In column (3), \( \text{peak}_{i,m} \) now becomes statistically significant at the 5% level, with a positive sign, and \( \text{peak}_{i,m-1} \) in column (4) remains insignificant, but this time it shows the expected negative sign. An analogous analysis is performed in columns (5)–(8). This time the dependent variable is \( MC_{\text{corr}}_{i,m} \). Now we can see \( \text{peak}_{i,m} \) has a positive and statistically significant sign in all specifications, and \( \text{peak}_{i,m-1} \) remains insignificant, but with a negative sign. Importantly, the coefficient of \( \text{peak}_{i,m} \) is always larger when I restrict attention to democratic environments (compare column (c) vs. column (c-2)), and the coefficient of \( \text{peak}_{i,m-1} \) is more negative as well.

### 4.6 Corruption, Term Length, and Output Volatility

In this section, I study the relationship between corruption and term lengths and corruption and output volatility, at a superficial level. By interpreting a smaller \( \delta \) as a longer term, the theory developed in section 3 predicts we should observe higher corruption when mandates are longer, because the benefits from waiting are too far away. As for output volatility, the model doesn’t offer a clear-cut prediction.

Figure 9 depicts cross-sectional the relationship between average corruption and output volatility (panel (a)) and between average corruption and term length (panel (b)). Each observation corresponds to a country. In both panels, countries are grouped together according to their continents, in order to reduce heterogeneity in unobservables. I
### Table 11: Counter-Cyclicality of Future Corruption

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
<td>(3)</td>
<td>(4)</td>
</tr>
<tr>
<td>Peak</td>
<td>0.040</td>
<td>0.022</td>
<td>0.089**</td>
<td>0.071</td>
</tr>
<tr>
<td></td>
<td>(0.047)</td>
<td>(0.049)</td>
<td>(0.041)</td>
<td>(0.048)</td>
</tr>
<tr>
<td>Peak(m-1)</td>
<td>0.003</td>
<td>-0.015</td>
<td>-0.005</td>
<td>-0.012</td>
</tr>
<tr>
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<td>(0.048)</td>
<td>(0.050)</td>
<td>(0.051)</td>
<td>(0.062)</td>
</tr>
<tr>
<td>polity2(m-1) &gt; 0</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>N</td>
<td>580</td>
<td>505</td>
<td>493</td>
<td>438</td>
</tr>
<tr>
<td>R²</td>
<td>0.451</td>
<td>0.478</td>
<td>0.497</td>
<td>0.500</td>
</tr>
</tbody>
</table>

Notes: Observations correspond to country-mandate pairs. The dependent variable in columns (1)-(4) is the average corruption score within mandate $m$ in country $i$. The dependent variable in columns (5)-(8) is the maximum value of the corruption score within mandate $m$ in country $i$. A higher value of the corruption score indicates higher corruption. Columns (1), (2), (5) and (6) consider all available observations, whereas the other columns restrict attention to observations for which $polity2(m-1) > 0$, so the country was democratic at the beginning of the mandate under consideration. Peak is the value of the maximum business cycle shock during mandate $m$ in country $i$, whereas Peak(m-1) is the value from the previous mandate. All regressions include country and time fixed effects. Robust standard errors, clustered by country, in parentheses. Significance levels: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. 
computed output volatility for each country $i$ as the standard deviation of $\varepsilon_{i,t}$ over time (see equation (14)). Term lengths are computed by means of the variable $y_{rcurnt}$ from the DPI, which is equal to $T - 1$ every time the incumbent is in his/her first year in office, where $T$ is the corresponding term length. For each country $i$, I considered the term length to be the maximum value of $T$ in the period 1985–2011. Average corruption is the mean of variable $Corr_{i,t}$ for each country $i$ in the same period.

**Figure 9:** Further Analysis on Corruption: Output Volatility and Term Length

![Figure 9](image)

(a) Corruption and Output Volatility  
(b) Corruption and Term Length

The data seem to support the model’s prediction regarding corruption and mandate lengths. Output volatility has a positive, non-linear relationship with corruption. The relationship is strong and clear: A simple regression of average corruption on the natural log of output volatility (with no further controls) yields an $R^2$ value of 0.253. This finding indicates corruption is a convex function of the cyclical component of output, or at least locally so at the points where cycle realizations are more likely. To the best of my knowledge, this paper is the first to find such a relationship between corruption and economic volatility, which deserves further theoretical analysis and is left for future research. Several explanations for this long-run relationship are plausible. For example, a higher output volatility could lead to higher corruption through a selection effect: Because an incumbent’s losses are bounded from below because $x \geq 0$, more volatile economies might attract politicians who are more eager for rents. Of course, causality could also run in the opposite way. For example, because corruption mainly affects investment (Mauro 1995), more corrupt economies can generate broader investment and disinvestment cycles: Investment grows when it is low, because it offers high returns, and then it falls sharply when investors (either local or foreign) realize the incumbent government is corrupt; the
5 Conclusion

In this paper, I first theoretically analyzed the way in which output shocks affect the corrupt behavior of politicians. Importantly, the shocks affecting corruption have an imperfect persistence. In other words, shocks that are (or are thought to be) perfectly persistent should not affect the incentives of politicians to engage in corruption. Therefore, the key variable is the business cycle. In particular, business cycles lead corruption to behave according to a “golden goose effect” (Niehaus & Sukhtankar 2013): Transitory output booms, which are most likely to vanish in the near future, represent a good opportunity to grab rents today, thus weakening the desire of being re-elected to grab rents tomorrow. In short, the model predicts corruption is pro-cyclical. This same reasoning further implies economies with higher rates of growth should exhibit less corruption, indicating the negative relationship between corruption and rates of growth, often found in the literature, could be also running from the rates to corruption. In this sense, the estimations of the effects of corruption on growth could suffer from a positive bias. The second prediction of the theory developed in this paper is that output booms could have a positive, indirect effect on turnover, every time corrupt politicians are punished at the polls. Finally, this increase in turnover decreases future corruption, because voters are better able to get rid of the more corrupt incumbents. I took these three predictions to the data and found corruption is strongly and robustly pro-cyclical, regardless of how me measure the output cycles. Importantly, I found that effects of output cycles on corruption disappears when incumbents cannot be (immediately) re-elected, and they increase with the level of democracy. That is, greater electoral accountability implies a higher elasticity of corruption with respect to output fluctuations. As for political turnover, I showed it is strongly and positively associated with past corruption, whereas it is negatively associated with the performance of the economy during the leader’s mandate, as measured by the average rate of growth of GDP per capita within the mandate. However, I also showed party turnover is positively associated with business-cycle peaks during the mandate, and this correlation always decreases, up to the point of disappearing, once we control for the level of past corruption. Finally, I tested whether turnover decreases future corruption. I found evidence that I interpret as supporting the model: Turnover has a negative effect on future-relative-to-current corruption, and previous realizations of maximum business-cycle shocks have a negative effect on corruption in current mandates.
In the process, I also found a clear, positive relationship between average corruption in a country and its macro volatility, as measured by the standard deviation of the cyclical component of its output. A more detailed analysis of this novel finding is left for future research.
Appendix

A. Proofs

A.1. Equilibria

In this section I formally prove the results in section 3.2. As I do in the body of the paper, I will first work within the boundaries of the PBE concept, to later apply the equilibrium refinement presented in section 3.2.2. Throughout this section, $A_2$ must be more generally read as $E[A_2|A_1]$ whenever we are standing at period $t = 1$. However, I write $A_2$ to save in notation.

The reader must be warned that the following is a list of seemingly unrelated results. However, it must be noticed that the challenge relies in pinning down the properties of $\chi_1^*(\theta)$ (take a look at Figure 2 as an example). Can this be a non-monotonic function of the type? Is there any type whose equilibrium behavior does not change with the output path? Is the equilibrium function always continuous in $\theta$? If not, how many “jumps” can it exhibit? And so on, and so forth. Each one of the results below must be regarded as a step towards the ultimate goal of narrowing down the equilibrium behavior of period−1 incumbent and, thus, the set of equilibria.

Proof of Lemma 1. If type $\theta$ is replaced after playing as prescribed by the equilibrium strategy $\chi_1^*(\cdot)$, it must be that

$$A_1 v (\chi_1^*(\theta), \theta) \geq A_1 v (\chi', \theta) + \delta \cdot r^* (\chi') \cdot A_2 v (\theta, \theta), \ \forall \chi' \in [0, 1].$$

If $\chi_1^*(\theta) \neq \theta$, playing $\chi' = \theta$ is a profitable deviation:

$$A_1 v (\chi_1^*(\theta), \theta) < A_1 v (\theta, \theta) + \delta r^* (\theta) v (\theta, \theta).$$

Lemma 2. Assumption 1.iv implies that $v_\theta (\chi, \theta) v (\theta, \theta) < v (\chi, \theta) v_\theta (\theta, \theta) \ \forall \chi < \theta, \ \forall \theta \in (0, 1)$.

Proof. Assumption 1.iv says that $\frac{v(\chi, \theta)}{v(\theta, \theta)}$ is strictly decreasing in $\theta$, for all $\theta, \chi \in (0, 1)$.

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such that $\chi \leq \theta$. Then, by taking derivatives with respect to $\theta$ we have that

$$\frac{\partial}{\partial \theta} v(\chi, \theta) = \frac{v_\theta (\chi, \theta) v(\theta, \theta) - v(\chi, \theta) (v_\chi (\theta, \theta) + v_\theta (\theta, \theta))}{v(\theta, \theta)^2} \frac{v_\theta (\chi, \theta) v(\theta, \theta) - v(\chi, \theta) v_\theta (\theta, \theta)}{v(\theta, \theta)^2} < 0,$$

where the second line follows from the fact that $v_\chi (\theta, \theta) = 0$ (Assumption 1.ii). Then, $\forall \chi \in [0, 1], \forall \theta \in \Theta$ with $\chi < \theta$,

$$v_\theta (\chi, \theta) v(\theta, \theta) < v(\chi, \theta) v_\theta (\theta, \theta).$$

**Lemma 3.** In any equilibrium, $\chi^*(0) = 0$.

Recall $v(0, 0) = 0$ (Assumption 1.i). Then, $v(\chi, 0) \leq 0 \forall \chi \in [0, 1]$ because $\chi = 0$ maximizes $v(\chi, 0)$. Finally, for all $\chi \in [0, 1]$ and $A_1, A_2 \in \mathbb{R}_+$,

$$A_1 v(0, 0) \geq A_1 v(\chi, 0) + \delta r^*(\chi) A_2 v(0, 0)$$

which means that type $\theta = 0$ prefers $\chi = 0$ over any other option, regardless how the voter plays in equilibrium.

**Proof of Result (c).** Suppose it is not true that all good types $\theta \in [0, \theta^\ast]$ are always re-elected: there exists an equilibrium where some type $\theta \in [0, \theta^\ast]$ is replaced after playing his equilibrium action $\chi^*_1(\theta)$. Then, by Lemma 1, this type must be playing his bliss point. By the same Lemma, there can’t be any other type playing $\theta$’s bliss point, since this leads to sure replacement. This implies that, in equilibrium, $\theta$ is perfectly revealing his type to the voter by playing $\chi^*_1(\theta) = \theta$, but this contradicts the fact that the voter wants to replace the incumbent when she observes $\chi = \theta$, since $\theta$ is a good type.

**Lemma 4.** In any equilibrium, the voter re-elects the incumbent when $\chi_1 = 0$.

**Proof.** By Lemma 3, $\chi^*_1(0) = 0$ in any equilibrium. By Result (c), type $\theta = 0$ is re-elected in any equilibrium because he is a good type. Therefore, in any equilibrium the voter re-elects the incumbent if the observed degree of corruption is zero.

**Lemma 5.** $\chi^*_1(\theta)$ is increasing in $\theta$.

**Proof.** Suppose not: there exists a PBE and two types $\theta$ and $\theta'$ such that $\theta' > \theta$ and $\chi^*_1(\theta) > \chi^*_1(\theta')$. By Lemma 3, $\theta > 0$, since otherwise $\chi^*_1(\theta') < 0$, which is not feasible.
Equilibrium requires that $\theta$ must prefer $\chi^*_1(\theta)$ over $\chi^*_1(\theta')$, and the opposite must be true for $\theta'$. This leads to the following pair of inequalities:

$$A_1v(\chi^*_1(\theta), \theta) + \delta r^*(\chi^*_1(\theta)) A_2v(\theta, \theta) \geq A_1v(\chi^*_1(\theta'), \theta) + \delta r^*(\chi^*_1(\theta')) A_2v(\theta, \theta)$$

Adding both inequalities side-by-side we obtain

$$v(\chi^*_1(\theta), \theta) - v(\chi^*_1(\theta'), \theta) + v(\chi^*_1(\theta'), \theta') - v(\chi^*_1(\theta), \theta') \geq \frac{\delta A_2}{A_1} [r^*(\chi^*_1(\theta')) - r^*(\chi^*_1(\theta))] [v(\theta, \theta) - v(\theta', \theta')]$$

Notice that, since $\theta' > \theta$ and $\chi^*_1(\theta) > \chi^*_1(\theta')$, Assumption 1.iii says that the left-hand side is strictly negative, and therefore the right-hand side must be strictly negative as well. If $v(\theta, \theta) = v(\theta', \theta')$ the contradiction is immediate. Consider then the case $v(\theta, \theta) < v(\theta', \theta')$, so it must be that $r^*(\chi^*_1(\theta')) = 1$ and $r^*(\chi^*_1(\theta)) = 0$, which further implies that $\chi^*_1(\theta) = \theta$ by Lemma 1. Notice then that we have that $\theta' > \theta = \chi^*_1(\theta) > \chi^*_1(\theta')$. That is, $\theta'$ is not playing his bliss point, which means that he would be replaced if he did. Then, on the one hand, we have that $\theta$ must prefer playing $\chi^*_1(\theta)$ and being replaced over playing $\chi^*_1(\theta')$ and being retained, whereas $\theta'$ prefers to play $\chi^*_1(\theta')$ and being retained over playing his bliss point $\chi_1 = \theta'$ and being replaced. That is, it must be that

$$A_1v(\theta, \theta) \geq A_1v(\chi^*_1(\theta'), \theta) + \delta A_2v(\theta, \theta)$$


or

$$\frac{v(\theta', \theta') - v(\theta, \theta)}{v(\theta', \theta') - v(\chi^*_1(\theta'), \theta')} \geq \frac{A_1}{\delta A_2} \geq \frac{v(\theta, \theta)}{v(\theta', \theta')},$$

But then

$$\frac{v(\chi^*_1(\theta'), \theta')}{v(\theta', \theta')} \geq \frac{v(\chi^*_1(\theta'), \theta)}{v(\theta, \theta)},$$

which contradicts Assumption 1.iv, since $\theta' > \theta > \chi^*_1(\theta')$. The case $v(\theta, \theta) < v(\theta', \theta')$ is analogous: this implies that $r^*(\chi^*_1(\theta')) = 0 < r^*(\chi^*_1(\theta)) = 1$ and therefore $\chi^*_1(\theta') = 0$ (Lemma 1), and incentive compatibility thus requires

$$A_1v(\theta', \theta') \geq A_1v(\chi^*_1(\theta), \theta') + \delta A_2v(\theta', \theta')$$
\[ A_1 v(\chi^*(\theta), \theta) + \delta A_2 v(\theta, \theta) \geq A_1 v(\theta, \theta). \]

These inequalities together imply that
\[
\frac{v(\chi_1^*(\theta), \theta')}{v(\theta', \theta')} \leq \frac{v(\chi^*(\theta), \theta)}{v(\theta, \theta)},
\]
which contradicts once again Assumption 1.iv since \( \chi_1^*(\theta) > \theta' > \theta \).

**Proof of Result (a).** Suppose \( \chi_1^*(\theta) \) is injective in \( \theta \). Then, \( \chi_1^*(\theta) \) perfectly reveals the incumbent’s type to the voter, so all the good types are re-elected and all the bad types are replaced. By Lemma 1 all bad types play their bliss points: \( \chi_1^*(\theta) = \theta \) \( \forall \theta \in (\theta^*, 1] \). It is clear, then, that the equilibrium strategy \( \chi_1^*(\theta) \) cannot be continuous at \( \theta = \theta^* \), since otherwise type \( \theta^* + \varepsilon \), with \( \varepsilon > 0 \) and small, who is replaced after playing \( \chi_1^*(\theta^* + \varepsilon) \), would deviate and mimic type \( \theta^* \), who is re-elected after playing \( \chi_1^*(\theta^*) \). So \( \chi_1^*(\theta^*) < \lim_{\varepsilon \to 0^+} \chi_1^*(\theta + \varepsilon) = \theta^* \). But then \( \chi_1^*(\theta^*) \) would be strictly preferred by type \( \tilde{\theta} = \chi_1^*(\theta^*) < \theta^* \) over his own equilibrium strategy, since it coincides with his bliss point and it leads to sure retention.

**Proof of Result (b.i)** Lemma 5 and Result (a) together tell us that \( \chi_1^*(\theta) \) is weakly, but never strictly increasing. That is, there’s always at least a degree of corruption \( \chi \) at which some types pool together. Furthermore, the mass of types playing any pooling degree of corruption is non-zero: on the one hand, if there exist two types \( \theta, \theta' \) such that \( \chi_1^*(\theta) = \chi_1^*(\theta') = \chi \), the monotonic property of \( \chi^*(\theta) \) determines that types between \( \theta \) and \( \theta' \) must also play \( \chi \); on the other hand, \( g \) has full support in \([0, 1]\).

**Proof of Result (b.ii).** Let \( \{\chi_p^n\}_n \) be the set of pooling degrees of corruption. Suppose there exists a type such that, in some equilibrium, \( \chi_1^*(\theta) \notin \{\theta, \chi_1^p, \chi_2^p, \ldots\} \). By Lemma 1, type \( \theta \) is re-elected. But then type \( \tilde{\theta} = \chi_1^*(\theta) \) must be playing this degree of corruption as well, since it coincides with his bliss point and it leads to retention, so \( \chi_1^*(\theta) \in \{\theta, \chi_1^p, \chi_2^p, \ldots\} \). A contradiction.

**Lemma 6.** In equilibrium, if \( \theta \in (\theta^*, 1] \), either \( \chi_1^*(\theta) = \theta \) or \( \chi_1^*(\theta) = \chi \), for some \( \chi \in [0, 1] \).

**Proof.** By Result (b.ii) every type plays either his bliss point or some pooling degree of corruption. Suppose there exists an equilibrium where two different bad types \( \theta, \theta' \in (\theta^*, 1] \) play two different pooling degrees, \( \chi^p \) and \( \chi'^p \). Notice that for each one of these pooling degrees of corruption there exists at least one type (not necessarily \( \theta \) or \( \theta' \), but a third one) who is preferring it over his own bliss point. Then, these degrees must lead
to retention by Lemma 1. That is, \( E[\theta|\chi^p], E[\theta|\chi^{p'}] < \theta^* \). Then, in each case, \( \theta \) and \( \theta' \) are pooling together with good types. But by Lemma 5, the equilibrium strategy \( \chi_1^*(\theta) \) is increasing, which implies a contradiction.

**Lemma 7.** If \( \delta A_2 \geq A_1 \), \( \chi^*(1) = 0 \). If \( \delta A_2 < A_2 \), \( \chi^*(1) = 1 \).

**Proof.** If \( \delta A_2 \geq A_1 \) then Proposition 1 says that \( \chi^*(\theta) = 0 \ \forall \theta \in [0, 1] \). Consider then the case \( \delta A_2 < A_1 \). Suppose \( \chi^*(1) = \chi \neq 1 \). Since \( \chi \) is not type-1’s bliss point, he must be re-elected in equilibrium (Lemma 1). The voter’s optimality condition requires then that \( E[\theta|\chi] \leq \theta^* \). Since \( \chi^*(\theta) \) is increasing in \( \theta \), this further implies that (almost) all types must be playing \( \chi \) as well. However, if \( \chi > 0 \), there exists \( \tilde{\theta} \in (0, \chi) \) close enough to 0 such that \( v(0, \tilde{\theta}) > v(\chi, \tilde{\theta}) \) because of the single-peakedness of \( v(\chi, \cdot) \) (Assumption 1.ii). Type \( \tilde{\theta} \) cannot be playing \( \chi \) in equilibrium, and therefore, since \( \chi^*(\theta) \) is increasing, \( \chi^*(\tilde{\theta}) < \chi \). Furthermore, since \( \chi^*(\theta) \) is increasing, \( \chi^*(\theta) < \chi \) for all types in \( [0, \tilde{\theta}] \). But this would violate the requirement that \( E[\theta|\chi] \leq \theta^* \). It must therefore be that \( \chi = 0 \) and the voter re-elects the incumbent if(f) \( \chi = 0 \). Then, any type must prefer to pool at 0 and being re-elected rather than playing his bliss point and being voted-out. That is,

\[
A_1 v(0, \theta) + \delta A_2 v(\theta, \theta) \geq A_1 v(\theta, \theta).
\]

But this implies a contradiction, since the above inequality requires \( \delta A_2 \geq A_1 \) since \( v(\theta, \theta) \geq v(0, \theta) \geq 0 \ \forall \theta \in [0, 1] \). It must therefore be that \( \chi^*(1) = 1 \).

Notice that, in the above proof of Lemma 7, we could have asked for there to exist a real number \( c \) such that

\[
(1 - c) \cdot v(\theta, \theta) \leq v(0, \theta), \forall \theta \in [0, 1],
\]

and therefore, all types would have been willing to mimic type \( \theta = 0 \) if

\[
\frac{\delta A_2}{A_1} \geq c.
\]

In this sense, Assumption 1.i is pure normalization.

The following Proposition determines the equilibrium behavior for the rest of the bad types, assuming that, if indifferent between playing his own bliss point and getting thrown out and not playing his bliss point and getting re-elected, any type prefers the latter.

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Proposition 7. For \( \theta \in (\theta^*, 1] \), \( \chi_1^*(\theta) \) is of the form

\[
\chi_1^*(\theta) = \begin{cases} 
\chi^p & \text{if } \theta \in (\theta^*, \theta_h] \\
\theta & \text{if } \theta \in (\theta_h, 1]
\end{cases}
\]

with \( \theta_h \in [\theta^*, 1] \). If \( \delta A_2 \geq A_1 \), then \( \theta_h = 1 \) and \( \chi^p = 0 \). If \( \delta A_2 < A_1 \), then \( \theta_h < 1 \) and \( \chi^p < \theta_h \).

Proof. By Lemma 6 all bad types are either playing their bliss points or a unique pooling degree of corruption, call it \( \chi^p \). Let \( \Theta(\chi^p) \subset (\theta^*, 1] \) be the set of bad types who play \( \chi^p \) in equilibrium. Since \( \chi^*(\theta) \) is increasing, \( \Theta(\chi^p) \) must be an interval. If \( \Theta(\chi^p) \neq \emptyset \), then \( \Theta(\chi^p) = (\theta^*, \theta_h] \) for some \( \theta_h < 1 \), again because \( \chi^*(\theta) \) is increasing and \( \chi^p \) must be also played by some of their good types in order to satisfy \( E[\theta|\chi^p] \leq \theta^* \). If \( \Theta(\chi^p) = \emptyset \), \( \theta_h = \theta^* \) and all the bad types play their bliss points.

Suppose \( \delta A_2 \geq A_1 \), then Proposition 1 translates into \( \theta_h = 1 \) and \( \chi^p = 0 \).

Consider then the case \( \delta A_2 < A_1 \) and \( \theta_h > \theta^* \), so there is at least some pooling. It cannot be the case that \( \theta_h = 1 \), since Lemma 7 would imply that \( \chi^p = 0 \), which can only hold when \( \delta A_2 \geq A_1 \), so \( \theta_h < 1 \). Finally, suppose in some equilibrium \( \chi^p \geq \theta_h \). Since \( \chi_1^*(\theta) \) is weakly increasing, a strict inequality cannot hold, so \( \chi^p = \theta_h \) and \( \chi_1^*(\theta) \) is continuous at \( \theta = \theta_h \). But since \( \theta_h < 1 \), there exists \( \varepsilon > 0 \) small enough such that type \( \theta = \theta_h + \varepsilon \) wants to play \( \chi^p \) and being retained rather than playing his equilibrium strategy, \( \chi_1^*(\theta) = \theta_h + \varepsilon \), and being replaced. So this type would deviate. We can therefore conclude that \( \chi^p < \theta_h \).

Proposition 7 says that, if \( \delta A_2 \geq A_1 \), the equilibrium strategy \( \chi_1^*(\theta) \) is equal to \( \chi^p = 0 \) for all \( \theta \in (\theta^*, 1] \); and, if \( \delta A_2 < A_1 \), it is either (i) equal to \( \theta \) at any such type, or (ii) flat at some level \( \chi^p \) for the bad types below \( \theta_h \), and then jumping to the 45 degree line at \( \theta_h \).

Proof of Result (d). Suppose not: there exists an equilibrium such that \( \chi_1^*(\theta) = \theta \) \( \forall \theta \in [0, \theta^*] \). By Result (c), all good types are retained. By Result (a), a fully separating equilibrium does not exists, so there exists one good type, \( \tilde{\theta} \), who is being mimicked by some bad types. Since \( \chi_1^*(\theta) \) is weakly increasing by Lemma 5, it must be the case that \( \tilde{\theta} = \theta^* \). So, there exists a positive mass of bad types mimicking type \( \theta^* \). These bad types are being retained by the voter, since otherwise they would play their bliss points by Lemma 1. But then \( E[\theta|\chi_1^*(\theta^*, A_1), A_1] > \theta^* \), which implies a contradiction.

Up to this point, none of the results depended on the equilibrium refinement. Some cases cannot be ruled out without it. For example: all the good types might be playing
\( \chi_1 = 0 \) and retained, and all the bad types are playing their bliss points and are replaced. This can happen as long as \( \theta^* \) is indifferent between the two options. Or the good types could be playing multiple pooling levels of rent, in a stairway kind of fashion, as long as the types at the discontinuity points are indifferent between the levels to their right and to their left. Another example is SPS equilibria, analyzed at the end of section 3.2.1.

From now on, we will make use of the equilibrium refinement. Recall our equilibrium refinement defined in section 3.2.2. In particular, recall the set \( \Theta (\chi^o) \), composed by the types that could benefit (relative to equilibrium) from sending the off–equilibrium message \( \chi^o \) if treated in the best possible way by the voter (i.e., re–elected).

In what follows, we will make use of the following

**Lemma 8.** Suppose \( A_1 > \delta A_2 \). Let \( a := \frac{A_1}{\delta A_2} > 1 \) and \( \chi^p \in (0, 1) \). Define \( \theta_i (a, \chi^p) \in (\chi^p, 1] \) to be a type indifferent between

(a) playing his bliss point \( \chi = \theta_i \) and getting replaced and

(b) playing \( \chi^p \) and getting re–elected.

Then,

(i) \( \theta_i (a, 0) = 0 \);

(ii) \( \theta_i (a, \chi^p) \) decreases with \( a \);

(iii) \( \theta_i (a, \chi^p) \) increases with \( \chi^p \);

(iv) All types \( \theta > \theta_i (a, \chi^p) \) strictly prefer (a) over (b), whereas all types \( \theta \in [\chi^p, \theta_i (a, \chi^p)) \) strictly prefer (b) over (a).

**Proof.** For a type \( \theta \in \Theta \), being indifferent between (a) and (b) means

\[
A_1 v (\chi^p, \theta) + \delta A_2 v (\theta, \theta) = A_1 v (\theta, \theta),
\]

or, after dividing both sides by \( \delta A_2 \),

\[
\frac{a v (\chi^p, \theta) + v (\theta, \theta)}{\theta} = \frac{v (\theta, \theta)}{\theta}.
\]

Equation (29) implicitly defines \( \theta_i (a, \chi^p) \).

(i). Consider \( \chi^p = 0 \). \( v (0, \theta) = 0 \) \( \forall \theta \in \Theta \) by Assumption 1.i. Then, (29) becomes \( v (\theta, \theta) = a v (\theta, \theta) \), but since \( a > 1 \), it must be that \( v (\theta, \theta) = 0 \), and therefore \( \theta = 0 \).

(ii). Differentiating (29) with respect to \( a \) we obtain

\[
\left[ v_\theta (\chi^p, \theta) - \left( 1 - \frac{1}{a} \right) v_\theta (\theta, \theta) \right] \frac{\partial \theta_i}{\partial a} = \frac{1}{a^2} v (\theta, \theta).
\]
The right-hand side is strictly positive for \( \theta > 0 \). Using (29), the term inside the square brackets on the left-hand side is equal to

\[
v_\theta(\chi^p, \theta) - \left(1 - \frac{1}{a}\right)v_\theta(\theta, \theta) = \frac{v(\theta, \theta)v_\theta(\chi^p, \theta) - v(\chi^p, \theta)v_\theta(\theta, \theta)}{v(\theta, \theta)} < 0,
\]

where the inequality follows from Lemma 2. We can conclude that \( \frac{\partial \phi}{\partial a} < 0 \).

(iii). Differentiating (29) this time with respect to \( \chi^p \) we obtain

\[
- \left[v_\theta(\chi^p, \theta) - \left(1 - \frac{1}{a}\right)v_\theta(\theta, \theta)\right] \cdot \frac{\partial \theta}{\partial \chi^p} = v_{\chi^p}(\chi^p, \theta).
\]

Since \( \chi^p < \theta \), the right-hand side is positive due to Assumption 1.ii. We already know from (ii) that the term inside the square brackets is negative, and therefore \( \frac{\partial \theta}{\partial \chi^p} > 0 \).

(iv). Consider any type \( \theta > \theta_i(a, \chi^p) \). By Assumption 1.iv we have that

\[
\frac{v(\chi^p, \theta)}{v(\theta, \theta)} < \frac{v(\chi^p, \theta_i)}{v(\theta_i, \theta_i)}.
\]

Then, since \( \frac{v(\chi^p, \theta_i)}{v(\theta, \theta)} = \frac{A_1 - \delta A_2}{A_1} \) from (29), we have that

\[
A_1v(\theta, \theta) > A_1v(\chi^p, \theta) + \delta A_2v(\theta, \theta),
\]

so \( \theta \) strictly prefers (a) over (b). Similarly, if we consider any \( \theta \in [\chi^p, \theta_i(a, \chi^p)] \), Assumption 1.iv says that

\[
\frac{v(\chi^p, \theta)}{v(\theta, \theta)} > \frac{v(\chi^p, \theta_i)}{v(\theta_i, \theta_i)} = \frac{A_1 - \delta A_2}{A_1},
\]

and therefore

\[
A_1v(\theta_i, \theta) + \delta A_2v(\theta, \theta) > A_1v(\theta, \theta),
\]

meaning that this politician strictly prefers (b) over (a).

Lemma 9. Suppose \( A_1 > \delta A_2 \) and let \( a := \frac{A_1}{\delta A_2} \). Let \( \theta_i(a, \chi^p) \in (0, 1) \) be defined as in Lemma 8. Suppose there exists an equilibrium where

\[
\chi^*_i(\theta) = \begin{cases} 
\theta_i & \text{if } \theta \in [\theta_1, \theta_h] \\
\theta & \text{if } \theta \notin [\theta_1, \theta_h]
\end{cases}
\]
with $\theta_1 < \theta_h = \theta_i(a, \theta_i)$; and the voter re-elects if($f$) $\chi \leq \theta_i$. Then, for an off-equilibrium message $\chi^o(\varepsilon) = \theta_l + \varepsilon$ with $\varepsilon > 0$ small enough such that $\theta_i(a, \chi^o(\varepsilon)) < 1$, we have that $\Theta(\chi^o(\varepsilon)) = [\theta'_i(\varepsilon), \theta'_h(\varepsilon)]$ with $\theta_1 < \theta'_i(\varepsilon)$ and $\theta_h < \theta'_h(\varepsilon) = \theta_i(a, \chi^o(\varepsilon))$. Moreover, $\frac{\partial \theta'_i(\varepsilon)}{\partial \varepsilon} > 0$.

**Proof.** Consider the off-equilibrium degree of corruption $\chi^o(\varepsilon) = \theta_l + \varepsilon$, with $\varepsilon > 0$ and small enough such that $\theta_i(a, \chi^o(\varepsilon)) < 1$, where $\theta_i(a, \chi^o)$ is defined as in Lemma 8. Let us now find the set $\Theta(\chi^o(\varepsilon))$ of types that could have sent the message $\chi^o = \theta_l + \varepsilon$ if treated in the best possible way by the voter.

Notice that the types $\theta \in [0, \theta_l]$ who in equilibrium are playing their bliss points would never deviate to $\chi^o(\varepsilon)$. These types are ruled out, so they do not belong to set $\Theta(\chi^o(\varepsilon))$.

Consider next the types $\theta \in (\theta_h, 1]$ who in equilibrium play their bliss points and are replaced by the voter. By Lemma 8.iii now there exists $\theta'_h(\varepsilon) > \theta_h$ such that $\theta'_h(\varepsilon) = \theta_i(a, \chi^o(\varepsilon))$. By Lemma 8.iv, all types in $(\theta'_h(\varepsilon), 1]$ still strictly prefer their bliss points over $\chi^o(\varepsilon)$, so $(\theta'_h(\varepsilon), 1] \cap \Theta(\chi^o(\varepsilon)) = \emptyset$. Once again by Lemma 8.iv, all types in $[\theta_h(\varepsilon), \theta'_h(\varepsilon))$ strictly prefer $\chi^o(\varepsilon)$ and get re-elected over their bliss points and get replaced, which is what happens in equilibrium, so $[\theta_h, \theta'_h(\varepsilon)] \subset \Theta(\chi^o(\varepsilon))$.

Finally, consider the types $\theta \in (\theta_l, \theta_h)$ who are pooling at $\theta_l$ in equilibrium. Notice that, by the single-peakedness of $v(\chi, \cdot)$ (Assumption 1.ii), there exists $\theta'_l(\varepsilon) \in (\theta_l, \chi^o(\varepsilon))$ such that $v(\chi^o(\varepsilon), \theta'_l(\varepsilon)) = v(\theta_i, \theta'_l(\varepsilon))$. That is, type $\theta'_l(\varepsilon)$ is indifferent between playing $\theta_i$ and $\chi^o(\varepsilon)$. Then, by Assumption 1.iv, all types in $(\theta'_l(\varepsilon), \theta_h)$ strictly prefer $\chi^o(\varepsilon)$ over $\theta_l$, whereas all types in $[\theta_l, \theta'_l(\varepsilon))$ strictly prefer $\theta_l$ over $\chi^o(\varepsilon)$. We can conclude that $\Theta(\chi^o(\varepsilon)) = [\theta'_l(\varepsilon), \theta'_h(\varepsilon)]$ with $\theta_l < \theta'_l(\varepsilon)$ and $\theta_h < \theta'_h(\varepsilon) = \theta_i(a, \chi^o(\varepsilon))$.

To see that $\theta'_l(\varepsilon)$ increases with $\varepsilon$, differentiate the equation $v(\chi^o(\varepsilon), \theta'_l(\varepsilon)) = v(\theta_i, \theta'_l(\varepsilon))$ with respect to $\varepsilon$ to obtain

$$[v_{\theta}(\chi^o(\varepsilon), \theta'_l(\varepsilon)) - v_{\theta}(\theta_i, \theta'_l(\varepsilon))] \frac{\partial \theta'_l(\varepsilon)}{\partial \varepsilon} = -v_{\chi}(\chi^o(\varepsilon), \theta'_l(\varepsilon)).$$

Since $v_{\chi, \theta}(\chi, \theta) > 0 \forall \theta, \chi \in (0, 1)$ (Assumption 1.iii) and $\chi^o(\varepsilon) > \theta_l$, we have that $v_{\theta}(\chi^o(\varepsilon), \theta'_l(\varepsilon)) > v_{\theta}(\theta_i, \theta'_l(\varepsilon))$. And since $\theta'_l(\varepsilon) < \chi^o(\varepsilon)$, $v_{\chi}(\chi^o(\varepsilon), \theta'_l(\varepsilon)) < 0$, so $\frac{\partial \theta'_l(\varepsilon)}{\partial \varepsilon} > 0$.

**Lemma 10.** It can never be the case that all bad types play their bliss points.

**Proof.** Suppose there exists an equilibrium such that $\chi^*_i(\theta) = \theta$ $\forall \theta \in (\theta^*, 1]$. Proposition (1) says that it must be the case that $A_1 > \delta A_2$. By Result (b.i) $\chi^*_i(\theta)$ is weakly increasing in $\theta$, so $\chi^*_i(\theta) \leq \theta^* \forall \theta \in [0, \theta^*]$. Then, all the bad politicians are revealing
their types to the voter and are therefore voted out. Then, it cannot be the case that 
\( \chi_1^* (\theta^*) = \theta^* \), since a bad type sufficiently close to \( \theta^* \) would prefer to mimic type \( \theta^* \) and being re-elected over playing his prescribed equilibrium action and being replaced. So 
\( \chi_1^* (\theta^*) < \theta^* \). Notice then that type \( \theta_i = \chi_1^* (\theta^*) < \theta^* \) is most certainly playing \( \chi_1^* (\theta^*) \) since it coincides with his bliss point and it leads to retention. Since \( \chi_1^* (\theta) \) is increasing, this implies that all types in \( [\theta_i, \theta^*] \) are playing this same degree of corruption, which we now call \( \chi^p \). Notice then that 
\( \chi_1^* (\theta^*) < \theta^* \). So it cannot be the case that \( \chi^p = 0 \). That is, the case \( \theta^h = \theta^* \) has been ruled out by the equilibrium refinement criterion.

\( \chi^p \) is determined by incentive compatibility. In particular, type \( \theta^* \) must be indifferent between playing \( \chi^p \) and being re-elected and playing his bliss point, \( \theta^* \), and being replaced. That is, \( \theta^* = \theta_i (a, \chi^p) \) as defined in Lemma 8. This comes from the fact that any bad type must prefer his equilibrium strategy over \( \chi^p \): \( \forall \theta \in (\theta^*, 1] \),

\[
A_1 v (\theta, \theta) \geq A_1 v (\chi^p, \theta) + \delta A_2 v (\theta, \theta),
\]

and, at the same time, type \( \theta^* \) must (weakly) prefer \( \chi^p \) over his bliss point:

\[
A_1 v (\chi^p, \theta^*) + \delta A_2 v (\theta^*, \theta^*) \geq A_1 v (\theta^*, \theta^*).
\]

By taking the limit as \( \theta \to \theta^{*+} \) we can see that \( \theta^* = \theta_i (a, \chi^p) \).

Now consider the off-equilibrium message \( \chi^o (\varepsilon) = \theta_i + \varepsilon \) with \( \varepsilon > 0 \) and small enough such that \( \theta_i (a, \chi^o (\varepsilon)) < 1 \). Then, by applying Lemma 9 we have that \( \Theta (\chi^o (\varepsilon)) = [\theta_i (\varepsilon), \theta^*_h (\varepsilon)] \) with \( \theta_i < \theta^*_i (\varepsilon) \) and \( \theta^*_h < \theta^*_h (\varepsilon) = \theta_i (a, \chi^o (\varepsilon)) \). Under our equilibrium refinement, if the voter observes \( \chi^o (\varepsilon) \), her beliefs satisfy 
\( E [\theta | \chi^o (\varepsilon)] = E [\theta | \theta \in \Theta (\chi^o (\varepsilon))] \). Since 
\( E [\theta | \theta \in [\theta_i, \theta^*]] < \theta^* \), for \( \varepsilon > 0 \) sufficiently small we have 
\( E [\theta | \theta \in \Theta (\chi^o (\varepsilon))] < \theta^* \) as well, and the equilibrium does not satisfy the equilibrium refinement criterion, since the voter wants to re-elect the incumbent after observing \( \chi^o (\varepsilon) \).

By Proposition 7 and Lemma 10, in any equilibrium satisfying the equilibrium refinement, \( \chi_1^* (\theta) \) for \( \theta \in (\theta^*, 1] \) must be of the form

\[
\chi_1^* (\theta) = \begin{cases} 
\chi^p & \text{if } \theta \in (\theta^*, \theta^*_h] \\
\theta & \text{if } \theta \in (\theta^*_h, 1]
\end{cases}
\]

where \( \theta^*_h \in (\theta^*, 1] \) and \( \chi^p < \theta^*_h \). If \( \theta^*_h = 1 \), \( \chi^p = 0 \). That is, the case \( \theta^*_h = \theta^* \) has been ruled out by the equilibrium refinement criterion.
Lemma 11. In equilibrium, good types play one, and only one pooling degree of corruption.

Proof. By Proposition 7 and Lemma 10, bad types play an equilibrium degree of corruption, $\chi^p$. Since it must be the case that $E[\theta|\chi^p] \leq \theta^*$, $\chi^p$ must be also played by some good types. In particular, since $\chi_1^*(\theta)$ is increasing, there exists a good type $\theta_l < \theta^*$ such that $\chi_1^*(\theta) = \chi^p \forall \theta \in (\theta_l, \theta^*)$. Suppose there exists another degree of corruption, $\chi'$, at which some good types pool together. Since $\chi_1^*(\theta)$ is increasing, $\chi' < \chi^p$. Both actions lead to retention, but only $\chi^p$ is played by bad types. $\chi'$ is played by good types, and good types only. In particular, there exists an open interval of good types $\Theta_{\chi'} = (\theta_l, \theta^*_{\chi'})$ with $\theta^*_{\chi'} \leq \theta_l$ such that $\chi_1^*(\theta) = \chi^p \forall \theta \in \Theta_{\chi'}$ and therefore $E[\theta|\chi'] = E[\theta|\theta \in \Theta_{\chi'}] < \theta^*$. None of the bliss points corresponding to types $\theta \in \Theta_{\chi'}$ is being played in equilibrium.

Consider any off-equilibrium degree of corruption which coincides with $\tilde{\theta}$’s bliss point, for some $\tilde{\theta} \in \Theta_{\chi'}$. Call it $\tilde{\chi}$. Notice that $\tilde{\chi} = \tilde{\theta} < \chi^p$, since otherwise $\tilde{\chi} \geq \chi^p > \chi'$ and $\tilde{\theta}$ would prefer to play $\chi^p$ instead of $\chi'$. But then, none of the bad types would ever prefer to play $\tilde{\chi}$ over $\chi^p$. Then, under our equilibrium refinement, it must be the case that $E[\theta|\tilde{\chi}] \leq \theta^*$, and the voter wants to re-elect the incumbent.

The proof indicates that, if the good types are playing more than 1 pooling degree of corruption, then only one of them would be played by the bad types (in particular, the one than represents the highest degree of corruption). The equilibrium refinement has eliminated this possibility. However, it must be noticed, a standard equilibrium refinement, such as the Intuitive Criterion (Cho & Kreps 1987), would have also ruled out this possibility.

Corollary 1. By Proposition 7 and Lemmas 10 and 11, in equilibrium there exists one, and only one pooling degree of corruption, $\chi^p$.

Lemma 12. In any equilibrium, $\chi_1^*(\theta) \leq \theta \forall \theta \in [0, 1]$.

Proof. Suppose the assertion is not true: there exists an equilibrium and a type $\theta$ such that $\chi_1^*(\theta) \in (\theta, 1]$. By Corollary 1 it must be the case that $\chi_1^*(\theta) = \chi^p$. Type $\tilde{\theta} = \chi^p > \theta$ must be playing $\chi^p$ as well: it is his bliss point and it leads to re-election. Furthermore, since $\chi_1^*(\theta)$ is weakly increasing, all types in $[\theta, \tilde{\theta}]$ are also playing $\chi^p$ and their corresponding bliss points are not being played in equilibrium. By Proposition 7 $[\theta, \tilde{\theta}] \subset [0, \theta^*]$ : all types in $[\theta, \tilde{\theta}]$ are good types.

Consider then any off-equilibrium degree of corruption which coincides with $\theta$’s bliss point, for some $\theta \in [\theta, \tilde{\theta}]$. Call it $\chi'$. Notice that $\chi' < \chi_1^*(\theta) = \chi^p$. But then, none of the
bad types would ever prefer to play \( \chi' \) over \( \chi^p \). Then, under the equilibrium refinement, it must be the case that \( E[\theta|\chi'] \leq \theta^* \), and the voter wants to re-elect the incumbent. ■

**Corollary 2.** By Proposition 1 and Corollary 1, in equilibrium \( \chi_1^* (\theta) \) is SPS. In particular, it is of the following form: if \( A_1 \leq \delta A_2 \), \( \chi_1^* (\theta) = 0 \ \forall \theta \in [0, 1] \); if \( A_1 > \delta A_2 \),

\[
\chi_1^* (\theta) = \begin{cases} 
\theta & \text{if } \theta \in [0, \theta_l] \\
\theta_l & \text{if } \theta \in [\theta_l, \theta_h] \\
\theta & \text{if } \theta \in (\theta_h, 1]
\end{cases},
\]

where \( \theta_l < \theta^* < \theta_h \) and

\[
E[\theta|\theta \in [\theta_l, \theta_h]] \leq \theta^*.
\]

Once again, notice that Corollary 2 could have been obtained by applying the Intuitive Criterion. However, as discussed at the end of section 3.2.1, the Intuitive Criterion does not impose much of a restriction on the equilibrium strategies in (30) as long as it satisfies (31). But there is a continuum of them. This is where the new refinement comes in handy.

**Proof of Proposition 3.** Corollary 2 does a big part of the job. We now just need to prove that there exists a unique equilibrium for the case \( A_1 > \delta A_2 \), with strategies given as in (30).

First notice that type \( \theta_h \) must be indifferent between \( \chi_1 = \theta_l \) with \( r^* (\theta_l) = 1 \) and \( \chi_1 = \theta_h \) with \( r^* (\theta_h) = 0 \). By Lemma 8.iv, if he is, all types \( \theta \in (\theta_l, \theta_h) \) strictly prefer the first option, whereas all types \( \theta > \theta_h \) strictly prefer the second one. Also, it is clear that the good types \( \theta \in [0, \theta_l] \) do not want to deviate. For the voter to retain the incumbent after observing \( \chi_1 = \theta_l \), (31) must hold. Notice that any off-equilibrium degree of corruption is equal to \( \chi^o (\varepsilon) = \theta_l + \varepsilon \), where \( \varepsilon \in (0, \theta_h - \theta_l] \). Suppose the voter observes \( \chi^o (\varepsilon) \). Then, by Lemma 9, if (31) holds with strict inequality, we can always find \( \varepsilon > 0 \) small enough such that \( E[\theta|\theta \in \Theta (\chi^o (\varepsilon))] < \theta^* \), and the equilibrium would fail the refinement. Then, the only possibility is \( E[\theta|\theta \in [\theta_l, \theta_h]] = \theta^* \). In this case, for any \( \varepsilon > 0 \) we have \( E[\theta|\theta \in \Theta (\chi^o (\varepsilon))] > \theta^* \), so the equilibrium survives the refinement.

Finally, we show that there exists a unique \( \theta_l \) that satisfies \( E[\theta|\theta \in [\theta_l, \theta_h]] = \theta^* \) for \( \theta_h = \theta_i (a, \theta_l) \).

First, notice that if \( \theta_l = 0 \), then \( \theta_h = 0 \) as well, since \( v (0, \theta) = 0 \ \forall \theta \in [0, 1] \) (Assumption 1.i), and \( E[\theta|\theta \in [\theta_l, \theta_h]] = 0 < \theta^* \). Second, if \( \theta_l = \theta^* \), \( E[\theta|\theta \in [\theta_l, \theta_h]] > \theta^* \). By continuity, there exists \( \theta_l \in (0, \theta^*) \) such that \( E[\theta|\theta \in [\theta_l, \theta_h]] = \theta^* \). To see uniqueness, let
\( \theta^*_h (\theta_l) \in [\theta^*, 1] \) be the unique solution to \( E[\theta | \theta \in [\theta_l, \theta_h (\theta_l)]] = \theta^* \), with \( \theta_l \in [0, \theta^*] \). It is easy to see that \( \frac{\partial \theta^*_h (\theta_l)}{\partial \theta_l} < 0 \). On the other hand, \( \theta_l (a, \theta_l) \) is strictly increasing in \( \theta_l \) (Lemma 9.ii), so for each \( a = \frac{A_1}{\delta A_2} > 1 \), there exists a unique \( \theta_l \) such that \( \theta_l (a, \theta_l) = \theta^*_h (\theta_l) \).

A.2. Comparative Statics

In this section I prove Proposition 4. Recall \( a := \frac{A_1}{\delta A_2} \).

**Lemma 13.** \( \frac{\partial \theta_l}{\partial a} < 0 \) and \( \frac{\partial \theta_l}{\partial a} > 0 \) when \( a > 1 \).

**Proof.** Recall the equilibrium conditions boil down to

\[
\left( \theta_h - \theta^* \right) v (a (\theta_l, \theta_h)) + \left( \frac{\partial v}{\partial a} (a (\theta_l, \theta_h)) - (a - 1) \frac{\partial v}{\partial \theta} (a (\theta_l, \theta_h)) \right) \frac{\partial \theta_l}{\partial a} = v (\theta_h, \theta_h) - v (\theta_l, \theta_h).
\]

By differentiating (33) with respect to \( a \) we obtain

\[
\theta_h \theta_l g (\theta) \partial \theta_l = \theta^* (G (\theta_h) - G (\theta_l)).
\]

Similarly, from (32),

\[
\theta_h \theta_l g (\theta) \partial \theta_l = \theta^* (G (\theta_h) - G (\theta_l)).
\]

Finally, by combining the two equations, we obtain

\[
\frac{\partial \theta_h}{\partial a} = \frac{v (\theta_h, \theta_h) - v (\theta_l, \theta_h)}{-av_h (\theta_l, \theta_h) \frac{(\theta_h - \theta^*) g (\theta_h)}{(\theta^* - \theta_l) g (\theta_l)} + av_l (\theta_l, \theta_h) - (a - 1) \frac{\partial v}{\partial \theta} (\theta_h, \theta_h)} < 0,
\]

\[
\frac{\partial \theta_l}{\partial a} = \frac{v (\theta_h, \theta_h) - v (\theta_l, \theta_h)}{-av_h (\theta_l, \theta_h) + \frac{(\theta^* - \theta_l) g (\theta_h)}{(\theta_h - \theta_l) g (\theta_l)} \frac{(av_l (\theta_l, \theta_h) - (a - 1) \frac{\partial v}{\partial \theta} (\theta_h, \theta_h))}{\theta_h - \theta_l} > 0,
\]

where the inequalities follow from the fact that \( v(\theta_h, \theta_h) > v(\theta_l, \theta_h), v_h(\theta_l, \theta_h) > 0 \) since \( \theta_l < \theta_h, \theta^* \in (\theta_l, \theta_h) \), and by (32) and Lemma 2,

\[
\frac{v (\theta_l, \theta_h) - v (\theta_h, \theta_h)}{v (\theta_h, \theta_h)} < 0.
\]
Lemma 14. $\frac{\partial \theta_i}{\partial \theta^*}, \frac{\partial \theta_h}{\partial \theta^*} > 0$.

Proof. By differentiating (33) with respect to $\theta^*$ we obtain

$$(\theta_h - \theta^*) g (\theta_h) \frac{\partial \theta_h}{\partial \theta^*} = (G (\theta_h) - G (\theta_l)) - (\theta^* - \theta_l) g (\theta_l) \frac{\partial \theta_l}{\partial \theta^*}.$$ 

From (32),

$$(a v_\theta (\theta_l, \theta_h) - (a - 1) v_\theta (\theta_h, \theta_h)) \frac{\partial \theta_h}{\partial \theta^*} = -a v_\chi (\theta_l, \theta_h) \frac{\partial \theta_l}{\partial \theta^*}.$$ 

Now combine to obtain

$$\frac{\partial \theta_h}{\partial \theta^*} = \frac{G (\theta_h) - G (\theta_l)}{(\theta_h - \theta^*) g (\theta_h) - (\theta^* - \theta_l) g (\theta_l) \frac{av_\theta (\theta_l, \theta_h) - (a - 1) v_\theta (\theta_h, \theta_h)}{av_\chi (\theta_l, \theta_h)}} > 0, \quad (34)$$

$$\frac{\partial \theta_l}{\partial \theta^*} = \frac{G (\theta_h) - G (\theta_l)}{(\theta^* - \theta_l) g (\theta_l) - (\theta_h - \theta^*) g (\theta_h) \frac{av_\chi (\theta_l, \theta_h) - (a - 1) v_\theta (\theta_h, \theta_h)}{av_\chi (\theta_l, \theta_h)}} > 0, \quad (35)$$

where once again Lemma 2 was applied.

Proposition 8. If $a > 1$, when $a$ increases, (i) corruption in period $t = 1$ increases, (ii) turnover increases, and (iii) corruption in period $t = 2$ decreases.

Proof. (i) Recall the definition of the degree of corruption in period $t = 1$:

$$C_1 := \int_0^{\theta_l} \theta g (\theta) d\theta + \int_{\theta_l}^{\theta_h} \theta g (\theta) d\theta + \int_{\theta_h}^1 \theta g (\theta) d\theta.$$ 

Then,

$$\frac{\partial C_1}{\partial a} = (\theta_l - \theta_h) g (\theta_h) \frac{\partial \theta_h}{\partial a} + (G (\theta_h) - G (\theta_l)) \frac{\partial \theta_l}{\partial a}.$$ 

Since $\frac{\partial \theta_h}{\partial a} < 0$ and $\frac{\partial \theta_l}{\partial a} > 0$ by Lemma 13, $\frac{\partial C_1}{\partial a} > 0$.

(ii) Turnover was defined as

$$\tau := 1 - G (\theta_h).$$

Therefore,

$$\frac{\partial \tau}{\partial a} = -g (\theta_h) \frac{\partial \theta_h}{\partial a} > 0.$$ 

(iii) The degree of corruption in period $t = 2$ was formally defined as

$$C_2 := \int_0^{\theta_h} \theta g (\theta) d\theta + \int_{\theta_h}^1 \theta^* g (\theta) d\theta.$$
Then,
\[
\frac{\partial C}{\partial a} = \frac{\partial \nu}{\partial a} g(\theta_h) (\theta_h - \theta^*) < 0.
\]

**Proposition 9.** When \( a > 1 \), an increase in \( \theta^* \) (i) decreases turnover, (ii) increases corruption in the second period, but (iii) it has an ambiguous effect on the first period degree of corruption.

**Proof.** (i) Since turnover is \( \tau = 1 - G(\theta_h) \), then by Lemma 14 \( \frac{\partial \tau}{\partial \theta^*} = -g(\theta_h) \frac{\partial \theta}{\partial \theta^*} < 0 \).

(ii) Consider corruption in the second period:
\[
\frac{\partial C}{\partial \theta^*} = (\theta_h - \theta^*) g(\theta_h) \frac{\partial \theta}{\partial \theta^*} + 1 - G(\theta_h).
\]
Since \( \theta_h > \theta^* \) and \( \frac{\partial \theta}{\partial \theta^*} > 0 \) by Lemma 14, \( \frac{\partial C}{\partial \theta^*} > 0 \).

(iii) Now consider the degree of corruption in period \( t = 1 \):
\[
\frac{\partial C_1}{\partial \theta^*} = (\theta_l - \theta_h) g(\theta_h) \frac{\partial \theta}{\partial \theta^*} + (G(\theta_h) - G(\theta_l)) \frac{\partial \theta_l}{\partial \theta^*}.
\]
From the expressions in (34) and (35),
\[
\frac{\partial C_1}{\partial \theta^*} = \frac{(G(\theta_h) - G(\theta_l)) + m(a)(\theta_l - \theta_h) g(\theta_h)) \cdot (G(\theta_h) - G(\theta_l))}{(\theta^* - \theta_l) g(\theta_l) + (\theta_l - \theta^*) g(\theta_h) m(a)}
\]
where
\[
m(a) := \frac{\nu (\theta_l, \theta_h)}{(a - 1) v(\theta_h, \theta_h) - \nu(\theta_l, \theta_h)} > 0.
\]
The sign of \( \frac{\partial C_1}{\partial \theta^*} \) depends on the sign of \( (\theta_l - \theta_h) g(\theta_h) m(a) + (G(\theta_h) - G(\theta_l)) \). The first component is the decrease in corruption due to the change in \( \theta_h \): the marginal bad type at \( \theta_h^+ \) lowers his degree of corruption from \( \theta_h \) to \( \theta_l \). The second term is the increase in corruption due to the increase in \( \theta_l \), which is played by all types in \( [\theta_l, \theta_h] \). The net effect ultimately depends on the shape of the probability distribution of types, \( G \).

**B. Infinite–Horizon Economy**

In this section I prove the Propositions in section 3.4.
B.1. Proof of Proposition 5.

Recall the Bellman equations for the value functions of the voter:

\[ V(g) = \max \left\{ V_0, \int \int_0^1 \varepsilon' \left(1 - \chi^*(\theta, \varepsilon', g)\right) g(\theta) d\theta f(\varepsilon') d\varepsilon' \right. \]

\[ + \beta (1 - \lambda) \int \int_0^1 V(g'(\varepsilon', g, \chi^*(\theta, \varepsilon', g))) g(\theta) d\theta f(\varepsilon') d\varepsilon' + \beta \lambda V_0 \right\}, \]

(36)

and

\[ V_0 = \int \int_0^1 \varepsilon' \left(1 - \chi^*(\theta, \varepsilon, g_0)\right) g_0(\theta) d\theta f(\varepsilon') d\varepsilon' \]

\[ + \beta (1 - \lambda) \int \int_0^1 V(g'(\varepsilon', g_0, \chi^*(\theta, \varepsilon', g_0))) g_0(\theta) d\theta f(\varepsilon') d\varepsilon' + \beta \lambda V_0 \]

(37)

Let us define the differential value from retention when end-of-period beliefs are given by \( g \) by \( D_{ret}(g) := V(g) - V_0 \). Then, by imposing this definition in (36) and (37) and after combining them we obtain

\[ D_{ret}(g) = \max \left\{ 0, C_{ret}(g_0) - C_{ret}(g) \right\}. \]

(38)

where

\[ C_{ret}(g) := \int \int_0^1 \varepsilon' \chi^*(\theta, \varepsilon', g) - \beta (1 - \lambda) D_{ret}(g'(\theta, \varepsilon', g)) g(\theta) d\theta f(\varepsilon') d\varepsilon'. \]

Given \( \chi^* \), the voter’s optimal behavior is now characterized by the single Bellman equation in (38). Notice that the function \( C_{ret}(g) \) measures discounted expected corruption following retention when the current distribution of types is \( g \). Analogous to the two-period economy, the voter decides by trying to minimize this variable, as one can see from (38).

In the case of the politicians, the Bellman equation was:

\[ P(\theta, \varepsilon, g) = \max_{\chi \in [0,1]} \varepsilon \left( \theta \chi - \frac{1}{2} \chi^2 \right) \]

\[ + \delta (1 - \lambda) r(\varepsilon, g, \chi) \int P(\theta, \varepsilon', g'(\varepsilon', g, \chi)) f(\varepsilon') d\varepsilon' \]

(39)

**Characterization of conjectured MPBE.** Let’s start by considering the equilibrium requirements of \( \theta_h(\varepsilon) \). Consider an information set along the equilibrium path which is not degenerate. In such an information set, and in our conjectured equilibrium,
beliefs will be determined by an interval, equal to \([\bar{\theta}_t (\bar{\varepsilon}), \theta_h (\bar{\varepsilon})]\) for some \(\bar{\varepsilon}\) previously realized. I will denote these beliefs by \(g_{\bar{\varepsilon}}\), and they satisfy that \(g_{\bar{\varepsilon}} (\theta) = \frac{g(\theta)}{G(\theta_0 (\bar{\varepsilon})) - G(\theta_1 (\bar{\varepsilon}))}\) if \(\theta \in [\theta_t (\bar{\varepsilon}), \theta_h (\bar{\varepsilon})]\), and \(g_{\bar{\varepsilon}} (\theta) = 0\) otherwise.

Suppose that the current realization of the output cycle is \(\varepsilon \in \mathbb{R}\), and let us consider type \(\theta \in [\theta^*, \theta_h (\bar{\varepsilon})]\). In particular, consider \(\theta = \theta_h (\bar{\varepsilon})\). Since this type, according to our conjecture, will mimic type \(\theta_t (\bar{\varepsilon})\) for all \(\varepsilon \leq \bar{\varepsilon}\) and will grab his bliss point for all \(\varepsilon > \bar{\varepsilon}\), his value function for \(\varepsilon \leq \bar{\varepsilon}\) must satisfy the following Bellman equation:

\[
P (\theta, \varepsilon, g_{\bar{\varepsilon}}) = \varepsilon \left( \theta \cdot \theta_t (\bar{\varepsilon}) - \frac{1}{2} \theta_t (\bar{\varepsilon})^2 \right) + \delta (1 - \lambda) \int_{-\infty}^{\bar{\varepsilon}} P (\theta, \varepsilon', g_{\bar{\varepsilon}}) f (\varepsilon') d\varepsilon'
\]

Now I make a guess for \(P (\theta, \varepsilon, g_{\bar{\varepsilon}})\) given \(\theta\):

\[
P (\theta, \varepsilon, g_{\bar{\varepsilon}}) = \varepsilon \left( \theta \cdot \theta_t (\bar{\varepsilon}) - \frac{1}{2} \theta_t (\bar{\varepsilon})^2 \right) + B \theta + C \theta^2 + D, \forall \varepsilon \leq \bar{\varepsilon}.
\]

If the guess is correct then

\[
P (\theta, \varepsilon, g_{\bar{\varepsilon}}) = \varepsilon \left( \theta \cdot \theta_t (\bar{\varepsilon}) - \frac{1}{2} \theta_t (\bar{\varepsilon})^2 \right) + \delta (1 - \lambda) \left( \theta \cdot \theta_t (\bar{\varepsilon}) - \frac{1}{2} \theta_t (\bar{\varepsilon})^2 \right) F (\bar{\varepsilon}) E [\varepsilon' | \varepsilon' \leq \bar{\varepsilon}]
\]

\[+ \delta (1 - \lambda) \frac{1}{2} \theta^2 (1 - F (\bar{\varepsilon})) E [\varepsilon' | \varepsilon' \geq \bar{\varepsilon}] + \delta (1 - \lambda) \left( B \theta + C \theta^2 + D \right) F (\bar{\varepsilon}).
\]

And we can now verify it:

\[
B \theta + C \theta^2 + D = \delta (1 - \lambda) \left( \theta \cdot \theta_t (\bar{\varepsilon}) - \frac{1}{2} \theta_t (\bar{\varepsilon})^2 \right) F (\bar{\varepsilon}) E [\varepsilon' | \varepsilon' \leq \bar{\varepsilon}]
\]

\[+ \delta (1 - \lambda) \frac{1}{2} \theta^2 (1 - F (\bar{\varepsilon})) E [\varepsilon' | \varepsilon' \geq \bar{\varepsilon}] + \delta (1 - \lambda) \left( B \theta + C \theta^2 + D \right) F (\bar{\varepsilon}).
\]

We therefore have that the guess is verified for:

\[
B = \theta_t (\bar{\varepsilon}) F (\bar{\varepsilon}) E [\varepsilon' | \varepsilon' \leq \bar{\varepsilon}] \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F (\bar{\varepsilon})},
\]
\[
C = \frac{1}{2} (1 - F (\bar{\varepsilon})) E [\varepsilon' | \varepsilon' \geq \bar{\varepsilon}] \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F (\bar{\varepsilon})},
\]
\[
D = -\frac{1}{2} \theta_t (\bar{\varepsilon})^2 F (\bar{\varepsilon}) E [\varepsilon' | \varepsilon' \leq \bar{\varepsilon}] \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F (\bar{\varepsilon})},
\]
and therefore

\[
P(\theta, \varepsilon, g_{\varepsilon}) = \varepsilon \left( \theta \cdot \theta_l(\tilde{\varepsilon}) - \frac{1}{2} \theta_l(\tilde{\varepsilon})^2 \right) + \left( \theta \theta_l(\tilde{\varepsilon}) - \frac{1}{2} \theta_l(\tilde{\varepsilon})^2 \right) \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F(\tilde{\varepsilon})} F(\varepsilon) E[\varepsilon'|\varepsilon' \leq \tilde{\varepsilon}] + \frac{1}{2} \varepsilon^2 (1 - F(\tilde{\varepsilon})) E[\varepsilon'|\varepsilon' \geq \tilde{\varepsilon}] \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F(\tilde{\varepsilon})}.
\]

We require that, in equilibrium, when \([\theta_l(\tilde{\varepsilon}), \theta_h(\tilde{\varepsilon})] = [\theta_l(\varepsilon), \theta_h(\varepsilon)]\),

\[
P(\theta_h(\varepsilon), \varepsilon, g_{\varepsilon}) = \frac{1}{2} \varepsilon \theta_h(\varepsilon)^2,
\]

which yields

\[
\theta_h(\varepsilon) = h(\varepsilon) \theta_l(\varepsilon),
\]

where

\[
h(\varepsilon) := \left( 1 - \sqrt{\frac{\delta (1 - \lambda) E[\varepsilon']}{(1 - \delta (1 - \lambda) F(\varepsilon)) \cdot \varepsilon + \delta (1 - \lambda) F(\varepsilon) \cdot E[\varepsilon'|\varepsilon' \leq \varepsilon]}} \right)^{-1}.
\]

So now \(\theta_h(\varepsilon)\) cannot be any function, but it must satisfy \((40)\) for a given function \(\theta_l(\varepsilon)\), which we still assume that is constant at 0 for \(\varepsilon \leq \varepsilon_0\), strictly increasing after \(\varepsilon_0\), and with limit value \(\theta^*\). Importantly, it can be verified from \((40)\) that if \(\theta_l(\varepsilon) \to \theta^*\) as \(\varepsilon \to \infty\), then \(\theta_h(\varepsilon) \to \theta^*\) as \(\varepsilon \to \infty\) as well, since \(h(\varepsilon) \to 1\) as \(\varepsilon \to \infty\). However, notice that nothing can be said from \((40)\) as for how \(\theta_h(\varepsilon)\) changes with \(\varepsilon\), even for increasing \(\theta_l(\varepsilon)\).

What we can say is, however, that \(\frac{\theta_h(\varepsilon)}{\theta_l(\varepsilon)} = h(\varepsilon)\) decreases with \(\varepsilon\), which is necessary for our conjecture to be valid. In order to have \(\theta_l(\varepsilon)\) increasing and \(\theta_h(\varepsilon)\) decreasing in \(\varepsilon\) for \(\varepsilon \geq \varepsilon_0\) we need

\[
0 < \frac{\theta'_l(\varepsilon)}{\theta_l(\varepsilon)} < -\frac{h'(\varepsilon)}{h(\varepsilon)}, \forall \varepsilon > \varepsilon_0.
\]

From the above analysis we can also find \(\varepsilon_0\) such that \(\theta_h(\varepsilon_0) = 1\) and \(\theta_l(\varepsilon_0) = 0\). This value of \(\varepsilon\) is the one that satisfies

\[
\varepsilon = (1 - F(\varepsilon)) E[\varepsilon'|\varepsilon' \geq \varepsilon] \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F(\varepsilon)}.
\]

Notice that this is the same point where the argument inside the parenthesis in \((41)\) is equal to 0. To see existence of \(\varepsilon_0\), consider the limits of both sides of \((42)\) as \(\varepsilon \to \infty\).
0. The right-hand side converges to $E[\varepsilon'] \delta (1 - \lambda) > 0$. On the other hand, when $\varepsilon \to \infty$, the right-hand side converges to $0 < \infty$. The continuity of both expressions therefore guarantees that at least one intersection point exists. For uniqueness, compute the derivative of the right-hand side with respect to $\varepsilon$:

$$\frac{\partial}{\partial \varepsilon} \left[ \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F(\varepsilon)} \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \right] = \frac{\delta (1 - \lambda) f(\varepsilon) (1 - \delta (1 - \lambda) F(\varepsilon))}{(1 - \delta (1 - \lambda) F(\varepsilon))^2} \times \left[ \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \right] \frac{\delta (1 - \lambda)}{1 - \delta (1 - \lambda) F(\varepsilon)} - \varepsilon).$$

Notice then that, at any $\varepsilon$ satisfying (42), this derivative is exactly 0, and therefore a unique solution to (42) exists.

Now that we have $\theta_h(\varepsilon)$ as a function of $\theta_l(\varepsilon)$, we can investigate how $\theta_l(\varepsilon)$ will be determined by the voter’s indifference condition.

Let us first analyze the voter’s Bellman equation when beliefs are degenerate at some type $\tilde{\theta}$. Let me denote $g$ by $\tilde{\theta}$ in such a case. Then, (38) reads

$$D_{ret}(\tilde{\theta}) = \max\left\{ 0, C_{ret}(g_0) - \int (\varepsilon' \chi^*(\tilde{\theta}, \varepsilon', \tilde{\theta}) - \beta (1 - \lambda) D_{ret}(\tilde{\theta})) f(\varepsilon') d\varepsilon' \right\}.$$

Recall that the conjectured equilibrium determines that $\chi^*(\tilde{\theta}, \varepsilon', \tilde{\theta}) = \chi^*(\tilde{\theta}) \forall \varepsilon' \forall \tilde{\theta}$. Now, if $\tilde{\theta}$ is supposed to be replaced after playing $\chi^*(\tilde{\theta}, \varepsilon', \tilde{\theta})$, $D_{ret}(\tilde{\theta}) = 0$ and therefore the second argument of the above max function is equal to $-E[\varepsilon'] \tilde{\theta} + C_{ret}(g_0)$, which must be strictly lower than 0. This implies that the voter wants to replace the incumbent iff $\tilde{\theta} > \theta_{rep}^*$, where

$$\theta_{rep}^* := \frac{C_{ret}(g_0)}{E[\varepsilon']}.$$

Now consider a type $\tilde{\theta}$ at state $(\varepsilon', g)$ with $g = \tilde{\theta}$ who is supposed to be re–elected. In this case the voter’s Bellman equation is

$$D_{ret}(\tilde{\theta}) = \frac{1}{1 - \beta (1 - \lambda)} \left( C_{ret}(g_0) - E[\varepsilon'] \tilde{\theta} \right)$$

The voter will therefore be willing to effectively re–elect the incumbent if(f) $D_{ret}(\tilde{\theta}) \geq 0$, or $\tilde{\theta} \leq \frac{C_{ret}(g_0)}{E[\varepsilon']} = \theta_{rep}^*$. That is, the voter wants to replace all incumbents such that $\theta > \theta_{rep}^*$, and wants to retain all incumbents such that $\theta \leq \theta_{rep}^*$. Notice then that in the
cases of degenerate beliefs the voter’s value function is

\[ D_{\text{ret}}(\tilde{\theta}) = \frac{1}{1 - \beta (1 - \lambda)} E[\varepsilon'] \max \left\{ \theta^*_{\text{rep}} - \tilde{\theta}, 0 \right\}. \]  

(43)

Now we need to consider those cases (along the equilibrium path) where the voter’s beliefs are determined by interval \([\theta_l(\varepsilon), \theta_h(\varepsilon)]\) for some \(\varepsilon\), that is,

\[ g_\varepsilon(\theta) = \begin{cases} \frac{g_0(\theta)}{\Pi(\varepsilon)} & \text{if } \theta \in [\theta_l(\varepsilon), \theta_h(\varepsilon)] \\ 0 & \text{otherwise} \end{cases}, \]

where \(\Pi(\varepsilon) := G_0(\theta_h(\varepsilon)) - G_0(\theta_l(\varepsilon))\). Notice that the types inside these intervals are pooling together when the realization of the cycle is \(\varepsilon\). This means that, in order for this to be consistent with equilibrium, the voter must re-elect the incumbent when she observes the pooling level, which is \(\theta_l(\varepsilon)\). The voter’s Bellman equation (38) in this case is

\[
D_{\text{ret}}(g_\varepsilon) = C_{\text{ret}}(g_0) - \int_{\theta_l(\varepsilon)}^{\theta_h(\varepsilon)} \varepsilon' \chi^*(\theta, \varepsilon', g_\varepsilon(\theta)) d\theta \int f(\varepsilon') d\varepsilon' \\
+ \beta (1 - \lambda) \int_{-\infty}^{\varepsilon} D_{\text{ret}}(g_\varepsilon) f(\varepsilon') d\varepsilon' \\
+ \beta (1 - \lambda) \int_{\varepsilon}^{\infty} \int_{\theta_l(\varepsilon')}^{\theta_h(\varepsilon')} D_{\text{ret}}(\theta) g_\varepsilon(\theta) d\theta \int f(\varepsilon') d\varepsilon' \\
+ \beta (1 - \lambda) \int_{\varepsilon}^{\infty} \int_{\theta_l(\varepsilon')}^{\theta_h(\varepsilon')} D_{\text{ret}}(g_{\varepsilon'})(\theta) g_\varepsilon(\theta) d\theta \int f(\varepsilon') d\varepsilon',
\]

so

\[
D_{\text{ret}}(g_\varepsilon) = \frac{1}{1 - \beta (1 - \lambda) F(\varepsilon)} \left[ C_{\text{ret}}(g_0) - \int_{\theta_l(\varepsilon')}^{\theta_h(\varepsilon')} \int f(\varepsilon') d\varepsilon' \right] \int f(\varepsilon') d\varepsilon' \\
+ \beta (1 - \lambda) \int_{\varepsilon}^{\infty} \int_{\theta_l(\varepsilon')}^{\theta_h(\varepsilon')} D_{\text{ret}}(\theta) g_{\varepsilon'}(\theta) d\theta \int f(\varepsilon') d\varepsilon' \\
+ \beta (1 - \lambda) \int_{\varepsilon}^{\infty} \int_{\theta_l(\varepsilon')}^{\theta_h(\varepsilon')} D_{\text{ret}}(g_{\varepsilon'})(\theta) g_\varepsilon(\theta) d\theta \int f(\varepsilon') d\varepsilon'.
\]

(44)

By applying the same equilibrium refinement than in the benchmark model, we will have that \(D_{\text{ret}}(g_\varepsilon) = 0\). In order to see this, suppose that \(D_{\text{ret}}(g_\varepsilon) > 0\). Consider then an off-equilibrium message \(\chi^o \in (\theta_l(\varepsilon), \theta_h(\varepsilon))\). The equilibrium refinement implies that the voter’s beliefs after such a message will be “shifted to the right”, in the sense that the
support of beliefs will be \([\theta_l(\varepsilon) + \zeta, \theta_h(\varepsilon) + \iota]\), for \(\iota, \zeta > 0\) and small. These are the types who could have sent the off-equilibrium message \(\chi^o\). (See Lemma 9 in Appendix A.1.) Then, the equilibrium refinement obliges the voter to apply Bayes’ rule for these types. We can make \([\theta_l(\varepsilon) + \zeta, \theta_l(\varepsilon) + \iota]\) arbitrarily close to \([\theta_l(\varepsilon), \theta_h(\varepsilon)]\) by taking \(\chi^o\) close enough to \(\theta_l(\varepsilon)\), and this will result in a positive value from re-election to the voter. Then, the equilibrium would fail the refinement. By applying this result in the Bellman equation in (44) we obtain

\[
D_{ret}(g_\varepsilon) = \frac{1}{1 - \beta (1 - \lambda)} \left[ C_{ret}(g_0) - \int_{\theta_l(\varepsilon)}^{\theta_h(\varepsilon)} \varepsilon' \chi^*(\theta, \varepsilon', g_\varepsilon(\theta)) d\theta \int f(\varepsilon') d\varepsilon' + \beta (1 - \lambda) \int_{\varepsilon}^{\infty} \left[ \int_{\theta_l(\varepsilon)}^{\theta_h(\varepsilon)} D_{ret}(\theta) g_\varepsilon(\theta) d\theta \int f(\varepsilon') d\varepsilon' \right] \right]
\]

Then, it must be the case that

\[
C_{ret}(g_0) = \int_{\theta_l(\varepsilon)}^{\theta_h(\varepsilon)} \varepsilon' \chi^*(\theta, \varepsilon', g_\varepsilon(\theta)) d\theta \int f(\varepsilon') d\varepsilon' - \beta (1 - \lambda) \int_{\varepsilon}^{\infty} \left[ \int_{\theta_l(\varepsilon)}^{\theta_h(\varepsilon)} D_{ret}(\theta) g_\varepsilon(\theta) d\theta \int f(\varepsilon') d\varepsilon' \right] \]

\[
= \theta^*_rep E[\varepsilon'], \quad \forall \varepsilon > \varepsilon_0, \quad (45)
\]

where the second line follows from the definition of \(\theta^*_rep\). From (45) and (43) we solve for \(\theta^*_rep\) and we obtain

\[
\theta^*_rep = \frac{\int_{\varepsilon_0}^{\infty} \left[ \int_0^{\varepsilon} \iota' \chi^*(\theta, \varepsilon', g_0(\theta)) d\theta \int f(\varepsilon') d\varepsilon' + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E[\varepsilon'] \int_{\varepsilon}^{\infty} \int_0^{\theta_h(\varepsilon')} \theta g_0(\theta) d\theta f(\varepsilon') d\varepsilon' \right]}{E[\varepsilon'] \left( 1 + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} \int_{\varepsilon_0}^{\infty} \int_0^{\theta_h(\varepsilon')} \theta g_0(\theta) d\theta f(\varepsilon') d\varepsilon' \right)}, \quad (46)
\]

Now, from the politician’s conjectured strategies and the expression for \(D_{ret}(\theta)\) in (43)
we can give more shape to the above voter's indifference condition: for all \( \varepsilon \geq \varepsilon_0 \),

\[
\theta^*_\text{rep} E [\varepsilon'] = \theta^*_l (\varepsilon) F (\varepsilon) E [\varepsilon' | \varepsilon' \leq \varepsilon] + \int_\varepsilon^\infty \left[ \int_{\theta_l (\varepsilon')}^{\theta_l (\varepsilon)} \left( \varepsilon' + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \right) \theta g_0 (\theta) \frac{d\theta}{\Pi (\varepsilon)} \right] f (\varepsilon') d\varepsilon' \]

\[
+ \int_\varepsilon^\infty \varepsilon' \theta_l (\varepsilon') \left[ \int_{\theta_l (\varepsilon')}^{\theta_h (\varepsilon')} g_0 (\theta) \frac{d\theta}{\Pi (\varepsilon)} \right] f (\varepsilon') d\varepsilon' \]

\[
+ \int_\varepsilon^\infty \varepsilon' \left[ \int_{\theta_h (\varepsilon')}^{\theta_l (\varepsilon')} \frac{g_0 (\theta)}{\Pi (\varepsilon)} d\theta \right] f (\varepsilon') d\varepsilon' \]

\[
- \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \theta^*_\text{rep} \int_\varepsilon^\infty \left[ \int_{\theta_l (\varepsilon')}^{\theta_h (\varepsilon')} g_0 (\theta) \frac{d\theta}{\Pi (\varepsilon)} \right] f (\varepsilon') d\varepsilon' \]

Let us consider the limit as \( \varepsilon \to \infty \):

\[
\theta^*_\text{rep} E [\varepsilon'] = \theta^* E [\varepsilon'] + \lim_{\varepsilon \to \infty} \int_\varepsilon^\infty \left[ \int_{\theta_l (\varepsilon')}^{\theta_l (\varepsilon)} \left( \varepsilon' + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \right) \theta g_0 (\theta) \frac{d\theta}{\Pi (\varepsilon)} \right] f (\varepsilon') d\varepsilon' \]

\[
+ \int_\varepsilon^\infty \varepsilon' \theta_l (\varepsilon') \left[ \int_{\theta_l (\varepsilon')}^{\theta_h (\varepsilon')} g_0 (\theta) \frac{d\theta}{\Pi (\varepsilon)} \right] f (\varepsilon') d\varepsilon' \]

\[
+ \int_\varepsilon^\infty \varepsilon' \left[ \int_{\theta_h (\varepsilon')}^{\theta_l (\varepsilon')} \frac{g_0 (\theta)}{\Pi (\varepsilon)} d\theta \right] f (\varepsilon') d\varepsilon' \]

\[
- \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \theta^*_\text{rep} \lim_{\varepsilon \to \infty} \int_\varepsilon^\infty \left[ \int_{\theta_l (\varepsilon')}^{\theta_h (\varepsilon')} g_0 (\theta) \frac{d\theta}{\Pi (\varepsilon)} \right] f (\varepsilon') d\varepsilon' \]

By L’Hopital’s rule, then,

\[
\theta^*_\text{rep} E [\varepsilon'] = \theta^* E [\varepsilon'] + \lim_{\varepsilon \to \infty} \left[ \int_{\theta_l (\varepsilon)}^{\theta_l (\varepsilon)} \left( \varepsilon + \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \right) \theta g_0 (\theta) \frac{d\theta}{\Pi' (\varepsilon)} \right] f (\varepsilon) \]

\[
+ \lim_{\varepsilon \to \infty} \frac{-\varepsilon \theta_l (\varepsilon)}{\Pi' (\varepsilon)} \left[ \int_{\theta_l (\varepsilon)}^{\theta_h (\varepsilon)} g_0 (\theta) \frac{d\theta}{\Pi' (\varepsilon)} \right] f (\varepsilon) \]

\[
+ \lim_{\varepsilon \to \infty} \frac{-\varepsilon}{\Pi' (\varepsilon)} \left[ \int_{\theta_h (\varepsilon)}^{\theta_l (\varepsilon)} g_0 (\theta) \frac{d\theta}{\Pi' (\varepsilon)} \right] f (\varepsilon) \]

\[
- \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} E [\varepsilon'] \theta^*_\text{rep} \lim_{\varepsilon \to \infty} \left[ \int_{\theta_l (\varepsilon)}^{\theta_h (\varepsilon)} g_0 (\theta) \frac{d\theta}{\Pi' (\varepsilon)} \right] f (\varepsilon) \]

\[
= \theta^* E [\varepsilon'] - \lim_{\varepsilon \to \infty} \varepsilon f (\varepsilon) \frac{\Pi (\varepsilon)}{\Pi' (\varepsilon)} \theta_l (\varepsilon) \]

Then, in order to have \( \theta^*_\text{rep} = \theta^* \), we need the transversality condition \( \lim_{\varepsilon \to \infty} \varepsilon f (\varepsilon) \frac{\Pi (\varepsilon)}{\Pi' (\varepsilon)} = 0 \).

Now go back to (47) and multiply both sides by \( \Pi (\varepsilon) \), and then take derivatives with
respect to \( \varepsilon \) to obtain:

\[
\theta^*_{\text{rep}} E[\varepsilon'] \Pi'(\varepsilon) = \theta_l'(\varepsilon) \Pi(\varepsilon) \cdot \int_{-\infty}^{\varepsilon} \varepsilon' f(\varepsilon') d\varepsilon' + \theta_l(\varepsilon) \Pi'(\varepsilon) \cdot \int_{-\infty}^{\varepsilon} \varepsilon' f(\varepsilon') d\varepsilon' \\
+ [\theta_h'(\varepsilon) \theta_h(\varepsilon) g_0(\theta_h(\varepsilon)) - \theta_l'(\varepsilon) \theta_l(\varepsilon) g_0(\theta_l(\varepsilon))] \cdot \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \\
+ (\theta^*_{\text{rep}} - \theta_l(\varepsilon)) \theta_l(\varepsilon) g_0(\theta_l(\varepsilon)) (1 - F(\varepsilon)) \frac{\beta(1 - \lambda)}{1 - \beta(1 - \lambda)} E[\varepsilon']
\]

(48)

We have now fully characterized the pair of functions \((\theta_l(\varepsilon), \theta_h(\varepsilon))\). These functions must satisfy:

1. Initial conditions: \(\theta_l(\varepsilon_0) = 0\) and \(\theta_h(\varepsilon_0) = 1\) for \(\varepsilon_0\) defined as the unique solution to (42);

2. Politician’s indifference: equations (40) and (41);

3. Voter’s indifference: differential equation (48), which is expressed in terms of parameter \(\theta^*_\text{rep}\), which satisfies (46);

4. Transversality condition: \(\lim_{\varepsilon \to \infty} \varepsilon f(\varepsilon) \frac{\Pi(\varepsilon)}{\Pi'(\varepsilon)} = 0\).

5. Equilibrium consistency: \(\lim_{\varepsilon \to \infty} \theta_l(\varepsilon; \theta^*_\text{rep}) = \theta^*_{\text{rep}}\).

\[\blacksquare\]

**B.2. Proof of Proposition 6**

Equation (48) can be re-written as follows:

\[
\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) \cdot \theta_h'(\varepsilon) = \theta_l'(\varepsilon) \cdot \varphi(\varepsilon)
\]

(49)

where

\[
\omega(\varepsilon) := \theta^*_{\text{rep}} E[\varepsilon'] - \theta_h(\varepsilon) \cdot \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' - \theta_l(\varepsilon) \cdot \int_{-\infty}^{\varepsilon} \varepsilon' f(\varepsilon') d\varepsilon'
\]

(50)

and

\[
\varphi(\varepsilon) := \Pi(\varepsilon) \cdot \int_{-\infty}^{\varepsilon} \varepsilon' f(\varepsilon') d\varepsilon' + (\theta^*_{\text{rep}} - \theta_l(\varepsilon)) E[\varepsilon'] g_0(\theta_l(\varepsilon)) \left(1 + (1 - F(\varepsilon)) \frac{\beta(1 - \lambda)}{1 - \beta(1 - \lambda)}\right).
\]

(51)

Furthermore, by (40),

\[
\theta_h'(\varepsilon) = h'(\varepsilon) \theta_l(\varepsilon) + h(\varepsilon) \theta_l'(\varepsilon),
\]

(52)

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and therefore, by combining (49) and (52) we obtain

\[ \theta_t'(\varepsilon) = \frac{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) \cdot (-h'(\varepsilon))}{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) \cdot h(\varepsilon) - \varphi(\varepsilon)} \cdot \theta_t(\varepsilon), \]  

(53)

and

\[ \theta_h'(\varepsilon) = \frac{\varphi(\varepsilon) \cdot (-h'(\varepsilon))}{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) \cdot h(\varepsilon) - \varphi(\varepsilon)} \cdot \theta_t(\varepsilon). \]  

(54)

We can compute \( h'(\varepsilon) \) by taking derivatives with respect to \( \varepsilon \) in (41), thus obtaining

\[ h'(\varepsilon) = -\frac{1}{2} \cdot R(\varepsilon) \cdot b(\varepsilon) \cdot h^2(\varepsilon) \]  

(55)

where

\[ R(\varepsilon) := \sqrt{\frac{\delta (1 - \lambda) E[\varepsilon']}{{(1 - \delta (1 - \lambda) F(\varepsilon)) \cdot \varepsilon + \delta (1 - \lambda) F(\varepsilon) \cdot E[\varepsilon'|\varepsilon' \leq \varepsilon]}}. \]

and

\[ b(\varepsilon) := \frac{(1 - \delta (1 - \lambda) F(\varepsilon))}{{(1 - \delta (1 - \lambda) F(\varepsilon)) \cdot \varepsilon + \delta (1 - \lambda) F(\varepsilon) \cdot E[\varepsilon'|\varepsilon' \leq \varepsilon]}}. \]

Notice that

\[
\lim_{\varepsilon \to \varepsilon_0^+} R(\varepsilon) = 1,
\]

\[
\lim_{\varepsilon \to \varepsilon_0^+} b(\varepsilon) = \frac{1 - \delta (1 - \lambda) F(\varepsilon)}{\delta (1 - \lambda) E[\varepsilon']}. \]

The differential equations (53) and (54) can therefore be re-expressed as

\[ \theta_t'(\varepsilon) = \frac{1}{2} \frac{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) \cdot R(\varepsilon) \cdot b(\varepsilon)}{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) - \varphi(\varepsilon) h(\varepsilon)} \cdot h(\varepsilon) \theta_t(\varepsilon), \]  

(56)

and

\[ \theta_h'(\varepsilon) = \frac{1}{2} \frac{\varphi(\varepsilon) \cdot R(\varepsilon) \cdot b(\varepsilon)}{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) - \varphi(\varepsilon) h(\varepsilon)} \cdot h(\varepsilon) \theta_t(\varepsilon). \]  

(57)

**Lemma 15.** (i). \( \lim_{\varepsilon \to \varepsilon_0^+} \theta_t'(\varepsilon) = \frac{1}{2} R(\varepsilon_0) \cdot b(\varepsilon_0) > 0; \)

(ii.a). If \( \theta^*_{\text{rep}} E[\varepsilon'] > \int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') \, d\varepsilon', \) then \( \lim_{\varepsilon \to \varepsilon_0^+} \theta_h'(\varepsilon) > 0; \)

(ii.b). If \( \theta^*_{\text{rep}} E[\varepsilon'] < \int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') \, d\varepsilon', \) then \( \lim_{\varepsilon \to \varepsilon_0^+} \theta_h'(\varepsilon) < 0; \) and

(ii.c). If \( \theta^*_{\text{rep}} E[\varepsilon'] = \int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') \, d\varepsilon', \) then \( \lim_{\varepsilon \to \varepsilon_0^+} \theta_h'(\varepsilon) = \infty. \)
Proof. First, let us compute the limit of $\omega (\varepsilon)$ as $\varepsilon \to \varepsilon_0^+$: from (50) and the fact that $\theta_h (\varepsilon_0) = 1$, $\theta_l (\varepsilon_0) = 0$, and both functions are continuous at $\varepsilon_0$, we have that

$$\lim_{\varepsilon \to \varepsilon_0^+} \omega (\varepsilon) = \theta_{\text{rep}}^* E [\varepsilon'] - \int_{\varepsilon_0}^{\infty} \varepsilon' f (\varepsilon') d\varepsilon'.$$

This limit may be positive or negative, depending on whether $\theta_{\text{rep}}^*$ is greater or smaller than $\frac{\int_0^\infty \varepsilon' f (\varepsilon') d\varepsilon'}{E [\varepsilon']}. Second, the limit of $\varphi (\varepsilon)$ is

$$\lim_{\varepsilon \to \varepsilon_0^+} \varphi (\varepsilon) = \int_{-\infty}^{\varepsilon_0} \varepsilon' f (\varepsilon') d\varepsilon' + \theta_{\text{rep}}^* E [\varepsilon'] g_0 (0) \left( 1 + (1 - F (\varepsilon_0)) \frac{\beta (1 - \lambda)}{1 - \beta (1 - \lambda)} \right) > 0.$$

(i). Consider first the case $\theta_{\text{rep}}^* \neq \frac{\int_0^\infty \varepsilon' f (\varepsilon') d\varepsilon'}{E [\varepsilon']}. Then, from (56), and recalling that $h (\varepsilon) \to \infty$ as $\varepsilon \to \varepsilon_0$ and $h (\varepsilon) \theta_l (\varepsilon) = \theta_h (\varepsilon) \to 1$ as $\varepsilon \to \varepsilon_0$, we have that

$$\lim_{\varepsilon \to \varepsilon_0^+} \theta_l (\varepsilon) = \frac{1}{2} R (\varepsilon_0) \cdot b (\varepsilon_0).$$

Now consider the case $\theta_{\text{rep}}^* = \frac{\int_0^\infty \varepsilon' f (\varepsilon') d\varepsilon'}{E [\varepsilon']},$ so that $\lim_{\varepsilon \to \varepsilon_0^+} \omega (\varepsilon) = 0.$ Notice that

$$\omega (\varepsilon) \cdot h (\varepsilon) = \left( \theta_{\text{rep}}^* E [\varepsilon'] - \theta_h (\varepsilon) \int_{\varepsilon}^{\infty} \varepsilon' f (\varepsilon') d\varepsilon' \right) h (\varepsilon) - \theta_h (\varepsilon) \cdot \int_{-\infty}^{\varepsilon} \varepsilon' f (\varepsilon') d\varepsilon'$$

and therefore,

$$\lim_{\varepsilon \to \varepsilon_0^+} \omega (\varepsilon) \cdot h (\varepsilon) = \left[ \lim_{\varepsilon \to \varepsilon_0^+} \left( \theta_{\text{rep}}^* E [\varepsilon'] - \theta_h (\varepsilon) \int_{\varepsilon}^{\infty} \varepsilon' f (\varepsilon') d\varepsilon' \right) h (\varepsilon) \right] - \int_{-\infty}^{\varepsilon_0} \varepsilon' f (\varepsilon') d\varepsilon'$$

$$= \left[ \lim_{\varepsilon \to \varepsilon_0^+} \left( \theta_{\text{rep}}^* E [\varepsilon'] - \theta_h (\varepsilon) \int_{\varepsilon}^{\infty} \varepsilon' f (\varepsilon') d\varepsilon' \right) \left. \frac{1}{h (\varepsilon)} \right] \right] - \int_{-\infty}^{\varepsilon_0} \varepsilon' f (\varepsilon') d\varepsilon'$$

$$= \left[ \lim_{\varepsilon \to \varepsilon_0^+} \left( - \theta_h (\varepsilon) \int_{\varepsilon}^{\infty} \varepsilon' f (\varepsilon') d\varepsilon' + \theta_h (\varepsilon) \varepsilon f (\varepsilon) \right) \left. \frac{1}{h (\varepsilon)} \right] \right] - \int_{-\infty}^{\varepsilon_0} \varepsilon' f (\varepsilon') d\varepsilon'$$

$$= \left[ \lim_{\varepsilon \to \varepsilon_0^+} \left( - \frac{1}{2} \omega (\varepsilon) g_0 (\theta_h (\varepsilon)) - \frac{\varphi (\varepsilon) \theta_h (\varepsilon) \varepsilon f (\varepsilon)}{h (\varepsilon)} \right) \right] \times$$

$$\times \frac{1}{2 \cdot R (\varepsilon) \cdot b (\varepsilon) \cdot h (\varepsilon)} - \int_{-\infty}^{\varepsilon_0} \varepsilon' f (\varepsilon') d\varepsilon'$$

$$= - \infty.$$
where the third line follows from L'Hôpital's rule, the fourth line from the expression for \( h' (\varepsilon) \) in (55) and the expression for \( \theta'_h (\varepsilon) \) in (57), and the final line follows from the fact that \( \omega (\varepsilon) \to 0 \) and \( \varphi (\varepsilon) \to 0 \), so \( \omega (\varepsilon) \cdot g_0 (\theta_h (\varepsilon)) - \varphi (\varepsilon) h (\varepsilon) \to 0 \). Finally,

\[
\lim_{\varepsilon \to \varepsilon_0^+} \theta'_h (\varepsilon) = \frac{1}{2} \lim_{\varepsilon \to \varepsilon_0^+} \frac{\omega (\varepsilon) \cdot g_0 (\theta_h (\varepsilon)) \cdot R (\varepsilon) \cdot b (\varepsilon) - \varphi (\varepsilon) h (\varepsilon) \cdot \theta_t (\varepsilon)}{\omega (\varepsilon) \cdot g_0 (\theta_h (\varepsilon)) - \varphi (\varepsilon) h (\varepsilon)} = \frac{1}{2} \lim_{\varepsilon \to \varepsilon_0^+} \frac{g_0 (\theta_h (\varepsilon)) \cdot R (\varepsilon) \cdot b (\varepsilon) - \varphi (\varepsilon) h (\varepsilon) \cdot \theta_t (\varepsilon)}{g_0 (\theta_h (\varepsilon)) - \varphi (\varepsilon) h (\varepsilon) \omega (\varepsilon)} = \frac{1}{2} R (\varepsilon_0) \cdot b (\varepsilon_0).
\]

(ii). For the limit of \( \theta'_h (\varepsilon) \) as \( \varepsilon \to \varepsilon_0^+ \), by (57) we have that

\[
\lim_{\varepsilon \to \varepsilon_0^+} \theta'_h (\varepsilon) = \frac{1}{2} \lim_{\varepsilon \to \varepsilon_0^+} \frac{\varphi (\varepsilon_0) \cdot R (\varepsilon_0) \cdot b (\varepsilon_0)}{\omega (\varepsilon_0) \cdot g_0 (1)}.
\]

Therefore, if \( \theta_{rep}^* > \frac{\int_{\varepsilon_0}^{\varepsilon_0^+} f (\varepsilon') d\varepsilon'}{E [\varepsilon]} \) then \( \lim_{\varepsilon \to \varepsilon_0^+} \theta'_h (\varepsilon) > 0 \); if \( \theta_{rep}^* < \frac{\int_{\varepsilon_0}^{\varepsilon_0^+} f (\varepsilon') d\varepsilon'}{E [\varepsilon]} \), \( \lim_{\varepsilon \to \varepsilon_0^+} \theta'_h (\varepsilon) < 0 \); and finally \( \lim_{\varepsilon \to \varepsilon_0^+} \theta'_h (\varepsilon) = \infty \) when \( \theta_{rep}^* = \frac{\int_{\varepsilon_0}^{\varepsilon_0^+} f (\varepsilon') d\varepsilon'}{E [\varepsilon]} \).

**Lemma 16.** Let \( \theta_{rep}^* > 0 \). Consider any \( \varepsilon > \varepsilon_0 \) such that \( \theta_t (\varepsilon) \leq \theta_{rep}^* \) and \( \theta_t (\varepsilon) > 0 \).

Then,

(i). \( \omega (\varepsilon) > 0 \Rightarrow sign \{ \theta'_h (\varepsilon) \} = sign \{ \theta'_t (\varepsilon) \} \);

(ii). \( \omega (\varepsilon) = 0 \Rightarrow \theta'_t (\varepsilon) = 0 \) and \( \theta'_h (\varepsilon) < 0 \), and

(iii). \( \omega (\varepsilon) < 0 \Rightarrow \theta'_t (\varepsilon) > 0 \) and \( \theta'_h (\varepsilon) < 0 \).

**Proof.** First notice that, for \( \theta_{rep}^* > 0 \), there exists \( \varepsilon > \varepsilon_0 \) such that \( \theta_t (\varepsilon) \leq \theta_{rep}^* \), since \( \theta_t (\varepsilon_0) = 0 \); also, from Lemma 15, \( \lim_{\varepsilon \to \varepsilon_0^+} \theta'_t (\varepsilon) > 0 \), so for \( \varepsilon \) close enough to \( \varepsilon_0 \) the requirement \( \theta_t (\varepsilon) > 0 \) is also satisfied.

Second, if \( \theta_t (\varepsilon) \leq \theta_{rep}^* \), then \( \varphi (\varepsilon) > 0 \) since \( \Pi (\varepsilon) > 0 \) which is true because \( \theta_h (\varepsilon) = h (\varepsilon) \theta_t (\varepsilon) \) and \( h (\varepsilon) > 1 \forall \varepsilon > \varepsilon_0 \). Third, notice that, since \( g_0 (\theta_h (\varepsilon)) , R (\varepsilon) , b (\varepsilon) , h (\varepsilon) > 0 \forall \varepsilon > \varepsilon_0 \), and \( \theta_t (\varepsilon) > 0 \) in the case we are considering, then

\[
\text{sign} \{ \theta'_h (\varepsilon) \} = \text{sign} \left\{ \frac{\omega (\varepsilon)}{\omega (\varepsilon) \cdot g_0 (\theta_h (\varepsilon)) - \varphi (\varepsilon) h (\varepsilon)} \right\}.
\]
and

\[ \text{sign} \{ \theta'_h(\varepsilon) \} = \text{sign} \left\{ \frac{1}{\omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) - \frac{\varphi(\varepsilon)}{h(\varepsilon)}} \right\} \]

(i). If \( \omega(\varepsilon) > 0 \) then the sign of \( \theta'_i(\varepsilon) \) is entirely determined by the sign of \( \omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) - \frac{\varphi(\varepsilon)}{h(\varepsilon)} \), and the same is true for \( \theta'_h(\varepsilon) \), so we can conclude that \( \text{sign} \{ \theta'_i(\varepsilon) \} = \text{sign} \{ \theta'_h(\varepsilon) \} \).

(ii). When \( \omega(\varepsilon) = 0 \), \( \theta'_i(\varepsilon) = 0 \) and \( \text{sign} \{ \theta'_h(\varepsilon) \} = \text{sign} \left\{ -\frac{\varphi(\varepsilon)}{h(\varepsilon)} \right\} \). Since \( \varphi(\varepsilon) > 0 \) for \( \theta_i(\varepsilon) \leq \theta_{rep}^* \), then \( \theta'_h(\varepsilon) < 0 \).

(iii). If \( \omega(\varepsilon) < 0 \) then \( \omega(\varepsilon) \cdot g_0(\theta_h(\varepsilon)) - \frac{\varphi(\varepsilon)}{h(\varepsilon)} < 0 \), since \( \varphi(\varepsilon) > 0 \) for \( \theta_i(\varepsilon) \leq \theta_{rep}^* \).

Then, \( \theta'_i(\varepsilon) > 0 \) and \( \theta'_h(\varepsilon) < 0 \). □

Lemma 16 indicates that \( \theta'_i(\varepsilon) = 0 \) when \( \omega(\varepsilon) = 0 \). Let us define then \( \tilde{\omega}(\varepsilon) \) as the value of \( \theta_i(\varepsilon) \) that makes \( \omega(\varepsilon) = 0 \) hold. That is,

\[ \tilde{\omega}(\varepsilon) := \frac{\theta_{rep}^* E[\varepsilon']}{h(\varepsilon) \cdot \int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'} \]

Lemma 17. (i). \( \lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}(\varepsilon) = 0 \), but \( \tilde{\omega}(\varepsilon_0) = 0 \) only if \( \theta_{rep}^* E[\varepsilon'] = \int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \);

(ii). \( \lim_{\varepsilon \to \infty} \tilde{\omega}(\varepsilon) = \theta_{rep}^* \);

(iii). \( \tilde{\omega}'(\varepsilon) > 0 \) \( \forall \varepsilon > \varepsilon_0^0 \);

(iv). \( \lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}'(\varepsilon) = \frac{\theta_{rep}^* E[\varepsilon']}{\int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'} \cdot \frac{1}{2} R(\varepsilon_0) b(\varepsilon_0) \).

Proof. (i). Since \( h(\varepsilon) \to \infty \) as \( \varepsilon \to \varepsilon_0^+ \), it is clear that \( \lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}(\varepsilon) = 0 \).

(ii). Notice that \( h(\varepsilon) \to 1 \) as \( \varepsilon \to \infty \), and therefore

\[ \lim_{\varepsilon \to \infty} \tilde{\omega}(\varepsilon) = \frac{\theta_{rep}^* E[\varepsilon']}{\int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'} = \theta_{rep}^* \]

However, \( \omega(\varepsilon_0) = \theta_{rep}^* E[\varepsilon'] - \int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \) and therefore \( \omega(\varepsilon_0) = 0 \) only when \( \theta_{rep}^* E[\varepsilon'] = \int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \).

(iii). We compute \( \tilde{\omega}'(\varepsilon) \) from (58):

\[ \tilde{\omega}'(\varepsilon) = \theta_{rep}^* E[\varepsilon'] R(\varepsilon) \left[ \frac{\frac{1}{2} \cdot b(\varepsilon) \cdot \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' + \frac{\varepsilon f(\varepsilon)}{h(\varepsilon)}}{\left( \int_{\varepsilon}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' + \frac{\int_{-\infty}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'}{h(\varepsilon)} \right)^2} \right] > 0, \forall \varepsilon > \varepsilon_0, \]

where we have used the expression for \( h'(\varepsilon) \) in (55).
(iv). From point (iii) we can compute \( \lim_{\varepsilon \to \varepsilon_0} \tilde{\omega}'(\varepsilon) \):

\[
\tilde{\omega}'(\varepsilon) = \theta^*_\text{rep} E[\varepsilon] \cdot \frac{\frac{1}{2} \cdot b(\varepsilon_0) \cdot \int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'}{\left( \int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon' \right)^2} = \frac{\theta^*_\text{rep} E[\varepsilon]}{\int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'} \cdot \frac{1}{2} R(\varepsilon_0) b(\varepsilon_0).
\]

\[\Box\]

**Proposition 10.** Let \( \theta^*_\text{rep} \in (0, 1) \). If \( \theta_l(\varepsilon) \) and \( \theta_h(\varepsilon) \) satisfy

1. \( \theta_l(\varepsilon_0) = 0 \) and \( \theta_h(\varepsilon_0) = 1 \) for \( \varepsilon_0 \) defined as the unique solution to (42),

2. \( \theta_h(\varepsilon) = h(\varepsilon) \theta_l(\varepsilon) \forall \varepsilon > \varepsilon_0 \) with \( h(\varepsilon) \) defined as in (41),

3. Differential equation (48) \( \forall \varepsilon > \varepsilon_0 \).

4. \( \lim_{\varepsilon \to \infty} \theta_l(\varepsilon; \theta^*_\text{rep}) = \theta^*_\text{rep} \),

then, \( \theta_l(\varepsilon) \) and \( \theta_h(\theta) \) exist iff \( \theta^*_\text{rep} < \frac{\int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'}{E[\varepsilon]} \). Furthermore, \( \theta_l'(\varepsilon) > 0 \) and \( \theta_h'(\varepsilon) < 0 \) \( \forall \varepsilon > \varepsilon_0 \).

**Proof.** If \( \theta_l(\varepsilon) \) and \( \theta_h(\varepsilon) \) satisfy requirements 2 and 3 we know we can express them in terms of the system of ODE given by (53) and (54). Furthermore, 1, 2 and 3 make Lemmas 15 and 16 hold.

(\( \Rightarrow \)) Suppose \( \theta^*_\text{rep} \geq \frac{\int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'}{E[\varepsilon]} \). By Lemma 15.ii we have that \( \theta_h'(\varepsilon) > 0 \) for \( \varepsilon > \varepsilon_0 \) close enough to \( \varepsilon_0 \). Since \( \theta_h(\varepsilon_0) = 1 \), this means that \( \theta_h(\varepsilon) > 1 \) for \( \varepsilon > \varepsilon_0 \) close enough to \( \varepsilon_0 \).

Consider now the subcase in which \( \theta^*_\text{rep} > \frac{\int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'}{E[\varepsilon]} \). Lemma 17 tells us that \( \lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}'(\varepsilon) = 0 \) and \( \lim_{\varepsilon \to \varepsilon_0^-} \tilde{\omega}'(\varepsilon) = \frac{\theta^*_\text{rep} E[\varepsilon]}{\int_{\varepsilon_0}^{\infty} \varepsilon' f(\varepsilon') d\varepsilon'} \cdot \frac{1}{2} R(\varepsilon_0) b(\varepsilon_0) > \lim_{\varepsilon \to \varepsilon_0} \theta_l'(\varepsilon) \), where the inequality follows from Lemma 15.i. But since \( \theta_l(\varepsilon_0) = 0 \), this says that, for \( \varepsilon > \varepsilon_0 \) close enough to \( \varepsilon_0 \), \( \theta_l(\varepsilon) < \tilde{\omega}(\varepsilon) \), which means that \( \omega(\varepsilon) > 0 \). Notice then that \( \theta_l(\varepsilon) \) must stay below \( \tilde{\omega}(\varepsilon) \), since crossing it from below requires \( \theta_l'(\varepsilon) > 0 \), but at such intersection point \( \omega(\varepsilon) = 0 \) by definition of \( \tilde{\omega}(\varepsilon) \), and therefore \( \theta_l'(\varepsilon) = 0 \) by Lemma 16, implying a contradiction. Staying below \( \tilde{\omega}(\varepsilon) \) also implies that \( \theta_l(\varepsilon) < \theta^*_\text{rep} \) since \( \tilde{\omega}(\varepsilon) < \theta^*_\text{rep} \forall \varepsilon > \varepsilon_0 \) by Lemma 17. Also, \( \theta_l(\varepsilon) \) must always increase, since in order to start decreasing there must be a point where \( \theta_l'(\varepsilon) = 0 \), but this requires \( \omega(\varepsilon) = 0 \) or, equivalently, \( \theta_l(\varepsilon) = \tilde{\omega}(\varepsilon) \). Finally, by Lemma 16.i, \( \text{sign} \{\theta_l'(\varepsilon)\} = \text{sign} \{\theta_h'(\varepsilon)\} \). That is, both functions are always increasing.
But then they cannot converge to the same point, since $\theta_h(\varepsilon) > 1$ and $\theta_l(\varepsilon) < \theta^*_h \leq 1$ for $\varepsilon > \varepsilon_0$. Therefore, requirement 4 is violated in this case.

In the subcase $\theta^*_h = \frac{\int_{E[\varepsilon]} \varepsilon f(\varepsilon) d\varepsilon}{\int_{E[\varepsilon]} E[\varepsilon]}$, by Lemma 17 we have that $\tilde{\omega}(\varepsilon_0) = 0$ and $\lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}'(\varepsilon) = \lim_{\varepsilon \to \varepsilon_0^+} \theta'_l(\varepsilon)$. But then this implies that $\theta'_l(\varepsilon_0) = 0$, contradicting the fact that $\lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}'(\varepsilon) = \lim_{\varepsilon \to \varepsilon_0^+} \theta'_l(\varepsilon) = \frac{1}{2} R(\varepsilon_0) b(\varepsilon_0) > 0$.

\([\Leftrightarrow] \) Suppose now that $\theta^*_h < \frac{\int_{E[\varepsilon]} \varepsilon f(\varepsilon) d\varepsilon}{\int_{E[\varepsilon]} E[\varepsilon]}$. First, by Lemma 15.ii we have that $\theta'_h(\varepsilon) < 0$ for $\varepsilon > \varepsilon_0$ close enough to $\varepsilon_0$. Also, Lemma 17 tells us that $\lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}(\varepsilon) = 0$ and $\lim_{\varepsilon \to \varepsilon_0^+} \tilde{\omega}'(\varepsilon) = \frac{\theta^*_h E[\varepsilon]}{\int_{E[\varepsilon]} E[\varepsilon]} \cdot \frac{1}{2} R(\varepsilon_0) b(\varepsilon_0) < \lim_{\varepsilon \to \varepsilon_0^+} \theta'_l(\varepsilon)$, where the inequality follows from Lemma 15.i. But since $\theta'_l(\varepsilon_0) = 0$, this says that, for $\varepsilon > \varepsilon_0$ close enough to $\varepsilon_0$, $\theta'_l(\varepsilon) > \tilde{\omega}(\varepsilon)$, which means that $\omega(\varepsilon) < 0$, and therefore $\theta'_l(\varepsilon) > 0$ by Lemma 16.ii. Now let us show that $\theta_l(\varepsilon)$ must stay above $\tilde{\omega}(\varepsilon)$.

If $\theta_l(\varepsilon)$ crosses $\tilde{\omega}(\varepsilon)$ at, say, $\varepsilon^*$, then $\omega(\varepsilon^*) = 0$ by definition $\tilde{\omega}(\varepsilon)$, and therefore $\theta'_l(\varepsilon^*) = 0$. Then, Lemma 16.ii says that $\theta'_h(\varepsilon^*) < 0$. Furthermore, for $\varepsilon > \varepsilon^*$ but close enough to $\varepsilon^*$, it must be that $\theta'_h(\varepsilon) < 0$ and $\omega(\varepsilon) > 0$ since $\theta_l(\varepsilon) < \tilde{\omega}(\varepsilon)$ for such $\varepsilon$. Lemma 16.i therefore implies that $\text{sign} \{\theta'_l(\varepsilon)\} = \text{sign} \{\theta'_h(\varepsilon)\}$, so $\theta_l(\varepsilon)$ is decreasing at such $\varepsilon$. Notice then that $\theta_l(\varepsilon)$ must decrease thereafter, since otherwise there would be a point at which $\theta'_l(\varepsilon) = 0$, but this requires $\omega(\varepsilon) = 0$ or, equivalently, $\theta_l(\varepsilon) = \tilde{\omega}(\varepsilon)$. But then it is clear that $\theta_l(\varepsilon)$ does not converge to $\theta^*_h$. We can conclude then that $\theta_l(\varepsilon) > \tilde{\omega}(\varepsilon)$ for $\forall \varepsilon > \varepsilon_0$.

Finally, let us show that $\theta_l(\varepsilon)$ cannot go above $\theta^*_h$. If it did, then the fact that $\theta_l(\varepsilon) \to \theta^*_h$ as $\varepsilon \to \infty$ would require a turning point at which $\theta'_l(\varepsilon) = 0$, but since $\theta_l(\varepsilon) > \tilde{\omega}(\varepsilon)$ for $\forall \varepsilon > \varepsilon_0$ this can never happen.

We conclude that $\theta_l(\varepsilon) \in (\tilde{\omega}(\varepsilon), \theta^*_h) \forall \varepsilon > \varepsilon_0$. Then, by Lemma 16.iii, $\theta'_l(\varepsilon) > 0$ and $\theta'_h(\varepsilon) < 0 \forall \varepsilon > \varepsilon_0$.

\[\blacksquare\]

**C. Construction of the Turnover Variables**

Turnover, $\tau$, takes a value of 1 in those cases with political turnover, and a value of 0 if the government was re-elected. For constructing this variable, I use two variables from the DPI: $yrsoffc$, which tracks the chief executive’s (CE) tenure and has a minimum value of 1; and $yrcurnt$, which indicates the CE’s years left in the current term. In this way, $yrsoffc = 1$ is indicative of political turnover in the previous year. Also, if $yrsoffc(t) = yrsoffc(t - 1) + 1$, but $yrcurnt(t) \neq yrcurnt(t - 1) - 1$, this is indicative of the CE being re-elected when s/he could have been voted out. However, this approach is
far from perfect or complete.

On the one hand, for some observations, these two variables seem to point in different directions. For example, in the case of Albania, we have that \( \text{yrsoffc} (1996) = 4 \) and \( \text{yrsoffc} (1997) = 5 \), indicating the same leader was in office in 1996 and 1997. However, \( \text{yrcurnt} (1996) = \text{yrcurnt} (1997) = 0 \), which is hard to interpret without any further information. As another example, in the case of Belgium, we have that \( \text{yrsoffc} (2008) = \text{yrsoffc} (2009) = 1 \), suggesting turnover in 2008, but at the same time \( \text{yrcurnt} (2008) = 3 \) and \( \text{yrcurnt} (2009) = 2 \), implying both 2008 and 2009 correspond to the same term. All such cases were handled individually, by referring to historical data of the corresponding country. The guiding criterion was to consider only those cases in which the leader was effectively removed from office, either by formal elections or by political or social pressure.

On the other hand, in some cases, the CE’s tenure might come to an end due to natural death or illness.\(^{38}\) Clearly, these cases do not qualify as proper political turnover. To omit these cases, I use the Archigos 4.1. database and its case–description documents (Goemans, Gleditsch & Chiozza 2016), which identify the effective primary ruler and provide data about the manner by which rulers enter and leave political power, among other things. The period 1985–2011 saw 33 cases of natural death and 16 of retirement due to ill health. Restricting attention to the cases I consider for the empirical analysis, I eliminate 22 cases of apparent turnover, out of 684.

For party turnover, I use \( \text{prtyin} \) from the DPI database, which measures the party’s tenure in power. Then I take the turnover variable just discussed, and if this variable indicates turnover in period \( t \), but \( \text{prtyin} (t) + 1 = \text{prtyin} (t + 1) \), I conclude no party turnover occurred (so I assign it a value of 0).

References


\(^{38}\)These cases are not always identifiable by looking at \( \text{yrsoffc} \) and \( \text{yrcurnt} \). For example, in the case of Guyana, \( \text{yrsoffc} = 1 \) in 1986 and \( \text{yrcurnt} = 0 \) in 1985, suggesting the leader in power in 1985 was facing the last year of the corresponding term, and in 1986, another leader succeeded him. However, the Archigos dataset indicates the leader at that time, Burnham, died in 1985. The same happens in the case of Guyana in 1997. The political datasets also indicate, for every year, whether legislative or executive elections took place in a country. However, this is not always a solution to our problem. Poland in 2010 and 2011 exhibits the same problem as the two former examples. Furthermore, the election dummies indicate that in 2010, executive elections were held — Poland had a presidential system. Still, Archigos indicates the leader, Lech Kaczyński, died of natural causes.

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