Essays in Political Economy and Macroeconomics

Ricardo Alfredo Mendes Pereira Vicente

Thesis submitted for assessment with a view to obtaining the degree of Doctor of Economics of the European University Institute

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European University Institute
Department of Economics

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Examining Board

Prof. Árpád Ábrahám, EUI, Supervisor
Prof. Piero Gottardi, EUI
Prof. Facundo Piguillem, EIEF
Prof. César Sosa-Padilla, McMaster University

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Abstract

In this thesis I develop two models that bring together macroeconomics and political institutions; these models allow me to draw conclusions about the impact of institutions on economic outcomes, and about the effect of economics on political results. In the first essay, I provide a formal theory that explains the effect of government coalitions on the probability of sovereign default, and the seemingly excessive number of surplus coalitions across the democratic world. In the second essay, I construct a model of an endowment economy in which a leader distributes income, and I show how investments in de facto power enable the leader to significantly increase his tenure in office, while collecting a large share of rents for his private benefit. Throughout the thesis it is assumed that leaders are selfish, and institutions (incentives) are the main determinant of their behavior in power.

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Contents

Preface

In this thesis I develop two models that bring together macroeconomics and political institutions; these models allow me to draw conclusions about the impact of institutions on economic outcomes, and about the effect of economics on political results.

In the first essay, I provide a formal theory that explains the effect of government coalitions on the probability of sovereign default, and the seemingly excessive number of surplus coalitions across the democratic world.

In a stochastic endowment economy, two parties rotate in power. They have the option to invite a third party, which represents that part of society which is more directly interested in retaining access to international borrowing markets, to form a coalition government. The presence of the smaller party in the coalition decreases the likelihood of default (coalition buys commitment), and hence, bond prices are higher. When the effect of higher bond prices dominates the redistributive effect of one more party in government, bigger political parties have an incentive to form a coalition, even when this is not necessary to guarantee majority support in the legislative body.

In the second essay, I construct a model of an endowment economy in which a leader distributes income, and I show how investments in de facto power enable the leader to significantly increase his tenure in office while collecting a large share of rents for his private benefit.

Citizens may depose the leader if they are able to buy back the de facto power investments, and face other deposition costs. The model accounts for important aspects of the data on durability in power and government effectiveness in both democracies and non-democratic regimes. Among other recommendations, it suggests a high degree of independence of the private economy from government for the purpose of achieving potential GDP.

Throughout the thesis it is assumed that leaders are selfish, and institutions (incentives) are the main determinant of their behavior in power. Economic policies and leader benevolence are the result of impersonal constraints: market forces and institutions.

Chapter 1
Sovereign Default and Coalition Formation[1]

Abstract

There is strong empirical evidence that the likelihood of sovereign debt default and rescheduling in democratic developing countries is reduced when the government is composed of more than one political party. A major tenet of coalition formation theory is the minimal-winning coalition; however, the relative frequency of surplus coalitions in both developing and developed countries seems to run counter to this theory. This paper links sovereign default empirical evidence with coalition formation theory. It provides a formal theoretical explanation for the coalition effect in the probability of default, and for the formation of surplus coalitions. In a stochastic endowment economy, two parties rotate in power. They have the option to invite a third party, which represents that part of society which is more directly interested in retaining access to international borrowing markets, to form a coalition government. The presence of the smaller party in the coalition decreases the likelihood of default (coalition buys commitment), and hence, bond prices are higher. When the effect of higher bond prices dominates the redistributive effect of one more party in government, bigger political parties have an incentive to form a coalition, even when this is not necessary to guarantee majority support in the legislative body.

[1] I am grateful to Árpád Ábrahám for his guidance, and many constructive comments, and as well to Piero Gottardi, Andrea Mattozzi, Lenno Uusküla, and seminar participants at the Tallinn University of Technology, the Estonian Business School, and the 2014 ECPR Graduate Student Conference. Sebastian M. Saiegh kindly provided his datasets. I acknowledge financial support from DGAE (Portuguese Foreign Affairs Ministry), Fundação para a Ciência e Tecnologia, and European Social Fund's Doctoral Studies and Internationalisation Programme DoRa.

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JEL Classification: D72; E32; E43; F34

1.1 Introduction

This paper links empirical evidence on sovereign default with coalition formation theory. It provides a formal theoretical explanation for the coalition effect in the probability of default, and it is able to predict the formation of surplus coalitions.

There is strong empirical evidence that the likelihood of sovereign debt default in developing countries is reduced when the government is composed of more than one political party (Saiegh, 2005a, 2009). This **coalition effect** is shown to be large. This finding can be accounted for by the fact that in the case of domestically held debt, a group of creditors, even a small one, has a better chance of being represented in government, and thus influence decision-making, when the government comprises more than one political party. As long as they are represented in government, creditors may influence decisions in the direction of the fulfilment of debt obligations.

At the theoretical level, this argument can easily be applied not only to developing countries, but also to advanced economies: the important point is that single-party government and coalition government are both possible. Furthermore, the argument can be extended to external debt. Debt restructuring and default have a negative general impact on

GDP, but this likely affects some groups in society more than others[2]. Hence, I can extend the original argument and claim as well that those groups have better odds of influencing government decision-making in the case of multi-party government.

Recent literature has discussed the democratic advantage in raising debt under better conditions[3]. Democratic governments can more credibly pledge that they will pay their debts because these are held in whole or part by voters, and voters can threaten to electorally punish the government should it decide to default. The electoral punishment, which is only possible in democracies, functions thus as a commitment technology[4].

When debt has been raised mostly abroad, the electoral punishment also works as a credibility mechanism. In this case, those constituencies more directly affected by default will likely vote the responsible parties out of government. Hence, the idea of democratic advantage does not necessarily hinge on voters actually holding any debt[5].

The crucial points are, thus, that some groups in society have a strong preference for debt repayment, whether or not they are debt holders, that these groups can electorally threaten governments, and that they are more likely to influence the decision to honor or to default the debt in those regime types in which the formation of coalitions is possible. This

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[2] For the distributional consequences of sovereign debt default, cfr. Stasavage (2003), Tomz (2002), and Tomz and Wright (2013). For a detailed view of default costs, cfr. Borensztein and Panizza (2008). Also on default costs: Hatchondo et al. (2007), and Panizza et al. (2009).

[3] Cfr. Schultz and Weingast (2003), and references therein; Saiegh (2005b); Beaulieu et al. (2012); and McGillivray and Smith (2003). For an historical perspective, Stasavage (2006). For a critical perspective, Tomz (2002).

[4] A more general argument can be made that stronger checks and balances on the executive body lead to a smaller probability of a debt incident (Kohlscheen, 2010).

[5] Another example of this can be found in Dixit and Londregan (1998), in which some electoral constituencies may favor government debt repayment even when they are not bondholders. This is due to the complementarity between private investment and public investment, the latter being funded by debt.

paper considers the coalition effect only, not the electoral threat, as it will be assumed that the decision to default has no effect on the probability of reelection.

Turning to coalition government theory, one of its pillars is the minimal-winning-coalition concept (Riker, 1962)[6]. In parliamentary systems, it is predicted that coalitions will be as small as possible while retaining the support of at least fifty percent plus one members of the parliament. Thus, in a minimal-winning coalition, if any of its constituent parties drops from it, the government loses majority support in the legislative body.

However, the prevalence of surplus coalitions and minority governments seems to counter the theory[7]. In the same dataset which was used to show the empirical significance of the coalition effect in developing democracies, and which includes both parliamentary, mixed, and presidential systems, it is found that 22% of the country-year observations correspond to surplus coalitions, while minority governments correspond to approximately 31% of the observations[8].

Furthermore, focusing now on industrialized parliamentary democracies, Laver and Schofield (1990) have found as well that surplus coalitions and minority governments are very common[9]. The authors present the frequency of coalition types for a set of twelve West European countries during the period 1945-1987. Excluding single-party majority

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6 For a survey of the theory of government coalitions, cfr. Crombez (1996).

7 A surplus coalition is a cabinet with more than one party such that the cabinet retains support of more than half of the seats in the parliament if its smallest component is dropped. A minority government is one in which the party or parties forming the cabinet hold less than half of the seats in the legislative chamber.

8 Saiegh (2009), and my calculations.

9 Cited in Mueller (2003).

governments, there were a total of 196 governments[10]. Of these, 73 (37%) were minority governments. Among the majority coalitions (123), 46 (37%) were surplus coalitions[11].

The two main objectives of this paper are to present a rigorous formalization of the coalition effect, and to offer an explanation for the high frequency of surplus coalitions.

In a stochastic endowment economy, two parties rotate in power, and have the option to invite a third party to form a coalition government. I call the former parties "big parties". The third party, alternatively referred to as the "junior" or "small" party, represents those elements of society which are more directly interested in retaining access to international borrowing markets.

The inclusion of the small party in the cabinet alters the relative weights of the welfare function used to decide on policies, leading to more redistribution to the constituency of the small party. By assumption, it does not improve any measure of government survivability or governability. Governments decide on redistribution, borrowing, and repaying or defaulting on their debt.

In case of sovereign default, there will be not only a general income cost to the economy, but also a specific cost to those represented by the third party. I model this specific cost as a loss of part of the income allocated to the third constituency. The presence of the junior party in the coalition thus decreases the likelihood of default, leading to higher bond prices.

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[10] A majority government is one in which the party or parties forming the cabinet hold at least fifty percent plus one of the seats in the parliament.

[11] Adopting a stricter concept of surplus coalition, namely one in which there is at least one party which can be dropped without loss of majority support in the legislature, and without loss of political connectedness in the cabinet, the share of surplus governments among majority coalitions would still be 30%.

I assume that the big parties optimally decide whether or not to form coalitions, but that they cannot decide on breaking them. In this way, coalition formation works as if the big party was *buying commitment* to debt repayment. Had the big parties the power to break coalitions, they would do so whenever it would be optimal for them to default. But then, under such assumption, the presence of the small party in the government would not bear any effect on the probability of default and, hence, on bond prices. Moreover, without such effect, coalitions would never be formed in the first place.

The decision to form a coalition depends on a trade-off involving an income redistribution effect and a bond price effect. On one hand, including the third party in the cabinet leads to higher bond prices. On the other hand, its inclusion changes the optimal allocation, with income being shifted from the big parties to the junior party.

When the effect of a higher bond price dominates the redistributive effect, bigger political parties have an incentive to form a coalition, even when this is not necessary to guarantee majority support in the legislative body, and even when survival in power and governability are not improved by the presence of the junior party. Surplus coalitions are, thus, formed *exclusively* as a consequence of the *coalition buys commitment* effect.

The model applies to parliamentary and mixed democracies, where governments may regularly step down at any period, and it is flexible enough to accommodate different party and electoral systems, which are represented by the probability that a political party wins a majority of its own following a power change[12].

[12] For a classification and discussion of electoral systems cfr. Norris (1997).

There are two possible statuses for the legislative power, depending on whether or not one party holds the majority. The status of the executive power can be either single-party government or coalition government. The political structure of the economy may, thus, take four different forms: single-party minority; single-party majority; minimal-winning coalition; and surplus coalition. The interaction between the executive and legislative branches, captured by these four possibilities, matters for the determination of policies, default risk, and, hence, interest rates.

After solving the model by value function iterations, and after running simulations, I show that, in equilibrium, sovereign default occurs, but it happens less frequently than in comparable models that lack any commitment mechanism. Also, both types of coalition are formed, and the frequency of surplus coalitions is nearly double the frequency of minimum-winning coalitions.

For all possible combinations of GDP and borrowing levels, coalitions face either equal or more favorable borrowing terms than single-party governments, as they have a significant partial effect in decreasing the likelihood of default.

Bond price differences across coalition and single-party government are substantial for many relevant GDP-borrowing pairs. The coalition effect on bond prices is highest in the case of a large economic contraction, and low borrowing needs: in a deep recession, while both types of government are equally likely to default on large and moderate mounds of debt, only the single-party government will default on a small debt stock.

The maximum price difference decreases with borrowing: the more that is borrowed, the more similar the two types of government become in their optimal default policies.

The preferences of the cabinet are only exactly aligned with those of a big party in the case of single-party government. Hence, big parties invite a small party to form a government only when there is a big effect of the coalition on bond prices. The simulations show that coalitions are typically formed in times of relatively mild recession and very high funding need. This is an implication of the model which may be tested in future work.

While coalitions offer lower interest rates ceteris paribus (i.e. keeping economic conditions and borrowed funds the same) the "unconditional" mean interest rates are higher under coalition governments. This is because, as stated above, coalitions are formed during recessions, when the risk of default is high; hence, interest rates tend to be higher. In the context of an economic contraction, and high interests rates, the coalition becomes thus a device for supporting consumption in hard times.

The route I will take is the following: the next section connects this paper with the related literature; Section 2 presents and discusses the model; equilibrium is defined in Section 3; the calibration strategy is presented in Section 4; results are shown and discussed in Section 5; Section 6 concludes.

1.1.1 Related literature

The field of sovereign debt had its genetic moment with Eaton and Gersovitz (1981)[13]. They modeled the special features of sovereign borrowing that distinguish it from private borrowing, namely that all borrowers are "inherently dishonest" and decide to default not necessarily because they have no means to redeem their debt but mainly because it is op-

[13] For a general perspective cfr. Hatchondo et al. (2007).

timal to do so ("willingness-to-pay" approach); that there is no contractual way to prevent the borrower from defaulting or punishing him should that happen; and that governments don't usually offer collateral. With stochastic net output, the motive for indebtedness is consumption smoothing. Debt repayment is optimal because of the desire to borrow in future periods (reputation works as a commitment mechanism).

Many contributions have been built on Eaton and Gersovitz's model (1981). Among them, the study of emerging markets has drawn a great deal of research interest. Examples of such are Aguiar and Gopinath (2006), and Arellano (2008) who have investigated the stylized facts about the business cycles of emerging markets, which include the occurrence of defaults, the countercyclicality of net exports and interest rates, and the high volatility of the latter. As will be seen, my model displays these same properties.

I am especially concerned with the links between sovereign debt theory and political institutions. Hatchondo and Martinez (2010) survey the corresponding theoretical and empirical literature[14].

Among the relevant research, my paper is most related to Cuadra and Sapriza (2008), and Arellano (2008)[15]. The focus of these papers is on emerging markets. Cuadra and Sapriza (2008) develop a model with two parties, which rotate in power. These parties are

[14] Cuadra and Sapriza (2008) also survey the empirical contributions.

[15] A formally related work is Cuadra et al. (2010), in which optimal fiscal policy is studied in a production economy with access to international borrowing.

essentially symmetric: they only differ in that each of them gives more weight to the utility of its own constituency ("polarization")[16,17].

Their main contribution is to present a formal modelization of the political-economic stylized facts that economies with higher government turnover and higher polarization have higher default rates, and the respective sovereign interest rate spreads tend to be large and more volatile[18].

I extend their model by including the possibility of inviting a junior party to form a government coalition. This party is relatively more penalized in case of sovereign default; hence, its inclusion in the government reinforces the pledge for debt repayment, leading to lower interest rates. When the coalition commitment-buying effect dominates the redistributive effect of the coalition, it is optimal for a big party to invite a junior party to form a coalition government.

I model the general income loss after default in the way proposed by Arellano (2008).

The next section presents the model in detail.

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[16] Models in which there are two different types of government, which differ only in their level of impatience, can be found in Cole et al. (1995), Alfaro and Kanczuk (2005), and D'Erasmo (2011). In these contributions, however, the different governments do not correspond to any different constituencies in society, and, thus, redistribution and polarization are out of their scope. Amador (2012) does model different groups in society, but government does not change as there are neither parties nor elections.

[17] The term "polarization" also applies to political parties having different preferences over an ideological continuum. Alesina and Perotti (1995) review the contributions that model the impact of such polarization on budget deficits.

[18] Alesina and Perotti (1995) review papers that link high polarization, and high turnover to larger debts.

1.2 The model

This section describes the model. I extend the framework in Cuadra and Sapriza (2008), which builds on Eaton and Gersovitz (1981) and Arellano (2008), by including the possibility of coalition governments.

1.2.1 General setup

The economy is characterized as small and open, while the political regime is parliamentary and democratic. Being small and open, it is a price-taker in international credit markets, and international creditors are able to punish the economy should sovereign default take place.

Being democratic and parliamentary, there are elections, in which the party or parties holding power change, and there is in every period a probability that the government steps down, which can be thought of as the consequence of a legislative vote of no confidence.

There are three political constituencies in society, which are represented by three political parties. Two of the parties rotate as the most-voted party, and therefore are referred as the "big parties"; these are indexed as A and B.

The third party, which I call "junior" or "small" party, and which is indexed as J, always ranks as the third most-voted party, and only enters the government at the invitation of the incumbent big party[19].

[19] In Portugal since 1974, for example, there have been two big parties, Partido Socialista, and Partido Social Democrata, and one smaller party, Centro Democrático Social (CDS), which has participated in many coalitions with both of the first two. CDS has not, however, always been the third party in terms of representation in the parliament, having taken also the fourth and fifth positions.

There are, hence, four possible government compositions: single-party government of A; the coalition of A with J; single-party government of B; and the coalition of B with J. The "grand coalition" is thus ruled out. Governments are represented by the indeces A, AJ, B, and BJ respectively.

In every period, nature determines the income level, y, which follows a Markov process $Q(y'|y)$. The government, whether single-party or coalition, decides on the redistribution among the three constituencies in society; on repaying or defaulting on its debt; and on borrowing.

Governments are able to sell a one-period non-contingent bond in the international market. Should sovereign default take place, the economy will face exclusion from the market, suffer an income loss, and the constituency of the small party incurs a specific default cost.

Default and repayment have distributional consequences[20]. For example, debt repayment may force governments to apply austerity measures the impact of which may be more strongly felt by some groups of people than by others. Tomz and Wright (2013) survey the empirical literature on sovereign debt and default and find that austerity is especially damaging to government employees, the unemployed and the poor[21]. Support for default is stronger among those groups, while people with low discount rates, people with large investment assets, and those enjoying a high level of job security tend to prefer debt repayment (Tomz, 2004, and Curtis et al., 2012).

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[20] Cfr. footnote 2.

[21] Cfr. references in Tomz and Wright (2013).

From this evidence, it is justified to represent the people with a clear interest in repayment as a specific political constituency, and to assume that such constituency is smaller than the groups favoring default. Moreover, the junior party may be thought of as a single-issue party, and these are usually small.

The period utility function of the representative citizen is the same across all social constituencies, and it takes the CRRA form:

$$u(C) = \frac{C^{1-\eta} - 1}{1 - \eta} \tag{1.1}$$

in which C is consumption level, and η is the risk-aversion parameter.

Citizens and parties discount the future at the same rate $\beta \in (0, 1)$.

1.2.2 Parties and governments

There is symmetry between the two big parties, which allows me to focus exclusively on one of them. Let that be A.

Each big party cares relatively more about its own social constituency. The junior party is the least valued by each of the big parties. The period utility of *big party A* is given by

$$\overline{\theta} u(C_A) + \underline{\theta} u(C_B) + \theta_J u(C_J) \tag{1.2}$$

with $\overline{\theta} > \underline{\theta} > \theta_J > 0$, $\overline{\theta} \in (0.5, 1]$, and $\overline{\theta} + \underline{\theta} + \theta_J = 1$.

There is a difference between parties and governments. When a big party steps down, and a new big party steps in, the new incumbent has the choice of inviting the junior party

to form a coalition. If the new incumbent opts to remain a single-party government, the period utility of the *government* coincides with the period utility of the big party.

If the junior party is invited, a coalition government is formed. The period utility of the *coalition government* composed of the big party A and the junior party when there is access to markets is given by

$$\left(\overline{\theta} - \xi_1\right) u(C_A) + \left(\underline{\theta} - \xi_2\right) u(C_B) + \left(\theta_J + \xi_1 + \xi_2\right) u(C_J) \tag{1.3}$$

with $\xi_1 \in [0, \overline{\theta})$, and $\xi_2 \in [0, \underline{\theta})$.

The parameters ξ_1 and ξ_2 are the political premia the junior party gets by being included in the coalition[22]. They are thus *transfer of power* parameters. After power is transferred, the two bigger parties must remain with some strictly positive power.

I assume symmetry in the sense that the transfer of power from the incumbent big party, whether that is party A or B, is always ξ_1, and the transfer of power from the party out of the coalition, let that be A or B, is always ξ_2.

The θs together with the ξs can be seen, thus, as representing the relative power of the social constituencies within the executive body. The political premia tilts redistribution in favor of the junior party's constituency, and away from the two bigger constituencies.

It is important to stress that all government decisions - redistribution, borrowing, default or repayment - are taken by the *government*. Hence, in case of coalition government,

[22] A political party's influence in the executive body is thus non-monotonic in the vote share: the third-most-voted party, if it is included in the cabinet, may enjoy more power than the second-most-voted party (Drazen, 2000).

those decisions are the result of the maximization of equation (1.3) and the corresponding coalition government continuation value.

When there is single-party government, and the incumbent big party considers the formation of a coalition, it foresees the optimal policies of the coalition, and then evaluates those policies using its own preference parameters, which are given in equation (1.2). This evaluation is then compared with the value of continuing as a single-party government.

To maintain consistency, the coalition of A with J evaluates all possible scenarios using the weights in (1.3). Besides that coalition, there are three other possible government compositions: big party A is alone in government; big party B forms a single-party government; big party B forms a coalition with J. Hence, the θs and ξs can also be seen as the parameters of the "true social preferences" of the coalition.

1.2.3 Access to markets and autarky

The first part of this section follows Arellano (2008) almost strictly.

The economy may have access to international borrowing markets, a situation represented by the index crd; or it may be in autarky, with index aut. Governments are price-takers in the international borrowing market.

As long as the economy retains access to international credit markets, the budget constraint of the government is

$$C_A + C_B + C_J = y + B - q^i(B'; y, M)B' \tag{1.4}$$

where C_A, C_B, and C_J are the consumption levels awarded to the three social constituencies; B is the stock of assets at the beginning of the period; $-B'$ is the level of new bonds issued; $q^i(B';y,M)$ with $i = A, AJ, B, BJ$ is the bond price function faced by government i, which depends on the level of funds demanded, and on the values the state variables take in the beginning of the period (these are defined below). If one unit of bonds is sold, $B' = -1$, and government's revenue is $-q^i(B';y,M)B' = q^i(B';y,M)$.

If a government defaults on its stock of debt, the economy is excluded from borrowing during that period. The budget constraint is then

$$C_A + C_B + C_J = y^{aut} \tag{1.5}$$

where aut is the index for the autarky case. During autarky, the economy suffers a GDP loss, which I will also call "general default cost": $y^{aut} = h(y) \leq y$, where $h(y)$ is an increasing function:

$$h(y) = \begin{cases} \widehat{y} \text{ if } y > \widehat{y} \\ y \text{ if } y \leq \widehat{y} \end{cases} \tag{1.6}$$

with $\widehat{y} = \phi E[y]$, where $\phi \in (0,1)$ is the default GDP cost parameter, and $E[y]$ is the long-term expected value of GDP (under permanent access to credit markets).

During periods of autarky, the constituency of the small party suffers a specific default cost. This is modelled as an ex post proportional reduction in the level of consumption awarded to that constituency. Should constituency J receive consumption level C_J, in autarky it will actually consume γC_J, with $\gamma \in (0,1)$[23].

[23] The utility of the junior party is thus $\left((\gamma C_J)^{1-\eta} - 1\right)/(1-\eta)$ in the cases of default and autarky.

Both types of government, single-party and coalition, must take that cost into account. Hence, in the period default occurs, and in periods of autarky, the period utility of a government composed only of big party A becomes

$$\overline{\theta}u(C_A) + \underline{\theta}u(C_B) + \theta_J u\left(\gamma C_J\right) \tag{1.7}$$

while the period utility of the coalition government formed by the big party A and the junior party is given by

$$\left(\overline{\theta} - \xi_1\right) u(C_A) + \left(\underline{\theta} - \xi_2\right) u(C_B) + \left(\theta_J + \xi_1 + \xi_2\right) u\left(\gamma C_J\right). \tag{1.8}$$

Note that there is a certain asymmetry between the two types of default cost. The specific default cost is felt whenever the economy is in default; the general default cost is only felt when the GDP is above the threshold $\widehat{y}$. For instance, if the threshold corresponds to the average level of GDP, the general cost will not apply when the economy is experiencing low GDP, while the specific cost will be effective nonetheless.

As there is at least one active cost during default and autarky, this model should be able to generate higher levels of debt than Arellano's (2008)[24].

In autarky, the government decides only on redistribution, which is a static decision. Given a fixed allocation $\{C_A, C_B, C_J\}$, the specific default cost γ only hurts constituency J. Governments, however, consider that cost when choosing the optimal consumption allocation, and its effect is to tilt redistribution towards J, in order to partially compensate it for the cost.

[24] In my model, the mean debt to GDP ratio is 16.28%, while in Arellano (2008) it is 5.95%. These results are not fully comparable (cfr. General business cycle statistics section, in particular footnote 39).

This means that the specific default cost γ also hurts constituencies A and B through a change in the redistribution of income.

Clearly, even though redistribution is tilted towards J in autarky, this constituency will *effectively* consume *less* than when there is access to markets (keeping everything else the same, i.e., keeping the same amount of available resources, and the same government structure).

After a period in autarky, the economy may reenter international credit markets with probability $\mu \in (0, 1)$.

1.2.4 Political dynamics and timing

In every period, there is the possibility of government change, or *turnover*. This can be thought of as being caused by the regular schedule of elections; the approval of a no-confidence vote in the legislative body, followed by new elections; the incumbent party strategically deciding for the anticipation of elections, etc..

In any case, it is assumed that whenever a government steps down, new legislative elections take place.

I begin with the case in which a government has just left. When this happens, both the big party and the smaller party (should there be a coalition) leave the government, and the other big party steps in.

Nature determines the legislative support of the new big incumbent: it wins elections with a legislative majority (indexed as maj) with probability $\sigma \in (0, 1)$, or it wins with

only minority support (min) with probability $1-\sigma$. Winning a majority means the big party has the support of fifty per cent plus one members of the legislative body.

The new incumbent may then invite the junior party to form a coalition. The junior party always accepts this offer, whether it comes from big party A or B. As the junior party gets more power once in the coalition, and as its presence there can only decrease the probability of default, it is always optimal to join a big party in government.

After the government is formed, its first decision is to repay previous debt (if there is any), or to default. If it decides on debt repayment, the next decision is on issuing new debt; and, afterwards, the government redistributes the available income, given by (1.4), across the three social constituencies. In case of default, the economy loses access to credit markets (autarky), and government redistributes the available income in (1.5). The period ends.

At the beginning of the following period, if the economy is in autarky, it regains access to credit with probability $\mu \in (0,1)$, or it continues to be excluded from borrowing with probability $1-\mu$. Then, nature determines the level of GDP according to the Markov process $Q(y'|y)$.

Nature also determines whether the incumbent big party stays in power, or steps down. The probability of staying in power is $\pi(maj)$, in case the big party has majority support in the legislative body, and $\pi(min)$ otherwise, with $1 > \pi(maj) > \pi(min) > 0$.

The probability a big party survives in power thus increases with legislative support. This is the case when governments face votes of confidence or no confidence in the legislative chamber. It is also the case in which there is some persistence in electoral results: if a

big party won the previous elections with a big voting share, it has a higher probability of winning the next elections.

If the big party survives in power, the type of support, maj or min, stays the same for the period.

I assume $\pi(.)$ is independent of government type, whether single-party or coalition. This is because I want to focus on coalition formation not as a means to enhance survivability in power, but as a debt repayment commitment device. Hence, $\pi(.)$ is the incumbent big party's survivability in power probability, not the government's.

Furthermore, the probability of staying in power does not depend on the previous decision of repaying or defaulting on debt[25]. While the dependence of $\pi(.)$ on that decision would seem realistic, it poses a theoretical difficulty, as well as an analytical one.

At the theoretical and also the empirical levels, it is not clear whether sovereign debt default reduces or increases a government's popularity. For instance, Tomz (2002) challenges the view that in democracies the people always prefer their leaders to repay foreign debt. Considering the on-going debt crises in Greece and Portugal, should the political dilemma be presented as "austerity vs. default", it is very far from clear what the popular decision would be. Likely, it would depend on how long and deep the crisis has been. In the beginning, people might not even consider a debt restructuring; after some years in recession, they might begin to cautiously consider default as an option. This occurred in Portugal in mid-March 2014, about three years into the austerity program.

[25] This is also assumed in Cuadra and Sapriza (2008).

Furthermore, the presence of a political cost of default would pose the analytical problem of disentangling the reasons for repaying the debt: repaying debt would allow borrowing today, and it would also enhance survivability in power relative to default[26].

After a big party has survived in power, and if there is a coalition government, then nature plays one more time: it either breaks or holds the coalition. Given the incumbent big party has a majority of its own in the legislative body, the government coalition holds with probability δ^{SP}; if the big party has only minority support, the coalition holds with probability δ^{MW}. In compact form:

$$\delta(M) = \begin{cases} \delta^{MW} \textit{ if } M = min \\ \delta^{SP} \textit{ if } M = maj \end{cases} . \tag{1.9}$$

These probabilities are such that $1 > \delta^{MW} > \delta^{SP} > 0$. Hence, δ^{MW} is the probability a *minimal-winning coalition* holds, whereas δ^{SP} is the same probability for the case of a *surplus coalition*. I assume the chance a coalition will hold is greater when the smaller party is necessary to guarantee majority support in the legislative body[27,28].

There are many implicit assumptions behind these δs, all of which warrant discussion.

First, while the big party decides whether or not to invite the junior party to form a coalition, once the coalition is formed, I assume that the big party cannot throw out the smaller party.

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[26] The popularity effects of default; the different default costs faced by different social constituencies; the importance of electoral survivability concerns when deciding to repay or default; and how duration in power is affected conditional on default, and on repaying are all promising avenues of future inquiry.

[27] For example, Lijphart (1984) uses data on democratic, developed countries to provide evidence that minimal-winning coalitions last longer than surplus coalitions.

[28] The minimal-winning coalition can also be considered a *strong coalition*, while the surplus coalition may be considered a *weak coalition*.

This assumption is necessary so that coalitions bring some commitment to debt repayment; otherwise, incumbent big parties would just dissolve the coalition whenever default would be optimal for them, but not for the coalition. Then, coalitions would have no effect on the commitment of the government to debt repayment. Furthermore, without such effect, and without any survival advantage from being in a coalition, big parties would never form coalitions in the first place.

In the model, there is thus no real commitment to debt repayment, but only to keeping intact the coalition once it has been formed. Whether or not this assumption is realistic is a research topic in itself. The empirical questions to be answered are: how often are coalitions dissolved by the initiative of the bigger party, and how often by the initiative of the junior party? Are there any political or institutional constraints forcing a big party to keep a coalition? Are these contraints always present, or do they appear only in those circumstances when the incentives for default become more intense? These questions are left for future research.

Second, it is always optimal for the junior party to join and remain in the government; however, I assume the coalition can break exogenously.

In the real world, coalitions break for many reasons, as there are many conflicting issues among political constituencies beyond redistribution, debt issuance, and repayment or default. These reasons are beyond the limits of the model. This policy multi-dimensionality is thus encapsulated in the assumption that coalitions break according to an exogenous probability.

Third, even though the junior party suffers a specific cost in case of default, and can thus be seen as the "pro-debt repayment-party", I assume that the probability that the coalition breaks does not depend on the decision to default.

This means the junior party does not punish the big party for the decision to default on sovereign debt, and also that the junior party is not electorally accountable, at least in a punitive way, for that specific decision[29]. Say, though having more political clout while being part of the government, the junior party is most likely not going to have the last word on the repayment-default decision. This would be the typical case in which both prime minister and finance minister belong to the bigger party.

Should the coalition hold, the government proceeds with its decisions, as stated above. Should the coalition break, I assume the incumbent big party holds onto power, ruling over the economy as a single-party government.

I assume that the same big party can invite the junior party to return to the government: after a coalition has broken, if the incumbent big party survives in power in the following period, it is allowed to form a coalition with the smaller party. Thus, after one coalition breaks, the duration of single-party government is at least one period, the same period in which the coalition broke, but the very same coalition can be formed in the immediate period[30].

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[29] For a discussion about how electoral accountability may differ across political parties belonging to the same coalition government, cfr. Bawn and Rosenbluth (2003).

[30] The more realistic assumption of no invite-backs, or invite-backs only possible after a given number of periods would add significantly to the technical complexity of the model.

1.2.5 Notes on impatience and time-inconsistent behavior

The mechanics of political turnover, represented by $\pi(maj)$ and $\pi(min)$, and of polarization, expressed in $\overline{\theta}$ and $\underline{\theta}$, work in the same way as in Cuadra and Sapriza (2008).

From the perspective of the incumbent big party, and also from the perspective of coalitions, turnover and polarization together lead to a lower "effective" discount factor ("impatience") in the sense that the future is more heavily discounted than in the cases of polarization with no turnover, and of turnover with no polarization (cfr. for instance Hatchondo and Martinez, 2010).

Moreover, Chatterjee and Eyigungor (2016) show that models of government spending with polarization and political turnover are isomorphic to an intertemporal choice problem with quasi-geometric discounting. It is well known that such discounting implies time-inconsistent behavior[31]. In the next paragraphs I discuss in which ways "impatience" and time-inconsistent behavior arise from the assumptions of the model.

An incumbent big party's uncertainty about duration in power together with a surely smaller share of total income once out of office leads to a high degree of *impatience*, that is, giving relatively more weight to present rather than future utility. A higher level of impatience implies an intense willingness to borrow and a higher propensity to default, keeping everything else the same.

It should be clear that political turnover without polarization, that is $\pi < 1$ and $\overline{\theta} = \underline{\theta}$, does not lead to a higher degree of impatience: as big parties get the same share of income whether they are in or out of the government, it is not optimal for the party in power to

[31] Frederick et al. (2002) present a critical survey of time discount of models.

significantly increase consumption today at the expense of low consumption in the future by either deciding on a large amount of borrowing today, or by defaulting in the present period.

Another factor contributing to a smaller "effective" discount rate is the risk of not regaining access to international financial markets after default, and after a period in autarky. However, without access to borrowing, it is not possible to trade present consumption for future consumption (and it is not possible to default when there is no debt). Hence, the extra impatience stemming from μ has no direct effect on the optimal policies. It only matters for impatience in the sense that a future default is less valuable as long as $\mu < 1$, and the value of default is part of the continuation value of a government's value function.

My paper introduces another factor which contributes to impatience: the junior party gets a bigger share of income (from ξ_1 and ξ_2) as long as it stays in office, but duration there is uncertain, as there is an exogenous probability of coalition breakage (δ). The consequence is that not only incumbent big parties rush to make the most out of being in office, but junior parties do so as well[32].

Moreover, from the junior party's perspective, uncertainty about survival in power comes not only from $\delta(maj)$ and $\delta(min)$, but also from $\pi(maj)$ and $\pi(min)$, as if the bigger party steps down and the coalition is dissolved, there is no guarantee that the junior party will return to office immediately, this time at the invitation of the newly elected big party.

[32] The decisions on consumption allocation, borrowing, and repayment or default are taken together by the big party and the junior party in the case of coalition government.

It should also be clear that there is no extra degree of impatience if there is a possibility that the junior party will leave the coalition, but there is no power transfer; that is, when at least one of π and δ is strictly less than one while ξ_1 and ξ_2 are both zero. In this case, it does not matter for the smaller party whether or not it is included in the government: its consumption share will be the same, and hence, the allocation decision will not change in moving from single-party government to coalition government.

Turning again to the bigger political parties, there is no extra impatience when there is polarization, but not turnover; that is, $\overline{\theta} \neq \underline{\theta}$ and $\pi = 1$. Then, the big incumbent is in no rush to get the most from being in office because it will never step down and end up getting a smaller share of income.

A similar logic applies to the junior party: if at least one of ξ_1 and ξ_2 is strictly bigger than 0 and $\pi = \delta = 1$, there is no such rush because even though the junior party would get less in the case it left the government, this case never happens: after a coalition is formed, it would never break.

There is still another element of coalition impatience. If there is default or autarky, and if there is either a single-party government, or the coalition has just broken, then the agent "A with J" (and also the agent "B with J") knows a new coalition will not be formed until at least the economy regains access to credit markets. This is because it cannot be optimal to form a coalition during autarky, as will be later argued.

Hence, a coalition also needs to make the most of its time in power because it foresees that, should default take place, and the coalition be dissolved for some (exogenous) reason, it may be a relatively long time before the coalition is again in power.

The parameter μ, then, contributes to impatience as long as it is less than 1: if it is 1, the economy is able to borrow again already in the first period after default, and this possibility reactivates the incentive for coalition formation.

Time-inconsistencies arise at least in two ways. First, directly from turnover and polarization, in a similar way to the workings of the models of Cuadra and Sapriza (2008), and, for example, of Alesina and Tabellini (1990). Since the incumbent party doesn't know whether it will still be in power in the next period, it has an incentive to trade present consumption for future consumption, which is done through indebtedness. However, should it survive in power, its "future self" finds itself burdened by too much debt.

Also, for a combination of very low probabilities of survival in power, a very large degree of polarization, and large debt, the temptation to default is very high. However, in the case the defaulting government actually stays in power in the following period, its "future self" will not find optimal to having defaulted in the first place.

Furthermore, time-inconsistent preferences arise also from the other parameters (the δs and the μ) that enter the "effective" discount factors, that is, those factors which multiply terms belonging to the continuation value in an agent's value function. Because of those parameters, "effective" discount factors do not form a geometric sequence, and, hence, time-inconsistent preferences arise.

The second manifestation of time-inconsistent preferences can be better understood by considering a two-period version of the model. Considering the state variables in the first period, it may be optimal for a big party to form a coalition. However, since there can be no borrowing in the second period, the first period decision to form a coalition is never optimal from the perspective of the "future self" of the big party.

1.2.6 Political transition probabilities

I model the interaction between legislative power and executive power as the combination of two binary variables: $M = maj$ or min, and $G = sin$ or coa. The first of these variables describes whether the incumbent big party enjoys a majority of its own in the legislative chamber; G describes the structure of the executive body: single-party or coalition. This gives rise to four possible legislative-executive power combinations: single-party minority, (min, sin); single-party majority, (maj, sin); minimal-winning coalition, (min, coa); and surplus coalition, (maj, coa).

The motion from states (M, G) to (M', G') depends on exogenous probabilities, and on the future decision to form a coalition, which itself is dependent on the future level of income (y') and on the borrowing level decided on the present period (B'). This level depends on present period income (y) and debt (B).

Let

$$P^{i}_{MG,y,M'G'} \equiv \Pr\left[M', G' | i, M, G, y\right] \tag{1.10}$$

be the probability of moving to states (M', G') conditional on present period political states being (M, G), income being y, and agent i being in power, $i = A, AJ, B, BJ$. For economy

of notation, I do not indicate the dependence on the level of debt. There are sixteen such probabilities.

These probabilities are needed as components for deriving the (present-period) probability of (next-period) sovereign default. Hence, I only derive them for the state in which the economy has access to foreign credit.

The complete set of probabilities can be found in Appendix B; for illustration purposes, I derive in this section the probability of moving from (maj, sin) to (maj, sin), and the probability of moving from (maj, coa) to (maj, sin).

Let

$$\Gamma^i(y, B, M) = \begin{cases} 1 \textit{ if coalition} \\ 0 \textit{ otherwise} \end{cases} \quad \textit{where } i = A, B \tag{1.11}$$

be some coalition formation rule.

Then, the political transition probability $P^i_{(maj,sin,y),(maj',sin')}$ when agent i is in power, with $i = A, B$, is:

$$\begin{aligned} P^i_{(maj,sin,y),(maj',sin')} &\equiv \Pr\left[maj', sin' | i, maj, sin, y\right] = \\ &= \sum_{y'} Q(y'|y) \left\{ \begin{array}{c} \pi(maj) \times ... \\ ... \times [1 - \Gamma^i(y', B'^i, maj)] + ... \\ ... + [1 - \pi(maj)] \times ... \\ ... \times \sigma \times [1 - \Gamma^j(y', B'^i, maj)] \end{array} \right\}. \end{aligned} \tag{1.12}$$

Since the present-period government is single-party, the agent in charge can only be A or B, not AJ, and not BJ. The coalition-formation decision in the following period depends on present-period choice of bonds, B', and on GDP level, y', which in turn depends on present-period GDP, y.

If the incumbent big party survives in power, their type of legislative support, maj or min, stays the same by assumption; and the type of government, single-party or coalition, remains sin depending on decision $\Gamma^i(y', B'^i, maj)$.

If the incumbent steps down, the new big party in government will enjoy a majority with probability σ. Its decision whether or not to form a coalition, $\Gamma^j(.)$, depends on the stock of bonds decided by the previous incumbent, B'^i.

In the case of a symmetric equilibrium, $\Gamma^A(.) = \Gamma^B(.) \equiv \Gamma(.)$. Then, the above probability can be simplified to

$$P^i_{(maj,sin,y),(maj',sin')} = [\pi(maj) + (1 - \pi(maj)) \times \sigma] \sum_{y'} Q(y'|y) \left[1 - \Gamma(y', B'^i, maj)\right]. \tag{1.13}$$

The probability of moving from (maj, coa) to (maj, sin) in a symmetric equilibrium, with $i = AJ, BJ$, is:

$$\begin{aligned} P^i_{(maj,coa,y),(maj',sin')} &= \pi(maj)\left(1 - \delta(maj)\right) + ... \\ &\quad ... + (1 - \pi(maj)) \times \sigma \sum_{y'} Q(y'|y) \left[1 - \Gamma(y', B'^i, maj)\right]. \end{aligned} \tag{1.14}$$

In moving from coalition government to single-party government, there are two possibilities: either the incumbent big party survives, and the coalition breaks, with the probability of coalition breakage being $1 - \delta(maj)$; or a power reshuffle takes place, and the new incumbent does not form a coalition.

1.2.7 Foreign lenders

Here, I make the same assumptions as in Arellano (2008) and Cuadra and Sapriza (2008) with regard to the international credit market.

Foreign lenders are risk-neutral; have access to a risk-free rate r_f; have perfect information with respect to all the state variables and parameters of the economy; and carry their activity in a perfectly competitive setting.

Hence, in equilibrium, and considering default risk, the price of the one-period non-contingent bond is such that expected profits are zero:

$$q^i(B';y,M) = \frac{1-\lambda^i(B';y,M)}{1+r_f} \tag{1.15}$$

for $i = A, AJ, B, Bj$, where $\lambda^i(B';y,M)$, for $i = A, AJ, B, BJ$, is today's probability of sovereign default tomorrow, which depends on bonds sold in the present period, and on the state variables (more about the probability of default below).

The bond price is indexed to the government composition. This means that I allow bond prices to depend not only on states $M = maj$ or min, and $G = sin$ or coa, but

also on which of the two big parties holds power[33]. It also allows for a little notational parsimony, as an explicit indication of the state G can be avoided.

1.2.8 Probability of sovereign default

The (present-period) probability of (next-period) sovereign default, $\lambda(.)$, is only meaningful when the economy has access to foreign lending markets. It depends on the exact government composition, on the corresponding sovereign default and debt issuance decision rules, and on the political transition probabilities. Formally, $\lambda^i = \lambda^i(B'; y, M)$, $i = A, AJ, B, BJ$ (it does not depend on the stock of debt inherited from the previous period).

Let

$$D^i(y, B, M) = \begin{cases} 1 \textit{ if default} \\ 0 \textit{ otherwise} \end{cases} \quad \textit{where } i = A, AJ, B, BJ \tag{1.16}$$

be some sovereign default rule (as in equation 1.15, there is no need to explicitly indicate the dependence on G).

Besides the condition for a symmetric equilibrium stated in the previous section, I add the symmetry condition that $D^i(.) = D^j(.) \equiv D(., sin)$ for $i = A$ and $j = B$, and that $D^i(.) = D^j(.) \equiv D(., coa)$ for $i = AJ$ and $j = BJ$. In a symmetric equilibrium, the default decision is the same for the two possible single-party governments, and it is the same for the two possible coalition governments.

[33] In a symmetric equilibrium, the bond price for the single-party government case is the same whether it is A or B the party holding power, and similarly for the coalition government case.

When agent i is in charge in the present period, with $i = A, AJ, B, BJ$ (and the state G being consistent with i), the probability of sovereign default in a symmetric equilibrium is

$$\lambda^i(B'; y, M) = \sum_{y'} Q(y'|y) \times ... \\ ... \times \begin{bmatrix} P^i_{(M,G,y),(maj',sin')} \times D(y', B', maj, sin) + ... \\ ... + P^i_{(M,G,y),(min',sin')} \times D(y', B', min, sin) + ... \\ ... + P^i_{(M,G,y),(maj',coa')} \times D(y', B', maj, coa) + ... \\ ... + P^i_{(M,G,y),(min',coa')} \times D(y', B', min, coa) \end{bmatrix}. \tag{1.17}$$

The probability of sovereign default is a function of B', y, M and G. It is the average decision to default weighted by the conditional probabilities of reaching the different legislative-executive power combinations, and by the conditional probabilities of reaching different GDP levels.

1.2.9 Summary

Nature plays first: if the economy is in autarky, nature determines whether or not the economy regains access to the market; nature sets the GDP level for the period; it lets the incumbent big party survive in power, or brings a new party in; if there is a new incumbent in government, nature decides which legislative support it will enjoy in the parliament, majority or minority; in case the previous incumbent survived, and a coalition had been formed, nature keeps or breaks the coalition.

After these moves, a newly elected big party decides to form a coalition or stay as single-party government; if there is any debt from previous periods, the big party alone, or the coalition decides to redeem or default; finally, if possible, government decides how much to borrow, and how to redistribute the available resources.

In case a big party has survived from the previous period, and whether there is single-party or a coalition, the government takes decisions in the same sequence: if applicable, defaulting or not; if possible, borrowing; and redistribution.

Figures in Appendix C present the timing of play in extensive form.

1.3 Equilibrium

1.3.1 Evaluation of scenarios

At any given period, the economy is characterized by a combination of different states: GDP level, y; stock of foreign debt, B; the state of having access to credit, or being in autarky, $A = crd$ or aut; the support enjoyed by the incumbent big party in the legislative body, $M = maj$ or min; and the type of executive power, single-party government or coalition, $G = sin$ or coa.

As big parties are symmetric, I keep my focus on party A. I use the following conventions: the superscript of a value function determines whose agent it is; a subscript indicates the composition of the government; R refers to debt redemption, D to sovereign default; S to single-party government, C to coalition government.

For example, $VD_B^{AJ}(.)$ is how much the coalition of A with J (superscript) values the scenario in which party B (subscript) is in government and has just decided to default. Such value functions are necessary when the coalition of A and J considers the possibility of being out of power.

There are thus *direct* value functions, and *cross* value functions: the former are the value functions of agent i when i itself is in power; the latter are i's value functions when j is in power, with $i \neq j$.

As four different government compositions are possible, there are also four different agents in the polity: A alone, A with J, B alone, and B with J.

Each of those agents must evaluate the *value of debt repayment*, and the *value of default*, when each of the four possible government compositions is in place, and given any combination of the states y, B, and M. This leads to a set of thirty-two basic value functions, corresponding to the last branches of the game tree (cfr. table A1 in Appendix A, and figures in Appendix C)[34].

Those value functions are

$$VR_j^i(.) \text{ and } VD_j^i(.) \text{ with } i, j = A, AJ, B, BJ. \tag{1.18}$$

At a higher level, corresponding to the previous moment in the time structure of the model, each agent has to evaluate *having the option itself* between default or payback, when that option is held by any of the four possible governments.

[34] Because of symmetry, only sixteen of these value functions are needed when solving the model with a computer.

This option corresponds to the maximum of a pair of basic value functions, one for default, the other for repayment. It is, thus, the *value of coalition*, or the *value of single-party government*, across the four possible government types, and evaluated by each of the four possible agents, given any combination of states (y, B, M) (cfr. table A2 in Appendix A, and figures in Appendix C)[35].

Formally, the value functions are

$$VS_j^i(.) \text{ with } i = A, AJ, B, BJ, \; j = A, B \tag{1.19}$$

and

$$VC_j^i(.) \text{ with } i = A, AJ, B, BJ, \; j = AJ, BJ. \tag{1.20}$$

Since default is not a possible choice while in autarky, the value of having the option to pay back or to default collapses, during autarky, into the respective value of default.

In a yet earlier moment, which occurs immediately after nature has played her moves, a big party that finds itself as the sole member of government decides whether or not to form a coalition.

The value of this option corresponds to the maximum between the value of coalition, and the value of single-party government (cfr. table A3 in Appendix A, and figures in Appendix C). It is thus the value itself of holding onto power given access to credit. Since it is never optimal to form a coalition during autarky, as it will be argued below, the value of holding onto power in autarky corresponds to the respective value of having decided to default[36].

[35] At this level, there are sixteen such value functions; because of symmetry, only eight are needed for solving the model.

[36] There are eight value functions at this level, and, due to symmetry, only four are used when solving the

The decision to form a coalition or not is evaluated by the four different agents. Formally,

$$V_j^i(.) \textit{ with } i = A, AJ, B, BJ \textit{ and } j = A, B. \tag{1.21}$$

Appendix A summarizes the value functions which were used to solve the model. I omit the value functions from the perspectives of party B, and of B with J because those functions are symmetric to the ones presented.

The next two sections show the basic value functions from the perspective of big party A alone, and from the perspective of the coalition of A with J.

Value of repayment, and value of default: big party perspective

The value for big party A of paying the extant debt, when the only party in government is A itself, is given by:

$$\begin{aligned} VR_A^A(y, B, M) = & \max_{C_A, C_B, C_J, B'} \overline{\theta} u(C_A) + \underline{\theta} u(C_B) + \theta_J u(C_J) + ... \\ ...+\beta \sum_{y'} Q(y'|y) & \left[\pi(M) V_A^A(y', B', M) + (1 - \pi(M)) \begin{pmatrix} \sigma V_B^A(y', B', maj) + ... \\ ... + (1 - \sigma) V_B^A(y', B', min) \end{pmatrix} \right] \\ & \textit{s.to } C_A + C_B + C_J = y + B - q^A(B'; y, M) B'. \end{aligned} \tag{1.22}$$

The first line of this expression is the period utility, which depends on consumption shares; these depend on the available resources, determined by the budget constraint, which itself depends on new debt issued.

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model with a computer.

The second term on the right-hand side of the equation is the continuation value. The level of GDP in the following period depends on the present GDP level, according to the Markov process $Q(y'|y)$. In that period, big party A's probability of surviving in power is $\pi(M)$. Should it survive, it will have the chance to choose between forming a coalition or keeping its own single-party government. The value of this option is $V_A^A(y', B', M)$.

In case big party A steps down from office, with probability $(1 - \pi(M))$, big party B will step in. Party B wins elections with a majority of its own with probability σ, and then chooses between single-party government, or coalition government. The value of this option *as seen by big party* A is $V_B^A(y', B', maj)$. Similarly, when big party B wins elections with only minority support, the value of choosing government type *from the perspective of party* A is $V_B^A(y', B', min)$.

The value of sovereign default for party A when A's single-party government is in power is given by:

$$VD_A^A(y, M) = \max_{C_A, C_B, C_J} \overline{\theta} u(C_A) + \underline{\theta} u(C_B) + \theta_J u(\gamma C_J) + ...$$

$$... + \beta\mu \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) V_A^A(y', 0, M) + ... \\ \\ ... + (1 - \pi(M)) \left(\begin{array}{c} \sigma V_B^A(y', 0, maj) + ... \\ \\ ... + (1 - \sigma) V_B^A(y', 0, min) \end{array} \right) \end{array} \right] ...$$

$$... + \beta (1 - \mu) \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) VD_A^A(y', M) + ... \\ \\ ... + (1 - \pi(M)) \left(\begin{array}{c} \sigma VD_B^A(y', maj) + ... \\ \\ ... + (1 - \sigma) VD_B^A(y', min) \end{array} \right) \end{array} \right]$$

s.to. $C_A + C_B + C_J = y^{aut}$.

(1.23)

This expression is similar to the previous one. The main differences are that the stock of present debt is dropped, and the resources available to the economy are only y^{aut}, as the economy suffers a GDP cap à la Arellano, and the government cannot issue new debt.

The continuation value now has two parts: the first part corresponds to the case in which the economy reenters borrowing markets in the following period, with probability μ. In that case, whichever big party holds office, it will face the possibility of creating a coalition, while not having to pay any previous debt, hence the zeros.

The second part of the continuation value is the scenario in which the economy remains in autarky, with probability $1 - \mu$. The value of that situation for big party A when it stays in power is $VD_A^A(y', M)$, which is the value of default with updated GDP level. During autarky, it cannot be optimal to form a coalition, thus, the value of choosing between government types collapses to the value of default.

The last line before the budget constraint is the case of power change. Similarly, under autarky, it will not be optimal for the new governmental incumbent to form a coalition.

The value of repayment, and the value of default for big party B, when this is the only party in government, are given by $VR_B^B(y, B, M)$, and $VD_B^B(y, M)$. These value functions are symmetric to the ones above (one only needs to interchange the "A"s and the "B"s).

Big party A also evaluates default and repayment when it is B the party in power. The value of repayment for big party A when big party B is the sole party in government is:

$$VR_B^A(y,B,M) = \overline{\theta}u(C_A^{*B}) + \underline{\theta}u(C_B^{*B}) + \theta_J u(C_J^{*B}) + ...$$

$$... + \beta \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) V_B^A(y', B'^{*B}, M) + ... \\ \\ ... + (1-\pi(M)) \left(\begin{array}{c} \sigma V_A^A(y', B'^{*B}, maj) + ... \\ \\ ... + (1-\sigma) V_A^A(y', B'^{*B}, min) \end{array} \right) \end{array} \right] \tag{1.24}$$

where $\left\{C_A^{*B}, C_J^{*B}, C_B^{*B}\right\}$ and B'^{*B} are the optimal decisions taken by the government of party B, which maximizes $VR_B^B(y,B,M)$. Note that the weights in the first line correspond to A's preferences, as this value function pertains to that party, and not to the agent in power (B).

From the perspective of party A, the value of party B having the choice of government type in the following period is $V_B^A(y', B'^{*B}, M)$. Should party B step down from government in that period (this happens with probability $1-\pi(M)$), party A steps in and chooses government type. In that scenario, party A will face a stock of debt equal to B'^{*B}.

In a similar way, the value of default from the perspective of party A, when party B is in charge is given by:

$$VD_B^A(y,M) = \overline{\theta}u(C_A^{aut*B}) + \underline{\theta}u(C_B^{aut*B}) + \theta_J u(\gamma C_J^{aut*B}) + ...$$

$$... + \beta\mu\sum_{y'}Q(y'|y)\left[\begin{array}{c} \pi(M)V_B^A(y',0,M) + ... \\ ... + (1-\pi(M))\left(\begin{array}{c} \sigma V_A^A(y',0,maj) + ... \\ ... + (1-\sigma)\,V_A^A(y',0,min) \end{array}\right) \end{array}\right] ...$$

$$... + \beta\,(1-\mu)\sum_{y'}Q(y'|y)\left[\begin{array}{c} \pi(M)VD_B^A(y',M) + ... \\ ... + (1-\pi(M))\left(\begin{array}{c} \sigma VD_A^A(y',maj) + ... \\ ... + (1-\sigma)\,VD_A^A(y',min) \end{array}\right) \end{array}\right]$$

(1.25)

where $\left\{C_A^{aut*B}, C_J^{aut*B}, C_B^{aut*B}\right\}$ is the optimal redistribution under autarky, decided by the government of party B, which maximizes $VD_B^B(y,M)$.

Big party B's evaluation of big party A's repayment and default decisions are $VR_A^B(y,B,M)$, and $VD_A^B(y,M)$; they are symmetric to the two previous equations.

The big party A also evaluates the decisions taken by the *coalition* of itself with J, and the coalition of B and J. The value of debt redemption, in the perspective of A, when such decision is taken by the coalition government of A and J is:

$$VR^{A}_{AJ}(y,B,M) = \overline{\theta}u\left(C^{*AJ}_{A}\right) + \underline{\theta}u\left(C^{*AJ}_{B}\right) + \theta_{J}u\left(C^{*AJ}_{J}\right) + ...$$

$$... + \beta\sum_{y'}Q(y'|y)\left[\begin{array}{c} \pi(M)\left(\begin{array}{c} \delta(M)VC^{A}_{AJ}(y',B'^{*AJ},M) + ... \\ \\ ... + (1-\delta(M))VS^{A}_{A}(y',B'^{*AJ},M) \end{array}\right) \\ \\ ... + (1-\pi(M))\left(\begin{array}{c} \sigma V^{A}_{B}(y',B'^{*AJ},maj) + ... \\ \\ ... + (1-\sigma)\,V^{A}_{B}(y',B'^{*AJ},min) \end{array}\right) \end{array}\right] \tag{1.26}$$

where $\left\{C^{*AJ}_{A}, C^{*AJ}_{J}, C^{*AJ}_{B}\right\}$ and B'^{*AJ} are the optimal decisions taken by the government of parties A and J, which maximize $VR^{AJ}_{AJ}(y,B,M)$.

In the case that party A stays in power in the following period, the coalition holds with probability $\delta(M)$. Should this happen, the coalition will have the option of repayment or default. The value of this option from party A's perspective is $VC^{A}_{AJ}(y',B'^{*AJ},M)$.

If party A stays in power, and the coalition breaks, big party A will have to rule the economy as a single-party government. The value of this situation is given by $VS^{A}_{A}(y',B'^{*AJ},M)$.

The value of default, from the perspective of A, with A and J in government is:

$$
\begin{aligned}
VD^{A}_{AJ}(y,M) &= \overline{\theta}u(C^{aut*AJ}_{A}) + \underline{\theta}u(C^{aut*AJ}_{B}) + \theta_{J}u(\gamma C^{aut*AJ}_{J}) + ... \\
&... + \beta\mu\sum_{y'}Q(y'|y)\left[\begin{array}{l}
\pi(M)\left(\begin{array}{c}\delta(M)VR^{A}_{AJ}(y',0,M) + ... \\ \\ ... + (1-\delta(M))VR^{A}_{A}(y',0,M)\end{array}\right) + ... \\ \\
... + (1-\pi(M))\left(\begin{array}{c}\sigma V^{A}_{B}(y',0,maj) + ... \\ \\ ... + (1-\sigma)\,V^{A}_{B}(y',0,min)\end{array}\right)
\end{array}\right] ... \\
&... + \beta\,(1-\mu)\sum_{y'}Q(y'|y)\left[\begin{array}{l}
\pi(M)\left(\begin{array}{c}\delta(M)VD^{A}_{AJ}(y',M) + ... \\ \\ ... + (1-\delta(M))VD^{A}_{A}(y',M)\end{array}\right) + ... \\ \\
... + (1-\pi(M))\left(\begin{array}{c}\sigma VD^{A}_{B}(y',maj) + ... \\ \\ ... + (1-\sigma)\,VD^{A}_{B}(y',min)\end{array}\right)
\end{array}\right]
\end{aligned}
\tag{1.27}
$$

where $\left\{C^{aut*AJ}_{A}, C^{aut*AJ}_{J}, C^{aut*AJ}_{B}\right\}$ is the optimal redistribution under autarky, decided by the coalition of A and J, which maximizes $VD^{AJ}_{AJ}(y,M)$.

After a default, and if the economy regains access to credit markets, default is not an option and, thus, the value functions for that situation are *formally the same* as the value functions for the redemption case, with B set to 0: $VR^{A}_{AJ}(y',0,M)$, in the case of the coalition holding, and $VR^{A}_{A}(y',0,M)$, in the case of the coalition breaking.

The other big party also evaluates the decisions of repayment and default when such decisions are taken by a coalition in which it takes part: $VR^{B}_{BJ}(y,B,M)$, and $VD^{B}_{BJ}(y,B,M)$, which are similar to the two value functions just presented.

Finally, big party A evaluates the decisions of the coalition of B and J. The value of paying back debt is:

$$VR^A_{BJ}(y,B,M) = \overline{\theta}u\left(C^{*BJ}_A\right) + \underline{\theta}u\left(C^{*BJ}_B\right) + \theta_J u\left(C^{*BJ}_J\right) + ...$$
$$... + \beta\sum_{y'}Q(y'|y)\left[\begin{array}{c} \pi(M)\left(\begin{array}{c}\delta(M)VC^A_{BJ}(y',B'^{*BJ},M) + ... \\ \\ ... + (1-\delta(M))VS^A_B(y',B'^{*BJ},M)\end{array}\right) + ... \\ \\ ... + (1-\pi(M))\left(\begin{array}{c}\sigma V^A_A(y',B'^{*BJ},maj) + ... \\ \\ ... + (1-\sigma)\,V^A_A(y',B'^{*BJ},min)\end{array}\right)\end{array}\right] \tag{1.28}$$

and the value of default is:

$$VD^A_{BJ}(y,M) = \overline{\theta}u\left(C^{aut*BJ}_A\right) + \underline{\theta}u\left(C^{aut*BJ}_B\right) + \theta_J u\left(\gamma C^{aut*BJ}_J\right) + ...$$
$$... + \beta\mu\sum_{y'}Q(y'|y)\left[\begin{array}{c} \pi(M)\left(\begin{array}{c}\delta(M)VR^A_{BJ}(y',0,M) + ... \\ \\ ... + (1-\delta(M))VR^A_B(y',0,M)\end{array}\right) + ... \\ \\ ... + (1-\pi(M))\left(\begin{array}{c}\sigma V^A_A(y',0,maj) + ... \\ \\ ... + (1-\sigma)\,V^A_A(y',0,min)\end{array}\right)\end{array}\right] + ...$$
$$... + \beta\,(1-\mu)\sum_{y'}Q(y'|y)\left[\begin{array}{c} \pi(M)\left(\begin{array}{c}\delta(M)VD^A_{BJ}(y',M) + ... \\ \\ ... + (1-\delta(M))VD^A_B(y',M)\end{array}\right) + ... \\ \\ ... + (1-\pi(M))\left(\begin{array}{c}\sigma VD^A_A(y',maj) + ... \\ \\ ... + (1-\sigma)\,VD^A_A(y',min)\end{array}\right)\end{array}\right] \tag{1.29}$$

Symmetrically, the value of redemption and default from B's point of view, when A and J hold onto power, are $VR^B_{AJ}(y, B, M)$ and $VD^B_{AJ}(y, M)$.

Value of repayment, and value of default: coalition perspective

This section takes the perspective of agent "A plus J".

The value of debt repayment, when big party A shares power with the junior party, is given by:

$$VR^{AJ}_{AJ}(y, B, M) = \max_{C_A, C_B, C_J, B'} \left(\overline{\theta} - \xi_1\right) u(C_A) + (\underline{\theta} - \xi_2)\, u(C_B) + (\theta_J + \xi_1 + \xi_2)\, u(C_J) +$$

$$... + \beta \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) \left(\begin{array}{c} \delta(M) VC^{AJ}_{AJ}(y', B', M) + ... \\ \\ ... + (1 - \delta(M)) VS^{AJ}_{A}(y', B', M) \end{array} \right) + ... \\ \\ ... + (1 - \pi(M)) \left(\begin{array}{c} \sigma V^{AJ}_{B}(y', B', maj) + ... \\ \\ ... + (1 - \sigma)\, V^{AJ}_{B}(y', B', min) \end{array} \right) \end{array} \right]$$

s.to. $C_A + C_B + C_J = y + B - q^{AJ}(B'; y, M)B'$.

(1.30)

The value for the coalition when it has the option to repay or default is given by $VC^{AJ}_{AJ}(y', B', M)$ in the following period; the value for A and J when the single-party government of A has that option is $VS^{AJ}_{A}(y', B', M)$.

The value of default, when big party A shares power with the junior party, is given by:

$$VD_{AJ}^{AJ}(y,M) = \max_{C_A,C_B,C_J} \left(\overline{\theta} - \xi_1\right) u(C_A) + (\underline{\theta} - \xi_2)\, u(C_B) + (\theta_J + \xi_1 + \xi_2)\, u(\gamma C_J) +$$

...

$$... + \beta\mu \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) \left(\begin{array}{c} \delta(M) VR_{AJ}^{AJ}(y',0,M) + ... \\ \\ ... + (1-\delta(M)) VR_{A}^{AJ}(y',0,M) \end{array} \right) + ... \\ \\ ... + (1-\pi(M)) \left(\begin{array}{c} \sigma V_{B}^{AJ}(y',0,maj) + ... \\ \\ ... + (1-\sigma)\, V_{B}^{AJ}(y',0,min) \end{array} \right) \end{array} \right] + ...$$

$$... + \beta\,(1-\mu) \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) \left(\begin{array}{c} \delta(M) VD_{AJ}^{AJ}(y',M) + ... \\ \\ ... + (1-\delta(M)) VD_{A}^{AJ}(y',M) \end{array} \right) + ... \\ \\ ... + (1-\pi(M)) \left(\begin{array}{c} \sigma VD_{B}^{AJ}(y',maj) + ... \\ \\ ... + (1-\sigma)\, VD_{B}^{AJ}(y',min) \end{array} \right) \end{array} \right]$$

s.to. $C_A + C_B + C_J = y^{aut}$.

(1.31)

The default and payback values when the coalition of B and J is in power, from B and J's perspective, are symmetric to the two value functions above, and represented by $VD_{BJ}^{BJ}(y,M)$, and $VR_{AJ}^{AJ}(y,B,M)$.

Each coalition also evaluates the policies of the other coalition. Correspondingly, there are for such functions: $VR_{BJ}^{AJ}(y,B,M)$, $VD_{BJ}^{AJ}(y,M)$, $VR_{AJ}^{BJ}(y,B,M)$, and $VD_{AJ}^{BJ}(y,M)$. The first pair of these is presented below, while the second pair is derived by symmetry.

$$VR_{BJ}^{AJ}(y,B,M) = \left(\overline{\theta} - \xi_1\right) u(C_A^{*BJ}) + (\underline{\theta} - \xi_2)\, u(C_B^{*BJ}) + (\theta_J + \xi_1 + \xi_2)\, u(C_J^{*BJ}) +$$

...

$$... + \beta \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) \left(\begin{array}{c} \delta(M) VC_{BJ}^{AJ}(y', B'^{*BJ}, M) + ... \\ \\ ... + (1 - \delta(M)) VS_B^{AJ}(y', B'^{*BJ}, M) \end{array} \right) + ... \\ \\ ... + (1 - \pi(M)) \left(\begin{array}{c} \sigma V_A^{AJ}(y', B'^{*BJ}, maj) + ... \\ \\ ... + (1 - \sigma)\, V_A^{AJ}(y', B'^{*BJ}, min) \end{array} \right) \end{array} \right]$$

(1.32)

and

$$VD_{BJ}^{AJ}(y,M) = \left(\overline{\theta} - \xi_1\right) u(C_A^{aut*BJ}) + (\underline{\theta} - \xi_2)\, u(C_B^{aut*BJ}) + (\theta_J + \xi_1 + \xi_2)\, u(\gamma C_J^{aut*BJ}) +$$

...

$$... + \beta\mu \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) \left(\begin{array}{c} \delta(M) VR_{BJ}^{AJ}(y', 0, M) + ... \\ \\ ... + (1 - \delta(M)) VR_B^{AJ}(y', 0, M) \end{array} \right) + .. \\ \\ ... + (1 - \pi(M)) \left(\begin{array}{c} \sigma V_A^{AJ}(y', 0, maj) + ... \\ \\ ... + (1 - \sigma)\, V_A^{AJ}(y', 0, min) \end{array} \right) \end{array} \right] ...$$

$$... + \beta\,(1 - \mu) \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) \left(\begin{array}{c} \delta(M) VD_{BJ}^{AJ}(y', M) + ... \\ \\ ... + (1 - \delta(M)) VD_B^{AJ}(y', M) \end{array} \right) + ... \\ \\ ... + (1 - \pi(M)) \left(\begin{array}{c} \sigma VD_A^{AJ}(y', maj) + ... \\ \\ ... + (1 - \sigma)\, VD_A^{AJ}(y', min) \end{array} \right) \end{array} \right] .$$

(1.33)

The coalition of A and J also evaluates the policies taken by party A alone:

$$VR_A^{AJ}(y,B,M) = \left(\overline{\theta}-\xi_1\right)u(C_A^{*A}) + (\underline{\theta}-\xi_2)\,u(C_B^{*A}) + (\theta_J+\xi_1+\xi_2)\,u(C_J^{*A}) + ...$$
$$... + \beta\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)V_A^{AJ}(y',B'^{*A},M)+... \\ \\ ...+(1-\pi(M))\left(\begin{array}{c}\sigma V_B^{AJ}(y',B'^{*A},maj)+... \\ \\ ...+(1-\sigma)\,V_B^{AJ}(y',B'^{*A},min)\end{array}\right)\end{array}\right] \tag{1.34}$$

and

$$VD_A^{AJ}(y,M) = \left(\overline{\theta}-\xi_1\right)u\left(C_A^{aut*A}\right) + (\underline{\theta}-\xi_2)\,u\left(C_B^{aut*A}\right) + (\theta_J+\xi_1+\xi_2)\,u\left(\gamma C_J^{aut*A}\right) +$$

...

$$... + \beta\mu\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)V_A^{AJ}(y',0,M)+... \\ \\ ...+(1-\pi(M))\left(\begin{array}{c}\sigma V_B^{AJ}(y',0,maj)+... \\ \\ ...+(1-\sigma)\,V_B^{AJ}(y',0,min)\end{array}\right)\end{array}\right] + ...$$
$$... + \beta\,(1-\mu)\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)VD_A^{AJ}(y',M)+... \\ \\ ...+(1-\pi(M))\left(\begin{array}{c}\sigma VD_B^{AJ}(y',maj)+... \\ \\ ...+(1-\sigma)\,VD_B^{AJ}(y',min)\end{array}\right)\end{array}\right] \tag{1.35}$$

The value of debt repayment, and of default from B plus J's point of view, when B alone holds power, is $VR_B^{BJ}(y,B,M)$, and $VD_B^{BJ}(y,M)$.

Finally, the coalition of one big party with the junior party evaluates the policies of the other big party alone. There are four such functions: $VR_B^{AJ}(y,B,M)$, and $VD_B^{AJ}(y,M)$, which are presented below; $VR_A^{BJ}(y,B,M)$, and $VD_A^{BJ}(y,M)$, which are deduced by symmetry.

$$VR_B^{AJ}(y,B,M) = \left(\overline{\theta}-\xi_1\right)u(C_A^{*B}) + (\underline{\theta}-\xi_2)\,u(C_B^{*B}) + (\theta_J+\xi_1+\xi_2)\,u(C_J^{*B}) + ...$$
$$... + \beta\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)V_B^{AJ}(y',B'^{*B},M)+... \\ \\ ...+(1-\pi(M))\left(\begin{array}{c}\sigma V_A^{AJ}(y',B'^{*B},maj)+... \\ \\ ...+(1-\sigma)\,V_A^{AJ}(y',B'^{*B},min)\end{array}\right)\end{array}\right] \tag{1.36}$$

and

$$VD_B^{AJ}(y,M) = \left(\overline{\theta}-\xi_1\right)u\left(C_A^{aut*B}\right) + (\underline{\theta}-\xi_2)\,u\left(C_B^{aut*B}\right) + (\theta_J+\xi_1+\xi_2)\,u\left(\gamma C_J^{aut*B}\right) +$$

...

$$... + \beta\mu\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)V_B^{AJ}(y',0,M)+... \\ \\ ...+(1-\pi(M))\left(\begin{array}{c}\sigma V_A^{AJ}(y',0,maj)+... \\ \\ ...+(1-\sigma)\,V_A^{AJ}(y',0,min)\end{array}\right)\end{array}\right] + ...$$
$$... + \beta\,(1-\mu)\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)VD_B^{AJ}(y',M)+... \\ \\ ...+(1-\pi(M))\left(\begin{array}{c}\sigma VD_A^{AJ}(y',maj)+... \\ \\ ...+(1-\sigma)\,VD_A^{AJ}(y',min)\end{array}\right)\end{array}\right] \tag{1.37}$$

1.3.2 Optimal decisions

In defining the decisions of agents, I follow backward induction. An asterisk is used as a mark of optimality.

The last decision is on the consumption allocation, which depends on available resources, given by (1.4) when the economy enjoys access to foreign credit, and by (1.5) when the economy is in autarky. If there is access to credit, the government also chooses how much to borrow in the foreign market.

In case of access to the credit market, and given a decision to repay debt, each of the four government types chooses an optimal consumption allocation

$$C^{*i}(y, B, M) = \left\{C_A^{*i}, C_B^{*i}, C_J^{*i}\right\} \text{ where } i = A, AJ, B, BJ \tag{1.38}$$

and an optimal level of borrowing

$$B'^{*i}(y, B, M) = B'^{*i} \text{ where } i = A, AJ, B, BJ \tag{1.39}$$

by way of maximization of the respective $VR_i^i(y, B, M)$, which is the value of debt redemption from the perspective of agent i, when it is i itself who is in power.

In case of autarky, or after deciding for default, each of the four government types chooses an optimal allocation

$$C^{aut*i}(y, M) = \left\{C_A^{aut*i}, C_B^{aut*i}, C_J^{aut*i}\right\} \text{ where } i = A, AJ, B, BJ \tag{1.40}$$

from the maximization of $VD_i^i(y, M)$.

When there is access to credit, and $B < 0$ (government is indebted), and before the decisions are made to issue new debt and to redistribute available resources, each of the four government types optimally chooses to redeem debt, or to default:

$$D^{*i}(y, B, M) = \begin{cases} 1 \textit{ if } VD_i^i(y, M) > VR_i^i(y, B, M) \\ 0 \textit{ otherwise} \end{cases} \quad \textit{where } i = A, AJ, B, BJ. \quad (1.41)$$

Note that the state variable $G = sin$ or coa is already implicit on the agent taking the decision, i.

The optimal default decision solves the problem

$$VS_i^i(y, B, M) = \max\left\{VR_i^i(y, B, M), VD_i^i(y, M)\right\} \textit{ with } i = A, B \quad (1.42)$$

in case of single-party government, and

$$VC_j^j(y, B, M) = \max\left\{VR_j^j(y, B, M), VD_j^j(y, M)\right\} \textit{ with } j = AJ, BJ \quad (1.43)$$

when there is a coalition in power[37].

Whether newly appointed to government, or after surviving in power and starting a period in a single-party government, each of the two big parties chooses optimally between forming a coalition, or ruling in a single-party government:

$$\Gamma^{*i}(y, B, M) = \begin{cases} 1 \textit{ if } VC_{iJ}^i(y, B, M) > VS_i^i(y, B, M) \\ 0 \textit{ otherwise} \end{cases} \quad \textit{where } i = A, B. \quad (1.44)$$

This decision is only relevant in the case of access to markets, as it cannot be optimal to form a coalition when the economy is in autarky. This is because a coalition implies

[37] I assume that, in case of indifference between default and repayment, governments choose repayment.

less consumption for the big party, but it can bring it no benefit during autarky, as it is then not possible to issue debt and, hence, there is no way to benefit from the higher bond price which would result from the presence of the junior party in the coalition.

Also, by assumption, the coalition decision is not available immediately after a coalition breaks. In such case, there will be a single-party government for the period, and a coalition may be formed only in the next period. Should access to credit be regained in the following period, the same big party or a new one will then be able to form a coalition prior to new debt issuance.

The optimal coalition formation decision is the solution to the problem[38]:

$$V_i^i(y, B, M) = \max\left\{VS_i^i(y, B, M), VC_i^i(y, B, M)\right\} \text{ with } i = A, B. \tag{1.45}$$

1.3.3 Definition of equilibrium

A recursive equilibrium is defined as

- a set of value functions $VR_j^i(y, B, M)$ and $VD_j^i(y, M)$, for $i, j = A, AJ, B, BJ$;
- a set of value functions $VS_j^i(y, B, M)$, for $i = A, AJ, B, BJ$, $j = A, B$; and $VC_j^i(y, B, M)$, for $i = A, AJ, B, BJ$, $j = AJ, BJ$;
- a set of value functions $V_j^i(y, B, M)$, for $i = A, AJ, B, BJ$, $j = A, B$;
- a set of consumption policies $C^{*i}(y, B, M)$, for $i = A, AJ, B, BJ$; and $C^{aut*i}(y, M)$, for $i = A, AJ, B, BJ$;

[38] I assume that, in case of indifference between single-party government and coalition, big parties choose single-party government.

- a set of bond policies $B'^{*i}(y, B, M)$, for $i = A, AJ, B, BJ$;
- a set of default policies $D^{*i}(y, B, M)$, for $i = A, AJ, B, BJ$;
- a set of coalition formation policies $\Gamma^{*i}(y, B, M)$, for $i = A, B$,

such that given bond price function $q^i(B'; y, M)$ for $i = A, AJ, B, Bj$, and given the policies of all other agents in the economy

- $C^{*i}(y, B, M)$ and $B'^{*i}(y, B, M)$ solve the maximization problem in $VR_i^i(y, B, M)$, for $i = A, AJ, B, BJ$;
- $C^{aut*i}(y, M)$ solves the maximization problem in $VD_i^i(y, M)$, for $i = A, AJ, B, BJ$;
- for $i = A, B$, $D^{*i}(y, B, M)$ solves the maximization problem in $VS_i^i(y, B, M)$;
- for $j = AJ, BJ$, $D^{*j}(y, B, M)$ solves the maximization problem in $VC_j^j(y, B, M)$;
- for $i = A, B$, $\Gamma^{*i}(y, B, M)$ solves the maximization problem in $V_i^i(y, B, M)$

with $q^i(B'; y, M)$, for $i = A, AJ, B, BJ$ being such that it depends on the probability of sovereign default $\lambda^i(B'; y, M)$, for $i = A, AJ, B, BJ$, and international lenders get zero-expected profits, with $\lambda^i(B'; y, M)$ depending on the above defined $D^{*i}(y, B, M)$ for $i = A, AJ, B, BJ$, and on the above defined $\Gamma^{*i}(y, B, M)$, for $i = A, B$.

A symmetric recursive equilibrium is a recursive equilibrium characterized by

- $C^{*i}(y, B, M) = C^{*j}(y, B, M)$, for $i = A$ and $j = B$; $C^{*h}(y, B, M) = C^{*k}(y, B, M)$, for $h = AJ$ and $k = BJ$;

- $C^{aut*i}(y, M) = C^{aut*j}(y, M)$, for $i = A$ and $j = B$; $C^{aut*h}(y, M) = C^{aut*k}(y, M)$, for $h = AJ$ and $k = BJ$;
- $B'^{*i}(y, B, M) = B'^{*j}(y, B, M)$, for $i = A$ and $j = B$; $B'^{*h}(y, B, M) = B'^{*k}(y, B, M)$, for $h = AJ$ and $k = BJ$;
- $D^{*i}(y, B, M) = D^{*j}(y, B, M)$, for $i = A$ and $j = B$; $D^{*h}(y, B, M) = D^{*k}(y, B, M)$, for $h = AJ$ and $k = BJ$; and
- $\Gamma^{*i}(y, B, M) = \Gamma^{*j}(y, B, M)$, for $i = A$ and $j = B$,

all of which are such that when all the other agents play the implied strategies above, it is optimal for any agent to also play its above-implied strategy.

In a symmetric equilibrium, by definition the two single-party governments follow the same strategy; and the coalition of A and J follows the same strategy of the coalition of B with J. As a consequence, the two possible single-party governments face the same bond price schedule, and the two possible coalition governments also face a common coalition bond price schedule.

1.4 Quantitative analysis

I solve the model numerically in order to obtain business cycle statistics, both general, and conditional on government type, and quantitative predictions about the frequency of sovereign default, the frequency of coalition formation, and the frequency of coalition forma-

tion conditional on type of parliamentary support: majority (surplus coalition), or minority (minimal-winning coalition).

Two guiding principles were followed when calibrating the model: similarity with the parameter values used in the related literature; and relation with values estimated from data.

The database from Cheibub et al. (2004) was used to obtain estimates of the political dynamics parameters (the πs, the δs, and σ). This database includes information on the political party composition of government, and opposition for most countries in the world for the period 1946-1999. My model presupposes that governments may be required to step down in a regular way at any period; hence, it is most suitable for parliamentary, or mixed systems. For this reason, I have excluded those observations in the database pertaining to dictatorships and presidential systems. Details and discussion on parameter estimation are found in Appendix D.

The following table presents the parameters used in solving the model, and also the parameters used in the papers that are the most comparable to mine. The calibration is quarterly.

TABLE 1 - PARAMETERS

Parameter			Source
Risk aversion	η	2	CS, A: 2; CSS: 2
Discount factor	β	0.94	CS, A: 0.953; CSS: 0.97
Endowment process	ρ_y	0.945	CS, A: 0.945; CSS: 0.85
	σ_y	0.025	CS, A: 0.025; CSS: 0,006
Incumbent big party	$\overline{\theta}$	0.61	CS: 0.62
Other big party	$\underline{\theta}$	0.37	CS: only one more party: 0.38
Junior party	θ_J	0.02	
Power transf. from incumbent	ξ_1	0.002	
Power transf. from other	ξ_2	0.002	
GDP loss	ϕ	0.9	CS, A: 0.969; CSS: 0.99
Specific junior loss	γ	0.85	
Re-entry probability	μ	0.282	CS, A: 0.282; CSS: 0.1
Majority win	σ	0.5	
Survival in power if majority	$\pi(maj)$	0.97	Data; CS: $\pi = 0.9$
Survival in power if minority	$\pi(min)$	0.94	
Coalition holding if majority	$\delta(maj)$	0.91	Data
Coalition holding if minority	$\delta(min)$	0.94	Data
Risk-free rate	r_f	0.017	CS, A: 0.017; CSS: 0.01

CS: Cuadra and Sapriza (2008); A: Arellano (2008); CSS: Cuadra et al. (2010). Data: values were estimated using the data from Cheibub et al. (2004).

Many parameters are the same as in Arellano (2008), and in Cuadra and Sapriza (2008). Those authors calibrate their models to reflect Argentinian business cycle properties, and the respective default rate, and they provide detailed motivation for parameter choice. I follow this same calibration when setting the values for the endowment process, ρ_y, and σ_y. Parameters from Cuadra et al. (2010) are also presented; these authors match their model with Mexican data.

As is rather common in the sovereign default literature, β is relatively small for quarterly data. The weight of the junior party in the social welfare function was chosen by drawing 1% from the weights of the two big parties in Cuadra and Sapriza (2008). The total transfer of power to the junior party, while seemingly small in absolute terms, corresponds to a 20% increase in power. The specific consumption loss suffered by the junior party when default takes place or there is autarky is 15%.

From the dataset, I calculate the average duration of *big party majority spells*, and of *big party minority spells*. The former is the average time a political party remains in power as the biggest party in the government, conditional on having a majority of its own in the first period; the latter is similar, but conditional on not having a majority of its own.

The computed values were 8.1, and 4.9 years. These are simple average durations, calculated across developed and developing countries. The majority status of the biggest party was allowed to change within one spell. By assumption, this cannot happen in the model: while in power, a big party always keeps its maj or min status. For this reason, it may be that those figures overestimate the spells with which the model is concerned, which are precisely defined as the average duration in power of a big party *given no changes to the majority status*.

The parameter $\pi(maj) = 0.97$ implies that the probability of staying in power is approximately 8.1 years, while $\pi(min) = 0.94$ leads to an average duration of 3.9 years. This value is kept lower than the respective estimate in order for the model to generate a relative frequency of minimum-winning coalitions of at least 1%.

The average durations of two other types of political spells were calculated from the dataset: *surplus coalition spells*, and *minimum-winning coalition spells*. Among other criteria (cfr. Appendix D), these spells are defined such that the biggest party in the cabinet remains the same. The respective values are 2.5, and 4 years. These estimates confirm the postulate that surplus coalitions are weaker than minimum-winning coalitions, which is also confirmed by the evidence presented in Lijphart (1984). The parameter values $\delta(maj)$, and $\delta(min)$ are consistent with the estimates and are set to 2.5, and 3.9 respectively.

The probability of winning a majority, σ, is 50%. This facilitates the comparison of policy outcomes across the states maj and min, as any differences across the two cannot stem from one being more likely than the other, should that actually matter somehow. As a reference, the proportion of big party changes in which the new incumbent enjoys a majority of its own in the first period in power is 36% in the data. This number, however, was calculated without controlling for the electoral system, and the number of political parties.

The following section presents and discusses the main results.

1.5 Results

I simulate the model 10000 times; each simulation is 400 periods long, corresponding to a 100-year period. For all simulations, a country begins with no stock of debt, with access to credit markets, and with a single-party minority government. It is not possible to form a coalition in the first period. The initial income level is randomly assigned from the limiting

distribution of the Markov transition matrix which is associated with the parameters of the $AR(1)$ GDP process.

The following section presents the basic business cycle results; the next section provides a detailed analysis of business cycles for each type of government; and the final section briefly deals with different parameterizations.

1.5.1 General business cycle statistics

When generating the simulated data, I have used this convention: "debt" is recorded as 0 in the period after the decision to default, and in periods of autarky, and as a positive number in the period when default takes place; "borrowing" is recorded as NaN in the period when default is decided, and in periods of autarky.

Business cycle statistics are presented in the next table[39].

[39] The model results found by Arellano (2008), Cuadra and Sapriza (2008), and Cuadra et al. (2010) provide an interesting benchmark, although they are not fully comparable to mine because in all those papers model data have been logged and filtered, and also because only the 74 periods prior to each default in their simulations were considered (50 in case of Cuadra et al., 2010).

TABLE 2 - MODEL BUSINESS CYCLE STATISTICS

	Model
Mean interest rate	2.06%
Mean interest rate (annualized)	8.51%
σ(annual interest rate)	2.79%
ρ(annual interest rate, GDP)	-27.10%
ρ(aggregate consumption, GDP)	96.24%
σ(aggregate consumption)$/\sigma$(GDP)	1.09
ρ(agg. consumption, annual int. rate)	-39.17%
ρ(trade balance, GDP)	-15.53%
ρ(trade balance, annual. int. rate)	52.67%
ρ(borrowing, GDP)	89.41%
Mean debt (percent potential output)	16.70
Mean debt as $\%$ of GDP	16.28%
Mean default rate	1.34%
Mean coalition formation rate	4.21%
surplus	2.73%
minimum-winning	1.48%

After default, and in autarky, aggregate consumption is $C_A+C_B+\gamma C_J$.

Interest rates are countercyclical, and so is the trade balance; hence, an above-average GDP is associated with higher borrowing at more favorable terms.

As access to borrowing is easier when it is less needed, that is, for high levels of GDP, consumption and GDP turn out to be highly correlated. This indicates a low level of consumption smoothing.

The mean debt-to-GDP ratio resulting from my simulations is closer to the Argentinian figure, which is 48.79%, than the values found in Arellano (2008), and in Cuadra and Sapriza (2008). My model is able to generate much higher levels of indebtedness than the levels found in those two models, and the mean debt levels in my paper are much closer to the levels observed in emerging market economies because while Cuadra and Sapriza (2008), Arellano (2008) and my paper all have an income cost of default, and exclusion from borrowing markets both after default and during autarky, my paper also models the asymmetrical impact default is likely to have across different groups in society. Moreover, my model allows for coalition formation which works as a commitment device for debt repayment, thus helping to sustain larger debt stocks.

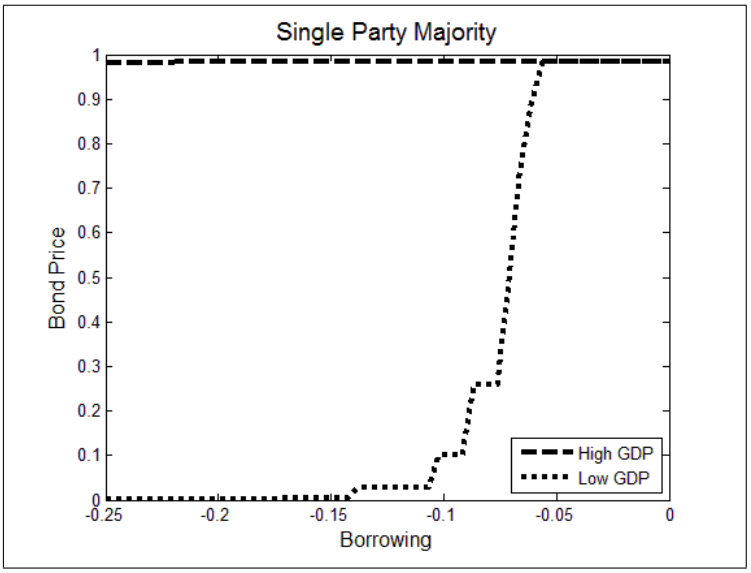

Fig. 1.1. Bond Price, Single-Party Majority

Figure 1.1 shows the bond price schedule for the single-party majority case; two different levels of GDP are shown. Prices decrease with the level of borrowing, and are

much less favorable for smaller levels of GDP, as in both cases the incentives to default in the next period are stronger. Bond price schedules for the other forms of government are qualitatively similar.

In case of a high level of GDP, the bond price schedule is almost flat at about 0.9833, which corresponds to the risk-free interest rate. This is usually the case, as the probability of defaulting in the following period for all the four types of government is zero for a large area of the state space which includes the higher GDP levels, as is shown in figure 1.2 below.

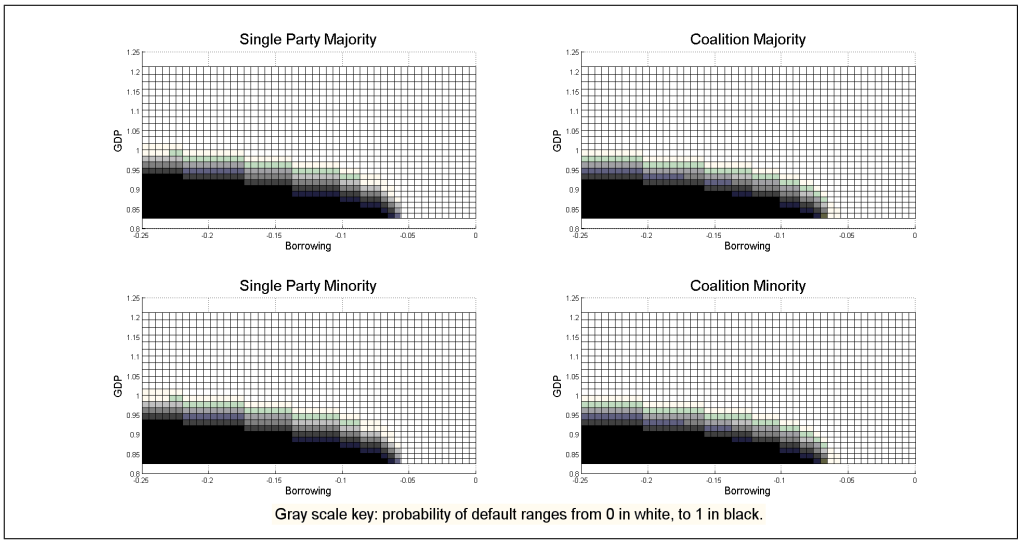

Fig. 1.2. Probability of Default

In that figure, the probability of default in the next period depends on the political states (majority or minority, single-party or coalition), on the present level of GDP, and on borrowing. Zero probability of default is represented in white, which occupies the areas of high GDP, and of low borrowing. Certain default corresponds to black, and it covers

the "very high borrowing-low to very low GDP" region, the "moderate borrowing-very low GDP region", and the "low borrowing-very low GDP" case.

Returning to Table 2, the default rate implies that there is on average 1.34 default occurrences every 100 years, which is lower than the model rates in Arellano (2008), and Cuadra and Sapriza (2008). While the general GDP loss and the re-entry probability are the same in this and their models, mine adds another GDP default loss: the specific junior party cost, γ. Its effect is to decrease the default rate, while supporting a higher average level of debt.

On average, a coalition is formed 4.2 times in a 100-year period; the percent of time under coalitional government is 8.7% (cfr. table 4 infra). The model, thus, succeeds in generating a high frequency of coalitional government, even though the enhancing survival in power motive for coalition formation is excluded by design. This is a first sign of the importance of the *coalition buys commitment effect*.

The 4.2 mean actually underestimates the likelihood a coalition is formed, because in calculating that mean, I count in the denominator those periods in which a coalition cannot be formed (either because it has already been formed, or because it is an autarky period).

The final lines of Table 2 show that in a 100-year period, surplus coalitions are formed on average 2.7 times, while the average number of minimum-winning coalitions is 1.5. By assumption, big parties with a majority last longer in power, and thus, the polity will be under a majority for approximately 63.2% of the time (cfr. table 4 infra), even though the probability of majority is 50%. Hence, one reason the number of surplus coalitions is

higher than that of minimum-winning coalitions is that the country spends more time under majority rule than under minority rule.

1.5.2 Business cycle and type of government

As aforementioned, there are four types of government, corresponding to the possible combinations of executive power structure and legislative power structure: single-party minority, also called "minority government"; coalition minority, or "minimum-winning coalition"; single-party majority, or "majority of one"; and coalition majority, also known as "surplus coalition".

The executive power decides on redistribution, on borrowing, on the repayment or default decision, and in case of single-party government, it also decides on coalition formation; the legislative power determines exogenously (as "nature") whether there is power turnover, and a whether a coalition holds or breaks. In case of turnover, voters decide exogenously, also as "nature", whether the new incumbent will have a majority or not.

The first main political-economic result is that the difference in bond price schedules, i.e. across the space (y, B'), between coalition government and single-party government is always positive or zero. As average GDP is standardized to 1, the average ceteris paribus price difference corresponds to slightly more than 2% of the average GDP (cfr. table 3). Hence, **coalition governments are offered significantly more favorable borrowing terms than single-party governments.**

TABLE 3 - BOND PRICES: COALITION VS. SINGLE-PARTY

	Majority	Minority
Maximum difference	0.7320	0.7328
Average difference	0.0228	0.0229
Minimum difference	0.0000	0.0000

This result is directly connected to figure 1.2, as bond prices are a simple function of the probability of default. Since the probability of default, conditional on y, B', and maj or min, is never bigger for coalition than for single-party, coalitions always have access to borrowing terms which are at least as good as those offered to single-party governments.

Coalitions are more likely to honor their debt, hence, they benefit from better borrowing terms. In short, **coalitions buy commitment**.

To understand the mechanics at play, let's consider two extreme scenarios, and what happens to the junior party's utility in case either a single-party government defaults, or a coalition government takes that decision.

In both scenarios, θ_J and γ are 0, which means that the junior party has no political power of its own, and the specific default (or autarky) cost is set to maximum. The difference between scenarios is that in the first one, $\xi_1 = \xi_2 = 0$, while in the second at least one of ξ_1 and ξ_2 is strictly positive; that is, the junior party may have some political power only in the second scenario.

In the first scenario, default entails no utility loss for the junior party whether this party is in office or not, because according to the optimal allocation, it gets 0 consumption in both types of government and in both situations of access to markets and autarky[40].

In the second scenario, default brings no utility loss for the junior party but *only* in case of single-party government, because in this case junior party's consumption is 0 whether there is default or not. However, choosing default does hurt the junior party in case of coalition government, because its optimal consumption is 0 under autarky (due to γ being zero), but it is strictly positive otherwise. Then, including the junior party in the coalition provides a disincentive to default only in the second scenario.

Moreover, in the second scenario, default hurts as well the other two parties, but only "indirectly", because the government has to compensate the junior party for its loss, and compensation implies shifting some income away from the bigger parties and to the smaller one.

Hence, γ must be strictly smaller than 1, and $\xi_1 + \xi_2$ must be strictly bigger than 0 in order for the *coalition buys commitment* effect to be in place; with such parameter conditions, the disincentives to default are bigger once the junior party joins the coalition.

Figure 1.3 shows the bond price difference between coalition government and single-party government, in the case of majority, and for three levels of borrowing: 7, 16, and 23 percent of potential output. The coalition effect on bond prices is stronger in the case

[40] Zero consumption leads to $-\infty$ utility; with $\theta_J = 0$, an indeterminacy emerges. To keep the argument simple, I ignore this indeterminacy. Stating that in both scenarios θ_J is a positive infinitesimal (together with some minor changes) solves the problem, while preserving the logic of the argument. Alternatively, one can modify the social welfare function in such a way that, when $\theta_J = 0$, the junior party's utility is dropped from it unless there is a coalition and $\xi_1 + \xi_2 > 0$.

of very low GDP and a low level of borrowing, in the case of low GDP and a moderate level of borrowing, and in the case of GDP below but close to potential and high levels of borrowing.

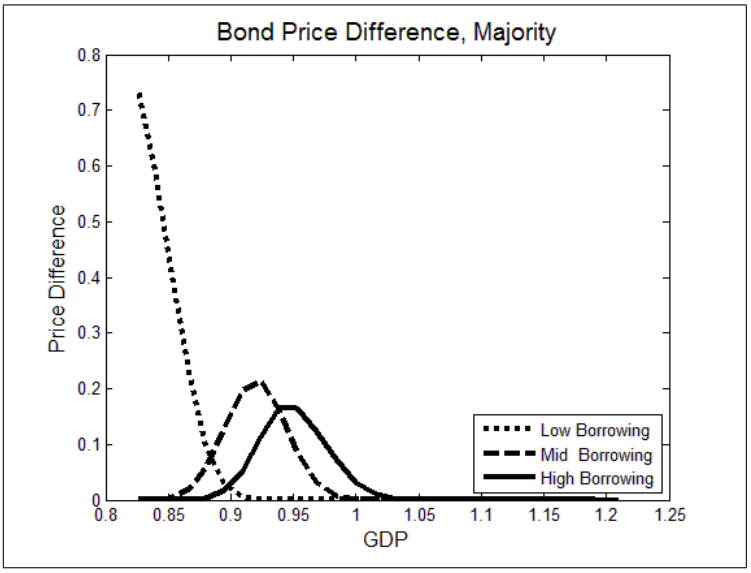

Fig. 1.3. Coalition - Single Party Bond Price Difference, Majority

The level of GDP that maximizes the price difference gets closer to potential GDP, when moving from low to high borrowing. This means that the price benefit enjoyed by coalitions depends on a strict negotiation involving GDP and borrowing levels: coalitions face better borrowing conditions than single-party governments, but as they want to borrow more, the GDP must also help in order to sustain a benefit for the coalition. Otherwise, if the GDP is either too high or too low for a given level of borrowing, coalitions do not enjoy any price benefit: in the case of relatively very high (very low) GDP, the probability of default in the following period is very low (very high) for both types of government, and thus there is no price difference.

Furthermore, the maximum price difference decreases with the level of borrowing. Hence, **coalitions are the most helpful in bringing interest rates down in situations of large economic contractions, but with relatively small borrowing needs**. This is likely the case when the stock of debt is relatively small, as debt and borrowing are highly correlated (correlation is 96%), and there is an unexpectedly harsh negative shock to the economy.

I present in table 4 the average relative frequency of each type of government across simulations (each observation corresponds to a quarter):

TABLE 4 - TYPE OF GOVERNMENT FREQUENCY

	Sing. Maj.	Sing. Min.	Coal. Maj.	Coal. Min.
Mean relative frequency	57.54%	33.72%	5.66%	3.09%
	Single Party		Coalition	
Mean relative frequency				
during majority	91.15%		8.85%	
during minority	91.92%		8.08%	

It should be no surprise that the economy is governed most of the time by single-party governments. Under coalition government, the consumption allocation depends on the political weights $\overline{\theta} - \xi_1$, $\underline{\theta} - \xi_2$, and $\theta_J + \xi_1 + \xi_2$, whereas in single-party government, the allocation is determined by the very preferences of the big party, represented by $\overline{\theta}$, $\underline{\theta}$, and θ_J. That is, the preferences of the *government* are aligned with the preferences of the big party in case of a single-party cabinet.

This means that, in the eyes of the big party, a coalition government represents a distortion in the redistributive decision. Hence, the big party only chooses to form a coalition if the benefits more than compensate the *coalition redistributive distortion*.

These benefits can only stem from the *coalition buys commitment effect*, as there are no other positive effects for the big party from coalition formation. For example, the incentives to form a coalition in order to enhance survivability or governability have been purposely left out of the model.

The evidence that coalitions are indeed formed is proof of the strength of the coalition effect. This effect seems particularly strong given that the total power transfer parameter ($\xi_1 + \xi_2$) was set at a seemingly very low value, 0.4%[41].

The model is able to generate *minimal-winning coalitions*, and *surplus coalitions*. In fact, from table 4, while the probability of majority is identical to the probability of minority (as $\sigma = 0.5$), **surplus coalitions are more frequent than minimal-winning coalitions**.

This is due to two reasons: first, even though $\sigma = 0.5$, the polity is more likely to stay in maj than in min simply because big parties last longer in power when they have a majority. Second, the incentives to form coalitions are likely to be stronger in the majority case, as it is suggested by the conditional frequency of coalitions, which is slightly higher under majority than under minority.

[41] It is true that with γ at 0.85, default implies a large direct cost to the junior party, and also indirect costs to the other parties due to a redistributive effect, as the optimal allocation in case of default must provide some extra consumption to the junior party in order to (partially) compensate it for its 15% consumption loss. But these effects take place equally in both single-party and coalition governments. Hence, in order to think about the relative magnitude of the *coalition buys commitment effect*, one should consider only the power transfer parameters, not γ. (Nevertheless, $\gamma < 1$ is a necessary condition for such effect to exist).

Minority big parties are more impatient than majority big parties because their odds of staying in power are less favorable. Hence, minority big parties place a bigger weight in the present period redistributive distortion stemming from coalition formation than big parties with a majority; but, for the same reason, minority big parties also place more weight on the present-period benefits from the coalition-buys-commitment effect, as a higher borrowing price means higher total income in the present period.

That the frequency of coalitions is higher given majority suggests, then, that it is easier for the coalition-buys-commitment effect to become stronger than the coalition redistributive distortion as parties become more patient.

A relevant conjecture is, then, that the ratio between coalition benefits and costs for political parties increases with the probability of survival, and possibly with any factors leading to more patience. Lower political turnover (that is, high πs) should lead to a higher frequency of coalition formation ceteris paribus[42]. In other words, when the leading political party is more patient or is more keen on the longer-run perspective, then coalitions are more likely to be formed.

There are yet other dynamic costs and benefits from coalition formation, which are perceived differently depending on the level of big party impatience. In the extreme scenario of $\delta(maj) = \delta(min) = 1$, forming a coalition leads, in the next period or periods to a *certain* redistributive cost, but to *uncertain* benefits, because there is uncertainty whether the economic and political states of the economy tomorrow would justify the coalition in

[42] This is a testable empirical question. It is not a trivial one due to reverse causality: coalitions themselves might contribute to lower turnover.

the eyes of the big party. This logic applies as well to the $\delta(maj), \delta(min) < 1$ case, but the effect is stronger the higher the δs.

This dynamic effect is likely to play against coalition formation in a stronger way the more *patient* a big party is, as an extremely impatient big party will enjoy the present benefits of coalition formation without concern for any future costs of being locked in an undesirable coalition.

The next table presents business cycle statistics which are conditional on type of government:

TABLE 5 - BUSINESS CYCLE AND TYPE OF GOVERNMENT

	Sing. Maj.	Sing. Min.	Coal. Maj.	Coal. Min.
Mean interest rate (annualized)	8.32%	8.27%	10.81%	10.52%
σ(annual interest rate)	2.61%	2.43%	3.14%	2.41%
ρ(borrowing, GDP)	87.34%	85.50%	86.97%	87.17%
Mean borrowing	16.98	16.69	15.90	15.73
Mean debt as $\%$ of GDP	16.29%	16.27%	16.37%	16.25%

Mean borrowing as percent of potential output.

Even though price schedules on the space (y, B') are more favorable to coalitions, they will pay on average about 2.5% higher interest rates *on the equilibrium path*, as coalitions are formed precisely during those circumstances when interest rate upward pressure is strongest: low output, and high debt (cfr. table 6). This is when it becomes more pressing to

access funds at more favorable conditions, which is achieved by coalitions. The formation of coalitions, then, contributes to support consumption during economic hardship.

However, the correlation between borrowing and GDP is almost the same across single-party majority and coalition majority, and it is even higher in the case of coalition minority when compared to single-party minority. This is because coalitions borrow much more than single-party governments during the best economic conditions (high GDP, low stock of debt), as portrayed in figure 1.4.

Overall, debt as a percentage of GDP is similar across all types of government[43].

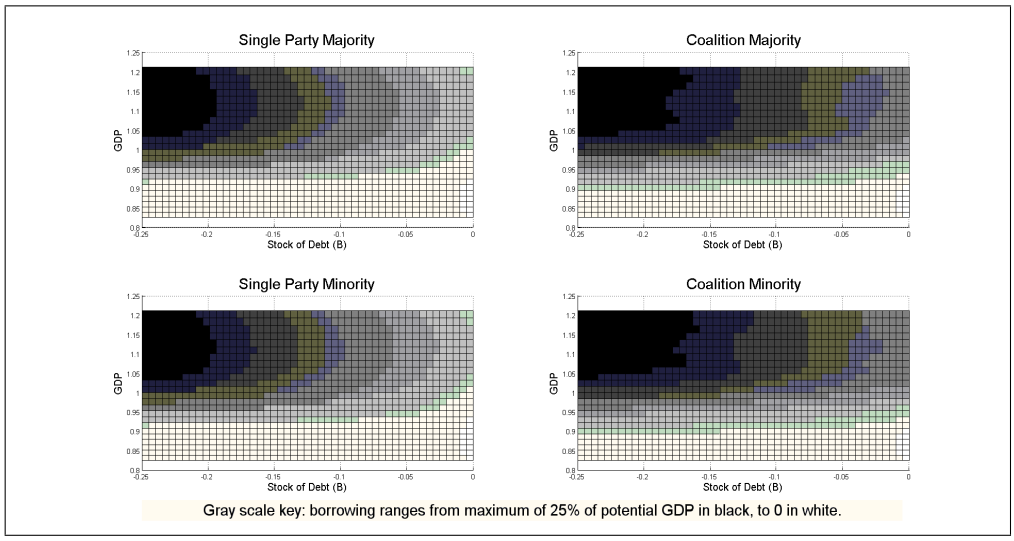

Fig. 1.4. Borrowing Policy

[43] Alesina and Perotti (1995) claim coalition governments accumulate more debt mostly because the negotiations within a multi-party government end up delaying any fiscal adjustments. References therein confirm that, controlling for many factors, the bigger the coalition in terms of number of parties, the bigger the public debt. These findings do not contradict my model, as the only available asset here is a one-period bond, and, thus, debt accumulation is possible only in a very limited sense, and as the complexities of negotiation within a coalition are beyond the scope of the model. Furthermore, as my paper shows that coalitions have access to more favorable borrowing conditions, it suggests that, in a richer model, coalitions may very well accumulate larger stocks of debt than single-party governments.

For most, if not all, combinations of GDP and stock of debt levels, the optimal policies imply that coalitions borrow more than single-party governments. This is not only because they have access to lower interest rates, but also because of more impatience. The coalition discount factors are lower than single-party governments': $\pi\left(maj\right) \times \delta\left(maj\right) \times \beta < \pi\left(maj\right)\beta$, and $\pi\left(min\right) \times \delta\left(min\right) \times \beta < \pi\left(min\right) \times \beta$. Hence, coalitions are willing to pay higher interest rates because they are more impatient than single-party governments: the *unconditional* probability one coalition holds, $\pi\left(M\right) \times \delta\left(M\right)$, is lower than the probability that a single-party government stays in power, $\pi\left(M\right)$[44].

Nevertheless, over time and across simulations, mean (absolute) borrowing turns out to be lower in the case of coalition government. Even though this type of government borrows more than a single-party government for most of the (y, B) space, it is the case that, given the exogenous stream of y, and the endogenous sequence of B, which depends on type of government, the equilibrium path of a coalition involves lower borrowing levels (cfr. the penultimate row of table 5). This is because those few combinations of GDP and debt levels for which the coalition government borrows less than the single-party government are very likely to occur, as they involve GDP at the potential level, and very high indebtedness.

TABLE 6 - COALITION FORMATION

	Mean GDP	Mean debt
all coalitions	0.9672	22
if majority	0.9672	22
if minority	0.9672	22

[44] $\delta(M)$ is the *conditional* probability that one coalition holds, that is, conditional to the bigger party surviving in power.

Mean debt as percent of potential output.

1.5.3 Probit model with the simulated data

In line with the methodology in Saiegh (2009), I use the simulated data to estimate a probit model of the conditional effect of coalitions on the probability of default. The specification used is $P[D=1]=\Phi(\beta' X)$ where D is the indicator of the decision to default, $\Phi(.)$ is the normal cumulative distribution function, and the matrix of controls X includes a constant, the GDP and debt levels at the beginning of the period, a dummy variable for the majority status, and a dummy variable for coalition. Since the data generating process is the same, I stack all the 400-period long simulations, and get data vectors with 4 million observations (there were 10 thousand simulations).

The levels of GDP and debt are strongly significant, and with the expected signs: higher GDP and lower debt make default less likely. The majority or minority status is not significant. **Coalitions are strongly significant and contribute to a lower likelihood of default.** Hence, coalitions work as mechanisms that provide a great level of commitment to pay off a country's debts[45].

1.5.4 Different parameterizations

Given the richness of the model, many experiments may be carried out. Quantitative results are very sensitive to small parameter changes. Qualitatively, the model is robust across

[45] The complete output of this exercise is available upon request.

different parameterizations. I briefly report a few simple yet interesting sensitivity-analysis results.

Keeping the parameters in Table 1, which is the benchmark parameterization, and decreasing the re-entry probability from 0.282 to 0.25, there is an amplification in coalition formation: its rate jumps from 4.21% to 9.65%. In case of default, the economy is expected to stay longer in autarky, and, hence, default becomes less of an option relative to the decision of paying back debt. This option, in turn, most likely requires issuance of new debt, which can be accomplished with better terms by a coalition government. Hence, the increase in the coalition formation rate. At the same time, the frequency of default decreases but it is still above a mean of 1 every one hundred years.

Beginning with the benchmark, but now decreasing the specific junior default cost from 0.85 to 0.8 (which makes the penalty harsher), there is a similar amplification of the coalition formation rate, and a similar decrease of the default rate.

These two experiments suggest that making default penalties harder leads to an increase in coalition formation rates (and, unsurprisingly, to a decrease in the likelihood of default). When default is more costly it becomes less of an option and governments feel thus a greater pressure to refinance the debt. In these circumstances, coalitions become more useful because they benefit from lower borrowing costs than those faced by single-party governments.

1.6 Conclusions

In this paper, I have presented a formal theory explaining both the empirical effect of coalitions on the likelihood of debt events, and the surprisingly high empirical incidence of surplus coalitions.

When there is a political party which is especially interested in sovereign debt repayment, because it will be particularly hurt in case of default, bigger parties achieve more favorable borrowing conditions by inviting into the government the party that strongly defends debt repayment. Hence, coalitions work as debt-repayment commitment devices.

The positive effect of coalitions on bond prices is strongest for the combination of a GDP much below potential with a low level of borrowing. In the case of very mild recessions, the coalition effect is the highest for a high level of borrowing, as both coalition and single-party governments are unlikely to default on moderate and low stocks of debt when GDP is only slightly below potential.

This effect of coalition formation must be compared with the cost of allocating a higher share of available income to the smaller party. When borrowing benefits outweigh the redistributive costs, coalitions are formed even though, in the model, coalitions do not enhance a big party's chance to stay in power.

For very low levels of debt, default is never optimal; hence, coalitions don't enhance the already very favorable borrowing conditions. Similarly, for very high indebtedness, and very low GDP, the incentives for default are overwhelming even in the case of a coalition.

Therefore, the coalition's role in committing a government to honor sovereign debt is most effective when there are opposing forces working for and against default. The

simulation results show that, on average, the conditions under which coalitions are formed involve GDP 3.3% below potential, and a stock of debt corresponding to 22% of potential GDP, which is very high given that in the model only one-period bonds are allowed.

As coalitions are more successful in achieving lower interest rates during mild recessions (for intermediate and high levels of borrowing), a conjecture can be made about economic volatility: for the same level of GDP persistence, low volatility economies may imply a greater ceteris paribus rate of coalition formation.

While the coalitions achieve equal or higher bond prices than single-party governments keeping everything else the same, the average interest rates paid by coalition governments are higher in the simulations, that is, unconditionally. This is because, as stated above, coalitions are typically formed during periods of hardship, when interest rates are high for any type of government.

The incidence of coalition formation is almost double in case the formateur party already disposes of a majority. This leads, in turn, to a higher frequency of surplus coalitions when compared to minimum-winning coalitions.

In future research work, it will be interesting to address with world data how economic factors contribute to the formation of coalitions.

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1.A Appendix: Value Function Summary

TABLE A1 - BASIC VALUE FUNCTIONS: VALUE OF DEFAULT; VALUE OF REPAYMENT

Symbol	Whose value function	Government composition	Decision
VD_A^A	A	A	default
VR_A^A	A	A	repay
VD_{AJ}^A	A	$A+J$	default
VR_{AJ}^A	A	$A+J$	repay
VD_A^{AJ}	$A+J$	A	default
VR_A^{AJ}	$A+J$	A	repay
VD_{AJ}^{AJ}	$A+J$	$A+J$	default
VR_{AJ}^{AJ}	$A+J$	$A+J$	repay
VD_B^A	A	B	default
VR_B^A	A	B	repay
VD_{BJ}^A	A	$B+J$	default
VR_{BJ}^A	A	$B+J$	repay
VD_B^{AJ}	$A+J$	B	default
VR_B^{AJ}	$A+J$	B	repay
VD_{BJ}^{AJ}	$A+J$	$B+J$	default
VR_{BJ}^{AJ}	$A+J$	$B+J$	repay

Value functions for B, and $B+J$ are symmetric to the ones above, and are thus not shown.

TABLE A2 - SECOND LEVEL: VALUE OF SINGLE-PARTY; VALUE OF COALITION

Symbol	Whose value function	Government composition	Comparison
VS_A^A	A	A	$VD_A^A \quad VR_A^A$
VC_{AJ}^A	A	$A+J$	$VD_{AJ}^A \quad VR_{AJ}^A$
VS_A^{AJ}	$A+J$	A	$VD_A^{AJ} \quad VR_A^{AJ}$
VC_{AJ}^{AJ}	$A+J$	$A+J$	$VD_{AJ}^{AJ} \quad VR_{AJ}^{AJ}$
VS_B^A	A	B	$VD_B^A \quad VR_B^A$
VC_{BJ}^A	A	$B+J$	$VD_{BJ}^A \quad VR_{BJ}^A$
VS_B^{AJ}	$A+J$	B	$VD_B^{AJ} \quad VR_B^{AJ}$
VC_{BJ}^{AJ}	$A+J$	$B+J$	$VD_{BJ}^{AJ} \quad VR_{BJ}^{AJ}$

Value functions for B, and $B+J$ are symmetric to the ones above, and are thus not shown. Value functions in the second level of backward induction correspond to the maximum between two basic value functions (comparison); that maximum is taken by the government (third column); and it is evaluated by the agent in the second column. Note that, under autarky, default is not an option; thus, all the value functions in this table pertain to the case of access to credit markets.

TABLE A3 - THIRD LEVEL: VALUE OF HOLDING POWER WITH ACCESS TO CREDIT

Symbol	Whose value function	Agent taking a decision	Comparison
V_A^A	A	A	$VS_A^A \quad VC_{AJ}^A$
V_A^{AJ}	$A+J$	A	$VS_A^{AJ} \quad VC_{AJ}^{AJ}$
V_B^A	A	B	$VS_B^A \quad VC_{BJ}^A$
V_B^{AJ}	$A+J$	B	$VS_B^{AJ} \quad VC_{BJ}^{AJ}$

Value functions for B, and $B+J$ are symmetric to the ones above, and are thus not shown. Value functions in the third level of backward induction correspond to the maximum between a pair of value functions from the second level (comparison); that maximum is taken by the big party in the third column; and it is evaluated by the agent in the second column. Note that, under autarky, it is never optimal to form a coalition; hence, the value of holding power during autarky collapses to the respective value of default (cfr. table A1).

1.B Appendix: Political Transition Probabilities

Let B'^i, $i = A, AJ, B, BJ$ be some borrowing level; let $\Gamma^i(y, B, M) = 1$ *if coalition* and 0 *otherwise*, $i = A, B$ be some coalition formation rule; and let $i \neq j$. In the case of a symmetric equilibrium, $\Gamma^A(.) = \Gamma^B(.) \equiv \Gamma(.)$, and this is the optimal coalition formation rule. Then, conditional on GDP being y, the political transition probabilities are[46]:

- with initial political states (maj, sin), $i = A, B$:

$$P^i_{(maj,sin,y),(maj',sin')} = [\pi(maj) + (1 - \pi(maj)) \times \sigma] \sum_{y'} Q(y'|y) \left[1 - \Gamma(y', B'^i, maj)\right]$$

$$P^i_{(maj,sin,y),(min',sin')} = (1 - \pi(maj)) (1 - \sigma) \sum_{y'} Q(y'|y) \left[1 - \Gamma(y', B'^i, min)\right]$$

$$P^i_{(maj,sin,y),(maj',coa')} = [\pi(maj) + (1 - \pi(maj)) \times \sigma] \sum_{y'} Q(y'|y) \Gamma(y', B'^i, maj)$$

$$P^i_{(maj,sin,y),(min',coa')} = (1 - \pi(maj)) (1 - \sigma) \sum_{y'} Q(y'|y) \Gamma(y', B'^i, min)$$

- with initial political states (min, sin), $i = A, B$:

$$P^i_{(min,sin,y),(maj',sin')} = (1 - \pi(min)) \times \sigma \sum_{y'} Q(y'|y) \left[1 - \Gamma(y', B'^i, maj)\right]$$

$$P^i_{(min,sin,y),(min',sin')} = [\pi(min) + (1 - \pi(min)) (1 - \sigma)] \sum_{y'} Q(y'|y) \left[1 - \Gamma(y', B'^i, min)\right]$$

$$P^i_{(min,sin,y),(maj',coa')} = (1 - \pi(min)) \times \sigma \sum_{y'} Q(y'|y) \Gamma(y', B'^i, maj)$$

$$P^i_{(min,sin,y),(min',coa')} = [\pi(min) + (1 - \pi(min)) (1 - \sigma)] \sum_{y'} Q(y'|y) \Gamma(y', B'^i, min)$$

[46] For economy of notation, I do not indicate the dependence on the level of debt.

- with initial political states (maj, coa), $i = AJ, BJ$:

$$P^i_{(maj,coa,y),(maj',sin')} = \pi(maj)\,(1-\delta(maj))+(1-\pi(maj))\times\sigma\sum_{y'}Q(y'|y)\,[1-\Gamma(y',B'^i,maj)]$$

$$P^i_{(maj,coa,y),(min',sin')} = (1-\pi(maj))\,(1-\sigma)\sum_{y'}Q(y'|y)\,[1-\Gamma(y',B'^i,min)]$$

$$P^i_{(maj,coa,y),(maj',coa')} = \pi(maj)\times\delta(maj)+(1-\pi(maj))\times\sigma\sum_{y'}Q(y'|y)\Gamma(y',B'^i,maj)$$

$$P^i_{(maj,coa,y),(min',coa')} = (1-\pi(maj))\,(1-\sigma)\sum_{y'}Q(y'|y)\Gamma(y',B'^i,min)$$

- with initial political states (min, coa), $i = AJ, BJ$:

$$P^i_{(min,coa,y),(maj',sin')} = (1-\pi(min))\times\sigma\sum_{y'}Q(y'|y)\,[1-\Gamma(y',B'^i,maj)]$$

$$P^i_{(min,coa,y),(min',sin')} = \pi(min)\times(1-\delta(min))+(1-\pi(min))\,(1-\sigma)\sum_{y'}Q(y'|y)\,[1-\Gamma(y',B'^i,mi$$

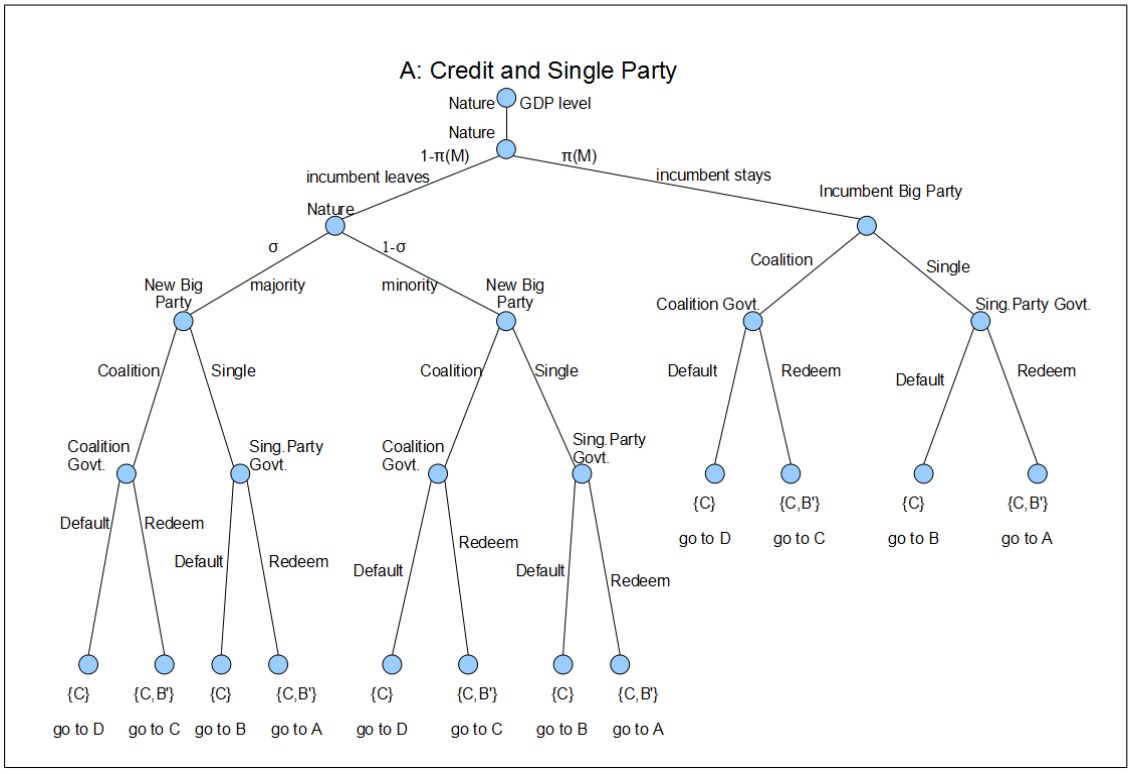
$$P^i_{(min,coa,y),(maj',coa')} = (1-\pi(min))\times\sigma\sum_{y'}Q(y'|y)\Gamma(y',B'^i,maj)$$

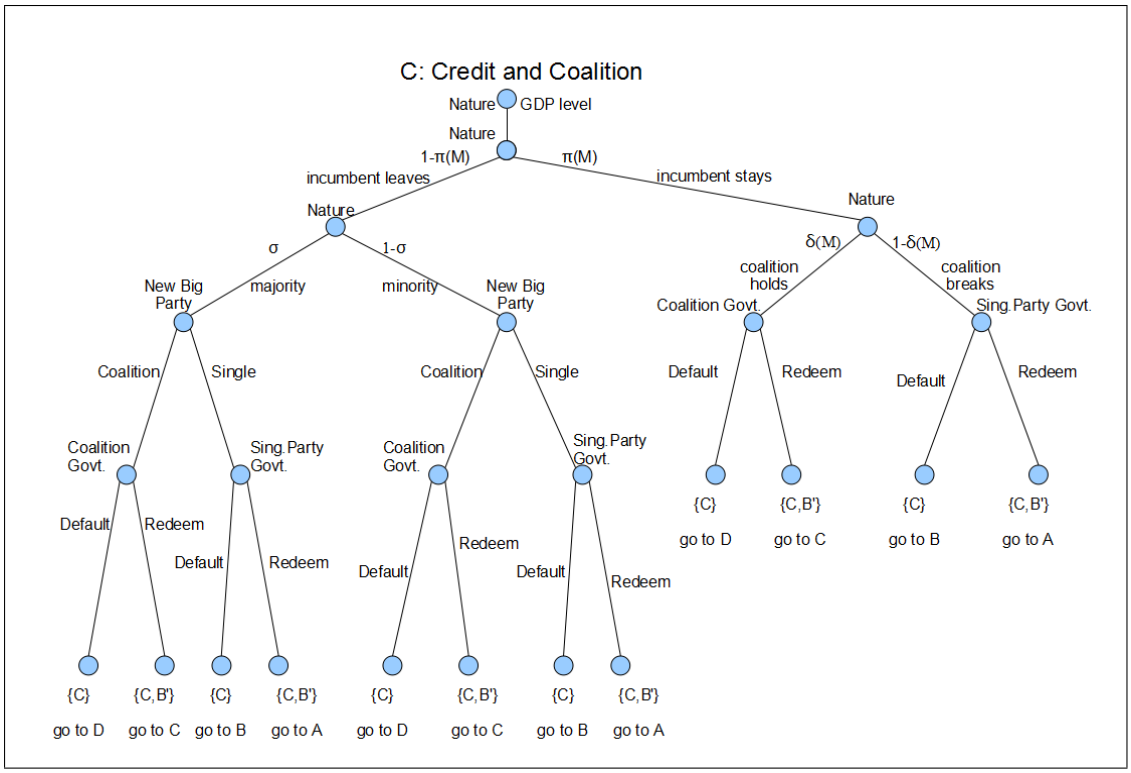
$$P^i_{(min,coa,y),(min',coa')} = \pi(min)\times\delta(min)+(1-\pi(min))\,(1-\sigma)\sum_{y'}Q(y'|y)\Gamma(y',B'^i,min)$$

1.C Appendix: Game Tree

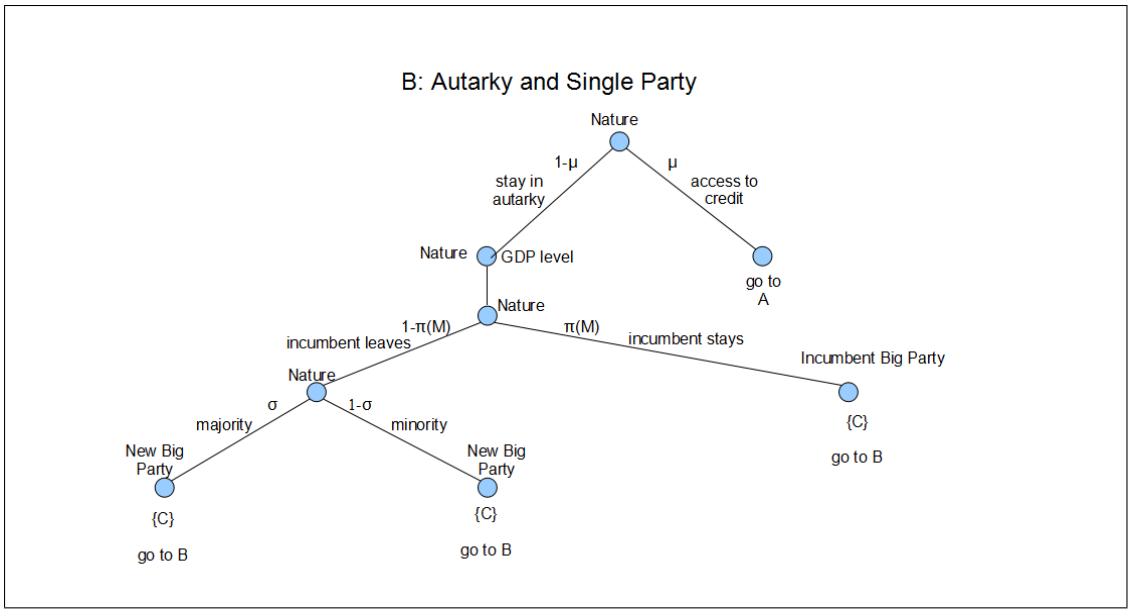
If arrival at *Credit and Single Party* or *Credit and Coalition* happens after default and regaining access to credit, then $B = 0$ and, thus, default is not an option. If arrival at *Credit and Single Party* or *Credit and Coalition* follows a period with access to credit but borrowing was then set to zero, then $B = 0$ in the present period, and, thus, default is not an option either. Default is an option only when B is strictly positive.

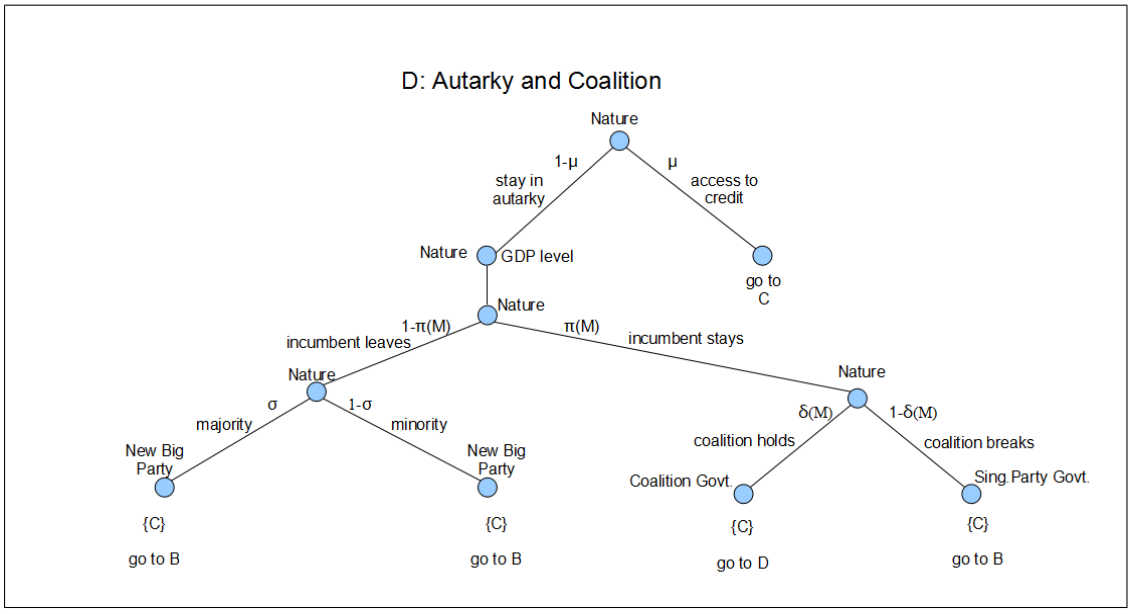
$\{C\}$ stands for the maximization decision over $\{C_A, C_B, C_J\}$ in case of default, while $\{C, B\prime\}$ stands for the maximization decision over $\{C_A, C_B, C_J, B'\}$ in case of access to financial markets.





In autarky, it cannot be optimal to form a coalition, and, thus, that option is not shown. A coalition implies less consumption for the big party, but it can bring it no benefit during autarky. That is because it is not possible to issue debt in autarky and, thus, there is no way to benefit from the higher bond price which may result from the presence of the junior party in the coalition (depending on the combination of borrowing and GDP levels). Should access to credit be regained in the following period, coalition formation may then take place.


B: Autarky and Single Party
Nature
1-μ
μ
stay in autarky
access to credit
Nature
GDP level
go to A
Nature
1-π(M)
π(M)
incumbent leaves
incumbent stays
Incumbent Big Party
Nature
σ
1-σ
majority
minority
{C}
go to B
New Big Party
New Big Party
{C}
go to B
{C}
go to B


D: Autarky and Coalition
Nature
1-μ
μ
stay in autarky
access to credit
Nature
GDP level
go to C
Nature
1-π(M)
π(M)
incumbent leaves
incumbent stays
Nature
Nature
σ
1-σ
δ(M)
1-δ(M)
majority
minority
coalition holds
coalition breaks
New Big Party
New Big Party
Coalition Govt.
Sing.Party Govt.
{C}
go to B
{C}
go to B
{C}
go to D
{C}
go to B

1.D Appendix: Notes on Calibration

This appendix details the empirical method used to calibrate parameters $\pi(maj)$, $\pi(min)$, $\delta(maj)$, and $\delta(min)$. A reference number for σ is also computed.

I begin with the dataset used by Cheibub et al. (2004), which contains country-year observations for most countries of the world in the period 1946-1999.

Considering that my model presupposes that governments may step down in a regular way at any period, and, hence, it is most suited to parliamentary or mixed systems, I drop from the dataset those observations corresponding to dictatorships, and presidential systems.

A *big party spell* is defined as a period during which the biggest party in the government is the same independently of changes in its percentage of parliamentary seats (as long as it remains the biggest in the cabinet). The size of a party is measured by its percentage of seats in the legislative body. Pre-electoral coalitions are considered as parties (for example, Germany's CDU/CSU).

The same spell may cover one or more elections[47]. In this way, the definition of big party spell is consistent with the model, as it does not feature any formal distinction between the circumstances that lead to a big party stepping down (for instance, not passing a vote of confidence, or an election loss). Also, a big party spell may end without elections, because of any circumstances that change which cabinet party is the biggest in terms of representation in the parliament.

[47] There is one case in which a big party spell covers the division of one country into two: Czechoslovakia/Czech Republic in 1992-1993; and there is the case of the German reunification, in which there is one spell starting in West Germany with CDU in 1988, and ending in Germany with CDU/CSU in 1997.

In order to avoid truncated data problems, I do not consider spells which would have to be registered as starting at the first year for which there is data, or which would have to be registered as ending at the last available year. Since I model regular transitions of power, I also do not use spells that ended because of a regime switch to dictatorship, but I do consider spells which start with a transition to democracy.

In case a pre-electoral coalition takes the role of the biggest cabinet party in terms of representation in the parliament, and the pre-electoral coalition breaks, and one of the pre-electoral coalition parties remains in power, and this party happens to be the biggest party in the cabinet after the break, then I register one big party spell for that party, covering the period before and after the pre-electoral coalition break, but I do not register the shorter spell of the party which left the cabinet after the break[48].

There are big party spells during which the big party looses or wins a majority of its own in the parliament. A spell is classified as *majority* if the big party enjoys a majority of its own in the parliament *in the first period of the spell*, and as *minority* otherwise. In this way, the *average duration of the majority spells* is interpreted as the expected time in power for a political party which has just become the biggest party in the cabinet, and which has its own majority; this expected time is independent of whether the big party keeps its majority or not during the spell. In a similar way, I compute the *average minority spell duration*.

Note that, according to the time structure and assumptions of the model, it is never the case that the same big party stays in power while the state maj or min changes. Hence,

[48] There are three such situations: Mauritius 1986-1987, Belgium 1967-1968, and Romania 1993-1994.

my definitions of average spell duration (majority and minority) overestimate the typical amount of time the biggest party stays in the government while keeping its own majority or minority status unchanged[49].

The average majority spell duration, and the average minority spell duration are used to calibrate respectively $\pi(maj)$, and $\pi(min)$.

In the model, the same probabilities $\pi(maj)$, and $\pi(min)$ are used independently of the number of periods the same big party has already survived in power. However, the average spell durations computed from the data refer to the first period a big party forms a government. While it would be possible to calculate average spell durations conditional on the past number of years in power, the inclusion of the respective conditional survival probabilities into the model would render the model intractable.

In the dataset, there are 56 big party majority spells, and the average duration is 8.1 years. For the minority case, there are 122 spells, and the average duration is 4.9 years. The average durations were calculated putting together developing and developed countries, and along many different decades.

In order to calibrate $\delta(maj)$, which is the probability a surplus coalition holds (conditional on the biggest party surviving in power), I calculate the average duration of a *surplus coalition spell*. This is defined as a period within a big-party spell such that: there is more than one party in the cabinet; the seats held by the parties in the cabinet correspond to more than 50% of the parliamentary seats; there is at least one party whose seats are not neces-

[49] Furthermore, the dataset spans many decades, and there is no reason to pressupose that, for any relevant definition of government spell, the mean duration didn't significantly change from one period to the other. For example, Alesina et al. (1992) found that the average government duration was markedly lower after the first oil shock for a set of OECD countries.

sary to guarantee a majority, i.e., an *unnecessary party*; the party composition of the cabinet remains the same, or one or more parties join the cabinet; the cabinet parties' shares in the parliament do not change considerably; and the spell ends when an unnecessary party or an unnecessary group of parties drops from the cabinet.

There are not many surplus-coalition spells wholly included in one big-party spell, and ending before the big-party spell ends. The existing few are usually very short. Much more commonly, there are surplus-coalition periods that are longer, but end with elections, or other circumstances[50].

As I am interested in estimating the average spell duration conditional on no cabinet-changing events taking place, and as there is no evidence or reason to assume that the cause of such events is that the surplus coalition lost one of its unnecessary parties - the longer surplus coalitions are properly seen as truncated[51].

However, omitting such truncated spells would actually exacerbate a problem of average-spell-duration underestimation, as the truncated spells are longer than those which are contained (but less than coextensive) in big-party spells. For instance, there are many cases of truncated spells which last four years (a typical period between two elections), or the remaining years until the following election.

Hence, I include the spells ending with elections which change the composition of the cabinet, and those starting in the first year with data[52].

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[50] As the dataset does not include a marker for election dates, it is presumed that an election took place when the seats held by most parties in the parliament change.

[51] An unnecessary party in one cabinet might not join the next cabinet after elections not because there was any political reason for it to drop out, but because the seats it got after the election, or some other changing circumstances, made it less useful politically.

[52] If an election does not affect the composition of the cabinet, and does not dramatically change parties'

I ignore the truncated spells ending in the last year in the dataset, or those ended seemingly due to special circumstances (for example, Sudan 1988-89). I also do not count the cases in which two unnecessary parties drop from the coalition, when these parties, as a group, were necessary for the majority.

For the calibration of $\delta(min)$, I calculate the average duration of the *minimum-winning coalition spells*. Each is defined as a period within a big-party spell such that: the cabinet is composed by more than one party; the seats held by the cabinet are above 50% of the total number of seats in the parliament; the smallest party in the cabinet is necessary to guarantee a majority; and the spell ends when one party or group of parties leaves the cabinet.

I treat truncated spells in the same way I treat surplus-coalition spells: I consider minimum-winning coalition periods ending with elections, or major cabinet changes, and also those beginning in the first period with data, but not those ending due to special circumstances (for example, a transition to dictatorship), or periods stopping at the last year in the dataset.

The data contains 102 surplus-coalition spells, with average duration equal to 2.5 years, and 90 minimum-winning coalition spells, the average duration of which is 4.0 years. The average durations were calculated putting together developing and developed countries, and along many different decades.

It is very likely that these numbers underestimate the conditional average durations, which could only be observed in the counter-factual world in which, say, elections would

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shares, then it does not terminate the corresponding big-party spell, or the coalition spell.

not take place at any moment after a coalition was formed unless one or more parties dropped, but political parties were not aware of such effect when forming a coalition.

Using a definition of coalition spell that is even more likely to underestimate the average spell duration, for it is stricter than mine, Lijphart (1984) found larger values than the ones computed here: 3.1, and 5.1 years, respectively for surplus, and minimum-winning coalitions. His data pertained, however, only to 20 countries.

The number of coalition spells is bigger than the number of big-party spells because one of the latter may contain more than one of the former, and because the criteria to avoid truncated observations is stricter in the case of big-party spells. Furthermore, there is no correspondence between surplus coalition, and big-party majority, as a surplus-coalition spell may be contained in a period when the biggest party in cabinet lacks a majority of its own.

A reference number for the probability of winning a majority, σ, is found by identifying all the instances in which the biggest party in cabinet changes, and computing the proportion of cases such that the new incumbent holds a majority in the legislative body. Elections that leave the identity of the biggest party unchanged are not counted, as my concern is the probability of winning a majority conditional on the event that a change in the biggest party has occurred.

I count the cases in which, following a hiatus, the same big party returns to the government. For example, between 1956 and 1988, the biggest party in the Sudanese government is the same, but as there are two political hiatus, I record three instances of biggest

party change. This is so even though in two cases there wasn't actually any big-party change, but a change from void of power to government.

I do not control for the electoral system, majoritarian or proportional, for richer or poorer countries, or for any measure of number of parties.

On the one hand, Anglophone countries have longer data series, and most of these countries are likely to have majoritarian systems. On the other hand, the other countries, while having shorter series, are many more in number and most of them are likely to have proportional systems.

There are 310 instances of biggest party change, and the proportion of new incumbents with their own majority is 36%.

The list of countries with the respective number of big-party spells and coalition spells is presented below.

TABLE A4 - NUMBER AND AVERAGE DURATION OF SPELLS

	Big Party		Coalition	
Country	Majority	Minority	Surplus	Min. Win.
Albania			2	
Australia	4	1	1	2
Austria			2	2
Bangladesh			1	
Barbados	2			
Belgium		5	5	9
Belize	3			
Brazil			3	
Bulgaria	2	1	1	
Canada	2	3		
Central African Rep.				1
Comoros		1		
Czechoslovakia/Czech. Rep.		2	1	2
Denmark		8		2
Dominica	1			
Estonia		2		1
Finland		6	9	3
France	2	10	8	5
West Germany/Germany		2	3	6
Greece	3	2		
Grenada	1	1		1
Hungary	1	1	2	
Iceland		8	3	8
India	3	3	1	
Ireland	2	6	1	3
Israel		7	9	4
Italy		1	9	3
Jamaica	2			
Japan	1	3	2	2
Latvia		1	3	
Liechtenstein			1	
Lithuania	1			
Luxembourg		1		8
Macedonia			3	
Mali			1	
Malta	3			
Mauritius	2		6	1
Moldova		1		1
Nepal	1	1	1	2
Netherlands		1	4	4
New Zealand	7			2
Niger		1	1	
Nigeria				1
Norway		8		2
Papua New Guinea		5	1	1
Poland		3	1	2
Portugal		4	1	1
Romania	1	1		
Slovakia				1
Slovenia		1	2	1
Solomon Islands		3		1
South Africa			1	
Spain	1	1		
Sri Lanka		2	2	1
St. Kitts and Nevis	1			
St. Lucia	1			
Sudan			2	
Suriname		1	2	
Sweden		6		3
Thailand			5	
Trinidad and Tobago	2			
Turkey	2	6	1	3
United Kingdom	5			
Vanuatu		2	1	1
Number of spells	56	122	102	90
Average duration in years	8.1	4.9	2.5	4.0

Sources: Cheibub et alea (2004), and my calculations.

Notes: A "big-party spell" is a period during which the biggest party in the cabinet is the same, irrespective of changes in its parliamentary representation, and regardless of events such as an election. A spell is classified as "majority" if the big party enjoys a majority of its own in the parliament in the first period of the spell, and as "minority" otherwise. A "surplus-coalition spell" is a period of coalition government in which at least one of

the parties in the cabinet is not necessary for a majority in the parliament. A "minimum-winning coalition spell" is a period of coalition government in which the smallest party in the cabinet is required for a majority in the parliament. Cfr. Appendix D for details and discussion of these definitions.

Chapter 2
On De Facto Political Power, Rent Extraction, and Tenure[53]

Abstract

A political leader redistributes income between herself and society in a deterministic endowment economy. Higher rent extraction leads to higher odds of deposition. To overcome the trade-off between rent extraction and survival in power, the leader deviates resources from her consumption into de facto political power. Society can depose the leader if it is able to buy back the de facto power investments, and face other deposition costs. In equilibrium, the leader will be able to last longer in office than in the case when investment in de facto power would not be possible. The model differences between democracy and non-democracy are kept to a minimum, and leaders are assumed to behave in the same way regardless of political regime. In democracy, leaders stay in power much shorter periods, do not invest in de facto power, and in most cases appropriate less resources. The model thus accounts for important aspects of the data on durability in power and government effectiveness in both democracies and non-democratic regimes. It prescribes a high degree of independence of the economy from government for the purpose of achieving potential GDP; short-term limits and regular checks on the executive power; and great scrutiny of public procurement and spending on security and defense.

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Keywords: Dynamic incentives, political economy, rent extraction, de facto power, democracy

JEL Classification: A12; B34; C56; D78

2.1 Introduction

> Good policy is bad politics, good politics is bad policy. *Bueno de Mesquita et al. (2003): "The Logic of Political Survival"*.

Studies about the survival of leaders have shown that the ones who hold onto power best are far from being the most civic-minded, democratic, and benevolent (cfr. Bueno de Mesquita et al., 2003, hereafter BM). Moreover, democratic leaders seem to stay in power for much shorter periods than their counterparts in non-democratic regimes. Using the Archigos (2009) database on political leaders, and the Worldwide Governance Indicators (2009) I show in Table 1 below that the countries where leaders, on average, stayed the longest in power register relatively low levels of "government effectiveness".

In this paper, I model the conflicts of self-interest that world leaders typically face. In a deterministic endowment economy, a political leader has the power to decide redistribution of income among herself and society. I assume such redistribution policies have no distortion effects (*no redistribution vs. efficiency trade-off* assumption) and that full income confiscation is possible.

The leader extracts rents for her own sake, but the more she extracts, the greater the likelihood of her deposition. This is the *survival in power vs. rent extraction trade-off*.

For a given fraction of income to be left for society, the leader chooses how to use her own share. She can spend it in consumption, and in investment in *de facto political power:* this is the *consumption vs. de facto power trade-off*.

De facto political power corresponds to the stock of any type of resources that make it more difficult for society to depose the incumbent leader. For example, in the real world leaders may allocate resources to repression mechanisms, such as a secret police, and they may try to gain control over the mass media, or the higher echelons of the judiciary.

For a given redistribution of income, the exact balance between leader consumption and investment in de facto political power has consequences for the odds of leader deposition.

The model in this paper is thus intended to explain the mechanism that allows leaders to break the trade-off between rent-extracting activities and survival in power. The crucial element of that mechanism is de facto political power.

TABLE 1 - TEN HIGHEST AVERAGE TENURES (1975-2004)

	average tenure *1975-2004*	government effectiveness *2004*
Cuba	46	−0.69
Togo	38	−1.44
Gabon	37	−0.74
Brunei	37	0.06
Libya	35	−0.69
Oman	34	0.41
UAE	33	0.69
Jordan	26	0.15
Maldives	24	0.15
Tunisia	24	0.44

"Government effectiveness 2004" takes values in the interval [-2.5;2.5], with mean 0, unit standard deviation, and with higher values meaning better governance. Source: Kaufmann et alea (2009a), *Worldwide Governance Indicators*. "Average tenure 1975-2004" computed by myself using the *Archigos* database (Goemans et alea, 2009a). For the detailed explanation of both variables cfr. Appendix A.

Investment in de facto political power can take many forms. Examples of these include: control over the mass media and trade unions, getting the support from the military either by corrupting it, directing more resources to that sector, or increasing conscription intensity, buying support from specific interest groups or economic sectors, such as landowners, the use of political repression (e.g., censorship, secret services and police, imprisonment and killing of political opponents, use of death penalty). All of the above are costly and largely wasteful.

Certainly, the composition and intensity of de facto power investment is correlated with the presence or absence of democracy (Acemoglu and Robinson, 2006, Mulligan et

al., 2004)[54]. However, it should be noted that at least some of the possible forms of de facto power can also be observed in democracies. In this paper, I do not make a distinction among the different forms that de facto power can take. Instead, I model the investment in de facto political power as the total sum over those possible forms, and I represent it as one of the leader's control variables.

In the model, a society, whether democratic or not, has the possibility of deposing its leader. That possibility is costly, though, and one of the components of the total cost is the amount of resources invested by the leader in de facto power. Thus, one possible interpretation of the model is that the leader buys political support through investment in de facto political power; and the society, in order to depose the leader, ought to buy back those supporting the leader.

In the real world, deposition occurs in different ways: an election where the incumbent is voted out, a vote of no confidence, a coup, or a revolution, etc.. I assume away the types and specificities of the deposition process, say, whether it is initiated by a specific group or by the population in general, whether its origin is civil or military, etc.. I also assume away a specification of the identity of those supporting the incumbent leader[55].

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[54] The "selectorate theory" presented in BM does not "preclude corruption in *large-W systems*; rather, history suggests such systems are relatively less corrupt than their small-coalition contemporaries". Large-W systems are mostly associated with democratic regimes in the sense of serving the interests of the majority (Acemoglu and Robinson, 2006).

[55] A possible extension of the model can explicitly include a "bureaucracy" sector.

2.1.1 Democracy and non-democracy

The distinction between democracy and non-democracy is kept at a minimum in my model - up to a few parameters. There are four reasons for that modeling choice.

The first reason is the axiomatic stance that leaders have the same objectives independently of the regime in which they act. It is institutions that constrain their behavior in ways that either lead to socially beneficial or socially harmful policies and outcomes (BM). Thus, the only regime features that I explicitly model, as parameters, are those which constrain a leader's behavior, and which are exogenous to her actions.

Second, I take as fact that deposition and investment in de facto power are possible and take place in all kinds of political regimes. Surely, removal of incumbent politicians is much more difficult in consolidated autocratic regimes, but that is in part the effect of their own de facto power investments. Hence, the level of difficulty in deposing a leader is (at least to a certain extent) endogenous. For this reason, I only minimally impose the type of political regime in the model.

Democracy and non-democracy seen as an outcome, that is, whether policies favor the majority or the ruler (Acemoglu and Robinson, 2006) will be mostly an endogenous result in my analysis. Specifically, low-rent extraction, and relatively short duration in power will be deemed as democratic outcomes, and the opposite will qualify as "non-democracy".

Third, Mulligan et al. (2004) have supported empirically that

"economic and social policies in all kinds of countries are to a first approximation the

outcome of tradeoffs (...) not specific to particular political institutions"

and that

> "The main empirical differences [between democracies and non-democracies] - both in the cross-country regressions and in the time series of countries with dramatic regime changes - are for policies relating to the process of winning and maintaining public office, rather than the social and economic policies featured in so many positive theories of the public sector".

Hence, I disregard all specific economic and social policies except redistribution and total investment in de facto power, which is approximately the same as "policies relating to the process of winning and maintaining the public office". These policies are the main focus of the model and will be endogenously determined through it. Also, I do not need to exogenously incorporate a specific political regime into the model, as the model is not designed to make any predictions on other "economic and social policies", and because, as implied above, those policies are not strongly associated with any particular regime type.

A fourth and final reason that applies mainly to democracies: Persson and Tabellini (2003) show that electoral rules (majoritarian versus proportional rule) and forms of government (presidentialism versus parlamentarism) have little explanatory value for corruption and government effectiveness in the provision of public services (they use the same government effectiveness variable as I do plus two others, all of which are highly correlated). Hence, it is legitimate that my analysis of the duration in power vs. rent extraction trade-off ignores those political features should it be applied only to the study of democracies[56].

[56] The same authors have found that low barriers to entry into politics (large number of legislators elected

The next section presents a literature review with a focus on the papers most closely related to this one. Section three describes the model in detail. Section four presents and discusses the main results, and makes policy recommendations. Finally, section five concludes.

2.2 Literature review

In order to investigate why autocratic leaders last in office so much longer than democratic leaders, BM built a model where the type of institutions has an effect on the quality and democratic benevolence of policies chosen by political leaders. These, in turn, might be successful in shaping institutions in order to stay longer in power. The fundamental axiom of the analysis is that any leader, regardless of political regime (democracy or some specific type of non-democracy), desires to keep her power above anything else, and that objective has consequences for most policies. Self-evident as it may seem, such a hypothesis has not always been the basis of economic analysis.

Indeed, the political economy literature has increasingly shifted focus from the *benevolent social planner* approach to the *self-interested ruler assumption*. The first perspective was seminally undertaken by Tinbergen (1952), and Theil (1956), and continued by the rational-expectations pioneers (Kydland and Prescott, 1977, and Barro and Gordon, 1983). Virtually all papers on optimal policy embrace the assumption of the benevolent social planner.

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per district) and whether citizens directly choose their representatives or vote in party lists (bloc voting) are significant in explaining corruption and government effectiveness. Such level of institutional detail, however, is beyond the scope of this paper.

In the optimal policy literature, a government sets some policy instruments that will impact on economic targets (say, inflation and unemployment) in order to achieve a social welfare maximum subject to some resource, structural, and time-consistency constraints. The benevolent social planner assumption is meant mainly to describe the most relevant benchmark of first-best policy (maximization of social welfare), that is, what economic authorities *should* do. This benchmark is also used to assess the impact of many possible distortions (first-best versus decentralized economy with market imperfections, etc.).

Government appears as an exogenous entity, whose preferences are implicitly described as identical to those of society, and whose role is to engineer some socially optimal outcome. Society is modeled as an absolutely homogenous entity where any agent is representative of the whole.

This approach fails to explain why governments so routinely and intensely deviate from the prescribed optimal policies, and why countries with similar resources and aims perform so differently (Alesina, 1994). The reasons for that failure are mainly the omission of government's own selfish preferences and a polity's institutions, and the assumption of no conflict of interests within society.

The self-interested ruler assumption was used when the link between political institutions and economic consequences became the major topic of analysis. This perspective was pioneered by Nordhaus (1975), Lindbeck (1976), and MacRae (1977), who assume political leaders only care for re-elections, and by Hibbs (1977), for whom leaders represent the interests of different platforms who favor either unemployment reduction over infla-

tion reduction or vice versa[57]. These studies rely on the assumptions of backward-looking citizens, and the existence of an exploitable Phillips curve.

Those assumptions were later relaxed by the rational-expectations school. Major contributions are those of Cukierman and Meltzer (1986), Persson and Tabellini (1990), Rogoff (1990), Rogoff and Sibert (1988), all of which have developed models of opportunistic leaders, and Alesina (1987), Chappell and Keech (1986, 1988), who proposed models of partisan politics.

Typically in this literature, rulers, who may or may not have ideological preferences, are interested both in *rent extraction,* and in staying in office as long as possible; and there may be different ideologies and preferences within society. Thus, in this type of analysis, not only the typical economic trade-offs exist (say, inflation versus unemployment) but there may also be conflict on *which outcome* should be considered superior.

The ruler may have conflicting objectives as well (especially but not only in democracies): staying longer in power may require introducing new forms of economic distortion which, in turn, reduce the size of the economy and the disposable income of the ruler.

2.2.1 Related approaches

This paper draws most of its inspiration from Bueno de Mesquita et al. (2003, BM), Acemoglu, Golosov and Tsyvinski (2008, hereafter, AGT), and Acemoglu and Robinson (2008, hereafter, AR)[58]. A comparison between my analysis and theirs follows.

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[57] Frey and Schneider (1978) present a trade-off between ideology and opportunism in which concerns for the first are honored as long as keeping incumbency is highly probable.

[58] Other closely related works are Acemoglu and Robinson (2000, 2001, and 2006a), Ticchi and Vindigni (2005), Jack and Lagunoff (2006), and Lagunof (2006).

I agree with the axioms put forth in BM that all leaders have exactly the same goals independently of the specific regime in which they act, and that it is the "Selection institutions[59] (...) [that] explain the differences in policy choices across all regime types". Without exception, all leaders attempt to stay in power for as long as possible and to personally benefit from that power as much as possible. Hence, I do not assume anything about a leader's adherence to principles of good governance, nor do I distinguish between democratic and non-democratic leaders. Rather, it is institutions that matter. Institutions lead politicians either to civic-minded or to socially undesirable behavior, irrespective of their personal beliefs and idiosyncrasies.

With these postulates in mind, both BM and this paper aim at encompassing all forms of political regimes within a single theory. Both works use data from most countries of the world.

Both BM and I seek to answer the same question: Why do leaders who implement "bad policies" last longer than those who implement "good policies"? The focus of the two works, though, is different. BM zeros in on the institutions that select leaders. They create a continuum of those institutions based on two numbers: the relative size of the *winning coalition* (those who directly support the leader) and the *selectorate* (those who have a say in deciding who the leader should be).

As against this very general definition of selection institutions, I consider a specific mechanism that enhances a leader's survival in office, namely, de facto power. Whereas BM propose a way to classify all regime types using a single ratio of parameters, and while they

[59] Those regulating the selection of leaders.

demonstrate the relevance of that ratio in predicting many economic and political outcomes, my research examines a particular mechanism to enhance survivability in power.

From the perspective of BM's theory, de facto power can be seen as the total sum of resources that have been spent by the leader in order to retain the support of the winning coalition. Then, citizens can counteract a leader's de facto power by buying back the individuals who support the leader. Citizens' spending in de facto power, which I do not model, can thus be interpreted along BM's theory too, specifically, as a challenger (or some citizens supporting him) buying the support of some members of the current winning coalition.

Whereas in BM's book good policies are peace and prosperity, my paper does not consider war/peace issues, economic growth and tax distortions. I investigate a purely redistributional issue, that is, how much of a fixed income goes to citizens, and how much goes to the leader.

For these objectives, I need only model a minimum of institutional and economic detail, which is also the methodology adopted by BM. This parsimony in institutional specification enlarges the scope of application of both models.

Finally, both BM and I treat leaders as individuals, which differs from the analysis of elite members versus citizens developed in Acemoglu and Robinson (2006) and (2008).

AGT present the rent-extraction/survival in power conflict in an extreme way: a leader is able to confiscate all the economy's wealth, but the immediate consequence of that policy is deposition; also, the time-consistent renegotiation-proof equilibrium features

a leader surviving in office forever and receiving a minimum of utility. Hence, their paper cannot account for leader turnover, which is one of my aims.

While the leader in their paper is self-interested, the regime is democratic in the sense that deposition can take place at any time. Further, under the assumption of the leader being sufficiently patient, aggregate distortions (in labor supply and investment) stemming from political economy disappear (there are still transfers from society to the leader)[60].

Thus, AGT's model predicts that a self-interested leader in a democratic regime will keep office eternally (no political turnover and no deposition) and, as long as she is patient enough, no efficiency distortions will exist in the long run.

This is at odds with the findings in BM and in my empirical exercise above. In BM, civic-minded politicians (in democratic regimes) who pursue socially desirable policies are shown to hold onto power for shorter periods than self-interested leaders, who last longer in power at the expense of the general welfare. Furthermore, in most contemporary democracies, spells in power are much shorter than infinity, and cases of pork-barrel spending, patronage, illegal party and campaign funding, corruption, etc. are not uncommon.

Even if AGT's politician is interpreted, instead, as a political party, a democracy where the same party always stays in power is an exceptional case (should there actually be any such case).

AGT's model is, thus, not adequate to match some important facts concerning duration in power of leaders, namely, that most leaders exit office for reasons other than natural

[60] This differs somewhat from the mechanism implied in the "encompassing interest" theory (Olson, 2000).

death, and that turnover is higher in those countries where government effectiveness is high, and, hence, where economic distortions are relatively smaller.

My model is aimed at analyzing the survival in power/rent extraction conflict in both democracies and non-democratic regimes and matching the basic empirical facts of power turnover, and of democracies displaying higher government effectiveness, than non-democracies.

Acemoglu and Robinson (2008, AR) model investment in de facto power. In their model, “economic institutions” (wage-rent pairs favoring either workers or the elite) and “political institutions” (whether workers have some de jure political power or not, and whether it is workers or the elite who benefit from public goods) are chosen by who has more overall political power. This is the sum of de jure and de facto powers. Both the elite and the workers can invest in the latter.

Labor is inelastically supplied and public goods are provided at no cost. There are two different public goods, and each enters the utility function of either citizens, or elite members.

Income is fixed but subject to a distortion in the case of economic institutions favoring the elite. Thus, AR’s model is one of a redistributional issue, but where a distortion in total output is created when redistribution favors the elite.

Whether the political regime is democratic or not has many direct consequences. First, the marginal power of resources invested in de facto power depends on it (for both groups in society). Hence, there is a "technology" which transforms resources into de facto power, and this "technology" depends on the regime itself. Second, if there is democracy

(non-democracy), citizens (the elite) can choose which type of public goods to provide. Finally, only if there is democracy will the citizens benefit from a fixed amount of power.

My paper centers on investment in de facto power, for which there is also a technology, but it ignores de jure political power. More importantly, while the deposition of the leader may be thought of as the citizens buying back those who support the leader, I do not model investment in de facto power by the citizens.

Democracy is an essentially nominal concept in AR's model. What matters therein is who (citizens or the elite) has more *overall* political power (de jure plus de facto). The "group in power" may be the elite even though the nominal political state is democracy. The group in power determines economic institutions in the current period (i.e., GDP redistribution) and sets political institutions in the next period.

Differently from AGT, in AR there can be turnover of regimes (democracy and non-democracy)[61]. There is also turnover of the group with the highest overall political power.

Under assumptions, the equilibrium features a regime-switching structure: "society fluctuates between democracy and associated competitive economic institutions and non-democracy with associated labor repressive economic institutions". While AGT featured no depositions and no turnover, AR seems to predict too-extreme institutional variability: are there any examples of full institutional fluctuation, that is, simultaneous change of political and economic institutions in a cyclical way?

[61] The identity of players is always the same: elite members and citizens keep their status independently of the regime.

The same equilibrium, however, also features *persistence* in the sense that the equilibrium probability that the elite will keep having more overall political power than the citizens is strictly bigger in the case of non-democracy. This means that non-democracy is more likely to be followed by non-democracy than by democracy, and analogously for democracy. This, however, seems only to guarantee that the predicted fluctuation, on average, will not display very short cycles; but when change happens, it is likely to be of both political and economic institutions.

Under more severe assumptions (namely, that it takes more overall power to change regime type than to change economic institutions), *captured democracy* becomes an equilibrium. This is the case in which a country remains nominally democratic while economic institutions favoring the elite persist.

A corollary of the above-noted results is the phenomenon of *invariance*. Under the assumption that the marginal effect of the elite's de facto power is the same under democracy and non-democracy, the probability that the elite will have more overall power and, thus, decide redistribution, is the same in both political regimes. This is the same as saying that the likelihood of repressive economic institutions does not depend on the nominal political regime but only on the amounts of de facto power.

My model is in line with this prediction: since what matters for economic outcomes is investment in de facto power and not which nominal regime type is in place, I model the regime type only minimally.

The distribution of de jure power established by the political state can, thus, be partially or fully offset by investment in de facto power. De jure power is not absolutely

determinant of anything. For example, the overall effect of economic regulation in democracies in the real world is sometimes less competition, an outcome that tends to favor some economic elites at the expense of the general welfare.

This result is somewhat similar to the above-presented conclusion found in Mulligan et al. (2004): democracies' and non-democracies' policies differ mainly with respect to those policies directly related to maintaining power; institutions may equally protect an economic elite in both a democracy and a non-democracy. In AR's model, the elites may be at an advantage in both democracies and non-democracies. For these reasons too, I do not impose a political regime into my model, which, thus, will be silent about the precise nature of the de jure political setting.

AR's model presumes that a representative of each group (i.e., elites and the citizenry) takes the decisions in the name of her group, and that all group members share the same preferences. Hence, the players in AR are not individuals but two groups, each of which can be seen as an individual player. Thus, the AR model explains turnover of regimes in a model of the interaction between two groups[62].

My approach differs from the one taken by AR in that I am not interested in the turnover of the relative power of different groups, or in regime changes. Rather, I am concerned with the turnover of the individual in power (the leader), for which I have data. It is not important to me whether this individual originally belonged to the citizenry or to some elite, nor is it of interest what her faith after stepping out of power will be[63].

[62] What matters in both my work and that of AR is the sum of individual investments in power: de facto power is by nature a public good.

[63] As a matter of fact, there are data for that too.

Furthermore, in my model leaders are not concerned with maintaining institutions; their only goals are to obtain resources for themselves, and to stay in power for as long as possible. My model has very few institutional details when compared with AR, and it is appropriate to match data concerning the duration of individuals in power.

A controversial result in AR is that in equilibrium citizens do not invest in de facto power (regardless of whether it is a democracy or a non-democracy). This result seems very odd: in both democratic and non-democratic regimes there are always some forms of organized opposition. In all regime types, non-politicians spend resources aimed at changing political leadership. These activities should be positive in equilibrium[64].

2.3 The model

2.3.1 Environment, timing, and information

Society is composed of a continuous of identical individuals forming a unity[65], and of a large group of fungible potential leaders. The economy is of the deterministic constant endowment type, and time is discrete.

An incumbent leader has the power to redistribute total income between herself and the citizenry. Furthermore, the leader allocates her income share between consumption, and investment in de facto power.

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[64] My model ignores the “who” and “how” questions concerning citizens’ de facto power investment: how society or a subgroup of it solves the collective action problem and inherent free-rider issues, how it comes together to invest in de facto power, how it takes decisions, etc..

[65] The "selectorate" in BM’s terminology.

In each period, the citizenry may decide to depose the leader. Deposition leads citizens to incur a utility cost, which is formed by two components: the amount of extant de facto power, and a random component. Citizens observe the value the random component takes before they decide whether or not to depose the leader. The leader knows the distribution of the random part of the deposition costs but she doesn't observe its value. The random cost of deposition is identically and independently distributed.

Each time period is divided into three moments:

1. a quantity y of pure manna is delivered to the economy; there is a leader who has either just been assigned to power (randomly from their large group) or was already assigned in some previous period; in the first case, the stock of de facto power is nil ($\phi^0 = 0$), and the leader is supposed to guarantee an exogenously determined minimum life-time utility level of ω^0 to the citizens; in the second case, there may be some level ϕ of de facto power from previous periods, and the leader is supposed to honor her previous lifetime utility promise ω; the random component d of the deposition technology is exogenously determined, and it is revealed to the citizens (but not to the leader);

2. the leader announces to the citizenry her proposed policies $\{\lambda, \omega', \phi'\}$: λ is the share of income the leader will retain for herself, with $0 \leq \lambda \leq 1$; the leader commits herself to a new (or the same) life-time utility promise ω' before the citizens; and ϕ' is the new level of de facto power;

3. given the announced policies, and the knowledge of the shock d, the citizens decide to keep the leader in power or to depose her:

(a) in the case the leader is kept in power, the proposed policies are implemented; depreciation of the existing stock of de facto power takes place at a period rate δ; the leader spends some part (or none) of her share of income in investment in political de facto power so that, at the beginning of the next period, the total stock of power will be ϕ'; this investment is observed by the citizens; they consume their $1 - \lambda$ share of GDP, and the leader consumes her share minus the resources allocated to de facto power investment (if any)[66];

(b) in case of leader deposition, the citizens suffer a utility cost $d + \phi$, with ϕ being the stock of de facto power at the beginning of the period; this stock collapses to zero after deposition; citizens face also a GDP loss corresponding to the upheaval caused by having to endure one period with no leader in power; consumption takes place, with the citizens getting only ξy, with $\xi \in (0, 1)$ being the "initial cost of anarchy"; the deposed leader enjoys her exogenously determined outside option Ψ; a new leader is assigned to power.

2.3.2 Deposition technology

Deposition leads the citizenry into incurring in one utility cost, and one income cost. The utility cost has two components: the random component d; and the existing stock of de facto power, ϕ. Deposition costs are incurred only if deposition takes place.

[66] As it will be shown below, I assume that some part of the resources invested in de facto power may also be consumed by the leader. For example, an investment in personal security forces not only makes deposition more difficult, but it is also directly beneficial to the leader.

In order for society to depose the leader, it must spend resources and time corresponding to an utility loss of $d + \phi$.

The component ϕ corresponds to the resources the leader has paid to some bureaucrats or key figures in society so that these individuals will support her[67]. It may also be interpreted as a stock of capital whose output is a stream of services aimed at preserving political leadership.

Therefore, the deposition of a leader requires that society must *buy back* those influential people or bureaucrats, or capture the capital that helps the leader stay in power. The citizens are, thus, forced to engage in some utility-diminishing activities aimed at counterbalancing the effects of the accumulated de facto power[68].

Citizens cannot themselves create their own secret services, buy big broadcasters, or raise an army. Thus, their political efforts leading to deposition are best described by a utility loss rather than by the accumulation of physical resources.

The component d represents all the random forces, in favor or against, that relate to the deposition of a leader. It encompasses the costs of organization and coordination of society so that it decides for deposition, but it also includes the pure benefits accruing from a change in leadership[69]. Thus, this cost component is in general positive, but it may also take negative values. Furthermore, it comprises any external factors with impact on

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[67] The "winning coalition".

[68] The rate at which an existing stock of de facto power translates into an utility loss may be more generally modelled as $\gamma\phi$, where γ takes values on $(0; +\infty)$. A very high γ may be thought of as implying that the price bureaucrats ask from society to betray the leader is higher than the price the leader had previously paid them when buying their support.

[69] These pure benefits should not be confused with those arising from a possibly different redistribution of income due to leadership change.

a leader's survivability, such as pressure from the international community for leadership change.

Also, the difficulty of the collective-action problem at a given period is captured by d. It is likely to be easier to gather efforts to depose a ruler when she enjoys low levels of popularity. In such cases, deposition per se may have a positive impact on the well-being of the citizens. Hence, d may be interpreted as well as a measure of a leader's popularity.

The balance at a given time between the coordination costs (pressure for higher d) and the pure benefits from the removal of an unpopular leader (pressure for lower d) determines the sign of d.

When it takes negative values, d favors society. A negative value of d also corresponds to any fortuitous circumstances that make it especially beneficial for (some) citizens to self-organize and depose the leader.

Many factors may converge in helping or preventing society (or a part of it) from coordinating towards a specific political decision. They range from the difficulties associated with collective action to the asymmetrical personal benefits accruing from political change. We assume those factors are exogenous to the model, have a random nature, and also that they are not, as a whole, serially correlated: that is, they are highly unpredictable.

It is assumed, thus, that d is an i.i.d. random variable.

With the leader deposed, society must endure one period of "anarchy", in the sense of absence of government. Without leadership, many functions of government cannot be accomplished, and the consequence is a loss of GDP, denoted by ξ. This is the "initial cost of anarchy"; it is an income cost.

2.3.3 Incumbent leader's objective function

A political leader can find herself in two possible situations: she has been newly assigned or she is already incumbent. The main difference is that the incumbent leader is supposed to honor the utility promise ω she made in the previous period to society, whereas the newly assigned leader brings no commitment from the past and is, thus, subject to an hypothetical promise ω^0, which may be constitutionally defined.

I commence by presenting the incumbent leader's problem and, in the next section, I state the two specificities of the newly assigned leader's problem.

The objective function of the incumbent leader is the following:

$$V(\omega,\phi)=\max_{\{\omega',i,\lambda\}}\left[1-P^d(.)\right]\left\{U^L(\lambda y-\alpha i)+\beta^L E\left[V(\omega',\phi')\right]\right\}+P^d(.)\Psi \tag{2.46}$$

where i stands for investment in de facto power. De facto power accumulates according to:

$$\phi'=(1-\delta)\phi+i \tag{2.47}$$

The objective function is thus rewritten as the following Bellman equation:

$$V(\omega,\phi)=\max_{\{\omega',\phi',\lambda\}}\left[1-P^d(.)\right]\left\{U^L\left[\lambda y-\alpha\left(\phi'-(1-\delta)\phi\right)\right]+\beta^L E\left[V(\omega',\phi')\right]\right\}+P^d(.)\Psi \tag{2.48}$$

Bellman equation: $V(\omega,\phi)$ is the value function of the incumbent leader; it depends on the utility she has promised (ω) to the citizenry in the previous period, and on the stock of de facto power from previous periods (ϕ). $U^L(.)$ is the instantaneous utility function of

the leader; I assume it to be of the CRRA type, with parameter ρ^L. β^L is the time-discount factor of the leader, with $\beta^L \in [0,1]$. E is the expectations operator.

The leader's choice variables are ω', λ, and ϕ': ω' is the utility value promised in this period (which will be carried on to the next period should the leader remain in power); λ is the share of national income the leader takes for herself. She divides her income share between her own consumption and investment in de facto political power. The total stock of power at the end of the period is given by ϕ'.

These choice variables are announced by the leader, and are only made effective should the leader survive in power.

The stock of de facto power evolves according to (2.47). It is subject to depreciation, the rate of which is $\delta \in [0,1]$. Whether de facto power is physical in nature or intangible it depreciates: while buildings and weapons wear out, loyalties and trust may dissolve with time. Also, de facto power depreciates as a fraction of people, government agencies, and institutions who previously supported the leader defect.

De facto power takes time to be built: the announced level ϕ' is reached at the beginning of the following period (should the leader be kept in office).

Leaders enjoy direct benefits from spending in de facto power (other than increasing their survivability chances). For example, a leader who buys control over a mass media group not only increases her odds of staying in power but also earns profits from that investment. To account for those benefits, I model the fraction of de facto power investment that does not yield direct benefits for the leader as $\alpha \in (0,1]$.

Should α take the value 1, all de facto power spending corresponds to private goods granted to the leader's supporters, such as gifts, which cannot be enjoyed by the donor; lower values of α mean a bigger share of "public goods" in the de facto power bundle. These "public goods" are consumed both by those supporting the leader, and the leader herself (but not by the representative citizen).

Alternatively, the parameter α is the marginal cost of producing one unit of de facto power.

$P^d(.)$ is the probability of deposition; it is derived from the survival condition (see below). Ψ is the exogenous outside option of the leader; that is, it is her life-time utility in the event that she is removed from power. While in the real world former leaders may enjoy generous pensions after they retire from politics, others may be removed from power by death. The variation of post-politics outcomes is great (but the removal by death is probably more likely in non-democracies); a database on those outcomes exists.

2.3.4 Survival in power, and the probability of deposition

The leader is subject to a set of constraints. A leader is deposed if the following *survival condition* is not honored:

Survival condition [SC]*:*

$$U\left(\left(1-\lambda\right)y\right)+\beta\omega'\geq U\left(\xi y\right)-d-\phi+\beta\omega^{0} \tag{2.49}$$

The leader survives in power if the option of deposing the leader today is less valued by the citizens than the present expected utility they have just been offered. It depends on

the contemporary realization of the random variable d. Should deposition and keeping the same leader yield the same value, it is assumed that citizens keep the leader.

The LHS of (2.49) is the value for the citizenry from keeping the leader; it depends on the announced policies λ, and ω'; it consists of the utility from current period consumption when the announced share λ is applied, plus discounted promised utility; $U(.)$ is the utility function of the representative citizen; it is assumed to be of the CRRA type, with parameter ρ; β is the citizens' time-discount parameter.

The RHS of (2.49) is the value associated with deposition; in such case, the citizens do not have to share the GDP (y) between them and the leader, but total income suffers a loss of ξ; the value of deposition is thus composed of the utility from consuming ξy, minus the deposition utility costs d and ϕ, plus the discounted value of the citizens outside option, ω^0. This is the value for citizens when a new leader has just been assigned; it is the (possibly constitutionally inscribed) hypothetical utility promise new leaders should honor.

From (2.49), the leader remains in power when

$$d \geq U(\xi y) - U((1-\lambda)y) - \phi + \left(\omega^0 - \omega'\right)\beta \equiv d^* \tag{2.50}$$

With CRRA utility:

$$\begin{aligned} d &\geq \frac{(\xi y)^{1-\rho} - 1}{1-\rho} - \frac{((1-\lambda)y)^{1-\rho} - 1}{1-\rho} - \phi + \left(\omega^0 - \omega'\right)\beta \\ d &\geq \frac{\left[\xi^{1-\rho} - (1-\lambda)^{1-\rho}\right] y^{1-\rho}}{1-\rho} - \phi + \left(\omega^0 - \omega'\right)\beta \equiv d^* \end{aligned} \tag{2.51}$$

Assuming d follows a continuous uniform distribution with support $[d^{min}, d^{max}]$, deposition takes place when the shock d is strictly smaller than d^*. Then, the probability of deposition is:

$$P^D = P^D\left(\omega', \lambda; \phi; \beta, \omega^0, \xi, \rho, d^{max}, d^{min}\right) = \frac{d^* - d^{min}}{d^{max} - d^{min}} \tag{2.52}$$

The probability of deposition depends on two choice variables: the promise ω', and the redistribution rule λ. Moreover, it is affected by the past choice ϕ. Hence, investment in de facto power matters for leader survival only one period after it was carried through. The probability of deposition also depends on the citizens' outside option ω^0. Clearly, the higher this option, the more likely it is that the citizens will remove the incumbent leader. The bigger the stock of power (ϕ), and the greater the income loss (ξ), the less likely deposition will be.

The leader increases her chances of survival by being generous with citizens in the present period (low λ), and by making big utility promises (ω'). Setting a high or low ϕ' has no effect on survival in the present period, but a higher one enhances survival in the following period.

The policies λ and ω' are *substitutes* in the context of survivability: for the same probability of deposition, the leader may promise less by giving a bigger share of GDP to the citizens in the present period. Some combinations of policies may lead to higher probabilities of deposition, unless the inherited stock of power is sufficiently high.

Through $P^D(.)$, the survival condition is implicitly included in the leader's objective function (2.48).

It is useful to define as well the probability of survival in power:

$$P^s(.) \equiv 1 - P^d(.) \tag{2.53}$$

The leader knows the distribution of d but does not observe its value when she announces her policies. Low values of d increase the likelihood of failure to honor the SC and, thus, of being deposed. Hence, deposition and, thus, *leader turnover* occur because d is unobserved by the leader when she makes her choices: ω' and λ may be set too low, for a given unobserved value of d, such that it becomes optimal for citizens to depose their leader.

The leader cannot infer anything about the present period d from the fact that he survived in the previous period because d is an independently distributed shock.

2.3.5 Promise keeping

A *promise keeping constraint* is also imposed upon the leader. If there would never be deposition, the promise keeping constraint would be

$$U\left(\left(1-\lambda\right)y\right) + \beta\omega' \geq \omega \tag{2.54}$$

where ω is the previous life-time utility promise. However, deposition is possible and, hence, the leader must not only honor the past promise, but also take into account the possibility of deposition. The life-time utility promise must cover all possible contingencies, and that includes both the cases of the leader remaining in power, and of the leader being removed from it. In honoring the past promise, the announced policies must, then, compensate society for the possibility of deposition.

Promise keeping constraint [PKC]*:*

$$P^s(.)\left[U\left(\left(1-\lambda\right)y\right)+\beta\omega'\right]+P^d(.)E_{dep}\left[U\left(\xi y\right)-d-\phi+\beta\omega^0\right]\geq\omega \tag{2.55}$$

It guarantees past life-time utility promises are honored. It states that the weighted average of life-time utility over the possibilities that the leader stays in power, or that she is deposed is at least as high as the previous life-time utility promised.

The weights are the probabilities associated with the two possible events, deposition and leader's survival in power. If the leader is kept, citizens get $U\left(\left(1-\lambda'\right)y\right)+\beta\omega'$. Otherwise, they get $U\left(\xi y\right)-d-\phi+\beta\omega^0$.

E_{dep} is the expectations operator conditional on the occurrence of deposition. Formally,

$$E_{dep}[.]\equiv E[.|d<d^*] \tag{2.56}$$

Given that $d\sim U[d^{min},d^{max}]$, the PKC can be rewritten as:

$$\left[1-P^D(.)\right]\left[U\left(\left(1-\lambda\right)y\right)+\beta\omega'\right]+P^D(.)\left[U\left(\xi y\right)-\frac{d^*+d^{min}}{2}-\phi+\beta\omega^0\right]\geq\omega \tag{2.57}$$

where d^* is given by the expression in (2.51), and $P^D(.)$ is taken from (2.52).

The leader will no longer be accountable if she is removed from power. In that case, society gets $U\left(\xi y\right)-d-\phi+\beta\omega^0$. The leader considers this when making and honoring new promises.

However, the leader does not observe d and, thus, *ex ante*, the leader does not know what the realization of $U\left(\xi y\right)-d-\phi+\beta\omega^0$ would be (given that deposition occurs). This explains the expectations operator in the second term of the LHS of (2.55).

The leader is committed to society getting ω "on average", and this promise already considers the possibility society will depose her. Isn't the leader promising too much? No: by considering that society will get something even after deposition, the leader can actually promise *less*. The second term on the LHS of the PKC allows the leader to set a smaller ω' while still fulfilling the past promise ω.

The policies ω' and λ enter (2.57) directly, and indirectly through d^*, and $P^D(.)$. Are those policies substitutes in the context of keeping a given promise? Increasing λ decreases the LHS of (2.57) keeping everything else the same; increasing ω' increases the same LHS. Hence, the two policies are once more ***substitutes***: while keeping the same promise ω, it is possible to promise a smaller ω' by extracting a little bit less income (smaller λ).

Then, starting with $\omega' = \omega$, and λ equal to the maximum λ that still satisfies (2.57) given ϕ and given parameters (I call this $\lambda^{max}(\phi, \omega)$), it is possible to decrease the promised life-time utility, that is, to promise ω' below ω, by setting λ below $\lambda^{max}(\phi, \omega)$. The leader is able to honor the past promise and, at the same time, to promise less than that by being "generous", that is, by giving a higher share of income to the citizens than was strictly necessary in order to honor the PKC, that is, by setting $\lambda < \lambda^{max}(\phi, \omega)$. Then, in the following period, since the initial promise is now lower, the leader may extract higher rents: with a lower ω, the new $\lambda^{max}(\phi, \omega)$ will be higher.

I refer to this strategy of decreasing the promised level of utility in one period in order to be able to extract more rents later as the *fork strategy*.

The optimality of setting a new promise at a lower level than the previous one, while honoring the latter, depends crucially on the possibility of accumulating de facto power (as

will be seen in the results section). While trying simultaneously to extract more resources and to decrease the promised level of utility, the chances of being deposed may get dangerously high; to mitigate such risk it is necessary that the leader has the option of making deposition artificially costly by building up de facto power.

2.3.6 New leader's problem

The newly assigned leader's problem is identical to that of the incumbent leader, with two exceptions. The first of these is that the new leader is subject to a hypothetical life-time utility promise, ω^0, and the second is that he cannot benefit from the investments in de facto power of his predecessor (if any exist).

I assume, thus, that given a change of leadership, the stock of de facto power is either destroyed or changes into civil hands ($\phi^0 = 0$).

The hypothetical promise is assumed to be equal to ω^0, which is the outside option of the citizens. Clearly, a new leader cannot be selected without committing to providing society with at least the minimum they can get in a state of endless no-leadership ("anarchy")[70].

The new leader's value function is similar to that of the incumbent leader, with the exceptions being its arguments: $V(\omega^0, 0)$. And the RHS of the promise keeping constraint is ω^0.

[70] It is thus assumed that the minimum initial promise to society new leaders are willing to make is at least as high as the value of endless anarchy; otherwise, new leaders would never be selected.

A note on the "value of anarchy"

"Anarchy" appears in two different yet related contexts in this paper. First, when the leader is deposed, the society suffers *during one period* from disruption of governmental functions; this is represented by the parameter ξ. In this context, the "value of anarchy" is $U(\xi y)$. Second, if society was to remain leaderless *forever*, eventually some or all of the governmental functions would be resumed. In this longer situation, the "value of anarchy" is given by ω^0.

It is not necessary that $\omega^0 = U(\xi y) / (1 - \beta)$. This equation means that the value of endless anarchy would be equal to the value of "anarchy in each and every period". This would imply that society would never be able to mitigate the upheaval experienced in the first period without a leader.

2.3.7 Possibility of resignation

The probability of deposition increases with the proportion of income the leader takes for herself, λ. Could the leader, then, set a sufficiently high λ such that she would guarantee her own deposition, in the sense that, whatever the realization of d, the citizenry would always depose her?

The highest possible d the leader can face is d^{max} (making it the most difficult for the leader to be deposed); and in order to get deposed, the leader can at most announce $\lambda = 1$. Then, from (2.49), and assuming utility is of the CRRA type with relative risk aversion parameter greater than 1[71]:

[71] I assume the relative risk aversion parameter of citizens and of the leader is 2 (cfr. section Main Results).

$$U\left(\left(1-1\right)y\right)+\beta\omega' \;\geq\; U\left(\xi y\right)-d^{max}-\phi+\beta\omega^{0}$$

$$-\infty+\beta\omega' \;\geq\; U\left(\xi y\right)-d^{max}-\phi+\beta\omega^{0} \tag{2.58}$$

For whatever combinations of ϕ and ω', condition (2.58) never holds (unless $d^{max} = +\infty$); hence, the leader can always force her deposition by announcing full income confiscation: $\lambda = 1$.

For each pair $\{\omega', \phi\}$, there may be or there may be not a λ strictly lower than 1 that also implies certain deposition.

Assuming the leader chooses to stay in power when she is indifferent to whether she stays or leaves, and assuming the value of her outside option is $\Psi = -\infty$, then it is never optimal to resign.

If $\Psi > -\infty$, it may be optimal for the leader to resign. I impose that the leader must always satisfy the promise keeping constraint even when resignation is optimal. This means that it might happen that resignation is optimal but, nevertheless, the leader opts for staying in power because otherwise the PKC would not be satisfied.

2.3.8 Limits to promises, and to de facto power investment

The leader's control variables are subject to other constraints:

Limit to rent extraction:

$$0 \leq \lambda \leq 1 \tag{2.59}$$

Clearly, the endowment share the leader takes to herself cannot be negative and it cannot be bigger than 1. Full confiscation is possible.

De facto power investment constraint (i):

$$\lambda y \geq i \geq 0 \tag{2.60}$$

Investment in de facto political power in one period cannot be bigger than the leader's share of income, and it cannot be negative. Note also that the leader cannot save resources (this is valid for citizens too, as manna is non-storable).

De facto power investment constraint (ii):

$$\phi' - \phi \leq \phi^{dif} \tag{2.61}$$

Net investment cannot be bigger than $\phi^{dif} > 0$. This is a *time-to-build* parameter: it takes time to build-up de facto power, hence, its stock cannot be increased immensely overnight. Also, the accumulation of repressive means, and the gathering of loyalties are activities that require a certain level of secrecy: a great deal in a short time might just not be possible. It is likely easier to increase the stock of power in societies with fewer limits on a leader's activities; hence, a higher ϕ^{dif} is associated with less democratic regimes.

De facto power stock constraint:

$$0 \leq \phi \leq \phi^{max} \tag{2.62}$$

The total amount of available de facto power, $\phi^{\max}$, cannot be bigger than a given value. It is plausible that even in the most repressive regimes, stocks of de facto power are bounded from above. For practical purposes, ϕ^{max} will be measured as a share of GDP.

While necessary for solving the model numerically, this parameter has also a political interpretation: in a society with a weak system of checks-and-balances, the leader will be able to accumulate more de facto power. In democracies, a too-large stock of de facto power might trigger condemnation from the public, any opposition forces, and perhaps the international community. Hence, a lower ϕ^{max} is associated with more democratic regimes.

The parameters ϕ^{dif} and ϕ^{max} together provide a way to approximate convex investment costs. If the cost of investment in de facto power is convex, then it increases with the size of the invesment at an increasing rate, rendering large investments prohibitive. Then, it also becomes difficult to achieve very large stocks of de facto power.

Feasibility of promised utility constraint:

$$\omega' \leq \omega^{max}(\phi) \tag{2.63}$$

Lifetime utility promises are restricted to be feasible; the maximum feasible promise depends on the state variable ϕ.

The announced policies that are consistent with the maximum feasible promise are $\omega' = \omega^{max}(\phi)$ (the leader promises the feasible maximum), $\lambda = 0$, which means that the leader gives the whole GDP to the citizens, and $\phi' = (1 - \delta)\phi$: since the leader does not appropriate any resources today, she cannot make any investment in power, and thus she is forced to let the existing stock of power depreciate. Then, $\omega^{max}(\phi)$ is:

$$\begin{aligned}
\omega^{max}(\phi) &= \left[1 - P^D(max)\right]\left[U(y) + \beta\omega^{max}\right] + P^D(max)E_{dep}\left[U\left(\xi y\right) - d - \phi + \beta\omega^0\right] \\
&= \left[1 - P^D(max)\right]\left[U(y) + \beta\omega^{max}\right] + ... \\
&\quad ... + P^D(max)E\left[U\left(\xi y\right) - d - \phi + \beta\omega^0 | d < d^*(max)\right] \\
&= \left[1 - P^D(max)\right]\left[U(y) + \beta\omega^{max}\right] + ... \\
&\quad ... + P^D(max)\left\{U\left(\xi y\right) - \phi + \beta\omega^0 - E\left[d | d < d^*(max)\right]\right\} \\
&= \left[1 - P^D(max)\right]\left[U(y) + \beta\omega^{max}\right] + ... \\
&\quad ... + P^D(max)\left[U\left(\xi y\right) - \phi + \beta\omega^0 - \frac{d^*(max) + d^{min}}{2}\right]
\end{aligned} \tag{2.64}$$

where $d^*(max)$ is the d^* from choosing $\{\omega' = \omega^{max}(\phi), \lambda = 0, \phi' = (1-\delta)\phi\}$, and $P^D(max)$ is the corresponding probability of deposition. With CRRA utility, $d^*(max)$is

$$\begin{aligned}
d^*(max) &= \frac{\left[\xi^{1-\rho} - (1-0)^{1-\rho}\right] y^{1-\rho}}{1-\rho} - \phi + \left(\omega^0 - \omega^{max}\right)\beta \\
&= \frac{\left[\xi^{1-\rho} - 1\right] y^{1-\rho}}{1-\rho} + \left(\omega^0 - \omega^{max}\right)\beta - \phi
\end{aligned} \tag{2.65}$$

and the probability of deposition in the feasible maximum becomes

$$P^D(max) = P^D\left(\omega' = \omega^{max}, \lambda' = 0; \phi; \beta, \omega^0, \xi, \rho, d^{max}, d^{min}\right)$$

$$= \frac{d^*(max) - d^{min}}{d^{max} - d^{min}}$$

$$= \frac{\frac{\left[\xi^{1-\rho}-1\right]y^{1-\rho}}{1-\rho} + \left(\omega^0 - \omega^{max}\right)\beta - \phi - d^{min}}{d^{max} - d^{min}} \tag{2.66}$$

Plugging (2.65) and (2.66) into (2.64), and after some simplification, $\omega^{max}(\phi)$ is given by the following expression:

$$\omega^{max}(\phi) = \frac{y^{1-\rho} - 1}{1-\rho} + \beta\omega^{max} + \frac{\left\{\frac{\left[\xi^{1-\rho}-1\right]y^{1-\rho}}{1-\rho} + \left(\omega^0 - \omega^{max}\right)\beta - \phi - d^{min}\right\}^2}{d^{max} - d^{min}} \tag{2.67}$$

The maximum feasible promise is thus dependent on the state variable ϕ.

2.3.9 On the minimum feasible promise

Promises are constrained by the PKC: for a given pair of states $\{\omega, \phi\}$, and a given announced λ, ω' cannot be so low that (2.55) fails. However, as seen in the section on the PKC above, it is possible to decrease the level of promised life-time utility by giving to the citizens a share of GDP that is bigger than that which is strictly necessary to honor the PKC, while setting $\omega' < \omega$. Hence, promises can be decreased. The corresponding levels of a leader's share that just satisfy the PKC ($\lambda^{max}(.,.)$) will, thus, be increasing: in one period, in order to decrease the promise, it is necessary to set λ below $\lambda^{max}(\phi, \omega)$; but since in the following period ω will be smaller than before, λ^{max} will be bigger in the following pe-

riod, allowing for the leader's share to be larger. As λ^{max} goes up, the leader is allowed to extract more rents, while the citizens will consume less and less. Since with CRRA utility (with relative risk aversion parameter greater than 1)

$$\lim_{c \to 0} U(c) = -\infty \tag{2.68}$$

and since there is a correspondence between citizens' share, and ω (the lower the promise, the lower the citizens' share needs to be), there isn't *seemingly* a lower bound for ω.

However, the LHS of the PKC is likely not a continuous function: when the probability of deposition moves from extremely high to 1, the first term of the LHS of the PKC collapses, and the PKC might suddenly fail. This suggests that there should be a lower bound for ω'.

Nevertheless, with ever-lower ω', and ever-higher λ, the probability of deposition increases, and this might not be in the interest of the leader: trying to reap a very big share of income at a very great risk of being deposed might not be optimal (and it should be noted also that the stock of de facto power is capped at ϕ^{max}).

2.3.10 Summary of Assumptions

Here I collect all previous assumptions, and introduce a few (minor) ones.

A.0: *Environment:* time is infinite and discrete; the economy is of the deterministic endowment type; total income in each period is $y \in \mathbb{R}^{++}$; income is non-storable; there is a mass 1 of identical citizens; there is some set of potential identical leaders; timing of events and information flow is as established in Section 3.1.

A.1: *Preferences:* time discount factors are such that $\beta, \beta^L \in (0,1)$ for citizens, and for the leader; the representative citizen's period utility is $U(a) - b$, where $U(.)$ is the instantaneous utility of consumption, a is consumption, and b are utility costs of deposition; it is thus assumed that deposition leads to incursion in a utility loss; $U(.)$ is of the CRRA type with parameter ρ; leader's preferences are also of the CRRA type, with parameter ρ^L.

A.2: *Outside options:* a leader's outside option is $\Psi > -\infty$; citizen's outside option is $-\infty < \omega^0 < \frac{U(y)}{1-\beta}$, which means that in case there will never be any leader ("anarchy forever"), the life-time utility is smaller than consuming the whole GDP in each and every period forever; hence, it is assumed that having the worst leader possible is still preferable to "endless anarchy"[72].

A.3: *Rent extraction technology:* the share of income appropriated by the leader is $\lambda \in [0,1]$; full confiscation is, thus, possible;

A.4: *De facto power technology:* the total cost of producing i new units of de facto power is αi, with $\alpha \in (0,1]$; the stock of de facto power (ϕ') accumulates in accordance to $\phi' = (1-\delta)\phi + i$, with depreciation rate $\delta \in [0,1]$; the stock of de facto is limited to a maximum of $\phi^{max} > 0$; and net investment takes time to build: $\phi' - \phi \leq \phi^{dif}$.

A.5: *Newly assigned leader:* he accepts the value ω^0 as his hypothetical past promise; the previous stock of de facto power becomes useless to the new leader, so that he faces $\phi^0 = 0$.

[72] The thesis that having a bad regime is better than having no regime at all because this situation opens the door to the worst atrocities has been recently presented in Snyder (2015).

A.6: *Deposition costs:* the deposition technology is additive and it includes a random part, d, and one of the leader's choice variables: ϕ; the random part is such that $d \sim iid$ $U[d^{\min}, d^{\max}]$ with $d^{\min} \in \mathbb{R}$, and $d^{\max} \in \mathbb{R}^{++}$, which means that this cost can be negative; should deposition happen, GDP is restricted to ξy in one period, with $\xi \in (0, 1)$.

A7: *Promises:* $\omega' \leq \omega^{max}(\phi)$, which was determined above; ω' has a lower bound determined by the PKC.

2.3.11 Political Regime Parameters

The model is aimed at matching leader turnover with government effectiveness. The fundamental postulate is that what matters most for political-economic outcomes is neither de jure regime characteristics, nor any supposed leader idiosyncrasies, but rather de facto power and the way a polity works in practice, which means its de facto institutions.

With that postulate in mind, and intending to model both democracy and non-democratic regimes, I choose to keep any exogenous specifications of political regime and de jure power at a minimum: there are a total of eight political parameters

$$\left\{\alpha, d^{min}, d^{max}, \phi^{max}, \phi^{dif}, \phi^{0}, \omega^{0}, \Psi\right\} \tag{2.69}$$

and of these at most three may differ between the democratic parameterizations, and the non-democratic ones:

$$\left\{\alpha, d^{max}, \omega^{0}\right\} \tag{2.70}$$

I discuss now the three allowed regime differences.

The distribution of d is an element of the model structure of power. As discussed above, it encompasses many different forces that help or hinder leadership change. Some of these forces are de facto in nature while others are de jure institutions.

A distribution taking on mostly negative values would imply the easy deposition of a leader: such would be a distribution of deposition *benefits*, not costs. This is suggestive of a democratic environment, with free elections, free press, and possibly low levels of ideological fractionalization within society[73]. A mostly positive distribution of d is symptomatic of permanent barriers to leader deposition. In two of the parameterizations presented in the next section, d^{max} will have a lower value; those parameterizations are thus referred to as democratic.

The de facto power technology parameter is α; should it take on a low value, it will be cheaper to produce de facto power, or a big part of the investment in power is actually directly enjoyed by the leader. Hence, relatively low values are associated with lower democracy levels in practice, in which case counteracting formal democracy is relatively easy. Furthermore, low levels of α imply that the leader easily obtains high levels of private benefits from investments funded by public resources. Such scenario corresponds to a low respect for the general good on the part of the leader. Moreover, a low α may mean that the stock of de facto power is mainly composed of goods and services with no rivalry in consumption: one and the same unit of those goods and services may be consumed both by the leader and his supporters.

[73] A high level of fractionalization might make the coordination necessary to depose a leader too difficult.

As aforementioned, the citizens' outside option, ω^0, is the minimum hypothetical promise a potential leader must commit to in order to be selected. Hence, ω^0 represents the bargaining power of citizens *vis-à-vis* potential leaders. Clearly, if citizens would enjoy the same level of consumption in anarchy as they would when ruled by a leader they would refuse any candidate to the leadership. That bargaining power can be either constitutionally defined (de jure), or determined by "the street" (de facto). Also, this power depends on some existing conditions, such as the general level of development of the country, social capital, human capital, etc.. Hence, while it precedes the announcement and implementation of any policies, it may be determined by the specific past history of a given place. Countries that enjoyed democracy and a market economy for a long time are likely to have developed an environment such that its citizens can endure a relatively long stretch without any leadership. The opposite is likely to be true for countries with an extended experience of repression. Then, the value of "endless anarchy" should be higher in those polities with a democratic past, and lower for the non-democracies, or young democracies.

The outside option of any leader is Ψ. It is unclear whether dictators have better or worse outside options than democrats: a fallen dictator might be killed, but she can also escape with a fortune secretly hoarded somewhere abroad. Hence, this parameter takes the same value for all model parameterizations.

2.4 Main results

The model is solved by value function iteration. The following parameter values are used:

TABLE 2: PARAMETER VALUES

		Non-democ.		Democracy		
	Parameter	(1)	(2)	(1)	(2)	(3)
y	total income	10				
β	citizens' time discount factor	0.95				
β^L	leader's time discount factor	0.99				
ρ	citizens' relative risk aversion	2				
ρ^L	leader's relative risk aversion	2				
ω^0	citizens' outside option	16		17.3		17.3
Ψ	leader's outside option	80				
d^{min}	unif. dist. minimum	-2				
d^{max}	unif. dist. maximum	4			3.5	3.5
ξ	GDP loss	0.05				
α	d.f.p. marginal cost	0.5			0.6	0.6
δ	d.f.p. depreciation rate	0.25				
ϕ^0	initial d.f.p. stock	0				
ϕ^{max}	maximum d.f.p. stock (% of GDP)	2.5%	0%			
ϕ^{dif}	maximum d.f.p. increase (% of GDP)	0.1%				

The reference parameterization is Non-democracy (1); the parameters for the other non-democracy case, and for the three democracy parameterizations are the same as the reference parameters except for those values in columns N-d (2), D (1), D (2), and D (3).

Non-democracy's column (1) is the reference parameterization. I refer to it as the ND (1) parameterization. The other parameterizations are Non-democracy (2), and Democracy (1), (2), and (3). I refer to them as ND (2), D (1), D (2), and D(3) respectively. These parameterizations share the same parameter values with the reference parameterization except

for those figures presented in columns ND (2), D (1), D (2), and D (3). I briefly comment on the reference parameters below.

The size of the economy (y) is purely conventional; most other level parameters are meaningful in relation to that size. The value of β is standard in the macroeconomics literature. The leader's time-discount factor differs from that of citizens': the assumption that the leader is more patient than society is necessary for matching average tenures. The leader and society have the same relative risk aversion parameter, which is standard in the macroeconomics literature.

Citizens and the leader have the same constant relative risk aversion parameter value.

As for α, it is assumed that half of the investment in de facto power generates direct benefits to the leader (other and beyond the increase in the probability of survival in power).

If a new leader comes to power, it is assumed he cannot use any fraction of the previously built up stock of de facto power ($\phi^0 = 0$). Citizens's outside option (ω^0), and the leader's outside option (Ψ) are both equivalent to receiving 50% of the endowment in each and every period forever; their values are different because I assume citizens and leader have different time-discount factors. In the analysis below, I present the life-time utility promises not in terms of utility levels but as the equivalent share of the fixed GDP that would be awarded in each and every period forever in order to honor the promise; I call this the *equivalent perpetual GDP share*.

The parameters d^{min} and d^{max} have been set such that the model approaches the mean duration in power of leaders in democracies and non-democracies. Those means and other statistics are shown in Table 3, where countries were defined as *democratic* when their

POLITY 2004 scores lay between 6 and 10, and as *non-democratic* otherwise[74]. In all specifications, d takes mostly positive values. The minimum value that d can take is the same in all five parameterizations, whereas d^{max} is lower on D (2), and D (3). The narrower positive scope of d implies that there are no major barriers in deposing a leader (other than buying back those who support her).

The parameters δ, and ϕ^{max} were not calibrated, as I am not aware of any literature on measuring the size of the de facto power sector in different countries. Such measuring may be approached, for example, as the sum of wages and rents accruing to public officials in propaganda offices, in the political police, secret services, and related offices. Measuring how many of those officials defect, and how much their facilities, and "means of production" wear out is not a trivial task either, but by setting δ at a seemingly high level I am assuming that the elite which supports the leader must be rewarded very regularly, and displays a relatively low level of loyalty.

Also, ϕ^{max} is motivated by a technical limitation: as the model solution method involves discretizing the state variable spaces, a large ϕ^{max} (relative to the permissible maximum de facto power net investment, ϕ^{dif}) would require a large grid for de facto power, and this would translate into much more computation time.

The parameter ϕ^{dif} is set with two ideas in mind, one empirical, the other technical. On the empirical side, it does not seem likely that in the real world any non-democratic (or democratic) leader would be able to divert a very large share of GDP into de facto power investment in one single period (quarter), no matter how powerful he may be. Hence, ϕ^{dif}

[74] This criterion is standard in the literature.

shouldn't be very big. On the technical side, the stock of power can only be increased in one-period steps corresponding to ϕ^{dif}, and a large ϕ^{dif} may prevent any de facto power from being accumulated, even though it is an effective means of extending duration in power (see below). This is because the preferences of the leader are concave, and hence the leader desires to smooth his consumption. An implication of this is that it is not optimal to divert a very large amount of resources from consumption to de facto power in one single period, and to invest only a little while consuming much more in the following period. For this reason, ϕ^{dif} should also be a low value.

Finally, the parameter ξ was set also such that the model matches the empirical leader durations in power.

TABLE 3: DURATION IN POWER (IN YEARS)

Democracies: POLITY 2004 $\in [+6; +10]$

obs.	mean	std. dev.	min.	max.
86	5.3	3.3	1	14.8

Non-democracies: POLITY 2004 $\in [-10; +5]$

obs.	mean	std. dev.	min.	max.
65	13	9.8	1.9	46

Value function iteration is the method used to approximate the policy functions for ω', ϕ', and λ (cfr. equation 2.48); optimization is done over a discretized state variable space for $\{\omega, \phi\}$. With those policy functions, 10000 simulations are performed; each simulation is composed of 1600 periods. The maximum duration in power is capped to 300 quarters (75 years). Each and every simulation begins with a new leader and with no stock of de

facto power. Statistics are computed first for each simulation, and then means are taken across simulations; the latter are shown below:

TABLE 4: SIMULATION RESULTS

	Non-democracy		Democracy		
	(1)	(2)	(1)	(2)	(3)
Mean n. of leaders per 100 years	7.5	15.1	19.4	19.0	20.5
Mean effective final power stock	1.19%	0	0	0	0
Mode effective final power stock	2.5%	0	0	0	0
Mean leader's share	51.1%	51.06%	28.32%	51.44%	28.23%
Maximum leader's share	52.69%	51.26%	50.91%	52.26%	50.73%
Initial effective leader's share	48.44%	48.44%	21.29%	48.53%	21.38%
Final effective leader's share	50.86%	51.07%	30.95%	51.52%	30.78%
Final announced leader's share	50.9%	51.08%	31.22%	51.55%	31.05%
Average duration in power	13.8	6.5	5.0	5.1	4.7
Std. deviation of duration	19.5	6.4	3.4	5.0	3.2
Maximum duration	70.3	30.4	15.2	24.7	14.5
Minimum duration	0.16	0.04	0.05	0.02	0.04

Non-democracy (1) is the reference parameterization; ND (2) is the same as the reference, but de facto power is not allowed; in D (1) the citizens' outside option is higher; in D (2) the cost of de facto power is higher, and the maximum deposition shock is lower; D (3) combines D (1) and D (2). All the statistics are means taken across 10000 simulations. Percentages refer to GDP. Duration statistics are in years.

2.4.1 Non-democracy

Non-democracy parameterizations (1) and (2) differ only in that investment in de facto power is not allowed in the latter.

In both cases, forced deposition is never optimal for any combination of state variable values.

The most striking difference between the simulation results for the two non-democracy cases is that average duration in power is much shorter when investing in de facto power is not possible (Column 2 of Table 1). Keeping everything else the same, such possibility more than doubles the average duration in office. This average duration is very close to the empirical figure, which is 13 years, when de facto power may be accumulated.

De facto power is, thus, an effective means for significantly extending survival in power. It is used in equilibrium when it is possible to use it and even though it represents a cost for the leader, and it is continuously accumulated until it reaches the maximum allowed as long as the leader remains in power: the mode stock of power the leader inherits in his last period in power is 2.5% of GDP, which corresponds to the maximum permissible.

The pattern of optimal accumulation of de facto power can be seen in the figure below. There, I form a *no-deposition sequence*, that is, a sequence of policies that would take place if there was never deposition (but the leader didn't know deposition was never to take place). After an initial period with no investment, the stock of de facto power increases continuously up to the maximum allowed.

It takes 32 quarters for power to reach its maximum, and while the average duration in power is almost 14 years, time in power registers a very big variation in the first non-democratic parameterization (the standard deviation is higher than 19 years). Hence, not

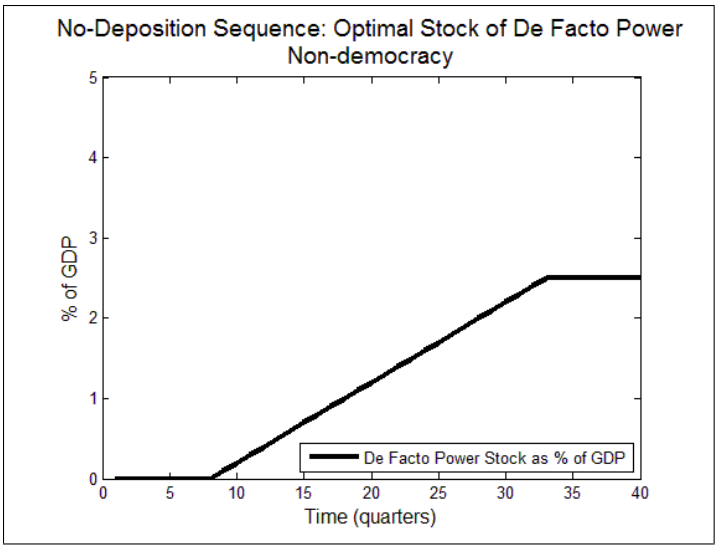

Fig. 2.5. No-Deposition Sequence: Optimal Stock of De Facto Power, N-d (1)

all leaders survive for long enough to let power reach the maximum of 2.5% of GDP: the average effective stock of power at the last period in power is just 1.19% of GDP[75].

The maximum duration in power is limited to 75 years; the average across simulations of the maximum duration gets close to that limit when power can be accumulated: 70.3 years.

The mean leader's share of GDP in the two non-democracy cases is almost identical, and it is very close to the mean of the second democratic parameterization. Hence, de facto power, while enhancing survival in power, does not directly lead to higher rent extraction for the leader. It may only help extract rents in an indirect way: when the optimal pattern of rent extraction is increasing along time, by increasing survival in office de facto power

[75] The final effective stock of power is the amount of de facto power at the beginning of the period in which the leader is deposed. In that period, the leader is still able to announce a new level of power, but this level ends up not becoming effective.

helps a leader achieve higher levels of rents. However, that pattern is not always increasing, as the figure below shows.

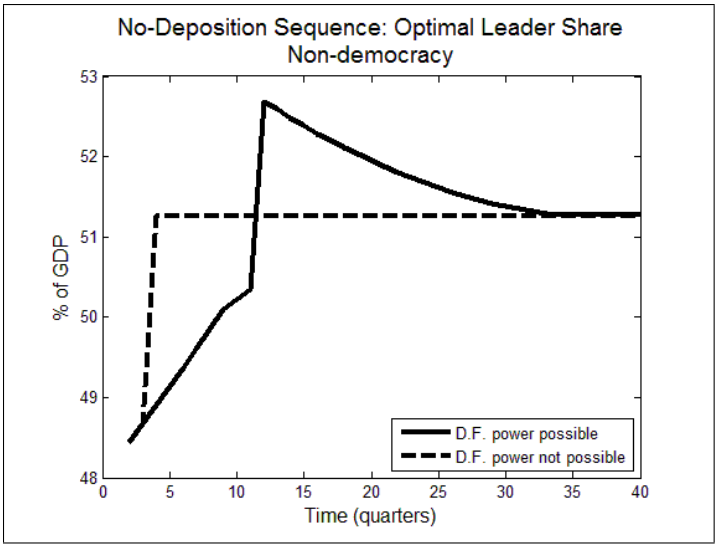

Fig. 2.6. No-Deposition Sequence: Optimal Leader Share in Non-democracy

Figure 2.6 makes it clear why the mean leader's share is almost as big when de facto power investment is not possible: predicting a relatively short stay in power, the leader is much more eager to appropriate resources. In such case, the pattern of rent extraction is faster: even though she is in power for less time (on average), after the first two quarters and until the eleventh quarter, the leader with no de facto power extracts larger rents than the leader with power.

This greater eagerness for rent extraction does not, however, imply higher chances of removal from office for the leader without de facto power (cfr. figure 2.7 below). In fact, after the first three quarters, the probability of deposition is higher for the leader with the option to invest in power. The two probabilities will be exactly the same in the 17th quarter,

after which the leader with de facto power will become more secure than the leader without power.

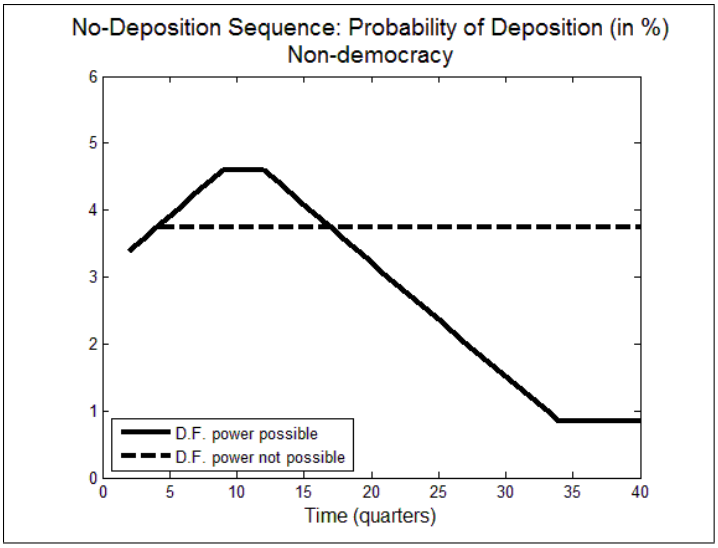

Fig. 2.7. No-Deposition Sequence: Probability of Deposition in Non-democracy (in %)

That is because the circumstance of having or not having access to de facto power changes radically the policy on promised utility (see figure 2.8); in fact, it changes the whole optimal-policy mix.

As discussed in Section 2.3.5 "Promise Keeping", a leader who wants to follow the strategy of simultaneously increasing rent extraction and decreasing the promised level of utility, which I call *fork strategy*, in order to be able to extract even larger rents in the future, will face fairly high probabilities of deposition. This risk is, however, worthwhile precisely because there will be higher rents to benefit from: exposure to higher risk is compensated by the expectation of higher consumption. Why then shouldn't the leader without power follow the same strategy?

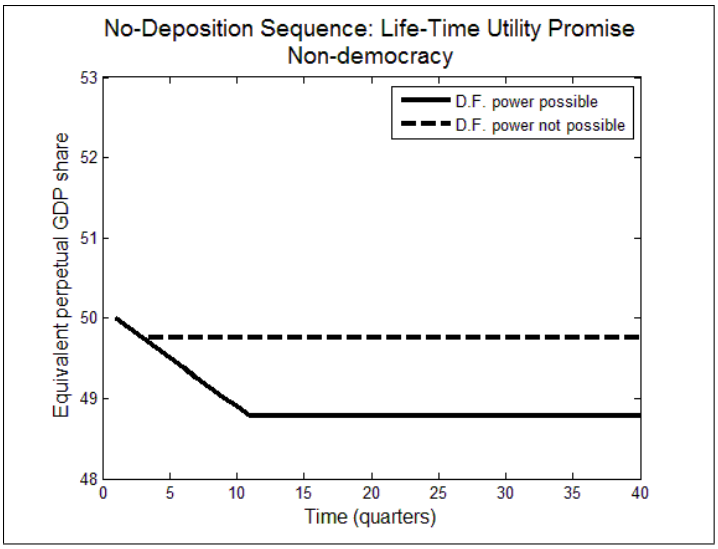

Fig. 2.8. No-Deposition Sequence: Life-Time Utility Promise in Non-democracy

The reason is that, without power, the probability of deposition under the aforementioned strategy would just be too high to be worthwhile. This can be seen in the plot (2.9) which compares the probability of deposition for the leader with de facto power (as in figure 2.7) with the probability of deposition for the same leader "inflated" by removing the effect of the accumulated power, this is, by dropping the ϕ from equation (2.51). Unsurprisingly, the probability is higher with the effect of power removed.

The leader with no de facto power could, however, initiate the fork strategy and follow it up to the 8th quarter: however, up to that quarter, he actually consumes more than the leader with de facto power, as the latter keeps decreasing the promised level of utility from quarter 3 [Q3] to Q11 (cfr. figure 2.8) and, hence, cannot increase his share as fast as the leader without de facto power can (otherwise, he would violate the promise keeping constraint). Furthermore, the leader with no de facto power would be stuck in a probability

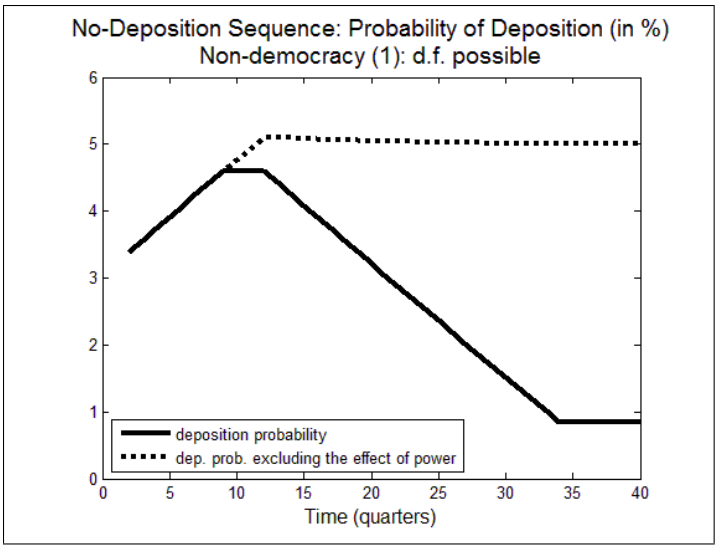

Fig. 2.9. No-Deposition Sequence: Prob. of Deposition in Non-dem. (%) when d.f. power is possible including and excluding the effect of power on the probability

of deposition of about 4.61%, while if he just follows his own strategy, the probability of deposition will remain at 3.74%[76].

All this being said, the possibility of investing in de facto power changes the optimal-policy mix in a qualitative way; with de facto power, the optimal policy is the fork strategy. Without it, such strategy is not only too risky, but it is also not worthy in terms of rent extraction, because decreasing the promised utility continuously in the first periods requires extracting rents at a slower pace.

Finally, I present the no-deposition sequence for a non-democratic leader's consumption in Figure 2.10.

I define the *long run* as the time it takes until all the optimal policies become constant in a no-deposition sequence. In the long run, the non-democrat without the option

[76] As these probabilities of deposition are quarterly, a 1% difference implies a significant difference in expected durations.

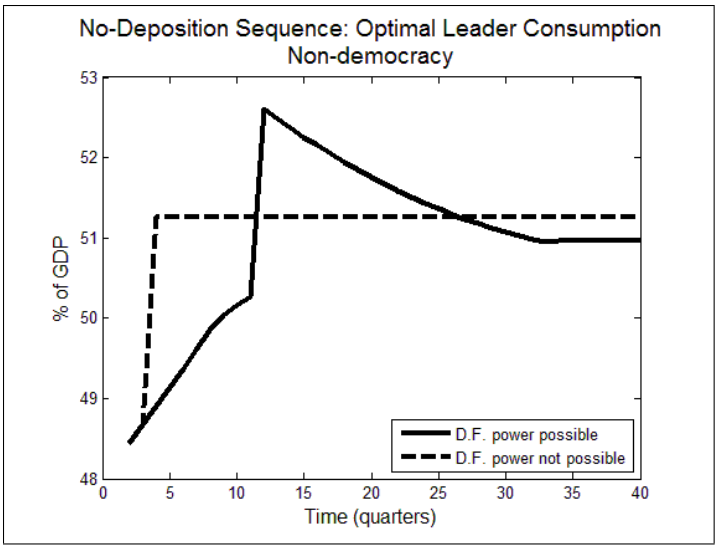

Fig. 2.10. No-Deposition Sequence: Optimal Leader Consumption in Non-democracy

of investing in his own power actually consumes more than the non-democrat with power. However, the combination of consumption and chances of survival is more favorable to the latter: a difference of 2.9% in the quarterly probability of deposition is extremely significant (cfr. figure 2.7). Furthermore, the average expected duration in power of the leader without power almost coincides with the point at which the two lines cross for the last time in the graph above: on average, the leader with no power is unlikely to remain in power for much time beyond the point at which his consumption his superior to the consumption of the leader with power.

It is worth noting that in both specifications the patterns of rent extraction and consumption increase in the first periods and eventually stabilize: up to a point, the longer a leader stays in power, the more he gets for himself; in a sense, duration causes extraction, as time in power enables more rent extraction.

2.4.2 Democracy

I present simulation results for three different democracy parameterizations: D (1), D (2), and D (3). The first one is identical to ND (1) except for the citizens' outside option, which I set as equivalent to a 74.1% share of GDP forever. This outside option implies that life without a government leads to a loss in production, but not as big a loss as that which occurs in the case of non-democracy. The implied assumption is that a democratic country has a set of structures and institutions that will work and allow a high level of production, with respect to potential GDP, even in the absence of any government.

In the second parameterization, I keep the same citizens' outside option as in the non-democratic benchmark, but now the barriers to deposition are lower (d^{max} is lower), and, possibly due to checks and balances and the role of the media, the share of the investment in de facto power that is directly consumed by the leader falls to 40% $(1-\alpha)$. A common ω^0 for ND (1) and D (2) implies the alternative assumption that whether society begins in democracy or dictatorship, the value of "anarchy" (as absence of government) will be the same for citizens: they will be able to produce and consume the same share of potential GDP, and this share will be low.

The third democracy parameterization combines the changes in D (1) and D (2) *vis-à-vis* ND (1).

In all cases, resignation is never optimal for any point in the state space. The mean leader's share is significantly reduced only in D (1), and D (3), but not in D (2): while a bigger value of anarchy implies that the leader will have to grant a very big part of the GDP to the citizens, otherwise they will be better off by themselves, a smaller barrier to

depose has almost no effect on leader's rent extraction, and less direct consumption out of investment in power does not significantly decrease the incentive to extract rents.

In D (1), the average duration in power is decreased to less than half that in ND (1), and it matches the empirical duration in power of leaders in democracy: 5 years. Duration in power is also lower in D (2) than in ND (1). Putting all the democratic parameters together does not decrease the average duration in power by much more: the leader stays in power on average 4.7 years in D (3).

Whether the outside option of citizens is higher, or the barriers to deposition are lower together with higher cost of investment in power - it is not optimal to invest in de facto power. As the leader expects to stay in power for a relatively short period, the optimal strategy is to consume as much as possible as early as possible, without applying any appropriated resources to de facto power investment, and even though the leader is very patient ($\beta^L = 0.99$). It is just not worthwhile to be patient for quite a number of quarters before being able to enjoy a pattern of high consumption and low probability of deposition as in figures 2.10 and 2.7 (d.f. power possible), because the chances the leader survives up to that point are low.

Turning to the no-deposition sequences, I begin by presenting the leader's share under the three different democratic regimes. As there is no investment in the de facto power in any of the specifications, a leader's share coincides with his consumption (see figure 2.11).

While both the pattern and the level of rent extraction in D (2) is not that different from ND (2)'s, in D (1) and D (3) the leader's share at the beginning of a spell in office is much lower than in the case of non-democracy.

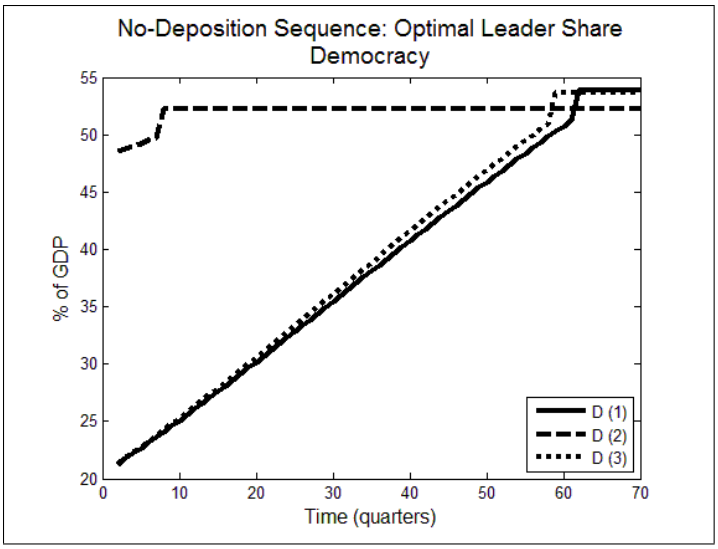

Fig. 2.11. No-Deposition Sequence: Optimal Leader Share in Democracy

In the long run, even democratic regimes 1 and 3 will register leader's shares at very similar levels to those in non-democracy. However, the leader in D (1) or D (3) is not likely to remain in power long enough to enjoy such levels. This means that while even democrats will try to extract as much to themselves as they can by manipulation of the promised utility level downwards, they just don't manage to achieve dictatorial levels of appropriation because institutions will remove them much too early for that.

The model, thus, is consistent with the hypothesis that leaders are prone to behave in the very same way in both democracy and dictatorship, the main difference in regimes being how easy it is for society to depose them.

Ease of deposition can be checked in figure 2.12 for democracy, and in figure 2.13, where all the five regimes are represented.

In the two democratic specifications with initial lower rent extraction, the probabilities of deposition are the lowest of all the five regimes in the first periods in power (figure

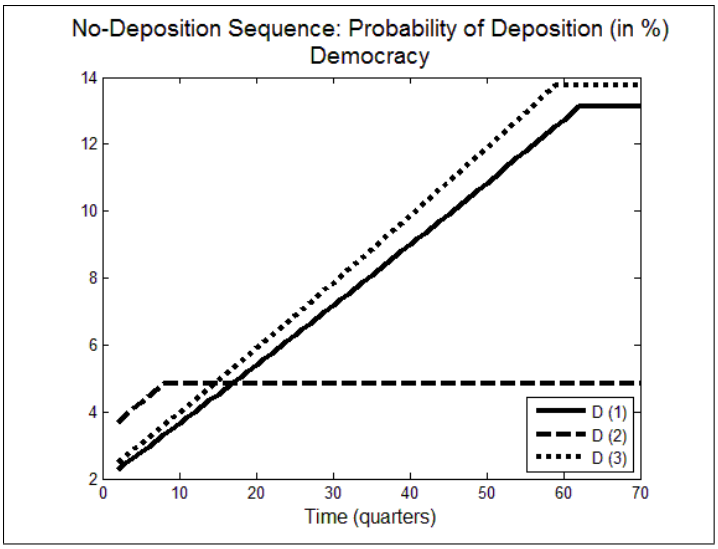

Fig. 2.12. No-Deposition Sequence: Probability of Deposition in Democracy (in %)

2.13). But these probabilities increase continuously over time, becoming by far the highest of all regimes in the long run.

This is in line with the democratic experience in general, and with what is expected from democratic regimes: recently elected leaders should be secure in power, as they enjoy political legitimacy, at least for a modicum of time; however, as time passes change of leadership should not only be possible, but it may also become desirable, as the leaders implement their policies, and, thus, their legitimacy is hollowed out, and as they appropriate an increasing share of income.

The only democratic regime where the leader benefits from rent extraction as high as in dictatorship is also the one where the probability of deposition is the highest of all the three democracy specifications. The time pattern of the probability of deposition in D (2) is also very similar to that of the non-democracy without access to power (ND 2).

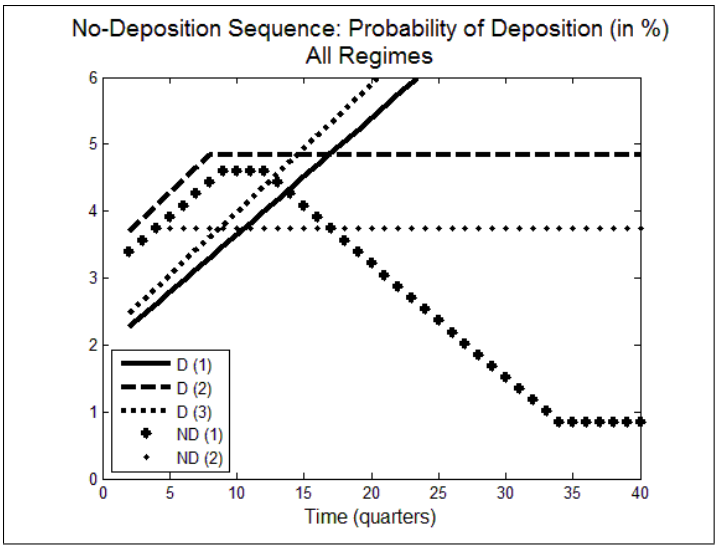

Fig. 2.13. No-Deposition Sequence: Probability of Deposition (in %), All Regimes

Of the five regimes, the only one where the probability of deposition is ever decreased in the optimum is the non-democracy with power (ND 1). Clearly, without de facto power, it is not optimal to decrease that probability, by either increasing the promised utility or by decreasing the leader's share or both: as the leader expects a short spell in power, it is better to extract as much as possible as soon as possible. Then, the patterns displayed in figure 2.14 are as just the expected ones: in all democracy cases, it is never optimal to promise more than in the previous period.

It is interesting to note that D (1) and D (3), while displaying the highest long-run levels of promised utility, are also the ones where those levels fall the most from the initial period onwards.

Just as in the case of non-democracy, the patterns of rent extraction are all strictly increasing for, at least, the first periods: the longer a leader stays in power, the bigger the share he collects from the economy's product.

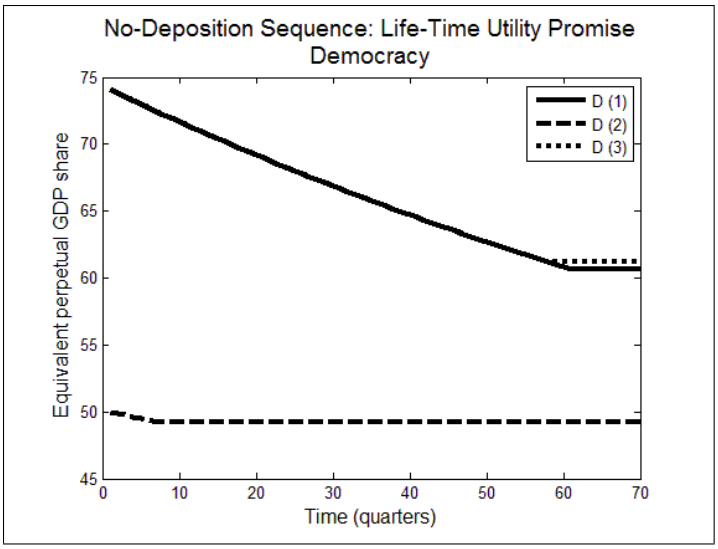

Fig. 2.14. No-Deposition Sequence: Life-Time Utility Promise in Democracy

The absence of investment in de facto power under democracy matches the empirical fact of greater government effectiveness in democratic countries, as investments in de facto power are purely wasteful.

2.4.3 The role of de facto power

In a non-democracy, investment in de facto power is useful for the leader, as it is set optimally at strict positive levels, even though it is costly. De facto power does not directly lead to higher levels of rent extraction, but it allows leaders to stay in power for significantly longer. Since patterns of rent extraction are always increasing in the first periods, de facto power enables higher rent extraction by increasing survivability in power.

By setting a sufficiently high level of de facto power, it is possible to promise a low level of utility while still enjoying a low probability of deposition. Low utility promises for

society translate into higher rents extracted for the leader. That, in turn, allows the leader to keep the stock of de facto power at a high level.

2.4.4 Policy recommendations

A high citizens' outside option is crucial to guarantee that rent extraction is relatively low. In practice, the "value of anarchy" can only be high when society is not much dependent on government for achieving its potential GDP, or when the relative contribution of government to GDP is low. While the second condition is a consequence of fundamental political choices (how big should government be?), the first condition may be accomplished by removing the impediments and hurdles that are set by the administration and that make it difficult to create enterprises, to exercise a profession, to invest, etc..

When it is not possible to invest in de facto power, and when it is not optimal to do so, leaders try and appropriate as much income as fast as they can. When investment in de facto power takes place, the pattern of appropriation is slower, but it reaches higher levels. In any case, rent extraction always presents a non-decreasing pattern.

It should be noted that investment in de facto power is wasteful: it would be Pareto-improving to keep the probabilities of survival, and the same distribution of GDP, and just let the leader or society or both consume a part or the whole of the resources invested in power.

Then, in order to improve efficiency and the welfare of citizens, investment in de facto power and survival in office should become simultaneously more difficult, as by making de facto power accumulation more difficult alone, there will be a stronger incentive for

leaders to behave impatiently and extract more rents in the first periods. A higher citizens outside option, or lower barriers to deposition together with a high cost of investment, or everything together will achieve those objectives.

In practice, a lower range for d can be easily achieved in an already-democratic context by setting shorter term limits, by restricting re-elections, by determining the executive power to face votes of confidence regularly; these settings are much more difficult to implement in a non-democracy. Furthermore, there is a trade-off in all those constitutional features: while shorter tenures make it difficult for leaders to encroach upon an economy's resources, it may also lead to a government's myopia and "short-termism", in which the optimal policies of an opportunistic government do not coincide with those of society. Also, governments expected to last only a short period may face less favorable external constraints, as for example higher interest rates in international financial markets (cfr. Cuadra Sapriza, 2008).

The cost of investment (or the share of it that is not directly consumed by the leader) may be increased by allowing a mass media that scrutinizes the necessity of each and every item on the spending side of a government's budget, especially those items concerned with internal security and defense. It also helps to have an independent authority that checks all government procurement plans, and these should be made transparent, competitive, and it should be given sufficient time so that public opinion can try to prevent some of those plans from taking effect.

The prescription of a lower proportion of de facto power that directly benefits the leader (beyond increasing his survival) is an argument for separation of powers understood

in a broad sense. For instance, a leader should not be allowed to use the military, the secret services, or the judiciary for his own purposes, and this objective can only be attained if there is sufficient separation between the leader that is responsible for income redistribution, and those institutions.

2.5 Conclusions

This paper presents a model that links rent extraction, investment in de facto power, and tenure of leaders who have the power to redistribute wealth between themselves and society. While the level of institutional detail is kept at a minimum, the model is able to replicate real statistics on leader duration in power for both democracies and non-democracies. It also matches the stylized fact that government effectiveness is higher in democratic countries, as investment in de facto power is inefficient, and it does not take place in equilibrium in the democratic model parameterizations.

The model sheds light on the way a specific mechanism works to keep a leader in power for a long time while allowing him to extract high rents. By decreasing the probability of deposition, and given that the time pattern of rent extraction never decreases, de facto power indirectly leads to higher resource appropriation by the leadership.

Thus, this paper offers a specific solution to the paradox of "good policy is bad politics, good politics is bad policy". The mechanism is de facto power investment, which is characterized as spending that, on the one hand, generates a utility punishment that society must endure should it decide to depose the leader, and, on the other hand, provides some direct consumption benefits for the leader which are independent of society's deci-

sion whether or not to keep her in power. When investment in de facto power is possible, a given low probability of deposition can be achieved with a smaller life-time utility promise; such low promise can then be fulfilled by the leader while extracting a higher level of rents for herself than in the period before.

Some policy suggestions are drawn, namely, that preventing a leader from directly benefiting from spending categories that can be used as de facto power, such as those related to security and intelligence gathering, will reduce the incentives for such spending, as it will become more costly. Also, a society less dependent on the government enjoys stronger bargaining power before the leader, who is then forced to be more benevolent towards the citizens.

The possibility of investing in de facto power changes a leader's optimal behavior. Whether in democracy or not, the patterns of rent extraction never decrease. However, non-democratic leaders without access to de facto power, and democratic leaders facing a society that is highly dependent on the government will both extract as much as possible as fast as possible, while the former enjoying de facto power will appropriate resources at a slower pace. In all regimes, the promised life-time utility will decrease in the initial periods before stabilizing.

In recent times, constraints on re-election in the law and in practice have been eased in some South American countries, but also in Russia, while civil dependence on the administration has not diminished. The model predicts an increase in the expected tenure of officials, an increase in rent-seeking activities, a reduction of net incomes to citizens, and

a recrudescence of public spending on activities whose main effect is the consolidation of the political elites in those countries.

The model is based on recursive contract theory. For its parsimony, it can support plenty of extensions and adaptations aimed at answering a myriad of political-economy questions.

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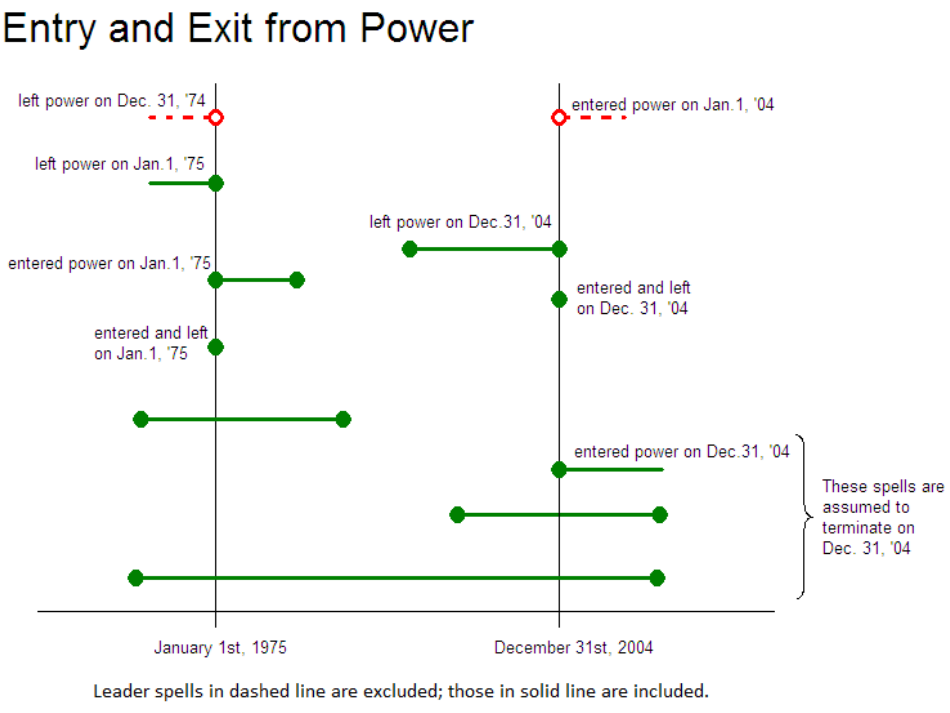
2.A Appendix: Duration in power, and government effectiveness

This appendix presents, and discusses the two variables used in the introduction to motivate this paper.

Government effectiveness 2004: taken from Kaufmann et alea (2009a); it captures "perceptions of the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies" (Kaufmann et al., 2009b); the range is $[-2.5, 2.5]$ with higher values meaning better governance; it is an estimate and I use the one for 2004. Total number of countries: 209. It exhibits a correlation greater than 95% with Kaufmann et alea's indicator on corruption. "Government effectiveness" has been used as a proxy for corruption and rent extraction by Persson and Tabellini (2003).

Average Years in Power: based on data from Archigos (Goemans et al., 2009a), which collects the exact dates of entry to and exit from power for effective primary rulers of independent states from 1875 to 2004. The effective primary ruler is "the person that *de facto* exercised power in a country" (*idem*). In practice, the highest responsible for foreign affairs and war/peace decisions is coded as the leader. I have changed the database to account for the few cases in which the effective primary ruler does not coincide with the economic policy/redistribution policy leader, which is the concept of leader I model in this paper (notes on these cases are available upon request). Total number of countries: 189.

For the reference period **1 January 1975 - 31 December 2004**, I compute the **simple mean of number of consecutive years in power** for all leaders that have exited from power after 31 December 1974 and up to 2004. A leader whose time in power is from 1950 to 1 January 1975 is included but a leader ruling from 1950 to 31 December 1974 is not. A leader that entered power on 31 December 2004 or before and exited on 31 December 2004 or after is included and **assumed** as leaving power on that date. Also, if both entry to and exit from power take place in 1974 then such leader is not included. If entry to power is on 1 January 2005 or after, then, no inclusion. (Country-specific cases and definitions: available upon request). The following graph depicts the inclusion criteria.



About the assumption above: if one believes government effectiveness 2004 was observed at 31 December 2004, than it is not relevant and it does not make sense to use

our knowledge that some leader-spells ended after that exact date. For present purposes, the duration of a given leader-spell up to the date of observation ends on that same date. Thus, the assumption that leaders in power on 31 December 2004 exited from power on that date is better described as assuming government effectiveness was observed on that date. If we assumed the spot of time for making that observation was, say, 30 June 2004, we would truncate leader-spells on that date. Since government effectiveness is an indicator based on many variables drawn from many data sources (cfr. Kaufmann et al., 2009b), it is quite plausible that on average the observation spot date across those sources is closer to 31 December 2004 than to any other specific day of that year.