THE TWELFTH
YOUNG ECONOMISTS'
SEMINAR
TO THE TWENTY-THIRD DUBROVNIK ECONOMIC CONFERENCE
Organized by the Croatian National Bank

Ricardo Vicente

Sovereign Default and Coalition Formation

Hotel "Grand Villa Argentina"
Dubrovnik
June 3 – 6, 2017

Draft version
Please do not quote

CROATIAN NATIONAL BANK

Sovereign Default and Coalition Formation*

Ricardo Vicente†

February 2017

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.

*I am grateful to Árpád Ábrahám for his guidance, and many constructive comments, and as well to Piero Gottardi, Andrea Mattozzi, Lenno Uusküla, César Sosa-Padilla, Facundo Piguillem, Rémi Bazillier, and seminar participants at the Tallinn University of Technology, the Estonian Business School, the 2014 ECPR Graduate Student Conference, the 2016 RIEF Doctoral Meetings, the 2016 EEA-ESEM Annual Congress, and the 2016 ASSET Annual Meeting. Sebastian M. Saiegh kindly provided his datasets. I acknowledge financial support from DGAE (Portuguese Foreign Affairs Ministry), Fundação para a Ciência e Tecnologia, European Social Fund's Doctoral Studies and Internationalisation Programme DoRa, and European Regional Development Fund's Doctoral Studies and Internationalisation Programme DoRa Plus.

†Tallinn University of Technology, Estonia, and CERGE-EI Foundation Teaching Fellow. E-mail address: Ricardo.Vicente@EUI.eu.

Keywords: Sovereign debt, Default risk, Interest rates, Business cycle, Political economy, Political risk, Majority government, Minority government, Surplus coalition, Minimum-winning coalition

JEL Classification: D72; E32; E43; F34

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[1]. 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[2]. 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[3].

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

[1] 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).

[2] 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).

[3] 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).

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[4].

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 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)[5]. 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[6]. 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[7].

Furthermore, focusing now on industrialized parliamentary democracies, Laver and Schofield (1990) have found as well that surplus coalitions and minority governments are very common[8]. 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 governments, there were a total of 196 governments[9]. Of these, 73 (37%) were minority

[4] 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.

[5] For a survey of the theory of government coalitions, cfr. Crombez (1996).

[6] 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.

[7] Saiegh (2009), and my calculations.

[8] Cited in Mueller (2003).

[9] 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.

governments. Among the majority coalitions (123), 46 (37%) were surplus coalitions[10].

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.

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.

[10] 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%.

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[11].

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.

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

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 Related literature

The field of sovereign debt had its genetic moment with Eaton and Gersovitz (1981)[12]. 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 optimal 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).

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

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[13].

Among the relevant research, my paper is most related to Cuadra and Sapriza (2008), and Arellano (2008)[14]. 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 essentially symmetric: they only differ in that each of them gives more weight to the utility of its own constituency ("polarization")[15,16].

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[17].

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.

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

[14] 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.

[15] 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.

[16] 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.

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

I model the general income loss after default in the way proposed by Arellano (2008). The next section presents the model in detail.

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.

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[18].

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

[18] 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.

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[19]. 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[20]. 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).

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:

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

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

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

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.

[19] Cfr. footnote 2.

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

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

$$\overline{\theta}u(C^A) + \underline{\theta}u(C^A) + \theta_J u(C^J) \quad (2)$$

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

$$\left(\overline{\theta} - \xi_1\right) u(C^A) + \left(\underline{\theta} - \xi_2\right) u(C^B) + \left(\theta_J + \xi_1 + \xi_2\right) u(C^J) \quad (3)$$

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[21]. 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, those decisions are the result of the maximization of equation (3) and the corresponding

[21] 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).

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 (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 (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.

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

$$C^A + C^B + C^J = y + B - q_i(B'; y, M)B' \tag{4}$$

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

$$C^A + C^B + C^J = y^{aut} \tag{5}$$

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:

$$h(y) = \begin{cases} \widehat{y} \text{ if } y > \widehat{y} \\ y \text{ if } y \leq \widehat{y} \end{cases} \tag{6}$$

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 $\gamma \in (0,1)$[22].

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

$$\overline{\theta} u(C^A) + \underline{\theta} u(C^B) + \theta_J u\left(\gamma C^J\right) \tag{7}$$

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

$$\left(\overline{\theta} - \xi_1\right) u(C^A) + \left(\underline{\theta} - \xi_2\right) u(C^B) + \left(\theta_J + \xi_1 + \xi_2\right) u\left(\gamma C^J\right). \tag{8}$$

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)[23].

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

[23] In my model, the mean debt to GDP ratio is 16.28%, while in Arellano (2008) it is 5.95%. These

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.

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 $\mu \in (0, 1)$.

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

results are not fully comparable (cfr. General business cycle statistics section, in particular footnote 39).

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 (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 (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[24]. While the dependence of $\pi(.)$ on that decision would seem realistic, it poses a theoretical difficulty, as well as an analytical one.

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

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.

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[25].

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:

$$\delta(M) = \begin{cases} \delta^{MW} \;\; if \;\; M = min \\ \delta^{SP} \;\; if \;\; M = maj \end{cases} . \tag{9}$$

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[26,27].

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

[25] 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.

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

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

smaller party.

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[28]. Say, though having more political clout while being part of the government, the junior party is most likely not going to have the last

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

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[29].

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[30]. 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,

[29] 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.
[30] Frederick et al. (2002) present a critical survey of time discount of models.

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 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[31].

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.

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:

[31] 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.

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.

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

$$P^i_{MG,y,M'G'} \equiv \Pr\left[M', G' | i, M, G, y\right] \tag{10}$$

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

$$\Gamma_i(y, B, M) = \begin{cases} 1 \; \textit{if coalition} \\ 0 \; \textit{otherwise} \end{cases} \quad \textit{where } i = A, B \tag{11}$$

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:

$$\begin{aligned} P^i_{(maj,sin,y),(maj',sin')} &\equiv \Pr\left[maj', sin' | i, maj, sin, y\right] = \\ &= \sum_{y'} Q(y'|y) \left\{ \begin{array}{c} \pi(maj) \times [1 - \Gamma_i(y', B'_i, maj)] \\ \\ + [1 - \pi(maj)] \times \sigma \times \left[1 - \Gamma_j(y', B'_j, maj)\right] \end{array} \right\}. \end{aligned} \tag{12}$$

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

$$P^i_{(maj,sin,y),(maj',sin')} = [\pi(maj) + (1 - \pi(maj)) \times \sigma] \sum_{y'} Q(y'|y) [1 - \Gamma(y', B_i', maj)] . \tag{13}$$

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

$$\begin{aligned} P^i_{(maj,coa,y),(maj',sin')} &= \pi(maj) (1 - \delta(maj)) \\ &\quad + (1 - \pi(maj)) \times \sigma \sum_{y'} Q(y'|y) [1 - \Gamma(y', B_i', maj)] . \end{aligned} \tag{14}$$

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.

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:

$$q_i(B'; y, M) = \frac{1 - \lambda_i(B'; y, M)}{1 + r_f} \tag{15}$$

for $i = A, AJ, B, BJ$, where $\lambda_i(B'; y, M)$ 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[32]. It also allows for a little notational parsimony, as an explicit indication of the state G can be avoided.

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

$$D_i(y, B, M) = \begin{cases} 1 \textit{ if default} \\ 0 \textit{ otherwise} \end{cases} \quad \textit{where } i = A, AJ, B, BJ \tag{16}$$

be some sovereign default rule (as in equation 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.

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

[32] 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.

$$\lambda_i(B';y,M) = \sum_{y'} Q(y'|y) \times \begin{bmatrix} P^i_{(M,G,y),(maj',sin')} \times D(y',B',maj,sin) \\ \\ +P^i_{(M,G,y),(min\prime,sin')} \times D(y',B',min,sin) \\ \\ +P^i_{(M,G,y),(maj',coa')} \times D(y',B',maj,coa) \\ \\ +P^i_{(M,G,y),(min\prime,coa')} \times D(y',B',min,coa) \end{bmatrix}. \quad (17)$$

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.

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 repay 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.

3 Equilibrium

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. In the case of consumption, the superscript indicates who receives a given level of consumption, whereas the subscript refers to the composition of the government, and an asterisk is used as a mark of optimality.

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)[33].

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

Those value functions are

$$VR^i_j(.) \textit{ and } VD^i_j(.) \textit{ with } i, j = A, AJ, B, BJ. \tag{18}$$

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.

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)[34].

Formally, the value functions are

$$VS^i_j(.) \textit{ with } i = A, AJ, B, BJ, \; j = A, B \tag{19}$$

and

$$VC^i_j(.) \textit{ with } i = A, AJ, B, BJ, \; j = AJ, BJ. \tag{20}$$

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 its 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

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

default[35].

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

$$V_j^i(.)\ with\ i = A, AJ, B, BJ\ and\ j = A, B. \tag{21}$$

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.

3.1.1 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:

$$\begin{aligned} VR_A^A(y,B,M) &= \max_{C^A,C^B,C^J,B'} \overline{\theta}u(C^A) + \underline{\theta}u(C^B) + \theta_J u(C^J) \\ &+\beta\sum_{y'} Q(y'|y)\left[\pi(M)V_A^A(y',B',M) + (1-\pi(M))\left(\begin{array}{c}\sigma V_B^A(y',B',maj) \\ +(1-\sigma)V_B^A(y',B',min)\end{array}\right)\right] \\ &s.to\ C^A + C^B + C^J = y + B - q^A(B';y,M)B'. \end{aligned} \tag{22}$$

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.

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

[35] There are eight value functions at this level, and, due to symmetry, only four are used when solving the model with a computer.

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:

$$
\begin{aligned}
VD_A^A(y, M) = & \max_{C^A, C^B, C^J} \overline{\theta} u(C^A) + \underline{\theta} u(C^B) + \theta_J u(\gamma C^J) \\
& + \beta\mu \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) V_A^A(y', 0, M) \\ + (1 - \pi(M)) \left(\sigma V_B^A(y', 0, maj) + (1 - \sigma) V_B^A(y', 0, min) \right) \end{array} \right] \\
& + \beta (1 - \mu) \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) VD_A^A(y', M) \\ + (1 - \pi(M)) \left(\sigma VD_B^A(y', maj) + (1 - \sigma) VD_B^A(y', min) \right) \end{array} \right] \\
& s.to.\ C^A + C^B + C^J = y^{aut}.
\end{aligned}
\tag{23}
$$

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:

$$VR_B^A(y, B, M) = \overline{\theta}u(C_B^{*A}) + \underline{\theta}u(C_B^{*B}) + \theta_J u(C_B^{*J})$$
$$+\beta \sum_{y'} Q(y'|y) \left[\begin{array}{c} \pi(M) V_B^A(y', B_B'^*, M) \\ +(1-\pi(M)) \left(\sigma V_A^A(y', B_B'^*, maj) + (1-\sigma) V_A^A(y', B_B'^*, min)\right) \end{array} \right] \tag{24}$$

where $\left\{C_B^{*A}, C_B^{*J}, C_B^{*B}\right\}$ 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:

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

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

$$+\beta(1-\mu) \sum_{y'} Q(y'|y) \begin{bmatrix} \pi(M) VD_B^A(y',M) \\ +(1-\pi(M))\left(\sigma VD_A^A(y',maj) + (1-\sigma) VD_A^A(y',min)\right) \end{bmatrix} \tag{25}$$

where $\left\{C_B^{aut*A}, C_B^{aut*B}, C_B^{aut*J}\right\}$ 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:

$$VR_{AJ}^A(y,B,M) = \overline{\theta} u\left(C_{AJ}^{*A}\right) + \underline{\theta} u\left(C_{AJ}^{*B}\right) + \theta_J u\left(C_{AJ}^{*J}\right)$$

$$+\beta \sum_{y'} Q(y'|y) \begin{bmatrix} \pi(M)\left(\delta(M) VC_{AJ}^A(y', B_{AJ}'^*, M) + (1-\delta(M)) VS_A^A(y', B_{AJ}'^*, M)\right) \\ +(1-\pi(M))\left(\sigma V_B^A(y', B_{AJ}'^*, maj) + (1-\sigma) V_B^A(y', B_{AJ}'^*, min)\right) \end{bmatrix} \tag{26}$$

where $\left\{C_{AJ}^{*A}, C_{AJ}^{*B}, C_{AJ}^{*J}\right\}$ 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 $VC_{AJ}^A(y', B_{AJ}'^*, M)$.

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:

$$VD_{AJ}^A(y,M) = \overline{\theta}u(C_{AJ}^{aut*A}) + \underline{\theta}u(C_{AJ}^{aut*B}) + \theta_J u(\gamma C_{AJ}^{aut*J})$$

$$+\beta\mu\sum_{y'} Q(y'|y)\begin{bmatrix} \pi(M)\left(\delta(M)VR_{AJ}^A(y',0,M) + (1-\delta(M))VR_A^A(y',0,M)\right) \\ +(1-\pi(M))\left(\sigma V_B^A(y',0,maj) + (1-\sigma)V_B^A(y',0,min)\right) \end{bmatrix}$$

$$+\beta(1-\mu)\sum_{y'} Q(y'|y)\begin{bmatrix} \pi(M)\left(\delta(M)VD_{AJ}^A(y',M) + (1-\delta(M))VD_A^A(y',M)\right) \\ +(1-\pi(M))\left(\sigma VD_B^A(y',maj) + (1-\sigma)VD_B^A(y',min)\right) \end{bmatrix} \tag{27}$$

where $\{C_{AJ}^{aut*A}, C_{AJ}^{aut*B}, C_{AJ}^{aut*J}\}$ 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: $VR_{AJ}^A(y',0,M)$, 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: $VR_{BJ}^B(y,B,M)$, and $VD_{BJ}^B(y,B,M)$, 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:

$$VR_{BJ}^A(y,B,M) = \overline{\theta}u\left(C_{BJ}^{*A}\right) + \underline{\theta}u\left(C_{BJ}^{*B}\right) + \theta_J u\left(C_{BJ}^{*J}\right)$$

$$+\beta\sum_{y'} Q(y'|y)\begin{bmatrix} \pi(M)\left(\delta(M)VC_{BJ}^A(y',B'^*_{BJ},M) + (1-\delta(M))VS_B^A(y',B'^*_{BJ},M)\right) \\ +(1-\pi(M))\left(\sigma V_A^A(y',B'^*_{BJ},maj) + (1-\sigma)V_A^A(y',B'^*_{BJ},min)\right) \end{bmatrix} \tag{28}$$

and the value of default is:

$$VD_{BJ}^{A}(y,M)=\overline{\theta}u\left(C_{BJ}^{aut*A}\right)+\underline{\theta}u\left(C_{BJ}^{aut*B}\right)+\theta_{J}u\left(\gamma C_{BJ}^{aut*J}\right)$$

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

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

(29)

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

3.1.2 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:

$$VR_{AJ}^{AJ}(y,B,M)=\max_{C^{A},C^{B},C^{J},B'}\left(\overline{\theta}-\xi_{1}\right)u(C^{A})+\left(\underline{\theta}-\xi_{2}\right)u(C^{B})+\left(\theta_{J}+\xi_{1}+\xi_{2}\right)u(C^{J})$$

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

$$s.to.\ C^{A}+C^{B}+C^{J}=y+B-q^{AJ}(B';y,M)B'.$$

(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 $VS_{A}^{AJ}(y',B',M)$.

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

$$VD_{AJ}^{AJ}(y,M) = \max_{C^A,C^B,C^J} \left(\overline{\theta}-\xi_1\right)u(C^A) + \left(\underline{\theta}-\xi_2\right)u(C^B) + \left(\theta_J+\xi_1+\xi_2\right)u(\gamma C^J)$$

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

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

$$s.to.\ C^A+C^B+C^J=y^{aut}. \tag{31}$$

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.

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

$$+\beta\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)\left(\delta(M)VC_{BJ}^{AJ}(y',B_{BJ}'^{*},M)+(1-\delta(M))VS_{B}^{AJ}(y',B_{BJ}'^{*},M)\right)\\ +(1-\pi(M))\left(\sigma V_{A}^{AJ}(y',B_{BJ}'^{*},maj)+(1-\sigma)V_{A}^{AJ}(y',B_{BJ}'^{*},min)\right)\end{array}\right] \tag{32}$$

and

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

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

$$+\beta(1-\mu)\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)\left(\delta(M)VD_{BJ}^{AJ}(y',M)+(1-\delta(M))VD_{B}^{AJ}(y',M)\right)\\ +(1-\pi(M))\left(\sigma VD_{A}^{AJ}(y',maj)+(1-\sigma)VD_{A}^{AJ}(y',min)\right)\end{array}\right] \tag{33}$$

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

$$VR_A^{AJ}(y,B,M) = \left(\overline{\theta}-\xi_1\right)u(C_A^{*A}) + (\underline{\theta}-\xi_2)\,u(C_A^{*B}) + (\theta_J+\xi_1+\xi_2)\,u(C_A^{*J})$$

$$+\beta\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)V_A^{AJ}(y',B_A'^{*},M)\\ +(1-\pi(M))\left(\sigma V_B^{AJ}(y',B_A'^{*},maj)+(1-\sigma)\,V_B^{AJ}(y',B_A'^{*},min)\right)\end{array}\right] \tag{34}$$

and

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

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

$$+\beta\left(1-\mu\right)\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)VD_A^{AJ}(y',M)\\ +(1-\pi(M))\left(\sigma VD_B^{AJ}(y',maj)+(1-\sigma)\,VD_B^{AJ}(y',min)\right)\end{array}\right] \tag{35}$$

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.

$$VR_B^{AJ}(y,B,M) = \left(\overline{\theta}-\xi_1\right)u(C_B^{*A}) + (\underline{\theta}-\xi_2)\,u(C_B^{*B}) + (\theta_J+\xi_1+\xi_2)\,u(C_B^{*J})$$

$$+\beta\sum_{y'}Q(y'|y)\left[\begin{array}{c}\pi(M)V_B^{AJ}(y',B_B'^{*},M)\\ +(1-\pi(M))\left(\sigma V_A^{AJ}(y',B_B'^{*},maj)+(1-\sigma)\,V_A^{AJ}(y',B_B'^{*},min)\right)\end{array}\right] \tag{36}$$

and

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

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

$$+\beta\left(1-\mu\right)\sum_{y'} Q(y'|y)\left[\begin{array}{c} \pi(M)VD_B^{AJ}(y',M) \\ +\left(1-\pi(M)\right)\left(\sigma VD_A^{AJ}(y',maj)+\left(1-\sigma\right)VD_A^{AJ}(y',min)\right) \end{array}\right] \tag{37}$$

3.2 Optimal decisions

In defining the decisions of agents, I follow backward induction.

The last decision is on the consumption allocation, which depends on available resources, given by (4) when the economy enjoys access to foreign credit, and by (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

$$C_i^*(y,B,M) = \left\{C_i^{*A}, C_i^{*B}, C_i^{*J}\right\} \textit{ where } i = A, AJ, B, BJ \tag{38}$$

and an optimal level of borrowing

$$B_i'^*(y,B,M) = B_i'^* \textit{ where } i = A, AJ, B, BJ \tag{39}$$

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

$$C_i^{aut*}(y,M) = \left\{C_i^{aut*A}, C_i^{aut*B}, C_i^{aut*J}\right\} \ \textit{where } i = A, AJ, B, BJ \tag{40}$$

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:

$$D_i^*(y,B,M) = \begin{cases} 1 \ \textit{if } VD_i^i(y,M) > VR_i^i(y,B,M) \\ 0 \ \textit{otherwise} \end{cases} \quad \textit{where } i = A, AJ, B, BJ. \tag{41}$$

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

$$VS_i^i(y,B,M) = \max\left\{VR_i^i(y,B,M), VD_i^i(y,M)\right\} \ \textit{with } i = A, B \tag{42}$$

in case of single-party government, and

$$VC_j^j(y,B,M) = \max\left\{VR_j^j(y,B,M), VD_j^j(y,M)\right\} \ \textit{with } j = AJ, BJ \tag{43}$$

when there is a coalition in power[36].

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:

$$\Gamma_i^*(y,B,M) = \begin{cases} 1 \ \textit{if } VC_{iJ}^i(y,B,M) > VS_i^i(y,B,M) \\ 0 \ \textit{otherwise} \end{cases} \quad \textit{where } i = A, B. \tag{44}$$

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

[36] 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[37]:

$$V_i^i(y, B, M) = \max\left\{VS_i^i(y, B, M), VC_i^i(y, B, M)\right\} \ \ with\ i = A, B. \tag{45}$$

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 $C_i^{aut*}(y, M)$, for $i = A, AJ, B, BJ$;
- 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

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

- $C_i^*(y,B,M)$ and $B_i'^*(y,B,M)$ solve the maximization problem in $VR_i^i(y,B,M)$, for $i = A, AJ, B, BJ$;

- $C_i^{aut*}(y,M)$ 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 $k = BJ$;

- $C_i^{aut*}(y,M) = C_j^{aut*}(y,M)$, for $i = A$ and $j = B$; $C_h^{aut*}(y,M) = C_k^{aut*}(y,M)$, 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.

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 formation 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.

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.

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[38].

[38] 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)/σ(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.

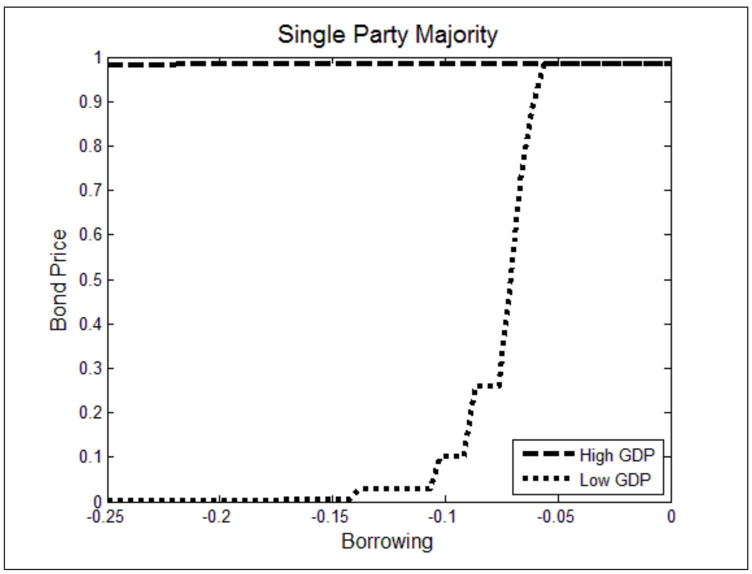


Figure 1: Bond Price, Single-Party Majority

Figure 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 2 below.

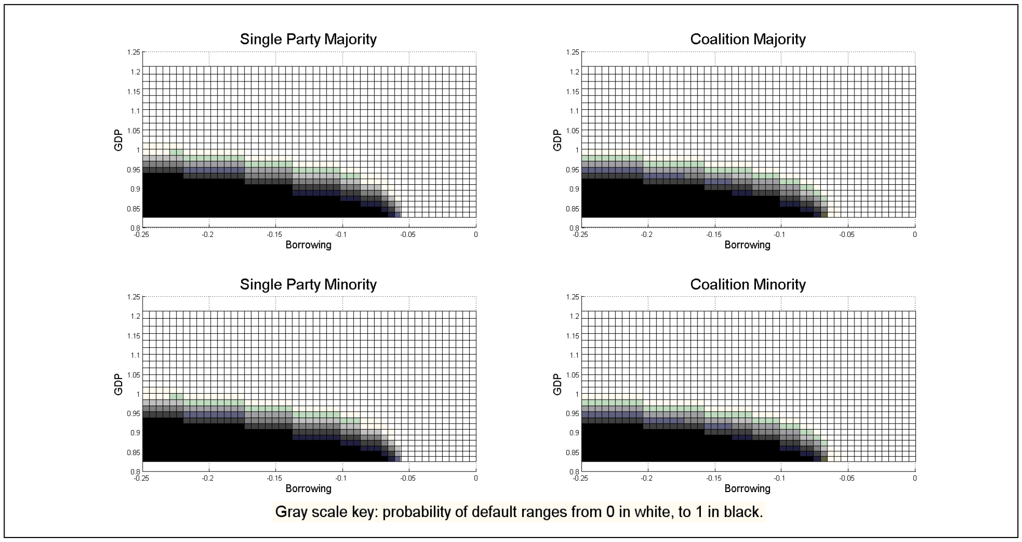


Figure 2: Probability of Default

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.

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 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[39].

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

[39] 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 $\xi_1 + \xi_2 > 0$.

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 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 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.

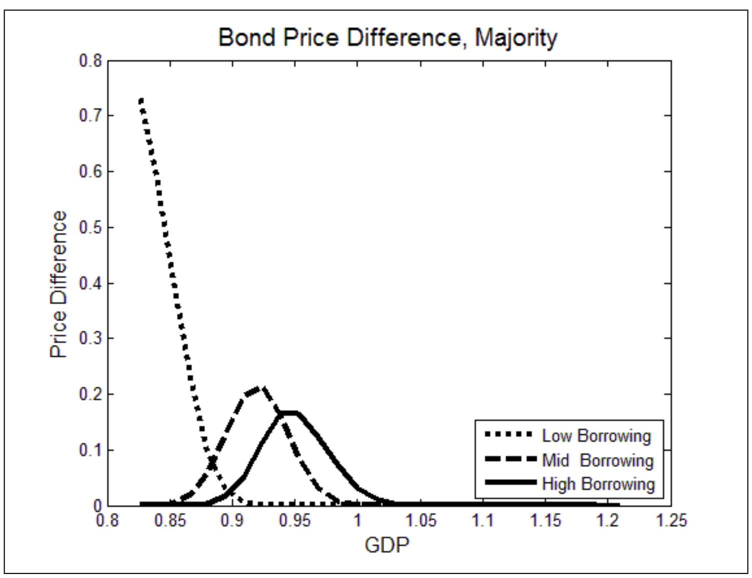


Figure 3: Coalition - Single Party Bond Price Difference, Majority

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%[40].

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.

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

[40]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).

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[41]. 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 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:

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

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 4.

Overall, debt as a percentage of GDP is similar across all types of government[42].

[42] 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.

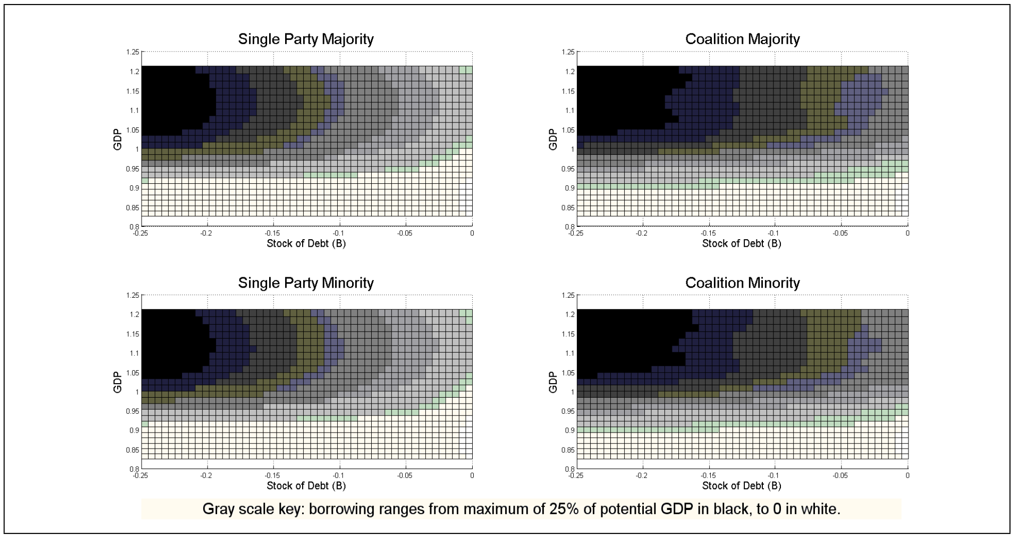


Figure 4: Borrowing Policy

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': $\pi(maj) \times \delta(maj) \times \beta < \pi(maj)\beta$, and $\pi(min) \times \delta(min) \times \beta < \pi(min) \times \beta$. Hence, coalitions are willing to pay higher interest rates because they are more impatient than single-party governments: the *unconditional* probability one coalition holds, $\pi(M) \times \delta(M)$, is lower than the probability that a single-party government stays in power, $\pi(M)$[43].

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.

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

Table 6 - Coalition Formation

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

Mean debt as percent of potential output.

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[44].

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

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

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.

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.

References

[1] **Aguiar, Mark, and Gita Gopinath** (2006), "Defaultable debt, interest rates and the current account", *Journal of International Economics*, **69**: 64-83.

[2] **Alesina, Alberto, Gerald D. Cohen, and Nouriel Roubini** (1992), "Macroeconomic Policy and Elections in OECD Democracies", *Economics and Politics*, **4**: 1-30.

[3] **Alesina, Alberto, and Roberto Perotti** (1995), "The Political Economy of Budget Deficits", *IMF Staff Papers*, **42**(1): 1-31.

[4] **Alesina, Alberto, and Guido Tabellini** (1990), "A Positive Theory of Fiscal Deficits and Government Debt", *Review of Economic Studies*, **57**: 403-414.

[5] **Alfaro, Laura, and Fabio Kanczuk** (2005), "Sovereign debt as a contingent claim: a quantitative approach", *Journal of International economics*, **65**: 297-314.

[6] **Amador, Manuel** (2012), "Sovereign Debt and the Tragedy of the Commons", mimeo, Stanford University.

[7] **Arellano, Cristina** (2008), "Default Risk and Income Fluctuations in Emerging Markets", *American Economic Review*, **98**(3): 690-712.

[8] **Bawn, Kathleen, and Frances Rosenbluth** (2003), "Coalition Parties versus Coalitions of Parties: How Electoral Agency Shapes the Political Logic of Costs and Benefits", mimeo, UCLA and Yale University.

[9] **Beaulieu, Emily, Gary W. Cox, and Sebastian Saiegh** (2012), "Sovereign Debt and Regime Type: Reconsidering the Democratic Advantage", *International Organization* **66**(4): 709-738.

[10] **Borensztein, Eduardo, and Ugo Panizza** (2008), "The Costs of Sovereign Default", IMF Working Paper.

[11] **Bulow, Jeremy, and Kenneth Rogoff** (1989), "Sovereign Debt: Is to Forgive to Forget?", *American Economic Review*, **79**(1): 43-50.

[12] **Chatterjee, Satyajit, and Burcu Eyigungor** (2016), "Continuous Markov Equilibria with Quasi-Geometric Discounting", *Journal of Economic Theory,* **163**: 467-494.

[13] **Cheibub, José António, Przeworski, Adam, and Sebastian M. Saiegh** (2004), "Government Coalitions and Legislative Success Under Presidentialism and Parliamentarism", *British Journal of Political Science*, **34**(4): 565-587.

[14] **Cole, Harold L., James Dow, and William B. English** (1995), "Default, Settlement, and Signalling: Lending Resumption in a Reputational Model of Sovereign Debt", *International Economic Review*, **36**(2): 365-385.

[15] **Crombez, Christophe** (1996), "Minority government, minimal winning coalition and surplus majorities in parliamentary systems", *European Journal of Political Research*, **29**: 1-29.

[16] **Cuadra, Gabriel, Juan M. Sanchez, and Horacio Sapriza** (2010), "Fiscal policy and default risk in emerging markets", *Review of Economic Dynamics*, **13**: 452-469.

[17] **Cuadra, Gabriel, and Horacio Sapriza** (2008), "Sovereign default, interest rates and political uncertainty in emerging markets", *Journal of International Economics*, **76**: 78-88.

[18] **Curtis, K. Amber, Joseph Jupille, and David Leblang** (2012), "I Save for Icesave: Self-Interest and Sovereign Debt Resettlement", *Institutions Program Working Paper Series*, University of Colorado at Boulder.

[19] **Dixit, Avinash, and John Londregan** (1998), "Political Power and the Credibility of Government Debt", *Journal of Economic Theory*, **94**: 80-105.

[20] **Drazen, Allan** (2000), "Political Economy in Macroeconomics", Princeton University Press.

[21] **D'Erasmo, Pablo** (2011), "Government Reputation and Debt Repayment in Emerging Economies", mimeo, University of Maryland.

[22] **Eaton, Jonathan, and Mark Gersovitz** (1981), "Debt with Potential Repudiation: Theoretical and Empirical Analysis", *The Review of Economic Studies*, **48**(2): 289-309.

[23] **Frederick, Shane, George Loewenstein, and Ted O'Donoghue** (2002), "Time Discounting and Time Preference: A Critical Review", *Journal of Economic Literature*, **40**(2): 351-401.

[24] **Hatchondo, Juan Carlos, Leonardo Martinez, and Horacio Sapriza** (2007), "The Economics of Sovereign Defaults", *Economic Quarterly*, **93**(2): 163-187.

[25] **Hatchondo, Juan Carlos, Leonardo Martinez** (2010), "The Politics of Sovereign Defaults", *Economic Quarterly*, **96**(3): 291-317.

[26] **Kohlscheen, Emanuel** (2010), "Sovereign risk: constitutions rule", *Oxford Economic Papers*, **61**(1): 62-85.

[27] **Laver, Michael, and Norman Schofield** (1990), "Multiparty Government", Oxford University Press.

[28] **Lijphart, Arend** (1984), "Measures of Cabinet Durability: A Conceptual and Empirical Evaluation", *Comparative Political Studies*, **17**(2): 265-79.

[29] **McGillivray, Fiona, and Alastair Smith** (2003), "Who can be trusted?: Sovereign debt and the impact of leadership change", mimeo, New York University.

[30] **Mueller, Dennis C.** (2003), "Public Choice III", Cambridge University Press.

[31] **Norris, Pippa** (1997), "Choosing Electoral Systems: Proportional, Majoritarian and Mixed Systems", *International Political Science Review*, **18**(3): 297-312.

[32] **Panizza, Ugo, Federico Sturzenegger, and Jeromin Zettelmeyer** (2009), "The Economics and Law of Sovereign Debt and Default", *Journal of Economic Literature*, **47**(3): 651-698.

[33] **Riker, W.** (1962), "The Theory of Political Coalitions", New Haven, CT: Yale University Press.

[34] **Saiegh, Sebastian M.** (2005a), "Can Democracy Prevent Sovereign Debt Repudiation?", in Miguel A. Centeno, Harold James, and John Londregan (eds.) *The Political Economy of Recurrent Debt*, Princeton University Press.

[35] **Saiegh, Sebastian M.** (2005b), "Do Countries Have a "Democratic Advantage"?", *Comparative Political Studies*, vol. **XX**, no. X: 1-22.

[36] **Saiegh, Sebastian M.** (2009), "Coalition Governments and Sovereign Debt Crises", *Economics and Politics*, Vol. **38**(2): 232-254.

[37] **Schultz, Kenneth, and Barry Weingast,** (2003), "The Democratic Advantage: Institutional Foundations of Financial Power in International Competition", *International Organization* **57**(1), 3-42.

[38] **Stasavage, David** (2003), "Public Debt and the Birth of the Democratic State", New York University: Cambridge University Press.

[39] **Stasavage, David** (2006), "Cities, Constitutions, and Sovereign Borrowing in Europe, 1274-1785", mimeo, New York University.

[40] **Tomz, Michael** (2002), "Democratic Default: Domestic Audiences and Compliance with International Agreements", mimeo, Stanford University.

[41] **Tomz, Michael** (2004), "Interests, Information, and the Domestic Politics of International Agreements", mimeo, Stanford University.

[42] **Tomz, Michael, and Mark Wright** (2013), "Empirical Research on Sovereign Debt and Default", *Annual Review of Economics*, **5**: 247-72.

Appendix 1: 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).

Appendix 2: 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[45]:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

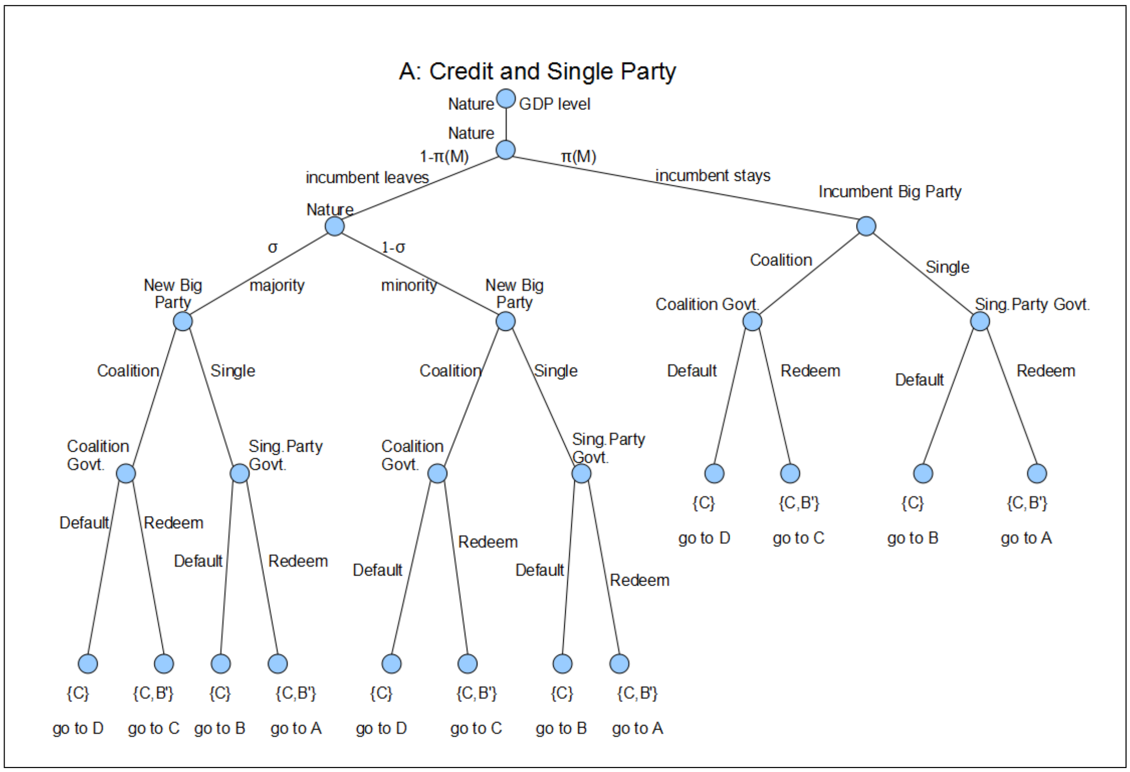
$$P^i_{(min,coa,y),(maj',coa')} = (1-\pi(min)) \times \sigma \sum_{y'} Q(y'|y)\Gamma(y', B'_i, maj)$$

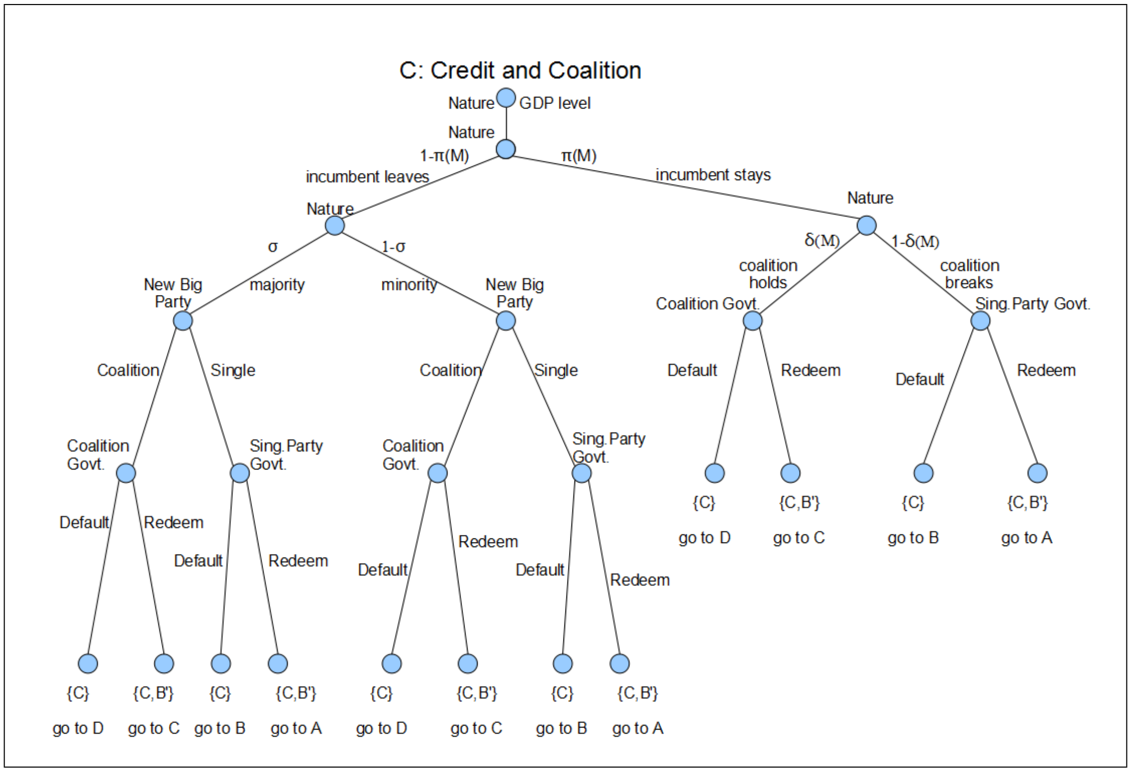
$$P^i_{(min,coa,y),(min',coa')} = \pi(min) \times \delta(min) + (1-\pi(min))\,(1-\sigma) \sum_{y'} Q(y'|y)\Gamma(y', B'_i, min)$$

Appendix 3: Game Tree

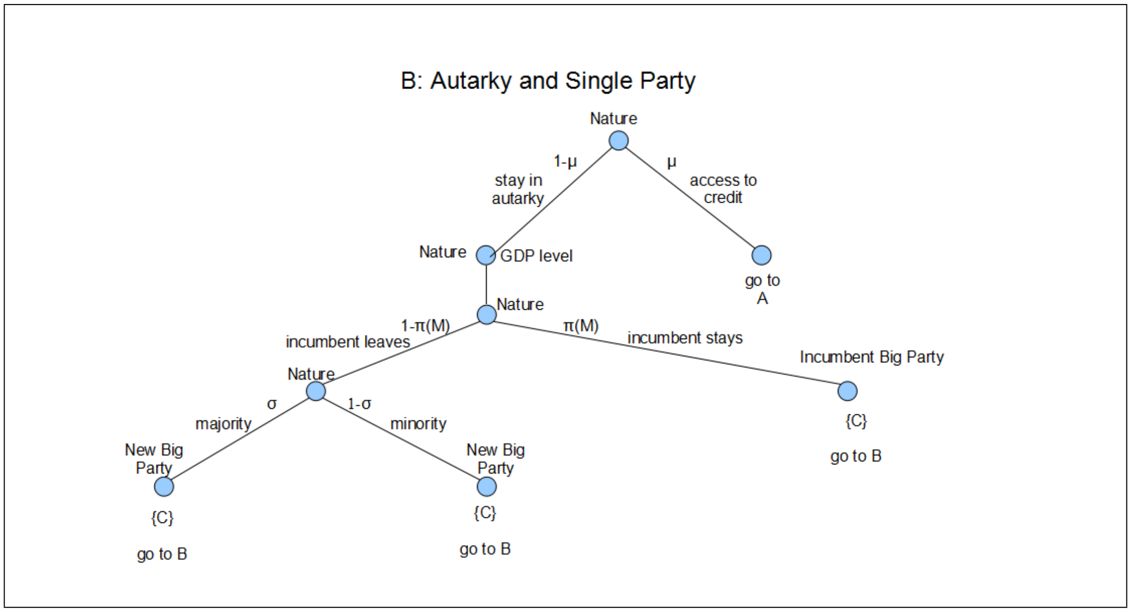
If arrival at *Credit and Single Party* or *Credit and Coalition* happens after default and regaining access to credit, then $B = 0$ and, thus, default is not an option. If arrival at *Credit and Single Party* or *Credit and Coalition* follows a period with access to credit but borrowing was then set 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.

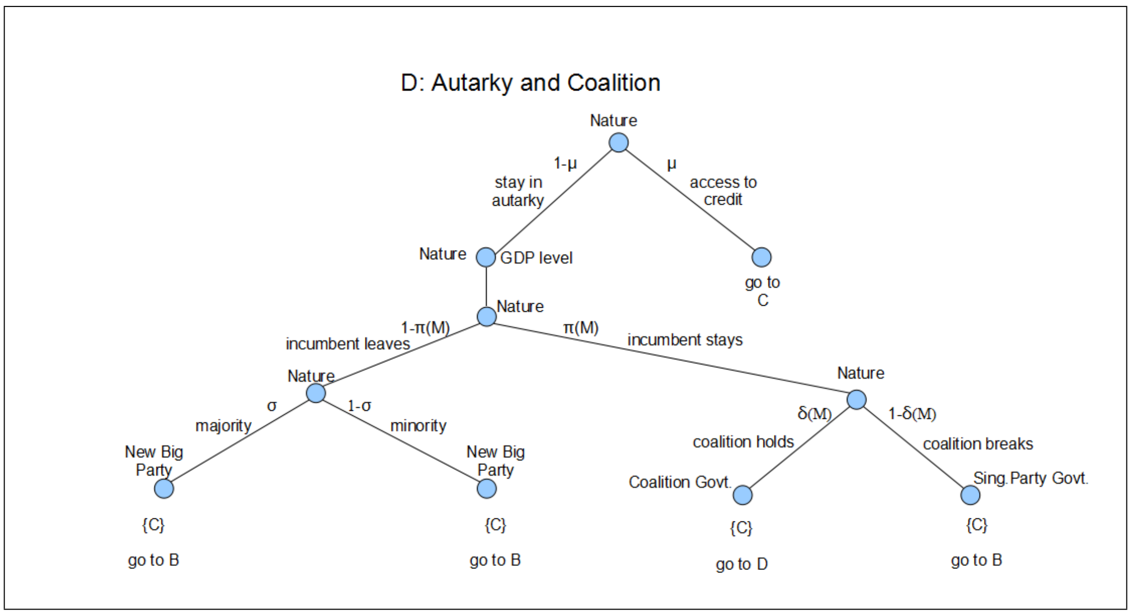
$\{C\}$ stands for the maximization decision over $\{C^A, C^B, C^J\}$ in case of default, while $\{C, B'\}$ stands for the maximization decision over $\{C^A, C^B, C^J, B'\}$ in case of access to financial markets.





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


D: Autarky and Coalition
Nature
1-μ
stay in autarky
μ
access to credit
Nature
GDP level
go to C
Nature
1-π(M)
incumbent leaves
π(M)
incumbent stays
Nature
σ
majority
1-σ
minority
Nature
δ(M)
coalition holds
1-δ(M)
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

Appendix 4: 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[46]. 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.

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

[46] 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.

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[47].

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, 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[48].

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.

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

[48] 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.

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 necessary 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[49].

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[50].

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[51].

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,

[49] 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.

[50] 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.

[51] If an election does not affect the composition of the cabinet, and does not dramatically change parties' shares, then it does not terminate the corresponding big-party spell, or the coalition spell.

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 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

Country	Big Party		Coalition	
	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.