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Endogenous Political Turnover and Fluctuations in Sovereign Default Risk[1]

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Abstract

A sovereign default model in which the sovereign derives private benefits from public office and contests elections to stay in power is developed. The economy's growth process is modeled as a Markov switching regime, which is shown to be a better description of the data for our set of emerging economies. In the model, consistent with evidence, the sovereign is less likely to be reelected if economic growth is weak. In the low-growth regime, there is higher probability of loss of private benefits due to turnover, which makes the sovereign behave more myopically. This growth-linked variation in effective discount factor is shown to be important in generating volatility in sovereign spreads.

Keywords: growth regimes, elections, sovereign default risk

JEL Codes: C73, D72, E10, F34, G15, H63, P26

1 Introduction

In the quantitative-theoretic literature that developed in the wake of Eaton and Gersovitz (1981), Aguiar and Gopinath (2006) and Arellano (2008), the sovereign is commonly modeled as a benevolent dictator maximizing the utility of the representative citizen. This literature has achieved considerable quantitative success but posits very low discount factors to explain aggregate facts. Across models, the quarterly discount factor is generally less (sometimes *far* less) that 0.95. As a description of people's intertemporal preferences, such discount factors seem implausibly low.[1]

This paper explores the implications of conflict of interest between policymakers and citizens as a source of the myopia required to account for external sovereign debt facts of emerging economies. In this, we are motivated by the strong suggestion in political economics th at conflict of interest between the governors and the governed can lead to short termism in political leaders. Following the public choice approach to political economy (Mueller (2003), Besley (2006)), we model the sovereign as a provider of public goods subject to an agency cost, namely, that the sovereign derives private benefits from public office. Among the many ramifications of this approach, we focus on one: If tenure as a leader is expected to be short, the anticipated loss of private benefits will make the sovereign behave myopically.[2]

For this purpose, we study three emerging economies — Mexico, Peru and Turkey — and focus on accounting for these economies' average external debt-to-GDP ratio as well as the mean and standard deviation of their sovereign spreads. We show that conflict of interest between the sovereign and citizens can indeed microfound low discount factors and that political turnover, when it is linked to economic malperformance of the country, can contribute significantly to fluctuations in sovereign default risk.

We endogenize political turnover *via* a model of elections. In this we are guided by evidence presented in Brender and Drazen (2008) who show that, for developing countries that elect their

[1] As a point of comparison, in models designed to explain developed country facts, the comparable value would be 0.99 or higher.

[2] The idea that conflict of interest can lead to short termism transcends the specific model of this paper. The general basic idea is that political arrangements that permit spending on select groups using revenues raised via general taxation — the so-called "common pool problem" — lead to fiscal excess (Inman and Fitts (1990), Ingberman and Inman (1988)). In a dynamic context, in which politicians place nonnegligible probability on losing power in the future, it can lead to a deficit bias and overborrowing (Persson and Svensson (1989) and Alesina and Tabellini (1990)). It is as if fiscal decisions are made by an entity with a "present bias" i.e., an overweighting of *current* expenditures, partially targeted to a select group, relative to true intertemporal preferences of citizens. Legislative bargaining models in which legislators place positive probability on being excluded from future winning coalitions (Baron and Ferejohn (1989), Battaglini and Coate (2007)) also feature similar present bias.

leaders, there is a strong positive link between the rate of economic growth during a leader's term and the likelihood of his reelection. Specifically, they document that a 1 percentage point increase in the rate of GDP growth during the leader's term is associated with a 6-9 percentage point increase in the probability of his reelection.

We model the parameters of the economy's growth process as switching over time according to a (hidden) two-state Markov process as in Hamilton (1989), a better description of the growth data for all three countries than a single-regime AR1 process. To incorporate the evidence on the positive link between economic growth and reelection, we assume that when a new leader is elected the economy's growth regime is newly drawn from a given distribution. This has the implication that voters are more likely to replace the incumbent leader if they perceive that they have a better shot at the good growth regime with a new leader.

Endogenous political turnover links the sovereign's effective discount factor positively to economic performance. When economic growth is strong, the leader's chances of reelection are high, which extends his planning horizon, causes him to borrow less, and therefore, causes spreads to fall. Consistent with this, observed spreads are negatively correlated with the estimated probability of being in the better of the two growth regimes in all three economies. When the model is calibrated to target the average external debt-to-GDP ratio, average spreads, and the observed magnitude of the sensitivity of reelection probability to economic growth, this effect is predicted to be quantitatively strong — the standard deviation of spreads is an order of magnitude larger than in standard models, or models with exogenous political turnover, and close to observed spread volatilities.

Relative to the existing quantitative-theoretic literature, our finding that endogenous political turnover can contribute to volatility of sovereign spreads is noteworthy. As mentioned previously, quantitative versions of the Eaton and Gersovitz (1981) model require the sovereign to have a low discount factor. The sovereign's optimal policy then is to borrow all the way to the point where the default risk is just high enough to balance the sovereign's desire for current expenditure. In this situation, shocks to fundamentals — absent default — translate rather quickly into changes in the debt-to-GDP ratio that leaves default risk essentially unchanged. It is as if the sovereign has a target level of default risk and manages his borrowings to attain that target closely. Hence, equilibrium spread volatility is very low.[3] However, this changes when the effective discount factor gets linked to economic performance: Now, it is as if the target default risk itself moves with economic growth — falling when economic growth is positive and stable, and rising when it is negative and volatile. These fluctuations in the target default risk generate fluctuations in sovereign spreads.

The paper is organized as follows. Section 2 discusses connections to the main existing studies related to ours. Section 3 presents some facts regarding growth regimes and their correlation with spreads. Section 4 lays out the environment, taking some care to explain the novel elements of the model. Endogenous turnover, diversions and the effective discount factor are covered in Section 5. Section 6 discusses the calibration of the model and Section 7 presents the findings. Concluding thoughts are collected in the Section 8.

2 Connections to the Sovereign Debt and Default Literature

There is a growing volume of quantitative-theoretic research on the connections between politics and the risk of sovereign default.[4] This literature is explicitly or implicitly based on Alesina and Tabellini's (1990) and Persson and Svensson's (1989) models of redistributive conflict and political turnover. Cuadra and Sapriza (2008) import the Alesina-Tabellini setup into an otherwise standard Eaton-Gersovitz model to study the role of political uncertainty — meaning a positive probability of turnover of leaders — on fiscal policy and default risk. They show that political uncertainty elevates sovereign default risk. Scholl (2016) has a similar setup but adopts the Persson-Svensson view that political parties differ with respect to their proclivity toward public spending. She shows that if political parties come into power by winning elections, the differences between the borrowing and default behavior of the two parties are accentuated. In comparison with these two studies, we adopt an agency cost view of the conflict of interest. Our goal is to connect political uncertainty (the probability of turnover) to growth regimes and draw out its implications for fluctuations in sovereign default risk.

Aguiar and Amador (2011) focus on political friction as opposed to political uncertainty. They posit quasi-hyperbolic (or quasi-geometric) discounting (i.e., discounting with "present bias") for

[3]This tendency can be potentially attenuated by making the (proportional) default costs sensitive to GDP in the right way as in Arellano (2008); see Chatterjee and Eyigungor (2012, p. 2690) for a discussion of this point. However, this mechanism is not effective if the volatility in fundamentals is itself low, which happens to be the case for Mexico; see Aguiar, Chatterjee, Cole, and Stangebye (2016, p. 33) for a discussion of this point.

[4]For a the survey of the more empirical parts of the literature, see Hatchondo and Martinez (2010).

policymakers and conventional geometric discounting for citizens.[5] They examine the speed of capital accumulation (in a perfect foresight set up) when the sovereign cannot commit to not expropriating foreign investment. The main finding is that political friction can slow down convergence to steady state. Alfaro and Kanczuk (2016) posit an identical preference structure and focus on a normative analysis of different fiscal rules when endowments are uncertain. Their central finding is that rules that limit borrowing improve welfare for citizens.[6] Amador (2012) shows that the present bias resulting from the common pool problem circumvents Bulow and Rogoff's (1989) critique of reputation-based sovereign lending.

Political uncertainty also plays a role in Hatchondo, Martinez, and Sapriza (2009), who model it as exogenous fluctuations in the discount factor of the sovereign (interpreted as replacement of one political regime by another). They study conditions under which default is triggered when the regime changes from a patient to an impatient one. D'Erasmo (2012) studies a similar environment but assumes that the sovereign's discount factor is not observable to investors. The goal is to understand how the desire of the patient sovereign to separate itself from the impatient type (i.e., a desire to maintain a reputation for creditworthiness) affects its borrowing and default decisions and its settlement decision following a default.[7] Our paper shares the emphasis on fluctuating impatience as well, but the fluctuations are *endogenous* to the evolution of beliefs regarding the growth regime, which is unobservable to all decision makers.

3 Growth Regimes and Spreads

We study three emerging economies — Mexico, Peru, and Turkey — for which our data source reports relatively long time series on real GDP.[8] For each country, the sample period for national income data (real GDP and net exports, to be specific) is 1980Q1 to 2015Q2. For sovereign spreads, we use JP Morgan's Emerging Markets Bond Index (EMBI), for which the sample period is 1993Q2 to 2015Q2.

[5]This preference structure can emerge endogenously from an Alesina-Tabellini setup if the probability of reelection is one-half; see Appendix B of Chatterjee and Eyigungor (2016) for a demonstration.

[6]The point that present bias in preferences implies a positive welfare role for debt limits is also made in Chatterjee and Eyigungor (2016). Relatedly, Nakajima (2015) points out that a present bias in preferences can make an increase in the costs of default welfare-reducing.

[7]Egorov and Fabinger (2016) have a similar focus but assume that sovereigns differ with respect to their privately observed default costs. Cole, Dow, and English (1995) and Tomz (2007) are important precursors that argue for the importance of reputation in sovereign repayment decisions.

[8]A relatively long time series is required to estimate growth regimes with some accuracy. Our data source is the Haver Analytics' Emerge Database.

We begin with the estimation of the growth regimes. We assume that the growth rate follows the AR1 process

$$\ln(g_{t+1}) = \mu_i + \rho \ln(g_t) + \varepsilon_{it}, \;\; \varepsilon_{it} \sim \mathrm{N}(0, \sigma_i^2), \; \left|\rho\right| < 1, \tag{1}$$

where $g_t = Y_t/Y_{t-1}$ and $i \in \{\mathrm{B}, \mathrm{G}\}$ indexes the growth regime in place in period t. We assume that there are two regimes that can differ in terms of their average growth rate and the standard deviation of the growth rates. For the three countries studied in this paper, one growth regime is estimated to have a lower mean growth rate and a higher standard deviation than the other. This motivates labeling the two regimes G (high growth and low volatility) and B (low growth and high volatility). We assume that regimes switch with constant probability; the probability of switching to $\sim i$ from i is α_i, $i \in \{\mathrm{B}, \mathrm{G}\}$. For each country, we use deviations of quarterly g_t from the (sample) mean and estimate (1).

The results are reported in Table 1. Note that the quarterly growth rate is positively serially

Table 1: Parameters of Growth Processess

Parameters	Description	Mexico	Peru	Turkey
	Two-Regime AR1 Growth Processess			
ρ	Autocorrelation	0.28	0.43	0.19
μ_{G}	% Mean growth in G regime	0.16	0.39	0.20
μ_{B}	% Mean growth in B regime	-0.28	-0.59	-0.17
σ_{G}	% S.D of growth in G regime	0.67	0.88	0.69
σ_{B}	% S.D. of growth in B regime	1.82	3.80	3.19
ν_{G}	Prob. G to B	0.04	0.07	0.10
ν_{B}	Prob. B to G	0.07	0.11	0.11
	Akaike info. criterion	-6.14	-5.03	-5.15
	Single-Regime AR1 Growth Processes			
ρ	Autocorrelation	0.32	0.41	0.05
σ	% S.D. of growth	1.25	2.58	2.30
	Akaike info. criterion	-5.91	-4.47	-4.69

correlated for all countries, but the correlation is not high. Second, the mean growth rate in the G regime is positive, while that in the B regime is negative. The difference in growth rates across the two regimes range between 1.5 and 4.0 percent, annualized. More importantly, the volatility of growth in the B regime is three to four times larger than volatility in the G regime. Finally, both regimes are fairly persistent with the B regime being generally less persistent (more so for Peru and Mexico). For comparison purposes, we also estimate a (standard) AR1 process for each country. The single-regime process has volatility that is intermediate between the B and G regimes and tends to have a lower degree of autocorrelation. By the Akaike information criterion (AIC), the two-regime model is a better fit (has lower AIC value) than the single-regime process for each country.

Next, we examine some statistics regarding the correlation of spreads with real GDP growth and with the estimated probability of the G regime (for the latter, we use the smoothed estimates of the G-regime probability). The results are reported in Table 2. As one would expect, real GDP growth and the estimated probability that the economy is in the G regime is positively correlated for all three countries, although the correlation is modest. As one would also expect, the correlation between spreads and real GDP growth is negative. The new finding is that the correlation between spreads and the estimated probability of being in G regime is negative and significantly higher in magnitude than the simple correlation between economic growth and spreads for Peru and Mexico. Thus, whether the country is perceived to be in the G or B regime can matter more for the spreads than economic growth itself. For Turkey, the correlation of the G-regime probability with spreads is about the same as the correlation of the growth rate of real GDP with spreads.

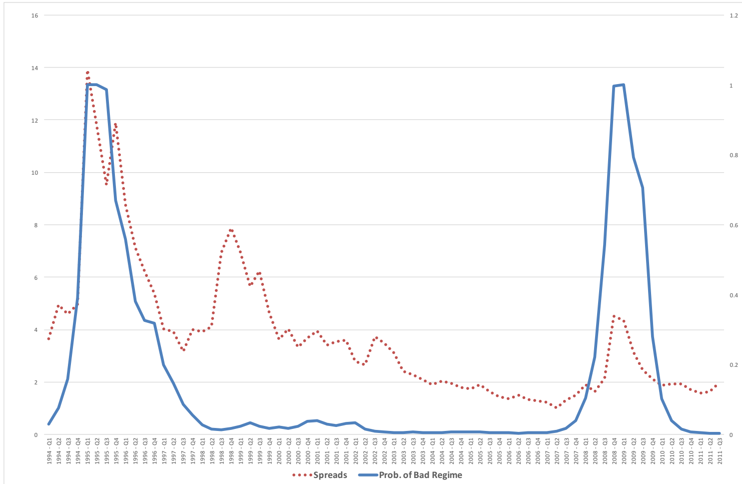
Table 2: Correlation of Spreads, Growth, and Probability of G Regime

Description	Mexico	Peru	Turkey
Corr (g, prob. of G regime)	0.26	0.36	0.13
Corr (Spreads, g)	-0.34	-0.31	-0.37
Corr (Spreads, prob. of G regime)	-0.59	-0.68	-0.35

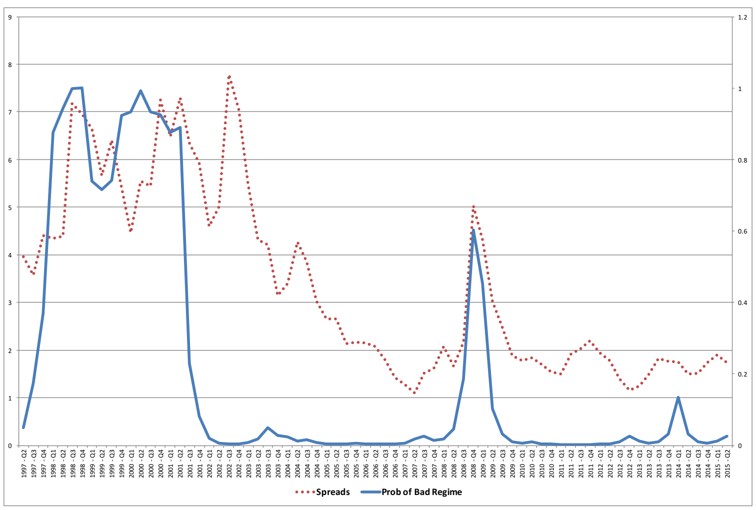
Figure 1 gives a visual representation of the co-movements between spreads and regime probabilities. It plots the estimated probability of the B regime along with sovereign spreads. Evidently spreads tend to rise with the estimated probability of the B regime in each country. The 2008-09 global financial crisis appears to be a common driver of the probability of the B regime in all three countries. More generally, though, the cross correlation between the probability of bad regimes across the three countries is modest.[9]

[9] Between Peru and Mexico it is 0.23, between Mexico and Turkey it is 0.33, and, between Peru and Turkey, it is -0.21.

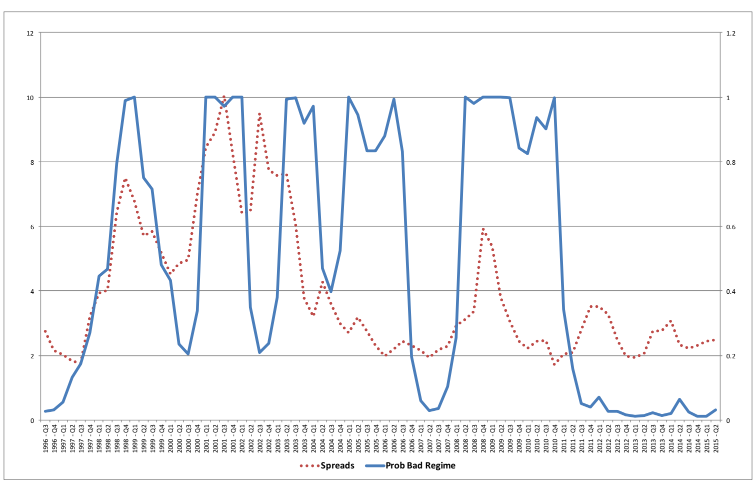
Figure 1: Probability of the Low Growth and High Volatility Regime and Spreads



(a) Mexico



(b) Peru



(c) Turkey

4 Environment

Time is discrete and denoted by $t = 0, 1, 2, \ldots$. We consider a small open economy that takes world prices as given. The economy is populated by a representative individual and two political leaders who circulate in power. All individuals are infinitely-lived and derive utility from the sequence of expenditures on a public good. The provision of the public good is done by whichever leader is in power.

4.1 Preferences

The politician who is in power derives a benefit from diversion of public funds toward private use. If K_t is the expenditure on the public good inclusive of the diversion to private use, then $(1-\tau)K_t$ is the true expenditure on the public good, where $\tau \in (0,1)$. The per-period utility of the political leader in power is

$$U[(1-\tau)(K_t + M_t)] + \Psi U[\tau(K_t + M_t)], \ \Psi > 0 \tag{2}$$

where M_t is an i.i.d. preference shock and Ψ is a scale parameter. We think of τ as a number close to 0 but Ψ as potentially very large, capturing the fact that even a very small amount of diversion of national funds can confer a very large benefit to an individual.

The politician who is out of power does not benefit from the diversion of public funds, so his per-period utility flow is

$$U[(1-\tau)(K_t + M_t)]. \tag{3}$$

Citizens also do not benefit from the diversion of public funds. For simplicity we ignore the i.i.d. shock to the value of public consumption for citizens. Then, the representative citizen's per-period utility from the provision of public goods is simply

$$U([1-\tau]K_t). \tag{4}$$

In what follows, we assume that

$$U(C) = \frac{C^{1-\gamma}}{1-\gamma}, \ \gamma \in (0,1) \tag{5}$$

and normalize Ψ such that $(1-\tau)^{1-\gamma} + \Psi\tau^{1-\gamma} = 1$. Then, the per-period utility of the politician in power from a diversion-inclusive expenditure level K_t is simply $U(K_t + M_t)$ and that of the politician out of power is $\zeta U(K_t + M_t)$, where $\zeta = [1 - \Psi\tau^{1-\gamma}]$. Given our normalization, $\zeta \in (0,1)$. The per-period utility of citizens is also $\zeta U(K_t)$. Observe that for some given (small) τ, the larger is Ψ the smaller is ζ.

We assume that all individuals discount future utility at the common discount factor $\beta \in (0,1)$.

4.2 Revenue

The level of revenues in period t, Y_t, is assumed to be a constant proportion of the level of real GDP. Thus, $Y_t/Y_{t-1} = g_t$, where g_t is the rate of growth of real GDP in period t. The process for g_t follows the process given in (1).

4.3 Politicians, Growth Regimes, and Elections

A newly elected politician chooses economic policies for the rest of his political tenure. This choice determines whether the low- or high-volatility growth regime is chosen. The probability that his policy choices lead to good growth regime is $\underline{\theta} > 0$. Once a growth regime i is in place, the economy continues on in that regime next period with probability $(1 - \alpha_i) \in (0,1)$.

We assume that the growth regime in place is not directly observable to citizens, politicians or foreigners. But everyone observes the history of growth rates under a particular political leader and can make inferences about which growth regime the economy is in. With the election of a new politician (and, thus, a new economic regime), history ceases to be relevant, and the probability that the economy is in the good regime resets to $\underline{\theta}$.

To stay in power, the leader must periodically contest elections with the politician who is currently out of power. The probability that an election is called in any period is $\pi \in (0,1]$. As is realistic, the outcome of any election (if one is called) is intrinsically random, but the incumbent is more likely to be reelected if the voters' expected utility is higher under the incumbent's leader relative to expected utility under a new leader.

4.4 The Default Option, Timing of Events, and the Market Arrangement

The provision of the public good is financed from tax revenues and (potentially) from the issuance of long-term debt to foreigners. The sovereign reserves the right to default on its (external) debt, so investors bear default risk. In the event of default, creditors do not receive any payment, and the sovereign is excluded from the international capital markets for some random length of time. During the period of financial autarky, revenues are lower by some constant fraction $\phi \in (0,1)$ of nondefault revenues.

The timing of events within a period is as follows: A country that has access to credit in the previous period arrives into a period with some existing debt $B_t \leq 0$ and a prior $s_t \in (0,1)$ that the economy is in a good growth regime.[10] At the start of the period, all agents learn the current growth rate g_t and whether there will be an election or not. If an election is called, the political leader is (randomly) determined; otherwise, the incumbent leader continues in power for sure.

Once the period t leader is determined, he decides whether to repay or default on the debt. In the event of repayment, B_{t+1} is chosen; in the even of default, $B_{t+1} = 0$ is chosen and the level of revenues shrinks by the proportion ϕ. These decisions determine the level of the public good provided to citizens (and the political leader's private gain from this provision), and the period comes to a close.

A country with no access to credit enters the period with $B_t = 0$ and a prior s_t that the economy is in a good growth regime. The country learns the value of g_t, whether there will be an election or not, *and* whether its exclusion from the credit market is over. If exclusion is over, which occurs with probability $(1-\xi)$, period t's political leader can borrow in the international credit market. Otherwise, the country continues in a state of financial autarky.

We assume that investors are risk neutral and care only about the one-period expected return on the debt. The period t price of a unit of sovereign debt then depends on the endowment level Y_t, the growth rate g_t, investors' posterior belief that the economy is in the good growth regime, θ_t, and the level of debt outstanding at the start of the next period, B_{t+1}. Because of the possibility of a future default, these variables inform the expected one-period rate of return on the debt. We

[10]We abstract from accumulation of foreign assets by the sovereign. This simplifies the statement of the sovereign's decision problem, and the restriction never binds in the quantitative exercises performed in the paper.

denote period t's bond price by $q(Y_t, g_t, \theta_t, B_{t+1})$. Under competition, $q(Y_t, g_t, \theta_t, B_{t+1})(1 + r_f)$ must equal the expected return on the debt, where r_f is the world risk-free interest rate.

4.5 Exogenous State Transitions

We now describe the state transition equations for the exogenous states Y_t, g_t, and M_t. To this end, let θ_t denote the probability that the economy is currently in the G regime. Since there is a chance the economy may stochastically change regimes, the probability that it starts next period in a good regime, denoted $s_{t+1}(\theta_t)$, is $(1-\alpha_{\mathrm{G}})\theta_t + \alpha_{\mathrm{B}}(1-\theta_t)$. Let $f(g_{t+1}|g_t, i)$ be the density of g_{t+1} conditional on g_t and i (as implied by (1)).

Since g_{t+1}, Y_{t+1}, and M_{t+1} are random variables, the corresponding state transitions are conditional probability distributions. For g_{t+1} this distribution is

$$\mathrm{P}(g_{t+1} \le \tilde{g}|g_t, \theta_t) = s_{t+1}(\theta_t)\int_{-\infty}^{\tilde{g}} f(g_{t+1}|g_t, \mathrm{G})dg + (1 - s_{t+1}(\theta_t))\int_{-\infty}^{\tilde{g}} f(g_{t+1}|g_t, \mathrm{B})dg, \tag{6}$$

for Y_{t+1} it is

$$\begin{aligned}\mathrm{P}(Y_{t+1} \le \tilde{Y}|Y_t, g_t, \theta_t) = \\ s_{t+1}(\theta_t)\int_{-\infty}^{\tilde{Y}/Y_t} f(g_{t+1}|g_t, \mathrm{G})dg + (1 - s_{t+1}(\theta_t))\int_{-\infty}^{\tilde{Y}/Y_t} f(g_{t+1}|g_t, \mathrm{B})dg,\end{aligned} \tag{7}$$

and for M_t it is

$$\mathrm{P}(M_{t+1} \le \tilde{M}|Y_t) = \int_{-\infty}^{\tilde{M}/Y_t} h(m)dm, \tag{8}$$

where h is the density of $m \equiv M_{t+1}/Y_t$ (to maintain stationarity, we assume the M_{t+1} scales with Y_t). We denote the triple (Y_t, g_t, M_t) by Ω_t and the conditional probability distributions (6) - (8) collectively by the transition function $F(\Omega_t, \theta_t, \Omega_{t+1})$.

Finally, the expression for the probability that the economy is in the G regime next period conditional on no change in leadership is:

$$H(\theta_t, \Omega_{t+1}) = \frac{s_{t+1}(\theta_t)f(g_{t+1}|g_t, \mathrm{G})}{s_{t+1}(\theta_t)f(g_{t+1}|g_t, \mathrm{G}) + (1 - s_{t+1}(\theta_t))f(g_{t+1}|g_t, \mathrm{B})}. \tag{9}$$

4.6 Decision Problem of Politicians

We first consider the recursive decision problem of the political leader when the country has access to international credit markets. Let $\Omega = (Y, g, M)$ denote the set of exogenous states and let $\tilde{\theta} = H(\theta_{-1}, \Omega)$. With this notation, $\tilde{\theta}$ refers to the pre-election probability of being in the good regime and θ refers to the post-election probability of being in the good regime. If no election is held, or if an election is held and the incumbent wins, θ is $\tilde{\theta}$ and if an election is held and the opposition wins then θ is $\underline{\theta}$.

- $W_P(\Omega, \theta, B)$ denote the optimal value of the leader given access to international credit markets and the option to default,
- $V_P(\Omega, \theta, B)$ and $X_P(\Omega, \theta)$ denote his optimal values from repayment and exclusion from international credit markets, respectively,
- $W_O(\Omega, \theta, B)$, $V_O(\Omega, \theta, B)$, and $X_O(\Omega, \theta)$ denote the analogous quantities for the politician out of power, and let
- $\eta(\Omega, \tilde{\theta}, B)$ denote the probability that the incumbent wins (conditional on an election) when the country has access to international markets and let $\eta_X(\Omega, \tilde{\theta})$ denote the analogous probability when the country is excluded from credit markets (the expressions for η and η_X are given in the (sub) section on voters).

Then,

$$
\begin{aligned}
&V_P(\Omega, \theta, B) = \\
&\quad \max_{B' \leq 0} U(K + M) + \beta \mathbb{E}_{(\Omega'|\Omega,\theta)} \Big\{ [1 - \pi] W_P(\Omega', \tilde{\theta}', B') \quad + \\
&\quad\quad \pi[\eta(\Omega', \tilde{\theta}', B') W_P(\Omega', \tilde{\theta}', B') + (1 - \eta(\Omega', \tilde{\theta}', B')) W_O(\Omega', \underline{\theta}, B')] \Big\} \\
&\text{s.t.} \\
&K + q(\Omega, \theta, B')[B' - (1 - \lambda)B] = Y + [\lambda + z(1 - \lambda)]B, \\
&\tilde{\theta}' = H(\theta, \Omega'),
\end{aligned}
\tag{10}
$$

and

$$
\begin{aligned}
X_P(\Omega,\theta) = U([1-\phi]Y+M) + \beta\mathbb{E}_{(\Omega'|\Omega,\theta)}\Big\{\xi[(1-\pi)X_P(\Omega',\tilde{\theta}') \; + \\
\pi(\eta_X(\Omega',\tilde{\theta}')X_P(\Omega',\tilde{\theta}') + (1-\eta_X(\Omega',\tilde{\theta}'))X_O(\Omega',\underline{\theta}))] \; + \\
(1-\xi)[(1-\pi)W_P(\Omega',\tilde{\theta}',0) + \pi(\eta(\Omega',\tilde{\theta}',0)W_P(\Omega',\tilde{\theta}',0) + (1-\eta(\Omega',\tilde{\theta}',0))W_O(\Omega',\underline{\theta},0))]\Big\},
\end{aligned}
\tag{11}
$$

s.t.

$$\tilde{\theta}' = H(\theta,\Omega'),$$

where the expectation over continuation values is taken with respect to the transition function $F(\Omega,\theta,\Omega')$. In addition,

$$W_P(\Omega,\theta,B) = \max\{V_P(\Omega,\theta,B), X_P(\Omega,\theta)\}. \tag{12}$$

Let $A(\Omega,\theta,B)$ denote the leader's optimal borrowing decision under repayment, and let $D(\Omega,\theta,B)$ be the optimal default rule.

The politician who is out of power does not make any decisions. His value when the economy has access to financial markets is given by

$$
\begin{aligned}
V_O(\Omega,\theta,B) = \\
\zeta U(K+M) + \beta\mathbb{E}_{(\Omega'|\Omega,\theta)}\{([1-\pi]W_O(\Omega',\tilde{\theta}',B') \; + \\
\pi[\eta(\Omega',\tilde{\theta}',B')W_O(\Omega',\tilde{\theta}',B') \; + (1-\eta(\Omega',\tilde{\theta}',B'))W_P(\Omega',\underline{\theta},B')]\}
\end{aligned}
\tag{13}
$$

s.t.

$$K + q(\Omega,\theta,B')[B'-(1-\lambda)B] = Y + [\lambda + z(1-\lambda)]B,$$

$$\tilde{\theta}' = H(\Omega',\theta) \text{ and } B' = A(\Omega,\theta,B),$$

and his value when the economy is excluded from international markets is given by

$$\begin{aligned} X_O(\Omega,\theta) = & \\ & \zeta U([1-\phi]Y+M)+\beta\mathbb{E}_{(\Omega'|\Omega,\theta)}\{\xi[(1-\pi)X_O(\Omega',\tilde{\theta}') + \\ & \quad \pi[\eta_X(\Omega',\tilde{\theta}')X_O(\Omega',\tilde{\theta}')+(1-\eta_X(\Omega',\tilde{\theta}'))X_P(\Omega',\underline{\theta})]+(1-\xi)[[(1-\pi)W_O(\Omega',\tilde{\theta}',0) + \\ & \quad\quad \pi[\eta(\Omega',\tilde{\theta}',0)W_O(\Omega',\tilde{\theta}',0)+(1-\eta(\Omega',\tilde{\theta}',0))W_P(\Omega',\underline{\theta},0)]]\}, \\ & \text{s.t.} \\ & \tilde{\theta}' = H(\theta,\Omega'). \end{aligned} \tag{14}$$

And, thus,

$$W_O(\Omega,\theta,B) = [1-D(\Omega,\theta,B)]V_O(\Omega,\theta,B)+D(\Omega,\theta,B)X_O(\Omega,\theta). \tag{15}$$

4.7 Voters

Citizens do not make any decisions other than to choose who to vote for in an election. For citizens, the only difference between the incumbent and the opposition is the probability that the economy is in the good growth regime. For the incumbent, this probability is $\tilde{\theta}$ and for the opposition it is $\underline{\theta}$.

Let $V(\Omega,\theta,B)$ and $X(\Omega,\theta)$ be the utility of citizens (following an election if there was one) if the country has access to credit markets and no access, respectively. Then,

$$\begin{aligned} & V(\Omega,\theta,B) = \zeta U(K+M) \quad + \\ & \beta\mathbb{E}_{(\Omega'|\Omega,\theta)}\{[1-\pi]V(\Omega',\tilde{\theta}',B')+\pi[\eta(\Omega',\tilde{\theta}',B')V(\Omega',\tilde{\theta}',B')+(1-\eta(\Omega',\tilde{\theta}',B'))V(\Omega',\underline{\theta},B')]\} \\ & \text{s.t.} \\ & K+q(\Omega,\theta,B')[B'-(1-\lambda)B] = Y+[\lambda+z(1-\lambda)]B, \\ & \tilde{\theta}' = H(\theta,\Omega') \text{ and } B' = A(\Omega,\theta,B) \end{aligned} \tag{16}$$

and

$$
\begin{aligned}
X(\Omega,\theta) = {} & \zeta U([1-\phi]Y+M) \quad + \qquad (17)\\
& \beta \mathbb{E}_{(\Omega'|\Omega,\theta)}\{\xi[[1-\pi]X(\Omega',\tilde{\theta}') + \pi[\eta_X(\Omega',\tilde{\theta}')X(\Omega',\tilde{\theta}') + (1-\eta_X(\Omega',\tilde{\theta}'))X(\Omega',\underline{\theta})]] \quad + \\
& (1-\xi)[[1-\pi]V(\Omega',\tilde{\theta}',0) + \pi[\eta(\Omega',\tilde{\theta}',0)V(\Omega',\tilde{\theta}',0) + (1-\eta(\Omega',\tilde{\theta}',0))V(\Omega',\underline{\theta},0)]]\}\\
& \text{s.t.}\\
& \tilde{\theta}' = H(\theta,\Omega').
\end{aligned}
$$

If every citizen were to cast his vote according to his utility under the two leaders, he would vote for the incumbent if and only if his utility under the incumbent regime is at least as high as his utility under the opposition. This would make the probability that the incumbent wins either 0 or 1. In the real world, however, there is always some uncertainty regarding the outcome of an election. We recognize this uncertainty by setting

$$
\eta(\Omega,\tilde{\theta},B) = \frac{\exp(V(\Omega,\tilde{\theta},B)/\kappa)}{\exp(V(\Omega,\tilde{\theta},B)/\kappa) + \exp(V(\Omega,\underline{\theta},B)/\kappa)}, \qquad (18)
$$

and

$$
\eta_X(\Omega,\tilde{\theta}) = \frac{\exp(X(\Omega,\tilde{\theta})/\kappa)}{\exp(X(\Omega,\tilde{\theta})/\kappa) + \exp(X(\Omega,\underline{\theta})/\kappa)}. \qquad (19)
$$

Here, $\kappa > 0$ is a measure of the randomness in elections.[11] When κ is very large, the expressions in (18) and (19) are close to 1/2, which means the outcome of the election is almost random. In contrast, when κ is close to zero, then $\eta(\Omega,\tilde{\theta},B)$ (for instance) is equal to 1 or 0 with probability close to 1 or 0 depending on whether $V(\Omega,\tilde{\theta},B)$ is greater than or less than $V(\Omega,\underline{\theta},B)$.[12]

[11] As in the discrete choice literature, these probability expressions can be motivated by assuming that lifetime utility from electing the opposition leader is $V(\Omega,\underline{\theta},B)+\epsilon$, where ϵ is an i.i.d. draw — across elections — of a preference shock. This shock could represent the influence of noneconomic issues on the relative attractiveness of the candidates contesting the election. Then the incumbent is reelected if and only if $V(\Omega,\theta,B) - V(\Omega,\underline{\theta},B) > \epsilon$. If it is assumed ϵ is drawn from a Type 1 extreme value distribution, then the η's will have the form given in the text. See, for instance, Train (2009).

[12] For values of debt encountered in equilibrium, $V(\Omega,\theta,B)$ is increasing in θ, and, hence, the leaders reelection chances are greater than (or less than) 0.5 depending on whether θ is greater than (or less than) $\underline{\theta}$.

4.8 Normalization

Since Y_t is nonstationary, elements of the exogenous state vector Ω are unbounded. We stationarize the model by normalizing all period-t nonstationary variables by Y_{t-1}. Since $Y_t/Y_{t-1} = g_t$, the normalized Ω_t contains only g_t and M_t/Y_{t-1}. We denote M_t/Y_{t-1} by m_t and the pair (g_t, m_t) by ω_t.

Turning to the leader's value under repayment, we normalize the budget constraint by dividing both sides by Y_{-1}, the value of Y in the previous period. Defining $K = K/Y_{-1}$, $b' = B'/Y$, and $b = B/Y_{-1}$, the normalized budget constraint becomes

$$k + q(\omega, \theta, b)[gb' - (1-\lambda)b] = g + [\lambda + z(1-\lambda)]b. \tag{20}$$

Here, we have guessed that $q(\Omega, \theta, B')$ is homogeneous of degree 1 in nonstationary variables and, thus, is equal to $q(\omega, \theta, b')Y_{-1}$. Next, observe that the state transition equation for $\tilde{\theta}'$ does not involve nonstationary variables, so $\tilde{\theta}' = H(\omega, \theta)$ trivially. Finally, given the form of $U(\cdot)$, we guess that all value functions are homogeneous of degree $1-\sigma$ in the nonstationary variables. In particular, $W_j(\Omega, \theta, B) = Y_{-1}^{1-\sigma} W_j(\omega, \theta, b)$, $j \in \{O, P\}$, $V(\Omega, \theta, B) = Y_{-1}^{1-\sigma} V(\omega, \theta, b)$ and $X(\Omega, \theta, B) = Y_{-1}^{1-\sigma} X(\omega, \theta, B)$. Under this guess, the reelection probabilities are homogeneous of degree 0 in nonstationary variables, and, thus, $\eta(\Omega, \tilde{\theta}, B) = \eta(\omega, \tilde{\theta}, b)$ and $\eta(\Omega, \tilde{\theta}) = \eta(\omega, \tilde{\theta})$.

Then,

$$\begin{aligned} &V_P(\omega, \theta, b) = \\ &\quad \max_{b' \le 0} U(k+m) + g^{1-\gamma} \beta \mathbb{E}_{(\omega'|\omega,\theta)} \Big\{ [1-\pi] W_P(\omega', \tilde{\theta}', b') \quad + \\ &\qquad \pi[\eta(\omega', \tilde{\theta}', b') W_P(\omega', \tilde{\theta}', b') + (1 - \eta(\omega', \tilde{\theta}', b')) W_O(\omega', \underline{\theta}, b')] \Big\} \\ &\text{s.t.} \\ &k + q(\omega, \theta, b')[gb' - (1-\lambda)b] = g + [\lambda + z(1-\lambda)]b \\ &\text{and } \tilde{\theta}' = H(\theta, \omega'), \end{aligned} \tag{21}$$

$$
\begin{aligned}
X_P(\omega,\theta) = & \\
& U([1-\phi]g+m)) + g^{1-\gamma}\beta\mathbb{E}_{(\omega'|\omega,\theta)}\Big\{\xi[(1-\pi)X_P(\omega',\tilde{\theta}') \ + \\
& \pi(\eta_X(\omega',\tilde{\theta}')X_P(\omega',\tilde{\theta}') + (1-\eta_X(\omega',\tilde{\theta}'))X_O(\omega',\underline{\theta}))] \ + \\
& (1-\xi)[(1-\pi)W_P(\omega',\tilde{\theta}',0) + \pi[\eta(\omega',\tilde{\theta}',0)W_P(\omega',\tilde{\theta}',0) + \\
& (1-\eta(\omega',\tilde{\theta}',0))W_O(\omega',\underline{\theta},0))]]\Big\},
\end{aligned} \tag{22}
$$

and

$$
W_P(\omega,\theta,b) = \max\{V_P(\omega,\theta,b), X_P(\omega,\theta)\}. \tag{23}
$$

The repayment program delivers a stationary decision rule $A(\omega,\theta,b) = A(\Omega,\theta,B)/Y_{-1}$, and the choice between repayment and default delivers the normalized default decision rule $D(\omega,b,\theta)$. With these decision rules in hand, we can get expressions for all other stationarized value functions.

4.9 Equilibrium

There are three equilibrium conditions in this model. One relates to the bond price function, which must be consistent with investors earning the risk-free rate in expectation, and the other two relate to the reelection probability functions, which must be consistent with voters' behavior. To state these condition, let f denote the triple $\{q(\omega,\theta,b), \eta(\omega,\theta,b), \eta_X(\omega,\theta)\}$. Then, the three equilibrium conditions are as follows:

$$
\begin{aligned}
& q(\omega,\theta,b') = (1+r_f)^{-1} \times \\
& \mathbb{E}_{(\omega'|\omega,\theta)}\left[\begin{array}{l} [1-\pi+\pi\eta(\omega',\tilde{\theta}',b')][1-D(\omega',\tilde{\theta}',b';f)][\lambda+(1-\lambda)[z+q(\omega',\tilde{\theta}',b'')] \\ +\,\pi(1-\eta(\omega',\tilde{\theta}',b'))[1-D(\omega',\underline{\theta},b';f)][\lambda+(1-\lambda)[z+q(\omega',\underline{\theta},b''))] \end{array}\right] \\
& \text{s.t. } \tilde{\theta}' = H(\omega',\theta) \text{ and} \\
& b'' = A(\omega',\tilde{\theta}',b';f) \text{ if incumbent is reelected, and} \\
& b'' = A(\omega',\underline{\theta},b';f) \text{ otherwise;}
\end{aligned} \tag{24}
$$

$$
\eta(\omega,\tilde{\theta},b) = \frac{\exp(V(\omega,\tilde{\theta},b;f)/\kappa)}{\exp(V(\omega,\tilde{\theta},b;f)/\kappa) + \exp(V(\omega,\underline{\theta},b;f)/\kappa)}; \tag{25}
$$

and

$$\eta_X(\omega,\tilde{\theta}) = \frac{\exp(X(\omega,\tilde{\theta};f)/\kappa)}{\exp(X(\omega,\tilde{\theta};f)/\kappa)+\exp(X(\omega,\underline{\theta};f)/\kappa)}. \tag{26}$$

Here, we have indexed value functions and decision rules by f to recognize that these objects depend on the bond price and reelection probability functions. An equilibrium is a fixed point, f^*, of the mapping defined by (24)-(26).

Some brief comments on the computation of f^*. First, it assumed that g and b are discrete and can take only finite number of values. θ is also restricted to a discrete and finite set $\Theta = \{0,\ldots,\theta_j,\theta_{j+1},\ldots,1\}$ (specifically, a set of uniformly spaced points in $[0,1]$). Since the function $H(\theta,\omega')$ need not return a value in Θ, $\tilde{\theta}'$ is randomly assigned to $\theta_j \le H(\theta,\omega')$ with probability $[H(\theta,\omega')-\theta_j]/[\theta_{j+1}-\theta_j]$ and to $\theta_{j+1} \ge H(\theta,\omega')$ with complementary probability. The i.i.d. shock to preferences, m, is *not* assumed to be discrete. Indeed, the fact that it is a continuous random variable is essential to ensuring the existence of at least one fixed point f^*. Finally, although not necessary for computing f^*, fewer calculations are required if it is assumed that in the event of default the value of m is set to 0 in the default period.

5 Endogenous Turnover, Diversions, and the Effective Discount Factor

In this section, we explain how endogenous political turnover causes fluctuations in the effective discount factor of the political leader. For this discussion, we will ignore the shock to marginal utility m. Then, the leader's expected lifetime utility conditional on ω and θ and some choice of b' is

$$\begin{aligned} U(k) + g^{1-\gamma}\beta\mathbb{E}_{(\omega',\tilde{\theta}'|\omega,\theta)}[1-\pi+\pi\eta(\omega',\tilde{\theta}',b')]\,U(k(\omega',\tilde{\theta}',b')) + \\ g^{1-\gamma}\beta\mathbb{E}_{(\omega',\tilde{\theta}'|\omega,\theta)}[\pi(1-\eta(\omega',\tilde{\theta}',b'))]\zeta\,U(k(\omega',\underline{\theta},b')) + \ \ldots\ , \end{aligned} \tag{27}$$

where $k(\omega,\theta,b)$ is the sovereign's belief about the expenditure decision rule of future sovereigns and the trailing dots represent contribution from future periods. Now suppose that the current θ is such that $\tilde{\theta}' = H(\omega',\theta)$ is well above $\underline{\theta}$ for most values of ω'. Then $\eta(\omega',\tilde{\theta}',b')$ will be close to 1 for most values of ω'. In this case, the expression in (27) will be approximately

$$U(k) + g^{1-\gamma}\beta\mathbb{E}_{(\omega',\tilde{\theta}'|\omega,\theta)}U(k'(\omega',\tilde{\theta}',b')) + \quad \ldots\ . \tag{28}$$

Thus, when choosing b', the political leader will behave according to a discount factor that is the same as the (growth adjusted) discount factor of citizens (voters). In contrast, consider a situation where θ is such that $H(\omega', \theta)$ is close to $\underline{\theta}$ for most values of ω'. Then, $\eta(\omega', \tilde{\theta}', b')$ will be close to 1/2 for most values of ω'. In this case, the expression in (27) will be approximately

$$U(k) + g^{1-\gamma}\beta[(\pi/2)\zeta + (1-(\pi/2))]\mathbb{E}_{(\omega',\tilde{\theta}'|\omega,\theta)}U(k'(\omega', \tilde{\theta}', b')) + \quad \ldots \tag{29}$$

and, since $\zeta < 1$, the political leader will behave according to a discount factor that is *lower* than the discount factor of citizens. Thus, as citizens' beliefs regarding the growth regime fluctuates, the effective discount factor of the leader also fluctuates.

Note that for the fluctuations in the effective discount factor to materialize, both endogenous political turnover *and* diversion of public funds into private use are necessary ingredients. To see the role of diversions, suppose that $\tau = 0$, so there is no diversion of public funds into private use. Then, $\zeta = 1$, and the effective discount factor in (29) is the same as in (28). In this case, a political leader who is perceived to be performing poorly may well be voted out in the next election, but this impending loss of leadership has no consequences for the discount factor of the leader because the leader does not suffer any private loss from loss of office. To see the importance of endogenous political turnover, assume that the likelihood of being reelected in any election is constant and equal to 1/2. In this case, the effective discount factor will be $g^{1-\gamma}\beta[(\pi/2)\zeta + (1-(\pi/2))]$ *regardless* of the value of θ and the leader will always be more impatient than citizens. Again, there will be no fluctuations in the effective discount factor.

The quantitative exercises reported in this paper will show that this fluctuation in the effective discount factor caused by changes in reelection probabilities is key to generating volatility of spreads. When the economy is more likely to be in the B regime, reelection probability and the effective discount factor fall. As a result, the incumbent borrows more because he is more tolerant of default risk.[13] In addition, the B regime has a negative trend in growth and high volatility. Thus, all else remaining the same, the probability that the economy will suffer a growth shock

[13]Since expected endowment growth is higher in the G regime, all else the same, the (impatient) sovereign has a stronger incentive to borrow in the G regime compared to the B regime. This effect works to increase borrowing when θ is high. However, in the calibrated models, this effect is overwhelmed by the countervailing effects of the increase in the effective discount that occcurs with a rise in θ.

bad enough to trigger default is higher.[14] The impatience and volatility effects reinforce each other causing higher spreads in the B regime and leading to higher volatility of spreads.

The low reelection probability also affects incumbent leader's default incentives. A leader whose reelection probability is low has a *lower* incentive to default because the costs of default occur immediately while the benefits — the greater disposable income in the longer-run, once the exclusion period is over — accrue too far in the future to be of much value. Thus, all else the same, a leader with a low reelection probability would prefer to service the debt (and thus maintain the level of his private benefits) more so than a leader with a high probability of reelection. Interestingly, this effect could explain why unpopular sovereigns often choose to delay default and why a change in leadership often precipitates default.

6 Calibration

Calibration of the model involves assigning values to 20 parameters. Seven of these relate to the revenue processes (ρ, μ_i, σ_i, α_i, $i \in \{B,G\}$), two to preferences (β, γ), two to default costs (ϕ, ξ), three to the bond market (r_f, λ, z), four to politics[15] (ζ, π, $\underline{\theta}$, κ), and one to convergence of the solution algorithm ($\bar{m}$).

Of these, the ones that are chosen independently are displayed in Table 3. Turning first to the revenue process parameters, since we assume that revenue is a constant proportion of real GDP in any period, the calibration of the revenue growth process boils down to calibration of the real GDP growth process. The autocorrelation, mean, and volatility parameters of the GDP growth regimes are set to the values that were estimated and reported in Table 1. For reasons explained later, the regime-switching probabilities cannot be set independently.

Next, the two preference parameters were set to the same values for each country. Our target for the discount factor was a value consistent with a quarterly discount rate of 1.0, which is also the quarterly risk-free rate in our calibration. However, for computational reasons, we set to a slightly lower value of 0.9876, implying a quarterly discount rate of 1.3 percent. As such, this

[14]When b' so large in magnitude that default occurs unless g' is very high, repayment becomes more likely in the volatile B regime for which very high realizations of $g'$are more likely. But such high levels of debt rarely occur along equilibrium paths.

[15]A value of $\zeta \in (0,1)$ implies a locus of $\tau > 0$ and $\Psi > 0$ values satisfying $(1-\zeta) = \Psi\tau^{1-\gamma}$. Thus, τ and Ψ are not separately identified by our calibration.

Table 3: Parameters Chosen Independently

Parm.	Description	Targets {MX,PE,TR}	Values {MX,PE,TR}
	Revenue Process		
ρ	Autocorrelation of growth rates	{ 0.28, 0.43, 0.19 }	{ 0.28, 0.43, 0.19 }
μ_G	% Mean growth, G regime	{ 0.16, 0.39, 0.20 }	{ 0.16, 0.39, 0.20 }
μ_B	% Mean growth, B regime	{ -0.28, -0.59, -0.17 }	{ -0.28, -0.59, -0.17 }
σ_G	% S.D. of growth, G regime	{ 0.67, 0.88, 0.69 }	{ 0.67, 0.88, 0.69 }
σ_B	% S.D. of growth, B regime	{ 1.82, 3.80, 3.19 }	{ 1.82, 3.80, 3.19 }
	Preferences		
β	Discount factor	{0.988,0.988 ,0.988 }	{0.9886,0.988,0.988}
γ	Utility curvature	0.5	0.5
	Default Cost		
ξ	Prob. of re-entry	1 year to settlement, on average	0.25
	Bond Market		
r_f	Risk-free Rate	0.01	0.01
λ	Prob of maturity	Maturity in years {9.65, 8.18, 6.70}	{0.026 , 0.031, 0.037}
z	Coupon rate	0.01	0.01
	Politics		
π	Prob. of election	Every 4 years, on average	1/16

Note: MX = Mexico; PE = Peru; TR = Turkey

is a very high discount factor relative to what is typically used in the literature. The curvature parameter γ was set to 0.5.[16]

[16]The exact value of the curvature parameter is not too important, but if it is chosen to be greater than 1, then utility when out of power (namely $\zeta U(k)$) would be *higher* than utility in power ($U(k)$). At the cost of introducing another parameter, this problem could be remedied by augmenting the utility function by a (large) positive constant term when $\gamma > 1$.

Table 4: Parameters Chosen Jointly

Parm.	Description	Targets {MX,PE,TR}	Values {MX,PE,TR}
	Revenue Process		
α_G	Prob. of G to B	{0.04, 0.07, 0.10}	{ 0.04, 0.06, 0.10 }
α_B	Prob. of B to G	{0.07, 0.11, 0.11}	{0.02, 0.06, 0.08 }
	Bond Market		
ϕ	Default cost	Avg. haircut × Avg. (b/y) 0.37× {0.92,1.5, 0.91}	{0.11,0.20, 0.11}
	Politics		
ζ	Diversion	% Annualized avg. spreads {3.4, 3.4, 3.9}	{0.16, 0.66, 0.23}
$\underline{\theta}$	Prob. new gov't is G	Avg. incumbency of 8 years, equivalently, avg. reelection probability of 0.5	{0.87, 0.81, 0.64}
κ	Election uncertainty	A reelection prob. increase of 6-9 ppts for 1% rise in average g over term	{0.06, 0.24, 0.05}
	"Tremble"		
$\bar{m}$	$m \sim U[-\bar{m}, \bar{m}]$	Convergence in $< 10^4$ iterations	$10^{-2}\times$ {2.5, 1, 1.5}

Note: MX = Mexico; PE = Peru; TR = Turkey

Of the default cost parameters, only the probability of re-entry was set independently. Given that settlement on defaulted debt in the Brady era has generally been quick (Argentina is the big exception to this), we assumed an average exclusion period of 1 year.

Regarding the bond market parameters, the quarterly risk-free rate was set to 1 percent, the value standard in the literature. The average maturity of sovereign bonds was set to match the average maturity of bonds issued by these countries during the Brady era, as reported in Broner, Lorenzoni, and Schmukler (2013). We do not have information on the coupon rate on bonds issued by these countries, so the coupon rate was set to 1 percent (which implies that a risk-free bond will sell almost at par).

Regarding political parameters, the value of π was set to 0.0625, which implies elections every 4 years, on average.

We now turn to the calibration of the parameters that are set jointly to match model and data moments, listed in Table 4. Generally speaking, the choice of any parameter in this collection will affect all moments of the model to some degree. However, there is always one moment that is affected most for any given parameter. This is the moment listed next to the parameter under the column "Targets."

Turning first to the regime-switching probabilities α_i, these are set so that the model-generated frequency of switches between the two regimes match the estimated regime switching probabilities ν_i. In the model, the probability that the economy is in the G regime changes to $\underline{\theta}$ whenever there is a change in leadership. Since the probability of the G regime under an incumbent who loses an election will generally be lower than $\underline{\theta}$ (which is why he lost the election), elections are a force that boost the probability of transition into the G regime when the pre-election probability of the G regime is low. For this reason, the value of α_{B} has to be set lower than the value of ν_{B}, otherwise, the frequency of transitions from B to G in the model will be too high to be consistent with ν_{B}. Table 4 shows that the calibrated values of α_{B} are generally lower than those for ν_{B}. Similar consideration applies for the G regime as well, but since leadership changes are less likely when the economy is in the G regime, the adjustments to α_{G} are very minor.

The default cost parameter ϕ was chosen to generate the right amount of indebtedness. In our model, default implies that creditors receive nothing. This, of course, is far from reality. To adjust for this, we calibrate the default cost parameter so that the amount of debt sustainable in the model is, on average, equal to the average amount *lost* in the event of default, i.e., we target the level of unsecured debt. According to Cruces and Trebesch (2013), the average haircut imposed on creditors in the post-1980 era is about 37 percent. Thus, we target a debt-to-GDP ratio that is 0.37 of the average debt-to-GDP ratio for each country.[17] The implied proportional default cost (which is incurred for about four quarters, given $\xi = 0.25$) ranges from 10 to 20 percent. If the average time to settlement is lengthened, the required value of ϕ will be lower.

Turning to the parameters related to politics, we varied ζ in order to target the average spread on sovereign debt. In previous studies (such as Chatterjee and Eyigungor (2012)), this moment is targeted by the choice β, a practice that can lead to very low annual discount factors (as mentioned

[17] Since Y is revenue in the model, we could target the debt-to-revenue ratio, which would be a much larger number. However, this would then require us to increase ϕ, the proportional cost of default, substantially. But the costs of default come from reduced public and private consumption, and the latter is ignored in our model. Given this omission, we chose to target the debt-to-GDP ratio so that the value of ϕ has the interpretation that is standard in sovereign debt models.

earlier). In contrast, the average spread level is matched in this paper by varying ζ, which effectively varies the *leader's* discount factor when turnover is likely. To match the observed spreads, the implied ζ must be low. The reason for this is that equilibrium spreads reflect the average likelihood of default over a 7- to 10-year horizon, and for a leader to put up with this average default probability he must downweight the costs of a future default. He does that if his effective discount factor is low when θ is low.

We chose $\underline{\theta}$ — the probability that a new leader will start in the G regime — to match the average number of years of incumbency for politicians. It is somewhat challenging to determine when there is actually a change in leadership that matters for the growth prospect of the economy. We set the value of $\underline{\theta}$ so that the average incumbency is about eight years.

Regarding the choice of the election uncertainty parameter κ, it is natural to think that this choice affects the sensitivity of reelection probability to economic growth during the incumbent's tenure as a leader. And it does but only up to a point. Brender and Drazen (2008) report that this sensitivity is of the order of a 6 to 9 percentage point increase in reelection probability for every 1 percentage point increase in growth rate of GDP over the term of the leader. In their sample, a 1 percent increase in average growth during the term is equivalent to a 0.41 standard deviation rise in average growth during incumbency. We attempted to target a similar magnitude of sensitivity of reelection probability to growth during incumbency but could only generate a lower sensitivity of 2 to 6 percentage points. Although κ tightly controls the sensitivity of the reelection probability to θ, it only weakly controls the sensitivity of reelection probability to average g over the incumbent's tenure. Since tenure lasts for 4 years (on average), there is limited variation in average g over an incumbent's tenure.

The final parameter in the calibration is the magnitude of the volatility of the m shock. We assumed that m is uniformly distributed and chose its support to be wide enough so that a solution to the bond pricing equation could be found within a reasonable number of iterations (10,000 to be precise) for a wide range of parameter values.[18]

[18]The role played by this shock in the computation of default models with long-term debt is discussed in more detail in Chatterjee and Eyigungor (2012).

7 Findings

We present our findings in three parts. First, we show how the calibrated models perform for each country for both targeted and relevant nontargeted moments in long simulations of the model. In doing these simulations, we exclude all periods when the country is in financial autarky following default and following entry we exclude the first 16 periods.[19] We discuss the sources of performance improvements by studying the performance of intermediate models in which the novel elements of the main model are added in sequence. Second, following Arellano (2008), we simulate the calibrated models with the realized paths of output growth rates and the estimated probabilities of the two regimes and compare the path of model-implied sovereign spreads with the actual path of sovereign spreads. Finally, we explore the implications of political turnover for default in our calibrated models.

7.1 Model Performance

Table 5 displays a subset of the important targeted moments and some relevant nontargeted moments for the three countries. For each country, the first column records the data, and next two columns report the outcome for the Aguiar-Gopinath (AG) model and the main model. The AG model is the model in which the growth process is assumed to follow a single-regime AR1 process, with parameters as reported in the bottom panel of Table 1. In this model there is never any election or diversion of resources. The values of β and ϕ are selected to match the average spreads and the average (unsecured) debt-to-DGP for each country, respectively.[20]

Turning to targeted moments, we see that both models can match the average spreads and the average (unsecured) debt-to-GDP ratio. Thus, both models perform equally well for all three countries. Turning to nontargeted moments, we see that for Mexico and Turkey, the standard deviation of spreads in the AG model is an order of magnitude lower than the data, while it is much closer to the data for the main model. The exception here is Peru, for which the AG model delivers volatile spreads and the main model has spreads that are more volatile than in the data.

[19]Because our model abstracts from repayment on defaulted debt, we follow common practice of excluding the periods immediately following reentry to eliminate counterfactually low debt periods.

[20]In Table 3, only the parameters listed under preferences, default cost, and bond market are relevant (the probability of election is 0). Of these, all parameters except β take the values reported in the table. Of the parameters listed in Table 4, only ϕ (the default cost parameter) is relevant. The "tremble" parameter is kept the same as in the main model.

However, we will show later that the results for Peru reflect a deficiency in our data sample: We don't have spread data for 1980-1993, a period during which Peru's real GDP was very volatile.

Although we do not have data counterparts for the average reelection probability or its volatility, we report what these quantities are in the two models. For the AG model, volatility of the reelection probability is 0 since there are never any elections. In the main model, the probability of reelection (conditional on an election being held), namely $\eta(\omega, \tilde{\theta}, b)$, is fairly volatile. This volatility is largely controlled by the election uncertainty parameter κ; when κ is low, the probability of reelection is more sensitive to variations in θ.

The next four moments report relevant correlations. The data counterparts of the first three moments were reported in Table 2 and are reported in Table 5 for convenience. The data counterpart of θ is the smoothed estimate of the likelihood of being in the G regime in each quarter; the model counterpart is the model-implied likelihood of being in the G regime in the simulation (i.e., the r.h.s. of (9) for each period).

Looking first at the correlation between the realized growth rate and θ, we find that the model-implied correlation is somewhat lower than in the data but not too different. Turning next to the correlation between spreads and θ, recall that these correlations are quite high in the data — ranging from -0.35 for Turkey to -0.68 for Peru. The correlation in the model is also negative and but generally higher in magnitude than in the data. For Mexico and Turkey, the correlation is -0.90 and -0.72, respectively. Turning to the correlation between spreads and the growth rate, the correlation is in the range of -0.31 to -0.37 in the data. In the AG model, the correlation between spreads and growth rate is considerably higher — ranging from -0.54 to -0.72. In contrast, the correlation between spreads and growth rate in the main model is lower — ranging from -0.42 to -0.51. Thus, with regard to these three types of correlation, the main model comes closer to the facts for all three countries than the standard model.

The final correlation reported in Table 5 is the correlation between spreads and net exports. In this class of models, net exports is one measure of capital flow into (or out of) the country. For all three countries, the correlation between spreads and net exports is generally strongly positive. Periods of low spreads are when capital flows into the country and net exports are low (typically negative), and periods of high spreads is when capital flows out and net exports are high (typically positive). Both models get the sign of the correlation right. The correlation is stronger in the main model relative to the data for Peru and it is weaker for Mexico and Turkey. Additionally, the correlations are lower in the main model relative to the AG model. In both models, given that it is more expensive to borrow when spreads are high, borrowing shrinks and net exports rise. However, in the main model this effect is attenuated because when spreads are high, the sovereign's effective discount factor is typically low which boosts borrowing.

Table 5: Data and Model Performance

	Mexico			Peru			Turkey		
Moments	Data	AG	Model	Data	AG	Model	Data	AG	Model
Targeted									
% Annual spreads	3.40	3.42	3.40	3.37	3.38	3.42	3.90	3.90	3.90
unsec. debt-to-GDP ratio	0.34	0.34	0.34	0.56	0.56	0.55	0.34	0.34	0.34
Avg. reelection prob.*	-	-	0.5	-	0.5	0.5	-	0.5	0.5
Untargeted									
% S.D. of spreads	2.50	0.33	1.70	1.96	1.37	3.20	2.20	0.43	1.59
S.D. of reelection prob.	-	-	0.39	-	-	0.37	-	-	0.39
Corr(g, θ) *	0.26	-	0.24	0.36	-	0.29	0.13	-	0.11
Corr(Spreads, θ)	-0.59	-	-0.90	-0.68	-	-.45	-0.35	-	-0.72
Corr(Spreads, g)	-0.34	-0.72	-0.42	-0.31	-0.54	-0.51	-0.37	-0.69	-0.47
Corr (Spreads, NX)	0.73	0.63	0.26	0.31	0.44	0.43	0.84	0.65	0.36

*: Model moments computed using all simulation periods; all other model moments computed ignoring autarky periods and the first 16 periods following re-entry.

Overall, what we take from Table 5 is that the features introduced into our model improve model performance relative to the AG (or standard) model along several dimensions. The four dimensions that stand out are the volatility of spreads, which is generally much higher in our model than in the AG model; the correlation between g and θ, which is nonexistent in the AG model but positive in the data and our model; the correlation between spreads and θ, which, again, is nonexistent in the AG model but strongly positive in the data and in our model; and, finally, the correlation between spreads and growth rates, which is generally low in the data and significantly lower in the main model than in the AG model. In the rest of this section, we delve a bit more into the factors that lead to these improvements.

To do so, we compute the equilibrium of two models that are intermediate between the AG model and the main model. The first of these intermediate models has the same endowment process as the AG model but features exogenous political turnover — in the event of an election, the probability that the incumbent is reelected is equal to 0.5. We label this the ARX model (autoregressive with exogenous reelection). The parameters ϕ and ζ are again chosen to match the average spread and average debt-to-GDP ratio for each country.[21]

The second of the two intermediate models is the same as the ARX model, except that the endowment process incorporates the two growth regimes G and B with parameters listed in Table 3. We label this the GRX model. This model is also calibrated to match the average spread and the average unsecured debt-to-GDP ratio by selecting ϕ and ζ.[22]

Table 6: Sources of Improvement in Model Performance

Moments	Data	AG	ARX	GRX	Model
			Mexico		
% S.D. Sp	2.50	0.33	0.33	0.66	1.70
Corr (Sp, θ)	-0.59	-	-	-0.05	-0.90
Corr (Sp, g)	-0.34	-0.72	-0.72	-0.49	-0.43
Corr (Sp, NX)	0.73	0.63	0.61	0.40	0.26
			Peru		
% S.D. Sp	1.96	1.37	1.41	2.19	3.20
Corr (Sp, θ)	-0.68	-	-	-0.35	-0.45
Corr (Sp, g)	-0.31	-0.54	-0.55	-0.56	-0.51
Corr (Sp, NX)	0.31	0.44	0.45	0.48	0.43
			Turkey		
% S.D. Sp	2.20	0.43	0.43	0.90	1.59
Corr (Sp, θ)	-0.35	-	-	-0.24	-0.72
Corr (Sp, g)	-0.37	-0.69	-0.69	-0.60	-0.47
Corr (Sp, NX)	0.84	0.65	0.66	0.56	0.36

[21] For this model, the parameters listed under preferences, default costs, and politics in Table 3 are all relevant and have exactly the values displayed for each country. With regard to parameters listed in Table 4, only the default cost parameter ϕ and the diversion parameter ζ are relevant (since there are no growth regimes and reelection happens with constant probability).

[22] Of the parameters listed in Table 4, only α_G, α_B, ϕ, $\underline{\theta}$, and ζ are relevant. Of these, $\underline{\theta}$ is set to the same value as in the main model and the values of α_i are adjusted to match the frequency of switches between the regimes implied by the estimation (this adjustment is also required for the main model, as explained earlier).

Table 6 reports the results as we go from the AG model to the main model via the ARX and the GRX models. Observe, first, that going from the AG model to the ARX model makes almost no difference to model performance. This shows that when calibrated to the same set of facts, the benevolent dictator model is indistinguishable from a model in which short-termism results from conflict of interest between the sovereign and citizens. In this sense, conflict of interest can microfound the low discount factors required in the benevolent dictator model. We stress, however, that the two models have very different implications for how citizens value consumption streams. The utility from future consumption is discounted at a much lower rate in the ARX model than in the AG model: In the AG model, the required annual discount rate for Mexico, Peru and Turkey are 17.4 percent, 11.5 percent, and 20.2 percent, respectively, while the common annual discount rate in the ARX model is only 5.1 percent.

Moving from the ARX model to the GRX model increases the volatility of spreads. For Mexico and Turkey, the standard deviation of spreads essentially doubles, but the magnitude still remains low relative to the data. For Peru, spread volatility rises by 55 percent.

Moving from the GRX model to the main model — which adds endogenous political turnover to the GRX model — the volatility of spreads increases substantially for Mexico and Turkey. Thus, for these two countries, the majority of the increase in spread volatility between the AG model and the main model is due to growth-linked variations in the effective discount factor of the leader. This general pattern is also evident for Peru, although the AG model already comes close to the observed spread volatility (more on Peru later).

Turning to the negative correlation between spreads and θ, the bulk of it comes as we move from the GRX model to the main model. The generally small negative correlation between spreads and θ implied by the GRX model stems from the fact that the two regimes do not imply very different behavior for the political leader when reelection probability is exogenous (and 0.5). Thus, there is some change in spreads, but the change is small — for Mexico, the change is so small that the correlation between spreads and θ is negligible in the GRX model. All this changes dramatically for Mexico and Turkey when we move to the main model. Now, θ has a large impact on the effective discount factor of the leader and thus on spreads: As θ declines and the leader becomes more impatient, the probability of default, and, thus the spreads, goes up. Evidently, the effect is so strong that the model-implied correlation between spreads and θ is more strongly negative in the model than in the data.

Regarding the correlation between the spreads and g, the AG model implies a counterfactually high negative correlation. The reason is that in the AG model, the connection between low realizations of g and default is very strong. In the GRX and the main models, investors fear the B regime because of the associated high volatility of g as well as low g per se. Since a low realization of g will have lower impact on spreads if it occurs when market participants are confident that the regime is G, the model-implied correlations between spreads and g decline, which brings the models closer to the data.

7.2 Model-Implied Spreads Along the Sample Path

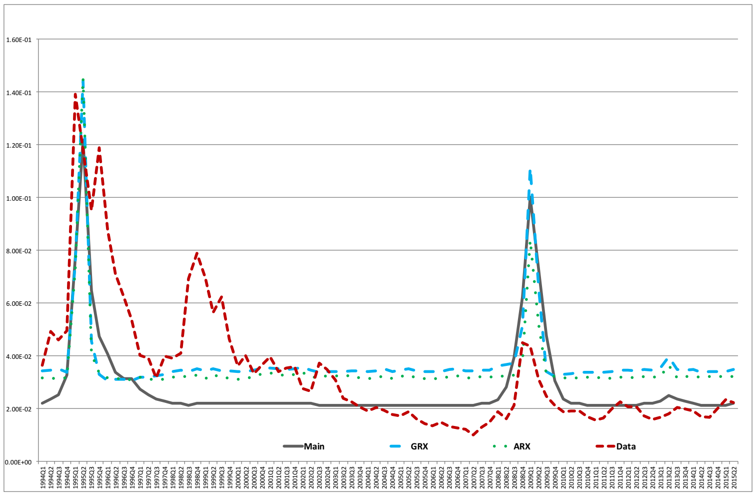
An alternative way to gage model performance is to compare the path of model-implied spreads given the realized values of the exogenous shocks to actual spreads. In the current context, the realized shocks are the actual growth rates of output and the estimated probabilities of the two regimes for the 1980Q1-2015Q3 period. To perform the simulations, b in 1980Q1 is set to 0 and for the quarters for which we have spread data (1993Q2 to end-of-sample) it is assumed that there is never any change in political leadership.

Figure 2 shows the simulated spreads from the three models as well as the data. We see that actual spreads are quite volatile, and there is general downward trend in spreads in all three countries. The simulated spreads from the ARX and GRX models capture some of this volatility but do not capture the downward trend. The simulated spreads from the main model capture more of the ups and downs but, most important, capture the downward drift in spreads. Basically, the period of the mid-2000s was a period of stable growth for these countries, and, as a result, estimated probability of the G regime is high and the implied spreads are low.

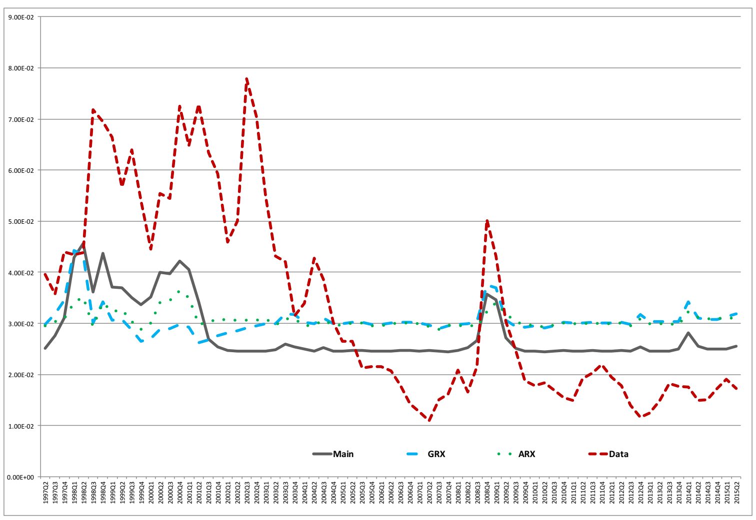
That being said, there are some (initially) puzzling features of these graphs. For all countries, the model-implied spreads for the ARX and GRX models lie very close to each other and yet we found that the spread volatility in GRX model was *twice* that of the ARX model for Mexico and Turkey and about 50 percent higher for Peru. The explanation is this: *Conditional* on the realized path of output growth (and regime probabilities) the ARX and GRX models perform similarly but the realized path of output growth over the 1993Q2-2015Q3 period is a lower probability event for the AR1 process than the GR process. Consequently, model-implied *population* spread volatility in the ARX model is lower than that of the GRX model for all countries. A striking example of this is Mexico which experienced growth rate drops (from its mean value) of more than 5.5 percentage points in 1994Q4 and 1995Q1 and a drop of around 4.5 percentage points in 2009Q1. Both drops cause big spikes in the spreads in the ARX model (and in the data). However, drops of this magnitude almost never happen in long simulations of the AR1 process but can happen with measurable (albeit small) probability for GR process.

In a similar vein, there seems to be missing volatility in the path for spreads implied by the main model for Peru: The main model-implied spread path is clearly *less* volatile than actual spreads whereas the model-implied (population) standard deviation of spreads is about 44 percent *higher* than standard deviation of actual spreads. The explanation for this discrepancy is that the realized path of output growth rates for the 1993Q2-2015Q3 period is unusually stable given the estimated GR process which takes into account the very volatile output growth path for Peru in the 1980s. Consequently, long simulations of the model generate significantly more volatile spreads than what is actually observed for Peru (for the period for which we have spread data).

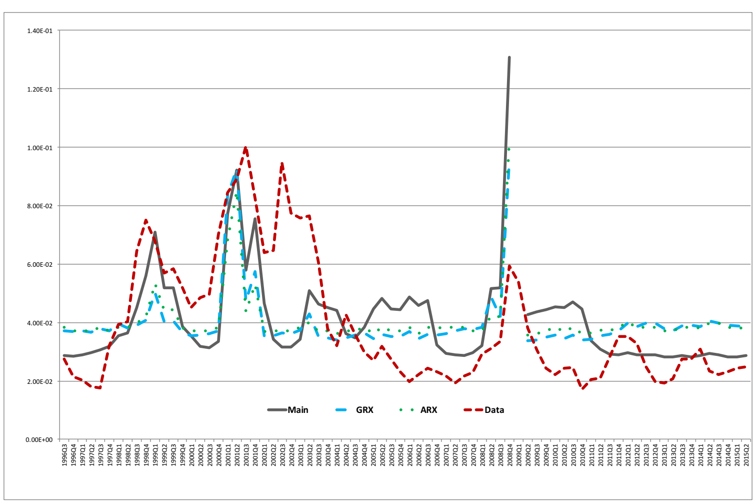
Figure 2: Spreads: Data and Simulation



(a) Mexico



(b) Peru



(c) Turkey

7.3 Political Turnover and Default

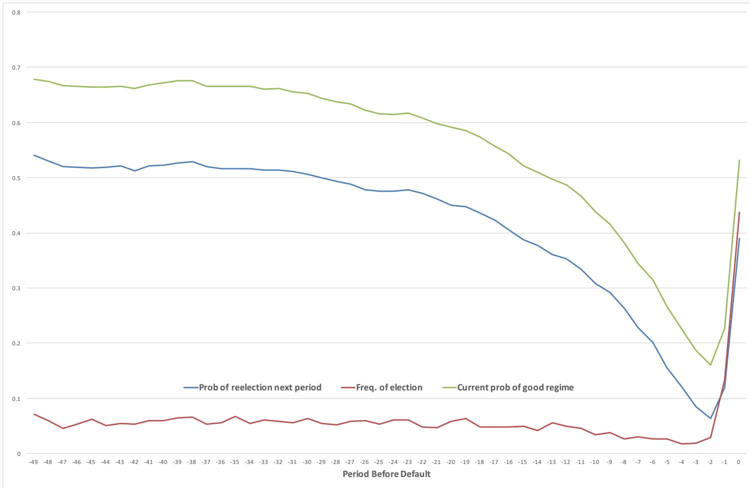
We study the impact of political turnover on default by examining what happens in the periods leading up to a default. Figure 3 plots, for each of the 50 quarters leading up to a default, and for each country: (i) the probability the economy is in a good growth regime (θ), (ii) the probability of reelection next period conditional on an election ($\mathbb{E}_{(\omega'|\omega,\theta)}\eta(\omega',\tilde{\theta}',A(\omega,\theta,b))$), and (iii) the fraction of times an election is held, averaged over a large number of default episodes.

Some common patterns are observable across all countries. First, the average probability the economy is in the good growth regime declines as the date of the default draws near and, close to the default date, the average probability plummets to low levels. For two out of the three countries, there is an upturn in this probability that begins in the period preceding a default — the upturn being very pronounced for Mexico. Second, the average probability of reelection next period (conditional on an election being called) follows the same qualitative path as the probability that the economy is in the good growth regime. Third, the fraction of times an election is called drifts down as the default date approaches and then jumps up on the date of default.

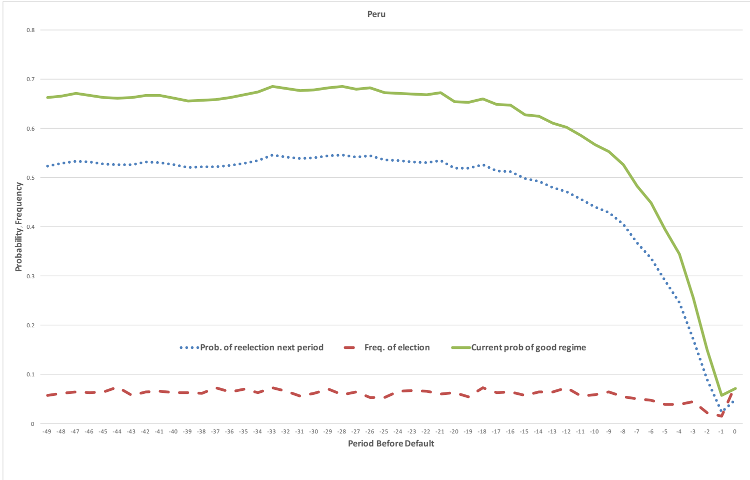
One implication of these patterns is that defaults tend to be precipitated by a combination of economic *and* political bad luck. Some random event shifts the economy into the bad growth regime and the paths that end in default are the ones for which the shift persists. This persistence is symptomatic of economic bad luck in that the economy fails to shift into the good regime (either exogenously or following an election). Furthermore, the fraction of times there is an election called is also declining, and, so, there is political bad luck in that the opportunity to replace the incumbent leader is (randomly) presented less frequently.

For Peru and Turkey the upturn in the probability of being in the G regime in the period of default (and the immediately preceding period) is modest. For these countries, the average probability of the G regime is quite low around default. This is intuitive in that default is more likely to be triggered in a regime in which growth is negative on average and in which the volatility of growth is quite high. However, for Mexico, the upturn in the probability of the G regime is very pronounced and the likelihood the economy is in the G regime in the period of default is greater than 50 percent. In Mexico, the B regime is not as volatile as in Peru or Turkey, and, consequently, the stronger default incentives of a leader with higher effective discount factor plays a bigger role in default. As noted in Section 5, a leader with a higher reelection probability has a stronger

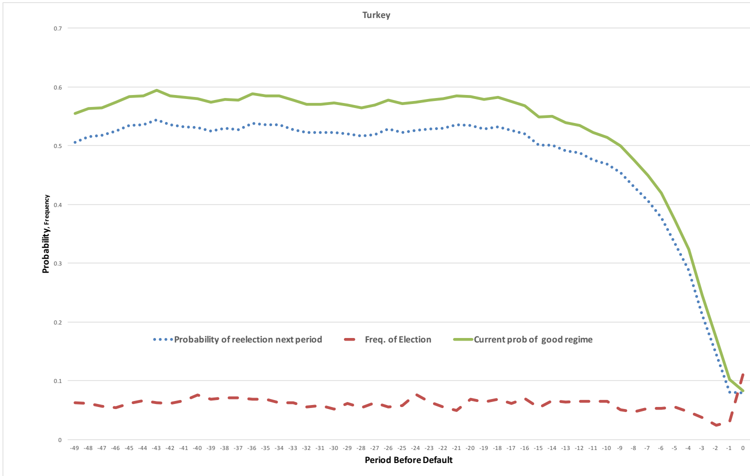
Figure 3: Political Turnover and Default: Simulations



(a) Mexico



(b) Peru



(c) Turkey

incentive to default because he discounts the utility from greater disposable income following the exclusion period at a lower rate. The fact that the likelihood of an election also jumps up in the period of default indicates that the rise in the effective discount factor is likely associated with the appearance of new leader.

8 Conclusions

In this paper, we explored the role of conflict of interest between the sovereign and citizens in accounting for external debt facts of emerging economies. We modeled the sovereign as a provider of public goods who, in the process of doing so, diverts resources towards private use. When reelection probability is low, the anticipated loss of private benefits leads to policy short termism.

We focused on three emerging economies and showed that if the likelihood of political turnover varies with economic growth in a manner that is line with developing country evidence, the predicted variation in sovereign default risk is quantitatively large. The mechanism works through the effective discount factor of the sovereign, which rises or falls with the likelihood of reelection.

Since standard quantitative models of sovereign debt and default tend to predict too little volatility in sovereign spreads, our findings suggest that incorporating the political underpinnings of sovereign behavior is a promising way to bring this class of models into closer conformity with facts.

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