As Time Goes By : Essays on Maturity and Sovereign Debt

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Dedication

Para:

Ligia: A quien le debo mi curiosidad intelectual

Simon y Federico: Honestamente, nada de esto existiria sin ellos y su ayuda.

Patricia y Luis Fernando: Que por más de todavía no sepan a que me dedico, me han dado su apoyo incondicional durante todos estos años.

Gracias. Totales

Abstract

In the first chapter, I explore a novel pattern in the correlation between default risk and currency depreciation risk for emerging economies. It confirms there is a positive correlation between currency depreciation risk and default risk, but it shows that such correlation disappears in the short horizon, broadly defined as less than three years. The pattern in the correlation is fairly robust to the measures of default risk and currency depreciation risk; as well as for controlling for other factors. I build a small open monetary economy model to take into account a new feature of the trade-offs associated with inflation and future output, and inflation and ability to repay. The model is able to match the untargeted correlation between depreciation risk and default risk for different maturities for Brazil. The model also quantifies the changes in the capital investment decision for Brazil between 1995 and 2010 and finds that Brazil invested around 1.1 % of GDP less because of the inflation risk related to the majority of their debt being in Brazilian Real.

In the second chapter of this dissertation, I study how does political turnover risk affect the choice of the maturity length by the party in power. I build a model of sovereign debt where there exist political economy forces that do not rely on different types of governments or shocks to the discount factor. The government faces the risk of being replaced by an identical agent while valuing consumption more when they are in power. In a 3-period model, they face the choice of borrowing in either long-term bonds or short-term bonds. I find that this risk causes the agents to behave as if they had quasi hyperbolic discounting preferences, which makes long-term debt more attractive. The main finding is that as political disagreement, the gap between the utility received in power vs out-of-power, grows,

the government shifts its debt composition towards long-term bonds. The model is also able to predict similar behavior to that during debt crises.

Finally, in the third chapter of this dissertation, I take a critical survey of the literature on how the risk premium affects sovereign debt accumulation and crises. I review several strands of the literature and their finding, both empirical and theoretical, to better understand the strategic environment that governments face. I find that risk aversion plays an important part in the pricing of debt, and can impose serious restrictions on the choices that governments can make. The main takeaway of my review is that while the empirical literature has found great importance in the role of international business cycles and the risk aversion of investors, there is still a lot of unanswered questions in the quantitative side of the literature.

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Puzzling Correlations and When to Find Them: Sovereign Spreads and Inflation

1.1 Introduction

The shift in the currency composition of developing countries' sovereign debt portfolios has brought the issues associated with nominal debt into the consciousness of the sovereign debt literature. In recent years, developing countries have started to borrow more in their local currency, a change from the status quo of the 1980s and 1990s (Du and Schreger (2016),Arslanalp and Tsuda (2014)). Associated with this decision, there is the risk of sovereigns inflating away real obligations. Theoretically, we can think of a sovereign using inflation as a way to partially default on a portion of their bonds. However, empirically inflation and default seem to be associated with being complements; the long-term risk of inflation and default have positive co-movements, and default episodes are associated with high inflation. Understanding how governments reduce real liabilities by using inflation while balancing the associated cost is paramount to understanding the actual mechanism for which inflation impacts the incentives and the ability to repay.

My paper studies the relationship between inflation and default, first empirically and then through a structural model. In the data, I find that there is only a positive correlation in the long horizon. To explain the lack of correlation in the short run, I merge two strands of the literature and build a small open economy model that incorporates how inflation affects capital accumulation. I use the framework to measure the decrease in investment associated with issuing debt in local currency for Brazil from 1995 to 2010. I also show the changes in welfare associated as a result and decompose it between the insurance that local debt offers versus the lower output as a result of lower investment.

While a significant part of the literature has focused mostly on how inflation changes the incentives to default, this paper wrestles with the question of how inflation changes the country's future ability to repay its debt through inflation's effect on capital accumulation. The mechanism explored in this paper questions the conventional wisdom that overcoming the original sin of developing countries was a triumph without negative consequences. Furthermore, it focuses on how the consequences of inflation change between short and long horizons.

I show that for a group of developing countries, the correlation between implied yields in currency forwards and default risk is high in the long run and disappears in the short run. Similarly, the correlation between inflation risk, measured by the spreads in bonds linked to inflation, and default risk is also only positive in the long run. Recent literature has focused only on comparing the realized inflation with default risk or comparing long-term inflation risk and default risk. Galli (2020) documented that the correlation was positive, however, when the horizon shortens, the positive correlation disappears.

I use Bloomberg to get prices from secondary markets for bonds and currency futures. I rely on the fact that all countries in my sample issue part of their bonds in USD, so the spreads between local bonds issued in USD and US treasury bonds is the expected default. As a robustness check for default risk, using credit default swaps (CDS) gives similar results. Following Du and Schreger (2016) amongst others, I use the implied yield in futures to measure the expected depreciation of a currency versus the USD at different maturities. Finally, to get a better measure of expected inflation in the short term, I use the spreads of Local Currency (LCU) bonds indexed-to-inflation and LCU bonds not indexed to inflation. The underlying assumption is that the probability of default is the same for both, and the only difference is the expected inflation.

I find that the correlation between expected depreciation of a currency and expected default goes on average from 0.07 in the 1-year maturity structure to 0.48 in the 5-year maturity. The result is robust to all countries, and to using CDS instead of spread. Similarly, the correlation between expected inflation and expected default goes from 0.15 at 1 year to 0.76 at 5 years. The expected inflation is only done for Brazil, Mexico, and Chile due to data constraints. The 5-year correlations are inline with what has been found by Galli (2020) and in similar magnitudes to the correlation between realized inflation and default found in Arellano et al. (2020). This paper is the first one, to my knowledge, to document the short-term correlation and the differences in term structures.

Once again, the shape of the correlation curves for different maturities are at least mildly surprising. A simple way of thinking about the relationship between inflation and default would be that the government uses money creation to implicitly default on debt, therefore we should expect to see a negative correlation between expected inflation and expected default. On the other hand, if we expect both to be caused by reactions to negative shocks, then we should expect high positive correlations. Previously in the literature, the empirical relationship between these has been either ignored or assumed to be positive and constant for all maturities.

With these new correlations in mind, I build a model which incorporates classic elements of monetary models, a Cash-in-Advance constraint (CIA) la Stockman (1981), into a small open economy framework with lack of commitment in both monetary policy and debt repayment. The model is able to capture the trade-off between inflation and future output by incorporating that future capital decreases with inflation. As a result, the government faces a trade-off between lowering their default probability today by increasing it tomorrow through lower capital and expected output tomorrow. My approach is new to the literature as it blends two different parts of the sovereign debt literature. It combines the work done in adding capital to sovereign debt models with the new emerging models of the interaction between monetary policy and default. Most of the others in the literature take output to be a stochastic process, and inflation is assumed to only matter in the price of new bonds and how much you have to repay today, which implies that the correlation between expected inflation and default does not vary with the maturity structure.

The model is a small open economy with households, government, and international investors. Government issues nominal debt and chooses government consumption and money growth. Households choose private consumption and choose money balances and capital for the next period. Households face a CIA constraint on both consumption and investment, and face adjustment costs of their money balances and capital. In the model, the government does not have access to complete tax instruments, and as such does not choose capital directly. Households do not internalize that their capital decision changes the default probability tomorrow and therefore underinvest relative to what the government would like. The taxes being exogenous to the model captures some political economy forces that do not allow for quick responses in tax rates; they also match the empirical evidence that emerging market countries use seigniorage instead of taxes to smooth out business cycle fluctuations. Therefore, taxes are taken to be exogenous and so the only source of time-varying government revenue is seigniorage. It is through the CIA that inflation distorts the capital investment decision; by lowering the real money balances, households decrease their capital holdings to smooth out consumption. In other words, the government uses seigniorage to raise revenue and lower the value of their liabilities, but to the households, it is a tax on current wealth and they react by lowering their investment to smooth out changes in consumption. I use Simulated Method of Moments to match Brazil 1995-2010. Brazil is an interesting case as it faced hyperinflation before 1995 and experienced rapid growth afterward. The government implemented reforms to lower inflation, but their central bank is not independent. During this period, Brazil was able to reduce their inflation, experienced an increase in capital investment, and they borrowed mostly in Brazilian Reals. And thanks to a commodity boom, they had a high TFP growth rate. By 2010, Brazil was considered one of the giants of the emerging markets. Finally, Bank of Brazil could withdrawal unlimited funds from the central bank to fund the government spending. Brazil provides an environment in where inflation risk, default risk, nominal debt, and large capital investment are all present. The model is able to measure the effects that borrowing on their own currency had on Brazil.

I use Simulated Method of Moments to match Brazil 1995-2010. The model is able to match business cycle moments well and reproduces the untargeted correlations between inflation risk and default risk for different horizons. The model measures the effect that borrowing on their own currency had on Brazil and finds large yearly underinvestment attributed to the risk of future inflation. The result is surprising not only in magnitude but also given that Brazil is usually regarded as a success story of growth and how to get inflation under control.

For Brazil between 1995 and 2010, I find that investment was on average about 1.1 % of GDP lower every year compared to a baseline in which they had borrowed in dollars or linked-to-inflation debt. It is mostly due to the difference in the amount of capital that they are able to sustain. Borrowing in real debt leads to less seigniorage, and so the return on capital is higher. I also find welfare gains of about 3%, coming mostly from differences in capital accumulation. It is a contrasting result to the traditional monetary literature as Gomme (1993), De Gregorio (1993) and Jones and Manuelli (1995) all find modest effects of inflation on capital accumulation. The main difference is that in my framework there is lack of commitment with respect to debt and the government has extra incentives to use seigniorage to lower debt obligations and get revenue. Section 3 will discuss more in-depth the model and the validity of the assumptions.

My road-map for the paper is to first go into the empirical work and focus on showing the correlations between inflation risk and default risk. The empirical work should be thought of as being at least a hint of what the mechanism the literature missing is. Then build a sovereign default model that has a capital and CIA on consumption and investment so as to incorporate the trade-offs associated with inflation and future ability to repay. The main idea is that inflation affects future capital and is very correlated with itself. To test the model, it will be used to match moments from Brazil 1995-2010. And given that match, I will look at the counterfactual of what would happen if they had borrowed in real debt rather than nominal debt. Finally, I would look at the welfare effects and how they decompose between capital accumulation and ex-post insurance.

1.1.1 Related Literature

The topic of inflation and sovereign debt is not a new one, and this paper owes a lot to its intellectual predecessors. The general framework builds on sovereign default models following the path of Eaton and Gersovitz (1981), Arellano (2008b), Aguiar and Gopinath (2006) and subsequent work since. More specifically, it contributes to three different strands of the literature.

In terms of money and sovereign default, the closest work to this is Galli (2020), Roettger (2019) and Sunder-Plassmann (2020). They consider the interaction of monetary policy in default decisions. I add to their work by adding capital which makes inflation affect future output and repayment. It allows me to explore the dynamic trade-off that inflation poses, by reducing default today but increasing it tomorrow. Similarly, Gomez-Gonzalez (2019) explores the role of inflation-linked debt, while abstracting from inflationary and capital concerns. Aguiar et al. (2013) explore the credibility of joining monetary unions and exposure to self-fulling crises, something this paper does not consider because of tractability. Finally, Arellano et al. (2020) merges a New Keynesian open economy with a sovereign debt framework. Their work includes capital, but monetary policy follows a rule and government borrows in real debt. In contrast, I focus on an environment in where there is strategic inflation to lower real liabilities. Because of tractability, this paper abstracts from the portfolio choice between nominal and real debt, which is analyzed by Ottonello and Perez (2019), Engel and Park (2018) and Du and Schreger (2016).

The paper also adds to the literature that studies sovereign default and capital. Gordon and

Guerron-Quintana (2018), and Park (2014) both focus on the interactions between capital accumulation and sovereign spreads. They show that capital does not trivially lower default since capital changes both the value function to default and to repay, something that is present in the model. Esquivel (2020) studies the impact of giant oil discoveries on the sovereign debt, and shows that they increase the probability of default. I build on these works by integrating capital adjustment costs, while adding money and nominal debt.

Finally, there is a long tradition in monetary frameworks of including capital. Tobin (1965) shows that an increase in the monetary growth rate leads to capital formation in the long run. However, an anti-Tobin effect is also possible, as shown by Stockman (1981) and Abel (1985). Cooley and Hansen (1989, 1991) also find anti-Tobin effect when labor supply is endogenous. I follow in the tradition of Stockman (1981) and Abel (1985) and build a model with a CIA constraint on capital investment. Compared to their model, this paper deals with both a small open economy, and the government lacks commitment. Aruoba et al. (2011), Janiak and Monteiro (2011), and Arawatari et al. (2018) all also focus on the negative relationship between money growth and inflation.

1.2 Facts

I use Bloomberg to get monthly prices from secondary bond and currency markets, and focus on the period between 1/1/2004 to 2/1/2020. I use the earliest time frame possible and end before the COVID epidemic. The sample contains Brazil, Colombia, Mexico, Argentina, Peru, Chile and Turkey. All of these are countries that borrow both in local currency and in USD.

First, I measure the default risk. Following the standard way it is done in the literature. I define spreads as:

$$Spreads_T = r_{USD\ Foreign\ Bonds,T} - r_{US\ Bonds,T} \tag{1.1}$$

Spreads therefore are the difference in yields between bonds denominated in USD compared to US Bonds [1]. All countries have enough of their debt denominated in USD and the markets are active enough. For the local bonds denominated in USD, I take the average price traded for that month and calculate the yield-to-maturity and use that as a the $_{USD\ Foreign\ Bonds,T}$. Since the bonds are denominated in foreign currency, they are not exposed to currency depreciation risk, so I interpret the spreads to measure the risk of default

Measuring the expected inflation is a lot harder and less clean. First, I define the currency depreciation risk as:

$$i_T - i_{T^*} = \frac{Fwd_T}{Spot} \tag{1.2}$$

The currency depreciation risk is measured by using the implied yield in exchange rate forwards between LCU and USD. It measures the currency depreciation risk over the US dollar for a fixed maturity, following Du and Schreger (2016). While it serves a good proxy for the expected inflation in the long term, in the short term the interpretation of it as expected inflation has the problem of Fama and French (1988) regression that shows that in the short-term forwards are bad predictors of future inflation. It is still a worthwhile object to consider for two reasons. One it is the price that a foreign investor would have to pay in order to hedge currency risk, regardless of the maturity. Secondly, the data is more widely available than other measures of expected inflation.

[1] I get the data of the US nominal yield curve from Grkaynak et al. (2007) and use it as the benchmark of the risk-free rate for different maturities.

$$Spreads_{i\,T} = r_{Inflation-Linked\,Bonds,T} - r_{Not-Linked\,Bonds,T} \tag{1.3}$$

As a way to better capture the expected inflation, I use the spread between bonds issued in LCU that are indexed to inflation and bonds issued in LCU that are not. In the price of both bonds, default risk is present. However if we assume that both bonds have the same probability of being defaulted on, then the difference should be the expected inflation. It is a new way of measuring expected inflation. The downside is that in order to get the measure of expected inflation, sovereigns need to issue bonds issued that are index to inflation and not. The requirements limit the countries to just Brazil, Chile, and Mexico.

Table 1 shows the correlation between default risk (Equation 1) and currency depreciation risk (Equation 2). Notice that most countries exhibit statistically zero correlation if the maturity is less than 1 year, with Argentina being the exception. The general pattern is that the correlations become stronger as the maturity becomes farther into the future. It is instructive to look at the averages and see that the 1-year has a correlation of 0.151 while the 5 year has .504, almost 5 times higher.

Table 2 shows the correlation between correlation between default risk (Equation 1) and inflation risk (Equation 3). Due to the data requirements, most countries are dropped from the sample when switching over to Table 2. A similar pattern emerges as Table 1, where in the short run (less than 3 years) the correlation is low, yet in the longer horizon it rises. An interesting feature is that the correlations in the long term, both in Table 1 and Table 2, have similar magnitudes to the correlations of realized inflation and default risk in found previous literature (Galli (2020), Arellano et al. (2020)) .

An important point to make is that the correlations are between inflation risk and default risk in the same maturity. Therefore, the result comes from that in one year if there is

	3M	**6M**	**1Y**	**2Y**	**3Y**	**4Y**	**5Y**	**10Y**
Mexico	-0.007	0.063	0.132	0.259	0.374	0.445	0.377	
Brazil	0.012	0.128	-0.003	0.128	0.331	0.33	0.485	0.506
Peru	-0.016	-0.009	-0.029	0.394	0.241		0.42	
Colombia	-0.049	-0.79	0.039		0.129			
Turkey			0.21	0.662	0.472		0.467	
Argentina			0.558		0.66			
Chile			0.151	0.405	0.412		0.769	
Average	-0.015	-0.152	0.151	0.370	0.374	0.388	0.504	0.506

Table 1.1: Correlations of Spreads on USD denominated debt and Implied Yield of Currency Futures

inflation, it does not correlate with default, but if it is in 5 years then it correlates highly with default. The theory of this paper is that inflation in 5 years means inflation for the next 5, which implies the decimation capital stock, while inflation tomorrow means only on the period, which means it is already priced in and other factors dominate.

Figures 1.1 and 1.2 show the correlations for different horizons for Brazil. The general shape of the correlations is fairly robust to using quarterly, daily, or even yearly data. I also check that using Credit Default Swaps (CDS) for default risk does not change the results. While one might worry about the effects coming from the Great Recession, the results hold whether or not the time period includes it, but does mechanically increase the standard errors because of the loss of data. Running a panel regression on the spreads vs. US bonds on the implied yields while using country and time fixed effects also does not change the significance of the short and long maturities.

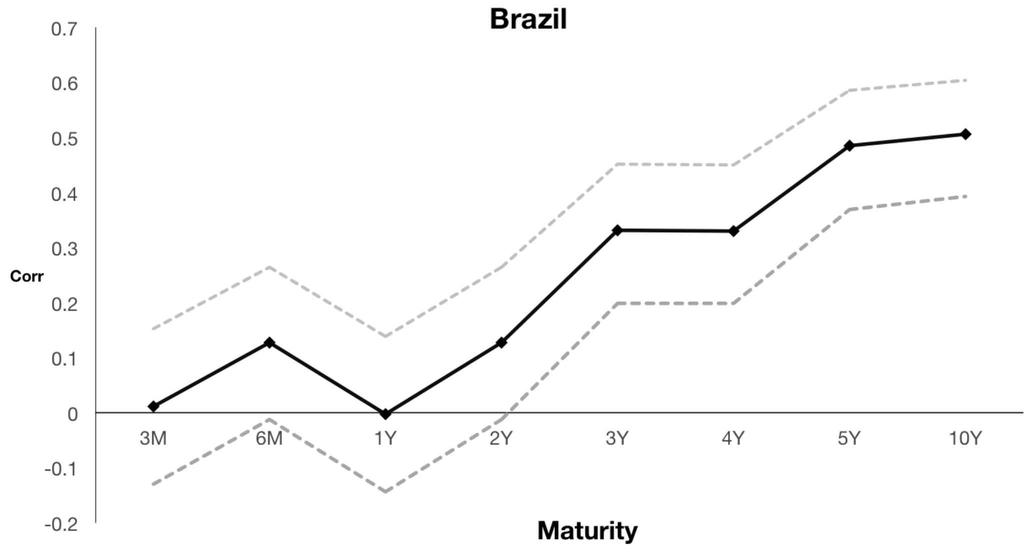

Figure 1.1: Correlation between Default Risk and Currency Depreciation Risk

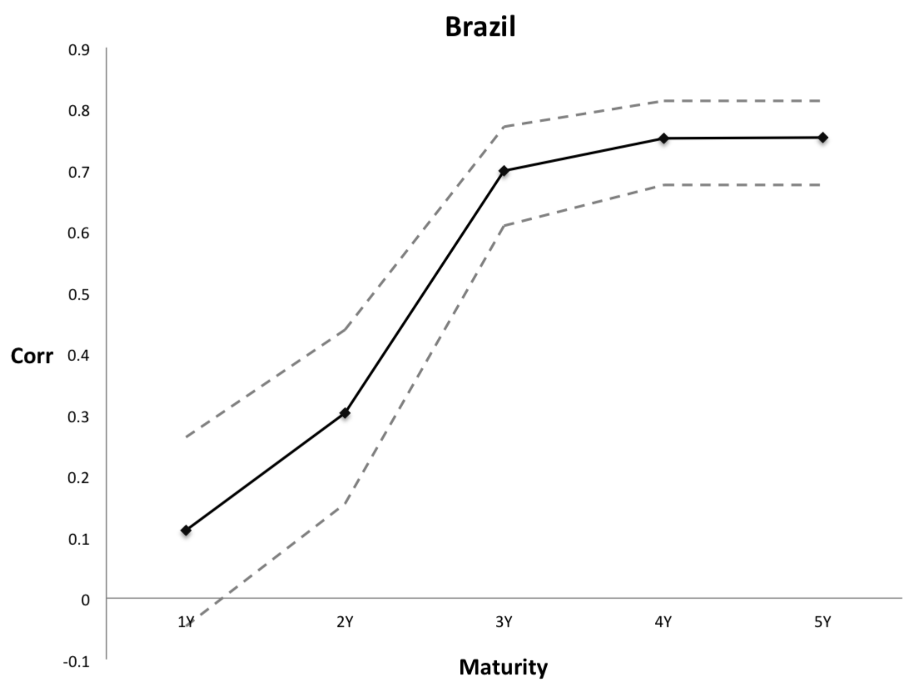

Figure 1.2: Correlation between Inflation Risk and Default Risk

	1Y	2Y	3Y	4Y	5Y	8Y
Brazil	0.263	0.439	0.771	0.813	0.813	
Mexico		0.252	0.22	0.43	0.505	0.502
Chile	0.169	0.329		0.36	0.485	
Average	0.216	0.340	0.495	0.534	0.601	0.502

Table 1.2: Correlations of Spreads on LCU Linked-to-Inflation Bonds and LCU Not Linked Bonds

1.3 Model

The model is an infinite-horizon small open economy model, where time is discrete and indexed by $t \in \{0, 1, 2, \ldots\}$. There are 3 types of agents: Domestic Households, a government, and international lenders. Households are atomistic with measure one and will choose private consumption, investment, and money balances for the next period. Money is used for transactions during this period, which gives rise to a cash-in-advance constraint on household consumption and investment. Households also face a quadratic adjustment cost of changing both their money balances and capital. The government has chosen endogenous government spending, issued nominal debt and money supply, and has a default decision and inflation. Tax rate is fixed and so the only source of revenue that the government can change is seigniorage. Finally, foreign and risk neutral lenders buy bonds from the government.

1.3.1 Timing

The timing in the model is as follows: At the start of each period, the government can be either in good standing or in financial autarky, depending on its default history. The state of the world is summarized by one-period nominal bonds from the government B_t, money balances M_t, a stochastic productivity shock θ_t, and capital inherited from a previous period K_t. The government then announces its choices of default, new bond issuance (0 if they are in default), money supply, and government spending. While the government doesn't have commitment from period to period, it has commitment within a period and these announcements are binding. The households, taking the government policy functions, prices, and state of the world as a given, decide their consumption, holdings of money balances, and investment. Finally, production and consumption take place and if the country is not in default, the holders of maturing bonds are paid.

1.3.2 Domestic Households

Preferences

Households have preferences given at time T by:

$$\mathbb{E}_T \left[\sum_{t=T}^{\infty} \beta^t (U(C_t) + (1 - L_t)) + U_G(G_t) \right]$$

Where $\mathbb{E}_T$ is the expectation operator conditional on date T, $0 < \beta < 1$ is the discount factor, $0 \leq L_t \leq 1$ is the labor given that period, and $U(\cdot)$ is the utility function on private consumption assuming the standard conditions. The function $U_G(\cdot)$ is the utility of consuming the government expenditure, but its separable from the private consumption and since households take government as given, they take it as a fixed transfer.

Budget Constraint

At every time t, households face the budget constraint of:

$$C_t + \frac{M_{t+1}^{hh}}{P_t} + I_t = \frac{M_t^{hh}}{P_t} + (1 - \tau)(\theta_t F(K_t, L_t) - \frac{\psi}{2} \left(\frac{M_{t+1}^{hh}}{M_t^{hh}} - 1 \right)^2)$$

The left side of the budget constraint for the household is simple; they either consume, C_t, invest in physical capital, I , or hold money balances for the next period ,M. The right side is the income: they receive real money balances and they produce net of a tax. This production is taxed exogenously at a constant rate, and they also face the cost of changing their money balances. While not being standard, the cost is meant to capture the cost of inflation on output in the present period. I made in the tradition of Rotemberg (1982).

Investment is :

$$K_{t+1} - (1-\delta)K_t = I_t - \phi(K_t, K_{t+1})$$

where δ is the constant depreciation rate, and $\phi(\cdot, \cdot)$ is the capital adjustment cost. This adjustment cost is standard in small open economy models, as in Gordon and Gordon and Guerron-Quintana (2018) and Esquivel (2020). It will be used to match the volatility of investment.

Households do not have access to international markets. They can only smooth consumption by saving in either money balances or capital. Capital has a stochastic return because L_t and θ_t will be stochastic. On the other hand, money also has a stochastic return. The government uses seigniorage, it will work as an inflation tax on the household's money holdings [2]. The tax will look as a wealth tax on households, so they will have to decrease their investment and consumption. However, they will choose to decrease capital to smooth out consumption in bad times.

[2]The timing on the cash-in-advance constraint is Svensson (1985) and not Lucas timing, which is to say HHs choose their money holdings one period ahead. This creates the situation in which the households have a fixed money holdings for their C and I this period, and so are exposed to the governments decision. Seigniorage acts as an unexpected shock to the real value of their money holdings

Cash-in-Advance (CIA)

Households face a cash-in-advance constraint every period [3]:

$$C_t + I_t \leq \frac{M_t^{hh}}{P_t}$$

The constraint, while new to the sovereign debt literature, has a long history in monetary frameworks. Stockman (1981) and Abel (1985) provide the original CIA constraint on capital investment in the neoclassical growth model to show that inflation can lead to lower capital accumulation/growth since inflation acts as a tax on agents holdings of real money balances, ultimately reducing the capital stock. Cooley and Hansen (1989, 1991) find similar results when they use endogenous labor supply. Recently, Aruoba et al. (2011) has shown that this CIA can be thought of as a lower bound for the effect of money on capital accumulation and welfare since it does not capture moments related to velocity, and misses market structures like bargaining, which could create large effects of the money supply on aggregate investment . The CIA is the a main component of my results. As government increases the money supply, it increases the price of money in terms of goods. In turn, the right hand side of the CIA will decrease, and households will have to adjust by reducing investment and consumption. Households will choose to reduce investment more to smooth out the decrease in consumption.

[3] Consider 2 people in a household. One is a worker and the other is a shopper. At the beginning of the period the shopper take the money balances and goes to buy investment and consumption for next period in a decentralized markets. Simultaneously and independently, the worker sells his labor in a decentralized market for labor and gets paid at the end of the period and choose money balances for next period. The set up is a natural extension which creates the need for money and gives rise to the CIA.

1.3.3 Government

The government is benevolent and values consumption stream as the households. The government's flow utility at period t is just:

$$U(C_t) + (1 - L_t) + U_G(G_t)$$

where the government chooses G_t.

The budget constraint of the government is

$$G_t + D_t\tfrac{B_t}{P_t} = D_t q(\cdot)B_{t+1} + (\tfrac{M_{t+1}}{P_t} - \tfrac{M_t}{P_t}) + \tau[\theta_t F\left(K_t, L_t\right) - \tfrac{\psi}{2}\left(\tfrac{M_{t+1}}{M_t} - 1\right)^2]$$

where G_t is government consumption, D_t is if the government is in default or not, B is nominal government bonds, q is the price at which the bonds are traded which depends on $B_{t+1}, M_{t+1}, \theta_t, K_{t+1}$, and M is the money balances.

The left-hand side is government expenditures and payments of maturing debt, if any. The right-hand side is the income, which breakdowns into new debt, seigniorage, and tax income. Tax revenue is net of costs. It should be clear to see that seigniorage is just the difference between the money balances issued today and the ones owed to them today.

1.3.4 International Lenders

International lenders are assumed to be infinitely lived and make zero profits in expectation. Recall that bonds are nominal. Therefore, the break-even condition includes both the inflation and default risk:

$$q(B_{t+1}, M_{t+1}, \theta_t, K_{t+1}) = \tfrac{1}{(1+r)}\mathbb{E}_t\left[\tfrac{1-D_t(B',M',\theta',K')}{(1+\pi_{t+1}(B',M',\theta',K'))}\right]$$

where D_t is the default probability and $(1 + \pi_{t+1})$ is the inflation tomorrow.

Given the price, we can now look at the model equivalent of the derived default and inflation risk in the empirical part.

The default risk at time t+i while on period t is :

$$\mathbb{D}_{t+i} = \mathbb{E}_t[D_{t+i}]$$

And since in the model the inflation risk and the currency depreciation are the same, we just have the inflation risk for the next period :

$$\mathbb{E}_t[1+\pi_{t+1}] = \mathbb{E}_t[\tfrac{P_{t+1}}{P_t}]$$

$$= \mathbb{E}_t[\tfrac{P_{t+1}}{P_t}\tfrac{M_{t+1}}{M_{t+1}}\tfrac{M_t}{M_t}]$$

$$= \mathbb{E}_t[\tfrac{M_t}{P_t}\tfrac{P_{t+1}}{M_{t+1}}\tfrac{M_{t+1}}{M_t}]$$

$$= \tfrac{M_t}{P_t}\tfrac{M_{t+1}}{M_t}\mathbb{E}_t[\tfrac{P_{t+1}}{M_{t+1}}]$$

We can similarly define inflation risk for time as t+j:

$$\mathbb{E}_t[1+\pi_{t+j}] = \tfrac{M_t}{P_t}\mathbb{E}_t[\tfrac{M_{t+j}}{M_t}]\mathbb{E}_t[\tfrac{P_{t+j}}{M_{t+j}}]$$

1.4 Equilibrium

I focus on a Markov perfect equilibrium, actions are only a function of payoff relevant state. In this case is where the government understands the effect of its choices on the household allocations and prices while takes futures policies as given. Households are atomistic and take both government current and future policy choices as given as well as prices. I drop the time subscript and adopt to mean the next period value.

1.4.1 Normalization

The state variables are θ, B, K, M, where θ is the exogenous productivity. The values of B,M come from the a mapping between the policy function given by the solution to the governments problem and the state space. In the same vein, K is given by the mapping between the solution to the PSE and the state space. Finally, market clearing is the money demand of the household is equal to the money supply of the government. In this class of monetary models, the ratio of B/M is a sufficient statistic for the government endogenous state. I normalize all nominal variables by dividing by M and denote them with ˆ (hat). Therefore, the state becomes $(\theta, \hat{B}, K)$

Define the set of current government choices to be $s := (D, \hat{B}', G, \mu)$ where D is the default decision, $\hat{B}'$ is the normalized future bonds, G is government consumption, and $\mu = \frac{M'}{M}$ is money growth. Government policy functions is then defined as a mapping from aggregate states to policy choices $S = H(\theta, \hat{B}, K)$

Since HHs take the current and future actions of the government as given, define S to be $S = (\theta, \hat{B}, K, s)$ and the inverse of the normalized price level is $m(S) = \frac{M}{P}$

1.4.2 Private Equilibrium

Definition Private Sector Equilibrium (PSE):: Given aggregate state and current government policies S, the future government policy function $\mathcal{H}$, PSE is a set of functions $(C(S), L(S), \hat{M}^{hh}, K'(S), m(S))$ such that:

1. They are a solution to the the HHs maximization problem subject to budget constraint, and CIA
2. Market clears for money balances, $\int \hat{M}^{hh} = 1$

1.4.3 Recursive Problem

The recursive problem of the government can be described as:

$$V(\hat{B}, \theta, K) = max_{D\in\{0,1\}} \left\{(1-D)V^r(\hat{B}, \theta, K) + (D)V^d(\theta_{def}, K)\right\}$$

where: D is the default decision, B is the bonds held by international investors, θ is stochastic productivity, and K is capital inherited from the previous period. I will denote the policy functions of the household as being functions of the state, e.g. $C(S)$ represents the consumption policy function of households.

The value function for repayment is:

$$V^r(B, M, \theta, K) = max_{\hat{B}', \mu, G} \quad U(C(S), L(S), G) + \beta \mathbb{E}\left[V(\hat{B}', \theta', K'(S))\right]$$

Subject to the feasibility:

$$C(S) + G + \hat{B}m(S) + I = q(\hat{B}', \theta, K'(S))\hat{B}'\mu m(S) + \theta F\left(K, L(S)\right) - \tfrac{\psi}{2}\left(\mu - 1\right)^2$$

and CIA:

$$C(S) + K'(S) - (1-\delta)K + \phi(K, K'(S)) \leq m(S)$$

and where $(C(S), L(S), K'(S), m(S))$ are solutions to the Private Sector Equilibrium associated with the governments choices.

Similarly, the value function for default is:

$$V^d(M, \theta, K) = max_{\mu, G} \quad U(C(S), L(S), G) + \Theta\beta\mathbb{E}\left[V(0, \theta', K'(S))\right]$$
$$+(1-\Theta)\beta\mathbb{E}\left[V^d(\theta', K'(S))\right]$$

$$ST :: C(S) + G + I(S) = \theta_{def} F\left(K, L(S)\right) - \tfrac{\psi}{2}\left(\mu - 1\right)^2$$
$$C(s) + K'(s) - (1-\delta)K - \phi(K_t, K_{t+1}) \leq m(S)$$

where $(C(S), L(S), K'(S), m(S))$ are in a PSE.

Definition Markov Perfect Equilibrium:: A Markov perfect recursive equilibrium is

- Value functions $(V(\hat{B}, \theta, K), V^r(\hat{B}, \theta, K), V^d(\theta_{def}, K))$

- Policy functions $(D, \hat{B}', G, \mu)$
- a PSE, $\mathcal{P}$

such that given the aggregate state and debt price functions q :

1. Policy functions maximize the government problem, given $\mathcal{P}$
2. $\mathcal{P}$ corresponds the value and policy functions
3. current policy functions $\in \mathcal{H}$

1.5 Quantitative Exercise

1.5.1 Brazil

The model is calibrated to Brazil. Brazil is an emerging market with a history of hyperinflation. After a series of reforms in the early 90s, Brazil managed to stop hyperinflation. However, the country continued to borrow in Brazilian Real, experienced inflation at higher rates than some of its neighbors, while also going through a period of relatively good GDP growth. While no default occurred during the 1995-2010 period, CDS rates remained constantly around 5%.

I use the World Development Indicators, and IMF data to get data on output, private and government consumption, capital formation, investment, debt, and inflation. I use Bloomberg to get information on bond prices and CDS spreads.

1.5.2 Parameterization

I calibrate the model to a quaterly frequency, as the data in the empirical section was also quarterly. I use standard functional forms in the literature. Household and government preferences are given by:

$$U = \frac{C^{1-\rho}}{1-\rho} + \frac{G^{1-\eta}}{1-\eta}$$

The production function is taken to be

$$F(K, L) = K^{1-\alpha} L^{\alpha}$$

while the productivity penalty is as in Chatterjee and Eyigungor (2012)

$$\theta_{def} = \theta - max\{0, d_0\theta - d_1\theta^2\}.$$

The capital adjustment cost is quadratic as in Gordon and Guerron-Quintana (2018)

$$\phi(K_t, K_{t+1}) = \phi_0 \times (K'(s) - (1-\delta)K)^2.$$

I take the exogenous productivity to follow an AR(1) process.

The parameters chosen exogenously are as follows:

Variable		Value	Source
U C curvature	ρ	2	Standard
U G curvature	η	4	Galli (2020)
Risk free rate	r	0.002	US treasury
Auto correlation	κ	0.967	Estimated
Output st dev	σ_ϵ	0.023	Estimated
Re-entry	Θ	0.04	Aguiar and Gopinath (2006)
Depreciation	δ	0.006	7% Yearly
Capital share	$1-\alpha$	0.37	Standard

Table 1.3: Exogenous Parameters

Table 1 shows the values of the exogenously chosen parameters. The curvature of the utility function of private consumption is standard in business cycle analysis. The curvature of the utility on the government expenditure is taken from Galli (2020), while the exact value isn't critical to the results, it is important that $\rho \leq \eta$. The depreciation rate is chosen to be consistent with IMF estimates and World Bank estimates, which have ranged from 6% to 11%. However, more work is needed to really get a good estimate of capital depreciation. Gordon and Guerron-Quintana (2018) have a discussion about the role of capital depreciation in sovereign default models and conclude that one-period models will miss their target of investment-output ratio in the steady state without foreign lending.

1.5.3 Solution method

The solution method follows Gordon (2019), Dvorkin et al. (2018),and Galli (2020). I add taste shocks to smooth out the probabilities of the policy functions of the government. Otherwise, the model struggles to converge due to having money and capital. I choose the smallest values such that the model converges.

1.5.4 Targeted Moments

Table 2 shows the variables used to match moments from the data. For example, the discount factor, while low, is still within the previously used range and serves to drive the model towards impatience being the dominant force when borrowing. The taxes are chosen to be exogenously, this can be seen as capturing some political economy forces that do not allow for quick responses in tax rates. Here they are chosen to be lower than the "optimal" so the government has an extra incentive to use seigniorage to raise revenue. The costs do not have an natural way of interpreting the magnitude of the numbers. The default costs seem around what the literature uses, and so do the capital adjustment costs. Given that it is new, the money adjustment cost has no literature to compare with. Arellano et al.

(2020) use Rotemberg adjustment costs and find the value to be a higher value.

Variable		Value
Discount Factor	β	0.98
Taxes	τ	0.18
Money Adj. Cost	ϕ	53
Output Cost	d_0, d_1	-0.47, 0.55
Capital Adj. Cost	Φ	2.8

Table 1.4: Parameters used to match

While all numbers are co-chosen to match the targets, some seem more tied to certain targets. The discount factor pins down the debt service, the capital adjustment costs tracks the standard deviation of investment, and the output cost upon default is responsible for the default probability, which in the data is taken from CDS spreads. The money adjustment cost is necessary for the CPI inflation and (I +C)/GDP.

Target	Data	Model
Debt Service/GDP	0.114	0.129
(I +C)/GDP	0.801	0.749
CPI Inflation	0.107	0.113
C/G	4.228	4.021
Default Prob.	0.05	0.05
σ_I/σ_Y	3.49	4.18

Table 1.5: Model vs. Data Comparison

1.5.5 Untargeted Moments

The model is able to deliver similar correlations to those in the data. The main mechanism is the trade-off between inflation and capital. With that, the realized inflation is correlated with low capital , which itself is highly correlated with high default. The reason is that high past realized inflation implies that in the past the CIA was tight and therefore it created low inflation. Similarly, future high inflation is correlated with low levels of investment, since it means that in the future it is expected to have a tight CIA and therefore low investment. In the short-run, the capital level is more or less fixed because of the capital adjustment cost , while in the long run it can fluctuate more as the capital adjustment costs are spread out. Finally, lower levels of capital are associated with higher levels of default as the repayment capacity becomes lesser, and governments can not keep rolling their over their debts or inflating them away.

Untargeted	Data	Model
$\rho(B, \pi_0)$	0.59	0.48
$\rho(\mathbb{D}_1, \pi_1)$	0.11	0.09
$\rho(\mathbb{D}_5, \pi_5)$	0.75	0.62
$\rho(Y, \mathbb{D}_0)$	-0.62	-0.43

Table 1.6: Untargeted moments

Similarly, the model delivers the correlations found in the empirical section. Since inflation is correlated with its past self, inflation in 5 years informs us about what the inflation in 4 years probably was. Although the model matches the untargeted correlations closely, it does underestimate it in the long run.

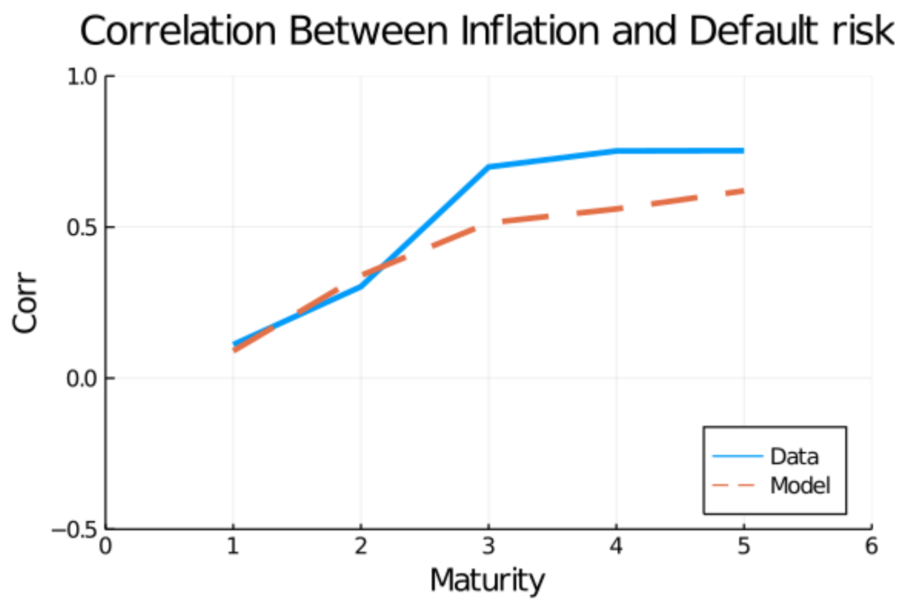

Figure 1.3: Comparing the correlations of expected inflation and expected default

1.5.6 Investment Counterfactual

Finally, the model can be used to estimate if Brazil under invested in this time period. I will solve two different models, one will be the one presented before, and the other one will be with everything the same except the government will have to borrow in real debt instead of nominal. Using the same parameters, I feed the series of productivity shocks to the two different models. I choose the initial level of capital of both models so that the nominal model can match the average investment during this period. Then I compare the investment decision of the households in both cases. This allows me to see what the households would have done if the debt was real.

The model finds that investment would have been on average about 1.1% of GDP higher every year if they would have borrowed in real terms. This result can is driven by the difference in the average level of capital at each steady state. The model with real debt is able to sustain on average more capital as there is more investment as there is less expected

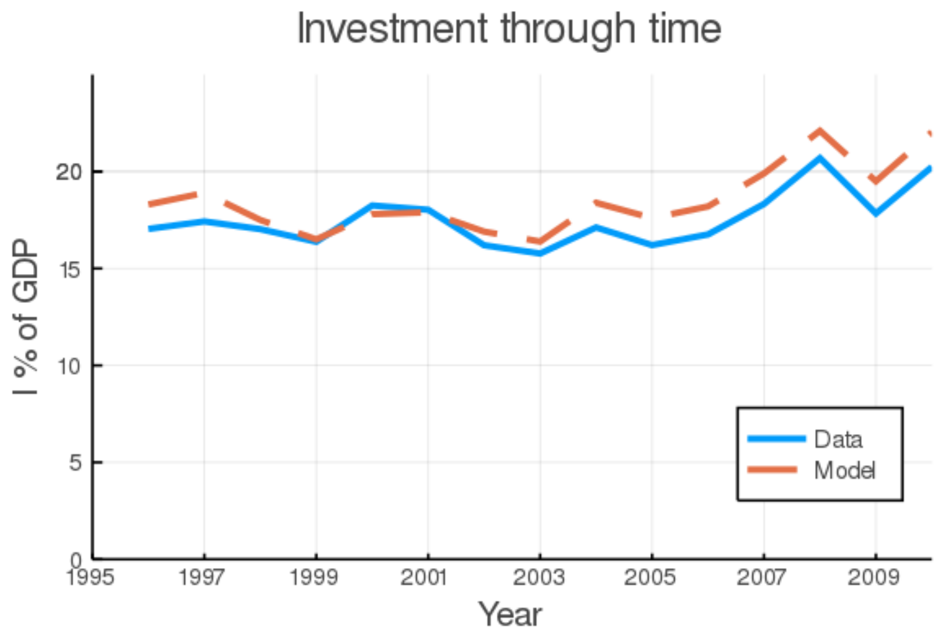

Figure 1.4: Aggregate investment in the data and the nominal model

seigniorage and inflation. The difference between the average steady states is about 15% higher in the model with real debt. It should be noted that the exercise makes the change from all debt being nominal to all debt being real. However, in the data, borrowing is not done only in nominal terms, so this can be thought of as an upper bound. I also run a secondary exercise to determine the change in investment. Instead of choosing the initial capital to match the average investment period, I match the implied price of capital for 1995. I then compare the average investment and find it would have been .8% lower when the debt is nominal. The difference between the two results is mainly driven by the initial capital, and in the first exercise the initial capital is lower and so households choose to invest more as a percentage of output since the return on capital is higher.

1.5.7 Welfare Analysis

There exist trade-offs between nominal debt and real debt. Nominal debt offers the government debt that is more state-contingent, as the price level adjusts to negative shocks, and so they pay more in good times and less in bad times. However, since the government lacks commitment, it also creates the temptation to have higher inflation and lower value of liability ex-post. Additionally, real debt can accumulate more capital since there is less temptation to engage in seigniorage, and so have better output in general. The trade-off includes different levels of capital, debt, and inflation, which makes the welfare analysis not be trivial, or has one debt strictly dominate the other one in terms of welfare.

Using the two models, one for real debt and the other one for nominal. I construct a series of consumption paths using the same parameters as the calibration. With both paths of consumption, I can find the welfare consumption equivalent (CE). I find that CE to be 2.7% higher in the real debt model, meaning the households would have to get 2.7% more of consumption to switch from a world with real debt to the one with nominal debt.

With that in mind, I decompose the change in welfare and see how much of the change is because of the higher capital and how much is due to the extra state contingency.

First, I do a consumption equivalent of the real model and one where the nominal model has the capital decision and money growth of the model with real debt. By keeping the capital and money decision fixed, it allows the second model to enjoy the state contingencies of nominal debt without the temptations. The difference should be attributed to the extra state contingency. I find that the CE would be .92%, meaning the households would have to get .92% more of consumption to give up the state contingency.

Afterward, I do a welfare comparison of a model with real debt, and one with real debt but keeping the money growth and debt decision to be the one of the nominal debt. Neither of the two has state-contingent debt, and the difference would be how much more capital is accumulated in the real debt model. The model finds that the CE would be 3.77%, meaning the households would have to get 3.77% more of consumption to give up the extra capital.

1.6 Conclusion

The paper is able to shed some light into new empirical facts over the correlations between default and inflation. Then I propose a theory about the trade-off associated with inflation and investment, and build on the new mechanism. The model is able to capture the trade-off between inflation and new investment. The model relies on seigniorage being a tool governments use to raise revenue and the incompleteness of the tax instrument, both of which are supported by the data. Finally, after showing that the model can match untargeted moments, I use it to quantify the underinvestment in Brazil between 1995 to 2010.

Chapter 2

Thats a Problem for Future Me: Political Economy and Maturity Structure

2.1 Introduction

In the last couple of decades, governments have started to shift the composition of their debt portfolios from short maturities to longer ones. The shift has not only been in the restructuring towards their existing maturity terms, but also they have started to borrow in longer maturities than before, and in the case of Argentina and Mexico have issued 100-year bonds. Part of the motivation comes from the governments trying to avoid crises related to rolling over their debt while balancing the costs associated with long-maturity bonds. At the same time, recent defaults, Argentina in 2001 and Greece in 2015, have strongly hinted that sovereign default is not only an economic phenomenon but that it also has a strong interaction with the political situation and turnover of the country.

This paper answers the natural question of how does political turnover risk affects the choice of the maturity length. While the literature has mostly focused on the default decision itself or on the amount of debt, this paper studies the ex-ante effects of governments preferring to stay in power. While borrowing using shorter maturities allows for cheaper borrowing and thus more debt, longer maturities can serve as a way of making repayment happen in states of the world where you are no longer in power. With these tensions in mind, I build a model to see how a sovereign might balance short-term and long-term borrowing.

There is a rich connection between political conflict and sovereign default. Hatchondo and Martinez (2010) survey the literature of both theoretical and empirical. They find governments may be willing to repay their debt because it is incentive-compatible with agents in power [1], and also that political turnover can directly induce sovereign default risk. Empirically, they also found a strong and significant connection between political factors and default decisions. For example, Tomz and Wright (2007a) argue that that political turnover plays a large role in the decision to default since around 40% of defaults in their sample occurred in years when the output level in the defaulting country was above the trend. Similarly, Hatchondo and Martinez (2010) find that an event like the turnover of government officials, or higher in political instability, or democratically elected president instead of a parliament system are statistically associated with higher default probabilities. More recent studies like Ballard-Rosa et al. (2021) use the differences in global and local conditions to decompose the drivers of bond price changes and find that while political systems and incentives matter for the pricing of debt and the probability of default, that political cycles are not significant. Brooks et al. (2019) support this finding and go one step

[1] Amador (2012) provides such a case in which borrowing can be sustained with two political parties with the threat of political and international autarky.

further and find that pricing in sovereign debt markets is not systematically associated with elections generally, nor partisan outcomes of certain elections.

In this paper, I present a model of sovereign debt where there exist political economy forces that do not rely on different types of governments or shocks to the discount factor. In the model, the agent in power values consumption more in the periods in which they are in power than those in which they are out of power and face a risk of permanently losing power. Once a government loses power, an identical government with exactly the same preferences replaces it. They are also exposed to a random output shock. I consider a 3-period model to set up, which can easily be extended into an infinite horizon model.

The model can predict similar patterns to those observed in the data. Mainly, the democracy advantage associated with stable democracies is related to the maturity choice of having shorter bonds, while borrowing slightly more. This is studied empirically Ballard-Rosa et al. (2021) where they find that democratic structures facilitate debt rather than electoral events. The model also features stable yet unpredictable spreads around changes of power. In the data, we observe that elections can raise spreads but are hard to predict in what direction they will move after a winner is declared. In the model, this is captured by the fact that since the government going out of power and the replacing one are identical, the change does not cause a jump in prices.

Additionally, the model captures some empirical results around debt crises. Yu (2016) finds that a higher probability of political turnover translates to a higher chance of default [2]. While both Kim et al. (2014) and Arellano and Ramanarayanan (2012) find that the maturity structure of governments significantly shortens during crises, and they rely on shorter maturities. The model captures both of these during crises, broadly defined as

[2] They and others in the literature also find that defaults are associated with higher political turnover

periods of high debt and low output. Intuitively, in these periods, the desire to use debt as a way of transferring resources from future states where the party in power is different to the current state dominates. And so the higher debt that short-term maturity provides is preferred. Similarly, as the level of political disagreement increases or the probability of political turn-over, the default rate also increases during a crisis.

I present two models. First, a 3 period model with full commitment. At each time, the government can choose how much to borrow, facing the natural debt limit. Then considering only the Markov Perfect Equilibrium (MPE), the model is solved through backward induction. It allows me to characterize the complete equilibrium and see how the levels of political economy can change the equilibrium and policy choices of the government in power. Secondly, I will relax the assumption of full commitment and show the game with an endogenous default choice. There I will focus again on MPE, but this time I will have to rely on numerical exercises to show that similar behavior persists

I show that the political economy element makes the model turn into hyperbolic discounting regardless of the level of commitment. It shows the tension between wanting to get consumption now and pay the price later without necessarily changing the price schedule. It also helps link the political science literature to the literature on saving games with long-term assets. Finally, it also adds to the literature that challenges the usual justification for really low beta as a proxy for political economy in the sovereign debt literature.

Another result is that as the gap between the utility in power and out of power increases, they respond with more debt and the composition of debt also becomes more tilted towards longer maturity. As they discount the states of the world in which they are out of power, they discount the future more, and the hyperbolic discounting increases. While the political science literature considers currency and law, maturity is often omitted from the analysis.

The literature on maturity does not take into account political economy forces. The model, by introducing the link between political economy and hyperbolic discounting in sovereign debt, shows that a traditional model can be a misspecified model and overstate the benefits of long-term debt.

When limited commitment is introduced, most of the behavior is maintained for "reasonable" parameters. However, a new force does emerge, the costs of defaulting are also long term, while the benefits of more consumption are immediate. Therefore, the sovereign might default more even if it prefers longer maturity bonds.

As robustness, it can be shown that losing power permanently is model-equivalent to one in which there is a chance in the future of regaining power. None of the numerical results rely on the finite period and can be extended to an infinite horizon setting while preserving all the main results. Future research is needed to see the quantitative importance and infinite horizon proofs.

The road map for the rest of the paper will be: First, a simple 3-period model will be introduced to see a simple exercise of how the forces work. Solving the model will allow comparing how political pressure can distort future discounting more than just lowering the discount factor. Then, a more complete model can be solved and we can compare its behavior with that of the data.

2.2 Model

The model is a small open economy with stochastic output Y is inhabited by a continuum of identical individuals. There are 3 periods indexed by $t \in \{1, 2, 3\}$. The economy starts with some initial level of debt B_1 and one of the agents in power. The agent has a probability

$(1-\lambda)$ of staying power and (λ) of being replaced by another individual. [3] At any time, the agent in power can choose to default on its debt obligations and face a default penalty and remain in autarky for the remaining periods. Assuming that the country is in good standing, at period t=1, the agent in charge will choose bonds B_2, which mature in period 2, and B_L, which mature in period 3. At period t=2, the agent in charge will choose bonds B_3, which mature in period 3. Finally, borrowing is done from risk-neutral outside lenders that make 0 profits in expectation.

Assumption 1:(Present Bias) An agent enjoys a utility flow $u(c)$ when in power and a utility flow $\theta u(c)$ when not in power, where c is consumption and where $0 < \theta < 1$.

$\theta < 1$ implies that the government in power is more impatient. It creates a disagreement between those in power and out of power, where the out of power wish for less borrowing while the in power want to borrow more. It leads to a present-bias time inconsistency problem.

2.2.1 Full Commitment

First, we can solve the model with full commitment [4]. A non-negative consumption constraint will imply a natural debt limit when agents are borrowing.

Under this we have that at T=3 the value function for the party in power is:

$$V_3(B_3, B_L, Y_3) = U(Y_3 - B_3 - B_L)$$

and for the out of power

[3]Notice that this ensures that once an agent has left power, the probability of regaining power is 0, so its effectively permanently losing power. This assumption can be relaxed so that there are finite many agents and there is a probability of regaining power, and as in Cao and Werning (2016), it can be shown that they are equivalent

[4]This is akin to having the default costs being $-\infty$

$$V_3^{out}(B_3, B_L, Y_3) = \theta U(Y_3 - B_3 - B_L)$$

For period T=2, we have that for the party in power:

$$V_2(B_2, B_L, Y_2) =$$

$$\max_{B_2} \quad U(Y_2 - B_2 + q_3 B_3) + \beta \mathbb{E}\left[(1-\lambda)U(Y_3 - B_3 - B_L) + \lambda\theta U(Y_3 - B_3 - B_L)\right]$$

$$= \max_{B_2} \quad U(Y_2 - B_2 + q_3 B_3) + \beta \mathbb{E}\left[(1-\lambda) + \lambda\theta\right] U(Y_3 - B_3 - B_L)$$

And similarly for the out of power the utility becomes,

$$V_2^{out}(B_3, B_L, Y_2) = U(Y_2 - B_2 + q_3 B_3) + \beta\theta \mathbb{E}[U(Y_3 - B_3 - B_L)]$$

Finally for T=1,

$$V_1(B_1, Y_1) \max_{B_2, B_L} \quad U(Y_1 - B_1 + q_2 B_2 + q_L B_L) + \beta \mathbb{E}\left[(1-\lambda)V_2(B_2, B_L, Y_2) + \lambda\theta V_2^{out}(B_3, B_L, Y_2)\right]$$

$$= \max_{B_2, B_L} \quad U(Y_1 - B_1 + q_2 B_2 + q_L B_L) + \beta\left((1-\lambda) + \lambda\theta\right) \mathbb{E}_{Y_2|Y_1}\left[U_2(\circ)\right] +$$

$$\beta^2 \left((1-\lambda)^2 + \lambda(2-\lambda)\theta\right) \mathbb{E}_{Y_3|Y_1}\left[U_3(\circ)\right]$$

First notice that the discounting in period 1 isn't just geometric, but also has created a quasi-hyperbolic discounting. The model builds on the discrete-time quasi-hyperbolic models of Laibson (1997), Aguiar and Amador (2011), and others.

2.2.2 Equilibrium

I focus on a Markov Perfect Equilibrium (MPE). The model is solved through backward induction, starting at T=3 and then taking the actions as given in T=2, and similarly for periods 1 and 2. In this case, is where the government understands the effect of its choices on the future's government borrowing decision in two ways, one is through the natural debt limit and the second is through risk aversion.

Definition Markov Perfect Equilibrium:: is a set of functions $B_3^*(B_2, B_L, Y_2)$,$B_2^*(B_1, Y_1)$ and $B_L^*(B_1, Y_1)$ such that

- Policy function $B_3^*(B_2, B_L, Y_2)$, such that it maps from B_2, B_L, Y_2 to argmax of $V_2(B_2, B_L, Y_2)$

- Policy functions $B_2^*(B_1, Y_1)$ and $B_L^*(B_1, Y_1)$ such that given $B_3^*(B_2, B_L, Y_2)$, it maps from B_1, Y_1 to argmax of $V_1(B_1, Y_1)$

We can then characterize the equilibrium by

$$U_2' q_3 = \beta \left[(1-\lambda) + \lambda\theta\right] \mathbb{E}\left[U_3'\right] \tag{2.1}$$

$$U_1' q_2 = \beta \left[((1-\lambda) + \lambda\theta) - \left[\frac{(\lambda^2\theta + \lambda^2\theta^2)}{[(1-\lambda) + \lambda\theta]}\right] q_3 \frac{\partial B_3}{\partial B_2}\right] \mathbb{E}_{Y_2|Y_1}\left[U_2'\right] \tag{2.2}$$

$$U_1' q_L = \beta^2 \left((1-\lambda)^2 + \lambda(2-\lambda)\theta - \left[\lambda^2\theta + \lambda^2\theta^2\right] \frac{\partial B_3}{\partial B_L}\right) \mathbb{E}_{Y_3|Y_1}\left[U_3'\right]) \tag{2.3}$$

Equation 2.1 is the classic Euler equation at time 2, with the discount factor being $\beta\left[(1-\lambda) + \lambda\theta\right]$. However, because of the existence of quasi-hyperbolic discounting, there is a disagreement on how to discount between period 2 and period 3. Equation 2.3 is extremely similar to Equation 2.2, they both are composed of the marginal utility at period one must be equal to the marginal at later periods with a wedge that is composed of two parts. Equation 2.2 has the short-term discount factor of $\beta\left[(1-\lambda) + \lambda\theta\right]$, but then the marginal propensity to consume out of cash-on-hand is the second term. It explains that you would like to spend money in the current period, rather than the ones that you are not in power in the future, therefore it acts as a greater wedge in the Euler equation.

2.2.3 Results and proofs discussion

Lemma 1:$\frac{\partial B_3}{\partial B_L} < 0$

A quick lemma, it just says as you enter period 2 with more debt, then you can borrow less. It will help with the propositions later on. The proof through contradiction is straight forward from 2.1, as if at time 2 you increase B_L, you are not changing $U_2' q_3$, but you do change $\mathbb{E}_{Y_3|Y_1}[U_3'])$ since you repay more in period 3. Therefore, as B_L increases,B_3 needs to decrease.

Similarly, 2.1 bounds $\frac{\partial B_3}{\partial B_2}$

Proposition 1: Let Y be i.i.d. uniform, $U = \frac{C^{1-\sigma}}{1-\sigma}$, and $B_3^*(B_2, B_L, Y_2)$,$B_2^*(B_1, Y_1)$ and $B_L^*(B_1, Y_1)$ be an MPE. Then as θ decreases, $B_2^*(B_1, Y_1)$ and $B_L^*(B_1, Y_1)$ increase.

Proposition 1 is simple yet lengthy. As the political economy parameter decreases, meaning the agents care less about what happens when they are out of power, the amount of borrowing goes up. It follows from the first-order conditions and some algebra. Intuitively, what is happening is that θ acts as a way of discounting the nodes of the game in which the agent is out of power, and so it discounts the future. As the government gets more impatient, it borrows more.

Proposition 2: Let Y be i.i.d. uniform, $U = \frac{C^{1-\sigma}}{1-\sigma}$, and $B_3^*(B_2, B_L, Y_2)$,$B_2^*(B_1, Y_1)$ and $B_L^*(B_1, Y_1)$ be a SPE, and $\beta = q = \frac{1}{R}$. Then as θ decreases, $B_2^*(B_1, Y_1)$ increases slower than $B_L^*(B_1, Y_1)$ increases.

Proposition 2 is the main result of the paper. As the political economy parameter decreases and the agents care less about the future, they borrow more against it. The two forces that work with it are that the fact that you care less about the future reduces the incentive to engage in precautionary savings. Secondly, the government in power discounts the future more heavily than the outside lenders, even more so the far future than the short-term one.

Both of these forces push for more long-term borrowing.

Moreover, note that the more you discount the future, the more debt you have and carry over. It is independent of the existence of political disagreement in the economy. It is also is consistent with empirical results found in Political science literature. Furthermore, we can compare other results from the literature and compare them to model predictions. They match key patterns like democracies borrow more, political turnover leads to more debt, and elections do not change the borrowing behavior. [5]

2.3 Numerical Example with default

Now, we can solve the model without full commitment. It will look very similar to the full commitment model but with a default decision at every stage. If a default happens, there is an exogenous default cost, $d(Y)$, while in default, and all future governments are excluded from international markets. Apart from the exogenous default cost on the economy, the ruling party also has a higher probability of losing power ($\lambda_D > \lambda$) if the country is in autarky. Finally, a change in power doesn't change its standing in international markets.

We have the value function at T=3 for the party in power is:

$$V_3(B_3, B_L, Y_3) = \max_{D_3 \in \{0,1\}}(1 - D_3)U(Y_3 - B_3 - B_L) + D_3 U(Y_3 - d(Y_3))$$

and for the out of power

$$V_3^{out}(B_3, B_L, Y_3) = \theta(1 - D_3)U(Y_3 - B_3 - B_L) + \theta D_3 U(Y_3 - d(Y_3))$$

For period T=2, we have that for the party in power:

$$V_2(B_2, B_L, Y_2) = \max_{D_2 \in \{0,1\}}(1 - D_2)V_2^R(B_2, B_L, Y_2) + D_2 V_2^D(Y_2)$$

[5] see: Ballard-Rosa et al. (2021), Yu (2016), and Hatchondo and Martinez (2010)

and V_2^D and V_2^R are defined as:

$$V_2^R(B_2, B_L, Y_2) = \max_{B_3} \quad U(Y_2 - B_2 + q_3 B_3) + \beta\left[(1-\lambda) + \lambda\theta\right]\mathbb{E}V_3(B_3, B_L, Y_3)$$

$$V_2^D(Y_2) = U(Y_2 - d(Y_2)) + \beta\left[(1-\lambda_D) + \lambda_D\theta\right]\mathbb{E}U(Y_3 - d(Y_3))$$

And similarly defined for the out-of-power party.

Finally, for T=1, define the repayment value function,

$$V_1^R(B_1, Y_1) = \max_{B_2, B_L} \ U(Y_1 - B_1 + q_2 B_2 + q_L B_L) +$$

$$+\beta\mathbb{E}\left[(1-\lambda)V_2(B_2, B_L, Y_2) + \lambda\theta V_2^{out}(B_2, B_L, Y_2)\right]$$

$$V_1^D(Y_1) = U(Y_1 - d(Y_1)) + \beta\mathbb{E}\left[(1-\lambda_D)V_2^d(Y_2) + \lambda_D\theta V_2^{out}(Y_2)\right]$$

The introduction of default actually makes the quasi-hyperbolic discounting worse. It affects the way that the agent in power discounts the future. It makes being in default less attractive; specifically, since it makes it more likely to lose power, ex-ante you discount the branch of the tree more. Additionally, it introduces a new tool for taking resources from the future. In equilibrium, if an agent decides to default, his within-period consumption must rise [6]. Therefore, defaulting is gaining some utility while in power, while the costs are paid in part when you expect not to be in power. Below we will discuss the implications for the model and what way these two forces impact the results.

2.3.1 Parameterization

I try to use the standard utility functions and reasonable parameters.

[6] This works in the exact way that Arellano (2008a) works, if the consumption were not to rise then the agent would be better off not defaulting since the continuation value of being in good standing must be at least weakly greater than being in default

I use standard functional forms in the literature. Preferences are given by:

$$U = \frac{C^{1-\sigma}}{1-\sigma}$$

while the productivity penalty is as in Chatterjee and Eyigungor (2012),

$$d(Y) = Y - max\{0, d_0 Y - d_1 Y^2\}.$$

I take the exogenous productivity to follow an AR(1) process.

The parameters chosen exogenously are as follows:

Variable		Value
Discounting	β	.98
U C curvature	σ	.5
Risk free rate	r	0.02
Prob. of losing power	λ	0.45
Prob. of losing in Default	λ_d	0.55
Auto correlation	κ	0.2
Output st dev	η	0.053
Output st dev	η	0.053
Output Cost	d_0, d_1	-0.57, 0.75

Table 2.1: Exogenous Parameters

2.3.2 Results

We can solve this model with different levels of θ and see how different levels of political spending disagreement the party in power reacts.

The first point is that as we decrease θ we get that there is more borrowing at T=1, B_2 and B_L go up. This is a numerical analog of **Proposition 1**.

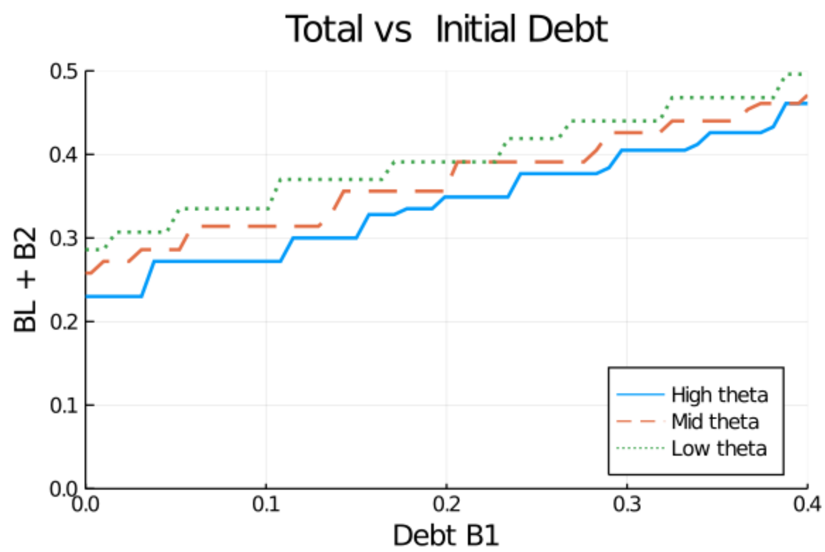

Figure 2.1: The total stock of debt at time=1 ($B_L + B_2$), while varying the initial level of debt. Keeping everything else fixed for different levels of θ. Here High=.9 , Mid= .85, Low= .8. Higher levels of disagreement are associated with higher debt.

Additionally, the composition of debt becomes more tilted towards longer maturities. We can measure that by looking at $\frac{B_2}{B_L}$ and seeing how for different levels of θ it decreases. Intuitively, what is happening is that as the future gets discounted more and the hyperbolic disagreement increases, the party-in-power's incentive to borrow increases and more so in the long term. From their perspective, borrowing guarantees spending in times they are in power, and repayment happens in states they care less about.

One surprising result is that, for a fixed level of debt, the lower θ the less likely an agent is to default. Because of the higher turnover in the states in which you are in default, the punishment of default increases as political disagreement increases. If we define $B(\hat{Y})_1$ as the level of initial debt for which an agent is indifferent between default and repayment at T=1, then $B(\hat{Y})_1$ is increasing as θ decreases. We can also see the same effect in the probabilities of default at T=1 for different levels of θ.

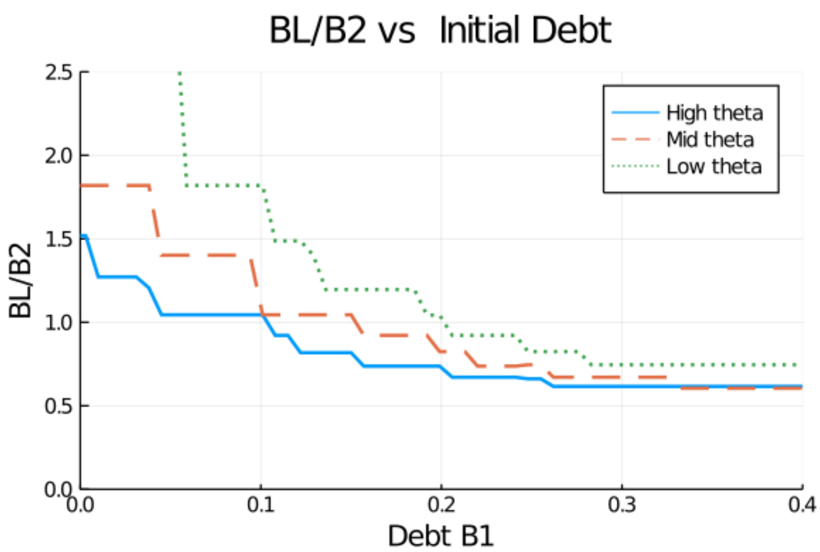

Figure 2.2: The ratio of long term debt to short term debt, while varying the initial level of debt. Keeping everything else fixed for different levels of θ. Here High=.9 , Mid= .85, Low= .8. Higher levels of political disagreement lead to more long term debt.

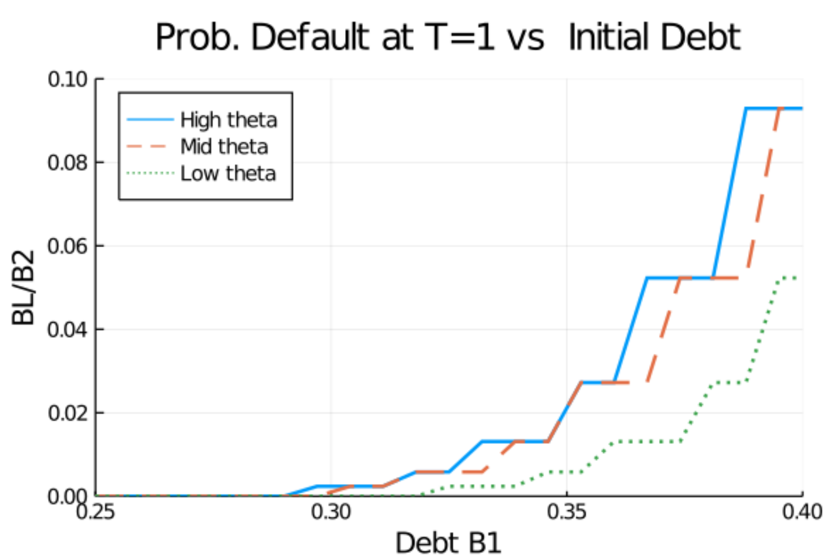

Figure 2.3: The probability of defaulting in period 1 as a function of initial level of debt. Keeping everything else fixed for different levels of θ. Here High=.9 , Mid= .85, Low= .8. The higher disagreement, the higher the default probability

Output default costs play an interesting role in the model. If the costs are too low, then the previous results are reversed and higher disagreement can lead to higher rates of default. Since higher disagreement (lower θ), leads to a higher discount of the future. As we mentioned previously, default leads to higher consumption in the present period, but the costs are later. Therefore, more discounting leads to more temptation to default.

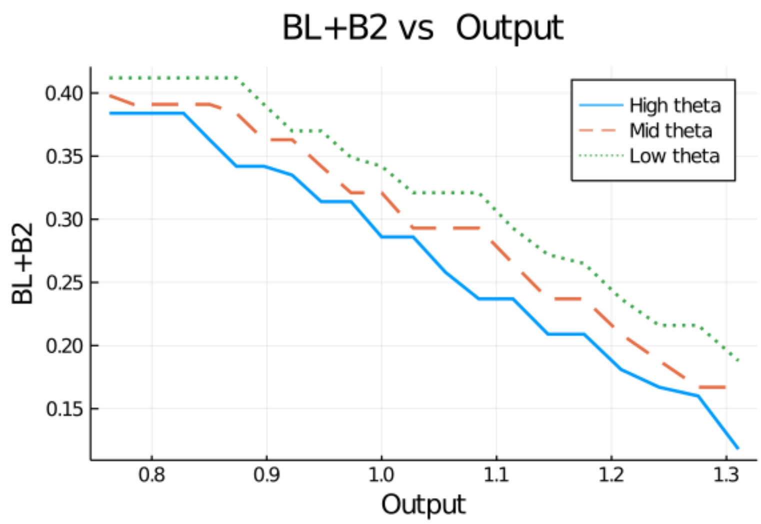

Figure 2.4: The total stock of debt in period 1 as a function of initial output. Keeping everything else fixed for different levels of θ. Here High=.9 , Low= .8. As you have more output, you borrow less

While in non-default times, disagreement can lead to bonds having longer average maturity and less default, the motive to use default as a way of anticipating consumption from states of the world in the future where the agent is not in power flips this behavior around times of debt crisis. We can model a debt crisis as a high initial debt level relative to its output, and as the degree of political disagreement grows maturity becomes actually shorter. The consumption relief from defaulting becomes grows faster and the future punishment for default decreases. We see similar patterns in the data, where as countries go through a debt crisis , they borrow more in short-term bonds and it becomes a back-loaded schedule.

Chapter 3

Risk Premia in the Sovereign Default Literature

3.1 Introduction

Countries borrow, and most of the time they repay their debts. However, other times they don't, which usually starts a long process of renegotiation. For the most part, this is a well-understood problem, and investors are aware of the risks they are taking. However, how much do countries have to pay to compensate for the risk raises a different question. Historically, most empirical and theoretical papers of sovereign yields assume that investors are risk-neutral and so the rate the compensation on sovereign bonds should only be the expected probability of default taking into account recovery rates. When the literature has tested the risk-neutral assumption, it has been thoroughly rejected. The question arises of what is the premia that countries have to pay risk-averse lenders and how does that affect sovereign debt decisions?

The risk aversion of lenders can play an important and straightforward role. As Tomz and

Wright (2007b) finds that countries tend to default when output is low, if lenders needs are correlated with the local business cycles, then the states with higher risk are also those where the lenders want the most insurance. This can be created by the lenders either being local or if the lenders' main country has a business cycle that matches up with the local one. All of this creates a situation where the time component of sovereign borrowing becomes ever more important.

3.2 Empirical Work

The start of answering these questions was clearly empirical in the literature. As the quantitative sovereign default models were taking off, Gonzlez-Rozada and Yeyati (2008) simultaneously studies the factors of emerging market spreads in the data. They find that they are largely driven by exogenous factors and events, and highlight the importance of risk appetite on sovereign spreads. Similarly, Verdelhan and Borri (2010) look at the JP Morgan EMBI and instead of finding 0% excess return like a risk-neutral model would imply, they find returns ranging from with returns ranging from 4% to 15%. Secondly, they find that a high correlation between previous foreign bond performance and U.S. market returns was a predictor for higher average sovereign excess returns. Indicating that investors are being compensated for taking aggregate risks. The second finding is complemented by Broner et al. (2013a), who find that capital flows in emerging markets collapse during recessions, causing an outflow of foreign funds of foreigners. Longstaff et al. (2011) studies the importance of the risk premium on sovereign bond pricing. They look at sovereign credit default swaps (CDS) on the bonds of 26 countries to decompose sovereign credit spreads into their risk premium and default risk components. On average, they find that the risk premium encompasses about one-third of the credit spread, with it becoming more important during the Great Recession. Others [1] have also found similar results linking global conditions and risk premia and sovereign debt. The importance of risk premia for pricing sovereign debt has become an accepted fact.

The literature on sovereign debt has largely focused on local factors rather than the aforementioned global components found in the empirical work above. Lizarazo (2013) focuses only on how international risk aversion can change debt and default decisions and therefore change how risk premium affects sovereign spreads. It incorporates risk-averse international investors[2], with decreasing absolute risk aversion preferences (DARA), into a small open economy endogenous default model. Unsurprisingly, DARA preferences by the lenders imply that default risk, capital flows, and bond spreads are a function of wealth and risk aversion of the bond investors. On the other hand, Seoane (2019) discards risk-averse lenders and rather focuses on aggregate income volatility changes sovereign spreads. And once again, much like in the data, the model can produce a positive correlation between sovereign spreads and aggregate income volatility. Finally, Guimaraes (2011) looks in a theoretical model how the volatility of world interest rates affects domestic default and borrowing decisions.

The most complete answer so far has been Johri et al. (2020), who try to deal with the issue by incorporating variations in the world interest rate, as a proxy for changing global factors and risk premium, in a classical in an equilibrium model of sovereign default. They combine risk-averse lenders and a risky world interest rate in a standard long-term debt model. The model can find up to a half of the positive comovement between world interest

[1] See: Hilscher and Nosbusch (2010), Akinci (2013), Maltritz (2012), Uribe and Yue (2006) amongst others

[2] The existence of risk-averse lenders can be thought about as being the result of market segregation as in Vayanos and Vila (2021)

rate and emerging markets sovereign spreads.

3.3 Monetary Policy and Risk Premia

The relationship between risk premium and monetary policy can be challenging as time variation in risk premia challenges the transmission mechanism of monetary policy. Central banks usually control the short-term rates, while longer-term interest rates are usually the result of investors and households. With this in mind, Wright (2011) builds a panel of zero-coupon nominal government bond yields for ten industrialized countries that cover from January 1990 to May 2009 and estimates the risk premia or term premia. He finds that the term premia have declined globally over the sample period due to commitment to monetary policy. But for developing countries that face sovereign default risk, it is an open question. For countries with sovereign default risk, the question of monetary transmission is more complicated. Countries and central banks need to balance monetary policy with the effects of spreads and implicit default depending on currency composition. Emerging markets are usually thought to lack commitment in both the repayment of debt and in monetary policy. Jeanneret and Souissi (2016) try to empirically test if countries are more likely to default in foreign currency debt rather than local one currency debt. They can show that simultaneous defaults on foreign and local currency bonds occur frequently. Albeit, they also find evidence that a larger banking sector would deter default on domestic debt, and that high levels of inflation happen simultaneously with local currency defaults. And finally, they use VIX to proxy global factors and find that while it might play a role in spreads, it does not affect the differential treatment in terms of default based on the currency denomination of the bonds.

Inflation can help reduce the real debt burden during bad times. The desire to use locally denominated debt as a way of achieving the desired level of state-contingency clashes with investors. Investors can worry about the lack of commitment from the government to monetary policy, and since investors are risk-averse, they will also require a premium to insure governments in states of the world where they will also be in bad times. This tension is exactly what Du et al. (2020) explores. They find that empirically the governments who benefit the most from the state-contingency of local currency debt shift their portfolio to borrow more in foreign currency. They show that since the government lacks commitment, ex-post, they choose excessively counter-cyclical inflation; in turn, it leads to rises in the ex-ante spreads of locally denominated debt since lenders are risk-averse. Finally, they present some evidence that the cross-country differences between local currency bond spreads are correlated with the governments inflation credibility by studying newspaper word counts.

The link between monetary policy and risk premia in countries with default risk is still understudied. While a lot of the literature might include risk-averse lenders, they also focus exclusively on a single asset, usually real rather than nominal debt, which then limits the role of risk aversion in either portfolio choice or in how local monetary policy can be transmitted. In future work, merging the work of the quantitative sovereign default literature with the portfolio choice of Du et al. (2020) can lead to a more robust understanding of the dynamics at play and what role do they play. Similarly, while papers like Bianchi and Mondragon (2019) studying the ways that lack of monetary policy can affect bond prices and default crises, there is a gap in our knowledge of how default crises and risk premia can constraint or change a governments ability to use monetary policy during downturns.

3.4 Fiscal Policy

A growing debate in the empirical literature is taking place on whether constraints on fiscal policy such as fiscal rules can lower sovereign spreads [3]. Heinemann et al. (2013) amongst others argue that fiscal rules can restore some reputation to countries that lack a history of stability, and so decreasing the risk premium on their bonds. And the IMF fiscal sustainability framework uses bond prices to guide their level of observance. In general, the risk premia can be a two-way street. As a country can set up fiscal limits to commit to some future fiscal policies, then the risk premia the country faces can be lowered. Similarly, the presence of a high-risk premium can cause a government to maintain a sustainable equilibrium with fiscal limits, as the punishment is increasing on the risk premia since high-risk premia can make the lack of fiscal commitment to be more costly.

Bi (2012) studies the effects of having an endogenous fiscal limit resulting from the Laffer curve on sovereign risk and risk premia. The model generates the dynamic that as fiscal expenditures grow, lenders anticipate the government being forced to default because of the fiscal limit, and as such start to increase the ex-ante risk premia which can lead it to a crisis. A one-time cut in turn does not change the trajectory but rather a credible change in expenditure policy is needed. Martinez et al. (2020) builds on this and studies fiscal rules through the lens of a quantitative sovereign default model. They define "A debt-brake (spread-brake) rule imposes a ceiling on the fiscal deficit when the sovereign debt (spread) is above a threshold." Their main finding is that while both archive similar welfare gains for individual countries, in the case of a union, like the EU, spread brakes generally dominate.

[3]The majority of the literature has focused on the US, at the federal and state level, and Europe, while not including developing countries. For a more in-depth discussion see: Dahan and Strawczynski (2010) and Heinemann et al. (2013)

This second result is partially generated by their modeling of the time-varying world interest rate. This is because the spread-brake is informative about the price that they have to pay and the expectations that foreigners see, while a debt brake only looks at the total stock rather than the price of the marginal debt.

On the other side of the coin, Debrun and Kinda (2016) find that high-risk premia can trigger fiscal adjustments in developing countries. The intuition is that as the risk premia rise, debt service becomes more expensive and so in bad times lowers spending too much, which then motivates governments to embark on fiscal consolidation beyond what is strictly necessary to secure solvency, as a way of insurance against remaining in that situation.

Generally, the intersection of fiscal policy and risk premium is another area that could use more research. Very little of it focuses on emerging markets or on measuring the effects that have been found. It is a common topic of policy discussion when sovereign crises happen and are also often found in IMF recommendations on how to deal with them. However, their effects on highly indebted countries are clear neither in the data nor the theory, especially its effect on sovereign pricing.

3.5 Maturity and Term Structure

Governments organize their maturity structure depending on the forces facing them at any given period, either externally or on their internal want to change incentives or hedge risk. Both Broner et al. (2013b) and Arellano and Ramanarayanan (2012) find empirical evidence of countries paying a higher risk premium as the maturity of the bonds increases. Additionally that during a crisis, the gap between risk premiums goes up, and as a result governments shift the composition of their portfolio towards shorter maturities. Both papers even argue that the change in default probabilities during a crisis can account for the inversion of the yield curve observed in the data during crises. The disagreement of the two papers comes in how they view this pattern emerging; Broner et al. (2013b) see this as part of the general paradigm it reflects changing risk premia, while Arellano and Ramanarayanan (2012) focus on the governments and focus on hedging motives.

Broner et al. (2013b) present a really simple model of risk-sharing between a government and risk-averse lenders. Risk-averse lenders are a key feature as it will lead in general to higher borrowing costs in long-term bonds than in short-term bonds. And the key insight of as a crisis occurs, the volatility increases and so lenders demand a higher price to hold bonds for longer horizons. The increase in costs makes the government reduce the amount of long-term debt and increases the likelihood of a rollover crisis.

In the more demand-side argument, Arellano and Ramanarayanan (2012) focus on the government balancing the hedging provided by long-term debt and the incentive provided by short-term debt. The trade-off structure between the relative incentive benefit of short-term debt and the hedging benefit of long-term debt changes through the business cycle. During bad times, there is more of a benefit of repayment incentive rather than hedging. They also do take into account the risk premia and extend their benchmark model to include it. The risk premia change the equilibrium bond prices and provide a better fit to the data. However, the trade-off between insurance and incentives dominates in shaping the bond prices.

The empirical literature is also mixed in its findings. While mostly focusing on developed countries, Cohen et al. (2018) find that changes in the term spread have tended to be driven by the underlying rates rather than by changes in risk premia. It gives credence to Arellano and Ramanarayanan (2012) since they do not need risk premia to be moving. However, by using a larger sample of countries, Calice and Zeng (2021) find that changes in the term premia can predict changes in CDS rates even when controlling for conventional macroeconomic factors. In turn, it gives some evidence of the Broner et al. (2013b) mechanism at work, since in this case, it is lender behavior that changes the country behavior and risk absorption.

3.5.1 Term Structure and Currency Carry Trade

One of the big distinctions between advanced economies and developing countries is the currency in which they issue debt. While developed countries issue most of their bonds in local currency, developing economies rely a lot more on bonds that are issued in foreign currency, mostly U.S. dollars. As we covered, this can have a significant impact on how much risk hedging governments can do.

Lustig et al. (2019) find that in developed countries the term premia, which increases with the maturity of the bonds, offset the currency risk premia, which decreases with maturity. However, these results only hold for developed countries. Because of the presence of default risk in developing countries, we observe the opposite effect: as bond maturity increases, low-interest-rate currency bonds have larger returns in dollars than those denominated in high-interest-rate currencies. Borri and Shakhnov (2018) find this by using currency carry trade strategies implemented with Treasury bills and Treasury bonds for series of emerging markets. They also decompose the effects into currency, default, and term premia. They find that, for all countries, the term premium is responsible for the change in returns. The default premium is positive, but mostly does not change with the bond maturity, therefore so it contributes to the level but not the slope of the returns. The result really highlights the strong relationship between currency and bond risk premia.

3.6 Restructurings

Since the risk aversion of lenders can rationalize larger and more volatile spreads, it would be foolhardy to assume that it wont play a role in renegotiating debt after default. In general, restructuring sovereign debt is highly inefficient, costly, and protracted. It is estimated that a country leaves default even more indebted, creditors suffer a loss of about 40%, and they take around 7 years to resolve (Benjamin and Wright (2009)). With the risks and untimeliness associated with renegotiation, it would seem that a risk-averse agent would highly discount any payoff associated with going through all of it.

The world interest rate can affect default in two main ways: borrowing costs and expected renegotiation terms after default. Almeida et al. (2021) take the view that in renegotiation, high rates lead to lenders to accept higher haircuts in exchange for resuming payments. The higher rates act as a higher discount for the future, so they are more willing to take less today than wait for more later. However, their model only includes risk-free lenders with shocks to the risk-free rate. The inclusion of risk-free lenders could add to their model as it would capture the mechanism that during bad times the lenders are more willing to take larger haircuts. while making ex-ante, more likely to default and so the risk premia would increase even more.

The only paper to my knowledge that directly deals with the effects of risk-averse creditors on restructuring delays and haircuts is Asonuma and Joo (2019). In it, they try to link the specific creditors and the people negotiating to different debt crises. They find that when creditors have high GDP growth in their home countries, renegotiations have larger delays and smaller haircuts. It is a puzzling finding as it means that lenders are willing to miss the high home growth to receive better terms. They can create a theoretical model of sovereign debt with endogenous defaults where both lenders and borrowers are risk-averse. They also have a multi-round debt renegotiation when default does occur. The main mechanism of the paper is the consumption-smoothing motive of the creditor through the recovered debt payments after a successful renegotiation. Therefore, when a creditor faces a good income shock, they want to transfer some of that utility into the future states to insure themselves against bad states of the world. While being an important step in understanding the ways that risk aversion interacts with renegotiation, the paper does miss some important things which future work should build on. First, in the empirical part, they focus on matching the creditors to GDP growth. While it is a novel contribution, it is not clear why it is an improvement over the standard measures for world risk aversion. For example, the authors could have used the spreads in government bonds and corporate bonds as a better proxy for risk aversion. Similarly, it is not clear why the preferences of the creditor committee chair" are the ones that are represented rather than some weighted measure of all creditors. Their modeling choices also overstate the importance of their mechanism. The lenders are assumed to be very restricted in their savings options, as the only way of saving is through lending to the government. Thus, in default, accepting a settlement is akin to cashing out their savings. By looking at their regressions, I also worry that what the model is actually capturing is the international business cycle, where interest rates and income negatively co-move. The higher income can also be explained as being states of the world where there are low-interest rates, which as Almeida et al. (2021) point out, can lead to lower haircuts and more patience. Future work should try to disentangle the income effect and the risk aversion effect. A more plausible model would seem to be a risk-averse lender would take a worse deal in bad times, while also increasing the delays described in Benjamin and Wright (2009).

3.7 Conclusion

In this chapter, I explored the ways that risk premia and sovereign debt can interact. First, defining what risk premia is apart from default risk premia. Then we dove into the empirical literature to see the current evidence of both its existence and the way investors price it. Then I explored the interactions that risk premia can have with monetary policy: since monetary policy lowers repayment in bad states, it increases risk; in turn, it reduces the effectiveness of monetary policy for developing countries. On the other hand, risk premia can act as a disciplinary mechanism on a country's fiscal policy. The time component of risk premia is not straightforward as multiple explanations clash while the data is unclear. Finally, we see how risk premia can have effects after default occurs and show promising research avenues in the literature.

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