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The Bribe Rate and Long Run Differences in Sovereign Borrowing Costs*

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Abstract

The average cost of borrowing on international financial markets varies widely from nation to nation even after controlling for the varying levels of indebtedness of their governments. This suggests that markets assign country specific default risk assessments. In this paper we focus on one natural source of this difference – the quality of their institutions. We begin by showing that the average sovereign spread is positively related to the average percentage of a government contract that must be given as a “gift” in order to secure the contract. We then build a sovereign default model where the government is constrained to use corrupt bureaucrats to deliver public goods and services and manage its accounts. Using the gift data as a measure of the public resources diverted by bureaucrats, and the Rule of Law index as a measure of institutional quality, we estimate the diversion policy of bureaucrats and use it to calibrate our model to international data. We use the model to generate an artificial international data set where countries vary only in the institutional quality parameter. Running the same regressions on our artificial data, we find that average spreads are positively associated with the bribe (gift) rate and with average debt levels. The model implies that when revenue streams are low, a benefit of default is that public services net of bureaucratic diversion actually increase. Since the net gain in public services obtained by defaulting is decreasing in the level of institutional quality, international lenders assign lower default risk to those countries.

JEL classification: D73, F34, F41, G15, H63.

Keywords: Sovereign default, country spreads, bureaucratic corruption, bribes, provision of public goods.

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1 Introduction

Emerging nations pay widely differing interest rates on their sovereign debt when these rates are averaged over many years. Figure 1 reports the average spread of sovereign bonds for various nations contained in the EMBI Global Index over U.S. ten year treasuries averaged between 2006 - 2015. Over this period, the sovereign spread ranges from a high of over 1470 basis points for Ivory Coast to a low of 52 basis points for Thailand. It would appear that different nations are assigned higher or lower default risk on average.

Figure 1: **Average sovereign spreads in basis points: 2006-2015**

In this paper we wish to explore one reason why international debt markets assign different long term default risk assessments to different countries - the quality of their institutions, specifically those related to the public budget which differ widely across nations and are fairly stable over long periods of time. The idea is that when legal and judicial institutions are weak

and policing, journalistic and accounting oversight are ineffective, then it is easier to steal money from the public purse. We will provide evidence that average spreads are higher in nations that display greater rates of diversion of public funds. We will then build a model to explain why this correlation exists in the international data. Our focus on long term differences in borrowing costs and international differences in institutions that persist over many years to explain them differentiate this paper from the quantitative sovereign default literature. Existing models of sovereign default (and for the most part, empirical work) tend to focus on short term factors that may affect the ability or desire of national governments to repay their debt, such as the current state of the business cycle in a country or their access to foreign exchange, or the level of current debt obligations relative to GDP. Obviously, these short term factors are less relevant for understanding the source of long term variation in spreads (with the exception of debt levels which may show secular differences across nations).

More specifically, in order to establish the positive correlation between long run sovereign spreads and the average level of bribes collected by bureaucrats in the provision of public services, we turn to evidence collected by the World Bank Enterprise Survey on the percentage of a government contract that must be given as a “gift” in order to secure the contract in various nations. Since this data is only available for a few years, we calculate an average number for each country and then regress the average spread on the gift percentage which we will call the bribe rate henceforth. Theory suggests that international lenders will offer loan terms in which higher debt levels come with higher interest rates. As a result, we must condition our correlation between spreads and bribe rates with the external debt of each nation as a percentage of GDP averaged over 2006-2015. We find that a nation with a bribe rate that is one percent higher pays roughly 46 basis point more in interest costs, holding indebtedness constant. By comparison, a one percent higher debt to GDP ratio is associated with spreads that are 9 basis points higher on average. Clearly international lenders appear to respond to the diversion of public funds by bureaucrats but it is not at all clear why they should assign worse terms to nations with higher bribes.

One prevalent argument is that when bureaucrats divert considerable funds from public projects this hampers the ability of a government to repay its debt, leading to higher default risk. This explanation, however, can not be the full story. Economic theory tells us that the sovereign will evaluate the value of defaulting against the value of repaying the debt in any

period that repayment is due. If the diversion of public funds reduces the value of both options symmetrically, then no change in decisions occur, and the probability of default is unchanged. As a result, sovereign spreads in a nation where a lot of diversion occurs would be the same as another where much less stealing occurs. In order to build further insight into the joint dynamics of bureaucratic diversion, debt, default frequencies and sovereign yields we build a quantitative sovereign default model in which both international lenders and the sovereign government are aware that the public purse is managed by bureaucrats who will garnish a part of the total resources of the government. In choosing their optimal debt levels and default policy, governments of different nations take the choices of bureaucrats (which depend upon national institutions) into account. We show that if the amount of bureaucratic diversion only depends on the average institutional quality of the nation then only a constant value is diverted whether the sovereign defaults or repays debt. In this situation, economies that differ in the equilibrium amount of stealing by bureaucrats will have the same equilibrium default frequencies. As a result lenders will charge them the same long run average sovereign spread and there would be no relationship between average spreads and bribe rates. In contrast, our benchmark model implies that bureaucratic diversion is increasing in government resources and decreasing in institutional quality. We estimate this “diversion policy function” on our assembled emerging economy data and use the estimated parameters in our quantitative model. We show that when the amount of stealing is increasing in the size of the government budget then the model can generate considerable co-movement between the bribe rate and long run spreads. Specifically, we vary institutional quality relative to our benchmark model and show that the model-generated data displays the same patterns between bribe rates, long run spreads and debt levels as seen in the international data. The model also implies that economies with better institutional quality will borrow more than their counterparts with lower quality institutions. We show that this is also a feature of our international data.

The key insight driving our results is that public services, ie., public spending net of diversion, increase when a nation defaults on its debt. This gain is larger when institutional quality is lower so that default is locally more attractive (given debt and revenue levels) in economies where institutional quality is lower and diversion levels higher. International lenders understand this and assign higher default risk to nations with lower institutional quality and higher bribe rates.

1.1 Related literature.

Our model is related to several papers that incorporate spending on public goods and services into quantitative sovereign default models, especially Chatterjee and Eyigungor (2019) and Cuadra et al. (2010).¹ Building on Cuadra et al. (2010), Hatchondo et al. (2015) study fiscal policy in a sovereign default model with long run debt and focus on the effects of limiting the level of debt or the sovereign interest rate. In the absence of any such fiscal rules, they find the model delivers procyclical fiscal policy like Cuadra et al. (2010). Bianchi et al. (2019) add New-Keynesian features and study the question of the optimal cyclicity of fiscal policy in the presence of default risk. On the one hand, expansionary policy can ease the recession, on the other defaults are more likely leading to a preference for procyclical fiscal policy. Lopez-Martin et al. (2019) add an exogenous stream of commodity revenue to the structure in Cuadra et al. (2010) and study the role of financial hedging instruments. Unlike us, the sovereign chooses both the tax rate and the level of public spending in these papers. In contrast, in Arellano and Bai (2017), the tax rate cannot be changed but the level of debt and government spending can be changed. Asonuma and Joo (2019) incorporate different forms of public expenditure while also keeping the tax rate fixed and show that the model can deliver declines in public investment during restructurings which is a feature of the data. The models differ in several respects from our work, especially that government revenue in our model is exogenous whereas in their model it depends on the interaction of given tax rates and endogenous income and consumption. None of these papers involve bureaucratic diversion of public resources. Unlike these papers, Chatterjee and Eyigungor (2019) incorporates politicians who divert public funds when in office. Their study focuses on political turnover and links the exogenous growth regime to the re-election probability of politicians. Cotoc et al. (2018) incorporate political competition between left-wing and right-wing parties into a sovereign default model. The parties differ in the elasticity of their re-election probability with respect to fiscal policy. The model implies that left-wing sovereigns pay higher spreads on average and display more countercyclical spreads than right-wing sovereigns which are features of the data. This occurs because the left has a stronger desire to default in bad times in order to prevent government spending and political

¹See Goncalves and Guimaraes (2015) for a related paper which is not quantitative and highlights the time consistency problem associated with fiscal choices of the sovereign. See also Talvi and Vegh (2005) for a related model of procyclical fiscal policy with international borrowing without default.

support from falling too much. Scholl and Tong (2020) develop a sovereign default model where private agents avoid taxes by producing in the underground economy. In a debt crisis, the higher interest costs force the government to raise taxes which drives down tax revenue and makes default more likely. In contrast, our model focuses on the relationship between institutions, bureaucratic diversion of public funds and default risk with particular attention to long run international differences in sovereign spreads induced by these institutional differences.

Layout. The rest of the article proceeds as follows. Section 2 presents our empirical findings. Section 3 introduces our benchmark model of sovereign borrowing and default with bureaucratic diversion of public resources. Section 4 discusses the calibration of the model, and section 5 studies the main results and quantitative implications of the theory. Section 6 concludes.

2 Empirical findings

We begin this section with an exploration of the correlation between the average rate of “gifts” that must be given in order to secure a government contract in a country and the sovereign spread of that country. We will refer to the former variable as the bribe rate. The bribe rate is very useful for our work because it provides direct information on international differences in the diversion of public funds. It is based on an Enterprise Survey question which asks firms about the percentage of contract value expected as a gift in order to secure a government contract which we will interpret as a bribe that leads to diversion of public funds. Since the survey is only done in a few years that are not the same for each country, we take a country average and use it as a country specific value in our regressions. Similarly we calculate the average value of the country spread over the same time period. We include the average debt to GDP ratio as a conditioning factor since theory suggests that more indebtedness should be correlated with higher spreads on average. Finally, we include the average growth rate of the economy on the grounds that high average indebtedness may be less risky in a fast growing environment where the ability to pay is increasing. The specific regression for the spread of country i is

$$Spread_i = \alpha + s_i + Z_i + u_i, \tag{1}$$

where s_i is the bribe rate of the country, Z_i refers to the controls which are average debt to gdp in specification (i) while specification (ii) adds the average GDP growth rate.

Our results are reported in Table 1 where t-values are reported in the column next to the estimated coefficients in parentheses. Our results are meant to highlight some conditional correlations in international data and are not meant to be viewed as indicating causality. Indeed, in our theory, the amount of bribes, the level of debt and the equilibrium spread are all endogenous objects. Both specifications reported in Table 1 indicate that after conditioning for the amount of indebtedness of a country, there exists a positive and significant relationship between the average spread of a country and the average bribe rate - a one percent higher bribe rate is associated with an average spread which is approximately 46 basis points higher, *ceteris paribus*.

Since it is rare to see the bribe rate being used in international studies and because the empirical literature on the impact of corruption on economies usually works with the corruption perception index (see Ciocchini et al. (2003) for a link to sovereign spreads and Wei (2000) to foreign direct investment) from Transparency International, we repeated the same regressions with this measure.² As expected, both the corruption perception index and debt to GDP ratio display positive (and statistically significant) association with the average spread.³ We nonetheless prefer to focus our work on the bribe rate because it provides a quantification of the amount of stealing from the public purse which we can later use to tie down the parameters of our quantitative model.

Table 1: Bribes and Spreads: country averages

Dep. variable: Average Spread				
	(i)	(t-stat)	(ii)	(t-stat)
Constant	152.4	(1.9)	198.1	(1.6)
Bribe rate %	47.1	(2.9)	45.8	(2.8)
Ext. debt/GDP	8.9	(2.7)	8.8	(2.7)
Y growth			-8.4	(-0.5)

²Other survey measures of corruption such as the ICRG have also been used extensively (see Fredriksson and Svensson (2003) and Svensson (2000)) in the economics literature and have been shown to be highly correlated with the corruption perception index. Some studies, such as Alquist et al. (2019) provide sensitivity to various measures and find the results are robust to changing the index.

³Result available from authors.

There is a vast empirical literature exploring the correlates of sovereign spreads. Some early studies include Edwards (1984) and Cline and Barnes (1997) where a nation’s spread is correlated with the nation’s GDP and exports. Cantor and Packer (1996) as well as Eichengreen and Mody (1998) find that they are correlated with domestic economic conditions when measured using the credit rating channel. This literature typically works with a panel of time-series data rather than country averages (see Catao and Mano (2017) for a recent example). We will now show that the long term relationships uncovered in the country averages can also be found in an international panel of annual data. Since the data is annual, business cycle frequency variation in the desire or ability to repay debt becomes a more important consideration according to theory so that many more conditioning variables will be needed beyond the debt to GDP ratio. Details regarding the data can be found in the appendix.

Our empirical specification may be written as

$$Spread_{it} = \alpha + s_i + Z_{it} + F_t + u_{it}, \quad (2)$$

where Z_{it} refers to controls discussed below while F_t refers to global variables that vary over time but are the same for all countries or to year dummy variables. We report the results of three specifications in Table 2 with incrementally added controls. Specification (i) uses annual data on the external debt to GDP ratio, the log deviations of GDP from trend as controls and includes year fixed effects. Following Johri et al. (2020) and a long literature studying the role of global factors, specification (ii) adds the ten year US treasury bill rate and the ten year to one year treasury yield curve as global conditioning factors in addition to the variables in the previous specification while removing year fixed effects. Finally, specification (iii) also adds the export to GDP ratio and the foreign reserves to GDP ratio to the variables in specification (ii). Specification (iii) also excludes year fixed effects since the specification already has two global variables playing that role.⁴ The specifications do not include country fixed effects because we wish to uncover the relationship between spreads and the bribe rate which is a country specific

⁴The empirical literature emphasizing the role of global factors in influencing sovereign spreads is too vast to cover here so we refer readers to the citations in Johri et al. (2020). These authors build a sovereign default model where country risk responds to variation in both the level and volatility of the world interest rate and provide evidence that emerging economy sovereign spreads respond to US treasury yields. The importance of global factors

has been reinforced using a variety of empirical methods and proxies for global risk over varying time periods and countries in related work. We mention Akinci (2013) as an example using a very different methodology (structural VAR on a panel of emerging nations) with similar implications.

value that is constant over time. Indeed we may think of the bribe rate as one potential source of country specific differences in the spreads. We explore this relationship after discussing the results of our three specifications.

The main patterns discussed above are evident in all three specifications. Both the bribe rate and the debt to GDP ratio are positively associated with spreads and the estimated coefficients are always significantly different from zero at conventional levels of significance. The addition of global variables in specification (ii) has little impact on the estimated relationship between spreads and bribe rates. The addition of reserves in specification (iii), leads to a slight fall in this relationship. Across specifications, nations with one percent higher bribe rates are associated with spreads that vary around average levels that are 30-39 basis points higher.

Table 2: Bribes and Spreads: yearly regressions

Dep. variable: Spreads						
	(i)	(t-stat)	(ii)	(t-stat)	(iii)	(t-stat)
Constant	314.3	(2.1)	-146.7	(-1.5)	159.4	(1.7)
Bribe rate %	37.7	(5.1)	38.5	(5.2)	29.9	(4.6)
Ext. debt/GDP	14.7	(12.8)	14.9	(13.1)	14.3	(12.9)
Log Y dev. from trend	-4.916	(-3.6)	-4.0	(-2.9)	-3.7	(-3.1)
10 yr US Tbill			26.3	(1.5)	4.5	(0.3)
US yield curve 10/1			59.2	(2.5)	52.5	(2.6)
Exports/GDP					-1.5	(-1.3)
Reserves/GDP					-8.6	(-8.0)
Year FE	yes		no		no	
Adj. R^2	0.32		0.30		0.34	

We draw two conclusions from these results. First, the long term data suggests that some of the observed differences in the borrowing costs of different national governments are related to the rate at which funds can be diverted from government projects. Second, this positive relationship is not driven solely by greater average indebtedness in nations with more corrupt bureaucracies. Turning to the annual data, we see that nations are assigned a higher probability of default when the prevalence of bribes in government projects is higher. This occurs even when we control for a host of factors that have been shown to be important in the literature. At face value, these results imply that a nation with an average bribe rate of 6% faces an average borrowing cost that is 150-193 basis points higher than a nation with a 1% bribe rate, ceteris

paribus, thus highlighting the considerable significance of this channel for emerging economies. For reference, average bribe rates in our data range from a low of 0.1% to a high of 9%. As discussed in the Introduction, we will explore these ideas more fully in the sections that follow using our quantitative model.

Figure 2: The bribe rate and estimated country fixed effects

Before turning to the model, we wish to explore the idea that international variation in the bribe rate is one important source of country specific fixed effects observed in spread regressions. To explore this we estimate the following relationship with country fixed effects:

$$Spread_{it} = \alpha + C_i + Z_{it} + u_{it}, \quad (3)$$

where we include the external debt to GDP ratio and the log deviations of GDP from trend as controls and C_i refers to the country specific fixed effects. Next we obtain the country specific coefficients from this regression and regress these on the average bribe rate. Figure 2 plots these coefficients against the bribe rate along with the line of best fit. The estimated coefficient on the bribe rate is 40.4 with a t-statistic of 2.24 suggesting a strong positive correlation.

3 The Model Environment

The economy is made up of a sovereign government, a bureaucrat and international lenders. We consider the problem of an infinitely lived sovereign government operating in a small open economy that wishes to deliver public goods and services to the economy using an exogenously given stochastic stream of government revenue y , while also having the ability to borrow from

foreign lenders using one period debt⁵. The sovereign cannot commit to repay its debt so that risk neutral lenders will charge an interest rate at a level above the risk-free world interest rate in order to be compensated for the probability of default, as is standard in models that follow Eaton and Gersovitz (1981) and especially the quantitative implementations that build on Arellano (2008) and Aguiar and Gopinath (2006). The actual provision of government goods and services requires the use of a bureaucrat who is a self-interested agent with the ability to divert public funds for private use.

In what follows we use recursive notation, where *un-primed* variables (e.g. x) represent current values, while *primed* variables (e.g. x') represent next-period values. Time is discrete and goes on forever: $t = 0, 1, 2, \dots$.

3.1 The Government

The sovereign is infinitely lived and only derives utility from the provision of public goods (g) which is reminiscent of the set up in Chatterjee and Eyigungor (2019), however, unlike the setup in that paper, it is not the sovereign that diverts resources from public goods but bureaucrats. Moreover, we do not consider political turnover in this model. The per-period utility function is given by:

$$u(g) = \frac{g^{1-\xi}}{1-\xi} \quad (4)$$

The flow budget constraint of the government is:

$$g + s = \begin{cases} y + b'q(b', y) - b, & \text{if debt repaid} \\ y_a, & \text{if defaulted} \end{cases} \quad (5)$$

where $y_a \leq y \forall y$ and s is the amount diverted from public coffers by corrupt officials using bribes. Here y refers to domestic sources of revenue available to the government which is assumed to have compact support $\mathcal{Y}$ and to follow a Markov process with transition function $\mu(y', y)$. y_a refers to the amount of revenue available after default and b to the amount of debt that is due

⁵This simplification is equivalent to a more standard set up in the quantitative sovereign default literature where agents in the economy receive an endowment from which the sovereign collects taxes at a fixed rate. We note that information on tax rates are notoriously imprecise and hard to obtain for emerging nations so we prefer to use readily available data for total revenue collections when we calibrate our model. To be consistent, we model it as an exogenous process here.

to be repaid while q is the price at which sovereign bonds can be sold. Note that total spending by the government on public goods equals $g + s$ but only g units add to utility.

3.2 Bureaucrats

The government is constrained to use bureaucrats in order to provide public goods but cannot prevent them from diverting resources for their own use. Bureaucrats derive utility from these funds but successful diversion comes at a cost. Studies have highlighted many costly activities associated with corruption: manipulating the accounts of the government, hiding illicit income and its use as well as bribing others in order to prevent detection. We will not explicitly model any of these activities, opting instead for a simple parametric cost specification that we can estimate using the available data. Moreover, since we are interested in the dynamics of aggregate variables, we will assume there is only one representative risk neutral bureaucrat who solves a static optimization problem which only involves choosing the amount of government resources to divert such that her collections, net of cost are maximized. Consistent with Blackburn et al. (2006), this cost is increasing in the total amount diverted by bureaucrats in the economy.⁶ In addition, we assume that the costs of appropriating government funds is decreasing in the size of incoming government resources, x . The idea here is that it is easier to steal a given amount from a project, without detection, if it is a smaller percentage of the total amount. Similarly, any attempts to manipulate accounting statements are less likely to be noticed the more accounting items that have to be tracked. The obvious implication is that the level of stealing will tend to increase with the size of the budget. This idea can also be seen in operation in Alesina et al. (2008) where the equilibrium amount of diversion is increasing in GDP.⁷ Finally we assume that costs are increasing in the quality of institutions present in the economy, m . A nation with well functioning courts and police, a strong and independent media with high quality journalists, and a general regard for the rule of law will make it harder for corrupt officials to divert public funds than a nation without institutions of the same quality. Thus we may express the costs of diverting resources from the public purse as $C(m, s, x)$ where C is

⁶Blackburn et al. (2006) assume that some bureaucrats may not be corrupt and that the cost is a function of both the amount stolen by one official and the total number of corrupt officials. For simplicity, we ignore this distinction here.

⁷The context of Alesina et al. (2008) is quite different – the incumbent government takes rents for itself and these rents are limited by the public by threatening to vote in another government if their utility falls below a threshold.

increasing in m and s and decreasing in x which is defined as

$$x = \begin{cases} y + b'q(b', y), & \text{if debt was repaid} \\ y_a, & \text{in default} \end{cases} \quad (6)$$

The bureaucrat chooses s to maximize $s - C(m, s, x)$ and we will refer to the optimal bureaucratic diversion policy as $s^*(m, x)$. The sovereign realizes that bureaucratic diversion will occur in equilibrium and takes $s^*(m, x)$ as given when choosing government spending, debt levels and whether to default or not.⁸

3.3 Debt and Default

Each period, conditional on being in good financial standing, the sovereign chooses whether to honor its outstanding foreign debt or default. Default involves temporary exclusion from international financial markets and depressed revenue levels but opens up fiscal room for government spending since debt is not repaid. This intertemporal problem can be written as a dynamic programming problem. For a given institutional quality m , let $V(b, y)$ denote the government's value function when it has access to credit markets, begins the period with a level of debt b , and a realized value of y . Let $V^R(b, y)$ represent the value associated with the government's decision to repay its debt, and $V^D(y)$ the value function when it decides to default. The problem can be expressed as follow:

$$V(b, y) = \max\{V^R(b, y), V^D(y)\}. \quad (7)$$

When the government has access to financial markets, its value function is given by:

$$V^R(b, y) = \max_{b'} \left\{ u(g) + \beta \int_{y'} V(b', y') \mu(y', y) dy' \right\}, \quad (8)$$

⁸It is possible to represent the bureaucratic diversion policy presented here in terms of the probability of detection of corrupt bureaucrats instead of diversion costs with a very similar formulation. Assume there are many identical bureaucrats of measure one, each managing an equal portion of the total resources of the government. Imagine that the probability of detecting a corrupt bureaucrat is increasing in the size of diversion relative to the budget managed by the bureaucrat, ie., s/x , and the institutional quality, m , is a parameter in this function. Further assume that the bureaucrat must return any diverted funds when he or she is detected to be diverting resources. Then the total amount of diverted funds, S follows $S = s(1 - p(s/x; m))$ since p measures the fraction of bureaucrats who will be caught. Clearly the optimal aggregate diversion policy s^* will be increasing in x and decreasing in m in a manner similar to our cost formulation in the benchmark model.

subject to its budget constraint :

$$g + s = y + b'q(b', y) - b. \quad (9)$$

and the optimal diversion policy of the bureaucrat s^* .

When the government defaults on its debt obligations, the problem is:

$$V^D(y) = \max_g \left\{ u(g) + \beta \left(\theta \int_{y'} V(0, y') \mu(y', y) dy' + (1 - \theta) \int_{y'} V^D(y') \mu(y', y) dy' \right) \right\} \quad (10)$$

subject to

$$g + s = y_a,$$

and the optimal diversion policy s^* . Here

$$y_a = \begin{cases} y & \text{if } y \leq \psi \bar{y}, \\ \psi \bar{y} & \text{otherwise.} \end{cases}$$

and $\bar{y}$ is mean revenue.

The economy gets excluded from international credit markets in the default period, but it could regain access in any future period with probability θ . When the economy returns to credit markets, it does so without a debt burden, which is captured by the value function $V(0, y')$. Alternatively, the economy may remain in autarky with probability $1 - \theta$.

Default decision. The default policy of the sovereign is characterized by:

$$d(b, y) = \begin{cases} 0 & \text{if } V^R(b, y) \geq V^D(y) \\ 1 & \text{otherwise.} \end{cases} \quad (11)$$

Let $\mathcal{D}(b)$ represent the set of revenue realizations for which the sovereign finds it optimal to default, given a debt level b and diversion level s :

$$\mathcal{D}(b) = \{y \in \mathcal{Y} : d(b, y) = 1\},$$

hence, the next-period default probability of the sovereign is

$$\lambda(b', y) = \int_{\mathcal{D}(b)} \mu(y', y) dy'.$$

3.4 Foreign Lenders

Foreign lenders are risk neutral and assign the value $1/(1 + r^*)$ to payoffs received in the next period, where r^* is the international risk-free interest rate. Lenders have perfect information about the revenue process of the small open economy and observe the institutional quality, m , and understand the behavior of bureaucrats. Bonds are priced in a competitive market inhabited by a large number of identical lenders, which implies that bond prices are pinned down by a zero expected profit condition. The risk of default is taken into consideration by foreign lenders when determining the price of the bond:

$$q(b', y) = \frac{1 - \lambda(b', y)}{1 + r^*} \quad (12)$$

3.5 Recursive equilibrium definition

Definition 1. *The recursive equilibrium for this economy is characterized by*

1. *a set of value functions V , V^R , and V^D ,*
2. *a default policy rule d and a borrowing policy rule b' for the sovereign government,*
3. *policy rules for s , the amount of resources diverted by the bureaucrat for own use and g , for public services,*
4. *a bond price function q ,*

such that:

- (a) *given the default and borrowing policy functions of the government and diversion and government spending rules of the bureaucrat, V , V^R , and V^D satisfy equations (7), (8) and (10) when the government can trade bonds at q ;*
- (b) *given the default and borrowing policy functions, and the diversion policy of the bureaucrat, the bond price function q is given by equation (12);*
- (c) *the default and borrowing policy functions d and b' solve the dynamic programming problem defined by equations (7), (8), (10) and (11) when the government can trade bonds at q and given the diversion policy rule s*
- (d) *given the default and borrowing policy rules and the bond price function, the diversion policy rule solves the bureaucrat's problem.*

4 Calibration

We solve the model numerically using value function iteration. A period in the model is one year. Some of our parameters are taken from the literature. We will discuss these first. We assume a coefficient of relative risk aversion of 2, which is the standard value in studies of real business cycles in small open economies. The risk-free rate was set to 4% annually, the standard value in literature which is based on U.S. real treasury rates. The probability of reentry into international debt markets was set to 33%, so that the government remains in exclusion for a period of three years after a default episode, on average. This is the annual equivalent of the quarterly probability used in Mendoza and Yue (2012). Moreover, it is right around the mean value reported for the 1990s in Gelos et al. (2011) and within their overall range of 2-4 years.

Turning to the estimates of the revenue process, we proceed as follows. From our list of nations, we choose those nations for which revenue data is available from 1995-2015 without any missing years. The data is logged and linearly de-trended for each country and ρ and σ are then calculated using an auto-regression of order one. We take the mean of these country values for each parameter and report it in Table 3. The tax revenue data for each country is constructed by multiplying tax revenue as a percentage of GDP with GDP per capita in constant terms, both of which are obtained from the World Development Indicators database.

Table 3: Parameter values.

y autocorr.	ρ	0.64	Estimation
SD of ϵ	σ	0.062	Estimation
Borrower's risk aversion	ξ	2	Prior literature
Risk-free rate	r^*	0.04	Prior literature
Duration of defaults	θ	0.33	Prior literature
Diversion parameter	γ	2.1	Estimation
Diversion parameter	ϵ	5.2	Estimation
Average institutional quality	m	2.02	Mean value of index
Discount factor	β	0.82	Calibration
Default cost parameter	ψ	0.87	Calibration

In order to calibrate the parameters of the cost function (γ, ϵ) that also appear in the optimal diversion policy rule of the bureaucrat, we run the following cross-country regression. We regress the average diversion level, s_i , on our measure of institutional quality, m_i , and on

x_i , which measures the resources flowing into government coffers, where the subscript i refers to the country index. In order to implement this, we assume the following functional form for the cost function:

$$C_i = \frac{m_i^\epsilon}{\gamma x_i} s_i^\gamma, \gamma > 1. \quad (13)$$

The first order condition implies the optimal amount of resources diverted by the bureaucrat in country i is given by

$$s_i^* = \left(\frac{x_i}{m_i^\epsilon} \right)^{\frac{1}{\gamma-1}} \quad (14)$$

so that bureaucratic diversion rises in equilibrium with government resources whereas it falls as institutional quality rises.

Our institutional quality index is based on the Rule of Law index taken from the World Governance Indicators (WGI) database (details in the Data Appendix). Since the index is scaled from -2.5 to +2.5 points, we rescale it to always take positive values. As a result we add 2.5 to the value for each country. Since the index is available for more than one year, we take the country average as our measure of institutional quality. The average value of m varies from a low of 0.8 to a high of 3.84 though the range in the non-averaged data is greater. We calibrate the benchmark economy to the average value in our data set which is 2.02. The WGI dataset contains six indicators – Voice and Accountability, Political Stability and Absence of Violence, Government Effectiveness, Regulatory Quality, Rule of Law and Control of Corruption. Of these six indicators, only the last two appear to be relevant as a proxy for m . The definitions provided in WGI documentation states that the “Rule of law captures perceptions of the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence.” In contrast, “Control of corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as ”capture” of the state by elites and private interests.” Based on this we conclude that the Rule of Law index is a better measure of the institutions in place in society that limit bribe giving and taking as well as illegal diversion of public funds whereas the Control of Corruption index measures the extent of corruption in a society as opposed to institutional quality. Since we already have the bribe rate, a perceptions based measure of overall corruption is neither necessary nor desirable in our context. Moreover, the corruption

index conflates state capture by elites and private interests which may be more relevant for policy choices as opposed to diversion of state resources. Overall, while it is apparent that none of the available institutional quality measures are perfect for our purposes, the Rule of Law index comes closest to what we have in mind. Indeed the estimates reported below show that the Rule of Law is correlated with the bribe rate. Estimates of γ , and ϵ are obtained using a non linear cross country regression based on equation (14). All variables are average values for each country from 2006 to 2015. Our estimate of $\epsilon = 5.2$ with a t-value of 9.26 while our estimate of $\frac{1}{\gamma-1} = 0.94$ (t-value of 89) which implies that $\gamma = 2.1$ approximately.

We jointly calibrate β and ψ so that the benchmark model can match the weighted average spread and debt to government revenue moments from our dataset. The target for the spread is 250 basis points, where the spread of each country is weighted by GDP when calculating the average value. Our target for debt to revenue ratio is 13%. This value is obtained by targeting an unsecured debt-to-revenue ratio that is 37% of the weighted average ratio of debt to revenue for all countries in our data set. Note that on average the haircut imposed on creditors in the post-1980 defaults is about 37% (Cruces and Trebesch, 2013), so we approximate unsecured debt using this proportion. To achieve these targets, we set $\beta = 0.82$ and $\psi = 0.87$.

Table 4: Non targeted moments

Moment	Data	Benchmark Model
s.d spreads	201	176.8
s.d govt. spending	0.11	0.09
corr(spread, govt. spending)	-0.22	-0.71
corr(spread, net exports/revenue)	0.44	0.60
corr(revenue, govt. spending)	0.42	0.97

In order to get a sense of the ability of the calibrated model to deliver the key co-movement properties associated with sovereign spreads and fiscal policy as discussed in the literature, we report some measures of volatility and co-movement in Table 4. The first column reports the mean value of the moment in our panel. We calculate the moment for those nations in our dataset where information was available for the entire time period from 1995-2015. Nations with missing observations during this period were dropped. The corresponding moment from the simulated benchmark model is reported in column two. Government spending is logged

and a linear trend is removed prior to calculating the moments. The model does quite well in capturing the volatility of the sovereign spread and of government spending. The model also delivers key features of emerging economy business cycles – spreads are negatively correlated with government spending and positively correlated with net exports (expressed relative to revenue). Moreover, government spending and revenue are positively correlated, though this correlation is much higher than in the data.

5 Results

5.1 The impact of institutional quality on emerging economies

In this subsection, we discuss the behaviour of the sovereign with respect to debt and default choices and the behaviour of the bureaucrat with respect to stealing and government spending. We show how variation in institutional quality affects these decisions and discuss the mechanism underlying the results.

Figure 3: Default Regions

Figure 3 displays default regions associated with two economies. The red line refers to

the benchmark calibrated economy while the green line refers to an economy with the highest average institutional quality ($m=4.13$). This level of m in the model economy, generates an average bribe rate equal to 0.1%, which is the lowest value seen in our international dataset. We will refer to these economies in what follows as the benchmark economy and the HIQ (high institutional quality) economy. Each line divides the space into two regions with default occurring below and to the right of the line. The vertical axis measures government revenue while the horizontal axis reports sovereign debt relative to revenue. For any given level of debt, lower realizations of government revenue lead to default in each economy. As debt rises, the revenue level that is needed to avoid default also rises. These features of the default region are consistent with the quantitative sovereign default literature. It is clear that the default region is smaller for the HIQ economy and that default is therefore more likely to occur at almost all debt levels in the benchmark economy. At very low levels of debt, neither economy will default, even when revenue levels are low.

Figure 4: Interest Rate Menus at Average Revenue

Since lenders evaluate the probability of default when pricing the debt of each economy, it is not at all surprising that they offer worse terms to the economy that is more likely to default,

ie., the benchmark economy. Figure 4 displays the menu of debt and interest rates on offer to the two economies. A number of properties of the sovereign default model are immediately apparent from Figure 4. First, for any economy, the interest spread that must be paid over and above the world interest rate (4%) is increasing in the amount of debt chosen by the sovereign. Second, the maximum amount of debt is limited from above due to the sharply rising interest costs available from international lenders. Third, at any given debt level, (except the very lowest levels where neither economy will default, so that each pays the world interest rate) the red line is above the green, suggesting that the benchmark economy with worse institutions will pay higher spreads. Fourth, the endogenous debt limit imposed by the equilibrium menus is looser for the HIQ economy.

Figure 5: Debt Choices at Average Revenue

Figure 5 displays the amount of debt chosen by the sovereigns of the two economies at various current debt levels conditional upon revenue being at its mean level. The better terms on offer to the HIQ economy seen in Figure 4 leads to its sovereign choosing higher debt levels. The endogenous debt limit is also clearly visible. We note that this level is lower for the benchmark economy. The relationship between debt levels and institutional quality is also a feature of

international data. Figure 6 presents a scatter plot of the average external debt to GDP ratio of various nations against their average Rule of Law index. The line of best fit from regressing the debt to GDP ratio on the rule of law index is also shown and clearly demonstrates the positive relationship between the two variables of interest. The regression coefficient implies that a unit increase in the index is associated with an additional 9 percent of debt to GDP on average.⁹

Figure 6: Average Debt and Rule of Law

Figure 7 explores the amount of government services g , provided by the bureaucrat after diverting resources, as government revenue varies while debt is held constant. It is clear that the HIQ economy has more government services available to it than the benchmark economy except at the revenue level where the benchmark economy defaults while the HIQ economy does not. Note too, that the benefit of defaulting is apparent in the sharp rise in government services available after default, relative to that available at the marginally higher revenue level when debt is repaid. It is also clear why the HIQ economy does not default at the revenue level at which the benchmark economy defaults. Since it has a higher level of consumption of government services than the benchmark economy, the gain from defaulting is 1.95% while it is 4.1% in the benchmark economy. As a result the HIQ economy prefers to repay until the gain in g from defaulting is bigger. This occurs at a lower revenue level with a correspondingly lower g level.

Figure 8 explores the amount of diversion, s , undertaken by the bureaucrat as government revenue varies and debt is held constant. In Figure 8 we note that holding debt at its mean level,

⁹The estimated coefficient is 9.15 with a t-statistic of 10.4.

Figure 7: Government Service Levels at Mean Debt

diversion of public resources increases in good times as government revenue rises. This occurs because of the expansion of the budget given existing debt obligations. This expansion can be funded, not only because there is more revenue available, but also because it is possible to take on more debt since good times are associated with lower spreads. Equation 14 implies that diverting funds is easier as the government budget expands, so the bureaucrat takes advantage of the good times and we observe pro-cyclical stealing in both economies. We also note that diversion falls sharply in default. Compared to the HIQ economy, the diversion level is higher in the benchmark economy as expected. Moreover, as revenue expands, diversion rises faster in the benchmark economy than in the HIQ economy in the no-default region. In other words, stealing is more pro-cyclical in the benchmark economy. Finally, note that diversion of resources drops more in default in the benchmark economy compared to the HIQ economy. This difference in the behaviour of the bureaucrat is the mirror image of the behaviour of government services shown above and it explains why defaults are more likely in the benchmark economy. Bureaucratic diversion of public resources is a dead-weight loss to the sovereign which must be tolerated as a part of doing business. A benefit of default is that this dead-weight loss is lowered while bearing

the output loss caused by the default decision. Note that since the output loss from default is the same in both economies, it is clear that there is a bigger net gain when institutional quality is low than when it is high.

Figure 8: Bureaucratic Diversion at Mean Debt

Figure 9 displays the behaviour of total government spending, $g + s$, as revenue varies while holding debt at its mean value. The procyclicality of government spending observed in emerging economy data is evident in the figure. This procyclical behaviour is consistent with emerging economy data and also is a feature of quantitative sovereign default models with endogenous fiscal policy as in Cuadra et al. (2010).

These results suggest that the model may be consistent with the long run positive co-movement between bribe rates and sovereign spreads found in the empirical section – as institutional quality falls, bribe rates increase and spreads rise since default is more desirable. We use the model in the next section to generate artificial data that can be compared to our actual international data. Since the choice of debt is an important covariate of spreads, we need to control for it like we did in the empirical section. We therefore proceed to run identical regressions on the simulated data as we did for the emerging economy data. We discuss this

Figure 9: Government Spending Levels at Mean Debt

next.

5.2 Comparing the model to the data

In order to compare the model's ability to re-produce the main findings in the cross-country data, we generate simulated data from 47 artificial nations that vary only in institutional quality while all parameters are kept at their benchmark values. We vary m in the range needed to match the minimum and maximum average bribe rate found in our data (from 0.1% to 9%). This requires m to range from 1.6 to 4.13. We generate 100,000 observations of simulated data for each nation, drop all periods in default or in exclusion, and calculate averages. We regress the average spread on the average bribe rate, the average debt to revenue ratio and a constant and report the results in column 3 in Table 5. Table 5 also reports reports the same regression coefficients from the data.¹⁰ Like the actual international data, the simulated model-generated data produces a positive correlation between the average spread and the average bribe rate

¹⁰Note that in order to be consistent with the model, we regress the spread on the debt to revenue ratio as opposed to the debt to GDP ratio. This results in small differences from the results in Section 2.

once we control for indebtedness. The model based coefficient is about a third of that found in the data. In contrast, the coefficient of the debt to revenue ratio is bigger than in the data, though also of the correct sign. Our model suggests that a nation that has 5% higher diversion rates will face average spreads that are 60 basis points higher, holding other things constant. The corresponding rise in average spread is 177 basis points in the emerging economy data set which suggests that the calibrated model can account for roughly one-third of the observed comovement between spreads and bribe rate.

Table 5: 47 nations that differ in m only

Dep. variable: Average Spread	Data	(t-stat)	Simulation	(t-stat)
Constant	164.9	(2.3)	-382.9	(-11.8)
Bribe rate %	35.5	(2.1)	12.2	(8.4)
Debt/revenue	1.6	(3.1)	46.5	(20.6)

5.3 Acyclical stealing model

In this subsection we contrast the results of our model with a specialized version where the amount of resources diverted by the bureaucrat only depends on institutional quality. All other parts of the model remain the same. In other words we rewrite equation 14 as $s = m^{\frac{\epsilon}{(1-\gamma)}}$, so that s is a constant in each nation. In Figure 10, we plot the default regions of two nations as before. The green line refers to the HIQ economy ($m=4.13$) while the red line to the benchmark economy ($m=2.02$). As is apparent from a glance, there is no difference in the default sets. As a result, the two nations face identical debt-interest rate menus from foreign lenders. The two governments select very slightly different levels of debt and government spending (not shown here). The only major difference being that the bureaucrat in the benchmark economy divert more resources for their use than in the HIQ economy. This result highlights the importance of the interaction of the cyclicalities of revenue with the amount of resource diversion in generating a linkage between the diversion rate and default risk seen in the data.

Figure 10

6 Conclusions

International data suggests that nations differ in the average interest rate paid on their sovereign bonds and these differences persist for decades. This suggests that international debt markets assign idiosyncratic default risk that varies from country to country. In this paper we show that this idiosyncratic difference is linked to the average bribe rate in the country. The bribe rate measures the percentage of a government project value that must be given as a “gift” in order to secure a contract for the project. We find that a one percent increase in the bribe rate is associated with a 36 basis point rise in average sovereign spreads when the data is averaged from 1995-2015.

In order to understand why international debt markets assign higher default probabilities to nations with higher bribe rates, we build a sovereign default model of a small open economy in which the government wishes to provide public goods and services but is constrained to utilize corrupt bureaucrats to manage the budget and implement public projects. Bureaucratic diversion of public resources is increasing in the size of incoming government resources and de-

creasing in the quality of institutions. We obtain estimates of this diversion policy by measuring institutional quality through the rule of law index from the World Governance Indicators and measuring the diversion of public resources through the bribe rate. We find that the amount of diversion is decreasing in institutional quality and increasing in the resources flowing into the government accounts.

We calibrate the model to international data and embed the estimates of the diversion policy into the model parameters. Our benchmark model delivers the key cyclical properties of sovereign spreads and government spending. The spread falls in good times when revenue increases while government spending increases. The model also delivers volatility of spreads and government spending that are in line with the data. When we vary institutional quality, the model implies a positive relationship between the average amount of diversion of public resources and the average spread. Running the same regression on the artificial data and on the international data, we obtain similar results – conditioning on the average debt to revenue ratio, a one percent increase in the bribe rate is associated with a 36 basis point increase in the average spread in the data while the model reports a 12 basis point increase. The key insight driving the higher default risk for nations with lower institutional quality is that the diversion policy is increasing in the amount of resources flowing into the budget. In bad times, when revenue is low, a government may choose to default so that it can provide more public services net of bureaucratic diversion than if it repaid its debt. This gain in net public services is higher when institutional quality is lower so that default is more appealing. As a result the default region is bigger for nations with worse institutional quality, and so they face higher spreads. These nations with lower institutional quality face worse loan terms in international markets and thus are forced to take on less debt in order to control their borrowing costs.

In this paper we have explored one source of differences in institutions and highlighted how bureaucratic corruption may increase borrowing costs for countries. Our quantitative results suggest that there may be other sources of long run differences in spreads that would be interesting to explore in future work.

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7 Appendix

7.1 List of countries

Angola, Argentina, Azerbaijan, Belarus, Bolivia, Brazil, Bulgaria, Chile, China, Colombia, Cote D'Ivoire, Croatia, Dominican Republic, Ecuador, Egypt, Arab Rep., El Salvador, Ethiopia, Gabon, Ghana, Guatemala, Honduras, Hungary, India, Indonesia, Iraq, Kazakhstan, Kenya, Latvia, Lebanon, Lithuania, Malaysia, Mexico, Mongolia, Morocco, Mozambique, Namibia, Nigeria, Pakistan, Panama, Paraguay, Peru, Philippines, Poland, Romania, Russian Federation, Senegal, Serbia, Slovak Republic, South Africa, Sri Lanka, Tanzania, Thailand, Trinidad And Tobago, Tunisia, Turkey, Ukraine, Uruguay, Venezuela RB, Vietnam, Zambia

7.2 Construction of Country Averages Data

We amalgamate data from 4 different sources in order to build the dataset of country averages. The main source on corruption data is The World Bank Enterprise Survey. We downloaded this dataset from <https://www.enterprisesurveys.org/> and we selected the variable “Value of gift expected to secure a government contract (% of contract value)”. There are one to three observations for each of the 139 countries in this dataset. These observations are for different years, anywhere from 2006 to 2018.

The source on institutional quality data is The World Governance Indicators. This dataset was downloaded from <http://info.worldbank.org/governance/wgi/> and we selected the “Rule of Law” variable. There are several annual observations for each of the 214 countries in this dataset for the following years: 1996, 1998, 2000, and 2002 to 2016.

Spread data comes from J.P. Morgan’s EMBI Global Index and consists of weekly observations ranging from the first week in 1995 to May 29, 2015. There are a total of 67 countries in this dataset. In order to convert to annual frequency, we computed annual averages for each country.

We gathered data on domestic macroeconomic variables from The World Development Indicators dataset of the World Bank, which can be downloaded from <https://databank.worldbank.org/reports.aspx?source=2&series=NY.GDP.MKTP.CD&country=#>. We downloaded data on 217 countries for years 1995 to 2015. We chose these years in order to be consistent with the aforementioned EMBI dataset. The following series were collected: “GDP (current US\$) - NY.GDP.MKTP.CD”, “GDP growth (annual %) - NY.GDP.MKTP.KD.ZG”, “External debt stocks, public and publicly guaranteed (PPG) (DOD, current US\$) - DT.DOD.DPPG.CD”, “Revenue, excluding grants (% of GDP) - GC.REV.XGRT.GD.ZS”, and “General government final consumption expenditure (% of GDP) - NE.CON.GOV.T.ZS”.

We took country averages of all observations between 2006 and 2015 for each of the series. We chose 2006 because we did not have any data from the Enterprise Survey prior to this year.

The following data transformations were performed to obtain the series used in the paper. We computed “External debt to GDP” by dividing “External debt stocks, public and publicly guaranteed (PPG) (DOD, current US\$)” by “GDP (current US\$)”. “General government final consumption expenditure” was computed by multiplying “General government final consumption expenditure (% of GDP)” by “GDP (current US\$)”. The country average of “General government final consumption expenditure” was multiplied by the country average “Value of gift expected to secure a government contract (% of contract value)” in order to compute the average “Diversion level” by country. The “Rule of Law” variable from The World Governance Indicators ranges from -2.5 to +2.5. We rescaled this variable by adding 2.5 to the average value of each country to ensure that it is always positive. “Total Resources” was computed by adding “External debt to GDP” to “Revenue, excluding grants (% of GDP)” and multiplying everything by “GDP (current US\$)”. “External debt to tax revenue” is computed by dividing “External debt to GDP” by “Revenue, excluding grants (% of GDP)”.

7.3 Construction of Annual Dataset

This dataset used four sources, three of which were already described in the previous section: The World Bank Enterprise Survey, J.P. Morgan’s EMBI Global Index, and The World Development Indicators. Aside from the series mentioned in the Country Averages Dataset, we also used the following series: “GDP per capita (constant 2010 US\$) - NY.GDP.PCAP.KD”, “Exports of goods and services (% of GDP) - NE.EXP.GNFS.ZS”, “Total reserves (includes gold, current US\$) - FI.RES.TOTL.CD”, and “Imports of goods and services (% of GDP) - NE.IMP.GNFS.ZS”.

The fourth source is the Federal Bank of St Louis. We downloaded the series “10-Year treasury constant maturity rate - GS10” and “1-Year treasury constant maturity rate - GS1” from <https://fred.stlouisfed.org/> for years 1995 to 2015. In order to convert to annual frequency, we computed annual averages.

The following data transformations were performed. “Log Y deviations from trend” was computed by logging “GDP per capita (constant 2010 US\$)” and then removing the linear trend. The “10-Year yield curve” series was computed by subtracting the “1-Year treasury constant maturity rate” from the “10-Year treasury constant maturity rate” and then taking the annual average. We computed “Reserves to GDP” by dividing “Total reserves (includes gold, current US\$)” by “GDP (current US\$)”. “Detrended tax revenue” was computed by multiplying “Revenue, excluding grants (% of GDP)” by “GDP per capita (constant 2010 US\$)”, taking logs and then removing the linear trend. “Net exports to revenue” was computed by subtracting “Imports of goods and services (% of GDP)” from “Exports of goods and services (% of GDP)” and dividing it by “Revenue, excluding grants (% of GDP)”.