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Sovereign debt, government myopia, and the financial sector[1]

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What determines the sustainability of sovereign debt? In this paper, we develop a model where myopic governments seek electoral popularity but can nevertheless commit credibly to service external debt. They do not default when they are poor even though default costs are low because they would lose access to debt markets and be forced to reduce spending; they do not default when they become rich because of the adverse consequences to the domestic financial sector. Interestingly, the more myopic a government, the greater the advantage it sees in borrowing, and therefore the less likely it will be to default (in contrast to models where sovereigns repay because they are concerned about their long term reputation). More myopic governments are also likely to tax in a more distortionary way, and increase the vulnerability of the domestic financial sector to government debt default. We use the model to explain recent experiences in sovereign debt markets.

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Why do governments repay external sovereign borrowing? This is a question that has been central to discussions of sovereign debt capacity, yet the answer is still being debated.[2] Models where countries service their external debt for fear of being excluded from capital markets for a sustained period (or some other form of harsh punishment such as trade sanctions or invasion) seem very persuasive, yet are at odds with the fact that defaulters seem to be able to return to borrowing in international capital markets after a short while.[3] With sovereign debt around the world at extremely high levels, understanding why sovereigns repay foreign creditors, and what their debt capacity might be, is an important concern for policy makers and investors. This paper attempts to address these issues.

A number of recent papers offer a persuasive explanation of why *rich industrial* countries service their debt even if they are not likely to experience coordinated punishment by lenders.[4] As a country becomes more developed and moves to issuing debt in its own currency, more and more of the debt is held by domestic financial institutions, or is critical to facilitating domestic financial transactions because it is perceived as low-risk, interest bearing collateral. Default on domestic bond holdings now automatically hurts domestic activity by rendering domestic banks insolvent, or reducing activity in financial markets (see especially Bolton and Jeanne (2011) or Gennaioli, Martin, and Rossi (2011)). If the government cannot default selectively on foreign holders of its debt only, either because it does not know who owns what, or it cannot

[2] See, for example, Eaton and Gersovitz (1981), Bulow and Rogoff (1989a), Fernandez and Rosenthal (1990), Cole and Kehoe (1998), Kletzer and Wright (2000), and Tomsz (2004).
[3] See, for example Eichengreen (1987), Sandleris, Gelos, and Sahay (2004), and Arellano (2009). Ozler (1993) and Flandreau and Zumer (2004) find that increased premia on debt of past defaulters are too small to suggest strong incentives to pay.
[4] See, for example, Basu (2009), Broner, Martin, and Ventura (2010), Bolton and Jeanne (2011), and, Gennaioli, Martin, and Rossi (2011).

track sales by foreigners to domestics (see Guembel and Sussman (2009) and Broner, Martin, and Ventura (2010) for rationales), then it has a strong incentive to avoid default and make net debt repayments to all, including foreign holders of its debt.

What is less clear is why a poorer developing country or emerging market, that has a relatively underdeveloped financial sector, and hence little direct costs of default, would be willing to service its debt. Of course, one could appeal to reputation models where governments strive to maintain the long-term reputation of their country even though default is tempting. However, we are more realistic (or perhaps cynical). Most governments care only about the short run, with horizons limited by elections or other forms of political mortality – such short termism is perhaps most famously epitomized by Louis XV when he proclaimed "*Apres moi, le deluge!*" (After me, the flood.) Short-horizon governments are unlikely to see any merit in holding off default until their country becomes rich, solely because their reputation then will be higher – after all, the benefits of that reputation will be reaped only by future governments.

Short termism may, however, help in another way that explains why developing countries or emerging markets, with little cost of defaulting, still continue to service their debt. Short horizon governments do not care about a growing accumulation of debt that has to be serviced – they can pass it on to the successor government – but they do care about *current* cash flows. So long as cash inflows from new borrowing exceed old debt service, they are willing to continue servicing the debt because it provides net new resources. Default would only shut off the money spigot, as renegotiations drag on, for much of the duration of their remaining expected time in government. This may explain why some governments continue servicing debt even though a debt restructuring, and a write-off of the debt stock, may be so much more beneficial for the long-term growth of the country.

Thus we have a simple rationale for why developing countries may be able to borrow despite the absence of any visible mode of punishment other than a temporary suspension of lending; lenders anticipate the developing country will become rich, will then be subject to higher domestic costs of defaulting, and will eventually service its accumulated debt. In the meantime, the country's short-horizon government is unlikely to be worried about debt accumulation, so long as lenders are willing to lend it enough to roll over its old debts plus a little more. Knowing this, creditors are willing to lend to it today.

Key in this narrative, and a central focus of our analysis, are the policies that a developing country government has to follow to convince creditors that it, and future governments, will not default. To ensure that the country's debt capacity grows, it has to raise the future government's ability to pay (that is, ensure the future government has enough revenues) as well as raise its willingness to pay (that is, ensure the future penalties to default outweigh the benefits of not paying). The need to tap debt markets for current spending thus gives even the myopic government of a developing country a stake in the future. The policies that it follows will, however, potentially reduce the country's growth as well as increase its exposure to risk. For instance, a higher tax rate will lead to lower real investment by the corporate sector, and therefore lower resources for a future government to tax, and a lower ability to pay. But it will also lead to more financial savings (because these typically escape the heavy taxes production is subject to), a larger holding of government bonds by domestic entities, and thus a greater willingness of the future government to service its debt for fear of doing widespread damage to the economy through default.

In deciding whether to service its legacy debt or not, a myopic developing country government has to trade off the benefits from added resources if it decides to service the debt and can raise new debt against the distortions from taxing the economy so as to preserve access to debt markets. We trace out the maximum debt that countries will be able to service.

Interestingly, as a government becomes less myopic and discounts the future less, its willingness to default on legacy debt increases. Default costs go up over time as a country's financial markets depend more on government debt. Therefore, not only does the long-horizon government anticipate rising default costs, it also internalizes the future cost of paying back borrowing, as well as the distortions that stem from tax policies required to expand debt capacity. This makes borrowing less attractive, and since for a developing country government the ability to borrow more is the only reason to service legacy debt, the long-horizon developing country government has more incentive to default (or less capacity to borrow in the first place). Similarly, developing countries with a more productive technology may also have lower debt capacity because the distortionary taxation needed to sustain access to debt markets will be more costly for such countries.[5]

[5] Greater borrowing by developing countries need not be associated with better fundamentals. Studies show that correcting for the obvious factors, developing countries that are more dependent on external financing seem to grow relatively slower (see, for example, Prasad, Rajan, and Subramanian (2007)), a puzzle that Aguiar and Amador (2009) suggest is explained by the government's worry about the adverse consequences of debt overhang on the private sector).

Finally, we also allow the government to determine the vulnerability of the financial sector to government default. We show that shorter horizon governments have a greater incentive to create more vulnerability, in part because the future costs of default will not be borne by them, while the benefit of greater debt capacity will. Thus myopia is again important in creating debt capacity. We offer some examples in the paper.

It is useful to compare the implications of our model to the implications of existing models of external sovereign debt. In many of these models (see, for example, Eaton and Gersowitz (1981)), the cost of defaulting on foreign debt, either in terms of sanctions, exclusion from financial markets, or costs of higher future risk premia, have to be very high to outweigh the benefit of defaulting on the enormous stock of debt. Hence, for example, "trigger" strategy models require punishment for a large number of periods if the borrower defaults. In our paper, though, the assumption of short government horizon ensures that the government emerging from poverty never internalizes the cost of repaying the entire stock of debt (or equivalently, the benefit from defaulting on it when default costs are low). All it cares about is whether the expected cash inflows from retaining access to the external debt market is positive over the remaining term of the government. If it is, the government will continue servicing debt, even if the only cost of default is the disruption of credit markets for a short while.[6]

Bulow and Rogoff (1989b) show that the reputational arguments for repayment break down because by defaulting and investing potential repayments in asset markets to self-insure when net repayments have to be made, a country can guarantee itself higher

[6] Indeed, that developing country governments myopically service their debts too long is consistent with the findings in Levy-Yeyati and Panizza (2006) that growth starts picking up in countries almost immediately after they default, while output declines steadily before. Of course, another explanation is the equilibrium one that only countries that benefit from default do so.

consumption if it defaults than in if it does not. Anticipation of such default should preclude a country from borrowing in the first place.

In a sense, our developing country government is a special case of Bulow-Rogoff, but our model clarifies that borrowing need not be impossible so long as future governments have the ability and willingness to pay too. Of course, if countries face default costs only when they are rich, long-horizon poor country governments would have little incentive to service debt, preferring to default on the stock and have it written down before it becomes enforceable. Our assumption of government myopia explains why even poor countries do not default when default costs are small. Our model then implies a feasible time profile of repayments that cannot be exceeded.

Amador (2008) also argues that the Bulow-Rogoff no-borrowing equilibrium breaks down, but for a different reason. In his model, countries do not consist of representative agents but self-interested interest groups. Because each one cannot be trusted to not grab surplus savings, the country cannot stop debt repayments and purchase insurance with them in the market. In fact, the interest groups may prefer to maintain access to a credit line that supplies funds in dire contingencies, and hence do not default. The inability of interest groups to do what is collectively optimal (the Bulow-Rogoff equilibrium) thus makes debt sustainable. This is clearly a different rationale from ours.

We present the model in section I and solve it in section II, explore alternative assumptions in section III, draw out implications in section IV, and conclude in section V.

I. The model

Consider a world with three dates (t = 0, 1, 2) and two periods. The country that we focus on is emerging from poverty at date 0, with a pre-existing debt of amount D_0 built up in the past (it does not really matter whether this is private debt or previous government's debt – it will have to be repaid by taxing the private sector). We assume this is entirely foreign borrowing, and is repayable to foreigners at end of the first period. Households and companies (collectively known as the *private sector*) have an endowment of E_0.

The private sector has access to a production technology which, in return for an investment k_1 during period 1, produces a return in the short run (end of period 1) of $f_1(k_1)$ as well as in the long run (end of period 2) of $f_2(k_1)$, with $f_\bullet' > 0, \quad f_\bullet'' < 0$. The remaining resources, $E_0 - k_1$, represent financial savings which are invested in government bond markets or in the global capital markets. We assume universal risk-neutrality and a time preference rate of *r*, which is thus the cost of borrowing in domestic as well as foreign debt markets. The private sector has a slight home bias, so if expected returns between the domestic market and foreign markets are equal, it prefers investing in the domestic market.

We assume the politicians in the government discount the future using factor β ∈ $[0, \frac{1}{1+r}]$. When $\beta = \frac{1}{1+r}$, we have a long-horizon government which has the same rate of time preference as the market. When β=0, we have a short-horizon myopic government, which will be our focus initially. Such a government does not consider the effects of its actions over the long term. Its myopic behavior could be explained by finite government lives, or looming elections with small weight placed on continuation post-election.

Government leaders want to maximize spending on populist schemes, perhaps to increase the chance of reelection. Such spending could be induced in a "rat race equilibrium" (see Holmstrom (1999)) where there is short-run opacity about true economic outcomes – if sustainable jobs are harder to create, the politician may spend on make-work jobs so long as the public has a hard time distinguishing the two in the short run. Everyone knows the politician creates such jobs, and it is inefficient, but if he does less than the equilibrium amount, he will be punished for being ineffective.

The government can raise money for spending in two ways. First, it can levy taxes on the private sector of up to t^{Max} every period on the cash flows generated from real investment – we assume this reflects the political and economic capacity of the government to collect tax revenues. We assume financial investments (in government bonds) by the private sector are not taxed.[7] An equivalent formulation would be for the government to favor (through a lower tax on interest income on government bonds held by the private sector) or mandate (through prudential norms on banks) private sector holdings of government bonds. In either formulation, the net effect of such a policy would be lower private sector investment in real assets.

The government can either default on its inherited debt at the beginning of the period or decide to pay it back. If it defaults on its debt, the debt is written off but credit markets are disrupted and the country cannot borrow again until next period when it will be ruled by the next government. If the first period government does not default on its

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[7] Equivalently, there is a uniform income tax, and the government levies an additional set of taxes such as payroll taxes or excise duties on real investment projects. Financial investments are typically subject to lower taxation, partly because of their greater mobility in a country with an open capital account.

legacy debt D_0, it can borrow an amount D_1 that is payable at date 2 by the second period government. The first period government uses the proceeds of the new debt issued, as well as the taxes raised, to make committed debt repayments as well as to fund its spending.

We assume new debt D_1 is in the form of bearer bonds which are issued to both foreign and domestic investors. Let the amount foreign investors buy be denoted as D_1^{For} and the amount domestic investors buy be D_1^{Dom} with $D_1 = D_1^{For} + D_1^{Dom}$. We assume that there is no cost of defaulting on government debt held by foreigners, other than that of disrupting the credit markets and postponing any new borrowing to next period. There is, however, a cost to the second period government of defaulting on domestically held government debt which, in reduced form, results in the government spending $z\,D_1^{Dom}(1+r)$ less on populist measures, where $z > 1$.

The parameter z reflects the *vulnerability* of the domestic financial sector to government bond default. Vulnerability is likely to be high in developed countries. Developed country financial systems are typically more arm's length and market based, with the credit worthiness of financial sector participants of critical importance in supporting the high transaction volume. Any hint that any of the players could be impaired as a result of losses on their holdings of government assets could lead to questions about their creditworthiness, and a dramatic fall in financial activity and hence economic output (see, for example, Gennaioli, Martin and Rossi (2011)). For any given size of government bonds held by the financial sector, the cost of government default could be higher in rich countries because more transactions are disrupted. Another channel could be that government bonds are collateral (see Bolton and Jeanne (2011)) for transactions where even the slight hint of default risks could make transaction costs prohibitive. Again, many more such transactions are likely to take place in a rich country's financial system.

Of course, *z* could also be high in underdeveloped, repressed financial sectors, where financial institutions may be forced to hold disproportionate amounts of government debt because few other buyers can be found. However, the financial sector in poor countries typically accounts for a much smaller fraction of economic activity because financial penetration is low. So the costs of default are unlikely to be as high as in a developed country. Our model and its results do not depend on the determinants of *z*, though the empirical implications do depend on the costs of default increasing as a country gets richer. We will allow vulnerability *z* to be endogenously determined later in the paper. The timeline of the model is in Figure 1.

II. Solving for Debt and Default

We solve the model backwards. Since date 2 is the last period, the second-period government cannot borrow, and will repay existing debt if the cost of default exceeds the funds repaid, that is if,

$$D_1(1+r) \le zD_1^{Dom}(1+r). \qquad (1)$$

This represents the country's *willingness to pay*. Since $D_1 = D_1^{For} + D_1^{Dom}$, the willingness-to-pay constraint can also be expressed as a constraint on the foreign borrowing of the first-period government $D_1^{For} \le (z-1)D_1^{Dom}$, which is why we require *z* to be greater than 1.

Furthermore, at date 2, the second-period government will raise taxes to the maximum possible so that $t_2 = t^{Max}$. The government therefore has *the ability to pay* its debt if

$$D_1(1+r) \le t^{Max} f_2(k_1). \tag{2}$$

(1) and (2) are the key constraints in determining future debt capacity. Now let us fold back to date 1 when the first period government has to choose whether to default or not on initial debt D_0, the tax rate t_1, and the amount of debt it will borrow, D_1, if it has not defaulted.

2.1. Corporate Investment and First Period Government's Maximization Problem

Start first with the private sector's investment incentives. Corporations maximize the present value of their post-tax cash flows net of the cost of investment, discounted at the opportunity rate from lending in the bond market:

$$\max_{k_1} \frac{1}{(1+r)}(1-t_1) f_1(k_1) + \frac{1}{(1+r)^2}(1-t_2) f_2(k_1) - k_1. \tag{3}$$

Clearly $k_1 \le E_0$ for external borrowing to be feasible (external borrowing is infeasible if there is no domestically-held government debt going into the last date, and a positive level of domestically-held government debt requires domestic private sector financial savings, so $k_1 < E_0$). Assume E_0 high enough that the inequality holds for the emerging market. Then, the first-order condition for corporate investment satisfies

$$\frac{1}{(1+r)}(1-t_1) f_1'(k_1) + \frac{1}{(1+r)^2}(1-t_2) f_2'(k_1) - 1 = 0. \tag{4}$$

We denote the solution to (4) as $k_1^*(t_1,t_2)$. Corporate investment $k_1^*(t_1,t_2)$ obviously decreases in the level of tax rates t_1 and t_2. Since $t_2 = t^{Max}$ throughout, in what follows we adopt the simpler notation $k_1^*(t_1)$.

Now consider the myopic government's objective of maximizing spending this period. If it does not intend to default, it will solve

$$\max_{D_1, t_1} D_1 - D_0(1+r) + t_1 f_1(k_1^*(t_1)) \tag{5}$$

subject to constraints (1) and (2).

If the government does intend to default on its debt, it expects to be shut out from the debt market and will maximize

$$\max_{t_1} \quad t_1 f_1(k_1^*(t_1)) \tag{6}$$

We first assume no default, then the case with default, and compare the two to determine the default decision.

2.2. No default by first-period government

Clearly, assuming they do not expect default, government debt bought by domestic investors in the first period will equal domestic private savings (given their mild home bias, they do not invest abroad if expected returns are equalized), so $D_1^{Dom} = (E_0 - k_1^*)$.[8] Substituting into the willingness-to-pay constraint, we get

$D_1 \leq z(E_0 - k_1^*(t_1))$.

Now, consider the government's decision. Since the government derives benefits from spending, it wishes to borrow as much as possible until one of the two constraints

[8] We assume that the transition from poverty to middle income is defined by the condition $E_0 > k_1$ so financial savings of the private sector are positive.

binds. Depending upon which constraint binds first, the remaining part of the program – choosing the tax rate – can be analyzed separately under each constraint. Before we analyze each case separately, we consider which constraint – ability to pay or willingness to pay – binds and when.

Constrained by ability to pay or willingness to pay?

As the first-period tax rate (t_1) is varied, the ability-to-pay constraint binds before willingness-to-pay constraint if and only if

$$\frac{1}{(1+r)} t_2 f_2(k_1^*(t_1)) \leq z(E_0 - k_1^*(t_1)). \qquad (7)$$

Given that k^* decreases in t_1, we have

Lemma 1: There exists a level of corporate tax rate in the first period, $\bar{t}_1$, such that only the ability-to-pay constraint binds if $t_1 > \bar{t}_1$ and only the willingness-to-pay constraint binds if $t_1 < \bar{t}_1$. The threshold level $\bar{t}_1$ is decreasing in the starting endowment E_0 and deadweight cost of default z.

The intuition is straightforward. As the corporate tax rate rises, investment falls, reducing the next government's tax proceeds. Simultaneously, domestic financial savings increase, allowing government domestic borrowing to increase, increasing the deadweight costs suffered by next government from defaulting on sovereign debt, and increasing the willingness to pay. Thus, at high corporate tax rates, it is the ability-to-pay constraint that binds. Conversely, at low tax rates, the willingness-to-pay constraint binds.

Binding Ability To Pay

When the binding constraint is the ability to pay, the first-period government's maximization problem is given by

$$\max_{t_1} \frac{1}{(1+r)} t_2 f_2(k_1^*(t_1)) + t_1 f_1(k_1^*(t_1)). \tag{8}$$

Effectively, the current government chooses the tax rate to maximize the proceeds of taxes in both periods since it can borrow against next period's tax proceeds by taking on debt and passing on the burden of repayment to the next government. The optimal tax, t_1^A, satisfies the first-order condition:[9]

$$\left[\frac{1}{(1+r)} t_2 f_2'(k_1^*) + t_1 f_1'(k_1^*)\right]\frac{dk_1^*}{dt_1} + f_1(k_1^*) = 0. \tag{9}$$

Note that $\frac{dk_1^*}{dt_1} < 0$. At low tax rates, proceeds increase in tax rate (the direct effect of a higher marginal tax rate), but if the tax rate becomes very large, the indirect effects as it reduces corporate investment dominate – the Laffer Curve effect. With standard concavity of the optimization problem we have

Lemma 2: In the region where only the ability-to-pay constraint binds, the first-period government's optimal tax rate is given by t_1^A*, which solves* (9)*, and is unaffected by the starting endowment* E_0 *and deadweight cost of default z.*

[9] A sufficient condition to ensure the second-order condition is negative is that $\frac{d^2k_1^*}{dt_1^2} < 0$. Using condition (4), this is always met when $f_1''' < 0,\ f_2''' < 0$.

Next, we consider the solution when the willingness to pay is the binding constraint.

Optimal Taxes and Borrowing in the Willingness-to-pay Region

In this case, the first-period government's problem is

$$\max_{t_1} t_1 f_1(k_1^*(t_1)) + z(E_0 - k_1^*(t_1)) \tag{10}$$

Now, the government's tax rate choice becomes interesting. It can no longer borrow fully against next government's tax revenues as the next government is constrained by its willingness to repay public debt. On the one hand, the current government may want to lower the tax rate to induce the corporate sector to invest more, thus allowing the taxable revenues to increase. This is the incentive effect of lower taxes. On the other hand, lowering the corporate tax rate shrinks the financial savings in the economy, shrinking the domestic appetite for government debt, reducing the next government's willingness to pay, and in turn the current government's ability to borrow. Put differently, the short-horizon government may want to "crowd out" private real investment (and economic growth) in an attempt to increase its short-term borrowing and spending capacity.

The optimal tax rate trades off these two effects. We denote the solution to this program as t_1^W and it satisfies the first-order condition: [10]

$$\left[-z + t_1 f_1^{'}(k_1^*)\right]\frac{dk_1^*}{dt_1} + f_1(k_1^*) = 0. \tag{11}$$

[10] Again, a sufficient condition to ensure the second-order condition is negative is that $\frac{d^2 k_1^*}{dt_1^2} < 0$ which is always met when $f_1^{'''} < 0,\ f_2^{'''} < 0$.

Lemma 3: In the region where only the willingness-to-pay constraint binds, the first-period government's optimal tax rate t_1^W *satisfies (11), and is not affected by the starting endowment* E_0*, but is increasing in deadweight cost of default z.*

Optimal Taxes and New Borrowing

Comparing the first-order condition in the willingness-to-pay region (11) with that in the ability-to-pay region (9), it follows that $t_1^A < t_1^W$. Intuitively, raising taxes in the ability-to-pay region lowers debt capacity, while it increases debt capacity in the willingness-to-pay region. Therefore, the optimal tax is higher in the latter. Combining the analysis,

Proposition 1: Conditional on not defaulting, the first-period government chooses a tax rate t_1^* *where (i)* $t_1^* = t_1^A$*, if* $t_1^W \geq t_1^A > \overline{t_1}$*; (ii)* $t_1^* = \overline{t_1}$*, if* $t_1^W \geq \overline{t_1} \geq t_1^A$*; and, (iii)* $t_1^* = t_1^W$ *otherwise. Further, new government borrowing* D_1^* *is given by the condition:*

$$D_1^* = \min\left[\frac{1}{(1+r)} t_2 f_2(k_1^*(t_1^*)), z\left(E_0 - k_1^*(t_1^*)\right)\right], \tag{12}$$

where $k_1^*(t_1^*)$ *satisfies* (4) *for* $t_1 = t_1^*$ and $t_2 = t^{Max}$.

To understand the solution better, let us consider how it varies as we change the starting endowment E_0 and the sophistication of the financial sector *z*, which determines the deadweight cost of default. As Lemma 1 indicates, the threshold level $\overline{t_1}$ is decreasing in the starting endowment as well as the sophistication of the financial sector. We can show

Corollary 1: If the starting endowment E_0 is sufficiently low, that is, below some threshold level $\underline{E}_0$, then the economy is in the willingness-to-pay region ,with $\overline{t}_1 > t_1^W \geq t_1^A$, and as E_0 increases, neither the tax rate t_1^* nor investment $k_1^*(t_1^*)$ increase. Government borrowing D_1^*, however, increases. As E_0 increases above the threshold $\underline{E}_0$ but is below a higher threshold $\overline{E_0}$, $t_1^W \geq \overline{t}_1 \geq t_1^A$,and both ability-to-pay and willingness-to-pay constraints bind. The tax rate t_1^* now falls as E_0 increases, and government borrowing continues to increase. Finally, when $E_0 > \overline{E_0}$, the economy is in the ability-to-pay region, with $t_1^W \geq t_1^A > \overline{t}_1$. In this region again, as endowment E_0 increases, the tax rate t_1^*, investment $k_1^*(t_1^*)$, and government borrowing D_1^* all remain unaffected.

Consider a simple example that allows us to illustrate Proposition 1 and Corollary 1. Let $f_1(k) = \alpha\theta k^\gamma$, $f_2(k) = (1-\alpha)\theta k^\gamma$, where $\alpha \in (0,1), \theta > 0, \gamma \in (0,1).$[11] Let $\alpha = 0.75, \theta = 3, \gamma = 0.66, t^{Max} = 0.675$ (for both periods), $r = 0.05, E_0 = 1.0, z = 1.1$.

As Figure 2 suggests, optimal tax rates (assuming no default for now), given by t_1^*, decrease in the endowment for intermediate values of the endowment (when both constraints bind simultaneously); additional endowments increase willingness to pay, so tax rates have to fall for the economy's ability to pay to keep pace. However, the

[11] Closed form expressions for the example are in the appendix B.

relationship is flat both for very high and very low levels of endowment. This is because the optimal tax when only one of the constraints binds is independent of endowments.[12]

As Figure 3 suggests, new government borrowing D_1^* increases for low and moderate levels of endowment when the binding constraint is the willingness to pay, and the marginal addition to endowment goes into the domestic debt market, thus expanding debt capacity. However, there is no effect on debt at high levels of endowment – for countries with large endowments, debt is capped by their ability to pay, which is not affected at the margin by the additional endowments going into the domestic debt market.

In Figures 4 and 5, instead of varying endowment, we vary the productivity parameter θ. At low productivity levels, the economy's ability to pay is the constraint, whereas at high productivity levels, its willingness to pay is the constraint. In the region where both bind, the optimal tax increases in productivity – higher productivity means more goes to real investment, which means higher taxes are needed for funds to flow to the financial sector.

Less intuitive is that D_1^* is non-monotone in productivity (see Figure 5), rising initially and falling eventually. That new government borrowing rises with productivity in the ability-to-pay region is natural given that the more productive private sector will produce greater cash flows in the future, which alleviates the constraint. In the willingness-to-pay region, however, the short-horizon government has to tax harshly so as to boost domestic financial savings. When productivity is high, the required tax rate to

[12] Note that at very low levels of endowment, the unconstrained optimal tax rate t_1^W exceeds t^{Max} so that t_1^* is truncated at t^{Max}.

maintain a commensurate willingness to pay can be substantial, and debt capacity D_1^* can fall with productivity.

We can also characterize what happens as the parameter *z* representing the deadweight cost of default varies.

Corollary 2: If the deadweight cost parameter z is sufficiently low, that is, below some threshold level $\underline{z}$ *, then the economy is in the willingness-to-pay region and as z increases, government borrowing* D_1^* *and the tax rate* t_1^* *increase, while investment* $k_1^*(t_1^*)$ *decreases. As z increases above the threshold* $\underline{z}$ *but is below a higher threshold* $\bar{z}$ *,* $t_1^W > \bar{t}_1 > t_1^A$ *,and both constraints bind. The tax rate* t_1^* *now falls as z increases, and government borrowing continues to increase. Finally, if z increases over the threshold* $\bar{z}$ *, then the economy is in the ability-to-pay region. In this region, as z increases, government borrowing* D_1^* *, the tax rate* t_1^* *and investment* $k_1^*(t_1^*)$ *remain constant.*

Interestingly, the relationship between the deadweight cost parameter and the tax rate is non-monotonic, reflecting the effects of differing binding constraints. In particular, in the region where the willingness to pay binds, an increase in *z* increases the ability of the government to borrow in proportion to the amounts that go into financial savings, giving it a greater incentive to tax real corporate investment. This could be thought of as a form of "economic repression".

The remaining step is to analyze when the first-period government chooses to default versus repaying the legacy debt. We turn to that now.

2.3. No-default level of legacy debt

In case the government chooses to default, it is shut out from the debt markets. Its total resources available for spending come only from tax collection but it is free from repaying the debt of the past. Therefore, conditional on default, it chooses t_1 to solve

$$\max_{t_1} t_1 f_1(k_1^*(t_1)). \tag{13}$$

The solution to this problem is denoted as t_1^{**} and it satisfies the first-order condition:

$$t_1 f_1^{'}(k_1^*) \frac{dk_1^*}{dt_1} + f_1(k_1^*) = 0. \tag{14}$$

Note the tax rate conditional on an intent to default is in between the low tax rate when the government wants to enhance the future government's ability to pay debt, and the higher tax rate if it wants to enhance the future government's willingness to pay debt. The first-period government defaults if and only if

$$t_1^{**} f_1(k_1^*(t_1^{**})) \geq D_1^* - D_0(1+r) + t_1^* f_1(k_1^*(t_1^*)). \tag{15}$$

On inspection, we see:

Proposition 2: There is a threshold level of date-0 (legacy) debt D_0^{Max} *such that the first-period government defaults on this debt if and only if* $D_0 \geq D_0^{Max}$*, where* D_0^{Max} *is the value of* D_0 *that equates both sides of* (15)*, and where in turn* D_1^* *and* t_1^* *are as described in Proposition 1,* t_1^{**} *satisfies* (14)*, and* $k_1^*(t_1)$ *solves* (4)*. The no-default level of legacy debt* D_0^{Max} *is increasing in the initial endowment* E_0 *and the deadweight cost of default, z.*

In other words, we obtain the natural result that short-horizon governments are more likely to default following an adverse endowment shock, which reduces the willingness to pay of successor governments, and hence the ability to borrow today. Similarly, they are also more likely to default if the likely damage to the domestic financial sector from a future default is smaller, constraining their ability to borrow today.

We plot D_0^{Max} for different values of endowment in Figure 3 and for different values of productivity in Figure 5. D_0^{Max} is always weakly below D_1^*, suggesting the government finds deviations from the short-term revenue-maximizing tax rate to enhance debt capacity worthwhile only if it produces a net inflow from the debt markets. D_0^{Max} is equal to D_1^* only when parameters are such that the government selects the short-term revenue-maximizing tax rate even when it is trying to maximize D_1^*. Finally, as with debt capacity D_1^*, the default point D_0^{Max} is also increasing in endowments but non-monotone (first increasing and then decreasing) in private sector's productivity. We also plot the tax rate t_1^{**} that the short-term government charges if it defaults on legacy debt. This tax rate is invariant in endowment (Figure 2), and under the specific functional form for the example also invariant in productivity (Figure 4), and lies in between the tax rates charged absent default at the extreme values of endowment and productivity.

III. Alternative Assumptions

Let us now examine alternative assumptions to those made in our model.

3.1. Variable Horizon

A key assumption is that the government is myopic. Let us now compare the short-horizon government's decision to default with that of a long-horizon government, which cares about spending in both periods. Interestingly, a long-horizon government defaults more, that is, over a greater parameter range than a short-horizon government. Alternatively, the myopic government would borrow more at date 1 than a long-horizon government.

Formally, the government's objective function with a discount factor $\beta > 0$ is

$$\left[D_1 - D_0(1+r)\right] - \beta D_1(1+r) + t_1 f_1\left(k_1(t_1)\right) + \beta t_2 f_2\left(k_1(t_1)\right) \quad (16)$$

By inspection, if $\beta = \frac{1}{(1+r)}$, then a long-horizon government sees no benefit in bringing forward spending by borrowing, since that cuts into future spending. So it gets no benefit from having continued access to debt markets. As a result, it does not want to repay the legacy debt, and will always default. Now let us turn to see what happens at lower levels of β. We will show that the amount of legacy debt it is willing to service falls in β.

When the government's borrowing is constrained by its ability to pay, it can borrow up to second period revenues, so $D_1 = \frac{t_2 f_2}{1+r}$. Substituting in (16), the government's maximization simplifies to (8), which is just the short-horizon government's problem. So $t_1^{A,\beta=0} = t_1^{A,\beta>0}$. This should not be surprising because, as we noted earlier, the ability to borrow in the debt markets effectively lengthens the short-horizon government's horizon, and makes it fully internalize long-term revenue when ability to pay is the constraint.

However, the government's objective function when only the willingness to pay constraint binds is not the same as that of the short-horizon government. In that region, $D_1 = z(E_0 - k_1^*(t_1))$. Substituting in (16) and differentiating w.r.t. t_1, we get

$$\left[-z+t_1 f_1^{'}(k_1^*)+z\beta(1+r)+\beta t_2 f_2{}'(k_1^*)\right]\frac{dk_1^*}{dt_1}+f_1(k_1^*)=0. \tag{17}$$

Comparing with (11), we see that $t_1^{W,\beta=0} > t_1^{W,\beta>0}$. Moreover, differentiating w.r.t. β and using the envelope theorem, we see that $\frac{d\,t_1^{W,\beta>0}}{d\beta} < 0$; As the government cares more about the future, the tax rate it sets in the willingness-to-pay region falls. This is because it internalizes to a greater extent the distortions stemming from the higher tax rate needed to move resources into the financial sector so as to ensure greater willingness to pay for future governments. Note also that $\overline{t_1}$, which is the tax rate demarcating the boundary between the willingness to pay region and the ability to pay region, does not vary with β. This means that as β rises, the government moves from not being constrained by the willingness to pay to being constrained by the willingness to pay.

Finally, if the government decides to default, it sets t_1 to maximize

$$G \equiv t_1 f_1\left(k_1(t_1)\right)+\beta t_2 f_2\left(k_1(t_1)\right). \tag{18}$$

Let t_1^{**} be the solution. Then the government will not default iff

$G(t_1^{**}) \le D_1^* - D_0(1+r) - \beta D_1^*(1+r) + G(t_1^*)$ where D_1^* is the maximum amount of debt it can borrow at date 1. Rewriting, the maximal legacy debt that will be repaid is

$$D_0^{Max} = \frac{1}{(1+r)}\left[D_1^*(1-\beta(1+r))\right] + \frac{1}{(1+r)}\left[G(t_1^*)-G(t_1^{**})\right] \tag{19}$$

The first term in square brackets on the right hand side is the effective spending benefit from new borrowing. The shorter is the horizon, the more the government sees this to be. The second term, which is negative, is the effective spending cost from the fall in tax revenue as taxes are distorted to expand debt capacity. Thus the government is willing to service more legacy debt if the perceived benefits of new borrowing are high and the perceived costs of the fall in tax revenue are low. Differentiating w.r.t. β, we get :

Proposition 3: As the government's discount factor β *increases, the maximum legacy debt* D_0^{Max} *it is willing to repay falls. When* $\beta = \frac{1}{1+r}$*, the government is not willing to repay any legacy debt, that is,* $D_0^{Max} = 0$ *. The amount the government can borrow,* D_1^**, also decreases in* β*.*

Therefore lengthening horizons reduces the attractiveness of repaying legacy debt at date 0. With longer horizons, new borrowing is less attractive because, first, the government internalizes to a greater extent the future costs of repaying new debt, and, second, the government sees diminished revenues, both today and in the future, from setting the higher tax rate today that is needed to signal its willingness to pay. Longer horizons reduce the first period government's debt capacity (and of governments before it). By contrast, a short-horizon government will default under fewer circumstances because it values the benefits from immediate expenditures while disregarding the costs of new borrowing and lower future revenues, which largely fall on future governments. It will also borrow more at date 1.

Figures 6a and 6b illustrate for the parameters in our example how tax policy and debt capacity behave as a function of β , the inverse of government myopia, as endowment is varied. Figures 7a and 7b repeat the exercise as private sector's productivity is varied. As β rises, the government becomes more long-horizon in its decision-making. Its optimal tax rate given no default falls (so does its borrowing D_1^* in this case) and the maximum amount of legacy debt it will pay, D_0^{Max}, falls as well.

3.2. Valuable Government Spending and the Benefits of Short Horizons

Note that without any economic role for government spending, even the long-horizon government's taxation policy is suboptimal relative to the first-best, which is simply to have no taxes whatsoever. This, however, is again just for simplicity and our qualitative comparisons would hold even if we added a multiplier on government spending. Specifically, suppose government spending yields value that is *m* times the spending. Then, the objective function of the government (no matter of what type) does not change since all spending is multiplied by *m*. However, when *m* is greater than one but not too large, some government spending is efficient, and its level is obtained by equating the marginal return of private sector's capital investment to the multiplier on government spending.[13]

If some government spending is efficient, then a government could benefit its country by generating some additional debt capacity. Note that a short horizon government can generate more debt capacity than a long horizon government, simply because the former does not internalize the cost of repaying the debt, and therefore can commit to servicing it. Somewhat paradoxically then, the long horizon government may be unable to undertake valuable ex-ante spending precisely because its concerns about the ex-post distortions entailed in repaying such spending make lenders distrust it. The ex-

[13] When the multiplier is sufficiently large, it may be first-best efficient to have all spending be done by the government rather than some real investments being made by the private sector. If the multiplier is not too large, the private sector equates the present value of the after tax cash flows on the marginal dollar invested to 1. This achieves the first best when the tax rate is the same across periods and set at $\frac{1}{1-t} = m$. So long as $m > 1$, the first-best tax rate $t>0$ and some government spending is efficient in the first-best outcome.

post distortions may, however, be smaller than the ex-ante benefit, in which case short horizons may be beneficial.

3.3. Endogenous choice of vulnerability and uncertainty

Thus far, we have taken vulnerability, z, as given. Governments do have some freedom in choosing z, for instance, pushing it higher by encouraging a repo market in government assets.

A good example of quasi-public debt, which is so entangled with the financial sector's transactions that it is hard to default on, is the debt of government-sponsored enterprises (GSE), Fannie Mae and Freddie Mac, in the United States. A significant portion of the GSE debt is held by the financial sector and by foreign governments who trade it freely in a highly liquid and sophisticated market – the so-called "agency debt" market. Agency debt serves the role of collateral for open-market operations (OMO) with the Federal Reserve – equivalent to the role played by Treasuries, so that any default would disrupt the transactional services associated with this debt.[14] Market participants reasonably concluded that the special treatment accorded GSE debt as OMO collateral and the associated centrality of the agency debt market indicated that the United States government would stand behind this debt in the final eventuality. This implicit guarantee, in turn, enabled the GSEs to borrow substantially despite being privately held enterprises. The implicit guarantee was indeed honored by the government when GSEs were placed

[14] Further, default on GSE debt would not only impose collateral damage on the domestic financial sector, but also raise concerns about implications for repayment on Treasury debt: "They (foreign governments) wanted to know if the U.S. would stand behind the implicit guarantee – and what this would imply for other U.S. obligations, such as Treasury bonds." – Henry Paulson, the United States Treasury Secretary during Fall 2008, in his account of the crisis, *On the Brink*, Business Plus, 2010.

in government "conservatorship" in September 2008, without debt holders suffering any losses.[15]

Once z becomes a choice variable, willingness to pay is no longer a constraint on borrowing. With no uncertainty, the problem simplifies to determining optimal debt when the only constraint is the ability to pay. Given the optimal date-1 tax rate t_1^A, the level of

z is set such that $z \geq \frac{1}{(1+r)} \frac{t_2 f_2(k_1^*(t_1^A))}{\left(E_0 - k_1^*(t_1^A)\right)}$, and date-1 borrowing will be

$D_1^* = \frac{1}{(1+r)} t_2 f_2(k_1^*(t_1^A))$.

Of course, so long as the government does not default at date 2, the cost of default stemming from z is never incurred. To make the choice of z at date 0 interesting, we extend the model to allow for uncertainty in date-2 output.

Specifically, suppose that with probability q, second-period output will be high at $f_2^H(k_1) > 0$, and otherwise low at $f_2^L(k_1) = 0, \forall k_1$. Hence, the private sector's problem can be restated as $\max_{k_1} \frac{1}{(1+r)}(1-t_1) f_1(k_1) + \frac{1}{(1+r)^2}(1-t_2) q f_2^H(k_1) - k_1$, and its optimized investment level k_1^* is given by the modified first-order condition

$$\frac{1}{(1+r)}(1-t_1) f_1'(k_1) + \frac{1}{(1+r)^2}(1-t_2) q f_2^{H\prime}(k_1) - 1 = 0.$$

Now, whenever debt is to be repaid in the second period, the country will default in the low state and incur the default costs from disruption of the domestic financial sector. Denoting the face value of newly issued debt as D_1 (so that its market value is qD_1), the government's problem is

[15] See Acharya, Nieuwerburgh, Richardson and White (2011), Chapter 4, for a detailed discussion.

$$\max_{t_1,z,D_1} \quad \left[qD_1 - D_0(1+r)\right] - \beta q D_1(1+r) - \beta(1-q)zD_1^{Dom}(1+r) + t_1 f_1\left(k_1(t_1)\right) + \beta q t_2 f_2^{H}\left(k_1(t_1)\right) \tag{20}$$

subject to the constraints

$$D_1(1+r) \le \min[t_2 f_2^{H}, zD_1^{Dom}(1+r)] \tag{21}$$

and

$$D_1^{Dom} \le [E_0 - k_1(t_1)]. \tag{22}$$

Since there is no reason to set vulnerability higher than what is needed to enforce maximum debt repayment, $D_1 = zD_1^{Dom}$. Substituting in the objective function, it is clear it is increasing in zD_1^{Dom} iff $\beta \le \frac{q}{1+r}$. If this condition is satisfied (which is the only interesting case), we have $zD_1^{Dom} = \frac{t_2 f_2^{H}}{1+r}$. Substituting for zD_1^{Dom} and D_1 in the objective function, differentiating w.r.t. t_1 and collecting terms, we obtain the first-order condition with respect to t_1 as $\left[\left(\frac{q}{1+r} - \beta(1-q)\right)t_2 f_2^{H\prime} + t_1 f_1'\right]\frac{dk_1^*}{dt_1} + f_1 = 0$. Using the envelope theorem, and knowing that $D_1 = \frac{t_2 f_2^{H}}{1+r}$, $D_1^{Dom} = \left[E_0 - k_1^*(t_1)\right]$, and $z^* = \frac{t_2 f_2^{H}}{(1+r)[E_0 - k_1^*(t_1)]}$, we can show

Proposition 4: Only sufficiently myopic governments $\left(\beta \le \frac{q}{1+r}\right)$ *choose to make the financial sector vulnerable (z> 0), and for such governments,* $\frac{dt_1^*}{d\beta} > 0$, $\frac{dD_1}{d\beta} < 0$, $\frac{dz^*}{d\beta} < 0$.

Greater myopia makes governments care about new borrowing to service old debt, and hence about making the financial sector vulnerable. Interestingly, with *z* endogenous, the optimal date-1 tax increases as the government's horizon increases. This is because the expected cost to the government at date 2 – in terms of debt repayments and deadweight costs of default – exceeds the resources obtained from taxation at that date. Therefore, the higher the discount factor of the government, β, the less it wants to borrow. Because the only limit on borrowing is date-2 production, the government lowers date-2 production by raising the tax rate. It also reduces *z* to match the lower value of debt payment that has to be committed to.[16]

IV. Implications

Our paper suggests links between government horizons, domestic debt, external debt, and the health of the financial sector that could be tested. But first, what governments are myopic and how might one measure it?

4.1. Which Governments are Myopic

A democracy with a popular leader who has a high expectation of being re-elected is likely to have longer horizons than a fragile coalition with an unpopular leader. The longer horizon of the former government might induce it to renegotiate outstanding debt (a confounding effect, of course, is that the act of renegotiation itself may be popular if a country is very highly indebted) or take on less new debt.

One might be tempted to argue that dictatorships have longer horizons and therefore should be less reliable than democracies in servicing debt – if so, we would expect to see debt repudiation after coups but not after democratic changes. We would

[16] In contrast, the effect of uncertainty (q) is ambiguous. Note that higher q has the direct effect of making private sector's investment more attractive, all else equal, which expands date-2 production and therefore the borrowing capacity. Thus, on the one hand, a higher tax rate enables the government to collect more today without as much of a reduction of future taxes which are higher when q increases; on the other hand, a higher tax rate today reduces corporate investment (which is more productive in an expected sense as q increases) and thus reduces future tax collection. So we cannot unambiguously sign the effects of a higher q on the tax rate and debt proceeds. This ambiguity applies both when financial sector sophistication (*z*) is exogenous or chosen endogenously by the government.

also expect lower debt capacity for dictatorships. However, many dictatorships are illegitimate and unstable, and could have shorter horizons than democracies. Without delving deeper into the nature of the dictatorship, it is hard to be categorical.

Of course, one way to proxy for the effective horizon of a government is the ratio of its spending on activities that will pay off in the long term (e.g., infrastructure investment) to spending that has more immediate and visible benefits (e.g., income transfers to people). Our model would then suggest that governments that invest more for the long term would be less inclined to over-borrow, and more inclined to renegotiate legacy debt.

Conversely, our model explains why some myopic governments keep current on their debt, even when most market participants suggest it would be better for them to default. Indeed, the larger the primary deficit the government needs funded, the greater the incentive for the government to do what it can to keep lenders happy. For instance, in Europe, so long as the Euro area and multilateral institutions are willing to provide funding to tide the country over, myopic governments really see no benefit in default, no matter how much debt accumulates. That does not, however, mean that servicing debt or taking actions that maintain or expand long term debt capacity (such as creating greater vulnerability) are in the country's interest.

In this vein, our paper suggests a rationale why constitutional limits on government debt might be useful in countries where governments tend to be myopic. Alternatively, multilateral agreements (such as the fiscal compact that is being attempted in Europe today), if enforceable, could be a way for a country to restrain future governments from borrowing too much.

4.2. The Nature of Defaults

Our model suggests that for developing countries, the key concern for creditors of the sovereign is the time profile of the country's debt service burden and fears that the country will be required to make net debt repayments for a while that its myopic government will not honor. This means that countries may face sudden stops of lending if their expected debt profile goes even a little out of kilter, and the country will not be able to regain access to loans until its debt is rescheduled – though sometimes a minor rescheduling (see later) will be enough.

Multilateral lending institutions like the IMF can help sometimes, not just because they hold the carrot of additional loans, but because they can press the developing country government to cut unnecessary spending that will help put the country back on a sustainable (i.e., net positive debt inflows) debt path.

For rich countries, though, the direct cost of default is substantial, and default looms only when the country simply does not have the political and economic ability to raise the revenues needed to repay debt – as, for example, in the case of Greece. When rich countries are in danger of default, outside agencies that lend them more without helping these countries expand productivity and growth are only postponing the inevitable messy restructuring. Rich country defaults are more likely to be solvency defaults rather than liquidity defaults, and a simple rescheduling of debt without significant haircuts to face value is unlikely to help the country regain access to private markets.

In our model, the costs of default are sizeable only when the country becomes rich (when it rarely defaults), but the costs of default (as well as the benefits) when it is developing are small. This may explain some curious aspects of defaults that are less easily explained by models that have high default costs no matter what the country's state of development. Specifically, in models where large penalties are triggered by default, the extent of the default typically should not matter (again see, for example, Eaton and Gersovitz (1981)). If so, the country might as well repudiate all its debt following the maxim "in for a penny, in for a pound". Yet countries rarely do this.[17] Developing country debt renegotiations have ended with debtors agreeing to repay nearly 90 percent of present value of the outstanding debt (see the case of Uruguay's 2003 exchange described in Sturzenegger and Zettelmeyer (2005)).

The primary objective in developing country debt renegotiations seems to be to find a mutually acceptable deal that will allow the country to regain access to the debt markets. Indeed, following a default in our model, a relatively small haircut in the face value of existing debt (or a rescheduling of maturities) could make the sequence of cash inflows from the external debt markets positive for each successive government until the country becomes rich and has a sizeable cost of default. The small haircut to existing debt would therefore be enough to make the debt sustainable. A greater haircut on the debt is not something the myopic government renegotiating a past default needs, nor is it likely to want to prolong renegotiation (and its exclusion from external capital markets while thus engaged), no matter what the future benefit to the country. Given the purpose of renegotiation is to regain debt market access with positive net inflows, the loss of market access can indeed be temporary, and debt haircuts very moderate.[18]

[17] One could, of course, argue that the less that is repaid, the worse the type the country reveals itself to be.
[18] Tough negotiators, like the Argentinian government in the 2003-2005 debt negotiations, which till date of writing had yet to clear its arrears, are likely to be the exception, probably because their horizons are

4.3. Debt Profiles

Our paper also suggests that countries at the margin of their capacity to borrow should see a positive correlation between their domestic bank holdings of government bonds, and external issuances. The bond holdings of domestic banks give external creditors comfort.

This may be one explanation for the large holdings of government bonds by the banks of a distressed country. Acharya, Drechsler and Schnabl (2010) document that the 91 European banks stress-tested in 2010 held sovereign bonds on average up to a sixth of their risk-weighted assets, and that within these sovereign bond holdings, there is a "home bias" in that banks held substantial portion in own government bonds. Indeed, the home bias in sovereign bond holdings was the highest for countries with the greatest risk of government debt default,[19] suggesting they are positively correlated; Countries that are at greater risk of default also have banks whose portfolios are stuffed with own government debt.

One explanation (see Diamond and Rajan (2011)) is that banks have a natural advantage in loading up on risks that will materialize when they themselves are likely to be in default. But a second, not mutually exclusive, explanation is ours -- that countries have to prove to new bondholders their enduring resolve to service their foreign debt, and this is best done by making the costs of default on domestic debt prohibitively costly.

Of course, for countries that exceed their capacity to borrow without coercion, coercion of domestic institutions ("financial repression") is always the last resort. So the

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longer or because there is domestic political gain (that we do not model) to forcing large haircuts on unpopular foreign debt holders.

[19] In particular, in the stress test data released by European regulators in April 2010, banks of Greece, Ireland, Portugal, Spain and Italy held on average more than sixty percent of their government bonds in own government bonds.

last throes of a government in financial distress, faced with a sudden stop in external funding, will be to stuff domestic financial institutions with its debt either through explicit increases in reserve requirements or through mandates. In this case, the positive correlation between domestic bank holdings of government bonds and external issuances can break down.

Our model also suggests a possible explanation for why external debt becomes shorter and shorter maturity as a country's economic difficulties mount. Clearly, lenders want the ability to refuse to roll over their money if they see fundamental conditions deteriorating. But the key condition they could be monitoring is not the underlying country fundamentals but whether others are continuing to lend, giving the country an incentive to service debt – country liquidity and continuing debt service could be closely tied. So long as inflows are likely to be positive, the country will continue to service debt, and short-term lending can be quite lucrative. The key is to stop lending before others are anticipated to stop, which is why a country's access can become quite fragile, and prone to multiple equilibria, as its fundamentals deteriorate and maturities shorten. "Sudden stops" in lending, and subsequent country default, are the natural consequence (though their full modeling is beyond the scope of our model).

4.4. Selective Defaults

We have assumed that the country cannot default selectively on foreign holders of sovereign debt. All we need, however, is that the sovereign issues tradable claims where the nationality of the ultimate holder cannot be tracked easily ex ante. Indeed, a sovereign intent on maximizing borrowing has the incentive to issue such claims. For instance, default schemes of the following sort do not help avoid default costs – the country defaults on all its bonds and then pays only bondholders who come with their bonds and their passport proving nationality. In that case, it would be a simple matter once the default is declared for the foreigners to sell their bonds to the domestic investors, who would then collect on them. For similar reasons, a country cannot default on its debt and then recapitalize its domestic banks to avoid the dead-weight costs of default – anticipating the recapitalization, non-bank creditors would simply sell their bonds to the banks.

Of course, if creditors could be distinguished ex ante, selective defaults are possible. Consider the recent proposal of the Euro area think tank, Bruegel, for Euro area sovereigns to issue two kinds of debt, one (blue bond) that is guaranteed by all Euro area countries and will be held by domestic banks, and another (red bond) that is the responsibility of the issuing country only and which domestic banks will be prohibited from holding. Our model points out that there is very little reason for a country to service the red bonds. These will not be held by key domestic financial institutions, and therefore will not cause many ripples if they are defaulted on. This will make it hard for a country to borrow sizeable amounts through red bond issuances, which may indeed be the subtle intent of the proposal.[20]

[20] A somewhat related proposal is in Brunnermeier et al (2011). They suggest that all debt that is eligible for European Central Bank liquidity operations be managed centrally by a debt management office (and created as the senior-most tranche of a portfolio of government bonds of all countries). By losing this liquidity privilege, non-ECB-eligible debt of individual countries would not be readily held by the financial sector, lowering the countries' commitment to pay on such debt, and in turn, containing their debt capacity. An interesting parallel exists in the United States where federal debt (and debt of government-sponsored enterprises, as explained earlier) is accorded the special status in central bank open-market operations, but state-level debt is not. Interestingly, the state-level debt in the United States is found not to have much systemic inter-dependence unlike country-level debt in the Eurozone (Ang and Longstaff, 2011).

V. Related literature

There is a vast literature on sovereign debt that we do not have the space to do justice to (see Eaton and Fernandez (1995) or Tomsz (2007) for excellent discussions). Our work is most closely related to the recent literature explaining why rich countries repay because of the costs to the domestic financial sector of sovereign defaults. Our contribution to this literature is to explain why developing countries service debt even though the costs of default to them are small. Government myopia plays a key role in the explanation, as well as in determining fiscal policy and debt capacity.

Broner, Martin, and Ventura (2010) assume the costs of default on domestic bond holders and argue that the ability of foreigners who hold domestic bonds to sell out surreptitiously to domestic entities in the secondary debt markets ensures that the government will never be able to default selectively on foreigners. Thus the costs of defaulting on domestically held bonds, combined with liquid and anonymous secondary markets, ensures the sustainability of foreign borrowing. Gennaioli, Martin, and Rossi (2011) obtain a similar result in a model in which banks demand government bonds as a store of liquidity. Governments can increase domestic wealth by defaulting on external creditors, but the disruption of the domestic financial sector reduces this incentive. Thus, financial development in their setup, which boosts the leverage of banks, increases the government's cost of default. They also provide empirical support for the implications of the model concerning the complementarity of public and private borrowing in good times, and the severe disruptions to credit and output following sovereign defaults in countries with financially developed markets. In a similar vein, Andrade and

Chhaochharia (2011) estimate the effect of sovereign default on corporate earnings and valuation, and find that the cost is greater for financial firms than non-financial firms.

Bolton and Jeanne (2011) consider a setting in which governments want to maintain their credit quality so as to keep the inter-bank market working – government bonds serve a useful collateral role, and banks wish to hold government bonds of different countries for diversification reasons. While these forces allow the possibility for governments to borrow ex ante, the financial integration across countries leads ex post to contagion. Since the costs of contagion are not fully internalized by governments of weaker countries, there may be an inefficient equilibrium supply of government debt.

Finally, while we have argued that our paper offers an alternative lens to reputational models such as Tomsz (2007) through which to see sovereign debt, the two are not mutually exclusive. While we emphasize the short term outlook of governments and reputational models emphasize the reputational concerns of far-sighted governments, in reality most governments contain both short-term focused ministers as well as politicians who look to the long term. Whose influence is maximal, and when, will determine the kinds of behavior that one might see. More work is needed to nest the models and derive more detailed implications.

VI. Conclusion

We have made a number of assumptions in order to make the model more transparent. For instance, the two period model and the fact that we have investment only at date 1 allows us to solve for only one tax and one investment. We have also assumed the emerging market starts out with substantial endowment and legacy debt. A more general model would be one with no terminal date, and investment every period, and the country starts out poor with low endowment and low debt in the beginning. In Acharya and Rajan (2012), we solve such a dynamic model. While the dynamics introduce a number of interesting effects, the basic results of our simple model still hold. There are a number of other directions the model can be extended, including introducing a more direct link between government spending and election outcomes. There is ample scope for future research.

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Appendix A: Proofs

Lemma 1: Consider condition (7). Consider the difference between left hand and right hand sides given by $\frac{1}{(1+r)} t_2 f_2(k_1^*(t_1)) - z(E_0 - k_1^*(t_1))$. Since $f_2^{'} > 0$ and $\frac{dk_1^*}{dt_1} < 0$, it follows that this difference is a decreasing function of t_1. Thus, (assuming interior solutions) there exists a threshold tax rate $\bar{t}_1$ above which ability-to-pay constraint applies and below which willingness-to-pay constraint applies, and the threshold is given by the condition

$$\frac{1}{(1+r)} t_2 f_2(k_1^*(\bar{t}_1)) - z(E_0 - k_1^*(\bar{t}_1)) = 0. \tag{23}$$

Differentiating this condition with respect to E_0 and simplifying yields

$$\left[\frac{1}{(1+r)} t_2 f_2^{'}(k_1^*(\bar{t}_1)) + z\right] \frac{dk_1^*}{dt_1} \frac{d\bar{t}_1}{dE_0} = z. \tag{24}$$

Since $f_2^{'} > 0$ and $\frac{dk_1^*}{dt_1} < 0$, it follows that $\frac{d\bar{t}_1}{dE_0} < 0.$

Similarly, differentiating condition (23) with respect to *z* and simplifying yields

$$\left[\frac{1}{(1+r)} t_2 f_2^{'}(k_1^*(\bar{t}_1)) + z\right] \frac{dk_1^*}{dt_1} \frac{d\bar{t}_1}{dz} + k_1^*(\bar{t}_1) = E_0. \tag{25}$$

Since $k_1^*(\bar{t}_1) < E_0$ (investment is bounded above by economy's endowment), it follows that $\frac{d\bar{t}_1}{dz} < 0.$ Q.E.D.

Lemma 2: Note that the optimal interior tax-rate t_1^A in the ability-to-pay region satisfies equation (9) which is independent of E_0 and *z*. The rest of the lemma follows from the properties of $\bar{t}_1$ derived in Lemma 1. Q.E.D.

Lemma 3: Recall that t_1^A is given by the first-order condition (9) and t_1^W is given by the first-order condition (11). Since second-order condition is assumed to be met for both problems (see footnotes 9 and 10), and because $\frac{dk_1^*}{dt_1} < 0$, it follows that $t_1^W > t_1^A$. The properties of t_1^W in endowment E_0 and default cost *z* follow similarly to proof in Lemma 1 by taking derivatives of equation (11) with respect to E_0 and *z*, respectively. Q.E.D.

Proposition 1, Corollary 1 and Corollary 2: From Lemma 1, ability-to-pay constraint applies if tax rate is above $\overline{t_1}$ and willingness-to-pay constraint applies otherwise. Further, from Lemma 3, $t_1^W > t_1^A$. Hence, the three cases to consider are: *(i)* $t_1^W \geq t_1^A > \overline{t_1}$ *;* *(ii)* $t_1^W \geq \overline{t_1} \geq t_1^A$ *; and, (iii)* $\overline{t_1} > t_1^W \geq t_1^A$.

Under case (i), the feasible region is the ability-to-pay region, so that tax rate is set at the optimal interior tax rate t_1^A which from Lemma 2 is independent of E_0 and *z.*

Under case (ii), the feasible region is just the threshold point $\overline{t_1}$, which from Lemma 1 is decreasing in E_0 and *z.*

Under case (iii), the feasible region is the willingness-to-pay region, so that tax rate is set at the optimal interior tax rate t_1^W which from Lemma 3 is independent of E_0 but increasing in *z.*

Whether the equilibrium is in regions (i), (ii) or (iii) is determined by levels of parameters E_0 and *z.* Consider first the effect of varying E_0. As E_0 is raised, the optimal interior tax rates t_1^W and t_1^A corresponding to the willingness-to-pay and ability-to-pay regions, respectively, are unaffected, whereas the threshold rate $\overline{t_1}$ declines. It follows then that there exists threshold levels of E_0 (say $\overline{E_0}$ and $\underline{E_0}$) above and below which respectively case (i) and (iii) apply. Under case (i), the tax rate is t_1^A, which is independent of E_0; under case (iii), t_1^W which from Lemma 3 is independent of E_0; and in between the thresholds, the tax rate is $\overline{t_1}$, which from Lemma 1 is decreasing in E_0.

Consider next the effect of varying *z*. As *z* is raised, t_1^A is unaffected, $\overline{t_1}$ declines, whereas t_1^W rises. It follows then that there exists threshold levels of *z* (say $\overline{z}$ and $\underline{z}$) above and below which respectively case (i) and (iii) apply. Under case (i), the tax rate is t_1^A, which is independent of z; under case (iii), the tax rate is t_1^W which from Lemma 3 is increasing in z; and in between the thresholds, the tax rate is $\overline{t_1}$, which is decreasing in z.

Finally, consider the debt capacity $D_1^* = \min\left[\frac{1}{(1+r)} t_2 f_2(k_1^*(t_1^*)), z\left(E_0 - k_1^*(t_1^*)\right)\right]$. As explained above, in the ability-to-pay region (first term inside square brackets), the tax rate t_1^* is set to t_1^A which is independent of E_0 (Lemma 2). Then, since $\frac{dD_1^*}{dE_0} = \frac{1}{(1+r)} t_2 f_2^{'}(k_1^*(t_1^*)) \frac{dk_1^*}{dt_1} \frac{dt_1^*}{dE_0}$, in this region we have $\frac{dD_1^*}{dE_0} = 0$. Similarly, we obtain that $\frac{dD_1^*}{dz} = 0$ in this region.

In contrast, in the willingness-to-pay region (second term inside square brackets), the tax rate t_1^* is set to t_1^W. In this case, $\frac{dD_1^*}{dE_0} = z\left(1 - \frac{dk_1^*}{dt_1^*}\frac{dt_1^*}{dE_0}\right) > 0$ since $\frac{dk_1^*}{dt_1^*} < 0$ and $\frac{dt_1^*}{dE_0} = 0$ for $t_1^* = t_1^W$ (Lemma 3). Similarly, $\frac{dD_1^*}{dz} = \left(E_0 - k_1^*(t_1^*)\right) - z\frac{dk_1^*}{dt_1^*}\frac{dt_1^*}{dz} > 0$ since $\frac{dk_1^*}{dt_1^*} < 0$ and $\frac{dt_1^*}{dz} > 0$ for $t_1^* = t_1^W$ (Lemma 3).

In the intermediate region, the tax rate is set to $\overline{t_1}$. Now, since $f_2^{'} > 0$, $\frac{dk_1^*}{dt_1^*} < 0$ and

$\frac{dt_1^*}{dE_0} < 0$ (Lemmas 1), it follows that $\frac{dD_1^*}{dE_0} > 0$. Similarly, it can be shown that $\frac{dD_1^*}{dz} > 0$ in

this region.

Q.E.D.

Proposition 2: From equation (15), the threshold level of legacy debt D_0^{Max} above which

the short-horizon government defaults is given by

$t_1^{**} f_1(k_1^*(t_1^{**})) = D_1^* - D_0^{Max}(1+r) + t_1^* f_1(k_1^*(t_1^*)).$ The no-default case debt capacity is

$D_1^* = \min\left[\frac{1}{(1+r)} t_2 f_2(k_1^*(t_1^*)), z\left(E_0 - k_1^*(t_1^*)\right)\right]$ where the no-default case tax rate t_1^* is as

characterized in Proposition 1. The default-case tax rate t_1^{**} is given by condition (14).

Then, it follows that

$$(1+r)\frac{dD_0^{Max}}{dE_0} = \frac{d}{dE_0}\left[D_1^* - t_1^{**} f_1(k_1^*(t_1^{**})) + t_1^* f_1(k_1^*(t_1^*))\right]. \qquad (26)$$

From (14), $\frac{dt_1^{**}}{dE_0} = 0.$ And, $\frac{d}{dE_0}\left[D_1^* + t_1^* f_1(k_1^*(t_1^*))\right] = \frac{\partial}{\partial E_0}\left[D_1^* + t_1^* f_1(k_1^*(t_1^*))\right]$ by envelope

theorem as t_1^* is chosen by the short-horizon government to maximize $D_1^* + t_1^* f_1(k_1^*(t_1^*))$.

Since $\frac{\partial}{\partial E_0}\left[D_1^* + t_1^* f_1(k_1^*(t_1^*))\right] = \frac{\partial D_1^*}{\partial E_0} \geq 0$, it follows that $\frac{dD_0^{Max}}{dE_0} \geq 0.$ Similar arguments

show that $\frac{dD_0^{Max}}{dz} \geq 0.$ Q.E.D.

Proposition 3: Differentiating equation (19) w.r.t. β when $\beta < \frac{1}{(1+r)}$ (the other case

being discussed in text),

$$\frac{dD_0^{Max}}{d\beta} = \frac{1}{(1+r)}\left[\frac{dD_1^*}{d\beta}(1-\beta(1+r)) - D_1^*(1+r) + \frac{dG}{dt_1}\bigg|_{t_1^*}\frac{dt_1^*}{d\beta} - \frac{dG}{dt_1}\bigg|_{t_1^{**}}\frac{dt_1^{**}}{d\beta}\right]. \qquad (27)$$

As explained in the text, in the ability-to-pay region, $D_1 = \frac{t_2 f_2}{1+r}$ and $t_1^{A,\beta=0} = t_1^{A,\beta>0}$. Hence, in this region, $\frac{dD_1^*}{d\beta} = 0$ and $\frac{dt_1^*}{d\beta} = 0$. By definition of t_1^{**}, $\frac{dG}{dt_1} = 0$ at t_1^{**}. It follows then that in the ability-to-pay region, $\frac{dD_0^{Max}}{d\beta} = -D_1^* < 0$. The same arguments apply for the case when both constraints bind as $\overline{t_1^{\beta=0}} = \overline{t_1^{\beta>0}}$.

In contrast, in the willingness-to-pay region, we obtain by applying envelope theorem to the first-order condition (17) that

$$(soc).\frac{dt_1^W}{d\beta} + \left[z(1+r) + t_2 f_2^{'}\right]\frac{dk_1^*}{dt_1} = 0, \qquad (28)$$

where (soc) is the second-order condition, assumed to be negative. Then, since $f_2^{'} > 0$ and $\frac{dk_1^*}{dt_1} < 0$, it follows that $\frac{dt_1^W}{d\beta} < 0$. Further, in this region, $\frac{dD_1^*}{d\beta} = -z\frac{dk_1^*}{dt_1^W}\frac{dt_1^W}{d\beta} < 0$. Finally, substituting the first-order condition (17) into $\frac{dG}{dt_1}\Big|_{t_1^*}$, we obtain that $\frac{dG}{dt_1}\Big|_{t_1^*}$ equals $[1-\beta(1+r)]z\frac{dk_1^*}{dt_1}$. Then, substituting the various pieces in (28) and simplifying, we obtain that $\frac{dD_0^{Max}}{d\beta} = -z\left[E_0 - k_1^*(t_1^W)\right] < 0$. Q.E.D.

Proposition 4: Note that the optimal tax rate t_1^* is given by the condition (foc) $\left[\left(\frac{q}{1+r} - \beta(1-q)\right)t_2 f_2^{H\prime} + t_1 f_1^{\prime}\right]\frac{dk_1^*}{dt_1} + f_1 = 0$. The corresponding second-order condition (soc) is assumed to be negative. Then, differentiating the (foc) w.r.t. β, it follows that

$\frac{dt_1^*}{d\beta}$ has the same sign as $\frac{\partial(foc)}{\partial\beta} = -(1-q)t_2 f_2^{H'} \frac{dk_1^*}{dt_1} \geq 0$ since $\frac{dk_1^*}{dt_1} < 0.$ Then,

$$\frac{dD_1^*}{d\beta} = \frac{t_2}{(1+r)} f_2^{H'} \frac{dk_1^*}{dt_1^*} \frac{dt_1^*}{d\beta} < 0 \text{ and } \frac{dz^*}{d\beta} =$$

$$\frac{t_2}{(1+r)\left[E_0 - k_1^*\right]^2}\left[\left[E_0 - k_1^*\right] f_2^{H'} + f_2^{H}\right]\frac{dk_1^*}{dt_1^*}\frac{dt_1^*}{d\beta} < 0. \text{ Q.E.D.}$$

Appendix B: Example

Under the choice of functional forms $f_1(k) = \alpha\theta k^{\gamma}$, $f_2(k) = (1-\alpha)\theta k^{\gamma}$, we obtain the following solutions for analysis of Section II, which are employed in generation of Figures 2-7:

$$k_1^*(t_1) = \left(\frac{\gamma\theta}{(1+r)}\left[(1-t_1)\alpha + \frac{(1-t_2)(1-\alpha)}{(1+r)}\right]\right)^{\frac{1}{(1-\gamma)}}.$$

$\bar{t}_1$ is given implicitly (as it affects k^*) by the condition

$$\frac{t_2(1-\alpha)\theta(k^*)^{\gamma}}{z(1+r)} + k^* = E_0.$$

t_1^A satisfies the condition

$$\gamma\left[t_1\alpha + \frac{t_2(1-\alpha)}{(1+r)}\right] = (1-\gamma)\left[(1-t_1)\alpha + \frac{(1-t_2)(1-\alpha)}{(1+r)}\right].$$

$t_1^W(\beta)$ is given by the condition

$$\gamma\left[t_1\alpha + \beta t_2(1-\alpha)\right] = \left[(1-\gamma) + \gamma z\left(\frac{1}{(1+r)} - \beta\right)\right].\left[(1-t_1)\alpha + \frac{(1-t_2)(1-\alpha)}{(1+r)}\right].$$

Then, t_1^* and D_1^* are given respectively as

$t_1^* = t_1^A$ if $t_1^W \geq t_1^A > \overline{t_1}$; $\overline{t_1}$ if $t_1^W \geq \overline{t_1} \geq t_1^A$; and t_1^W otherwise, and

$$D_1^* = \min\left[\frac{1}{(1+r)} t_2 f_2(k_1^*(t_1^*)), z\left(E_0 - k_1^*(t_1^*)\right)\right].$$

Once in default, the tax policy $t_1^{**}(\beta)$ is given by the condition

$$\gamma\left[t_1\alpha + \beta t_2(1-\alpha)\right] = (1-\gamma)\left[(1-t_1)\alpha + \frac{(1-t_2)(1-\alpha)}{(1+r)}\right].$$

In turn, the threshold level of legacy debt above which the government defaults is given by

$$D_0^{Max} = \frac{1}{(1+r)}\left[D_1^*(1-\beta(1+r)) + G(t_1^*) - G(t_1^{**})\right]$$, where

$$G(t_1) = \left[t_1\alpha + \beta t_2(1-\alpha)\right]\theta\left(k^*(t_1)\right).$$

Figure 1: Model timeline

Period 1				Period 2	
t=0		t=1		$t=1^+$	t=2
(1) Existing foreign debt D_0 and corporate endowment E_0.	(2) Govt decides whether to announce “default” on legacy debt; It announces tax rate t_1; Corporate sector makes investment k_1 and saves the rest $(E_0 - k_1)$	(3) Short run corporate output $f_1(k_1)$ realized;	(4) Govt collects taxes $t_1 f_1(k_1)$; Govt repays debt of $D_0 (1+r)$ and raises new debt (if no default): Externally financed debt is D_1^{For}, domestically financed debt D_1^{Dom}.	(5) New govt comes in; Govt decides whether to announce “default” on legacy debt; announces tax rate t_2;	(6) Long run corporate output $f_2(k_1)$ realized; Govt collects taxes $t_2 f_2(k_1)$; Govt repays debt of $D_1 (1+r)$ (if no default)

Figure 2: Short-horizon government's tax policy (rate) as a function of endowment

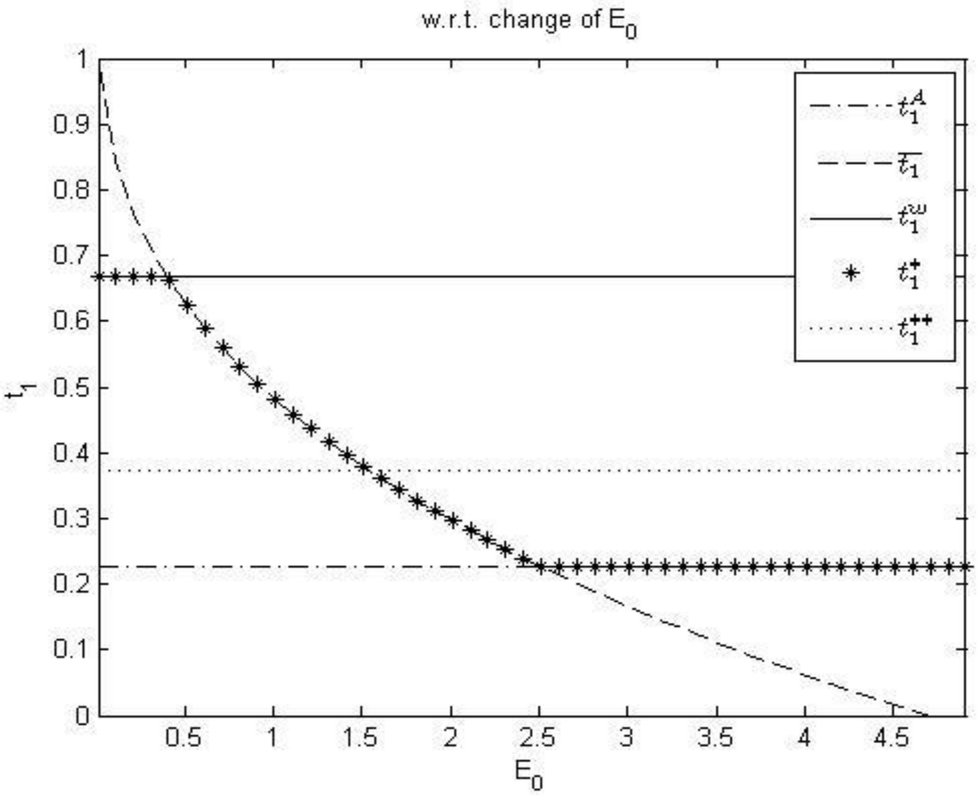

Figure 3: Short-horizon government's debt capacity as a function of endowment

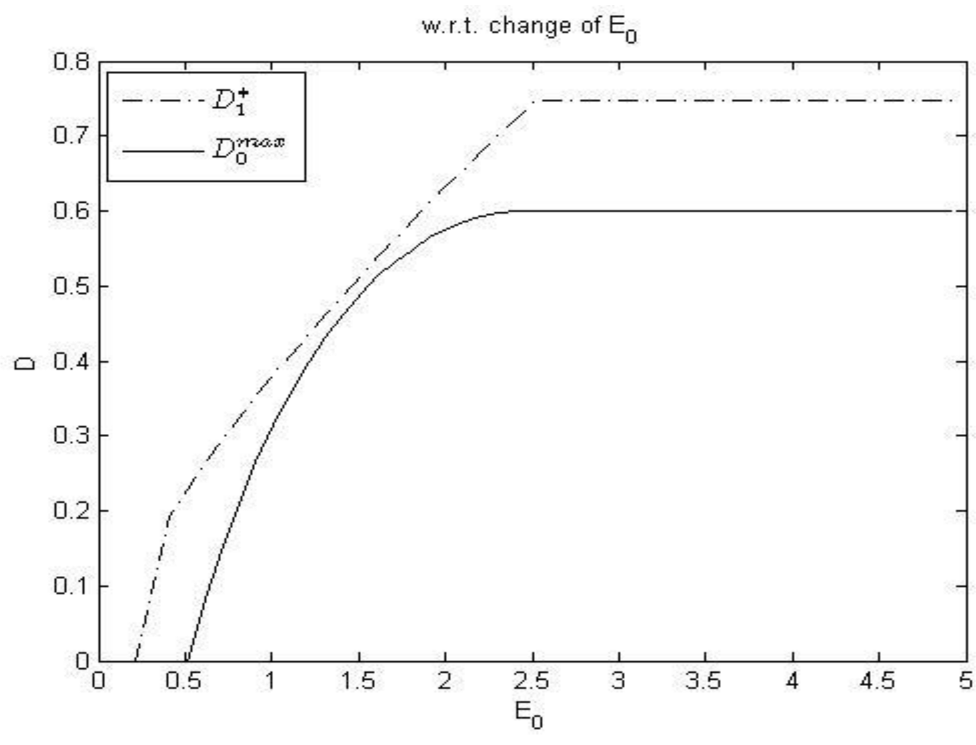

Figure 4: Short-horizon government's tax policy (rate) as a function of productivity

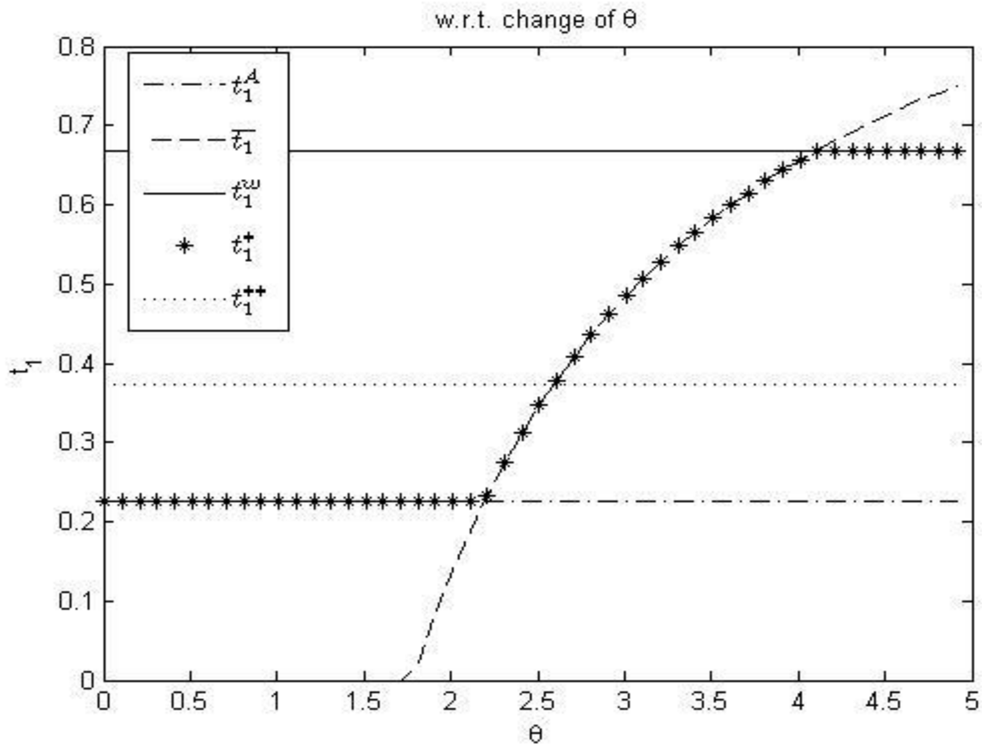

Figure 5: Short-horizon government's debt capacity as a function of productivity

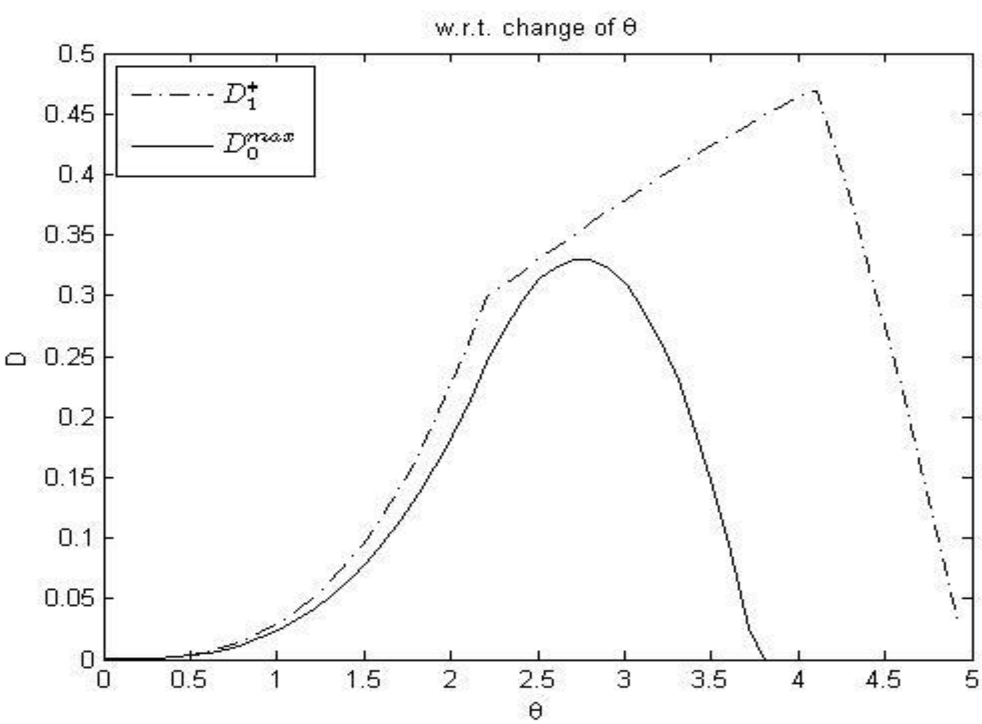

Figure 6a: Government's tax policy as a function of myopia for varying endowment

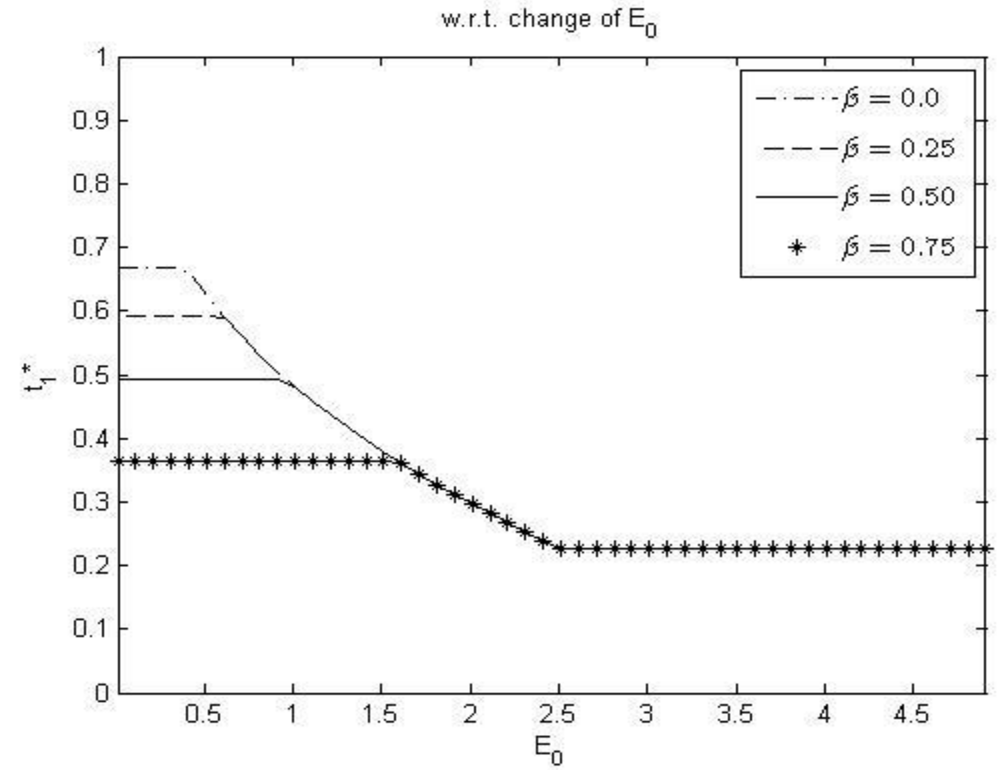

Figure 6b: Government's debt capacity as a function of myopia for varying endowment

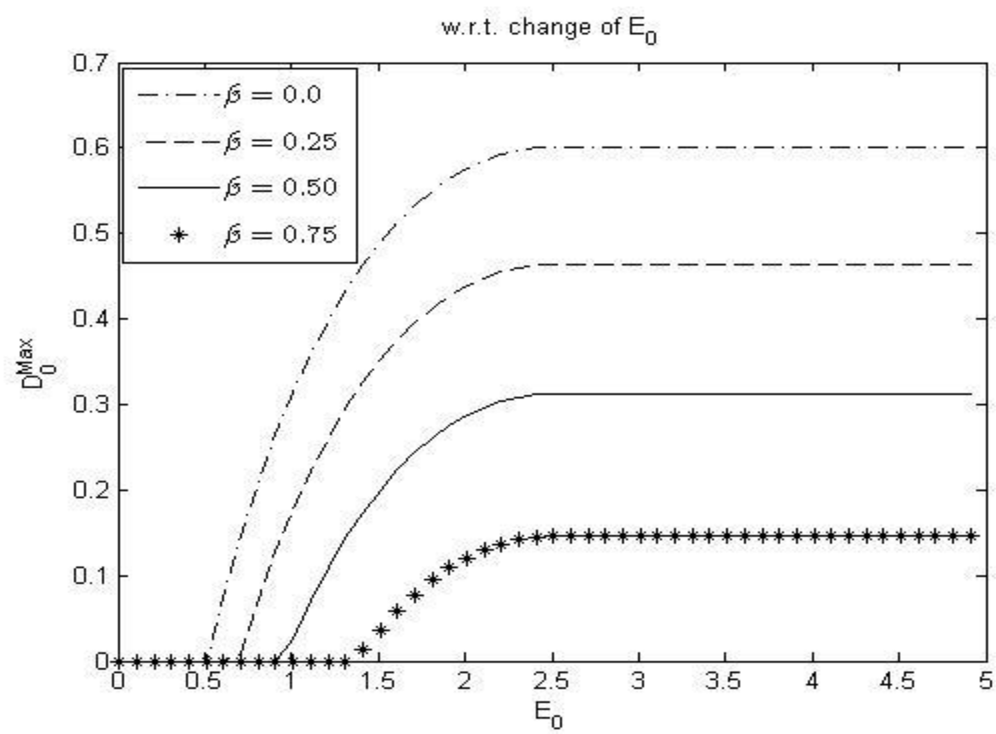

Figure 7a: Government's tax policy as a function of myopia for varying productivity

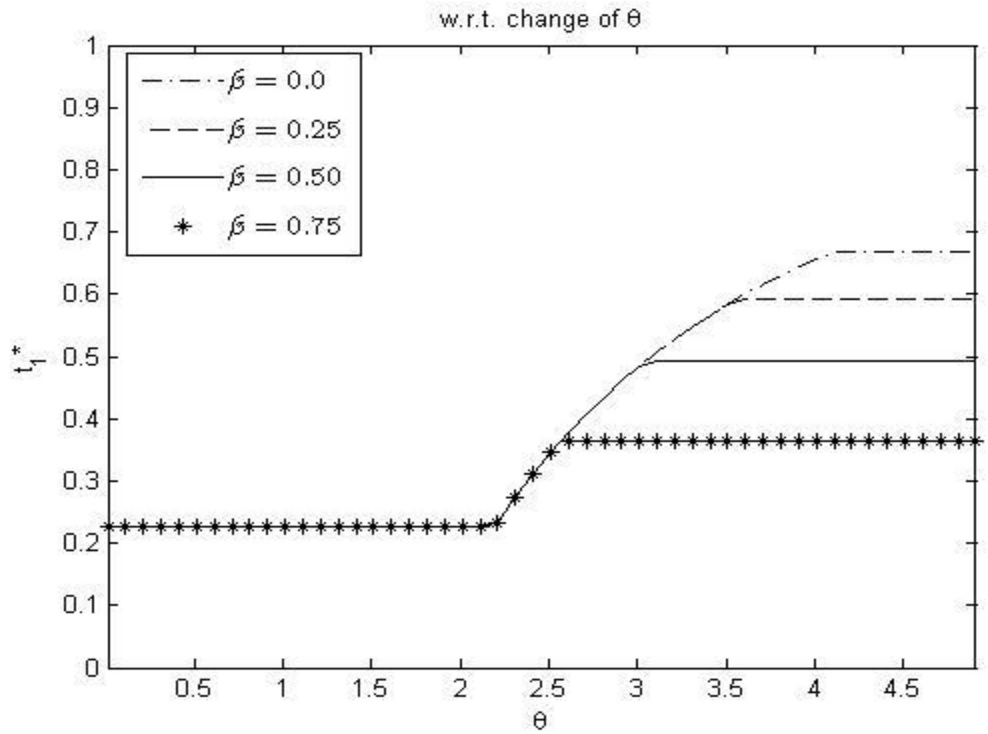

Figure 7b: Government's debt capacity as a function of myopia for varying productivity