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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 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 create more dependencies between the domestic financial sector and government debt that raise the costs of 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 in industrial countries 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 around the world. This paper attempts to address these issues.

A number of recent papers offer a persuasive explanation of why *rich industrial* countries service their debt without being subject to coordinated punishment.[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 risk-free, 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 track sales by foreigners to domestics (see Guembel and

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[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).

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 an emerging market or a poor country, 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). While there may be some such far-sighted governments, most governments care only about the short run, with horizons limited by elections or mortality – such short termism is perhaps most famously epitomized by Louis XV when he proclaimed "Apres moi, le deluge!"[5] 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 emerging markets or poor countries, 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

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[5] After me, the flood.

governments continue servicing debt even though a debt restructuring 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 be subject then 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 increasing debt capacity. 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 future governments to service their debt for fear of doing widespread damage to the economy through default. This way, short-horizon governments' taxation decisions will be influenced significantly by their effect on debt capacity.

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 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 the rate at which a government discounts the future falls (i.e., it becomes less myopic), its willingness to default on legacy debt increases. The long-horizon government internalizes the future cost of paying back new 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.[6]

Finally, we also allow the government to determine the degree to which the financial sector becomes dependent on government debt (thus exposing the country to greater costs when the government defaults, and setting in place a greater future

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[6] 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 government borrowing).

willingness to pay). We show that shorter horizon governments have a greater incentive to create more dependencies, in part because the future costs of default will not be borne by them, while the benefit of greater debt capacity will. To the extent that these dependencies emanate from the greater sophistication of the financial sector, a short-horizon government has an incentive to create financial market institutions (such as repo markets) or liberalize the financial sector, in order to expand its own borrowing capacity. It may, however, do this to excess. We offer some examples in the paper.

It is useful to compare 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 not repaying 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). 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.[7]

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[7] 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.

Bulow and Rogoff (1989b) show that the reputational arguments for repayment break down because by defaulting and using asset markets to self-insure when net repayments have to be made, a country can guarantee itself higher 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. This implies, however, a feasible time profile of repayments that cannot be exceeded.

More generally, because the costs of default are sizeable in our model only when the country becomes rich, the nature of developing country defaults and rich country defaults are likely to be very different. Developing countries are more likely to default when revenue shortfalls (crop failures or a fall in export prices) or increases in expenditure (natural disaster or a rise in import prices) lead to a buildup in debt that can imply net debt outflows for some time. The reason for default is not that the country cannot pay but that the time path of prospective payments does not make it worthwhile for the current government to maintain access to debt markets. 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.

Our model implies the sustainable level of debt for developing countries is likely significantly lower (see, for example, the evidence in Reinhart and Rogoff (2009a)), and that defaults could be cured with some re-profiling of the debt. However, it also implies that when rich countries are in danger of default, multilateral agencies like the IMF that

lend them more without helping these countries expand productivity and growth are only postponing the inevitable messy restructuring. Finally, the observation that rich country defaults are more likely to be solvency defaults than liquidity defaults has implications for the current sovereign debt situation in Europe that we discuss later in the paper.

The rest of the paper is as follows. In section I, we present the simple model and analyze it in section II. We compare the short-horizon government's choices to those of a long-horizon government in section III. In section IV, we examine the effects of endogenizing the degree of dependence of the financial market on government debt. In section V, we discuss implications, in section VI the related literature, and then conclude. All proofs are in Appendix A and details of the numerical example are in Appendix B.

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 (it does not really matter whether this is private debt or government 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

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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.

The government of the country is run by short-horizon politicians each period who want to maximize spending on populist schemes over the period, but do not consider the effects of their actions over the long term. Such myopic behavior could be explained by an inordinate desire to get re-elected (without considering the problems of governance if they are successful). Such spending could also 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 get punished for being ineffective. Clearly, extreme myopia is a caricature, and is only to make the effects of the model clear. Later, we will see what longer horizons might do, as well as consider the effects of more realistic objective functions.

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 by the private

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sector are not taxed.[8] A second way the government can raise more money is through additional debt issues.

The government can either default on its existing 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, 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 own-currency bearer bonds. Because the second period government cannot tell domestic investors from foreign investors, it cannot default selectively. 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 deadweight cost of default z reflects the centrality of low risk government bonds to the functioning of the domestic financial sector in a rich country. Rich country financial systems are typically more arm's length and market based, with the credit
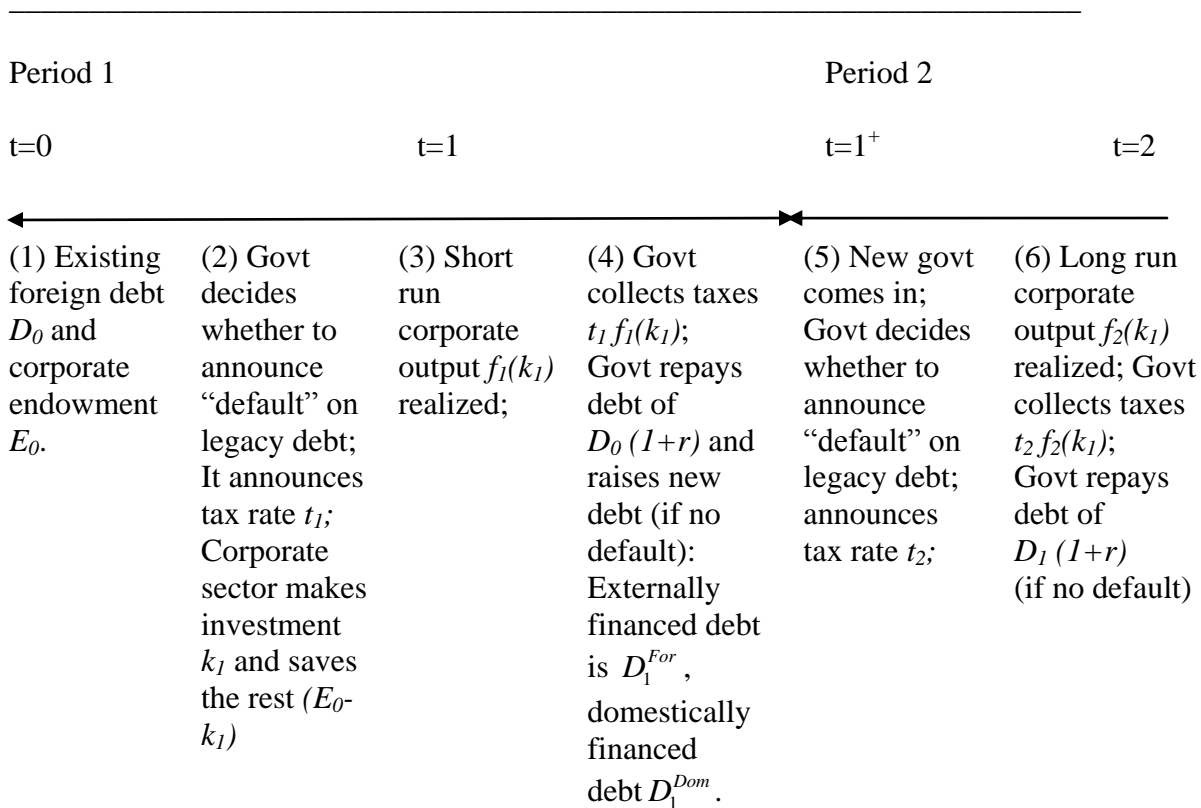
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[8] Equivalently, there is a uniform income tax, and the government levies an additional set of taxes such as payroll taxes or excise duties on real investment projects. Financial investments are typically subject to lower taxation, partly because of their greater mobility in a country with an open capital account.

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 many 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, a plausible argument could be made for z being higher 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. In our framework, though, borders are open, so enforcement mechanisms have to be very sophisticated for repression to be effective. This would again suggest z, if anything, is higher in more sophisticated financial systems where repressive regulations can be enforced.

We will allow the deadweight cost z to be endogenously determined later in the paper. It may be pushed higher if the government opens new markets for collateralized borrowing, or if the government mandates a higher liquidity holding of government bonds by domestic banks. The timeline of the model is in Figure 1.

Figure 1: Model timeline

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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) |

II.   Solving for Debt and Default

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,

$$D_1(1+r) \leq zD_1^{Dom}(1+r). \tag{1}$$

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 $D_1^{For} \leq (z-1)D_1^{Dom}$, which is why we require z

to be greater than 1.

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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

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

(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 $k_1 \leq E_0$ 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 the inequality holds. 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. 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

$D_1^{Dom} = (E_0 - k_1)$.[9] 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

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[9] 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.

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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

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

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 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: [10]

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

Note that $\dfrac{dk_1^*}{dt_1} < 0$ so that 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 standard 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.

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[10] A sufficient condition to ensure the second-order condition is negative is that $\dfrac{d^2 k_1^*}{dt_1^2} < 0$. 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 standard 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: [11]

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

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[11] Again, a sufficient condition to ensure the second-order condition is negative is that $\dfrac{d^2 k_1^*}{dt_1^2} < 0$ 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 $t_1^W > t_1^A$. Combining the analysis, we have:

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

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

(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 $\bar{t_1}$ 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, $\bar{t_1} > t_1^W \geq t_1^A$ 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 $\overline{\overline{E_0}}$, $t_1^W \geq \overline{t_1} \geq t_1^A$, and both constraints bind. The tax rate t_1^* now falls as

E_0 increases, and government borrowing continues to increase. Finally, when $E_0 > \overline{\overline{E_0}}$,

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 $\alpha \in (0,1), \theta > 0, \gamma \in (0,1)$.[12] Let

$\alpha = 0.75, \theta = 3, \gamma = 0.66, t^{Max} = 0.6, r = 0.05, E_0 = 1.0, z = 1.1$.

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

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.[13]

As Figure 3 suggests, new government borrowing D_1^* increases for low and

moderate levels of endowment when the binding constraint is the ability 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

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

[13] 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}.

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 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, whereas investment

$k_1^*(t_1^*)$ decreases. As z increases above the threshold $\underline{z}$ but is below a higher threshold $\overline{z}$,

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$t_1^W > \bar{t_1} > t_1^A$, *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 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

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

Thus, we obtain:

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 productivity (Figure 4), and lies in between

the tax rates charged absent default at the extreme values of endowment and productivity.

III.   Debt and Default with a Long Horizon Government

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 would default more, that is, over a greater parameter range

than a short-horizon government. The reason is that the myopic government does not

internalize the cost of the future repayment of current borrowing, and in the willingness-

to-pay region, also the distortion caused by current taxation (which tries to maximize

current resources including borrowing) on future output and tax revenues. The long-

horizon government internalizes these costs and therefore does not find borrowing to

repay old debt as attractive. It is more willing to default on legacy debt so as to restore

economy's long-run growth prospects.

3.1. Variable Horizon

Formally, suppose the government discounts the future using factor $\beta \in [0, \frac{1}{1+r}]$.

When $\beta=0$, we have our short-horizon government, while when $\beta=\frac{1}{1+r}$, we have a long-horizon government which has the same rate of time preference as the market. In between, we have differing degrees of myopia. The government's objective function if it borrows to repay existing debt and spends the rest, is given by

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

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 $\dfrac{d\, t_1^{W,\beta>0}}{d\beta} < 0$; 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 $\bar{t_1}$, 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. This means the maximal legacy debt that will be repaid is

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

Differentiating w.r.t. β, we get after some algebra:

Proposition 3: As the government's discount factor β increases, the maximum legacy debt D_0^{Max} it is willing to repay falls. When $\beta = \dfrac{1}{1+r}$, the government is not willing to repay any legacy debt, that is, $D_0^{Max} = 0$.

Therefore lengthening horizons reduces the attractiveness of repaying legacy debt at date 0. The sole benefit to repayment is the ability to borrow again. But 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 maximum amount of new debt it is willing to raise is also lower because the government internalizes the costs to future revenues from setting the higher tax rate today that is needed to signal its willingness to pay. Therefore, by making future borrowing less attractive, and therefore default more attractive, longer horizons reduce the first period government's debt capacity (and of governments before it). By contrast, a short-horizon government will not default 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.

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

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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.[14]

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.[15]

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

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[14] Note that two of the cases, $\beta = 0, 0.25$ correspond to identical outcomes in Figures 6a and 7a.

[15] 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.

ex-post distortions entailed in repaying such spending make lenders distrust it. The ex-post distortions may, however, be smaller than the ex-ante benefit, in which case short horizons may be beneficial.

Finally, to the extent that democratic governments have shorter horizons than more authoritarian governments, a switch from democracy to autocracy reduces a country's debt capacity and increases the risk associated with its outstanding debt. In other words, political risk associated with an increase in authoritarianism could be very detrimental to debt values.

IV.   Endogenous choice of financial sophistication

Thus far, we have taken the deadweight cost of defaulting on domestically held government debt, 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 creating a class of debt that is so entangled with the financial sector's transactions that it is hard to default on is the "special" status accorded to 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.[16]

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[16] 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.

Market participants could have 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 in government "conservatorship" in September 2008, without debt holders suffering any losses.[17]

Once z becomes a choice variable, willingness to pay is no longer a constraint on borrowing. However, with no uncertainty, governments cannot set a debt level at which they would default, for creditors would not agree to lend. 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 $\max_{k_1} \frac{1}{(1+r)}(1-t_1)f_1(k_1) + \frac{1}{(1+r)^2}(1-t_2)qf_2^H(k_1) - k_1$, and its optimized investment level k_1^* is given by the modified first-order condition

$$\frac{1}{(1+r)}(1-t_1)f_1{}'(k_1) + \frac{1}{(1+r)^2}(1-t_2)qf_2^{H\prime}(k_1) - 1 = 0.$$

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

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

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

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

(20)

subject to the constraints

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

and

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

Since there is no reason to set the deadweight losses higher than what is needed to

enforce maximum debt repayment, $D_1 = z D_1^{Dom}$. Substituting in the objective function, it

is clear it is increasing in $z D_1^{Dom}$ iff $\beta \le \dfrac{q}{1+r}$. This then means setting z such that

$$D_1 = z D_1^{Dom} = \frac{t_2 f_2^H}{1+r}.$$

Substituting for $z D_1^{Dom}$, 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

$$\left[\left(\frac{q}{1+r} - \beta(1-q) \right) t_2 f_2^{H'} + t_1 f_1' \right] \frac{dk_1^*}{dt_1} + f_1 = 0.$$ Using the envelope theorem, and knowing

that $D_1 = \dfrac{t_2 f_2^H}{1+r}$, $D_1^{Dom} = \left[E_0 - k_1^*(t_1) \right]$, and $z^* = \dfrac{t_2 f_2^H}{(1+r)[E_0 - k_1^*(t_1)]}$, we can show

Proposition 4: (i) $\dfrac{dt_1^*}{d\beta} > 0$, $\dfrac{dD_1}{d\beta} < 0$, $\dfrac{dz^*}{d\beta} < 0$.

(ii) $\dfrac{dt_1^*}{dq} < 0$, $\dfrac{dD_1}{dq} > 0$, $\dfrac{dz^*}{dq} > 0$.

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.

Conversely, the higher is q, the lower the probability the deadweight costs of default will be incurred, the higher the benefit to borrowing, and hence the lower the optimal date-1 tax so as to expand investment, date-2 production, and hence borrowing capacity.[18] Similarly, the higher is q, higher is z to ensure that the higher promised debt payment will be made.

More generally, the horizons of the government and the uncertainty affecting output both affect optimal debt and taxes. The more the government is myopic, the more it ignores the deadweight costs of default in the low state, and the higher the amount it wants to borrow. This implies lower taxes (to create future debt payment ability) and higher entanglement between the government and the financial sector so as to increase the future deadweight costs of default z. Less uncertainty again makes debt more attractive, and thus entails lower taxes today, and higher sophistication/entanglement.

V. Implications

The ongoing sovereign crisis in Europe raises some fundamental issues that our model can speak to. For instance, our model explains why some governments keep

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[18] Note that q also has the direct effect of making private sector's investment more attractive, all else equal, which also expands date-2 production and therefore the borrowing capacity.

current on their debt, even when most market participants suggest it would be better for them to default. 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 entanglements between domestic banks and domestic government debt) are optimal.

In this regard, the role of multilateral lending institutions has to be examined very carefully. Ostensibly, they lend to a country when private markets seize up, thus preventing the country from undergoing a wrenching real adjustment. The intent is that once private markets view the country more favorably – after real sector reforms shaped by conditions set by the multilateral institutions – the country will regain access to the private markets and repay its debt. Our model suggests that for developing countries, the key concern for the private markets 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 left to its own devices, the country will not be able to regain access 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. Of course, IMF conditionality is

onerous for governments, but they often fall behind program targets, reducing the effective cost.

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.

Another interesting development in the on-going sovereign debt crisis in Europe is the extreme degree of dependence of the health of a country's banking sector on the health of the government, and vice versa. 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.

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[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.

One explanation is that banks are buyers of last resort (perhaps with some arm-twisting) for their government's debt, and this is why risky countries, who find no other takers, stuff their banks with their paper. An alternative 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 third, 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.

In this vein, 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.

Let us now turn to other implications of our model. 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.[20] At the same time, the existence of sizeable discrete default costs would imply that developing countries should not default only to reduce their debt a little – but 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)).

Instead, the primary objective in debt renegotiations seems to be to find a mutually acceptable deal that will allow the country to regain access to the debt markets. In our model, following a default, 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 its own exclusion from external capital markets in search of it, 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.[21]

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

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[20] One could, of course, argue that the less that is repaid, the worse the type the country reveals itself to be.
[21] 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 longer or because there is domestic political gain (that we do not model) to forcing large haircuts on unpopular foreign debt holders.

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 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).

VI. 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 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

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defaulting on domestically held bonds, combined with liquid and anonymous secondary markets, ensures the sustainability of foreign borrowing.

Gennaioli, Martin, and Rossi (2011) build a model in which banks demand government bonds as a store of liquidity. This then allows banks to expand intermediation, investment, and output of the economy. 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.

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.

Acharya, Drechsler and Schnabl (2010) consider the incentives of a long-horizon government to default on legacy debt when faced with the prospect of bailing out its distressed financial sector. Being long-horizon, their government internalizes the under-investment induced in the private sector by excessive sovereign borrowing (and future

taxation), a force that pushes it in the direction of default on legacy debt. However, the government is deterred by the potential collateral damage from sovereign default to the financial sector due to its government bond holdings and implicit guarantees.[22]

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.

VII. Conclusion

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 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

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[22] Acharya, Drechsler and Schnabl (2010) also employ data on credit default swaps (CDS) on banks and sovereigns during the period 2007-2010 and show evidence of what they call "the two-way feedback": While bailouts transferred risks from the financial sector to sovereign balance-sheets in the Fall of 2008, the steady deterioration of sovereign health since then has in turn contributed to widening of bank CDS.

tax in a more distortionary way, and create more dependencies between the domestic

financial sector and government debt that raise the costs of default. We use the model to

explain recent experiences in sovereign debt markets.

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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 $\dfrac{d\bar{t_1}}{dz} < 0.$ 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 $\dfrac{dk_1^*}{dt_1} < 0$, 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 $\bar{t_1}$ 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)* $t_1^W \geq t_1^A > \bar{t_1}$;

(ii) $t_1^W \geq \bar{t_1} \geq t_1^A$; *and, (iii)* $\bar{t_1} > t_1^W \geq t_1^A$.

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

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$$\frac{dD_1^*}{dE_0} = \frac{1}{(1+r)} t_2 f_2'(k_1^*(t_1^*)) \frac{dk_1^*}{dt_1} \frac{dt_1^*}{dE_0}$$, 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

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

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

As explained in the text, in the ability-to-pay region, $D_1 = \frac{t_2f_2}{1+r}$ 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

$$(soc).\frac{dt_1^W}{d\beta} + \left[z(1+r) + t_2f_2'\right]\frac{dk_1^*}{dt_1} = 0,$$ (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)

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

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

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

Similarly, $\frac{dt_1^*}{dq}$ has the same sign as $\frac{\partial(foc)}{\partial q} = \left[\frac{1}{(1+r)} + \beta \right] t_2 f_2^{H'} \frac{dk_1^*}{dt_1} < 0$. Further, since

the (foc) for private sector's choice of k_1^* is given by

$$\frac{1}{(1+r)}(1-t_1)f_1'(k_1) + \frac{1}{(1+r)^2}(1-t_2)qf_2^{H'}(k_1) - 1 = 0,$$ differentiation of (foc) w.r.t. q and

assuming (soc) < 0, yields that $\dfrac{\partial k_1^*}{\partial q} > 0$. Then, $\dfrac{dD_1^*}{dq} = \dfrac{t_2}{(1+r)} f_2^{H'} \left[\dfrac{\partial k_1^*}{\partial q} + \dfrac{dk_1^*}{dt_1^*} \dfrac{dt_1^*}{dq} \right] > 0$ and

$$\dfrac{dz^*}{dq} = \dfrac{t_2}{(1+r)\left[E_0 - k_1^* \right]^2} \left[\left[E_0 - k_1^* \right] f_2^{H'} + f_2^{H} \right] \left[\dfrac{\partial k_1^*}{\partial q} + \dfrac{dk_1^*}{dt_1^*} \dfrac{dt_1^*}{dq} \right] > 0. \text{ Q.E.D.}$$

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:

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

$\overline{t_1}$ is given implicitly (as it affects k^*) by the condition

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

t_1^A satisfies the condition

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

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

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

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

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

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

Figure 2: Short-horizon government's tax policy (rate) as a function of endowment
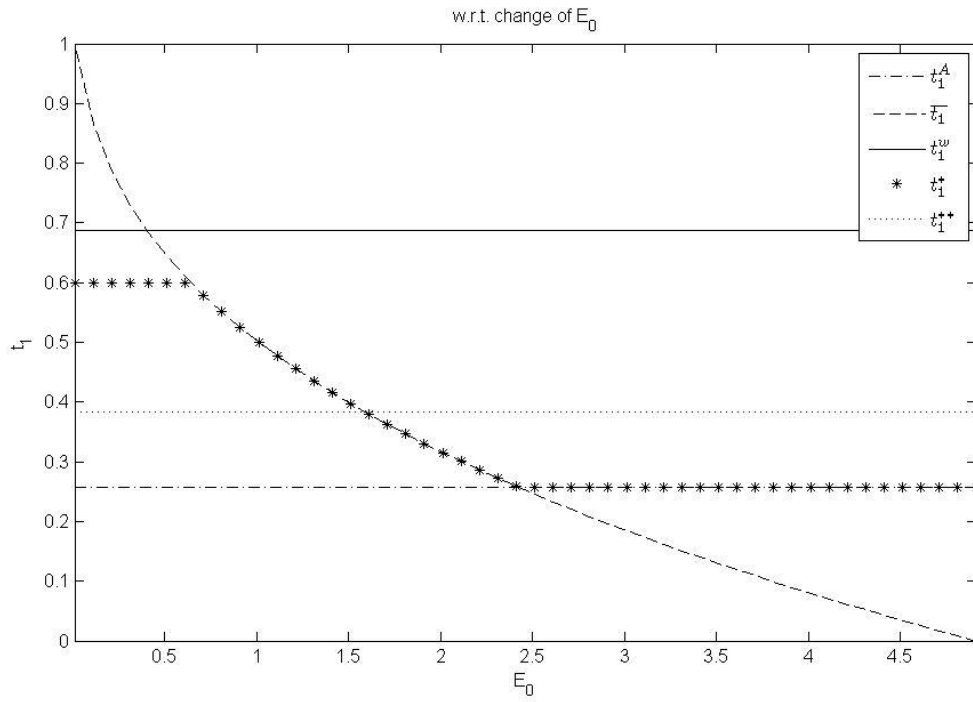
Figure 3: Short-horizon government's debt capacity as a function of endowment
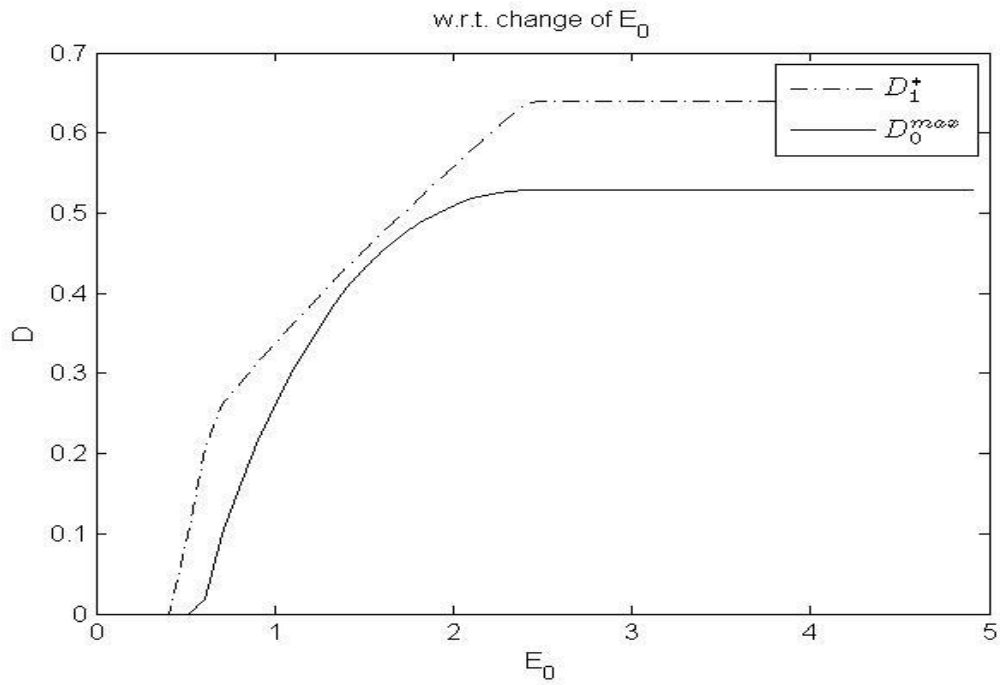
Figure 4: Short-horizon government's tax policy (rate) as a function of productivity
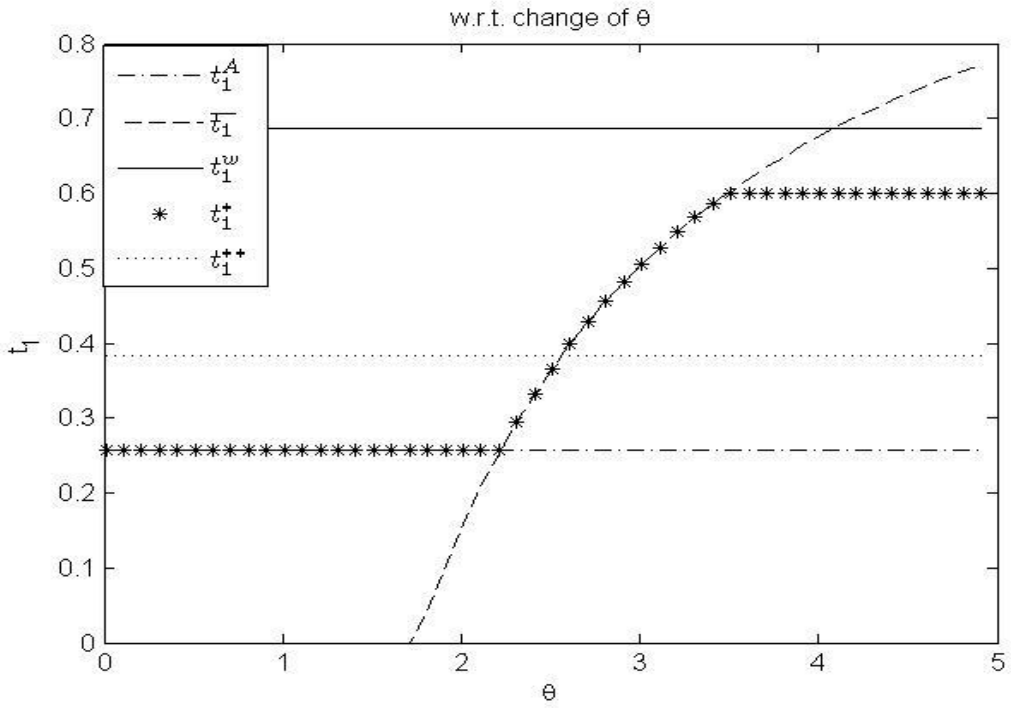

Figure 5: Short-horizon government's debt capacity as a function of productivity
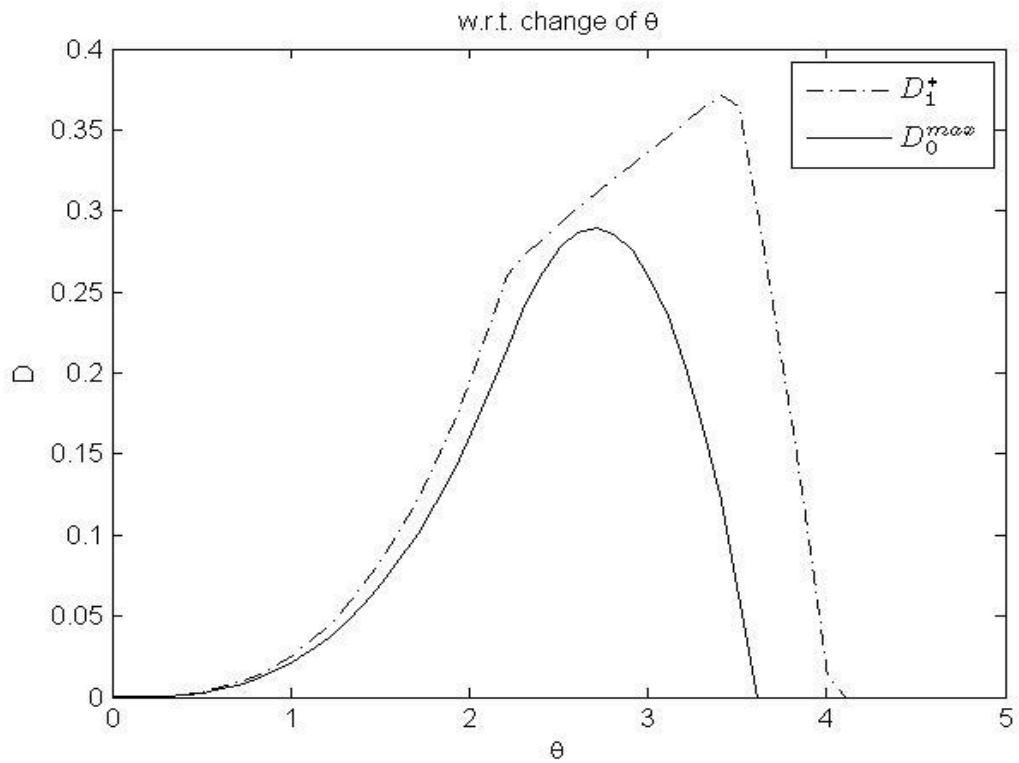
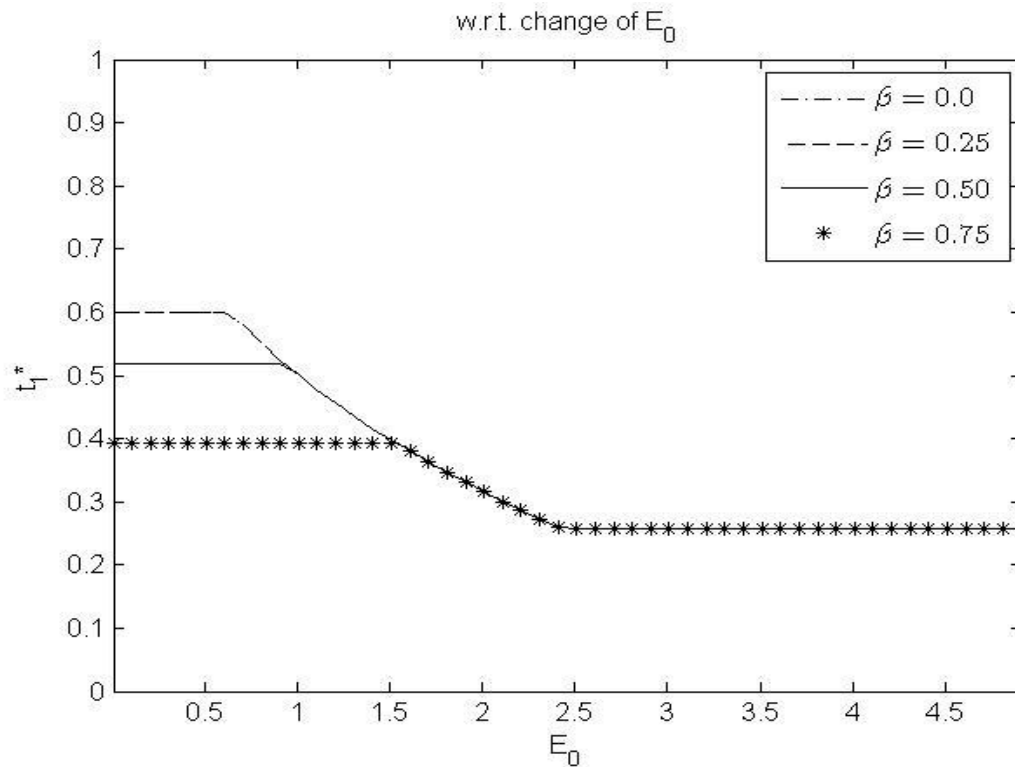Figure 6a: Government's tax policy as a function of myopia for varying endowment

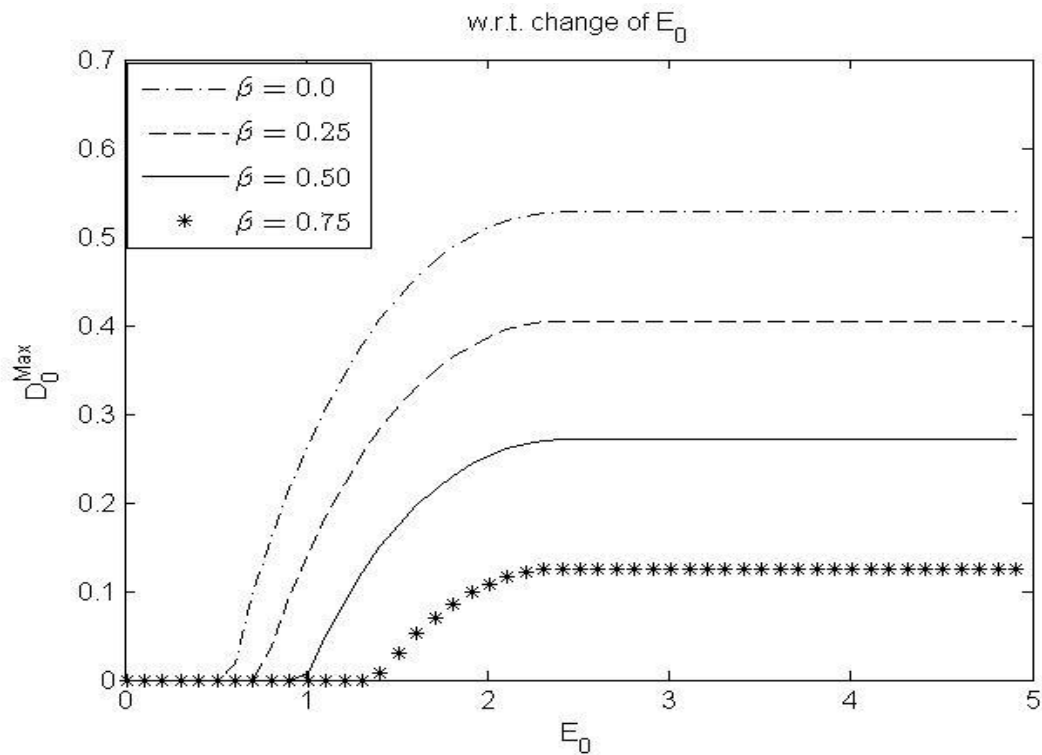Figure 6b: Government's debt capacity as a function of myopia for varying endowment

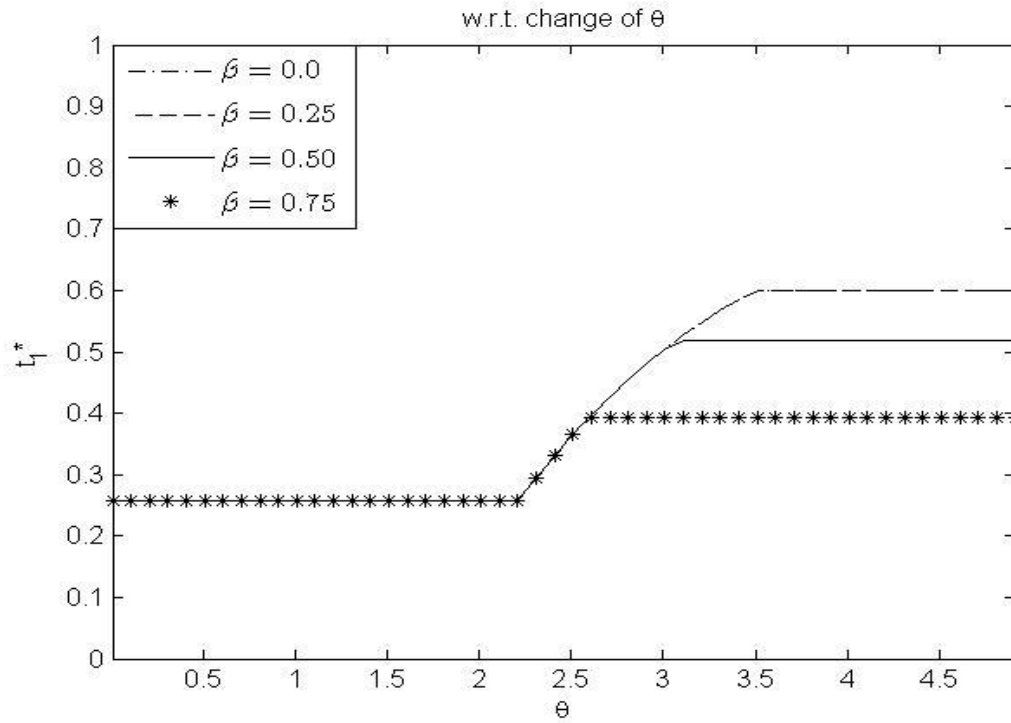Figure 7a: Government's tax policy as a function of myopia for varying productivity

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