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ABSTRACT

Sovereign Risk and Secondary Markets*

Conventional wisdom says that, in the absence of sufficient default penalties, sovereign risk constraints credit and lowers welfare. We show that this conventional wisdom rests on one implicit assumption: that assets cannot be retraded in secondary markets. Once this assumption is relaxed, there is always an equilibrium in which sovereign risk is stripped of its conventional effects. In such an equilibrium, foreigners hold domestic debts and resell them to domestic residents before enforcement. In the presence of (even arbitrarily small) default penalties, this equilibrium is shown to be unique. As a result, sovereign risk neither constrains welfare nor lowers credit. At most, it creates some additional trade in secondary markets. The results presented here suggest a change in perspective regarding the origins of sovereign risk and its remedies. To argue that sovereign risk constrains credit, one must show both the insufficiency of default penalties and the imperfect workings of secondary markets. To relax credit constraints created by sovereign risk, one can either increase default penalties or improve the workings of secondary markets.

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Consider the hypothetical situation of a country that has borrowed in the past and must now pay back to its foreign creditors. It does not matter whether it was the private sector or the government who borrowed in the first place. After all, even government debts must ultimately be paid by taxing the private sector. The last word on whether the country pays its foreign debt must come from the country's government however, since nobody else holds enough power to force the private sector to pay. The problem, of course, is that the government cares more about the private sector than foreign creditors, and finds it tempting not to enforce payments to foreigners. What prevents this? Only the expectation of costly default penalties, such as the loss of collateral and reputation, trade embargoes or even military interventions. These penalties eliminate sovereign risk, namely, the risk that the country willingly defaults on its foreign debt.

What would happen if these penalties are absent and the government decides not to enforce payments to foreigners? The standard answer is that foreign creditors will find at the time of enforcement that the country defaults on its debt. Once this answer is accepted, one immediately realizes that the situation being considered is hypothetical and not real. Anticipating default, foreign creditors could not have lent to the country in the first place. This inability to borrow prevents the country from taking advantage of good investment opportunities and from sustaining its consumption during bad times. Sovereign risk therefore constrains credit and lowers welfare. To relax this constraint, the country must make itself more vulnerable to default penalties. Only then foreigners will feel safe enough to lend to the country. This is, we think, a fair description of conventional wisdom.

This paper reviews the situation above and questions this conventional wisdom. Foreign creditors will not passively hold their debts until the time of enforcement arrives and default takes place. Instead, they will try to sell them in the secondary market and recover any value they can. Who will buy these debts? Certainly not other foreign creditors since the government will not enforce payments to foreigners. But the private sector will be willing to buy these debts if the government enforces payments to domestics. Moreover, it must be the case that the private sector always has enough funds to purchase them since otherwise foreign creditors would not have lent in the first place. In fact, the main result of this paper is that there is always an equilibrium in which the private sector buys back the debts at face value and the government chooses to enforce payments to domestics.¹ Moreover, in the presence of (even arbitrarily small) default penalties this equilibrium is unique. Hence, secondary markets transfer debts to those that value them most, leading

¹The proof of this result is based on two observations. The first one is that, once the private sector has bought back the debt, not enforcing domestic payments can at most redistribute wealth within the private sector but cannot increase its level of wealth. The second observation is that trading in the secondary market always ensures that the redistribution that would result from not enforcing domestic payments is undesirable for the government.

to maximization of their value and therefore enforcement. As a result, sovereign risk neither constrains credit nor lowers welfare. At most, it creates some additional trade in secondary markets as foreign creditors successfully circumvent the strategic or opportunistic behavior of the government by selling their debts to the private sector before enforcement.

The intuition behind this result is that secondary markets create a prisoner's dilemma situation that forces the country to buy back or repay its debt. It would be better for the different members of the private sector to coordinate actions and not to purchase each other's debts from foreign creditors. If such collusion were possible, it would lead to default and therefore to an increase in the wealth of the country. But the capital gains or profits from violating the agreement would be enormous for a small or infinitesimal individual who can purchase the country's whole foreign debt at a negligible price expecting to redeem it later at face value. Hence, the agreement is not feasible and the country as a whole ends up repurchasing all of its foreign debt in the secondary market. This outcome constitutes an ex-post inefficiency from the viewpoint of the country, but somewhat paradoxically ensures ex-ante efficiency since it allows the country to borrow in the first place.

This result provides a useful theoretical benchmark because it identifies a set of conditions under which sovereign risk is irrelevant even in the absence of default penalties. Of course, this is an idealized situation that requires frictionless secondary markets. Transaction costs, large agents, government interference and other imperfections might impair the workings of these markets. We analyze these frictions and show that, in their presence, sovereign risk still constrains credit and lowers welfare. But the tightness of the credit constraint depends on these secondary-markets imperfections rather than on the size of default penalties. More generally, the results presented here suggest a change in perspective regarding the origins of sovereign risk and its remedies. To argue that sovereign risk constrains credit, one must show *both* the insufficiency of default penalties *and* the imperfect workings of secondary markets. To relax credit constraints created by sovereign risk, one can *either* increase default penalties *or* improve the workings of secondary markets.

There is an extensive literature on sovereign risk that mostly focuses on the role of reputational considerations and direct penalties.^{2,3} One problem with these approaches, however, is that there is not much empirical evidence supporting the view that countries suffer losses of reputation or

²See Eaton and Gersovitz (1981), Grossman and van Huyck (1988), Bulow and Rogoff (1989a, 1989b), Fernández and Rosenthal (1990), Atkeson (1991), Cole, Dow, and English (1995), Cole and Kehoe (1997), Kletzer and Wright (2000), Kehoe and Perri (2002), Wright (2002), and Amador (2003). See Eaton and Fernández (1995) for an excellent survey.

³Two recent papers show how, even in the absence of reputational considerations and direct penalties, governments may enforce/and or make payments to foreigners. Broner and Ventura (2006a) show that when governments cannot discriminate between domestic and foreign creditors, enforcing foreign payments is useful because it avoids disrupting domestic ones. Sandleris (2006) shows that when governments have better information than the private sector, enforcing foreign payments is useful because it provides a good signal about the prospects of the country.

punishments as a result of defaults. For example, countries do not seem to be excluded from international financial markets for very long after default episodes and defaults do not seem to have much of an effect on trade in goods.^{4,5} Without exception, the existing literature has ignored the role of secondary markets and taken for granted that, if governments do not enforce and/or make payments to foreigners, then foreigners cannot collect on their debts. This (implicit) assumption was justified when the literature started in the early 1980's, since virtually all emerging market borrowing was done via syndicated bank loans which were difficult to retrade. However, the institutional setup of emerging-market borrowing has changed dramatically since then: a large fraction of both government and private borrowing is now done by selling bonds and stocks which are traded in deep secondary markets.

This paper is also related to the literature on the costs and benefits of debt buybacks.⁶ This literature asks whether it is optimal for a country that suffers a debt overhang to repurchase its foreign debt before the time of maturity. This question is answered from an 'ex-post' perspective in which the amount of outstanding debt is exogenous to the analysis. We instead focus on repurchases of debt at maturity when there is no debt overhang and the amount of outstanding debt is endogenous to the analysis. These repurchases are clearly suboptimal from an 'ex-post' perspective since they lead to the country paying back its debt even when there are no penalties for not doing so. Nonetheless, we find that these repurchases take place in equilibrium and also that they are beneficial from an 'ex-ante' perspective as they allow the country to borrow.

The paper is structured as follows. Section 1 proves the main result of the paper in a simple two-period, two-region setup. The goal is to develop the basic intuitions in a transparent way. Section 2 proves the main result in a general setup with many regions, many periods, many shocks, many sources of market incompleteness, and many sources of heterogeneity within and between regions. This setup encompasses many of the models used by the previous literature. Section 3 explores limits to the argument by introducing imperfections in secondary markets. In particular, we consider the effects of transaction costs, large agents, and various degrees of government commitment. Section 4 concludes.

⁴With respect to the former, Gelos, Sahay, and Sandleris (2004) find that the loss of access to international capital markets after defaults was about four years in the 80's and only a few months in the 90's. With respect to the latter, the evidence is mixed. Although Rose (2005) argues that there exists trade disruption after defaults, Martinez and Sandleris (2006) find that the fall in trade after defaults is the same vis a vis creditor and non-creditor trading partners, suggesting it is not due to sanctions.

⁵One way to reconcile theories based on reputation and sanctions with the empirical evidence is to assume that there are two types of default: excusable and strategic. Excusable defaults are more likely to be observed in equilibrium and have few negative consequences for the defaulter. Strategic defaults are less likely to be observed in equilibrium precisely as a result of the threat of loss of reputation and sanctions. See Grossman and van Huyck (1988).

⁶See Bulow and Rogoff (1988, 1991), Dooley (1988), Froot (1989), Helpman (1989), Krugman (1989, 1992), Sachs (1990), Kenen (1991), Rotemberg (1991), Detragiache (1994), Diwan and Spiegel (1994), and Fernandez-Ruiz (2000).

1 The basic argument

The main result of this paper is that, if secondary markets work well, it makes no difference for consumption and welfare whether we assume that all asset payments are enforced or, alternatively, we assume that governments strategically choose which ones, if any, to enforce. This result applies to a very broad class of models, as we formally prove in Section 2. In this section, we prove the result in a simple setup so as to develop intuition.

1.1 A barebones model of sovereign risk

This section presents one of the simplest worlds in which we can prove our result. We label it the Debtor-Creditor world and it is as follows:

Example 1 (Debtor-Creditor world). *The world lasts two periods: Today and Tomorrow, indexed by $t \in \{0, 1\}$; and it contains two equal-sized regions: Debtor and Creditor, indexed by $j \in \{D, C\}$. Let I^j be the set of individuals located in region j , and $I^W = I^D \cup I^C$. Each region contains a continuum of infinitesimal individuals that maximize this separable utility function: $U(c_{i0}, c_{i1}) = u(c_{i0}) + u(c_{i1})$ for all $i \in I^W$; where c_{i0} and c_{i1} are used, respectively, to denote the consumption levels of individual i Today and Tomorrow, and $u(\cdot)$ is monotonic, increasing and concave. All debtors (i.e. residents of Debtor) receive an endowment equal to $y - \varepsilon$ Today and $y + \varepsilon$ Tomorrow. All creditors (i.e. residents of Creditor) receive an endowment equal to $y + \varepsilon$ Today and $y - \varepsilon$ Tomorrow.*

In the Debtor-Creditor world there are no gains from domestic trade because all individuals within a region have the same preferences and endowments. But endowments differ across regions and this creates gains from international trade in bonds. To reap these gains, the world needs well-functioning bond markets. We refer to the bond markets that open Today and Tomorrow as primary and secondary respectively. For these markets to work well, bond payments must be enforced. We shall say that there is full enforcement if the world has institutions ensuring that governments always enforce bond payments regardless of the parties involved. We shall, instead, say that there is strategic enforcement if governments choose which bond payments, if any, to enforce. Our goal is to compare consumption and welfare under these two alternative institutional setups.

Under full enforcement, bond prices in secondary markets equal their face value. If prices were below face value, individuals could make a riskless profit by purchasing bonds and redeeming them.

If prices were above face value, the opposite strategy would then deliver a riskless profit. In primary markets bonds must promise a zero return given the strong symmetry between periods: there is no time preference for consumption and the world endowment is the same in both periods. Therefore, we have that:

$$(q_0^j)^* = (q_1^j)^* = 1 \text{ for all } j \in \{D, C\}, \quad (1)$$

where q_t^j is the price in period t of a bond issued by a resident of region j that pays one unit of output Tomorrow, and the asterisk is used to denote the full-enforcement equilibrium. Since bond returns are zero, we have the following equilibrium consumption:

$$(c_{i0})^* = (c_{i1})^* = y \text{ for all } i \in I^W. \quad (2)$$

That is, individuals completely smooth their consumption across periods.

Implementing the full enforcement consumption allocation requires debtors to borrow from creditors. Let x_{it}^j be the bonds issued by residents of region j that are held by individual i after trading in period t . There are many possible distributions of bond holdings in the primary market that support the consumption allocation in Equation (2), given the prices in Equation (1). Among them, it is customary to choose the distribution that minimizes trade volume.⁷

$$(x_{i0}^C)^* = 0 \text{ for all } i \in I^W \text{ and } (x_{i0}^D)^* = \begin{cases} -\varepsilon & \text{if } i \in I^D \\ +\varepsilon & \text{if } i \in I^C \end{cases} \quad (3)$$

Equation (3) states that debtors issue ε bonds and sell them to creditors. There are even more distributions of bond holdings in the secondary market that support the consumption allocation in Equation (2), given the prices in Equation (1). In fact, any redistribution of the original bonds achieves this since all individuals can directly collect any bond payment under full enforcement. It is again customary to choose among all of these distributions the one that minimizes trade volume which in this case means zero trade:

$$(x_{i1}^j)^* = (x_{i0}^j)^* \text{ for all } j \in \{D, C\} \text{ and } i \in I^W. \quad (4)$$

Note that creditors do not go to the secondary market but instead collect their debts directly from the original bond issuers. Therefore, the secondary market plays no role under full enforcement and closing it would have no effects on consumption and welfare. To sum up, Equations (1), (2), (3) and (4) provide a complete description of the full-enforcement equilibrium.

⁷Minimization of trade volume implies that gross and net bond holdings coincide and are both given by x_{it}^j .

Under full enforcement, regional governments are assumed to have both the means and the will to force domestic residents to pay their debts. Under strategic enforcement, governments are still assumed to have the means to enforce debts but they might not have the will to do so. In particular, governments choose enforcement after secondary markets close Tomorrow so as to maximize the average utility of the region, i.e. $W^j = \int_{i \in I^j} u(c_{i1})$ for all $j \in \{D, C\}$. Moreover, governments are assumed to have no credibility so that any promise made before the time of enforcement is discounted by individuals. To simplify the exposition, assume that governments can only discriminate bondholders by their characteristics when deciding enforcement. In the Debtor-Creditor world, this means that governments can only discriminate bondholders by their residence.

It is widely believed that in the Debtor-Creditor world with strategic enforcement international trade in bonds is not possible since there are no default penalties. The argument goes as follows: creditors lend Today only if they expect debtors to pay their debts Tomorrow. But Tomorrow Debtor's government will not force debtors to pay back their debts since this would lower the average utility of the region. Anticipating this, creditors do not lend Today. There is therefore a unique equilibrium without international trade in bonds in which each region (and therefore each individual) consumes its own endowment. We show next why this conclusion is incorrect.

1.2 The role of secondary markets

It is evident that Tomorrow Debtor's government will not enforce payments on bonds held by creditors. It is also evident that creditors must anticipate this Today. But it does not follow that creditors do not lend Today since they still have the option of reselling their bonds Tomorrow in the secondary market. In fact, we show next that in equilibrium bonds trade in the secondary market at face value. Anticipating this, creditors lend to debtors Today and all gains from trade are reaped even if governments choose enforcement strategically.

Define $e_{j'}^j \in \{0, 1\}$ to be a variable that takes the value one if bond payments from residents of region j to those of j' are enforced, and zero otherwise. Under full enforcement, we have that $e_{j'}^j = 1$ for all j and j' by assumption. Under strategic enforcement, $e_{j'}^j$ is obtained as part of the equilibrium and must be consistent with government preferences and bond holdings after the secondary market closes. For instance, assume prices, consumptions and bond holdings are those of the full-enforcement equilibrium. Since all bonds are in the hands of creditors after the secondary market closes, this is possible in a strategic-enforcement equilibrium if and only if Debtor's government prefers to enforce bond payments to creditors. But this cannot be since it

would lower the region's average utility:

$$\arg \max_{e_C^D} \left\{ \int_{i \in I^D} u((c_{i1})^* - (1 - e_C^D) \cdot (x_{i1}^D)^*) \right\} = 0.$$

As a result, Equations (1), (2), (3) and (4) cannot all simultaneously be part of a strategic-enforcement equilibrium.

This does not mean however that consumption and welfare differ between the full- and strategic-enforcement equilibria. Let a double asterisk denote a strategic-enforcement equilibrium. Assume that prices, consumptions and bond holdings Today are the same as in the full-enforcement equilibrium:

$$(q_0^j)^{**} = (q_1^j)^{**} = 1 \text{ for all } j \in \{D, C\}, \quad (5)$$

$$(c_{i0})^{**} = (c_{i1})^{**} = y \text{ for all } i \in I^W, \quad (6)$$

$$(x_{i0}^C)^{**} = 0 \text{ for all } i \in I^W \text{ and } (x_{i0}^D)^{**} = \begin{cases} -\varepsilon & \text{if } i \in I^D \\ +\varepsilon & \text{if } i \in I^C \end{cases} \quad (7)$$

but instead of assuming zero trade in the secondary market, assume that trade in this market leads to the following distribution of bond holdings:

$$(x_{i1}^C)^{**} = 0 \text{ for all } i \in I^W \text{ and } (x_{i1}^D)^{**} = \begin{cases} \delta_i & \text{if } i \in I^D \\ 0 & \text{if } i \in I^C \end{cases} \quad (8)$$

with $\int_{i \in I^D} \delta_i = 0$ and $\delta_i \leq y$ for all $i \in I^D$.⁸ That is, in secondary markets debtors purchase all the bonds from creditors although not necessarily in a symmetric way. Moreover, assume that Debtor's government enforces bond payments between debtors:

$$(e_D^D)^{**} = 1. \quad (9)$$

The distribution in Equation (8) and the enforcement policy in Equation (9) are consistent with maximization by both individuals and governments. If Debtor's government enforces bond payments between debtors, the distribution of bond holdings in Equation (8) is consistent with individual maximization since all bonds are in the hands of those (i.e. debtors) capable of redeeming them after the market closes. Otherwise there would be unexploited trade opportunities as those that cannot collect bond payments would not be selling their bonds to those that can. If individuals

⁸This distribution is feasible since the secondary market clears and no individual is left with a negative endowment after trading in it.

choose the distribution of bond holdings in Equation (8), enforcement of bond payments between debtors is consistent with Debtor's government maximization. Jensen's inequality implies that this raises the region's average utility:

$$\arg \max_{e_D^D} \left\{ \int_{i \in I^D} u \left((c_{i1})^{**} - (1 - e_D^D) \cdot (x_{i1}^D)^{**} \right) \right\} = 1.$$

Therefore, we have shown that Equations (5), (6), (7), (8), and (9) constitute a strategic-enforcement equilibrium.

Consumption and welfare are the same in the strategic- and full-enforcement equilibria. The only difference is the amount of trade in the secondary market. In both equilibria, trading in secondary markets must ensure that all bonds end up in the hands of those individuals that can collect payments from bond issuers. Since this is an empty requirement in the case of full enforcement, minimization of trade volume then leads to zero trade. But this is not an empty requirement with strategic enforcement. Since creditors hold all the bonds and Debtor's government never enforces bond payments to them, trade in the secondary market is needed to ensure that all bonds end up in the hands of debtors. It is easy to check that there are many distributions of bond holdings that fulfill this requirement.

Secondary markets play the usual role of transferring assets to those individuals that value them most, leading to maximization of asset value. This means moving bonds from those individuals that cannot collect payments from the original issuers to those that can, leading to maximization of enforcement. Creditors are willing to sell all their bonds at any positive price since they know that any bond left in their hands after the market closes will not be enforced. Therefore, the supply of bonds is vertical. Debtors are willing to buy any quantity of bonds at face value since they know that bonds left in their hands after the market closes will be enforced. That is, the demand for bonds is horizontal until all the endowment of Debtor has been exhausted, and downward-sloping thereafter. The equilibrium price is therefore equal to face value if demand and supply cross in the horizontal section of the demand curve. But this must be the case since the face value of all outstanding bonds cannot exceed Debtor's output. Otherwise, we would reach the contradiction that the full-enforcement allocation implies negative consumption for debtors.

Another useful and intuitive way of thinking about the role of secondary markets is that they create a prisoner's dilemma situation that forces the region to repurchase or repay its debt. Once Tomorrow arrives, it would be better for all debtors to agree not to purchase each other's bonds from creditors. If such collusion were possible, it would lead to default and therefore an increase in consumption for all debtors. But each debtor has a strong incentive to depart from such an

agreement. Since creditors are willing to sell their bonds at any positive price, the capital gains or profits from violating the agreement would be enormous for a small or infinitesimal debtor. Hence, the agreement is not feasible and the region as a whole ends up paying all of its debts in the secondary market. This outcome, which constitutes an ex-post inefficiency from the viewpoint of the region, somewhat paradoxically ensures ex-ante efficiency since it allows for international trade in bonds Today.

The widespread belief that the absence of default penalties *alone* leads to a unique equilibrium without international trade is thus incorrect. This requires the absence of both default penalties *and* secondary markets. Closing secondary markets does not make any difference with full enforcement, since creditors have the additional option of directly collecting debts from debtors. But closing secondary markets has dramatic effects with strategic enforcement, since creditors do not have this additional option available to them. Once these markets are closed, creditors lose any hope of being repaid and decide not to lend to debtors. As a result, each region (and therefore each individual) ends up consuming its own endowment. With secondary markets, government attempts to use enforcement policy to redistribute from foreign to domestic residents are easily circumvented with the help of additional trading and without creating any welfare loss. Without secondary markets, government attempts to use enforcement policy to redistribute from foreign to domestic residents are also futile. But they destroy valuable international trade and create welfare losses.

To sum up, the strategic-enforcement equilibrium delivers the same consumption and welfare than the full-enforcement equilibrium, but requires more trade in secondary markets. This additional trade is however only the first consequence of moving from full to strategic enforcement. The observant reader has already noticed a second one, namely, that consumption and welfare are unique with full enforcement but not with strategic enforcement. Our analysis of the deceptively simple Debtor-Creditor world is not over yet.⁹

1.3 Multiple equilibria and welfare

The strategic-enforcement equilibrium described in the previous section is based on the ‘optimistic’ belief that Debtor’s government will enforce bond payments between debtors. This belief is validated in equilibrium since trading in the secondary market delivers a distribution of bond holdings such that Debtor’s government chooses to enforce payments on all outstanding bonds. What would

⁹The full-enforcement equilibrium is unique with respect to consumption and welfare in the Debtor-Creditor world. But this need not be true in other worlds. We shall show later that for each (of the possibly many) full-enforcement equilibrium, there always exists a corresponding strategic-enforcement equilibrium that delivers the same consumption and welfare. What we analyze next is a set of additional strategic-enforcement equilibria that do not correspond to any full-enforcement equilibrium.

happen instead if creditors have ‘pessimistic’ beliefs about enforcement? We show next that it is also possible to construct equilibria based on various combinations of ‘optimistic’ and ‘pessimistic’ beliefs about enforcement.

Assume individuals are pessimistic and believe Debtor’s government will not enforce any bond payments. Then, there will be no demand in the secondary market and any bond traded there will command a zero price. This means that the return on any bond purchased in the primary market must be minus one. Anticipating this, creditors are unwilling to lend to debtors and each region (and therefore each individual) ends up consuming its own endowment. To conclude that this is an equilibrium, we must show that the pessimistic belief about enforcement is consistent with Debtor’s government maximization. But this must be the case here. Since no bonds are issued Today Debtor’s government has nothing to enforce Tomorrow. In addition, it is also clear that, even if an infinitesimal subset of creditors deviated and decided to lend, Debtors’ government would be indifferent between enforcing and not enforcing payments and, thus, not enforcing would be a best response. Therefore, we have found an additional equilibrium with different consumption and welfare.¹⁰

It is easy to show that there are no additional equilibria in our simple world. The reason is that there is only one meaningful enforcement decision Tomorrow, namely, whether Debtor’s government enforces bond payments between debtors. This is only because we have assumed that governments cannot make different enforcement decisions for different groups of residents. But this assumption was just adopted for convenience. Relaxing it generates additional strategic-enforcement equilibria with different levels of consumption and welfare based on different combinations of optimistic and pessimistic beliefs. The following example makes this point forcefully.

Example 2 (Debtor-Creditor world with names). *All assumptions are the same as in the Debtor-Creditor world, except that individuals are also given one of two possible names: ‘Dupont’ or ‘Dupond’.*

Although Duponts and Duponds have the same preferences and endowments, their different names allow governments to discriminate between them when deciding enforcement. This is clearly a minimal departure from the world of the previous section. But it forces Debtor’s government to make another meaningful enforcement decision Tomorrow and this creates two additional equilibria.

¹⁰This pessimistic equilibrium is not the same as the equilibrium with missing secondary markets that the previous literature has focused upon. Pessimism closes the bond market and eliminates all trade, domestic and foreign. Closing secondary markets geographically segments the bond market eliminating international trade but not domestic trade. This difference is obscured in the Debtor-Creditor world because all individuals within a region are identical and there is no domestic trade in equilibrium.

For instance, assume individuals believe that Debtor's government will enforce bonds issued by Duponts and held by other debtors, but it will not enforce any bonds issued by Duponds. Given these beliefs, Duponts can borrow while Duponds cannot and are therefore forced to consume their own endowment. Bond returns are negative and all individuals, except for credit-constrained Duponds, equalize the ratio of their marginal utilities Today and Tomorrow. Duponts are better off than in the optimistic equilibrium since the removal of competitors (i.e. Duponds) from the primary market improves the terms at which they can borrow. But both Duponds and creditors are worse off than in the optimistic equilibrium, the former because they cannot borrow and the latter because they lend at worse terms.¹¹

Under strategic enforcement there is always an 'optimistic' equilibrium with the same consumption and welfare than full enforcement. But we have seen that there are other 'pessimistic' equilibria too. In the previous examples, these 'pessimistic' equilibria never lead to a Pareto improvement over full enforcement. But this need not always be the case, as the following example shows:

Example 3 (Lucky-Unlucky world). *The world lasts two periods: Today and Tomorrow, indexed by $t \in \{0, 1\}$; and it contains two equal-sized regions: Home and Foreign, indexed by $j \in \{H, F\}$. Each region contains a continuum of infinitesimal individuals that maximize the already familiar utility function: $U(c_{i0}, c_{i1}) = u(c_{i0}) + u(c_{i1})$ for all $i \in I^W = I^H \cup I^F$. All individuals receive an endowment of y Today. But Tomorrow there are two states. If $s = s^H$, Home is lucky and its residents receive an endowment equal to $y + \varepsilon$, while Foreign is unlucky and its residents receive an endowment equal to $y - \varepsilon$. If $s = s^F$, Home is unlucky and its residents receive an endowment equal to $y - \varepsilon$, while Foreign is lucky and its residents receive an endowment equal to $y + \varepsilon$. Both states have equal probability.*

Clearly there are gains from international risk sharing in the Lucky-Unlucky world. By pooling their endowments, individuals could eliminate the volatility of their consumption at no cost in terms of mean consumption. But we shall consider a situation in which insurance markets are missing. The only asset that can be traded is a non-contingent bond. Under full enforcement there is no international trade and each region is forced to consume its own endowment. The same happens under strategic enforcement if beliefs are optimistic. This outcome is not Pareto efficient and the reason, of course, is that markets are incomplete.

¹¹To check that this is an equilibrium simply note that the belief that bonds issued by Duponts are enforced is validated in equilibrium and, although the belief that bonds issued by Duponds are not enforced cannot be validated in equilibrium, it is still consistent with Debtor's government maximization. Naturally, there is another equilibrium in which it is Duponds who can borrow while Duponts are forced to consume their endowment.

But there is another equilibrium with a mix of optimistic and pessimistic beliefs that can raise the welfare of all and lead to Pareto efficiency. Assume individuals believe that the lucky region will enforce bond payments between its residents, while the unlucky region will not. Given these beliefs, there is a trading strategy that ensures full risk sharing: in the primary market each individual buys ε bonds issued by residents of the other region and finances this sale by issuing and selling ε bonds. If an individual turns out to be unlucky, he/she will default on his/her bonds and enjoy a consumption equal to y . If an individual turns out to be lucky, he/she will have a capital loss equal to ε and enjoy a consumption equal to y as well.

What is going on? Pessimism closes markets (such as those for Dupond bonds) and/or leads to equilibrium default (such as when a region turns out to be unlucky). In the Debtor-Creditor world markets are complete and, as a result, the full-enforcement allocation is Pareto efficient. In this first-best context, closing markets and/or inducing defaults always reduces welfare. In the Lucky-Unlucky world insurance markets are missing and the full-enforcement allocation is no longer Pareto efficient. In this second-best context, it is well known that closing some markets and/or using defaults to change the span of existing assets might lead to Pareto superior outcomes. This classic second-best intuition explains why pessimistic beliefs might sometimes lead to higher welfare than optimistic ones.¹²

Up to this point we have shown that: (i) there is always an optimistic equilibrium that delivers the same level of consumption and welfare as the full-enforcement equilibrium; (ii) there are additional strategic-enforcement equilibria with different levels of consumption and welfare based on pessimistic beliefs about enforcement; (iii) the optimistic equilibrium need not be the one that delivers the highest possible welfare. The last topic we address here is robustness.

1.4 Robustness

Assume governments suffer a penalty b every time they decide not to enforce payments to foreigners. We shall think of b as being arbitrarily small but strictly positive. In particular, in the Debtor-Creditor world this implies that Debtor's objective function is now given by $W^j = \int_{i \in I^j} u(c_{i1}) - b \cdot (1 - e_C^D)$ for all $j \in \{D, C\}$. This small modification to our environment is of interest because it eliminates all equilibria based on pessimistic beliefs leaving the optimistic equilibrium as the unique strategic-enforcement equilibrium. Moreover, it is consistent with previous literature that has emphasized the role of default penalties.

To understand this result, it is worth being more explicit about why pessimistic beliefs are

¹²This example also shows that our results do not depend on assuming that markets are complete. The optimistic strategic-enforcement equilibrium replicates the consumption and welfare of the full-enforcement equilibrium regardless of whether the latter is Pareto efficient or not.

consistent in the Debtor-Creditor world without default penalties, i.e. $b = 0$. Assume all individuals expect Debtor's government not to enforce bond payments to debtors. We have argued that in this situation creditors do not lend to debtors and the government does not have to make a decision. How do we know that there are no unexploited trade opportunities? Imagine an infinitesimal creditor deviates and decides to lend. This creditor will certainly find a debtor that is willing to borrow. Naturally, this creditor will not be able to collect the bond payment directly from the original issuer and must go to the secondary market to sell the bond. But would this creditor find a debtor that buys the bond in the secondary market? The answer is negative since debtors expect their government not to enforce even if any of them deviates. After all, the government is indifferent between enforcing or not enforcing an infinitesimal bond payment since the effect of this decision on its welfare is negligible. This is exactly why individuals take enforcement decisions (and prices, of course) as given.

Assume next that there is a small but strictly positive default penalty, i.e. $b > 0$. Then, a pessimistic belief about enforcement is not consistent with individual maximization since it leaves unexploited trade opportunities. To see this, consider again a situation in which there is no trade due to pessimistic beliefs about enforcement. Like the previous case, a creditor that deviates and decides to lend will find a debtor that wants to borrow. But unlike the previous case, this creditor will now be able to collect the bond payment directly from the original issuer. The reason, of course, is that creditors expect that an infinitesimal bond payment will lead the government to enforce. The welfare effect of enforcing an infinitesimal bond payment to a foreigner is negligible. But now the government wants to avoid the (possibly small but not negligible) default penalty. Knowing this, creditors will lend and a situation in which there is no trade due to pessimistic beliefs about enforcement cannot be an equilibrium. We therefore add a fourth and final item to our list of results: (iv) only the optimistic equilibrium survives the introduction of (even arbitrarily small) default penalties.

This leads us to select the optimistic equilibrium for the Debtor-Creditor world. We then refer to the differences between this equilibrium and the full-enforcement one as the effects of sovereign risk. Our main result is that, if individuals can freely retrade existing assets, sovereign risk has no effects on consumption and welfare. The only effect of sovereign risk is to increase trade volume as individuals trade not only to smooth their consumption but also to circumvent the strategic or opportunistic behavior of governments.

2 The general case

Results (i)-(iv) were obtained with the help of a very stylized setup. This was useful to build intuitions. But these results apply to a very broad class of models that encompasses many of those that have been used in the previous literature. In this section, we provide a formal proof of these results in a general setup with many regions, many periods, many shocks, many sources of market incompleteness and many sources of heterogeneity within and between regions.

For obvious reasons, the style of this section is more formal and technical than that of the previous one. Some readers might prefer to read first Section 3 where we go back to the informal style of Section 1 and use simple variants of the Debtor-Creditor world to show the limits of the argument and develop further intuitions.

2.1 The model

Consider a world economy with J regions, indexed by $j \in J \equiv \{1, 2, \dots, J\}$, so that J is used to denote both the number and the set of regions. Each region contains a continuum of infinitesimal individuals. We use I^j to denote the set of individuals located in region j , whereas $I^W = \bigcup_{j=1}^J I^j$ denotes the total population of the world. Let $j(i)$ denote the region where individual i lives, namely $j(i) = j$ if $i \in I^j$; let $-j(i)$, on the other hand, denote the set of regions different from j (i), namely $-j(i) = J \setminus j(i)$.

The world lasts for $T + 1 \leq \infty$ periods, which are indexed by $t \in T \equiv \{0, 1, \dots, T\}$. Hence, T denotes both the last period and the set of all periods. At the beginning of each period, a shock $s_t \in S$ is realized. We use $h_t \equiv [s_0, s_1, \dots, s_t] \in H_t$ to denote the history of realizations of the shock up to period t . Let $H \equiv \bigcup_{t \in T} H_t$ denote the set of all histories. The probability of observing a history h_τ , conditional on having observed a history h_t , is denoted $\pi(h_\tau | h_t)$.

In each period t , after the shock is realized individuals receive a non-negative endowment y_{ih_t} of a perishable consumption good.¹³ We allow for heterogeneity in endowments within and between regions. At each history h_t , individuals maximize the expected net present value of their utility

$$U_{ih_t} = \sum_{\tau=t}^T \beta^{\tau-t} \cdot \int_{h_\tau \in H_\tau} \pi(h_\tau | h_t) \cdot u_{ih_\tau}(c_{ih_\tau}) \quad \text{for all } h_t \in H \text{ and } i \in I^W, \quad (10)$$

where c_{ih_τ} denotes consumption by individual i at history h_τ . All utility functions $u_{ih_t}(\cdot)$ are either monotonic and strictly concave or zero,¹⁴ and that they can vary across histories and individuals.

¹³This constitutes a slight abuse of notation since h_t indicates both that output takes place at t and that the history at that time is h_t . A similar convention will be used throughout this section.

¹⁴We allow $u_{ih_t}(\cdot) = 0$ to account for overlapping generations models.

Individuals can trade in asset markets. More specifically, in each period t the timing of events is as follows: the shock realizes and individuals receive their endowment, asset markets open and individuals retrade existing assets and issue new ones, enforcement of maturing asset payments takes place, and individuals consume. Although we allow for various restrictions in terms of asset structure, we assume that markets are frictionless and therefore all individuals in all histories can trade existing assets costlessly.

The asset structure of this economy is characterized by a set of available assets N . The payment promised by asset $n \in N$ at history h_t is denoted by $d_{h_t n}$. We use N_{h_t} to denote the subset of assets for which $d_{h_t n} > 0$. We allow for fairly general constraints on the types and amounts of assets that may be issued at each history by each individual. For example, (i) there may be no assets that pay in certain histories; (ii) there may be constraints on the contingency of assets, such as only allowing for non-contingent bonds; (iii) agents might face individual-specific constraints that limit the type and number of assets that they can issue; (iv) an asset may be issued in some histories but not in others. The only assumption we make on the asset structure itself is that asset payments are “separable”. That is, for each asset, there always exists a portfolio of existing assets that allows us to replicate each payment separately. This assumption is sufficient but not necessary for our main result to hold and its implications are highlighted below. The simplest environment in which payments are separable is one in which each asset n has a unique maturity period, which we will assume from now on: $N_{h_\tau} \cap N_{h_{\tau'}} = \emptyset$ for all $h_\tau, h_{\tau'} \in H$, $\tau, \tau' \in T$, and $\tau \neq \tau'$.

The economy described so far is general enough to encompass many of the previous models used in the literature as particular cases. In terms of asset structure, for example, we can replicate the bond models commonly used in the literature. Such is the case if for all $h_t, (h_t)' \in H_t$, $t \in T$, we impose $d_{(h_t)'} = d_{h_t n}$ for all $n \in N_{h_t}$. Our framework is also consistent with the two benchmark models in terms of demographics:

- Infinitely-lived representative-agent model: let $T = \infty$ and assume identical utilities, endowments and asset-market restrictions for all individuals in any given region.
- Overlapping-Generations economies à la Samuelson: let individuals be partitioned into cohorts I_t^j for $t \in T$ and $j \in J$. An individual $i \in I_t^j$ resides in country j and “lives” during periods $\{t, t + 1, \dots, t + l - 1\}$ where l is the number of periods individuals live. For an individual $i \in I_t^j$, $u_{ih_\tau}(\cdot) = 0$, $y_{ih_\tau} = 0$, and issuance at τ are zero for all $\tau \notin \{t, t + 1, \dots, t + l - 1\}$.

Perhaps the only important limitation of our framework is that it does not allow for investment. We however conjecture that the results presented here would also apply to a richer framework that allows for it.

2.2 Enforcement

Up to now, we have described the structure of our economy without making any reference to how promised asset payments are enforced. We now describe the two alternative scenarios. The first scenario is that of full enforcement. It consists simply of our economy with the additional assumption that all payments are enforced, regardless of the parties involved. In this scenario, all individuals know that they will have to deliver all the payments promised by any asset that they issue and that they will receive all the payments promised by any asset that they purchase.

The second scenario is that of strategic enforcement. It consists of our economy under the assumption that each region has a government that decides strategically on the enforcement of payments. We assume that governments have no ability to commit ex-ante to enforcing or to not enforcing payments. That is, governments make a decision regarding the enforcement of outstanding payments owed by their residents at each history h_t , after trade in asset markets has taken place. Hence, at any given history $h_t \in H$, the government of region $j \in J$ must decide on the enforcement of payments promised by assets $n \in N_{h_t}$ whenever these assets have been issued by some individual $i \in I^j$. When deciding on enforcement at history h_t , the government of region j maximizes

$$\int_{i \in I^j} \phi_i \cdot U_{ih_t}, \quad (11)$$

where $\phi_i \geq 0$ is the weight that the government assigns to the utility of individual i . Note that governments attach zero weight to the utility of foreigners.

Once it is assumed that governments can decide on the enforcement of different payments, we need to specify the enforcement technology that they have access to. We assume that governments can make different enforcement decisions for different payments owed by its residents. In particular, governments can discriminate according to the characteristics of issuers and holders. To be more precise, recall that we have allowed for individual heterogeneity in endowments, preferences, restrictions on asset issues and government weights. Let us partition the population of each region into groups of individuals with the same characteristics. In other words, let us partition the population of I^j , $j \in J$, into groups $g \in G^j$ where $I^j = \bigcup_{g \in G^j} g$, such that - if $g(i)$ denotes the group of individual i - for all $i, \tilde{i} \in I^j$, $g(i) = g(\tilde{i})$ only if (a) $y_{ih_t} = y_{\tilde{i}h_t}$ for all $h_t \in H$; (b) $u_{ih_t} = u_{\tilde{i}h_t}$ for all $h_t \in H$; (c) individuals i and \tilde{i} face the same restrictions on the types and amounts of assets that they may issue; and (d) $\phi_i = \phi_{\tilde{i}}$. Note that this means that all individuals in a given group have the same characteristics, but it does not rule out the possibility of there being two individuals with the same characteristics in two different groups. We let $G^W = \bigcup_{j \in J} G^j$ denote the set of all groups in the world.

We allow governments to discriminate according to the groups of the issuer and holder when enforcing payments. However, we assume that the government cannot discriminate based on the identity of the individual issuer and holder. In other words, if a government enforces the payment on asset $n \in N$ from individual $i \in g$ to individual $i' \in g'$ in a given history $h_t \in H$, then it must enforce all payments on asset n from individuals in g to individuals in g' in that history. For $g \in G^j$, let $e_{gh_t n}^g \in \{0, 1\}$ denote the decision of the government of region j regarding the enforcement of payments on asset n owed by individuals in group g , to individuals in group g' , at history h_t .¹⁵ We use $e_{gh_t n}^g = 1$ to denote enforcement of such payments, and $e_{gh_t n}^g = 0$ to denote non-enforcement. The government does not make a decision regarding the enforcement of assets that have not been issued by any of its residents. In order for individuals to take enforcement decisions as given in equilibrium, we assume that all groups $g \in G^W$ have positive mass.

This completes our description of the economy under the alternative scenarios of full and strategic enforcement. We now characterize the equilibria of the economy in each of these scenarios.

2.3 Equilibrium

Let $q_{h_t n}^g$ denote the price of asset n issued by an individual that belongs to group g at history h_t . Let $x_{ih_t n}^i$ denote the holdings of asset n by individual i , issued by individual i' , *before* trading in asset markets at history h_t . If $i' \neq i$, $x_{ih_t n}^i \geq 0$ since i cannot hold a negative amount of assets issued by i' . But $x_{ih_t n}^i \leq 0$ since it denotes the (negative of the) outstanding assets issued by individual i . Let $\hat{x}_{ih_t n}^i$ denote the holdings of asset n by individual i , issued by individual i' , *after* trading in asset markets at history h_t . Naturally, for all non-maturing assets at history h_t (i.e. $n \in N_{h_t}$ with $\tau > t$) it must be the case that $x_{ih_{t+1} n}^i = \hat{x}_{ih_t n}^i$ for all h_{t+1} consistent with h_t . Also, $x_{ih_0 n}^i = 0$ since the first time at which individuals can issue assets is when asset markets open in period 0. Let the total net holdings of individual i of asset n at history h_t be denoted by $x_{ih_t n} = x_{ih_t n}^i + \int_{i' \in I^W \setminus i} x_{ih_t n}^{i'}$; and similarly for $\hat{x}_{ih_t n}$. Likewise, we let $x_{ih_t n}^g$ ($\hat{x}_{ih_t n}^g$) denote individual i 's net holding of asset n issued by members of group g at history h_t , before (after) asset markets open.

Then, the budget constraints faced by an individual $i \in I^W$ at history $h_t \in H$ are given by

$$\hat{y}_{ih_t} \equiv y_{ih_t} + \sum_{n \in N} \sum_{g \in G^W} q_{h_t n}^g \cdot (x_{ih_t n}^g - \hat{x}_{ih_t n}^g) \geq 0, \quad (12)$$

¹⁵In each history h_t the government of region $j \in J$ has $2^{(\#G^j) \cdot (\#G^W) \cdot (\#N_{h_t})}$ potential enforcement choices, where $\#G^j$ denotes the number of groups in region j , $\#G^W$ denotes the number of groups in the world, and $\#N_{h_t}$ denotes the number of maturing assets.

$$c_{iht} \leq \hat{y}_{iht} + \sum_{n \in N_{h_t}} \sum_{g \in G^W} d_{h_t n} \cdot \left(e_{g(i)h_t n}^g \cdot \int_{i' \in g \setminus i} \hat{x}_{ih_t n}^{i'} - e_{gh_t n}^{g(i)} \cdot \int_{i' \in g \setminus i} \hat{x}_{ih_t n}^i \right), \quad (13)$$

where \hat{y}_{iht} denotes the endowment left in the hands of individual i after trading in asset markets and $\hat{x}_{ih_t n}^i$ must always satisfy the issuing constraints that individual $i \in I^W$ faces with respect to asset $n \in N$. Equation (12) states that an individual cannot have negative endowment after trading in asset markets, while Equation (13) states that an individual's consumption can be no greater than his endowment after trading in asset markets plus the net payments received from maturing assets. The latter takes into account the fact that not all payments from maturing assets might be enforced. Market clearing conditions are given by

$$\int_{i \in I^W} \hat{x}_{ih_t n}^g = 0 \quad \text{for all } h_t \in H, n \in N, \text{ and } g \in G^W. \quad (14)$$

An equilibrium of the economy with full enforcement is a set of: (i) asset prices; (ii) consumption profiles and asset holdings, and; (iii) enforcement decisions, such that individuals and governments correctly anticipate asset prices and enforcement decisions whenever these are observed and (a) all individuals maximize expected utility (Equation (10)) subject to their budget (Equations (12) and (13)) and issuing constraints, (b) governments always enforce payments, and (c) markets clear (Equation (14)). We denote full-enforcement equilibria with an asterisk:

$$\left\{ \left(q_{h_t n}^g \right)^*, \left(c_{iht} \right)^*, \left(x_{ih_t n}^g \right)^*, \left(\hat{x}_{ih_t n}^g \right)^*, \left(e_{g' h_t n}^g \right)^* \right\}_{h_t \in H, n \in N, g, g' \in G^W, i \in I^W}.$$

There are always many equilibria with the same consumption and prices (and, trivially, enforcement) but differ in their pre- and/or post-trade asset holdings. The Debtor-Creditor world of Example 1 illustrates this. In addition, there might be equilibria with different consumption and prices. For instance, the class of economies being considered includes OLG economies that can have bubbly equilibria.

An equilibrium of the economy with strategic enforcement is a set of: (i) asset prices; (ii) consumption profiles and asset holdings, and; (iii) enforcement decisions, such that individuals and governments correctly anticipate asset prices and enforcement decisions whenever these are observed and (a) all individuals maximize expected utility (Equation (10)) subject to their budget (Equations (12) and (13)) and issuing constraints, (b) governments maximize their objective function (Equation (11)), and (c) markets clear (Equation (14)). We shall denote strategic-enforcement

equilibria with two asterisks:

$$\left\{ (q_{h_t n}^g)^{**}, (c_{ih_t})^{**}, (x_{ih_t n}^g)^{**}, (\hat{x}_{ih_t n}^g)^{**}, (e_{g' h_t n}^g)^{**} \right\}_{h_t \in H, n \in N, g, g' \in G^W, i \in I^W}.$$

The only difference between the full- and strategic-enforcement equilibria is the behavior of governments. In the former governments maximize enforcement, while in the latter they choose enforcement to maximize a weighted average of the utility of the residents of their region.

2.4 Main result

Our main result is that for each full-enforcement equilibrium there is a corresponding strategic-enforcement equilibrium that delivers the same consumption profiles and, therefore, the same level of welfare. We now prove this result in the general setup described above, thereby substantially extending result (i) of Section 1:

Proposition 1. *Consider an economy satisfying the previous assumptions regarding preferences, endowments, asset markets, and enforcement technology. Given any equilibrium of this economy with full enforcement*

$$\left\{ (q_{h_t n}^g)^*, (c_{ih_t})^*, (x_{ih_t n}^g)^*, (\hat{x}_{ih_t n}^g)^*, (e_{g' h_t n}^g)^* \right\}_{h_t \in H, n \in N, g, g' \in G^W, i \in I^W},$$

there exists at least one equilibrium of this economy with strategic enforcement

$$\left\{ (q_{h_t n}^g)^{**}, (c_{ih_t})^{**}, (x_{ih_t n}^g)^{**}, (\hat{x}_{ih_t n}^g)^{**}, (e_{g' h_t n}^g)^{**} \right\}_{h_t \in H, n \in N, g, g' \in G^W, i \in I^W},$$

in which $(q_{h_t n}^g)^ = (q_{h_t n}^g)^{**}$, $(c_{ih_t})^* = (c_{ih_t})^{**}$, and $(x_{ih_t n}^g)^* = (x_{ih_t n}^g)^{**}$ for all $h_t \in H$, $n \in N$, $g \in G^W$, and $i \in I^W$.*

We prove this Proposition by construction. Consider the following pair of profiles of post-trade asset holdings and enforcement decisions $\left\{ (\hat{x}_{ih_t n}^g)^{CP}, (e_{g' h_t n}^g)^{CP} \right\}_{h_t \in H, n \in N, g, g' \in G^W, i \in I^W}$:

$$(\hat{x}_{ih_t n}^g)^{CP} = \begin{cases} \delta_{ih_t n} & \text{if } n \in N_{h_t} \text{ and } i \in g \\ 0 & \text{if } n \in N_{h_t} \text{ and } i \notin g \\ (\hat{x}_{ih_t n}^g)^* & \text{if } n \notin N_{h_t} \end{cases} \quad \text{for all } h_t \in H, g \in G^W, \text{ and } i \in I^W, \quad (15)$$

$$(e_{g h_t n}^g)^{CP} = 1 \quad \text{for all } n \in N_{h_t}, h_t \in H, \text{ and } g \in G^W \text{ for which } \int_{i \in g} (x_{ih_t n}^i)^* < 0, \quad (16)$$

where $\delta_{ihtn} \in \mathbb{R}$ such that $\int_{i \in g} \delta_{ihtn} = 0$ and $\sum_{n \in N_{h_t}} \delta_{ihtn} \leq (c_{iht})^*$ for all $h_t \in H$, $n \in N_{h_t}$, $g \in G^W$, and $i \in I^W$. Equation (15) states that, after trading in asset markets, all maturing assets are held by individuals that belong to the same group as the issuer, while non-maturing assets are held as in the full-enforcement equilibrium. Equation (16) states that governments enforce payments of all maturing assets within groups. We will show that:

$$\left\{ (q_{h_t n}^g)^*, (c_{iht})^*, (x_{ihtn}^g)^*, (\hat{x}_{ihtn}^g)^{CP}, (e_{g'h_t n}^g)^{CP} \right\}_{h_t \in H, n \in N, g, g' \in G^W, i \in I^W}$$

is an equilibrium of the strategic-enforcement economy.

We first show that the proposed equilibrium satisfies individual maximization. Prices are the same as in the full-enforcement equilibrium and, in particular, maturing assets still trade at face value. As a result, the consumption profiles and the pre-trade asset holdings of the full-enforcement equilibrium must also be consistent with individual maximization under strategic enforcement. Also, the fact that maturing assets trade at face value also implies that (a) individuals are indifferent between buying or not buying maturing assets issued by members of their same group; and (b) individuals prefer (at least weakly) to sell maturing assets issued by members of different groups. In addition, individuals are satisfying their budget constraints. Equation (13) is satisfied because maturing assets trade at face value and all payments are enforced. And Equation (12) is also satisfied because it follows from Equation (13) and the condition $\sum_{n \in N_{h_t}} \delta_{ihtn} \leq (c_{iht})^*$.¹⁶ Finally, individuals satisfy their issuance constraints since their issuance is the same as in the full-enforcement equilibrium.

We next show that the proposed equilibrium also satisfies government maximization. The analysis is substantially simplified by the fact that, since enforcement only affects current consumption, we only need to check that governments do not have incentives to deviate at any one history h_t .¹⁷ At the time of enforcement at history h_t , each government $j \in J$ chooses enforcement $\left\{ e_{g'h_t n}^g \right\}_{g \in G^J, g' \in G^W, n \in N_{h_t}}$ to maximize $\int_{i \in I^j} \phi_i \cdot u_{iht}$ which, given the proposed asset holdings, is given by

$$\sum_{g \in G^J} \int_{i \in g} \phi_i \cdot u_{iht} \left((c_{iht})^* - \sum_{n \in N_{h_t}} (1 - e_{g'h_t n}^g) \cdot \delta_{ihtn} \right).$$

By choosing $e_{g'h_t n}^g = 1$ for all $g \in G^j$ and $n \in N_{h_t}$, the government of j guarantees that consumption is equalized within each domestic group, i.e. $(c_{iht})^* = (c_{i'h_t})^*$ whenever $g(i) = g(i')$. Choosing any

¹⁶The assumption that asset payments are separable ensures that all groups have enough funds to repurchase at face value all the assets that they have issued in the past and mature at the considered history.

¹⁷Note that this is true even in environments with multiple equilibria in which enforcement might serve as a sunspot. It is obvious that in the full-enforcement economy enforcement cannot serve as a sunspot. As a result, we just need to consider cases in which enforcement does not serve as a sunspot in the strategic-enforcement economy either.

other enforcement would not affect total consumption in each group but will, in general, lead to consumption inequality within groups. A straightforward application of Jensen's inequality shows then that the proposed enforcement is a best response for governments.

Finally, we show that the proposed equilibrium satisfies market clearing. This is clearly the case for $n \notin N_{h_t}$. For $n \in N_{h_t}$ markets also clear since, under the proposed equilibrium: $\int_{i \in I^W} \hat{x}_{ihn}^g = \int_{i \in g} \hat{x}_{ihn}^g = \int_{i \in g} \delta_{ihn} = 0$ for all $h_t \in H$ and $g \in G^W$. With this, we complete the proof of the proposition.

We have shown that (a) if governments enforce within-group payments, individual maximization leads to each group purchasing its own maturing assets; and (b) if each group purchases its own maturing assets, government maximization leads to within-group enforcement. This combination of asset trade and enforcement always allows the economy with strategic enforcement to achieve the same consumption profiles and welfare as the economy with full enforcement. This is sufficient to prove Proposition 1. In general, there are many alternative combinations of asset trade and enforcement that achieve the same result. These alternatives involve groups with large weights in the governments objective function and/or low consumption purchasing maturing assets issued by other groups.

2.5 Additional strategic-enforcement equilibria

We have shown that each full-enforcement equilibrium has a corresponding strategic-enforcement equilibrium that delivers the same consumption profiles and, therefore, welfare. We next show that there is a set of additional strategic-enforcement equilibria that do not correspond to any full-enforcement equilibrium and deliver different consumption profiles and welfare. These additional equilibria describe situations in which individuals expect some asset payments not to be enforced. As shown in Section 1.3, this can lead to some asset markets being closed and/or some asset payments being defaulted in equilibrium.

Consider, for example, an equilibrium in which individuals expect enforcement to be given by

$$\left(e_{gh_{tn}}^{g'} \right)^{**} = 0 \text{ for all } h_t \in H, n \in N_{h_t}, \text{ and } g, g' \in G^W. \quad (17)$$

Given that no payments are expected to be enforced, equilibrium asset holdings are given by

$$\left(x_{ihn}^{i'} \right)^{**} = \left(\hat{x}_{ihn}^{i'} \right)^{**} = 0 \text{ for all } h_t \in H, n \in N, \text{ and } i, i' \in I^W,$$

since no individual is willing to hold any assets. This, in turn, implies that governments never

have to make an enforcement decision in equilibrium, so that individual expectations regarding enforcement are neither confirmed nor disproved and are therefore consistent with equilibrium. Moreover, individuals have no incentive to deviate, since they understand that non-enforcement of an infinitesimal amount of outstanding assets is a possible best response by the government. Hence, the strategic-enforcement economy always has a “pessimistic” equilibrium in which there is no trade in assets because everyone expects that no promises will ever be enforced.

Besides equilibria that implement the full-enforcement allocation and the pessimistic equilibrium just described, the strategic-enforcement economy will typically have other equilibria in which there is less than full enforcement because some -but not all- asset payments are expected not to be enforced. To see this, consider that expectations regarding enforcement are as in (17) except for a particular group $g \in G^W$, for which $\left(e_{gh_t n}^g\right)^{**} = 1$ for all $h_t \in H$, $n \in N_{h_t}$. This enforcement profile will generically deliver an equilibrium with positive trades of assets issued by group g , so that consumption profiles will be different from those of the pessimistic equilibrium but also from the ones that would arise under full enforcement. Examples of this type of equilibria were provided in Section 1.3. Proposition 2 summarizes the discussion:

Proposition 2. *Consider an economy satisfying the previous assumptions regarding preferences, endowments, asset markets, and enforcement technology. Under strategic enforcement, such an economy always has at least two types of equilibria. On the one hand, there is a set of equilibria that implement the full-enforcement consumption profiles as characterized in Proposition (1). On the other hand, there is always a pessimistic equilibrium in which no assets are traded because no payments are expected to be enforced. There may also be additional equilibria in which asset trades and enforcement are observed, but in which they are not enough to achieve the full-enforcement consumption profiles.*

This proposition substantially extends result (ii) of Section 1. Naturally, result (iii) follows directly from our analysis of the Debtor-Creditor with names and the Lucky-Unlucky worlds.

2.6 Robustness

We show next that the additional strategic-enforcement equilibria that do not correspond to any full-enforcement equilibrium are not robust to the introduction of even arbitrarily small default penalties. These penalties make the expectation of non-enforcement inconsistent with individual maximization.

Consider now that our economy is modified by introducing an arbitrarily small default penalty, denoted by b . It is assumed that b is the cost that must be borne by a government whenever it

chooses not to enforce a payment owed by a group of its residents to a foreign group. Hence, the government of region $j \in J$ maximizes the following objective function at any given history h_t

$$\int_{i \in I^j} \phi_i \cdot u_{ih_t} - b \cdot \sum_{g \in G^j} \sum_{g' \in G^W - G^j} \sum_{n \in N_{g'h_t}^g} (1 - e_{gh_tn}^g),$$

where $N_{g'h_t}^g \subseteq N_{h_t}$ denotes the set of maturing assets issued by at least one individual in group g and held by at least one individual in group g' .

As long as $b > 0$, regardless of how small it is, this economy does not have any pessimistic equilibria. To see why, consider the equilibrium in which no assets are traded because expectations regarding enforcement are as in Equation (17). In such an equilibrium it must be the case that $q_{h_t n}^g = 0$ for all $h_t \in H$, $n \in N$ and $g \in G^W$. But given these prices, individuals have an incentive to deviate once they understand that governments face a cost of non-enforcement. Consider, for example, that an individual purchases an asset issued by a resident of region j at price zero: when the asset matures, there will always be a resident of region j' , with $j' \neq j$, willing to buy it. This will force the government of region j to make an enforcement decision. To do so, it will compare the benefit of not enforcing this payment, which is negligible, with the default penalty, which is strictly positive. Naturally, the latter effect will always outweigh the former and the government will always find it optimal to enforce the payment. Anticipating this, individuals always have an incentive to deviate. Hence, pessimistic equilibria disappear with the introduction of a slight cost of non-enforcement.

Consider next the set of equilibria that attain the full-enforcement consumption profiles. Clearly, these equilibria are also equilibria of the economy when $b > 0$: this perturbation will only increase the benefit of enforcing payments, so all payments that were enforced in the original economy will be also enforced in the perturbed economy. Proposition 3 summarizes the discussion above:

Proposition 3. *Consider an economy satisfying the previous assumptions regarding preferences, endowments, asset markets, and enforcement technology. Assume that governments face a penalty $b > 0$ whenever they choose not to enforce a payment owed by a group of their residents to a foreign group. Under strategic enforcement, the only equilibria of such an economy are those that attain the consumption profiles that would arise under full enforcement.*

This proposition substantially extends result (iv) of Section 1. In what follows, we select the set of optimistic equilibria and refer to it as ‘the’ set of strategic-enforcement equilibria.

3 Limits to the argument

The general setup of Section 2 encompasses many of the models commonly used to study the effects of sovereign risk. Unlike the previous literature, however, we have allowed individuals to freely retrade existing assets. This turned out to be a crucial change in assumption since it leads to the new result that, even in the absence of default penalties, sovereign risk does not affect consumption and welfare. Perhaps surprisingly, the only effect of sovereign risk is to increase trade volume as individuals trade not only to redistribute their consumption across periods and states of nature, but also to circumvent the strategic or opportunistic behavior of governments.

Although the setup of the previous section is quite general in comparison with standard practice, it still remains a very stylized description of reality. It is therefore useful to explore the limits of our argument by relaxing those assumptions that seem to be playing a more important role in the proof of our result. In particular, we focus next on the following ones:

1. *No transaction costs.* All individuals can trade in asset markets with zero transaction costs in all periods and states of nature.
2. *Small agents.* All individuals are infinitesimal and, as a result, they take prices and enforcement decisions of governments as given.
3. *No commitment.* Governments are not credible and any promise they make before the time of enforcement is discounted by individuals.

A complete treatment of the effects of relaxing these assumptions in the general setup of Section 2 is beyond the scope of this paper. We instead return to the Debtor-Creditor world of Section 1 and develop further variants of it to sketch the main implications of allowing for transaction costs, large agents and commitment.¹⁸

3.1 Transaction costs

In Section 2 we considered a rich set of restrictions on the issuance of new assets. These restrictions affect both the set of contingencies that assets can incorporate and the set of individuals that can issue them in each period and state of nature. When these restrictions are binding, useful assets are missing and profitable trade opportunities are lost. As a result, the equilibrium is Pareto inefficient.

¹⁸Another assumption that might turn out to be important is that, for each asset, there exist always a portfolio of existing assets that allows us to replicate each asset payment separately. This assumption is sufficient (but not necessary) to ensure that there are enough funds in the secondary market to purchase all assets that deliver payments at face value. Relaxing this assumption might lead to situations in which the secondary market is not liquid enough and this creates problems. Given the current length of this paper, we do not analyze this case here.

But even in this case, we have always allowed all individuals (including those that cannot issue new assets) to freely trade all existing assets in all periods and states of nature. That is, although we allowed for restrictions in the number and type of assets that can exist, we also assumed that those assets that do exist are traded frictionlessly. This assumption is important since we have argued that sovereign risk only increases trade volume and this has no welfare consequences. What happens instead if this additional trade is costly? The next example introduces transaction costs in the Debtor-Creditor world:

Example 4 (Debtor-Creditor world with transaction costs). *All assumptions are as in the Debtor-Creditor world, except that buyers and sellers must now pay a proportional or ad valorem transaction cost equal to t_B and t_S , respectively.*

With full enforcement, creditors collect bond payments directly from the issuers of the bonds and, as a result, they only go to the primary market. This means that the relevant bond return for them is $\frac{1}{q_0 \cdot (1 + t_B)}$, while the relevant bond return for debtors is $\frac{1 + t_S}{q_0}$. The wedge between these bond returns is $(1 + t_B) \cdot (1 + t_S)$. Naturally, the model of Section 1.1. applies as the case in which transaction costs are negligible, i.e. $t_B = t_S = 0$, and there is no wedge. Starting from this benchmark or limiting case, increases in t_S reduce the supply of bonds while increases in t_B reduce the demand for bonds. Both shifts lead to lower trade and less consumption smoothing. Eventually, the combined value of transaction costs crosses the threshold that makes them prohibitive:

$$(1 + t_B) \cdot (1 + t_S) = \left(\frac{u'(y - \varepsilon)}{u'(y + \varepsilon)} \right)^2.$$

At this point, all trade disappears and each region consumes its own endowment.

With strategic enforcement, creditors cannot collect bond payments directly and are forced to sell their bonds in the secondary market. As a result, the relevant bond return for them is now $\frac{q_1}{q_0 \cdot (1 + t_B) \cdot (1 + t_S)}$. Debtors only purchase their bonds in the secondary market if those are sold with a discount that compensates for the transaction cost: $q_1 \cdot (1 + t_B) = 1$. Therefore, the wedge between bond returns is now one order of magnitude higher than in the full enforcement case, $(1 + t_B)^2 \cdot (1 + t_S)^2$. The reason, of course, is that the additional trading in the secondary market implies that transaction costs are paid twice. Starting from the limiting case of zero transaction costs, we find again that increases in t_S reduce the supply of bonds. But now they also reduce the demand for bonds since now creditors must also pay these transaction costs Tomorrow when they sell their bonds in the secondary market. Moreover, increases in t_B lead now to a larger reduction

in the demand for bonds since they have the additional effect of lowering the price of bonds in the secondary market. Like the case of full enforcement, increases in transaction costs lower trade and consumption smoothing. But this now happens at a faster rate since each transaction cost applies twice to each bond payment. Note also that the threshold that makes transaction costs prohibitive is lower now:

$$(1 + t_B) \cdot (1 + t_S) = \frac{u'(y - \varepsilon)}{u'(y + \varepsilon)}.$$

This example shows how sovereign risk magnifies the negative effects of transaction costs on consumption and welfare. With transaction costs, the full- and strategic-enforcement equilibria are still similar qualitatively but might differ quantitatively. Knowing that Debtor's government will not enforce bond payments to creditors, the latter are forced to go to the secondary market to sell their bonds and must incur additional transaction costs. Since these additional costs are pure waste, sovereign risk lowers the level of consumption. Since these additional costs increase the wedge between bond returns for debtors and creditors, sovereign risk also worsens the intertemporal distribution of consumption. The strategic or opportunistic behavior of Debtor's government remains futile, but it now causes a welfare loss.

Another popular model of transaction costs assumes that some individuals have negligible costs of going to the market, while the rest have prohibitive costs. This structure of costs gives rise to limited participation. Although transaction costs are never paid in equilibrium, the absence of some individuals from the market might also restore a negative role for sovereign risk, as the following example illustrates:

Example 5 (Debtor-Creditor world with limited participation). *All assumptions are as in the Debtor-Creditor world, except that only a fraction ϕ_t^j of individuals in region j can trade in period t .*

With full enforcement, there is trade only in the primary market. If $\phi_0^C = \phi_0^D$, limited participation affects the demand and supply for bonds symmetrically and the price of bonds remains one. As a result, all market participants choose a flat consumption profile. If $\phi_0^C < \phi_0^D$ ($\phi_0^C > \phi_0^D$), limited participation reduces more the demand (supply) for bonds, the price of bonds falls below (goes above) one, and market participants choose an upward-sloping (downward-sloping) consumption profile. In any event, those that cannot participate in the primary market are forced to live in autarky and consume their own endowment. Since the secondary market is not used, the equilibrium outcome does not depend on who can participate in it.

With strategic enforcement, creditors that purchased bonds in the primary market want to go to the secondary market and sell their bonds at face value. If this is possible, limited participation does not affect our results. But two things can go wrong however.

The first potential problem is default. If the probability of participating in the secondary market *conditional on having participated in the primary market* is less than one, say $\pi < 1$, there is default on a fraction $1 - \pi$ of the bonds issued in the primary market. Default prevents the Debtor-Creditor world from achieving the full-enforcement allocation, except for the special case in which default risk is only idiosyncratic.¹⁹ Defaults create undesirable redistributions between creditors and debtors that make consumption Tomorrow risky. This first effect is negative for both, debtors and creditors. There is a second effect on bond returns that depends on the third derivative of the utility function. If the latter is positive, we have the standard case of precautionary savings in which increases in uncertainty lower bond returns. This terms-of-trade effect benefits Debtor and hurts Creditor. The net effect of default risk is therefore negative for Creditor but ambiguous for Debtor. Naturally, the opposite is true if the third derivative of the utility function is negative.

The second potential problem is that debtors that participate in the secondary market do not have enough resources to repurchase the full-enforcement stock of bonds at face value, i.e. $\phi_1^D \cdot (y + \varepsilon) < \phi_0^D \cdot |(x_0^D)^*|$. It is clear that, in this case, the strategic enforcement equilibrium will involve less trade in the primary market, i.e. $|(x_0^D)^{**}| < |(x_0^D)^*|$. In addition, bonds will be traded at a discount:

$$(q_1^D)^{**} = \frac{\phi_1^D \cdot (y + \varepsilon)}{\phi_0^D \cdot |(x_0^D)^{**}|} < 1.$$

This discount creates a wedge between relevant bond returns for creditors, i.e. $\frac{q_1}{q_0}$, and debtors, i.e. $\frac{1}{q_0}$.

We could examine the effects of introducing other trading frictions. But the two examples of this section already convey a simple and, we think, quite robust intuition: since additional trade is needed to circumvent the strategic or opportunistic behavior of governments, sovereign risk magnifies the negative effects of trading frictions on consumption and welfare.

¹⁹ Assume that π is known and that ϕ_1^D is always large enough to ensure that all bonds are traded at face value in the secondary market. Then, there is no default risk in the aggregate and there are no discounts. Debtors can diversify away default risk simply by borrowing from many different creditors. Creditors can also diversify away default risk by buying insurance from each other for a value π of the face value of their debt. This additional trade in the primary market permits creditors that cannot access the secondary market to collect their debts from creditors that do. Since enforcing these insurance payments raises average utility, Creditor's government will always enforce them. Under these circumstances, bond prices in the primary market simply reflect the probability of default, i.e. $(q_0)^{**} = \pi \cdot (q_0)^*$. Since bond returns are the same as under full enforcement and no transaction costs are paid in equilibrium, the strategic-enforcement equilibrium delivers the same consumption and welfare as the full-enforcement one.

3.2 Large agents

An important assumption that we have made throughout the paper is that agents are small, in the sense that they take enforcement decisions and asset prices as given. This assumption has two important implications that we have invoked repeatedly for our result, namely: (a) there are always individuals who are willing to repurchase maturing assets at face value in the secondary market and; (b) these individuals actually have the resources to do so. In this section, we explore the implications of relaxing the assumption of small agents, by allowing for agents with positive mass or “large” agents. As we now show, the presence of such agents may substantially affect the demand for maturing assets in the secondary markets.

We begin by framing our discussion within a variation of our Debtor-Creditor world that allows for large agents:

Example 6 (Debtor-Creditor world with large agents). *All assumptions are as in the Debtor-Creditor world, except that now: (i) there is a continuum of infinitesimal debtors with mass λ^D that make their decisions collectively (i.e., a Debtor Bank), and, (ii) there is a continuum of infinitesimal creditors with mass λ^C that also make their decisions collectively (i.e., a Creditor Bank).*

Suppose first that $\lambda^D = 1$ and $\lambda^C = 0$. Under full enforcement, the presence of a large agent affects the equilibrium because it has market power. In fact, the Debtor Bank is a monopolist in the bond market Today: consequently, it will restrict the supply of bonds in order to raise their market price and the equilibrium will entail $(q_0^D)^* > 1$. Under strategic enforcement, though, the effects of having a unique debtor are much stronger, to the extent that Debtor is unable to borrow at all. The reason is simple: suppose the Debtor Bank issues any positive amount of bonds Today. Creditors purchase these bonds because they expect to sell them Tomorrow before enforcement. Once Tomorrow arrives, though, the Debtor Bank will never buy any of its bonds in the secondary market. It understands that, by purchasing its bonds at any positive price it is simply transferring resources to creditors. Therefore, it must necessarily be the case that $(q_1^D)** = 0$ in equilibrium. Anticipating this, creditors will not buy any bonds Today and the only possible equilibrium is one of autarky in which each region consumes its endowment.

What insight do we gain from this example? In the original Debtor-Creditor world, secondary markets are able to achieve the full-enforcement allocation because each individual debtor has a strong incentive to purchase bonds issued by other debtors. This outcome, which constitutes an ex-post inefficiency from the viewpoint of the region, ensures ex-ante efficiency by allowing for international trade in bonds Today. But this prisoner’s dilemma type of situation only arises insofar

as debtors are small and behave non-cooperatively. If there is a unique debtor, as in our example, this reasoning no longer applies.

Of course, the case in which $\lambda^D = 1$ is rather extreme, since the Debtor Bank is the only potential purchaser of its bonds in the secondary market. We now turn to the more interesting case in which $\lambda^D < 1$. We maintain $\lambda^C = 0$. Under full enforcement, the equilibrium is qualitatively similar as before: the Debtor Bank still has market power, so that the supply of bonds is lower, and their market price Today higher, than what they would be in the traditional Debtor-Creditor world. Under strategic enforcement, though, the presence of small debtors can make a substantial difference for the secondary market outcome. To see this, assume that the residents of Debtor as a whole issue $(x_0^D)^{**}$ bonds Today. When secondary markets open, small debtors are willing to buy any quantity of bonds at face value. Therefore, their aggregate demand for bonds is horizontal until all the combined endowment of small debtors has been exhausted, and downward-sloping thereafter. The equilibrium price is therefore equal to face value if their combined endowment is sufficient to repurchase all the bonds issued in the primary market at face value. In this case, and despite the large agent, the strategic-enforcement equilibrium delivers the same allocation as the full-enforcement one.

To make the example interesting, assume from now on that λ^D is sufficiently large to ensure that the combined endowment of the small debtors is not enough to repurchase all the bonds issued in the primary market. In this case, small debtors will use all of their endowment to purchase bonds in the secondary market.²⁰ But this is not the end of the story: once small debtors purchase bonds in the secondary market, it is in the interest of the Debtor Bank to enter the market as well. Assume not. Then, the Debtor Bank could make a profit by buying its own bonds at a discount instead of paying face value later when small agents come to redeem them. In equilibrium, the Debtor Bank will buy bonds up to the point in which this gain is offset by the increase in price of the inframarginal bonds. As a result, the Debtor Bank's demand for bonds is given by

$$(x_0^D)^{**} \cdot \left(1 - \sqrt{\frac{(1 - \lambda^D) \cdot (y + \varepsilon)}{(x_0^D)^{**}}} \right). \quad (18)$$

Given the total demand for bonds in the secondary market, equilibrium requires that the price be $(q_1^D)^{**} = \sqrt{\frac{(1 - \lambda^D) \cdot (y + \varepsilon)}{(x_0^D)^{**}}} < 1$, which is decreasing in λ^D and approaches zero as $\lambda^D \rightarrow 1$. Hence, equilibrium borrowing in Debtor is restricted with respect to the full-enforcement economy.

When the large agent is not too large, the Prisoner's dilemma is only partially solved and Debtor

²⁰As long as $u(0) = -\infty$, domestic payments are always enforced in equilibrium. We maintain this assumption throughout the section for simplicity.

can still borrow but not as much as it would like.

Before concluding, we wish to remark on the effects of allowing for large creditors. We now do so by setting $\lambda^C = 1$. We also maintain $\lambda^D < 1$. A first natural consequence of having a unique creditor - which is valid both under full and strategic enforcement - is that he will be a monopsonist in the primary market for bonds. This will exert downward pressure both on the price of bonds and on the amount of trade in the primary market. However, the presence of a large creditor does not affect the functioning of the secondary market. It could be thought that the Creditor Bank has an incentive to restrict the supply of bonds Tomorrow in order to raise their price, but it is never profitable to do so. This is evident if $\lambda^D = 0$ and the Creditor Bank can sell all bonds at face value. It is also evident if $\lambda^D = 1$ and the Creditor Bank is unable to sell them at any positive price. It can also be shown that if $\lambda^D \in (0, 1)$, restricting the supply of bonds is still not worthwhile because this decreases the Debtor Bank's demand for bonds more than proportionally (see Equation (18)).

There are therefore two main findings in this section. The first one is that coordination among debtors might restrict their collective ability to borrow. In fact, imagine that the government of Debtor generates an institutional arrangement that forces debtors to coordinate their actions. In a world of full enforcement, this would be a perfectly sensible policy from the viewpoint of Debtor, since it would allow its residents to exploit their collective market power and access international capital markets at better terms. In a world of strategic enforcement, on the other hand, this institutional arrangement might backfire if it persists until the time of enforcement. The same market power that benefits debtors at the time of borrowing allows them to distort the outcome of the secondary market: in the extreme case in which all residents of Debtor coordinate their actions, as we have seen, the latter effect manifests itself fully and eliminates all possibility of international borrowing.

The second finding of this section is that coordination among creditors does not enhance their ability to collect on maturing assets. Coordination among creditors certainly enhances their market power and allows them to lend at a higher interest rate. How much they actually collect from their outstanding loans at the time of maturity, though, is ultimately determined by the degree of coordination among debtors. In our world, then, institutional arrangements such as collective action clauses, which are designed to coordinate creditors in order to enhance repayment, are ineffective. The reason for this is clear: creditors in our environment never receive payments directly from debtors, so that coordinating does not benefit them in terms of negotiation or bargaining power. Indeed, they are only able to collect from maturing assets by selling them in the secondary market. Since coordination does not enable them to distort the outcome of the latter in their favor, their ability to extract resources from debtors is not affected by it.

3.3 Commitment

Up to now, we have referred to the ability of secondary markets to restore the full-enforcement allocation when governments have no commitment and choose enforcement strategically. This situation is often referred to as ‘discretion’ in the time-inconsistency literature. Some readers might have wondered why, instead of referring to an economy with full enforcement, we have not used the more common terminology of an economy in which governments have full commitment. Would these two alternatives not be fundamentally the same? In this section we show that they are not.

The widespread notion that full commitment leads to full enforcement is based, we think, on the prevalence of models with complete markets and representative agents. Consider, for instance, the Debtor-Creditor world with transaction costs of Example 4. If Debtor’s government could commit and choose enforcement policy Today, it would choose to enforce *all* payments. This choice would make trading in the secondary market unnecessary, would save on transaction costs, and would therefore maximize the average utility of debtors ex-ante. As a result, in this case full commitment leads to full enforcement.

When markets are incomplete, full commitment does not in general lead to full enforcement. Consider, for instance, the Lucky-Unlucky world of Example 3, in which each region contains a representative individual but markets are incomplete due to the absence of contingent bonds. As we argued in Section 1.3, in this world the full-enforcement allocation is inefficient. In fact, with full enforcement asset trade is useless. If Home and Foreign had full commitment, they would agree Today on the following enforcement policy: the lucky region enforces *all* bond payments, while the unlucky region enforces *none*. This pattern of enforcement would increase the span of non-contingent bonds and lead to higher ex-ante expected utility for all individuals in the world. As a result, in this world full commitment would raise welfare by preventing secondary markets from leading to the full-enforcement allocation. This is therefore a world in which discretion delivers the full-enforcement allocation, but full commitment does not.²¹

When agents are heterogeneous, full commitment does not even lead to a Pareto improvement. Consider, for instance, the Debtor-Creditor world with names of Example 2 but assume that Debtor’s government only cares about Duponts, i.e. $W^D = \int_{i \in I^D} \phi_i \cdot u(c_{i1})$ with $\phi_i = 1$ if i is a Dupont and $\phi_i \approx 0$ if i is a Dupond. In this world markets are complete but there is heterogeneity within the Debtor region. If Debtor’s government had full commitment, it would choose to enforce

²¹Note that this equilibrium is observationally equivalent to the equilibrium with a mix of optimistic and pessimistic beliefs that we studied in Section 1.3. With discretion, we showed that this equilibrium was neither unique nor robust. With full commitment, this equilibrium is both unique and robust.

bond payments by Duponts and not to enforce bond payments by Duponts. This would effectively remove Duponts from the primary market, lowering the supply of bonds and improving the terms at which Duponts borrow. This enforcement policy would raise the welfare of Duponts and that of Debtor's government at the expense of Duponts (and creditors). As in the previous case, full commitment does not lead to the full-enforcement allocation.²² Unlike the previous case, gaining full commitment does not lead to a Pareto improvement for debtors because Debtor's government uses this power to redistribute between groups of individuals.²³

The case of full commitment is probably too extreme. While governments might have some ability to commit, it is not realistic to assume that they can commit for the indefinite future. What would be the effect of less extreme degrees of commitment? To answer this question, in the remaining of the section we analyze the case of "short-term" commitment, in which we assume that governments make their enforcement decisions for each period before secondary markets open in that period.²⁴

Interestingly, short-term commitment tends to have more negative effects on enforcement and asset trade than full commitment. For example, in both the Debtor-Creditor and the Lucky-Unlucky worlds introducing short-term commitment completely destroys asset trade. The reason is that before secondary markets open Tomorrow the government of any region whose residents owe payments to foreigners understands that its residents are about to repay their debts to foreigners via secondary markets. But such a government would prevent these payments by committing not to enforce payments among domestic residents thereby driving the secondary-market price of domestic debt to zero. Of course, anticipating this Today the residents of the other region are not willing to purchase domestic debt and, thus, there is no trade in the primary market. Gaining short-term commitment destroys all trade and forces each region and individuals to consume their own endowment. Everybody (including governments) is worse off.

Although governments always have an incentive to commit not to enforce to avoid payments to foreigners, there may be countervailing forces that might lead to enforcement and asset trade even when governments have short-term commitment. The next two examples illustrate two such cases.

The first example generalizes the Debtor-Creditor world by introducing a role for domestic trade in primary markets and shows how this can reduce the governments' ability to preempt payments to foreigners.²⁵

²² Despite the preference for Duponts, the consumption allocation without commitment would still be the same as in the full-enforcement equilibrium. This is because Debtor's government would not need to enforce bond payments from Duponts to Duponts since in the secondary market only Duponts would purchase bonds issued by other Duponts.

²³ Idem footnote 21.

²⁴ Alternatively, we could assume that governments make their (contingent) enforcement decisions for each period after asset markets close in the previous period.

²⁵ This example is a stylized version of the worlds considered by Broner and Ventura (2006a, 2006b). Broner and

Example 7 (Debtor-Creditor world with ‘ex-post’ inequality). *All assumptions are as in the Debtor-Creditor world, except that now debtors are subject to idiosyncratic shocks Tomorrow. In particular, there are two states Tomorrow, s_1 and s_2 , each taking place with probability one half. If a given debtor is lucky, he receives $y + \varepsilon + \iota$; otherwise, he receives $y + \varepsilon - \iota$. Debtors are partitioned into two halves, I^1 and I^2 , such that all $i \in I^1$ are lucky in state s_1 and all $i \in I^2$ are lucky in state s_2 .*

In this version of the Debtor-Creditor world there are gains from domestic trade because there is ‘ex-post’ heterogeneity among debtors. The basic Debtor-Creditor world of Example 1 applies as the special case in which $\iota = 0$. We assume that markets are complete and that there are two assets: asset 1 pays one in state s_1 and zero in state s_2 , and asset 2 pays zero in state s_1 and one in state s_2 . In the full-enforcement equilibrium all debtors and creditors consume y in both periods. If $\iota \leq \varepsilon$, this consumption allocation can (but need not) be implemented with only international trade. If $\iota > \varepsilon$, this consumption allocation also requires domestic asset trade between debtors. It is straightforward to check that in the cases of discretion and full commitment consumption and welfare are the same as in the full-enforcement equilibrium. However, this is not always true with short-term commitment.

The key effect of short-term commitment in this world is that enforcement becomes non-discriminatory. In particular, while Debtor’s government can still choose enforcement before individuals trade in secondary markets, it cannot discriminate between debtor and creditor asset holders. The reason is that even if Debtor’s government committed only to enforcing payments between debtors, creditors would resell their assets in the secondary market to debtors at face value and would *de facto* receive their payment. Thus, if Debtor’s government wants to avoid payments to creditors, it must commit not to enforce any payments. This introduces a crucial trade-off: committing not to enforce avoids payments to creditors and increases the average consumption of debtors, while committing to enforce preserves payments between debtors and improves the distribution of consumption among them. Enforcement will take place if and only if the following condition holds:

$$u(y) \geq \frac{u(y + \varepsilon + \iota) + u(y + \varepsilon - \iota)}{2}. \quad (19)$$

Equation (19) is satisfied if idiosyncratic shocks are sufficiently large relative to regional shocks and the utility function is sufficiently concave. In this case, preserving domestic payments is worth more

Ventura (2006a) use a generalization of this model with many goods and transport costs to study the effects of trade integration on the structure of asset markets, domestic and international risk sharing, and welfare. Broner and Ventura (2006b) use another generalization of this model with capital accumulation to study the effects of financial integration on consumption, investment, economic growth, and welfare.

than avoiding foreign ones. If this condition holds, the economy with short-term commitment also implements the full-enforcement allocation. If this condition fails, however, the only equilibrium is one in which there is no trade and each individual consumes its own endowment. In the latter case, gaining short-term commitment destroys both domestic and international asset trade and everybody (including governments) is worse off.

Short-term commitment gives Debtor's government the ability to preempt the secondary market and render it ineffective. However, the situation is not the same as one in which secondary markets are simply missing. When secondary markets are missing, the government can discriminate between domestic and foreign payments and would choose to enforce the former but not the latter. This destroys international asset trade but does not affect domestic asset trade. When there are secondary markets and governments have short-term commitment, on the other hand, depending on whether Equation (19) holds either both international and domestic asset trade are unrestricted or neither is possible.

The second example shows that, when there are more than two periods and we allow for long-term assets, individuals can reduce the governments' ability to preempt payments to foreigners:

Example 8 (Debtor-Creditor world with three periods). *All assumptions are as in the Debtor-Creditor world, except that now there are three periods, Today, Tomorrow, and The-Day-After, indexed by $t \in \{0, 1, 2\}$. The-Day-After all individuals in the world receive an endowment equal to y .*

Assume first that the only available assets are short-term bonds. In particular, Today individuals can only issue bonds that pay Tomorrow, while Tomorrow they can issue bonds that pay The-Day-After. The full-enforcement allocation is characterized by all individuals in the world consuming y in each of the three periods. Today debtors sell ε bonds to creditors, which they repay Tomorrow. The-Day-After all individuals simply consume their own endowment. The analysis of the cases of discretion, full commitment, and short-term commitment are essentially the same as in the model with two periods. With either discretion or full commitment the full-enforcement allocation is achieved. With short-term commitment, on the other hand, no asset trade is possible and individuals are forced to consume their endowment in each of the three periods. Does adding a third period then not make any difference? It does, if we allow for long-term bonds.

Assume now that Today individuals can also issue long-term bonds that pay The-Day-After. What would happen if Today debtors sold ε long-term bonds to creditors? With full-enforcement,

debtors would repurchase these bonds from creditors Tomorrow. By doing so they would end up consuming y both Tomorrow and The-Day-After, while any individual who did not do this would consume $y + \varepsilon$ Tomorrow and $y - \varepsilon$ The-Day-After. But note that the same would happen with short-term commitment. Since these bonds are enforced The-Day-After, Debtor's government makes its enforcement decision only after secondary markets close Tomorrow. But by then debtors have already repurchased all bonds at face value from creditors! As a result, with long-term bonds the full-enforcement allocation is achieved even with short-term commitment.^{26,27}

The intuition for this result is that, just as governments have an ex-post incentive to preempt secondary markets and avoid payments to foreigners, domestic residents have an incentive to issue assets of a long-enough maturity to preempt such government intervention. There is an interesting parallel between Example 8 and the rest of the paper. Just as we had previously shown that allowing for additional markets, which are redundant with full-enforcement, can increase enforcement, Example 8 shows that allowing for additional assets, which are also redundant with full-enforcement, can also increase enforcement.

The examples and discussion of this section show that the connection between commitment, enforcement, and the role of secondary markets is a subtle one. A full analysis of this connection is well beyond the scope of this paper. Despite this, a few suggestive results have already been obtained. When secondary markets work well, all asset payments are enforced and commitment can only reduce enforcement. With full-commitment, this reduction in enforcement need not be welfare reducing if markets are incomplete and/or agents are heterogeneous. Although with short-term commitment the reduction in enforcement is more likely to be welfare reducing, we have shown that there may be countervailing forces. First, when there is not only international but also domestic asset trade, the effect of short-term commitment on enforcement depends on whether domestic or foreign payments are more important. While it is possible for enforcement to be maintained, it is also possible that domestic asset trade be destroyed along with international asset trade. Second, the maturity of assets can play an important role in the effects of short-term commitment on enforcement.

²⁶Example 8 suggests an interesting relationship between the length of commitment, the persistence of endowment shocks, and the maturity of assets. We conjecture that assets need to have a long enough maturity relative to the persistence of shocks and length of commitment, so that they can be repurchased while endowments are high but before the government decides enforcement.

²⁷In reality, bonds often have acceleration clauses that might facilitate default. Example 8 suggests that such clauses might have unintended costs in terms of enforcement.

4 Concluding remarks

Conventional wisdom views the problem of sovereign risk as a technological one: it arises whenever default penalties are insufficient to ensure that governments enforce payments to foreigners. The result is a credit constraint that lowers welfare. This problem is typically exacerbated if the private sector does not take into account the effects of its actions on enforcement decisions, thereby creating various externalities. Guided by this assessment of the problem, policy prescriptions to reduce sovereign risk have focused on fighting these externalities. For instance, the government might want to tax or restrict foreign borrowing by the private sector. Also, the government might want to favor increased trade ties and other forms of foreign dependence that make the country vulnerable to foreign retaliation.

This conventional wisdom is based on the extreme view that assets cannot be retraded in secondary markets and that, in the absence of commitment or reputational considerations, it is only default penalties that sustain international asset trade. Here we have presented the opposite and also extreme view that default penalties are negligible and that, in the absence of commitment or reputational considerations, it is only the ability to retrade assets in secondary markets that supports international asset trade.

This radical change of assumptions generates a new or unconventional view of sovereign risk as a problem of missing or imperfect markets. If secondary markets work well, foreign creditors can always use them to circumvent the strategic or opportunistic behavior of governments and there is no problem to speak of. It is only the malfunctioning of these markets that constraints credit and lowers welfare. This alternative assessment of the problem gives rise to a new and different set of policy prescriptions to reduce sovereign risk. Insofar as the problem of sovereign risk is symptomatic of underlying market imperfections, it should be addressed by policies aimed at developing new secondary markets or at improving the functioning of existing ones.

Extreme assumptions are a key ingredient of useful theory since only they can reveal each different face of a problem clearly and one at a time. Of course, in the real world these faces appear blurred and simultaneously. We therefore think that the results of this paper do not contradict the conventional wisdom, but instead complement it in a fundamental way. Sovereign risk is a serious problem in real economies and this is due to both the insufficiency of default penalties and the imperfect workings of secondary markets. Policies aimed at reducing sovereign risk should take this into account.

References

- [1] Amador, M., (2003). "A political economy model of sovereign debt repayment," mimeo, Stanford.
- [2] Atkeson, A. (1991). "International lending with moral hazard and risk of repudiation," *Econometrica* 59, 1069-1089.
- [3] Broner, F. and J. Ventura, (2006a). "Globalization and risk sharing," mimeo, CREI and Universitat Pompeu Fabra.
- [4] Broner, F. and J. Ventura, (2006b). "Rethinking the effects of financial liberalization," mimeo, CREI and Universitat Pompeu Fabra.
- [5] Bulow, J., and K. Rogoff, (1988). "The buyback boondoggle," *Brookings Papers on Economic Activity* 1988, 645-98.
- [6] Bulow, J., and K. Rogoff, (1989a). "Sovereign debt: Is to forgive to forget?" *American Economic Review* 79, 43-50.
- [7] Bulow, J., and K. Rogoff, (1989b). "A constant recontracting model of sovereign debt," *Journal of Political Economy* 97, 155-178.
- [8] Bulow, J., and K. Rogoff, (1991). "Sovereign debt repurchases: No cure for overhang," *Quarterly Journal of Economics* 106, 1219-35.
- [9] Cole, H., J. Dow and W.B. English, (1995). "Default, settlement and signaling: Lending resumption in a reputation model of sovereign debt," *International Economic Review* 36, 365-386.
- [10] Cole, H., and P. Kehoe, (1997). "Reviving reputation models of international debt," *Federal Reserve Bank of Minneapolis Quarterly Review* 21, 21-30.
- [11] Detragiache, E., (1994). "Sensible buybacks of sovereign debt," *Journal of Development Economics* 43, 317-33.
- [12] Diwan, I., and M. Spiegel, (1994). "Are buybacks back? Menu-driven debt reduction schemes with heterogeneous creditors," *Journal of Monetary Economics* 34, 279-93.
- [13] Dooley, M., (1988). "Buybacks and the market valuation of external debt," *IMF Staff Papers* 35, 215-229.

- [14] Eaton, J., and M. Gersovitz, (1981). "Debt with potential repudiation: Theory and empirical analysis," *Review of Economic Studies* 48, 289-309.
- [15] Eaton, J., and R. Fernández, (1995). "Sovereign debt," in G. Grossman and K. Rogoff (eds.), *Handbook of International Economics* III, Elsevier.
- [16] Fernández, R., and R. Rosenthal, (1990). "Sovereign debt renegotiations: A strategic analysis," *Review of Economic Studies* 57, 331-350.
- [17] Fernández-Ruiz, J., (2000). "Debt buybacks, debt reduction, and debt rescheduling under asymmetric information," *Journal of Money, Credit, and Banking* 32, 13-27.
- [18] Froot, K., (1989). "Buybacks, exit bonds and the optimality of debt and liquidity relief," *International Economic Review* 30, 49-70.
- [19] Gelos, G., R. Sahay, and G. Sandleris, (2004). "Sovereign borrowing by developing countries: What determines market access?" *IMF Working Paper* 04/221.
- [20] Grossman, H., and J. Van Huyck, (1988). "Sovereign debt as a contingent claim: Excusable default, repudiation, and reputation," *American Economic Review* 78, 1088-1097.
- [21] Helpman, E., (1989). "The simple analytics of debt-equity swaps," *American Economic Review* 79, 440-451.
- [22] Kehoe, P., and F. Perri, (2002). "International business cycles with endogenous incomplete markets," *Econometrica* 70, 907-928.
- [23] Kenen, P., (1991). "Debt buybacks and forgiveness in a model with voluntary repudiation," *International Economic Journal* 5, 1-13.
- [24] Kletzer, K., and B. Wright, (2000). "Sovereign debt as intertemporal barter," *American Economic Review* 90, 621-39.
- [25] Krugman, P., (1989). "Market-Based Debt-Reduction Schemes," in J. Frenkel, M. Dooley, and P. Wickham (eds.) *Analytical issues in debt*, 258-78.
- [26] Krugman, P., (1992). "Reducing developing country debt," in *Currencies and Crises*, MIT Press, 145-62.
- [27] Martinez, J., and G. Sandleris, (2006). "Is it punishment? Sovereign defaults and the declines in trade," mimeo, Johns Hopkins.

- [28] Rose, A., (2005). "One reason countries pay their debts: Renegotiation and international trade," *Journal of Development Economics* 77, 189-206.
- [29] Rotemberg, J., (1991). "Sovereign debt buybacks can lower bargaining costs," *Journal of International Money and Finance* 10, 330-48.
- [30] Sachs, J., (1990). "A strategy for efficient debt reduction," *Journal of Economic Perspectives* 4, 19-30.
- [31] Sandleris, G., (2006). "Sovereign defaults: Information, investment and credit," mimeo, Johns Hopkins.
- [32] Wright, M., (2002). "Reputations and sovereign risk," mimeo, Stanford.