Sovereign Risk and Secondary Markets[*]

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Abstract

The present paper shows that secondary markets can help solve problems of sovereign risk in international financial markets. We study an environment in which agents can trade a complete set of state-contingent securities with other agents, both in the same and in other countries. Governments cannot commit to enforce payments by their residents and payments to foreign residents are never enforced. In the absence of secondary markets, international risk sharing and borrowing are thus impossible. We show that when agents can trade assets ex-post in secondary markets, international risk sharing and borrowing become possible. The mechanism behind our results is that secondary markets tend to transfer securities from those agents who are less likely to be repaid to those agents who are more likely to be repaid. In particular, ex-post agents tend to purchase securities issued by other domestic agents from foreigners. This role of secondary markets in improving enforcement is robust to various extensions of the basic model and is likely to apply to other environments.

Keywords: sovereign risk, secondary markets, commitment, international risk sharing, international borrowing.

JEL Classification: F34, F36, G15.

The goal of this paper is to study the effects secondary markets on international asset trade. We consider a world in which individuals may borrow and lend in order to share risk - with respect to both individual and regional shocks – or to smooth consumption over time. Borrowing and lending takes place via financial markets where agents trade securities issued by every other agent in the world. In the absence of frictions, our economy achieves the optimal levels of asset trades, implementing the first best allocation. In the presence of sovereign risk, however, asset trades between regions become impossible, since governments never enforce payments from domestic to foreigners ex-post. Our main result is that, in such a world, the introduction of secondary markets restores the first-best allocation and eliminates the inefficiency generated by sovereign risk.

We consider a simple world economy with two regions. During old age individuals experience income shocks, against which they would like to insure during youth. Additionally, individuals may want to smooth their consumption over time. They can do both things by participating in a financial market with other domestic and foreign residents. We assume, in principle, that individuals can issue a full set of state contingent arrow securities.

We first analyze the equilibrium of our world economy in the absence of frictions. In such an environment, participation in financial markets allows individuals to achieve the first best allocation, which entails optimal smoothing of consumption over time and across states of nature. We then modify the environment by introducing sovereign risk. Namely, governments cannot commit "ex-ante" to enforce payments by their residents "ex-post." As a result, governments only enforce payments if this raises the welfare of domestic residents "ex-post", which in particular implies that payments to foreigners are never enforced. In the absence of secondary markets, this lack of commitment eliminates all international trades in assets and reduces the welfare of domestic agents "ex-ante."

We then study the effects of introducing secondary markets in this environment. In particular, it is assumed that, once the state of nature has been realized but before governments make their enforcement decisions, agents can buy and sell securities in secondary markets. We find that, under fairly general conditions, the introduction of such markets suffices to circumvent the inefficiency generated by governments' inability to commit, thereby allowing the world economy to achieve the optimal allocation.

The intuition behind the result is simple. In our framework, governments will never enforce payments to foreigners "ex-post". In the presence of secondary markets, they will not have to. Suppose foreigners buy securities issued by domestic residents. Once old age arrives and the state of nature is realized, they have two options: they can either hold on to these securities until the time of enforcement, or they can sell them in the secondary market. It is evident that the

former option cannot be optimal, since promises held by foreigners will never be enforced. On the other hand, they can sell them in the secondary market to domestic residents: as long as secondary markets are competitive, the latter will buy these securities at their face value because they correctly anticipate that payments between domestic residents will be enforced. In this way, once the time of enforcement comes, governments must only decide on enforcing payments between domestic residents and they always choose to enforce.

This paper is related to several strands of the literature. There is an extensive literature on sovereign risk that tries to explain why governments ever enforce payments from domestic to foreign residents. A usual answer is that governments want to keep their reputations so that they or their citizens can participate in foreign financial markets in the future.[1] Another answer is that governments want to avoid direct sanctions associated with non-enforcement, such as interference with trade in goods. The problem with these answers is that countries do not seem to be excluded from international financial markets for that long after default episodes and it is not clear that defaults have much of an effect on trade in goods.[2] A third, alternative answer is that governments may enforce payments to foreign residents because, in the presence of a coarse enforcement technology, not doing so would disrupt the working of domestic financial markets.[3]

Our approach differs from all the previous models by showing that secondary markets are enough to generate international trade in assets in equilibrium even in the absence of reputational considerations, sanctions, and coarse enforcement. This paper can be understood as studying the implications of removing the assumption by which, at the time of enforcement, asset holdings must be as they were after primary markets close. This assumption has been implicitly made by all the previous literature.

The paper is structured as follows. Section 2 provides the basic setup and derives the main result. Section 3 generalizes our basic model along different dimensions and shows that our result is robust to these specifications. Section 4 explores some limitations to our argument and provides some examples in which our result does not go through. Finally, Section 5 concludes.

1 A simple model of sovereign risk

In this section we analyze a simple model of sovereign risk in which reputation and sanctions play no role, and in which governments can discriminate between domestic and foreign creditors when

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[1]See Eaton and Gersovitz (1981), Bulow and Rogoff (1989a and 1989b), Cole and Kehoe (1997), Kletzer and Wright (2000), Wright (2002), and Amador (2003).

[2]Rose (2002) argues that there exists trade disruption after defaults, but Martinez and Sandleris (2004) find the opposite result.

[3]See Broner and Ventura (2006).

enforcing payments. We show that in the absence of secondary markets there is no international trade in assets and, thus, there is no international risk diversification and no international borrowing and lending. We then show that when we add secondary markets international trade in assets become possible, to the extent that the full-commitment complete-markets outcome is achieved.

1.1 Preferences, technology and social contracts

Consider a world economy with two regions, Home and Foreign, indexed by $j \in \{H, F\}$. Each region has an identical population size normalized to one. We use I^j to denote the set of individuals located in region j, whereas $I^W = I^H \cup I^F$ denotes the total population of the world. The world and its inhabitants last two periods, which we refer to as youth and old age. There is no uncertainty during youth, but there are various sources of uncertainty regarding old age. Each state of nature during old age is denoted by $s \in S$ and occurs with a probability of π_s. During youth and in each state during old age, there is a unique consumption good, which can be transported between regions at a negligible cost.

All individuals maximize a separable utility function of the form

$$U_i(c_{i0}, \{c_{is}\}_{s \in S}) = u(c_{i0}) + \int_{s \in S} \pi_s \cdot u(c_{is}) \tag{1}$$

where c_{i0} and c_{is} are used, respectively, to denote the consumption levels of individual i during youth and in state s during old age. We assume that $u(\cdot)$ is monotonic, concave and differentiable. Throughout, we assume that individuals understand their environment and form their expectations about the future rationally.

All individuals receive a strictly positive endowment during youth and old age: y_{i0} and y_{is} are used, respectively, to denote the endowments of individual i during youth and in state s during old age. There is ex-ante symmetry within regions. In particular, for every pair of individuals i and i' residing in the same region, $y_{i0} = y_{i'0}$ and, if there exists a state s with $\pi_s = \pi$ and given sets of endowments in Home $\{y_{is'}\}_{i \in I^H} = \underline{Y}$ and in Foreign $\{y_{is'}\}_{i \in I^F} = \overline{Y}$ in which $y_{is} = \overline{y}$, then there also exists a corresponding state s' with $\pi_{s'} = \pi$ and the same sets of endowments in Home and Foreign in which $y_{i's'} = \overline{y}$. This assumption implies that ex-ante endowments are the same for all individuals within a region. Of course, this need not be the case ex-post.[4]

In the absence of markets or any other social arrangement, individuals would be forced to

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[4]The assumption of symmetry is made here only for simplicity. We show in the next section that our result is robust to its removal.

consume their own production:

$$c_{i0} = y_{i0} \text{ for all } i \in I^W$$

$$c_{is} = y_{is} \text{ for all } i \in I^W \text{ and } s \in S$$

This allocation is clearly suboptimal in a Pareto sense, as individuals face too much variation in consumption both over time and across states of nature. A preferable allocation is obtained if all the young of the world participate in a social contract whereby they agree to pool their resources and share them optimally during youth and in each state s during old age.[5]

Although the social contract delivers an allocation that is Pareto optimal from an ex-ante point of view, it is subject to standard incentive issues. During youth, all individuals prefer to participate in the social contract and promise to abide by it in old age. But during old age those individuals in the rich region with the highest endowment prefer to break the social contract and enjoy a higher consumption. If this temptation can be resisted, the social contract can be implemented. This would be the case, for instance, if governments could commit to force all individuals to fulfill their promises and with the objective of maximizing average utility. This government would use its power to force all individuals that participate in the social contract to abide by it in their old age. Knowing this, all individuals would choose to participate in the social contract in their youth.

The problem we consider here, however, is that of governments that lack such ability to commit. In fact, we assume throughout that each region has its own government with the means to force domestic residents (but not foreign ones) to fulfill their promises ex-post. Moreover, we assume that governments maximize the average utility of their region. This gives rise to opportunistic behavior. During old age, governments prefer not to force domestic residents to fulfill their promises if this lowers the average utility of the region. Naturally, this temptation is anticipated during youth. If the government cannot credibly commit to force domestic residents to fulfill their promises the social contract breaks down. Governments would therefore like to tie their hands during youth and credibly commit not to act opportunistically in old age. But how can governments do this? It is typically thought that without an exogenously specified commitment technology there is no hope for governments to credibly commit to force their citizens to fulfill their promises.

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[5] In the particular case in which there is symmetry both within and between regions, the social contract would deliver the following consumption levels during youth and old age:

$$c_{i0} = \frac{1}{2} \cdot \int_{i \in I^W} y_{i0} \quad \text{for all } i \in I^W$$

$$c_{is} = \frac{1}{2} \cdot \int_{i \in I^W} y_{is} \quad \text{for all } i \in I^W \text{ and } s \in S$$

The main insight of this paper is that such a technology is not necessary since markets alone can discipline governments. We develop this insight in two steps. First, we show that opening a full set of Arrow-Debreu markets during youth is not enough to ensure Pareto efficiency when governments lack an exogenous commitment technology. Second, we show that if we complement the full set of (primary) Arrow-Debreu markets during youth with another full set of (secondary) Arrow-Debreu markets in each state during old age Pareto efficiency is ensured even in the absence of an exogenous commitment technology.

1.2 Primary markets

Assume that during youth there are asset markets that allow individuals to smooth their consumption over time and across states of nature. In particular, for each state $s \in S$, there exists a security that promises to deliver one unit of the consumption good in that state. We refer to these these markets as 'primary'. Is it possible to implement the optimal allocation with the help of these markets?

We first show that the answer is positive if governments have the ability to commit during youth to enforce all payments during old age. Assume governments commit to enforce all securities. Then, all securities that pay in the same state will have the same price. Let q_s be the price of the security that promises to deliver one unit of the consumption good in state s, and let x_{is} be the number of such securities held by individual i. The budget sets during young and old age are respectively characterized by:

$$c_{i0} + \int_{s \in S} q_s \cdot x_{is} = y_{i0} \quad \text{for all } i \in I^W, \tag{2}$$

$$c_{is} = y_{is} + x_{is} \quad \text{for all } s \in S \text{ and } i \in I^W \tag{3}$$

where (2) states that a young individual's consumption plus his expenditure in securities cannot exceed his endowment. Equation (3), on the other hand, simply states that the consumption of the old in any one state will be equal to their endowment plus their net holding of securities that pay in that state. Naturally, during youth primary markets must clear and

$$\int_{i \in I^W} x_{is} = 0 \text{ for all } s \in S. \tag{4}$$

since there is a zero net supply of all securities or promises.

If governments commit during youth to enforce all payments, a competitive equilibrium consists of a set of security prices and quantities such that individuals maximize expected utility subject to their budget constraints and primary markets clear. It is straightforward to check that, under full

commitment, this equilibrium is unique and implements the optimal allocation.

If governments cannot commit to enforce payments, they must choose enforcement after the state is revealed. Hence, the timeline of events in the world without commitment is as follows:

[Insert Figure 1 here.]

Once it is assumed that a government must decide on the enforcement of payments, it becomes crucial to specify what its enforcement technology is: must it enforce all promises or none of them? Can it discriminate by the region of residence of the payee when deciding whether or not to enforce? Can it discriminate across individuals of the same region? Here, and to simplify the exposition, we assume that governments can only discriminate between foreign and domestic residents, i.e., of all the promises issued by its residents, it must decide whether or not to enforce those on the hand of domestic residents and whether or not to enforce those on the hands of foreigners. Clearly, this is the main dimension along which governments would want to discriminate. We argue later on that this choice of enforcement technology is without loss of generality and show that our results would remain essentially unchanged if the government were allowed a greater degree of discriminatory ability.

It is immediate that governments never enforce payments to foreigners: doing so would not report any benefits and would always imply a decrease in the welfare of its residents. How about payments between domestic residents? To simplify the exposition, we proceed by conjecturing that governments always enforce these payments between their own residents: later, we will show that this conjecture is always verified in equilibrium. As a result of this discriminatory enforcement, securities issued in different countries cease to be perfect substitutes (as they were under full commitment), so that markets are geographically segmented and security prices might differ between regions. Let $x_{j,is}$ be the number of securities that pay in state s held by individual i issued by residents of region j, and let $q_{j,s}$ be the price of these securities. Therefore, the budget sets must be now rewritten as follows:

$$c_{i0} + \int_{s \in S} (q_{H,s} \cdot x_{H,is} + q_{F,s} \cdot x_{F,is}) = y_{i0} \text{ for all } i \in I^W, \tag{5}$$

$$c_{is} = y_{is} + x_{j(i),is} + d_{j(i),is} \text{ for all } s \in S \text{ and } i \in I^W \tag{6}$$

where $j(i)$ and $-j(i)$ denote, respectively, the region of residence of individual i and the other region, and $d_{j(i),is}$ denotes the number of securities issued by individual i and held by residents of region $-j(i)$. Note that $d_{j(i),is}$ enters positively because the payment of these securities is not enforced. In equilibrium $d_{j(i),is}$ will always equal zero. Note that our conjecture regarding enforcement does not

change the budget constraint during youth, so that (2) and (5) are essentially the same expression. The budget constraint during old age, which is now given by (6), is fundamentally different: if governments only enforce payments between their own residents, an individual's holding of securities issued by foreigners and foreign holdings of an individuals' securities will have no impact on his consumption during old age. Additionally, markets for securities issued in different regions now have to clear independently of one another, so that the market clearing condition is given by:

$$\int_{i \in I^W} x_{j,is} = 0 \text{ for all } s \in S \text{ and } j \in \{H, F\}. \tag{7}$$

If governments do not commit to enforce payments during youth, the competitive equilibrium consists of a set of security prices and quantities such that individuals maximize expected utility subject to their budget constraints, governments choose enforcement policy so as to maximize the average utility of the region, and primary markets clear.[6]

It can be readily verified that the consumption allocations in the absence of commitment are given by:

$$c_{i0} = \int_{i \in I^{j(i)}} y_{i0} \text{ for all } i \in I^W \tag{8}$$

$$c_{is} = \int_{i \in I^{j(i)}} y_{is} \text{ for all } i \in I^W \text{ and } s \in S \tag{9}$$

Equations (8) and (9) tell us that, in the competitive equilibrium without commitment, there will be perfect risk sharing within each region but there will be no risk sharing or borrowing and lending between regions. Hence, all individuals within a region will consume the same amount during youth and in all states of nature during old age, and their marginal utilities will be always equalized ex-post. These marginal utilities will, however, differ across regions.

The previous equilibrium has been derived under the conjecture that payments within residents of the same region are always enforced ex-post. We now show that this conjecture is actually verified. In our economy, domestic agents trade securities in order to smooth their consumption across states of nature. This means that, in any state of the world $s \in S$, individuals with a relatively high endowment in that state will owe payments to individuals whose endowment is relatively low. Before enforcement, concavity implies that the former will display a lower marginal utility of consumption than the latter. Therefore, it will always be ex-post optimal for governments that maximize the average utility of their residents to enforce payments between them, exactly as

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[6]Note that we have assumed that individuals take enforcement decisions as given. This is is an innocuous assumption as we later on. We adopt it in this simple model to streamline the discussion.

had been conjectured.

The present section has provided an overview of the competitive equilibria in our economy under two opposed assumptions regarding commitment. If governments can commit to enforce all promises, the competitive equilibrium will entail full risk sharing within and between regions and all individuals in the world will consume the same in each state of nature. On the other hand, if governments do not have the ability to commit, assets are never traded across regions and perfect risk sharing is only possible among individuals within the same region. Evidently, the latter case implies a loss of ex-ante welfare with respect to the former. Considering this, we next analyze how the introduction of secondary markets might be useful to avoid such a loss.

1.3   Secondary markets

Starting from the case in which governments do not have the ability to commit, we maintain our previous conjecture regarding enforcement and introduce secondary markets. By this we mean that individuals can trade securities again after the state of nature is revealed and before governments make their enforcement decisions. Hence, the timeline of events for the economy without commitment and with secondary markets is as follows:

[Insert Figure 2 here.]

The introduction of secondary markets allows for the amounts of securities held by an individual after trade in the primary and secondary markets to differ. Let $\hat{x}_{j,is}$ be the number of securities that pay in state s held by individual i issued by residents of region j, after trading in the secondary markets. Let $\hat{d}_{j(i),is}$ be the number of securities that pay in state s issued by individual i and held by residents of region $-j(i)$, after trading in the secondary markets. Let $\hat{q}_{j,s}$ be the price of these securities in these secondary markets. Then, the budget constraint during old age is no longer described by equation (6) but is given instead by:

$$c_{is} = \hat{y}_{is} + \hat{x}_{j(i),is} + \hat{d}_{j(i),is} \tag{10}$$

where $\hat{y}_{is}$ is the endowment left after trading in secondary markets which is given by:

$$\hat{y}_{is} = y_{is} + \hat{q}_{H,s} \cdot (x_{H,is} - \hat{x}_{H,is}) + \hat{q}_{F,s} \cdot (x_{F,is} - \hat{x}_{F,is}) \tag{11}$$

Equation (10) tells us that an individual's consumption during a state s will be equal to his endowment plus the domestic securities that he holds and that deliver in that state: the only

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difference with before is that now consumption depends on the endowment and the holdings of securities that an individual has after he has traded in the secondary markets. Equation (11), on the other hand, is the budget constraint that individuals must satisfy when trading in the secondary markets: essentially, it states that in order to buy securities in the secondary markets, an individual must either use his endowments or sell securities in these same markets. Besides the market clearing conditions in primary markets, market clearing must now also hold in the secondary markets:

$$\int_{i \in I^W} (\hat{x}_{j,is} - x_{j,is}) = 0 \text{ for all } s \in S \text{ and } j \in \{H, F\}. \tag{12}$$

The competitive equilibrium of the economy with secondary markets consists of a set of security prices and quantities such that individuals maximize expected utility in both dates subject to the appropriate budget constraints, governments choose enforcement policy so as to maximize the average utility of the region, and primary and secondary markets clear.

Before characterizing the competitive equilibrium of the economy with secondary markets, it is worthwhile to note that the usual assumption - by which only primary markets exist - amounts to adding the constraint that $\hat{x}_{j,is} = x_{j,is}$ in our current setup. This assumption has routinely been made in previous research on sovereign risk without justification. In fact, one can interpret this paper as dealing with one simple question: what happens when this common assumption is removed?

It turns out that secondary markets suffice to restore the optimal allocation as an equilibrium when governments cannot commit to the enforcement of promises. Without these markets, individuals never bought foreign securities because they anticipated that these would never be enforced. With secondary markets, they can sell them once the state of the world has been realized but before governments decide on enforcement and set:

$$\hat{x}_{-j(i),is} = 0 \text{ for all } s \in S \text{ and } i \in I^W \tag{13}$$

$$\hat{d}_{j(i),is} = 0 \text{ for all } s \in S \text{ and } i \in I^W \tag{14}$$

Who will buy these securities? Under the conjecture that payments within domestic residents are enforced, these securities will be bought by residents of $-j(i)$ as long as $\hat{q}_{-j(i),s} \leq 1$. It is also evident that $\hat{q}_{j,s} < 1$ for some $j \in \{H, F\}$ and $s \in S$ is not possible at equilibrium: this would mean that there is a region in which the total outstanding promises are greater than the sum of its residents' resources, which can only be possible if someone has violated his solvency constraint.

Hence, we have at equilibrium that

$$\hat{q}_{j,s} = 1 \text{ for } s \in S \text{ and } j \in \{H, F\} \qquad (15)$$

so that securities will be traded at their face value in the secondary markets. Figure 1illustrates the equilibrium in the secondary market for security x_{js}.[7]

[Insert Figure 3 here.]

Considering the expression for $\hat{y}$ along with conditions (13), (14), and (15) delivers the following expression for old age consumption (10):

$$c_{is} = y_{is} + x_{j(i),is} + x_{-j(i),is} \text{ for all } s \in S \text{ and } i \in I^W$$

meaning that, as in the case of full commitment, an individual's consumption depends on the endowment and on his holding of domestic and foreign securities. If individuals take this into account at the time of trading in the primary market, they will therefore buy and sell exactly the same amounts of securities that they would under full commitment. Hence, the presence of secondary markets makes it possible to restore the allocation that implements the optimal allocation by circumventing governments' inability to commit. It is important to note that the equilibrium entails no default and that all securities are traded in the secondary markets at their face value.

We have derived the result under the conjecture that governments will always choose to enforce payments between domestic residents. We now argue that this will always be verified at equilibrium. If governments enforce, we have seen that the equilibrium implements the optimal allocation, so that all individuals have the same marginal utility ex-post. Suppose that a government deviates and decides not to enforce payments between its own residents. This decision will not affect the total consumption of its residents: since all the securities issued by domestic residents have been repurchased by them in the secondary market, net payments within a region are zero. Hence, the only effect of not enforcing these payments will be to (weakly) affect the distribution of consumption among its residents, depending on how domestic assets are distributed among the population: individuals who hold a positive amount of domestic securities will lose, whereas the opposite will be true for those who hold a negative amount. Given that the government maximizes the average utility of its residents, and that the latter display a decreasing marginal utility of consumption, it can never be optimal for it to generate inequality by not enforcing payments between domestics.

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[7]The equilibrium displayed corresponds to the case in which no resident of j sells his holdings of x_{js} on the secondary market. Although not formally correct, this simplifies the graph since foreigners' supply of the securities is perfectly inelastic.

2 Extensions

In the previous section we showed how secondary markets can help solve the problem of sovereign risk, namely the inability of governments to commit to enforce payments to foreigners. In this section we show that secondary markets can help solve other types of commitment problems. We first analyze the case in which government want to redistribute consumption among domestic residents in such a way that it might not want to enforce payments ex-post. We then analyze the problems of enforcement that arise when there is political uncertainty (i.e. uncertainty about government preferences). Finally, we analyze the problem of commitment to repayment of public debt when taxes are distortionary.

2.1 Preference for Redistribution

Sovereign risk results from lack of commitment to enforcing payments and the fact that, since governments do not value the welfare of foreigners, they have no incentives to enforce payments to foreigners ex-post. A similar problem can arise on enforcement of payments among domestic residents. If governments have a preference for the distribution of consumption among domestic residents that is different from the one that would be implemented by complete markets, governments might be unwilling to enforce domestic payments ex-post. We now show that secondary markets can perform exactly the same role as before, allowing individuals to circumvent governments' lack of commitment and making it possible to achieve the optimal degree of risk sharing within regions. Although there could be potentially many reasons for which governments might want to redistribute consumption among its residents, we focus here on two reasons that arise naturally in our framework: a preference for redistributing wealth from rich to poor individuals, and a preference for redistribution to governments' "friends."

2.1.1 Redistribution to poor residents

Here we analyze our baseline model under the additional assumption that some residents are ex-ante "richer" than others. In particular, assume that the endowment of individual i is given by

$$y_{i0} = \varepsilon_i + \omega_{i0} \ \text{ for all } i \in I^W,$$
$$y_{is} = \varepsilon_i + \omega_{is} \ \text{ for all } i \in I^W \text{ and } s \in S,$$

where the symmetry assumptions of the previous section now apply to ω_{is} and we make the normalization choices $\int_{i \in I^j} \varepsilon_i = 0$. The baseline model analyzed to deal with sovereign risk corresponds

to the particular case in which $\varepsilon_i = 0$ for all i. Let the consumption allocation under complete markets (i.e. full commitment) be given by c_{i0}^* for all $i \in I^W$ and c_{is}^* for all $i \in I^W$ and $s \in S$. In general, this allocation cannot be found in closed form. But we will show that the same allocation is achievable in the absence of commitment when there are secondary markets.

In which way might this form of ex-ante heterogeneity affect enforcement? Since governments maximize the average utility of domestic residents, they might be unwilling to enforce payments from poor domestic residents (low ε_i) to rich domestic residents (high ε_i). However, a mechanism similar to the one analyzed for the case of pure sovereign risk still applies.

Assume that we can partition residents of each region in groups g according to their endowments ε_i (i.e. $\varepsilon_i = \varepsilon_g$ for all $i \in g$) such that all groups have positive mass. Let G^H and G^F denote, respectively, the sets of groups of Home and Foreign residents, i.e.

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\begin{aligned}
I^H &= \bigcup_{g \in G^H} g \\
I^F &= \bigcup_{g \in G^F} g
\end{aligned}
$$

Assume governments choose ex-post enforcement under the constraint that, if they enforce the payment of individual $i \in g$ to individual $i' \in g'$, they must enforce payments by all individuals in g to all individuals in g'. This guarantees that agents take government enforcement as given and secondary markets are competitive. Governments have $2^{\#G^H \cdot (\#G^H + \#G^F)}$ choices when enforcing payments, where $\#G^j$ denotes the number of groups in region j. This is because it must choose whether to enforce payments by residents in each of the $\#G^j$ domestic groups to residents in each of the $\#G^j + \#G^{-j}$ domestic and foreign groups. The previous section considered the special case in which $G^H = \{I^H\}$ and $G^F = \{I^F\}$.[8]

Under these assumptions, without secondary markets it might not be possible for poorer individuals (low ε_i) to share domestic risk with richer ones (high ε_i), as the government might not want to enforce payments from the former to the latter ex-post. With secondary markets, though, the government is unable to prevent such payments. In fact, a sufficient condition for the complete-markets outcome to be achievable is that there exist an outcome of the secondary market in which no resident holds securities issued by a poorer one. But this is obviously always possible. For example, assume that in the secondary market individuals sell all securities issued by residents of

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[8] In general, coarser enforcement helps achieve the full enforcement outcome: if payments are enforced given a secondary market outcome with a finer enforcement it will be enforced with a coarser one as well. So assuming enforcement at the group (as opposed to regional) level is not restrictive. Also, as we show in the appendix finer enforcement within groups also makes no difference except that enforcement at the individual level might place some constraints on the secondary market outcome (but not on the consumption allocation).

a group different from their own and are willing to purchase securities issued by residents of their own group as long as the price does not exceed one. If we think of there being one market clearing condition for securities issued by each group, it is clear that in equilibrium all securities will end up being held by individuals in the same group as the issuer. Clearly, governments will always (at least weakly) prefer to enforce payments within groups since all payments within groups increase the average utility of domestic residents as, under the complete-markets, this leads to equal consumption within groups.[9]

We have shown that ex-ante heterogeneity among residents of the same region does not affect the result that, with secondary markets, the full-commitment outcome is achievable even in the absence of commitment. The mechanism is similar to the one in the main case. Secondary markets discipline governments and are able to increase enforcement at equilibrium by transferring securities from those that are less likely to be repaid (foreigners or rich domestic residents) to those that are more likely to be repaid (poor domestic residents).

2.1.2 Redistribution to "friends"

Another reason for which governments might be reluctant to enforce all payments between their residents ex-post is that they like some of these individuals more than others. Assume now that all residents are ex-ante identical within regions but that each governments' objective functions consists of an arbitrary weighted sum of its residents' utilities. Formally, we preserve our notation as before but modify the environment so that the objective function at the time of enforcement in state $s \in S$ is given by

$$\int_{i \in I^j} \phi_{is} \cdot u(c_{is}) \ \text{ for } j \in \{H, F\},$$

where ϕ_{is} is the weight of agent i in the objective function of government $j(i)$ in state s. We assume $\phi_{is} \geq 0$ and impose the normalization $\int_{i \in I^j} \phi_{is} = 1$. The main case corresponds to the special case $\phi_{is} = 1$ for all i and all s. Let the consumption allocation under complete markets (i.e. full commitment) be given by c_{i0}^* for all $i \in I^W$ and c_{is}^* for all $i \in I^W$ and $s \in S$.

In which way might different government weights affect enforcement? Governments might be unwilling to enforce payments from domestic residents they like (high ϕ_{is}) to domestic residents they do not like (low ϕ_{is}). However, a mechanism similar to the one with equal weights still applies.

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[9]An alternative secondary-market outcome is the following. First, individuals in the poorest group spend all their endowment of consumption good in buying all securities issued by other individuals in the group, then on securities issued by the next poorest group, and so on. Second, individuals in the next to poorest group spend all their endowment of consumption good in buying all securities issued by other individuals in their group not held be the poorest group, then on securities issued by the next group, and so on. This process is repeated until all securities are bought. Clearly, this outcome only involves payments from richer to poorer residents and all payments will be enforced.

Assume that we can partition residents of each region in groups g according to their weights in their government's objective function ϕ_{is} (i.e. $\phi_{is} = \phi_{gs}$ for all $i \in g$) such that all groups have positive mass. We use the same group notation as above and assume that enforcement takes place at the group level, i.e. if a government enforces the payment of individual $i \in g$ to individual $i' \in g'$, then it must enforce payments by all individuals in g to all individuals in g'.[10] This guarantees that agents take government enforcement as given and secondary markets are competitive. A sufficient condition for the complete-markets outcome to be achievable is that there exist an outcome of the secondary market in which no resident holds securities issued by another agent that the government likes more. But this is always possible. For example, assume that in the secondary market individuals sell all securities issued by residents of a group different from their own and are willing to purchase securities issued by residents of their own group as long as the price does not exceed one. If we think of there being one market clearing condition for securities issued by each group, it is clear that in equilibrium all securities will end up being held by individuals in the same group as the issuer. Clearly, governments will always (at least weakly) prefer to enforce payments within groups since all payments within groups increase the average utility of domestic residents as, under the complete-markets, this leads to equal consumption within groups.[11]

2.2 Political uncertainty

Assume that, as in the previous section, the government does not maximize the average utility of its residents but instead maximizes a weighted sum of the latter's utilities. Differently from before, though, we want to consider the case in which such weights are state-contingent, so that a full description of a state of nature must now include both the realization of endowments and of governments' preferences. That is, the set of states of nature during old age is now given by

$$\Omega = S \times \Phi$$

where S is the original set of states of nature considering all "fundamental" sources of uncertainty and Φ represents the set of possible government preferences. To keep matters simple, we model government preferences so that, in any state $\omega \in \Omega$, the government of country $j \in \{H, F\}$ assigns weights $\phi_{i\omega} \in (0,1]$ to all $i \in I^j$. Consequently, we now use $x_{j,i\omega}$ to denote a security issued in region j and held by individual i that promises to deliver one unit of the consumption good in state ω. Note that, underlying this notation is the assumption that securities can in principle be

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[10] Once again, this is without loss of generality.

[11] Once again, an alternative secondary-market outcome is given by the groups the government likes more purchasing securities issued by the groups the government likes less.

contingent on the preferences of governments.

Suppose first that, in this modified world, the state of the world is fully revealed once old age arrives, so that all individuals know both the distribution of endowments and the preferences of governments simultaneously. If this is the case, then ex-post we are in a situation as the one in the previous section. A sufficient condition for the complete-markets outcome to be achievable is that there exist an outcome of the secondary market in which no resident holds securities issued by another agent that the government likes more (ex-post). But this is always possible. For example, assume that in the secondary market individuals sell all securities issued by residents of a group different from their own and are willing to purchase securities issued by residents of their own group as long as the price does not exceed one. If we think of there being one market clearing condition for securities issued by each group, it is clear that in equilibrium all securities will end up being held by individuals in the same group as the issuer. Clearly, governments will always (at least weakly) prefer to enforce payments within groups since all payments within groups increase the average utility of domestic residents as, under the complete-markets, this leads to equal consumption within groups.

What would happen instead if, at the time of trade in the secondary markets, the state of nature were only partially revealed? Consider, for example, the case in which all sources of uncertainty except the preferences of governments are revealed at the beginning of old age. Governments' preferences, on the other hand, are only revealed when enforcement decisions are made. Such a scenario is interesting for two reasons. In the first place, it seems quite natural, since it may be interpreted as representing a world in which governments can only reveal their preferences through their policy decisions. Moreover, since trade in secondary markets must be prior to enforcement, it represents a world in which individuals must trade in the secondary markets while still being uncertain about the state of nature that has realized.

In particular, assume that at the beginning of old age it is revealed that $\omega \in \{s\} \times \Phi \subset \Omega$, so that production levels are known but government preferences are not. As shown above, for each possible realization of government preferences there exists a post-secondary market distribution of assets that makes it optimal for governments with those preferences to enforce domestic payments. But if this is the case, individuals can achieve this distribution of holdings for each realization of government preferences, so that regardless of the governments' preferences that realize there will be enforcement and the optimal allocation will be implemented.

Underlying this result is the fact that the complete-markets allocation is independent of government preferences, even if governments' enforcement decisions are not. Hence, once the "fundamental" uncertainty is realized, there is no uncertainty regarding the optimal allocation: the only remaining uncertainty in our example refers to the distribution of asset holdings that will lead

to enforcement, but this can be dealt with by letting the holdings themselves be conditional on government preferences.

2.3 Tax Smoothing

[TO BE DONE] Up to now, we have analyzed situations in which the presence of secondary market enables an economy without commitment to function exactly as it would if governments had the ability to commit. There is, however, a classic case in which a government's inability to commit makes leads to a loss of welfare which we have not analyzed so far. This is the case in which a government needs to finance public expenditure and it finds it optimal to do so by smoothing taxes over time.

Consider our baseline economy but now suppose that the government of region j needs to finance an exogenously given level of public expenditure during youth, which we denote by E^j. In order to finance this expenditure, the government can either raise taxes or issue debt. It is assumed that the collection of taxes T_i from individual i entails an increasing and convex cost denoted by $c(T_i)$, so that $c'(\cdot) > 0$ and $c''(\cdot) > 0$.

3 Robustness and limits to the argument

In order to maximize theoretical clarity, we have developed the argument in a very simple model. It is worthwhile now to analyze different ways in which some of the assumptions underlying this simple model can be relaxed without affecting our main result. We also show that the result may fail to hold under some extreme conditions.

3.1 "Finer" enforcement technology

In Section 1 we assumed that governments had four choices when enforcing payments by domestic residents: enforce all payments to all residents of the world, enforce payments only to domestic residents, enforce payments only to foreign residents, and not enforce any payments. In Section 2 we assumed that governments could discriminate between groups when enforcing payments where groups differed either in their endowment process or in the weight assigned to them in the governments' objective function. What would happen if the enforcement technology did not coincide with these groups. It is easy to see that coarser enforcement, in the sense of not being able to discriminate between groups, makes enforcement more likely. This is because if enforcement of two types of payments are both individually desirable, enforcing of them will also be desirable if the government cannot enforce one without enforcing the other. In this section we instead allow

governments to have a "finer" enforcement technology. We show that secondary markets still lead to the full-commitment outcome.

Let us first consider the case in which enforcement is chosen between smaller groups of agents, although not at the individual level. Let us partition the sets of Home and Foreign residents into enforcement subsets or groups of positive mass, denoted g_E. Let G_E^H and G_E^F denote, respectively, the sets of enforcement groups of Home and Foreign residents, i.e.

$$
\begin{aligned}
I^H &= \bigcup_{g_E \in G_E^H} g_E \\
I^F &= \bigcup_{g_E \in G_E^F} g_E
\end{aligned}
$$

Assume governments choose ex-post enforcement under the constraint that, if they enforce the payment of individual $i \in g_E$ to individual $i' \in g_E'$, they must enforce payments by all individuals in g_E to all individuals in g_E'. Governments thus have $2^{\#G_E^H \cdot (\#G_E^H + \#G_E^F)}$ choices when enforcing payments, where $\#G_E^j$ denotes the number of groups in region j. This is because it must choose whether to enforce payments by residents in each of the $\#G_E^j$ domestic groups to residents in each of the $\#G_E^j + \#G_E^{-j}$ domestic and foreign groups.

These enforcement partitions G_E^H and G_E^F need not coincide with those in Section 2. For example, there can be two agents with different endowment processes and/or different weights in their government objective function who belong to the same group, or there can be two agents with the same endowment processes and the same weights in their government objective function who belong to different groups.

It is easy to show that the full-commitment outcome can still be achieved. Let G^H and G^F be as defined in Section 2, namely two agents belong to the same group if and only if they have the same endowment processes and the same weights in their government objective function. Assume that in the secondary markets agents sell all securities issued by agents in different groups and buy securities issued by agents in their same group (where groups are those of partitions G^H and G^F, not of enforcement partitions G_E^H and G_E^F). Then, when governments decide which payments to enforce they cannot affect payments between groups so they cannot distribute consumption to poor residents and/or friends. So they will choose to enforce payments by all domestic groups to all domestic groups. This mechanism works because individuals are infinitesimal and all groups have positive mass, so individuals cannot affect the enforcement decisions of governments by changing their asset trade in primary and secondary markets. In fact, not only does this finer enforcement technology allow for the full-commitment outcome, but it does so without placing additional re-

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strictions on security holdings after the secondary market closes. When enforcement is decided at the individual level, markets are no longer competitive since individuals can affect the enforcement of their payments. Although this case is not too realistic, in the Appendix we show that the full-commitment outcome is still achievable.

3.2   Imperfect primary markets

A natural way to extend our baseline model is to restrict the set of securities available in the benchmark economy with commitment, so that primary markets are assumed to be imperfect or incomplete. In our main section, the results were obtained under the assumption of complete primary markets, so that individuals were free to issue any combination of state-contingent securities as long as they did not violate their budget constraints. But there are many frictions in financial markets that typically lead to restrictions in the set of securities that individuals can issue. If some states need to be verified, for example, and the cost of verification is sufficiently high, some securities might not be issued at all even with full commitment in which case their primary markets never open. Or, in the presence of informational problems that give rise to borrowing constraints, there may be a limit to the amount of securities that can be issued in primary markets.

For any of these cases, it can be readily verified that the presence of secondary markets makes it possible to implement the allocation that would arise under full commitment. To see this, consider an environment in which individuals are constrained to issuing securities within a restricted subset $\Theta \in \mathbb{R}^S$. In such a scenario, the equilibrium of the economy with commitment would not implement the optimal allocation whenever the issuing constraint is binding. But, since our main result does not depend at all on the assumption of market completeness, it would still be true that the presence of secondary markets would enable the economy without commitment to attain the same equilibrium allocation as the economy with commitment.

In other words, we have chosen to focus on the case in which the only friction is the inability of governments to commit: absent this friction, the competitive equilibrium would implement the optimal allocation. We have argued that, if governments cannot commit, the presence of secondary markets suffices to restore the latter as an equilibrium. This argument has hinged on the assumption that there are as many secondary markets as primary markets there are in the economy with commitment. But, if we analyzed instead an economy in which - besides the lack of commitment - other frictions prevent primary markets from functioning properly, our result would not be affected: secondary markets would still allow individuals to circumvent governments' inability to commit, thereby making it possible to implement the equilibrium that would be attained under full commitment.

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3.3   Imperfect secondary markets

Suppose that, in our benchmark economy without commitment, there is some state of the world in which secondary markets do not exist at all. Then, obviously, the markets for assets delivering in that state would be geographically segmented. In such a state, then, only domestic risk sharing would be possible, but it would not be feasible to make or receive any payments from foreigners. There would still be risk sharing across those states of nature in which secondary markets exist, and it is also worthwhile to note that default would not be observed at equilibrium and that existing securities would always be traded at face value.

Besides this obvious consideration regarding the effects of missing secondary markets, can we think of a reason for which this might happen in reality. Since secondary markets essentially exist to guarantee enforcement in our world, it seems natural to think of cases in which the set of securities that can be issued is not as rich as would be required for these markets to guarantee enforcement. To see this, consider the economy analyzed in subsection 2.2, in which the state of the world is only partially revealed at the time of trading in the secondary markets. In that economy, it was crucial that securities could be made contingent on government preferences.

Suppose that, for some unspecified reason, this is not possible, so that securities can only be contingent on "fundamental" uncertainty whereas the set of states of nature also includes the possible preferences of governments. Note that this modification would have no effect on the equilibrium under commitment, since the preferences of governments are irrelevant in that case. If governments cannot commit, though, this modification alters the equilibrium in a crucial way. This can be best understood by remembering that the need of these securities was to ensure enforcement regardless of government preferences: by indexing securities to the latter, it was possible to distribute asset holdings in such a way that the government would always find it optimal to enforce ex-post. But if such securities are not available, then individuals cannot be sure that all domestic payments will be enforced and will have to take into account expected enforcement when trading in the secondary markets. This, in turn, means that securities will be traded at a discount with respect to their face value and that there will be some promises that will not be enforced at equilibrium.

It is best to illustrate this explanation with an example. Consider our benchmark economy when preferences are given by

$$U(c_{j0}, c_{j1}) = \frac{1}{2}\ln(c_{j0}) + \frac{1}{2}\ln(c_{j1})$$

where c_{jt} denotes the consumption of the only good by an individual in country $j \in \{H, F\}$ during period t. It is also assumed that, within each region, all individuals are ex-ante and ex-post identical

and that endowment profiles in countries H and F are given by

$$(y_{H0}, y_{H1}) = (\alpha, 1 - \alpha)$$
$$(y_{F0}, y_{F1}) = (1 - \alpha, \alpha)$$

where y_{jt} is the endowment of the consumption good of individuals in country j at time t and $\alpha > \frac{1}{2}$. In such an economy under full commitment, individuals in F would borrow from H during youth by issuing $(\alpha - \frac{1}{2})$ securities and repaying the same amount during old age. Equilibrium consumption would be given by

$$(c_{H1}^*, c_{H2}^*) = \left(\frac{1}{2}, \frac{1}{2} \right)$$
$$(c_{F1}^*, c_{F2}^*) = \left(\frac{1}{2}, \frac{1}{2} \right)$$

The same levels of consumption could be attained in the absence of commitment but with secondary markets. In the equilibrium that implements such an allocation, individuals in F would issue and sell the same number of securities during youth as they would in the economy with full commitment. During old age, though, H residents would not hold the securities until enforcement but would instead sell them at face value in the secondary market to residents of F. At the time of enforcement, the government of F would find that all securities issued during youth are held by its own residents, and would therefore enforce the corresponding payments.

Suppose that this environment is modified so that there is uncertainty regarding the preferences of the government of F. In particular, assume that, when it comes time to enforce payments, the F government maximizes the average utility of one half of its residents (which we call "friends") and disregards the welfare of the other half (which we call "foes"): it is important to note that no resident of F knows whether he is considered a friend or a foe until the time of enforcement comes. Since we are interested in the case in which securities cannot be contingent on the preferences of the government, we assume that individuals cannot issue securities that are contingent on them being considered a friend or a foe by the government.[12]

Note that, given its preferences, it is no longer true that the government of F will choose to enforce all domestic payments: it will enforce payments to its friends and payments between foes (it is indifferent), but it will never enforce payments from its friends to its foes. Hence, when the

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[12]It is important for this argument that an agent being considered a friend or a foe be independent of the status of every other agent. For example, imagine that there are two predetermined groups in the economy and that either all members or no members of a given group are considered friends. In this case, secondary markets would lead each group to hold all securities issued by members of the group and there would be full enforcement.

secondary market opens during old age, an individual $i \in I^F$ will not be willing to purchase the securities at face value since he anticipates that there is risk of default. If individual i turns out to be considered a friend by the government, the security will be enforced regardless of the status of the issuer. If, on the other hand, individual i is eventually considered a foe by the government, the security will only be enforced if the issuer is considered a foe as well. In our example, then, individuals in F perceive that the securities purchased in the secondary market have an expected return of .75, but they will be willing to pay an even lower price for them because the securities entail risk that cannot be diversified. This is due to the fact that each individual does not know whether he will be considered a friend or a foe: if this were known in advance, the risk associated to the status of the issuers could be diversified by purchasing a continuum of securities.

In such an environment, secondary markets will not be able to restore the allocation that would arise under full commitment. The presence of "enforcement risk" as explained above means that securities will be sold at a discount in the secondary market: this, of course, will also imply that the price of securities in the primary market will be lower than their expected return. This ultimately makes it costlier for individuals in F to borrow, the result being that the equilibrium with secondary markets will not entail perfect consumption smoothing over time. Also differently from the case of full commitment, the equilibrium will entail default and security prices that are below their face value. Although in the present example we have chosen to focus on the case of borrowing and lending for simplicity, a similar example could be easily constructed for a setting of risk sharing.[13]

3.4 Large agents

When there are "large" agents, they may be able to manipulate the price of their debt in the secondary markets. Although we argue that the conditions under which the presence of large agents affects our main result are somewhat extreme, we feel that a brief analysis of these conditions can be useful to further clarify the working of these markets.

To do so, we invoke once again our benchmark model but with one important modification: there is a single individual in each country, who understands that his actions can affect the price of the securities that he issues. With such a modification, the presence of commitment would by itself not be enough to implement the optimal allocation. The reason is that, understanding that they face a downward sloping demand for their securities, individuals would restrict their security issues to exploit their market power. Although each would have an incentive to do this individually, the equilibrium outcome would necessarily entail a lower degree of risk sharing (or borrowing and

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[13]A similar example could be constructed in which the government is a "defaulter" with some probability, in which case it does not enforce any payments.

lending) than the Pareto optimal allocation and, therefore, an ex-ante welfare loss with respect to the latter.

Suppose now that, in the same scenario, governments do not have the ability to commit. In that case, the introduction of secondary markets will not add anything to the equilibrium without commitment, and no exchange of assets between individuals will be possible. The reason is simple: none of the two individuals will ever buy a security issued by the other one in the primary markets, since both correctly anticipate that they will be unable to sell these securities in the secondary market. Once a state of nature has realized, each individual knows that the securities he issued will not be enforced as long as the other individual holds them: hence, neither of the two has any incentives to buy them back, which therefore makes it impossible to issue them in the first place.

It is important to note that this failure of our result regarding secondary markets would disappear if, instead of one, there were two identical agents per region. With two agents in each region, each would have an incentive to repurchase the securities issued by the other one: this situation, analogous to Bertrand competition among buyers, would equalize the price of securities in secondary markets to their face value, which would in turn suffice to restore the full commitment equilibrium.[14]

3.5   Short-run versus long-run commitment

We now make a slight digression to analyze the difference between governments' ability to commit in the long and in the short run. Throughout the paper, we have contrasted governments that have no ability to commit whatsoever with governments that can commit at one period in time to enforce payments in subsequent periods. In the present subsection, we shall refer to this latter case as one of long run commitment.

Consider an intermediate case, in which governments have the ability to commit in each period, but only to enforce payments within that same period. In our economy, this implies that governments can only commit to enforce payments at the beginning of old age, once the state of the world has realized. Without secondary markets, such enforcement technology by governments is inconsequential with respect to the case of no commitment, since the government will never enforce payments to foreigners and all asset trades between regions will be precluded.

Suppose that now secondary markets are introduced in such an economy. Hence, once a state of nature realizes, governments can make commitments regarding the enforcement of different payments, after which secondary markets open and - finally - enforcement decisions are made and

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[14]If both agents in each region are not identical, the result might fail. The case in which one of them is substantially richer than the other one, so that the latter cannot purchase the securities issued by the former, illustrates the point. We chose not to pursue this further at this point.

consumption takes place. We argue that the introduction of secondary markets in such a case can have both positive and negative effects and, in general, the outcome will be different from the full-commitment one.

To illustrate the intuition behind this result, note first that the presence of secondary markets means that governments cannot discriminate between domestic residents and foreigners when committing to enforce payments at the beginning of old age. Otherwise, if governments committed only to enforcing payments between domestics, foreigners would sell all their domestic securities in the secondary market at face value and would *de facto* receive their payment. Thus, if a government wants to avoid payments to foreigners, the only way for it to achieve this is by committing to not enforcing any promises. Will it ever want to do this? If it decides to not enforce any payments, it will certainly keep domestic residents from buying securities in the secondary market, thereby avoiding all transfers to foreigners. On the other hand, it will also destroy all payments between domestics, making it impossible for them to share risk domestically. Depending on which effect dominates, either all promises or none of them will be enforced. In fact, secondary markets and such partial commitment means that ex-post the government has to choose between enforcing all payments or none. This case is fully analyzed by Broner and Ventura (2006).

This result provides an interesting second best type of argument for different levels of commitment. In the presence of secondary markets, both full commitment and no commitment make it possible for the economy to replicate the optimal allocation. Short term commitment, on the other hand, may lead to a suboptimal outcome by forcing governments to destroy all trade of assets that deliver in states where the scope for international transactions is large relative to the gains from domestic ones.

4 Conclusions

[TO BE DONE]

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6   Appendix

Let us next consider the case in which enforcement is chosen at the individual level, namely, from each domestic resident to each domestic and foreign resident. This case is in principle subtler since agents can act strategically to affect government enforcement. Still, we show that the full-commitment outcome can be achieved in the presence of secondary markets.

During youth, every agent would like to commit to making payments during old age. Since this is not possible, agents would want their governments to commit to enforcing payments. As we have shown, even if governments cannot do this, secondary markets make it possible to achieve the same outcome that would arise under full commitment. If enforcement is decided at an individual level, could an agent i affect the enforcement of his payments in state s by trading assets during youth? In particular, assume that agent i were to issue so many state-s securities (i.e. $x_{j(i),is} + x_{-j(i),is}$ negative and large in absolute value) that enforcement of his payments in state s would imply an arbitrarily low level of consumption $y_{is} + x_{j(i),is} + x_{-j(i),is}$: with such an issuing strategy, the government of region $j(i)$ might not want to enforce payments by agent i in state s. Would agent i want to do this? No, because in that case the value of state-s securities issued by him would be zero. This would result in the same pattern of consumption as if enforcement always took place but agent i simply decided not to issue any state-s securities. But, if under complete markets the equilibrium is such that agent i wants to issue state-s securities, then he will have no incentive to destroy the possibility of issuing them by providing the government with incentives not to enforce them. The bottom line is that agents, as governments, prefer during youth the outcome attained

under complete markets and thereby have no incentives to affect the full-enforcement outcome delivered by secondary markets.

During old age, on the other hand, every agent would like to avoid making payments. Can an agent i affect the enforcement of his payments in state s by trading assets in secondary markets during old age? One possibility would be for agent i to affect the enforcement of his payments by not selling the foreign securities that he holds or by buying domestic securities at a price higher than one. Such actions would make him poorer and would lower his consumption in case of enforcement in a way that might lead the government to not enforce his payments.[15] Although intuitively appealing, it can be shown that the possibility of such a deviation does not affect our result, because there always exist equilibrium outcomes of the secondary markets that lead to full enforcement. For example, if each agent's debts are held by only one other domestic resident, then an agent can never induce the government to not enforce his payments by incurring in losses in the secondary market: by not enforcing, the government would be substantially reducing the utility of the unique creditor.[16,17]

As a result, when the enforcement technology is very fine in the sense that enforcement is decided at the individual level, the full-commitment outcome is still achievable but the set of equilibrium secondary market outcomes is reduced. Interestingly, with "coarser" enforcement there exist other inferior equilibria which disappear if enforcement is decided at the individual level. In these equilibria agents do not trade in assets ex-ante because they do not expect enforcement ex-post and, since there are no payments to enforce once old age arrive, no enforcement is in fact possible at equilibrium. These equilibria disappear when enforcement is individual because individuals take into account the impact of their issues on the government's enforcement decision.

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[15]For example, assume that in equilibrium after the secondary market clears all agents hold 100 units of the consumption good, owe 10 units to other domestic residents, and are owed 10 units by other domestic residents. Also assume that an agent is owed 10 by a single other domestic resident but his debts are spread out evenly over all domestic residents. Then the agent would have an incentive to lower his holdings of the consumption good from 100 to, say, 91: he could do so, for example, by not selling 9 foreign securities in secondary markets. The government would prefer to enforce the payment to this agent but not the payment by this agent. In this case this resident would consume 101 and the rest of the residents infinitesimally less than 100. This would be preferred by the government to the full enforcement distribution of 91 and 100. As a result, not all secondary-market outcomes that lead to full enforcement are equilibria since agents have an incentive to lower their consumption in case of full-enforcement so that their payments are enforced.

[16]In the example of the previous footnote, the government would prefer to enforce payments and have the agent consume 91 and all other residents 100 instead of not enforcing, which would lead this agent to consume 101 and his unique creditor to consume 90.

[17]These holdings might not be feasible when there is ex-post heterogeneity. In general, it can be shown that there always exist equilibrium holdings that lead to full enforcement based on the same principle.

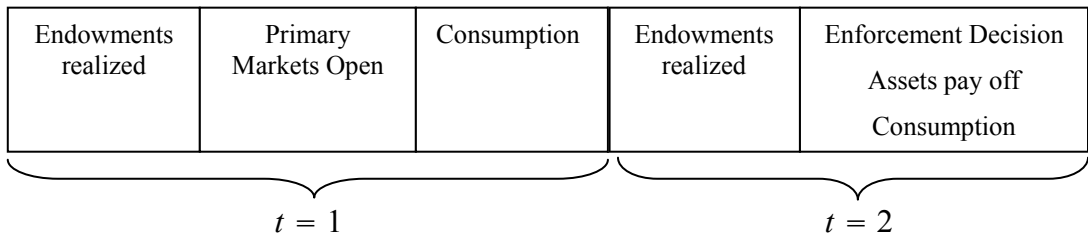Figure 1: Timeline of events without secondary markets

Endowments realized	Primary Markets Open	Consumption	Endowments realized	Enforcement Decision Assets pay off Consumption

$$t = 1 \qquad\qquad\qquad\qquad t = 2$$

Figure 2: Timeline of events with secondary markets

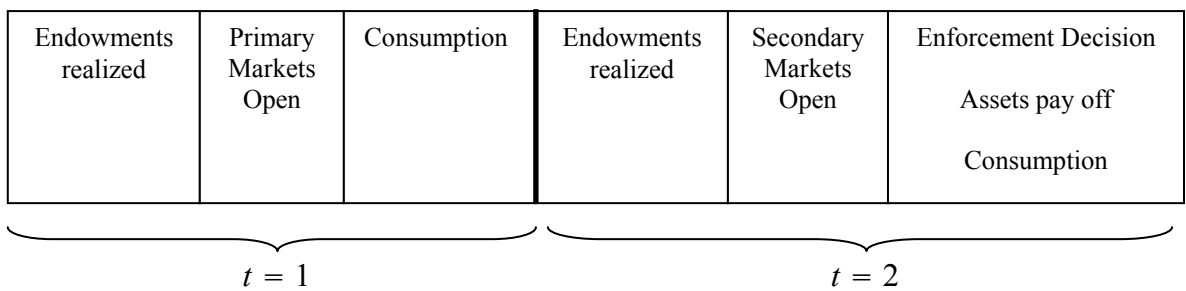| Endowments realized	Primary Markets Open	Consumption	Endowments realized	Secondary Markets Open	Enforcement Decision Assets pay off Consumption

$$t = 1 \qquad\qquad\qquad\qquad t = 2$$

Figure 3: Equilibrium in the secondary market for security $x_{j,s}$