Sovereign Risk, Anonymous Markets, and the Effects of Globalization[*]

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Abstract

The goal of this paper is to study the effects of globalization on the workings of financial markets. We adopt a "technological" view of globalization, which consists of an exogenous reduction in the cost of shipping goods across different regions of the world. We model financial markets where agents anonymously trade securities issued by every other agent in the world. In the absence of frictions, we show how globalization creates trade opportunities among residents of different regions of the world, thereby raising welfare. In the presence of sovereign risk, however, there emerge two crucial interactions between trade among residents within a region and trade among residents of different regions. First, the more residents within a region trade with each other, the more they can trade with residents of other regions. Second, the possibility of trade with residents of other regions sometimes leads a government to not enforce payments by its residents, destroying trade opportunities among residents within the region. The net effect on welfare of this process of creation and destruction of trade opportunities is ambiguous. We argue that there are no policies governments can take to avoid the negative effects of globalization on trade among domestic residents. In a dynamic extension, we analyze how our results are affected by reputational considerations.

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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. They can do so by participating in a financial market with other domestic and foreign residents. Importantly, we assume that individuals issue securities that trade in anonymous markets, as opposed to signing contracts with each other.[1] When the cost of transporting goods between regions is high enough such that risk sharing between domestic and foreign residents is prohibitively expensive, individuals insure their idiosyncratic risk with other domestic residents and are fully subject to their region-wide aggregate risk. Globalization reduces the cost of sharing risk with foreigners and can affect risk sharing both within and between regions. We consider three different environments.

In the first environment, we assume that markets are complete. Not surprisingly, globalization leads to an increase in asset trade opportunities as individuals now find it cheaper to share risk with foreign residents. Equilibrium asset trade increases and this improves the distribution of consumption across states of nature. All individuals of the world gain from this and welfare unambiguously increases.

In the second environment, we introduce sovereign risk. Namely, governments cannot commit "ex-ante" to enforce payments by their residents "ex-post." As a result, ex-post governments only enforce payments if this raises the welfare of domestic residents. Naturally, this lack of commitment

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[1] Securities consist of obligations of the issuer towards the holder of the security, and can be traded freely. Contracts stipulate obligations between the signing parties that cannot be traded freely.

reduces the welfare of domestic residents ex-ante. Just as in the complete-markets model, globalization creates new asset trade opportunities by making it cheaper to share risk with foreigners. If the financial market consisted of financial contracts, governments would never enforce payments from domestic to foreign residents, residents of different regions would not sign financial contracts ex-ante, and the regions would be unaffected by globalization. However, the effects of globalization are very different when the financial market consists of anonymous securities. In this case, governments cannot discriminate against foreign residents when enforcing payments, since even if they only enforced payments to domestic security holders foreign security holders could still get repaid (indirectly) by selling their securities to domestic residents. As a result, residents of different regions do trade securities and risk sharing between regions is feasible.

Governments face a trade-off when enforcing payments. On the one hand, enforcement increases payments from domestic to foreign residents and decreases average domestic consumption. On the other hand, enforcement increases payments between domestic residents and improves the distribution of consumption among domestic residents. This trade-off gives rise to two crucial interactions between asset trade among domestic residents and asset trade between domestic and foreign residents. First, the more important domestic risk sharing is (i.e. large idiosyncratic shocks) the more risk sharing between regions can take place since governments are more reluctant to stop enforcing payments. Second, the more important risk sharing between regions is (i.e. large aggregate shocks and low transport cost) the more likely it is that domestic risk sharing breaks down since governments are more tempted to stop enforcing payments when domestic residents must make large payments to foreigners. The net effect on welfare of the creation and destruction of asset trade opportunities as a result of globalization is ambiguous.

In the third environment, we study dynamic considerations by introducing an overlapping-generations structure. In particular, we analyze to what extent governments can "acquire commitment" by allowing for reputation equilibria.

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.[2] 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 defaults do not seem to have

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

much of an effect on trade in goods.[3] In this paper, governments enforce payments from domestic to foreign residents as a result of two assumptions. First, the financial market is anonymous and, thus, governments cannot discriminate against foreigners when enforcing payments. Second, governments care about the distribution of consumption across domestic residents. These assumptions imply that governments face a trade off when deciding whether to enforce payments in states in which domestic residents make payments to foreigners: if payments are enforced average domestic consumption is reduced but the allocation of that consumption across domestic residents improves. As a result, the more important risk sharing among domestic residents is the more domestic residents can insure aggregate shocks with foreign residents. In a more general context this suggests that developed domestic financial markets facilitate the access to international financial markets.

There is a growing literature on the relationship between domestic and foreign financial markets. Chang and Velasco (1999) emphasize the role of foreign investors in emerging-market banking systems. Caballero and Krishnamurthy (2001) emphasize the role of domestic markets in facilitating access to international markets, due to both their effects on the allocation of international collateral ex-post and their effects on the incentives to create international collateral ex-ante. Ventura (2004) shows how domestic financial frictions can give rise to asset bubbles and the role of bubbles in international capital flows. Tirole (2003) argues that in the presence of sovereign risk individual residents have incentives to overborrow. In our paper, domestic and foreign risk sharing are interconnected due to the inability of governments to discriminate against foreigners when enforcing payments. As in Caballero and Krishnamurthy (2001), domestic financial development facilitates access to international markets. But our mechanism is different: in our model the government enforces payments to foreigners (which allows for the possibility of issuing securities ex-ante) so as not to destroy valuable transfers between domestic residents. Also, in our model there is a second type of interdependence absent in the previous literature. When payments from domestic to foreign residents are high enough, governments prefer not to enforce payments. As a result, for extreme realizations of aggregate shocks governments do not enforce payments thereby destroying risk sharing among domestic residents.

1. Complete markets.

2. Sovereign risk: contract vs. securities.

3. Policy: contracts and securities, state specific taxes, and reforms.

4. Reputation.

5. Final remarks: Discussion on the menu of assets.

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[3] The latter is still an open issue. Rose (2002) argues that there exists trade disruption after defaults, but Martinez and Sandleris (2004) find the opposite result.

1 International risk sharing with complete markets

In this section, we begin our analysis of the effects of globalization on the workings of financial markets. As mentioned in the introduction, we adopt a "technological" view of the globalization process. According to this view, globalization consists of a gradual reduction in the costs of shipping goods across different regions of the world. It seems natural to start by examining the standard case of complete markets. As expected, an improvement in the transport technology increases trade and raises welfare in this case. The goal of this section is to explain how and why this happens. The results obtained in this case will serve to build intuitions and also provide a useful benchmark against which to compare the richer results that appear once we introduce sovereign risk.

Throughout we use a simple model of the world economy that abstracts from many important aspects of trade. For instance, in our model the only motive for trade within and across regions is the desire to insure against income shocks. We therefore disregard other important sources of domestic and foreign trade such as differences in technology and factor proportions, economies of scale and differences in the rate of time preference. We would like to be able to say that abstracting from these types of trade does not meaningfully affect the results we obtain. But the truth is that we do not know this. As the next sections will reveal, the problem we are analyzing is sufficiently complex in this simple framework. Despite this, we shall offer at the end of the paper some conjectures about how introducing additional motives for trade might affect the results we obtain here.

1.1 The model

Consider a world economy with two regions: Home and Foreign. Both regions have identical population size, normalized to 1. We define I and I^* as the sets of Home and Foreign residents, respectively. As usual, we use an asterisk to denote Foreign variables, and omit the asterisk to denote Home variables. The world and its inhabitants last two periods, which we refer to as youth and old age. There is no uncertainty about youth, but there are various sources of uncertainty regarding old age. Let S be the set of all possible states of nature during old age. This set includes all the relevant aspects of the world economy that are not known during youth. We denote by π_s the probability at youth of state $s \in S$ occurring during old age. There is a single good that is costly to transport across regions. If τ (≥ 1) units of the good are shipped from any region, only one unit of the good arrives to the other region. We refer to a good located at Home as a "Home" good and a good located in Foreign as a "Foreign" good.

All individuals maximize the expected utility of old-age consumption,

$$\int_{s\in S}\pi_s \cdot u(c_{is}) \ \text{ if } \ i \in I \ \text{ and } \ \int_{s\in S}\pi_s \cdot u(c_{is}^*) \ \text{ if } \ i \in I^*, \tag{1}$$

where c_{is} and c_{is}^* are the quantities of Home and Foreign goods consumed by individual i, and the utility function is assumed to take logarithmic form, i.e. $u(\cdot) = \ln(\cdot)$. Note that the utility function of Home residents is defined exclusively as a function of Home goods, while the utility function of Foreign residents is defined exclusively as a function of Foreign goods[4]. Throughout, we assume that consumption cannot be negative, i.e. $c_{is} \geq 0$ and $c_{is}^* \geq 0$ for all $i \in I \cup I^*$.[5]

During youth, individuals receive an endowment of the single good and use it to build a project located in their own region.[6] Projects pay off during old age. We refer to the return to the project of individual i as his/her production. Half of Home residents are "lucky" and receive $y_{is} = (1+\iota)\cdot y_s$ and $y_{is}^* = 0$ in state s, while the other half are "unlucky" and receive $y_{is} = (1 - \iota) \cdot y_s$ and $y_{is}^* = 0$, with $\iota \in [0,1)$. Similarly, half of Foreign residents are "lucky" and receive $y_{is}^* = (1 + \iota) \cdot y_s^*$ and $y_{is} = 0$ in state s, while the other half are "unlucky" and receive $y_{is}^* = (1 - \iota) \cdot y_s^*$ and $y_{is} = 0$. Note that the projects of Home residents only deliver goods in Home, while the projects of Foreign residents only deliver goods in Foreign. The average productions of Home and Foreign are therefore given by y_s and y_s^*, i.e. $y_s = \int_{i \in I} y_{is}$ and $y_s^* = \int_{i \in I^*} y_{is}^*$.[7] These assumptions imply that the projects of all the residents of a given region are ex-ante identical, but might differ ex-post. Throughout, we assume symmetry between regions: if there exists a state s with $\pi_s = \pi$ and $(y_s, y_s^*) = (\overline{y}, \underline{y})$, then there exists a corresponding state s' with $\pi_{s'} = \pi$ and $(y_{s'}, y_{s'}^*) = (\underline{y}, \overline{y})$. This assumption implies that the Home and Foreign regions are ex-ante identical, but might differ ex-post.

During youth, individuals have access to markets where a full set of Arrow-Debreu securities are traded. Let x_{is} and x_{is}^* be the number of securities held by individual i that promise to deliver one unit of the Home and Foreign good, respectively. We refer to these securities as "Home" and "Foreign" securities, respectively. With no loss of generality, we assume that individuals can only

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[4]This world with one good and two locations is isomorphic to an alternative world with one location and two goods. In this alternative world, half of the agents would consume exclusively one good and the other half consume exclusively the other good. There would also also exist a linear technology that converts τ of any of the goods into one unit of the other one.

[5]The assumption of logarithmic preferences ensures that consumption of Home (Foreign) goods by Home (Foreign) residents is always non-negative. But these restrictions are still necessary to ensure that consumption of Home (Foreign) goods by Foreign (Home) does not become negative.

[6]We are implicitly assuming that investing in the project dominates any other available technology to transform goods during youth into goods during old age.

[7]Rigorously, each state of nature is characterized not only by the average levels of income in each region (i.e. y_s and y_s^*) but also by how these incomes are distributed among their residents (i.e. the sets of lucky residents in each region). However, we will work with a more coarse partition of states and refer to all the states with the same average levels of income in each region as the same "state." This constitutes a slight abuse of notation but, given the symmetry among residents within each region, it greatly simplifies the exposition.

issue securities that are backed by their own production,

$$x_{is} \geq -y_{is} \quad \text{and} \quad x_{is}^* \geq -y_{is}^* \quad \text{for all} \quad i \in I \cup I^* \quad \text{and} \quad s \in S. \tag{2}$$

We can now write the budget constraint of the young as

$$\int_{s \in S} (q_s \cdot x_{is} + q_s^* \cdot x_{is}^*) \leq 0 \quad \text{for all } i \in I \cup I^*, \tag{3}$$

where q_s and q_s^* are the prices of Home and Foreign securities that pay in state s. Equation (3) basically says that purchases of securities must be financed by corresponding sales of other securities.

During old age, individuals have access to a market where they can trade goods. Let p_s and p_s^* be the prices of Home and Foreign goods, respectively. The budget constraint during old age is

$$p_s \cdot c_{is} + p_s^* \cdot c_{is}^* \leq p_s \cdot (y_{is} + x_{is} + t_{is} - \tau \cdot t_{is}^*) +$$
$$+ p_s^* \cdot (y_{is}^* + x_{is}^* + t_{is}^* - \tau \cdot t_{is}) \quad \text{for all} \quad i \in I \cup I^* \quad \text{and} \quad s \in S, \tag{4}$$

where t_{is} are the quantities of goods shipped to Home from Foreign and t_{is}^* are the quantities of goods shipped to Foreign from Home. Equation (4) states that consumption cannot exceed income. Naturally, it is not possible to ship negative quantities, so

$$t_{is} \geq 0 \quad \text{and} \quad t_{is}^* \geq 0 \quad \text{for all} \quad i \in I \cup I^* \quad \text{and} \quad s \in S. \tag{5}$$

To sum up, individuals maximize Equation (1) subject to Equations (2), (3), (4) and (5).

To complete the model, we must ensure that markets clear. During old age, the only relevant markets are those for Home and Foreign goods and these clear if and only if

$$\int_{i \in I \cup I^*} c_{is} = y_s + \int_{i \in I \cup I^*} (t_{is} - \tau \cdot t_{is}^*) \quad \text{for all} \quad s \in S, \tag{6}$$

$$\int_{i \in I \cup I^*} c_{is}^* = y_s^* + \int_{i \in I \cup I^*} (t_{is}^* - \tau \cdot t_{is}) \quad \text{for all} \quad s \in S. \tag{7}$$

Equations (6) and (7) ensure that the demands for Home and Foreign goods equal their respective supplies. In turn, supplies consist of domestic production plus net shipments. During young age,

the relevant markets are those for Arrow-Debreu securities and market clearing requires that

$$\int_{i \in I \cup I^*} x_{is} = 0 \quad \text{for all} \quad s \in S, \tag{8}$$

$$\int_{i \in I \cup I^*} x_{is}^* = 0 \quad \text{for all} \quad s \in S. \tag{9}$$

Equations (8) and (9) impose the condition that there is zero net supply of Home and Foreign securities.

The competitive equilibrium of this world economy consists of a set of prices and quantities such that individuals maximize expected utility –equation (1)– subject to their budget and technological constraints –equations (2), (3), (4), (5)– and markets clear –equations (6), (7), (8), (9). As usual, Walras' law implies that one of the market clearing conditions is redundant. We show next by construction that the assumptions made ensure that this equilibrium always exists and is unique.

1.2 Equilibrium risk sharing

The picture of trade, consumption and welfare that this model delivers is quite standard. In traditional models of international trade goods are traded according to comparative advantage. In this model, the same is true if one thinks of goods in different states of nature as being different goods. A region has a comparative advantage in goods in those states in which its output is high relative to the output of the other region.[8] Ex-ante, agents purchase securities which pay in those states in which their output is low and sell securities which pay in those states in which their output is high. This results in risk sharing both within and between regions. The extent to which agents diversify their exposure to their region's aggregate risk depends on the transport cost. As in traditional trade models, the higher the transport cost the less relative prices converge. As a result, the higher the transport cost the less relative consumptions are equalized over different states of nature and the less agents share risks between the two regions.

The possibility of shipping goods between regions implies that, ex-post, the price of the good in the two regions cannot be too different since otherwise agents would ship more goods from the region where the good is cheap to the region were the good is expensive. In particular, good prices

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[8]This corresponds to comparative advantage because the two regions have the same ex-ante expected output. If the two regions were not symmetric, a region would have a comparative advantage in goods in those states in which its output relative to the output of the other region is high compared to its average relative output.

satisfy the inequalities[9]

$$\tau^{-1} \leq \frac{p_s}{p_s^*} \leq \tau \quad \text{for all} \quad s \in S. \tag{10}$$

Equation (10) is an arbitrage condition that states that the difference in the price of Home and Foreign goods cannot be greater than the rate at which one good can be transformed into the other. In equilibrium, goods are shipped from the region with high output to the region with low output, up to the point at which the price in the importing region is no higher than the price in the exporting region times the transport cost.

The possibility of purchasing both Home and Foreign securities regardless of where an agent resides results in the following restriction on security prices,[10,11]

$$q_s = q_s^* \cdot \frac{p_s}{p_s^*} \quad \text{for all} \quad s \in S. \tag{11}$$

Equation (11) is another arbitrage condition, which is analogous to covered interest parity. It states that if agents can invest in two different securities that pay in the same state, then the return to these securities must be the same.

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[9] To see this, note that the optimal shipment decisions satisfy

$$t_{is} = \begin{cases} 0 & \text{if} \quad p_s < \tau \cdot p_s^* \\ [0, \infty) & \text{if} \quad p_s = \tau \cdot p_s^* \\ \infty & \text{if} \quad p_s > \tau \cdot p_s^* \end{cases} \quad \text{and} \quad t_{is}^* = \begin{cases} 0 & \text{if} \quad p_s^* < \tau \cdot p_s \\ [0, \infty) & \text{if} \quad p_s^* = \tau \cdot p_s \\ \infty & \text{if} \quad p_s^* > \tau \cdot p_s \end{cases}$$

for all $i \in I \cup I^*$ and $s \in S$. If the price in one region exceeds (falls short of) the other region's price plus the transport cost, individuals ship an infinite (zero) amount of goods to that region. If the price in one region equals the price of the other region plus the transport cost, individuals are indifferent about how many goods to ship.

[10] To se this, note that the optimal portfolios satisfy

$$x_{is} = \begin{cases} -y_{is} & \text{if} \quad q_s > q_s^* \cdot \frac{p_s}{p_s^*} \\ \left[-y_{is}, c_{is} + \frac{p_s^*}{p_s} \cdot c_{is}^* - y_{is} \right) & \text{if} \quad q_s = q_s^* \cdot \frac{p_s}{p_s^*} \quad \text{and} \quad x_{is}^* = \begin{cases} \frac{p_s}{p_s^*} \cdot c_{is} + c_{is}^* - y_{is}^* & \text{if} \quad q_s > q_s^* \cdot \frac{p_s}{p_s^*} \\ \left[-y_{is}^*, \frac{p_s}{p_s^*} \cdot c_{is} + c_{is}^* - y_{is}^* \right) & \text{if} \quad q_s = q_s^* \cdot \frac{p_s}{p_s^*} \\ c_{is} + \frac{p_s^*}{p_s} \cdot c_{is}^* - y_{is} & \text{if} \quad q_s < q_s^* \cdot \frac{p_s}{p_s^*} \end{cases} \end{cases} \quad -y_{is}^* & \text{if} \quad q_s < q_s^* \cdot \frac{p_s}{p_s^*} \end{cases}$$

for all $i \in I \cup I^*$ and $s \in S$. If the return to Home securities fell short of (exceeded) the return to Foreign securities, individuals would invest the minimum possible amount in Home (Foreign) securities. If this were the case, the market clearing condition (8) (condition 9) would not hold. If the return to investing in both securities were the same, individuals would be indifferent about the composition of their portfolios.

[11] Although the model has a unique equilibrium outcome in terms of consumptions and shipment of goods, there exist some indeterminacy in equilibrium portfolios. The reason is that agents only care about their net position for each state of nature, but they do not care about the composition of their portfolio between domestic securities and securities issued by the other country. Although this point does not play any role in this section, when we introduce sovereign risk we will need to revisit it.

Finally, the equilibrium pattern of consumptions across individuals and states is given by

$$
c_{is} = \begin{cases}
\dfrac{1}{2} \cdot (y_s + \tau \cdot y_s^*) & \text{if } \tau \leq \dfrac{y_s}{y_s^*} \\[2mm]
y_s & \text{if } \tau^{-1} \leq \dfrac{y_s}{y_s^*} \leq \tau \quad \text{and} \quad c_{is}^* = 0 \quad \text{for all} \quad i \in I \quad \text{and } s \in S, \\[2mm]
\dfrac{1}{2} \cdot \left(y_s + \tau^{-1} \cdot y_s^*\right) & \text{if } \dfrac{y_s}{y_s^*} \leq \tau^{-1}
\end{cases}
\tag{12}
$$

$$
c_{is}^* = \begin{cases}
\dfrac{1}{2} \cdot \left(y_s^* + \tau^{-1} \cdot y_s\right) & \text{if } \tau \leq \dfrac{y_s}{y_s^*} \\[2mm]
y_s^* & \text{if } \tau^{-1} \leq \dfrac{y_s}{y_s^*} \leq \tau \quad \text{and} \quad c_{is} = 0 \quad \text{for all } i \in I^* \quad \text{and } s \in S. \\[2mm]
\dfrac{1}{2} \cdot (y_s^* + \tau \cdot y_s) & \text{if } \dfrac{y_s}{y_s^*} \leq \tau^{-1}
\end{cases}
\tag{13}
$$

There is full domestic risk sharing and, as a result, all residents of a given region enjoy the same consumption regardless of whether their individual project gives a high or low return. There is, however, less than full risk sharing between regions because of the wedge in goods prices created by the transport cost. This wedge is reflected in two aspects of the optimal consumptions. First, there is a non-empty set of states in which no trade takes place even if productions differ between regions. Second, consumptions differ across regions even in those states in which there is trade.

1.3 Interactions between domestic and international risk sharing

When markets are complete, there are no interactions between domestic and international risk sharing. Globalization, which in this model corresponds to a decrease in the transport cost τ, tends to increase international risk sharing without affecting domestic risk sharing. This is depicted in Figure 1, in which we have assigned each value of τ to a different "stage of globalization," depending on the type of equilibrium it gives rise to. Define $U = \max_{s \in S} \left\{ \dfrac{y_s}{y_{s^*}} \right\}$ and $L = \min_{s \in S} \left\{ \dfrac{y_s}{y_{s^*}} \right\}$, and note that $\ln(L) = -\ln(U)$. For very high transport costs, in particular if $\tau > U$ (and $\tau^{-1} < L$), trading is so costly that there is no trade and both regions live in autarky. All states belong to the set NIT (no international trade). This is stage 1 of globalization. For lower transport costs, in particular if $\tau < U$, some international risk sharing takes place. Home sells part of its production in those states in which its income is highest relative to Foreign. The set of such states is denoted X (Home exports). In exchange, Home buys part of Foreign's production in those states in which its income is lowest relative to Foreign. The set of such states is denoted X^* (Foreign exports). A further reduction in τ has two effects. First, there is an extensive margin in that the set of states in which there is international risk sharing increases. Second, there is an intensive margin in that the amount of international risk sharing that takes place in those states in which international risk sharing was already taking place also increases. This is stage 2 of globalization. Throughout, there is perfect

domestic risk sharing for all values of the transport cost τ.

Domestic financial deepening, which in this model corresponds to an increase in ι, tends to increase domestic risk sharing without affecting international risk sharing. This is reflected in the fact that there is always perfect domestic risk sharing, so payments between domestic residents increase with ι. Also, the amount of risk sharing between regions is the optimal one for each value of τ, independently of the value of ι. This is seen in the fact that the consumption profiles (12) and (13), and Figure 1 do not depend on the value of ι.

We have assumed that financial markets consist of agents issuing and trading securities. However, had we assumed instead that financial markets consisted of agents signing individual contracts with each other, the results would have been identical in that in equilibrium the contracts would have resulted in the same consumption profiles. To summarize:

Result 1. *When markets are complete, and regardless of whether financial markets consist of securities or contracts, (i) globalization increases international risk sharing and does not affect domestic risk sharing, (ii) domestic financial deepening increases domestic risk sharing and does not affect international risk sharing.*

2 Sovereign risk

In section 1 we assumed that agents always pay during old age for the securities they issued when young. Why would this be so? The usual answer is that governments enforce payments. However, why would governments themselves enforce payments? In the context of international financial markets, this is a very important question since governments naturally care more about domestic residents than about foreigners. This problem is usually referred to as sovereign risk.

We analyze the effect of sovereign risk by making the following assumption standard in the literature:

Assumption 1. *SOVEREIGN RISK: (i) Ex-post, an individual only pays if his/her government forces him/her to pay. (ii) Governments cannot commit to enforce payments in the future. (iii) Governments only care about the welfare of domestic residents, in particular, governments maximize average utility of domestic residents.*

The effects of sovereign risk depend crucially on the structure of financial markets. When analyzing the complete-markets model we assumed that financial markets consisted of agents issuing and trading securities. However, had we assumed instead that financial markets consisted of agents signing individual contracts with each other, the results would have been identical in that the in

equilibrium the contracts would have resulted in the same consumption profiles. As we show next, this would not be the case in the presence of sovereign risk.

The literature on sovereign risk has so far implicitly assumed that financial markets consist of financial contracts signed by each pair of agents in the world. It has also assumed that governments can choose ex-post which payments to enforce and which payments not to enforce so that they can easily discriminate against foreigners when enforcing payments. In the context of our model, if we assumed that financial markets consist of agents signing individual contracts our results would be similar to those in the literature. The government would not enforce ex-post any contract that stipulates that a domestic resident must make a payment to a foreign resident. As a result, ex-ante no contracts between residents of different regions would be signed and no "international" risk sharing would take place. On the other hand, contracts between domestic residents would be enforced as long as the marginal utility of the payer is lower that the marginal utility of the receiver. As a result, full domestic risk sharing would take place. In other words, if financial markets consisted of individual contracts, there would be no interaction between risk sharing among residents of the same region and risk sharing among residents of different regions. As in the existing literature, absent long-term considerations the possibility of trading with residents of the other region would have no effects on domestic residents, neither creating nor destroying trade opportunities.

Result 2. *When there is sovereign risk and financial markets consist of contracts, (i) globalization does not lead to international risk sharing and does not affect domestic risk sharing, (ii) domestic financial deepening increases domestic risk sharing and does not affect international risk sharing.*

The focus of this paper is to study the effects of sovereign risk when financial markets consist of agents selling securities to other agents. As in section 1, we assume that there exists a full set of Arrow-Debreu securities although markets may now be incomplete because of sovereign risk. We make the following regarding financial markets and enforcement abilities:

Assumption 2. *ANONYMITY: Securities stipulate the seller but not the buyer and can be freely and anonymously traded between the time when uncertainty is resolved and the time when individuals pay them off.*

The assumption on anonymity implies that governments cannot discriminate between security holders when enforcing payments and generate crucial interactions between domestic and international financial markets. Without these interactions international asset trade would not be feasible. This paper is about analyzing these interactions.[12]

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[12]It is not necessary to make any assumption regarding partial enforcement in the sense of enforcing payment of less than 100% of face value. Agents' ability to condition securities on level of enforcement makes partial enforcement irrelevant.

An implication of these assumptions is that we can partition the set of states according to whether the Home and Foreign governments enforce payments or not. Let E and E^* be the subset of states in which Home and Foreign enforce payments, respectively. These sets will be determined as part of the equilibrium. As we shall see, the size of these sets depends on parameter values. In fact, we can reinterpret the model of section 1 not as a model of commitment but as a model in which the lack of commitment is not binding.

2.1   The model with sovereign risk

Sovereign risk affects the individual maximization problem in that agents can only sell securities which pay in states in which their government enforces payments. Agents solve the same maximization problem as in section 1, except that restriction (2) is replaced by

$$x_{is} \geq -\hat{y}_{is} \text{ and } x_{is}^* \geq -\hat{y}_{is}^* \text{ for all } i \in I \cup I^* \text{ and } s \in S, \tag{14}$$

where $\hat{y}_{is}$ and $\hat{y}_{is}^*$ are now pledgable income, defined as

$$\hat{y}_{is} = \begin{cases} y_{is} & \text{if } s \in E \\ 0 & \text{if } s \notin E \end{cases} \text{ and } \hat{y}_{is}^* = \begin{cases} y_{is}^* & \text{if } s \in E \\ 0 & \text{if } s \notin E \end{cases} \text{ for all } i \in I \cup I^* \text{ and } s \in S. \tag{15}$$

Equation (15) states that agents cannot pledge income in states in which their government does not enforce payments. For example, a Home resident might want to sell securities that pay in a state, say s, in which his production is high in order to purchase more securities that pay in states in which his production is low. However, if in that state the Home government does not enforce payments, $s \notin S$, the resident will not pay for those securities when state s materializes. Ex-ante, the resident would want to commit to pay but, ex-post, he will not do it without the government forcing him. Knowing this, ex-ante other agents would not be willing to purchase any state-s securities from Home residents. In this sense Home production in state s is not pledgable. Similarly, no agent would be willing to purchase securities from Foreign residents that pay in states in which the Foreign government does not enforce payments.[13]

Sovereign risk does not affect the market clearing conditions, and equations (6)-(9) still apply. This completes the description of the model for exogenously given sets E and E^*. This allows us to find patterns of consumption and security holdings as a function of governments' enforcement decisions. However, enforcement decisions are in turn a function of the patterns of consumption

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[13]If an agent could produce in both countries, we would need to specify whether governments have control over domestic residents or over domestic output. By assuming that residents only produce in their own countries, we sidestep this distinction.

and security holdings.

We assume that there exists a positive but negligible cost of enforcing payments. As a result, governments enforce payments ex-post if enforcement strictly increases the average utility of domestic residents. Namely,

$$E = \left\{ s \in S \left| \int_{i \in I} u\left(c_{is}\right) > \int_{i \in I} u\left(y_{is} + \tau^{-1} \cdot x_{is}^*\right) \right.\right\}, \tag{16}$$

$$E^* = \left\{ s \in S \left| \int_{i \in I^*} u\left(c_{is}^*\right) > \int_{i \in I^*} u\left(y_{is}^* + \tau^{-1} \cdot x_{is}\right) \right.\right\}, \tag{17}$$

where we have taken into account that the relative prices in case of non-enforcement must be equal to τ^{-1}, since the region would not be shipping any goods abroad in this case.

The competitive equilibria of this world economy consists of a set of prices, quantities, and enforcement sets such that individuals maximize expected utility –equation (1)– subject to their budget and technological constraints –equations (14), (3), (4), (5)– markets clear –equations (6), (7), (8), (9)– and enforcement is ex-post optimal –equations (16), (17).

Characterization of equilibria:

The equilibria of this model are characterized by sets of enforcement E and E^*. Given these sets, the agents' problem determines unique portfolio and consumption choices. In turn, these choices must result in ex-post enforcement in states E and E^* and non-enforcement in other states. In general, the model displays a large number of equilibria. There are three features of the set of equilibria worth emphasizing.

First, for any subsets $S' \subseteq S$ and $S'^* \subseteq S$ there exists an equilibrium in which the Home government does not enforce payments in S' and the Foreign government does not enforce payments in S'^*; namely, $S' \cap E = S'^* \cap E^* = \varnothing$. The reason is that if agents expect non-enforcement by the Home government in a state $s \in S'$, then Home residents will not be able to issue any state-s securities. As a result, ex-post there will not be any Home securities to enforce and the average utility of Home residents would not be affected by the enforcement decision of the Home government. Thus, the Home government will choose ex-post not to enforce payments in state s. The same argument applies to states $s \in S'^*$. This property of equilibria shows that, in general, there are many equilibria that correspond to arbitrarily shutting down markets in some or even all states.

Second, it is *not* true that for any subsets $S' \subseteq S$ and $S'^* \subseteq S$ there exists an equilibrium in which the Home government enforces payments in S' and the Foreign government enforces payments in S'^*; namely, $S' \subseteq E$ and $S'^* \subseteq E^*$. In particular, $E = E^* = S$ is usually not an equilibrium. The

reason is that for states with very extreme realizations of relative incomes, optimal consumption choices would imply such high transfers that the government of the region that makes payments would prefer ex-post not to enforce these payments.

Third, since we focus on symmetric equilibria we can analyze pairs of symmetric states independently. More specifically, let a state s be characterized by incomes $(y_s, y_s^*) = (\overline{y}, \underline{y})$ and let its symmetric state be the state s' with the same probability and incomes $(y_{s'}, y_{s'}^*) = (\underline{y}, \overline{y})$. (We have already assumed that such a state exists.) Since equilibria are symmetric, residents in both regions have the same budget constraint multipliers ω. Consider the possibility that $s \in E \cap E^*$ and $s' \in E \cap E^*$. In this case, since the multipliers ω are the same in both regions, it is easy to show that consumptions in states s and s' would be given as in equations (12) and (13). Given these consumption levels and associated portfolios, equations (16) and (17) determine whether it is possible to have $s \in E \cap E^*$ and $s' \in E \cap E^*$. The important point to note is that the consumption levels and associated portfolios in states s and s' and, as a result, whether enforcement is possible in these states in equilibrium is independent of the enforcement decisions in other states. By a similar argument, the possibility of other enforcement decisions in states s and s' is independent of enforcement decisions in other states as well.

Since all pairs of symmetric states can be analyzed independently, there exists a maximal equilibrium in which enforcement takes place in as many states as possible. To find this maximal equilibrium, we proceed as follows. For every pair of symmetric states, we check if (i) $s \in E \cap E^*$ and $s' \in E \cap E^*$ is consistent with ex-post enforcement. If it is, we include states s and s' in S and S^*. If it is not, we check if (ii) $s \in E$ and $s' \in E^*$ is consistent with ex-post enforcement. If it is, we include s in E and s' in E^*. If it is not, we check if (iii) $s \in E^*$ and $s' \in E$ is consistent with ex-post enforcement. If it is, we include s in E^* and s' in E. Otherwise, neither s nor s' can be included in either E or E^*.[14] The maximal equilibrium found by this procedure is unique. In addition, it is the best possible equilibrium, in the sense that residents in both regions are better off than in any other equilibrium. Thus, from now on we will focus on this equilibrium.

Some comments on our assumptions:

It is worth commenting on two assumptions we have implicitly made in the analysis above. First, note that for every state s either there is enforcement and agents' consumptions are unconstrained or there is no enforcement and agents cannot issue any state-s securities. This is a direct consequence of the assumption that agents take prices and government enforcement as given. However, if

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[14]One can show that if (i) is not consistent with ex-post enforcement, then (ii) is possible only if $\overline{y} < \underline{y}$ and (iii) is possible only if $\overline{y} > \underline{y}$. An implication of this is that if (i) is not consistent with ex-post enforcement, then (ii) and (iii) cannot be both possible. As a result, the order in which we check (ii) and (iii) is irrelevant.

unconstrained consumption in state s would lead to non-enforcement, why do agents not limit their security issuance in that state to a level such that the government enforces payments? After all, in principle agents which are "small" in terms of their production and security holdings could still have "large" effects by tipping the governments' enforcement decisions. We have ruled out this possibility and instead assumed that agents perceive themselves as having only "small" effects on enforcement decisions. Although this seems sensible on a priori grounds, one must also show that it is logically consistent with the assumptions of the model. We do this in the appendix.[15]

Second, in the model without sovereign risk portfolio choices, as long as they were consistent with equilibrium consumptions, were irrelevant for the analysis of the model. This is not necessarily the case when enforcement decisions are endogenous. It is clear from equations (16) and (17) that the more agents diversify their risk by purchasing securities from residents in the other region the lower the incentives for the domestic government to enforce payments. We will deal with this issue by restricting our attention to those portfolio choices that maximize enforcement. Let us define an equilibrium *without two-way payments* as one in which there is no state in which Home residents receive payments from Foreign while at the same time Foreign residents receive payments from Home, namely $\left(\int_{i \in I} x_{si}^* \right) \cdot \left(\int_{i \in I^*} x_{si} \right) = 0$ for all $s \in S$. We will only consider equilibria without two-way payments. Although this restriction seems like an assumption on portfolio choices, it is not. It can be easily shown that if there exists an equilibrium characterized by $\{c_{is}, c_{is}^*, q_s, q_s^*, p_s, p_s^*\}_{s \in S}$ *with* two-way payments, then there exists another equilibrium characterized by the same $\{c_{is}, c_{is}^*, q_s, q_s^*, p_s, p_s^*\}_{s \in S}$ *without* two-way payments. The reason is that, while eliminating two-way payments in state s increases the incentive to enforce payments in state s conditional on net portfolio positions, we can always construct equilibria without two-way payments and without enforcement in state s: if no agent issued securities that pay in state s then the government would choose not to enforce payments in state s. In other words, the restriction of no two-way payments is without loss of generality. In addition, we do not need to bother considering all the possible patterns of portfolio choices that satisfy no two-way payments. The reason is that without two-way payments when a region is a recipient of international payments the government always enforces payments and when a region is a source of international payments the pattern of security holdings among domestic residents does not affect the enforcement decision.

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[15] There is an extensive literature emphasizing the fact that domestic agents do not internalize the effect that their actions have on the policies of the domestic government. In most contexts, this causes agents to take actions that, while privately optimal, induce the government to choose policies that are too unfriendly to foreigners. This externality worsens the terms at which other domestic residents trade with foreigners. This effect can lead to overborrowing, too much investment in the non-tradable sector, etc. See Tirole (2003) for a more thorough discussion.

2.2 Equilibrium risk sharing

As in the model without sovereign risk, globalization allows for the possibility of international risk sharing. The potential benefits from international risk sharing and the effect of changes in the costs of transport τ on these potential benefits are as in the case without sovereign risk. However, in the presence of sovereign risk individuals can only make payments in states in which their government enforces payments. This limits the amount of risk sharing that can take place, both between and within regions.

The possibility of shipping goods across regions implies that the relative price of the good in the two regions still satisfies equation (10) for all $s \in S$. The possibility of purchasing securities issued in both regions implies that the relative price of Home and Foreign securities satisfy equation (11) for all $s \in E \cap E^*$. In states in which at least one of the governments does not enforce payments equation (11) does not hold since at least one of the securities does not exist.[16]

As mentioned above, we will analyze the equilibrium in which the amount of risk sharing is maximized since this equilibrium Pareto dominates all the others. We start then by analyzing the set of states in which both governments enforce payments, namely $E \cap E^*$. Given the symmetry of the model and the fact that we are analyzing a symmetric equilibrium, residents in both regions have the same budget constraint multipliers ω. As a result, for states $s \in E \cap E^*$ consumption levels are given by equations (12) and (13), and there is optimal risk sharing. To determine the states that can belong to $E \cap E^*$, we need to check the states for which governments have incentives to enforce payments when consumption levels are given by these equations. As mentioned above, in the absence of two-way payments governments always enforce payments as long as there are any domestic payments to enforce and the region is not a net payer to the other region. As a result, we just need to check for what states Home chooses to enforce payments when $\tau \leq \dfrac{y_s}{y_s^*}$ and for what states Foreign chooses to enforce payments when $\dfrac{y_s}{y_s^*} \leq \tau^{-1}$. In the first case, if Home enforces payments all Home residents consume $\dfrac{1}{2} \cdot (y_s + \tau \cdot y_s^*)$ while otherwise lucky residents consume $y_s \cdot (1 + \iota)$ and unlucky residents consume $y_s \cdot (1 - \iota)$. In the second case, if Foreign enforces payments all Foreign residents consume $\dfrac{1}{2} \cdot (y_s^* + \tau \cdot y_s)$ while otherwise lucky residents consume $y_s \cdot (1 + \iota)$ and unlucky residents consume $y_s \cdot (1 - \iota)$. If we define $\kappa \equiv 1 - (1 - \iota)^{1/2} \cdot (1 + \iota)^{1/2}$, it is easy to show that

$$E \cap E^* = \left\{ s \in S \left| \tau^{-1} \cdot (1 - 2 \cdot \kappa) < \frac{y_s}{y_s^*} < \tau \cdot (1 - 2 \cdot \kappa)^{-1} \right. \right\}. \tag{18}$$

---

[16] For states in which only one governments enforces payments, we could define the price of the security that does not exist as the one that satisfies equation (11). In this case, the equation would hold for all $s \in E \cup E^*$.

Within the set $E \cap E^*$, there are three subsets. When $\tau^{-1} < \dfrac{y_s}{y_s^*} < \tau$, marginal rates of substitution between states are similar in the two regions and it is not worth incurring transport costs, so there are no international flows. When $\tau < \dfrac{y_s}{y_s^*} < \tau \cdot (1 - 2 \cdot \kappa)^{-1}$, there are transfers from Home to Foreign, and when $\tau^{-1} \cdot (1 - 2 \cdot \kappa) < \dfrac{y_s}{y_s^*} < \tau^{-1}$ there are transfers from Foreign to Home. In all cases, there is perfect domestic risk sharing. When relative incomes are not too different from 1, optimal risk sharing is possible since it does not entail large international transfers. The highest amount of international transfers that can take place and still have governments want to enforce payments depends crucially on the importance of domestic markets, as reflected in κ. For example, when $\kappa = 0$ ($\iota = 0$), the set where both governments enforce payments is just equal to the set where no international flows take place, $E \cap E^* = \left\{ s \in S \, \middle| \, \tau^{-1} < \dfrac{y_s}{y_s^*} < \tau \right\}$. In other words, when domestic markets are worthless, no international flows can be sustained. On the other extreme, when $\kappa \geq \dfrac{1}{2}$, $E \cap E^* = S$ and enforcement takes place in every state. We study next what happens for intermediate levels of $\kappa \in \left(0, \dfrac{1}{2} \right)$.

Let us define the set $HHP \equiv \left\{ s \in S \, \middle| \, \tau \cdot (1 - 2 \cdot \kappa)^{-1} \leq \dfrac{y_s}{y_s^*} \right\}$, for "high Home production," as the set in which enforcement by both governments is impeded by the fact that Home production is too high. Similarly, let as define the set $HFP \equiv \left\{ s \in S \, \middle| \, \dfrac{y_s}{y_s^*} \leq \tau^{-1} \cdot (1 - 2 \cdot \kappa) \right\}$, for "high Foreign production," as the set in which enforcement by both governments is impeded by the fact that Foreign production is too high. We will analyze the patterns of consumptions and risk sharing in the HHP set, keeping in mind that the patterns in the HFP set are symmetric. In the HHP set Home residents cannot issue securities but they can purchase them from Foreign residents. There are two cases to consider, depending on whether the Foreign government enforces payments.

Case 1 (High Home Production - Missing Home Market)

The first observation is that for $s \in HHP$ the lucky Home residents are always constrained in the sense that they would like to sell securities but they cannot. For $\dfrac{y_s}{y_s^*} > \tau^{-1} \cdot (1 - \iota)^{-1}$, the unlucky Home residents are also constrained since their income is so high in these states that they would also want to sell securities to Foreign residents.[17] In this case, since Foreign residents do not make any payments to Home residents, the Foreign government enforces payments.

For $\dfrac{y_s}{y_s^*} \leq \tau^{-1} \cdot (1 - \iota)^{-1}$, on the other hand, the production by unlucky Home residents is so low relative to the production by the average Foreign resident that unlucky Home residents want

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[17]This condition corresponds to $y_s \cdot (1 - \iota)$ being higher than the consumption level unlucky Home residents would have if they shared risk with Foreign residents, which equals $\dfrac{1}{3} \cdot \left(y_s \cdot (1 - \iota) + 2 \cdot \dfrac{1}{\tau} \cdot y_s^* \right)$. As a result, unlucky Home residents would want to sell securities to Foreign residents, but they cannot do it since the Home government is not enforcing payments.

to purchase securities from Foreign residents. If $\frac{y_s}{y_s^*} > \tau^{-1} \cdot (1 - \iota)^{-1} \cdot (1 - 3 \cdot \kappa)$, the payments from Foreign residents are low enough so that the Foreign government chooses to enforce payments even though Foreign residents are making payments to Home residents.[18]

Consumptions are then given by

$$
c_{is} = \begin{cases} y_s \cdot (1 + \iota) & \text{if } i \in I \text{ is lucky} \\ \max \left\{ y_s \cdot (1 - \iota), \dfrac{1}{3} \cdot \left(y_s \cdot (1 - \iota) + 2 \cdot \tau^{-1} \cdot y_s^* \right) \right\} & \text{if } i \in I \text{ is unlucky} \end{cases} \tag{19}
$$

$$
c_{is}^* = \begin{cases} \min \left\{ y_s^*, \dfrac{1}{3} \cdot \left(\tau \cdot y_s \cdot (1 - \iota) + 2 \cdot y_s^* \right) \right\} & \text{if } i \in I^* \text{ is lucky} \\ \min \left\{ y_s^*, \dfrac{1}{3} \cdot \left(\tau \cdot y_s \cdot (1 - \iota) + 2 \cdot y_s^* \right) \right\} & \text{if } i \in I^* \text{ is unlucky} \end{cases} \tag{20}
$$

For $\frac{y_s}{y_s^*} > \tau^{-1} \cdot (1 - \iota)^{-1}$, there is no international risk sharing, there is domestic risk sharing in Foreign, and there is no domestic risk sharing in Home. Note that even though international payments do not take place in equilibrium, their possibility leads to a breakdown in domestic risk sharing at Home. Also, note that international risk sharing breaks down precisely in those states in which it would be most useful. For $\frac{y_s}{y_s^*} \leq \tau^{-1} \cdot (1 - \iota)^{-1}$, there is optimal risk sharing between both lucky and unlucky Foreign residents and unlucky Home residents. In particular, unlucky Home residents receive payments from Foreign residents. Lucky Home residents cannot participate in the arrangement because they would like to issue securities but the Home government does not enforce payments. The intuition for why international transfers take place from the low income to the high income region is that the residents of the high income region that can participate are poor relative to the average resident of the poor region.

Case 2 (High Home Production - Missing Home and Foreign Market)

If the amount of securities that the unlucky Home residents want to purchase from Foreign residents is so large that the Foreign government prefers not to enforce payments, i.e. $\frac{y_s}{y_s^*} \leq \tau^{-1} \cdot (1 - \iota)^{-1} \cdot (1 - 3 \cdot \kappa)$, then risk sharing completely breaks down. Consumptions are given by

$$
c_{is} = \begin{cases} y_s \cdot (1 + \iota) & \text{if } i \in I \text{ is lucky} \\ y_s \cdot (1 - \iota) & \text{if } i \in I \text{ is unlucky} \end{cases} \tag{21}
$$

$$
c_{is}^* = \begin{cases} y_s^* \cdot (1 + \iota) & \text{if } i \in I^* \text{ is lucky} \\ y_s^* \cdot (1 - \iota) & \text{if } i \in I^* \text{ is unlucky} \end{cases} \tag{22}
$$

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[18] This condition corresponds to the consumption of Foreign residents when they share risk with unlucky Home residents, $\frac{1}{3} \cdot (2 \cdot y_s^* + \tau \cdot y_s \cdot (1 - \iota))$, being such that transfers to unlucky Home residents are not too high. This consumption level must be higher than $y_s^* \cdot (1 - \kappa)$, since otherwise the Foreign government would not enforce payments.

and there is neither international risk sharing nor domestic risk sharing in either region. In this set of states, the disappearance of enforcement in Home leads to the disappearance of enforcement in Foreign.

Finally, the existence and number of states corresponding to each of these cases depends on the parameters of the model, in particular the transportation cost τ and the size of idiosyncratic shocks ι. We discuss this next.

2.3 Interactions between domestic and international risk sharing

When there is sovereign risk and financial markets consist of agents issuing securities that trade in anonymous markets, there are important interactions between domestic and international risk sharing. We start by analyzing the effects of globalization, which in this model corresponds to a decrease in the transport cost τ. This is depicted in Figure 2, in which again we have assigned each value of τ to a different stage of globalization. For very high levels of transport cost τ, in particular $\tau > U$ (and $\tau_0^{-1} < L$), no asset trade between regions takes place, even for the most extreme realizations of relative incomes. We call this the stage 1 of globalization. In this stage, all states belong to the set NIT (no international trade) in which there is no international risk sharing and there is perfect domestic risk sharing. This is stage 1 of globalization.

As τ decreases, eventually it becomes worth to make transfers for extreme realizations of relative incomes. This is stage 2 of globalization. The level of τ at which there is a transition from stage 1 to stage 2 is $\tau_{1,2} = U$. As τ decreases further, transfers start taking place for more states of nature (extensive margin) and become larger for the inframarginal states (intensive margin). In this stage, states with intermediate relative incomes belong to the set NIT, states with high Home relative income belong to the set X (Home exports) in which there are transfers from Home to Foreign, and states with high Foreign relative income belong to the set X^* (Foreign exports) in which there are transfers from Foreign to Home. There is perfect domestic risk sharing for all states.

In stages 1 and 2, reductions in τ have the same effects regardless of whether governments can commit to enforce payments or not. In these stages, further reductions in τ allow for more international risk sharing without affecting domestic risk sharing and are thus unambiguously welfare improving. The reason is that for high enough τ, the resulting international transfers are not high enough for governments to be willing to destroy domestic transfers from lucky to unlucky residents in order to avoid paying foreigners. However, at some point τ becomes low enough such that, for the most extreme realizations of relative income, governments do prefer to destroy domestic transactions to permit domestic residents not to pay foreigners. At this point, the stage 3

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of globalization starts, and the results of the model without commitment start differing from those of the model with commitment. The level of τ at which there is a transition from stage 2 to stage 3 is $\tau_{2,3} = U \cdot (1 - 2 \cdot \kappa)$.[19],[20]

In stage 3, there are the same sets X^*, NIT, X as in stage 2, plus sets of states with extreme realizations of relative incomes in which some markets are missing. In the set MHM (missing Home market), the Home government does not enforce payments while the Foreign government keeps enforcing payments. In this set, Home residents cannot make any payments but can still receive payments from Foreign residents. The absence of enforcement in Home has two negative effects for Home residents. They cannot pledge their income to Foreign resident in states in which the average income in Home is highest and, in addition, domestic markets are missing in these states and domestic risk sharing breaks down. The same happens in the Foreign region in the set MFM (missing Foreign market). It is interesting to note that in this stage there can be payments from residents in the "poor" region to residents in the "rich" region, which we call "reverse capital flows." Reverse capital flows take place for moderately high differences in incomes between regions, since they require both not too similar incomes so that payments are not enforced in the rich region and not too different incomes so that the unlucky in the rich region are poor enough relative to the average resident in the poor region. In this case, agents can partly overcome the fact that they cannot use domestic markets to insure against negative idiosyncratic shocks when their region is rich by purchasing securities from residents in the other region.[21] In stage 3, reductions in the transport cost τ have ambiguous welfare effects. On the one hand, globalization increases international risk sharing for intermediate values of relative incomes (both intensive and extensive margins). On the other hand, it reduces international risk sharing for extreme realizations of relative incomes, and it increases the set of states in which domestic risk sharing breaks down.

As a result of reverse capital flows, for low enough levels of the transport cost τ the government in the poor region might also find it optimal not to enforce payments. This happens when the payments from lucky residents in the poor region to unlucky residents in the rich region are high enough. In this case, the fact that markets are missing in the rich region cause markets to disappear

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[19] This corresponds to τ being so high that even for the highest level of $\dfrac{y_s}{y_s^*}$, the Home government wants to enforce payments, i.e. $\dfrac{y_s}{y_s^*} < \tau \cdot (1 - 2 \cdot \kappa)^{-1}$.

[20] Note that for high enough levels of $\kappa > \dfrac{1}{2} \left(1 - U^{-1} \right)$ there is always enforcement and globalization has the same effect with or without commitment for all values of τ.

[21] The level of τ at which reverse capital flows start taking place is equal to $\tau_3 = \sqrt{\dfrac{1 - 2 \cdot \kappa}{1 - \iota}}$. This corresponds to τ being such that there are some relative output levels high enough for the Home government to prefer not to enforce payments, namely $\dfrac{y_s}{y_s^*} \geq \tau \cdot (1 - 2 \cdot \kappa)^{-1}$, while at the same time low enough for unlucky Home residents to want to purchase securities from Foreign residents, namely $\dfrac{y_s}{y_s^*} < \tau^{-1} \cdot (1 - \iota)^{-1}$.

in the poor region, resulting in no risk sharing whatsoever. We denote these sets as $MHFM$ (missing Home and Foreign markets). The level of τ at which there is a transition from stage 3 to stage 4 is $\tau_{3,4} = \sqrt{\dfrac{(1 - 2 \cdot \kappa) \cdot (1 - 3 \cdot \kappa)}{1 - \iota}}$.[22],[23] The welfare effects of globalization in stage 4 are usually negative. The reason is that the fact that markets disappear in both regions reduces the mitigating effects of transfers to the unlucky residents in the rich region, and also reduces domestic risk sharing in the poor region.

Globalization tends to increase international risk sharing and decrease domestic risk sharing. There are two effects of globalization on international risk sharing. There is a positive intensive margin in that for inframarginal states it is worth shipping more of the good and making marginal utilities in the two regions closer when the transport cost is lower (sets X and X^*). There is an extensive margin with ambiguous sign. As τ decreases, there appear states for which it is now worthwhile shipping goods (low boundary of set X and high boundary of set X^*). On the other hand, as τ decreases the resultant international payments may be so high that enforcement breaks down in the rich region making it impossible for residents in the rich region to commit to make international payments (high boundary of set X and low boundary of set X^*).[24] The effect of globalization on domestic risk sharing is unambiguously negative. The reason is that when the government in the rich region stops enforcing contracts it not only destroys trade between residents of the rich region and residents of the poor region but also between lucky and unlucky residents of the rich region (high boundary of set X and low boundary of set X^*). In addition, when there are reverse capital flows a decrease in τ may increase so much payments from the poor to the rich region that the government in the poor region may also prefer not to enforce payments, which results in a breakdown of domestic risk sharing in both regions (high boundary of set X and low boundary of set X^* leading to sets $MHFM$ instead of MHM and MFM).

Domestic financial deepening, which in this model corresponds to an increase in κ, tends to increase both international and domestic risk sharing. An increase in κ increases governments' incentives to enforce payments ex-post, which enables residents to pledge more of their income to both domestic and foreign residents ex-ante. An increase in κ increases international risk sharing by shifting up the high boundary of set X and down the low boundary of set X^*, reflecting an

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[22] This corresponds to τ being such that there are some relative output levels high enough for the Home government to prefer not to enforce payments, namely $\dfrac{y_s}{y_s^*} \geq \tau \cdot (1 - 2 \cdot \kappa)^{-1}$, while at the same time low enough so that unlucky Home residents purchase so many securities from Foreign residents that the Foreign government does not enforce payments, namely $\dfrac{y_s}{y_s^*} < \tau^{-1} \cdot (1 - \iota)^{-1} \cdot (1 - 3 \cdot \kappa)$.

[23] For this type of equilibrium to exist, it is necessary to have both very low levels of τ (less than 1.08) and low levels of κ. For reverse flows it is also necessary to have relatively low levels of κ, but the condition is less stringent.

[24] There is an additional positive intensive margin in international risk sharing in the sense that reverse capital flows increase as τ decreases in sets MHM and MFM

increase in the ability of residents in the rich region to make payments to residents in the poor region. It also shifts down the high boundary of set $MHFM$ for high Home relative income and up the low boundary of set $MHFM$ for low Home relative income, reflecting an increase in the ability of lucky residents in the poor region to make payments to unlucky residents in the rich region when markets in the rich region break down. Finally, and increase in κ increases domestic risk sharing by increasing the size of payments between domestic residents when domestic markets work (intensive margin) and by decreasing the probability of domestic markets' not working (extensive margin).

Result 3. *When there is sovereign risk and financial markets consist of securities that trade in anonymous markets, (i) globalization tends to increase international risk sharing and decreases domestic risk sharing, (ii) domestic financial deepening increases domestic risk sharing and increases international risk sharing.*

3 Contracts and taxes

[FROM NOW ON, PRELIMINARY AND INCOMPLETE]

In this section we analyze two aspects of the model with sovereign risk. First, given that anonymous securities improve international risk sharing and worsen domestic risk sharing relative to individual contracts, is it possible to achieve a better outcome by allowing agents to simultaneously issue both types of claims? Second, can governments improve the outcome by using ex-ante taxes?

3.1 Securities and contracts

Assume that agents can both issue securities and sign contracts. Since the model can be solved by analyzing pairs of symmetric states independently, in equilibrium agents will choose to issue the optimal combination of claims for each such pair. For states in sets NIT, X, and X^*, agents can achieve the same outcome as with complete markets by issuing securities. As a result, even if given the option to sign contracts they would not sign contracts in which they have to make or receive payments in these states.[25] For states in sets MHM, MFM, and $MHFM$, on the other hand, agents achieve an outcome which is worse than autarky, since there is no international risk sharing and domestic risk sharing breaks down in at least one of the regions. As a result, in these states agents will prefer to sign contracts with other agents in the same region to insure idiosyncratic

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[25] There are equilibria in which agents only sign contracts in these regions. An individual agent would not have an incentive to deviate and issue securities since, with all domestic risk sharing already being done with contracts, those securities would be purchased by foreigners and the government would not enforce their payment ex-post. We disregard these type of equilibria since they are inferior to those in which agents issue securities and, remember, we always focus on the best possible equilibrium.

shocks and not issue any securities. By doing so, they recover domestic risk sharing. This outcome is illustrated in Figure 3. Sets MHM, MFM, and $MHFM$ are transformed into new sets NIT in which there is full domestic risk sharing and no international risk sharing. In the new NIT sets (very different relative incomes) agents only use contracts. In the old NIT set (similar relative incomes) agents are indifferent between using contracts and securities.

As a result, by combining contracts and securities agents can receive some of the potential benefits from globalization while avoiding its costs. In this case, out of the two interactions between domestic and international risk sharing only the positive effect of domestic risk sharing on international risk sharing remains.

Result 4. *When there is sovereign risk and financial markets consist of both contracts and securities that trade in anonymous markets, (i) globalization tends to increase international risk sharing and does not affect domestic risk sharing, (ii) domestic financial deepening increases domestic risk sharing and increases international risk sharing.*

Allowing for contracts eliminates the harmful effects of globalization, but does not allow to take full advantage of all its potential benefits. Next we analyze whether there is a better outcome.

3.2   Ex-ante taxes

There exist two market failures. First, sovereign risk. We will keep assuming that governments cannot take any action ex-ante to commit to enforce payments ex-post.

Second, "over-issuance" of securities. In the sets MHM, MFM, and $MHFM$ markets break down because, if they did not, agents would issue so many securities ex-ante that the government would not enforce payments ex-post. Are there any policies that could ameliorate this market failure?

We start the analysis by finding the best possible outcome constrained by the fact that payments are enforced ex-post only if governments choose to do so. In particular, we look for the pattern of security issuance and holdings as of the end of youth that results in a symmetric constrained Pareto optimum. To look for such optimum we analyze separately each pair of symmetric states. For all states in NIT, X, and X^* the equilibrium of section (2) was already the same as with complete markets and thus optimal. What is the constrained optimum for states in MHM, MFM, and $MHFM$? First, in the constrained optimum there is full domestic risk sharing in both regions. The reason is that less than full domestic risk sharing could be optimum only if it relaxed the ex-post incentive compatibility constraint on the governments. But the opposite is true. For whatever level of payments residents in the region are making to foreigners, average domestic utility if the

domestic government enforces payments is higher if enforcement results in full domestic risk sharing than if it does not. As a result, the government has more incentives to enforce payments when they result in full domestic risk sharing. Second, in the constrained optimum payments from the rich to the poor region are as high as possible constrained by the fact that the government in the rich region must choose ex-post to enforce payments. As a result, the constrained optimum results in the consumption profiles

$$
c_{is} = \begin{cases}
(1-\kappa) \cdot y_s & \text{if } \tau \cdot (1-2\cdot\kappa)^{-1} \leq \dfrac{y_s}{y_s^*} \\[2mm]
\dfrac{1}{2} \cdot (y_s + \tau \cdot y_s^*) & \text{if } \tau \leq \dfrac{y_s}{y_s^*} \leq \tau \cdot (1-2\cdot\kappa)^{-1} \\[2mm]
y_s & \text{if } \tau^{-1} \leq \dfrac{y_s}{y_s^*} \leq \tau \\[2mm]
\dfrac{1}{2} \cdot (y_s + \tau^{-1} \cdot y_s^*) & \text{if } \tau^{-1} \cdot (1-2\cdot\kappa) \leq \dfrac{y_s}{y_s^*} \leq \tau^{-1} \\[2mm]
y_s + \tau^{-1} \cdot \kappa \cdot y_s^* & \text{if } \dfrac{y_s}{y_s^*} \leq \tau^{-1} \cdot (1-2\cdot\kappa)
\end{cases}
\quad \text{and} \quad c_{is}^* = 0 \ \text{ for all } \ i \in I \ \text{ and } s \in S,
$$

$$(23)$$

$$
c_{is}^* = \begin{cases}
y_s^* + \tau^{-1} \cdot \kappa \cdot y_s & \text{if } \tau \cdot (1-2\cdot\kappa)^{-1} \leq \dfrac{y_s}{y_s^*} \\[2mm]
\dfrac{1}{2} \cdot (y_s^* + \tau^{-1} \cdot y_s) & \text{if } \tau \leq \dfrac{y_s}{y_s^*} \leq \tau \cdot (1-2\cdot\kappa)^{-1} \\[2mm]
y_s^* & \text{if } \tau^{-1} \leq \dfrac{y_s}{y_s^*} \leq \tau \\[2mm]
\dfrac{1}{2} \cdot (y_s^* + \tau \cdot y_s) & \text{if } \tau^{-1} \cdot (1-2\cdot\kappa) \leq \dfrac{y_s}{y_s^*} \leq \tau^{-1} \\[2mm]
(1-\kappa) \cdot y_s^* & \text{if } \dfrac{y_s}{y_s^*} \leq \tau^{-1} \cdot (1-2\cdot\kappa)
\end{cases}
\quad \text{and} \quad c_{is} = 0 \ \text{ for all } i \in I^* \ \text{ and } s \in S,
$$

$$(24)$$

where we have used the fact that residents in Home can at most pledge $\kappa \cdot y_s$ and residents in Foreign can at most pledge $\kappa \cdot y_s^*$.[26] The constrained optimum is illustrated in figure 4. In the sets $\overline{X}$ and $\overline{X}^*$ there is full domestic risk sharing in both region and the rich region makes payments to the poor region. However, these payments are constrained by the enforcement constraint.

Can governments implement this constrained optimum? The answer is a qualified yes. Governments need to use issuance taxes which are state specific, agent specific, and highly nonlinear.

4 Reputation

The literature has emphasized long-term considerations to understand why international asset trade is possible in the presence of sovereign risk. In particular, several papers have argued that govern-

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[26] Actually, the constraints are slightly tighter to compensate for the small enforcement cost. So consumption in the rich region is slightly above and consumption in the poor region is slightly below those in these equations.

ments may enforce payments to foreigners to keep their "reputations" and be able to participate in international financial markets in the future. Is there any relation between the mechanism analyzed in this paper and reputation? In the static model analyzed up to now, reputational considerations cannot play any role. As a result, we need to add some dynamics to be able to answer this question. We do this by incorporating an overlapping generations structure. Each generation is as described above. Generation t agents are born at time t, with a project that pays at $t+1$. They maximize expected utility from consumption at $t+1$. At time t they purchase and sell securities.to diversify their production risk. Generation t agents cannot trade securities with agents in different generations: at time $t+1$, they are old and the best they can do is to consume their output and the proceeds from the securities they traded at time t; at time t, the only other living generation is generation $t-1$, but since this generation is old they are not willing to trade securities either. As a result, agents diversify their production risk as much as they can by purchasing and selling securities to other agents in the same generation. For now, we assume that both the transport cost τ and the probability distribution over production levels $\{\pi_s\}_{s \in S}$ does not vary over time. In principle, it might seem that since each agent trades with agents in the same generation, the equilibria should not be affected by the overlapping-generations structure. However, with sovereign risk and a long-lived government, there might be equilibria in which governments can commit to higher levels of enforcement due to reputational considerations. We analyze these equilibria next.

5   Final Remarks

Discuss menu of assets.

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7   Appendix

We assume that there is a (small) non-monetary cost governments needs to pay to enforce payments, denoted $\varepsilon(x)$, where x is the probability that payments are in fact enforced. In particular, after observing the state of nature in the second period (and taking into account asset trades in the first period), governments choose a probability of enforcement x and pay cost $\varepsilon(x) = \overline{\varepsilon}x^{\gamma}$ where $\gamma > 1$. Note that $\varepsilon(\cdot) : [0,1] \to [0, \overline{\varepsilon}]$ is convex.[27]

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[27] If the enforcement cost where linear or concave in the probability of default or if the government's choice were just between enforcing with probability 1 or not enforcing, residents would be able to coordinate into not issuing so many securities that the government chooses not to enforce payments. This would be the case even when there are a very large number of residents. This is because at the point at which the government is indifferent between enforcing and not enforcing payments, any small increase in the number of securities issued would decrease the probability of enforcement from 1 to 0. We find this possibility highly unrealistic. When enforcement costs are convex, a small increase in security issuance has a small effect on the probability of enforcement. As a result, when there are many agents they cannot coordinate into not issuing too many securities and, thus there are states in which enforcement does not take place.

In general, the model has many equilibria. For example, any state can become a non-enforcement state if there is a lot of two-way trade between the two regions. Since residents have incentives to maximize ex-ante the probability of enforcement, we will limit our analysis to equilibria in which asset holdings do not involve any two-way trade (i.e. gross flows and net flows between regions are the same). Also, it is easy to show that the absence of two-way trade implies that regions always enforce payments when they are net recipients of international flows. As a result, the governments' benefits from enforcing payments in the relevant cases in which the region is a net payer are given by

$$
b_s = \int_{i \in I} u(c_{is}) - \int_{i \in I} u(y_{is})
$$
$$
b_s^* = \int_{i \in I^*} u(c_{is}) - \int_{i \in I^*} u(y_{is})
$$

The optimal probabilities of enforcement are thus

$$
x_s = \begin{cases} 1 & \text{if } b_s \geqslant \varepsilon'(1) \\ (\varepsilon')^{-1}(b_s) & \text{if } \varepsilon'(1) > b_s \geqslant \varepsilon'(0) \\ 0 & \text{if } \varepsilon'(0) > b_s \end{cases}
$$

$$
x_s^* = \begin{cases} 1 & \text{if } b_s^* \geqslant \varepsilon'(1) \\ (\varepsilon')^{-1}(b_s^*) & \text{if } \varepsilon'(1) > b_s^* \geqslant \varepsilon'(0) \\ 0 & \text{if } \varepsilon'(0) > b_s^* \end{cases}
$$

when a region is a net payer and 1 when the region is a net recipient.

Throughout, we will assume that the cost of enforcing payments by the government are very large relative to the size of an individual resident, but very small relative to the size of the economy. With some abuse of notation, let I be the number of Home residents. We assume that the model is the limit of a model in which $I \to \infty$, $\bar{\varepsilon} \sim \sqrt{I}$.[28] Similarly for the Foreign region.

This is the simplest way to account for the fact that small changes in asset holdings should have small effects on the probability (or extent) of enforcement. Alternatively, the existence of any amount of uncertainty affecting the government's enforcement decision but on which agents cannot condition their securities would have a similar effect. Examples of such type of uncertainty include unobserved enforcement costs and unobserved government preferences.

[28] The cost could could grow with the size of the economy at any power in the interval $(0, 1)$.

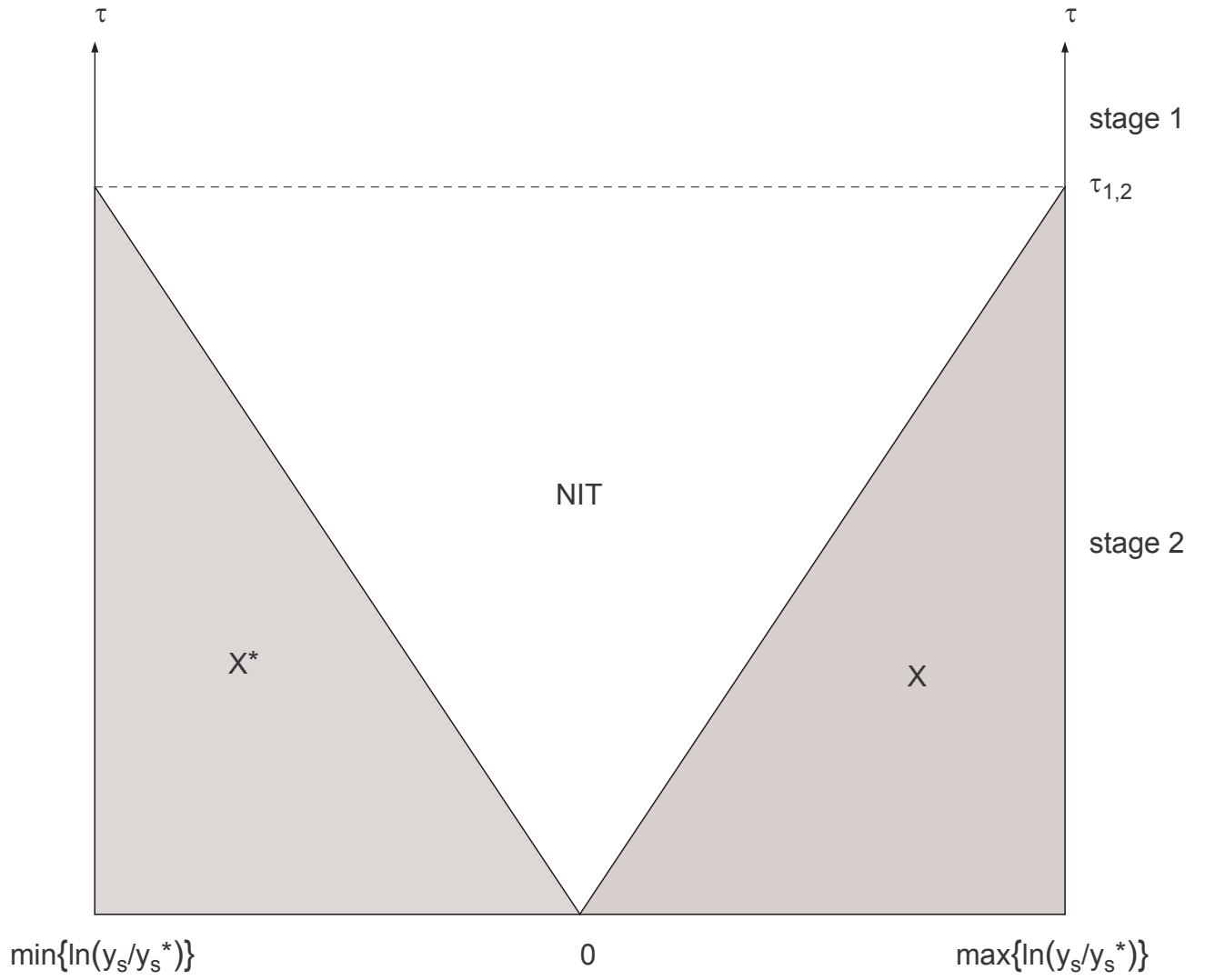Figure 1: Stages of globalization with complete markets

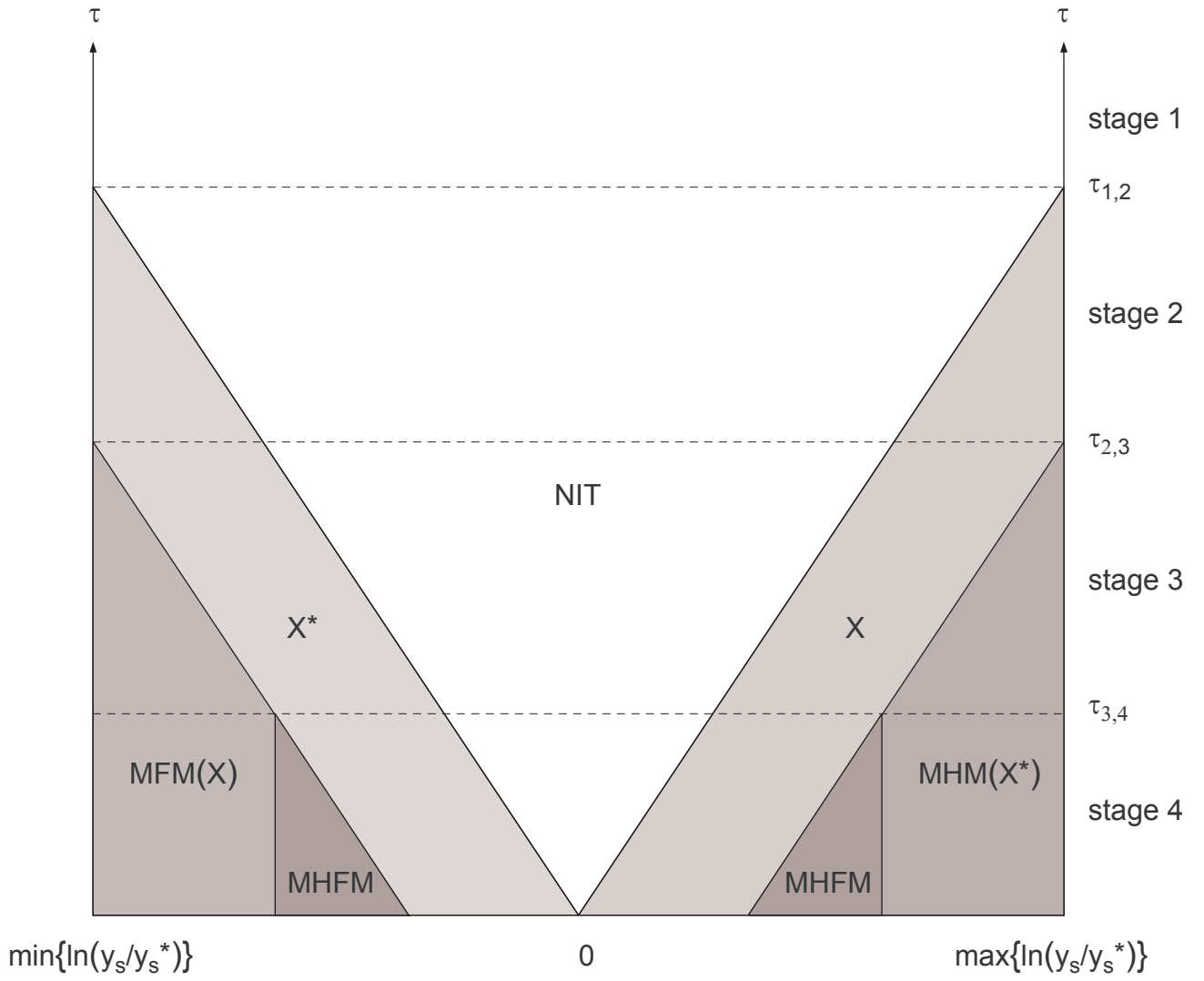Figure 2: Stages of globalization with sovereign risk and securities

Figure 3: Stages of globalization with sovereign risk, securities, and contracts

stage 1

$\tau_{1,2}$

stage 2

$\tau_{2,3}$

stage 3

NIT

X*

X

NIT

NIT

τ

τ

$\min\{\ln(y_s/y_s{}^*)\}$
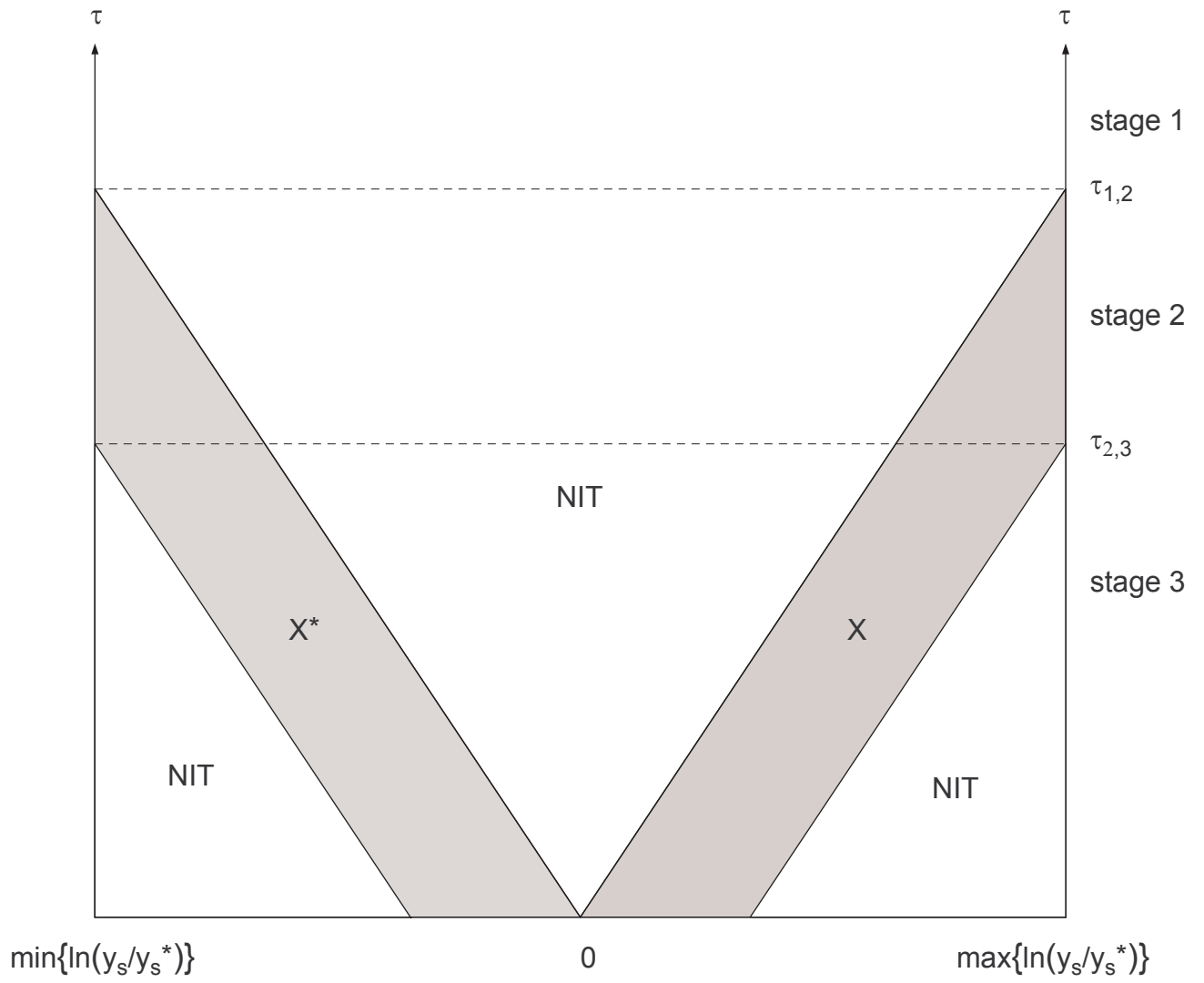
0

$\max\{\ln(y_s/y_s{}^*)\}$

Figure 4: Stages of globalization with sovereign risk and securities (constrained optimum)