Intergenerational Conflict and International Risk Sharing

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Abstract

Existing models of foreign debt and insurance capacity assume that the costs and benefits of default are evenly distributed across agents in the defaulting country. To study how tensions among different groups inside a country affect its sovereign risk management I consider an economy whose agents differ in their life spans. This makes the costs and benefits of default to be different across generations. The country is able to come up with a positive level of insurance or debt by linking intergenerational transfers to the default decision of the agents. This result is found both for the case of a benevolent social planner, and for the case of a political process where decisions are taken each period by majority vote of living generations.

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1 Introduction

Tensions among different groups inside a country affect society's efficiency in the use of its resources and also the redistribution of any economic surplus. Political economy arguments show how institutions are used to mediate this conflicts of interest. In an international setting there are also tensions among different countries, sometimes resulting in trade wars and defaults on sovereign contract obligations. In this paper I analyze the interaction between internal and external conflicts and see how this influences a country's ability to insure output shocks in international capital markets.

Korea's forced reschedulling of its short term debt at the end of 1997, and the defaults of Russia, later followed by Pakistan, Ecuador, and recently Argentina renewed interest on the issue of contract enforcement between sovereign nations. A central issue in the sovereign debt literature has been the study of the mechanisms that support a positive amount of lending, and the determinants of a country's debt and insurance capacity. Research has stressed the strategic nature of default, arguing that the binding constraint on contract repayments is often a country's willingness to pay instead of its ability to do so[1].

Much of the literature attempts to clarify the role that different penalties to default play in supporting a positive level of debt. Among these are *reputational*[2] models that assume that the only penalty available is to restrict a defaulting country's access to international capital markets. Whether reputational considerations are sufficient to support a positive level of debt, depends on the options open to a country after it defaults[3]. If the legal institutions are such that a defaulting country can be completely excluded from international capital markets, reputation can support some debt or insurance contracts.

Existing models assume that the costs and benefits of default are evenly distributed across agents in the economy. I argue in this paper that modelling

[1]See for example Eaton and Gersovitz (1981) and Eaton, Gersovitz and Stiglitz (1985).

[2]Reputation is a misnomer actually. The idea is that a country repays in order to maintain a "good" reputation and therefore maintain access to international capital markets.

[3]See Bulow and Rogoff (1989), Worral (1990), Cole and Kehoe (1995), Grossman and Han (1997), Kletzer and Wright (1998).

the structure of the economy in more detail clarifies the mechanisms through which a country can guarantee its promises to repay. I analyze the default decision of a country whose citizens have finite lives and are born at different dates. In a setting in which agents cannot collateralize their obligations they can get no insurance for their income shocks if they act individually. Nevertheless, society as a whole can raise reputational collateral to support its contractual obligations by instituting intergenerational transfers from the young to the old. And the interaction between intergenerational and international risk sharing leads to welfare improvements. These results are derived first for the case of a social planner that optimizes the discounted sum of the utilities of all present and future generations. I then check the robustness of the results by considering the optimal allocations in modern democracies, were public decisions are taken by popular vote, ignoring future generations. Under some assumptions intergenerational transfers still take place to secure foreign insurance contracts, and there are welfare improvements except for the extreme case in which policies are always chosen by a representative old agent.

Foreign insurance is modelled as a self-enforcing contract that the country writes with the outside insurers. Individual agents have the possibility to renege from the societary arrangement, therefore the optimal contract has to provide the incentives to prevent default. This will result in partial insurance as consumption must grow with individual income for high income levels[4]. The role played by the assumptions underlying this result is clarified by two useful benchmark cases. In the first one we see that if the social planner has full taxation powers then the problem reduces to a representative agent one. The reason being that in this case the social planner doesn't have to meet individual agents' incentive compatibility constraints. In the second benchmark the social planner has limited taxation powers, in the sense that now the agents' incentive constraints must be satisfied, but there are no intergenerational transfers. In this case it is shown that the country can get

[4]This result is related to the one found in the literature on international portfolio diversification that tries to explain why the observed degree of international risk sharing is so low. See French and Poterba (1991), Lewis (1994), Tesar and Werner (1995) and Kang and Stulz (1995).

no insurance.

The organization of the paper is as follows. In section 2 the optimal insurance contract is derived for a social planner, whose optimization problem is modeled as a Principal Agent maximisation subject to the relevant incentive compatibility constraints that guarantee that in every state of nature there will be no incentive to default. Section 3 considers the optimal allocation in a political economy setting, were policies are decided every period by majority vote among the living generations. Section 4 summarizes the findings and presents ideas for further research. The paper concludes with a mathematical appendix.

2 Foreign Insurance

2.1 Basic model

The economy considered has an infinite horizon overlapping generations structure. Each person lives for two periods and has a separable logarithmic utility function over current and future consumption, with discount factor $\beta < 1$.

$$E[U(C_1, C_2)] = E[\ln C_1] + \beta E[\ln C_2] \tag{1}$$

Random i.i.d. nonstorable endowments $Y_1(s)$ and $Y_2(s)$ are received in each period and in state $s \in S$ by the young and the old respectively. All individuals within each generation are identical in tastes and endowment, therefore there is no incentive for intragenerational trade, and nothing is available to trade with other generations.

Risk aversion and the presence of aggregate risk make it desirable to borrow from the international capital market to smooth consumption. Asset transactions between countries can be broken down in two components: a riskless intertemporal loan and a pure risk-sharing contract. Although in reality these come together, for convenience let's abstract from the lending component and concentrate on the risk sharing one, considering only one-period pure insurance contracts[5]. Let's remark that under this assumption

[5]This makes the incentive to default appear in the good states of nature, since it is in those that the country has to transfer resources to the insurers.

private and public savings with the rest of the world are not possible.

Let's assume the presence of an infinitely lived benevolent social planner that maximizes the discounted sum of every generation's utilities (discounted by the factor β), and centralizes contractual arrangements with the rest of the world. Every period, contracts are written before that period's uncertainty is revealed. The first best outcome would be that all the uncertainty be absorbed by risk neutral foreign insurers. But after the uncertainty is revealed both the young and the old can decide to default on the outstanding contracts and the economy reverts to autarky where each agent consumes their endowment and no transfers are made with the rest of the world. This restricts the ex-ante contracts to be self-enforceable, and competition among insurers results in the sovereign being offered an optimal contract.

The general set-up of the problem then has the social planner's objective function and the constraints that she faces. To have a usefull benchmark I include a restriction showing that it could also be the case that the social planner wants to default. The other constraints are the resource constraint that aggregate consumption must be equal to aggregate income net of insurance payments, and the zero profit condition for the insurers. The optimal contract must then solve the following problem:

$$\max_{C_{1,t}(s),C_{2,t}(s),P_t(s)} \quad \sum_{t=0}^{\infty} \beta^t [\sum_{s\in S} q_s \ln C_{1,t}(s) + \sum_{s\in S} q_s \ln C_{2,t}(s)] \tag{2}$$

subject to, $\forall t \geq 0$ and $s \in S$

$$(R.C.) \quad C_{1,t}(s) + C_{2,t}(s) \; = \; Y_{1,t}(s) + Y_{2,t}(s) - P_t(s)$$

$$(0 \; P.C.) \quad \sum_{s\in S} q_s P_t(s) \; = \; 0$$

$$(I.C.Y.) \quad \ln C_{1,t}(s) + \beta \sum_{z\in S} q_z \ln C_{2,t+1}(z) \geq \ln Y_{1,t}(s) + \beta \sum_{z\in S} q_z \ln Y_{2,t+1}(z)$$

$$(I.C.O.) \quad C_{2,t}(s) \geq Y_{2,t}(s)$$

$$(I.C.S.P.) \qquad \ln C_{1,t}(s) + \ln C_{2,t}(s) + \sum_{r=1}^{T} \beta^r [\sum_{z \in S} \ln C_{1,t+r}(z) + \sum_{z \in S} \ln C_{2,t+r}(z)]$$

$$\geq \ln Y_{1,t}(s) + \ln Y_{2,t}(s) + \sum_{r=1}^{T} \beta^r [\sum_{z \in S} \ln Y_{1,t+r}(z) + \sum_{z \in S} \ln Y_{2,t+r}(z)]$$

where q_s is the probability of state s, meaning a given outcome of the shock for both the young and old. $C_{1t}(s)$ and $C_{2t}(s)$ are consumption allocations at time t in state s to the young and old respectively. $P_t(s)$ are payments to the outside insurers at time t in state s (could be negative for some states). $(R.C.)$ stands for resource constraint and has associated multiplier $\nu_t(s)$, $(0\ P.C)$ stands for the zero profit condition for the insurers with multiplier μ_t, $(I.C.Y.)$ means incentive compatibility constraint for the young with multiplier $\lambda_t(s)$, $(I.C.O.)$ is the incentive compatibility constraint for the old with multiplier $\delta_t(s)$. Finally $(I.C.S.P.)$ is the incentive compatibility for the social planner and reflects the fact that the country is excluded from international capital markets for T periods. Its multiplier is $\gamma_t(s)$.

The young and the old, have to be given incentives not to default in any state of nature. This is reflected in the $(I.C.Y.)$ and $(I.C.O.)$ constraints. The $(I.C.Y.)$ thus reflects the fact that ex-post for every state i the young's expected utility if they abide by their contractual obligations must be at least as great as the expected utility they would get under autarky if they defaulted. The $(I.C.O.)$ constraint reflects that the old must be given at least their endowment in every state of nature. Finally the $(I.C.S.O.)$ shows that the social planner weighs the utility of following the contract today and for the next T periods in order to see if she wants to default or not. The form of the outside option needs to be discussed. It is assumed here that when somebody defaults she expects to be punished and consume her endowment. But if the social planner is able to reallocate domestic resources then this threat, although being subgame perfect, is not renegotiation proof. A rationale for this assumption would be to have a continumm of agents for each generation and that each of them does not internalize the fact that their actions will trigger economy-wide default. In this case they will consider consuming their endowments as their alternative to following the social planner's program.

Let's write now the lagrangian for the maximization problem of the social planner as given by (2),

$$
\begin{aligned}
L = \quad & \sum_{t=0}^{\infty} \beta^t [\sum_{s\in S} q_s \ln C_{1,t}(s) + \sum_{s\in S} q_s \ln C_{2,t}(s) + \sum_{s\in S} \nu_t(s)(Y_{1,t}(s) + Y_{2,t}(s) - P_t(s) \\
& -C_{1,t}(s) - C_{2,t}(s)) + \mu_t \sum_{s\in S} q_s P_t(s) + \sum_{s\in S} \lambda_t(s)(\ln C_{1,t}(s) + \beta \sum_{z\in S} q_z \ln C_{2,t+1}(z) \\
& - \ln Y_{1,t}(s) - \beta \sum_{s\in S} q_z \ln Y_{2,t+1}(z)) + \sum_{s\in S} \delta_t(s)(C_{2,t}(s) - Y_{2,t}(s)) \\
& + \sum_{s\in S} \gamma_t(s)\{\ln C_{1,t}(s) + \ln C_{2,t}(s) + \sum_{r=1}^{T} \beta^r [\sum_{z\in S} \ln C_{1,t+r}(z) + \sum_{z\in S} \ln C_{2,t+r}(z)] \\
& -(\ln Y_{1,t}(s) + \ln Y_{2,t}(s) + \sum_{r=1}^{T} \beta^r [\sum_{z\in S} \ln Y_{1,t+r}(z) + \sum_{z\in S} \ln Y_{2,t+r}(z)])\}]
\end{aligned}
$$

Taking the first order conditions with respect to $C_{1,t}(s)$, $C_{2,t}(s)$, and $P_t(s)$ gives the following relations,

$$\frac{dL}{dC_{1,t}(s)} = \frac{q_s}{C_{1,t}(s)} - \nu_t(s) + \frac{\lambda_t(s)}{C_{1,t}(s)} + \frac{\gamma_t(s) + q_s \sum_{r=1}^{T} \sum_{z\in S} \gamma_{t-r}(z)}{C_{1,t}(s)} = 0$$

$$\frac{dL}{dC_{2,t}(s)} = \frac{q_s}{C_{2,t}(s)} - \nu_t(s) + \frac{q_s \sum_{z\in S} \lambda_{t-1}(z)}{C_{2,t}(s)} + \frac{\gamma_t(s) + q_s \sum_{r=1}^{T} \sum_{z\in S} \gamma_{t-r}(z)}{C_{2,t}(s)} - \delta_t(s) = 0$$

$$\frac{dL}{dP_t(s)} = \nu_t(s) - q_s \mu_t = 0$$

then by replacing $\nu_t(s)$ from the third equation into the first two, dropping time indexes (since I concentrate on steady states), and rearranging terms,

$$\frac{1 + \frac{\lambda(s)}{q_s} + \gamma(s) + T \sum_{z\in S} \gamma(z)}{C_1(s)} = \mu \tag{3}$$

$$\frac{1 + \sum_{z\in S} \lambda(z) + \gamma(s) + T \sum_{z\in S} \gamma(z)}{C_2(s)} - \delta(s) = \mu \tag{4}$$

2.2 Social planner with full taxation power

As a first benchmark let's consider a scenario in which the social planner has full taxation power. In this case the incentive compatibility constraints of the young and old are irrelevant since the social planner is able to exact any amounts of income in the form of taxes. The problem from the previous set up reduces considerably as now it is the case that $\lambda(s) = \delta(s) = 0 \ \forall s \in S$. The first order conditions (3) and (4) reduce to,

$$C_1(s) = \frac{1 + \gamma(s) + T\sum_{z \in S} \gamma(z)}{\mu}$$

$$C_2(s) = \frac{1 + \gamma(s) + T\sum_{z \in S} \gamma(z)}{\mu}$$

Thus $C_1(s) = C_2(s) = C(s) \ \forall s \in S$. Let's consider now the $(I.C.S.P.)$. First note that since the social planner has full power to tax and make transfers the outside option for her is not autarky for every agent, but a situation in which she allocates consumption optimally in a closed economy. Optimal allocations in a closed economy are given by[6],

$$C_1^c(s) = C_2^c(s) = C^c(s) = \frac{Y_1(s) + Y_2(s)}{2}$$

Thus the $(I.C.S.P.)$ in steady state reduces to, eliminating a factor 2 on both sides, and defining the economy's aggregate resources in state s as $Y(s) \equiv Y_1(s) + Y_2(s)$,

$$\ln C(s) + \frac{1-\beta^T}{1-\beta} \sum_{z \in S} \ln C(z) \geq \frac{\ln Y(s)}{2} + \frac{1-\beta^T}{1-\beta} \frac{\sum_{z \in S} \ln Y(z)}{2}$$

This is simply the incentive compatibility constraint that is found in the literature for the case of a representative agent[7]. All their results must still hold. For bad shocks $\gamma(s) = 0$ and consumption is stabilized, but for higher income

[6] See Fischer (1983), with the caveat that in his set-up the social planner weighs second period income by the factor β.

[7] Worrall(1990), Obstfeld and Rogoff(1996) for whom $T = \infty$.

realizations the $(I.C.S.P.)$ starts to bind and consumption must increase with income.

Proposition 1. *If the social planner has full taxation power, the problem reduces to a representative agent economy. Each period, agents consume half the available income, net of insurance payments, irrespective of their endowments.*

2.3 Social planner with no taxation power and unable to make intergenerational transfers

From now on we will assume that the social planner has no taxation power. Any tax payments by the agents must be voluntary, satisfying their incentive compatibility constraints. If an agent consumes less than her income in a given state it must be because she expects to het a higher expected utility by doing this than what she would get by defaulting. Let's assume that the parameters T and β are such that the $(I.C.Y.)$ and $(I.C.O.)$ imply the $(I.C.S.P.)$, i.e. this last constraint is not binding in any state, and we can drop it from the problem's set-up.

At this point we will also assume that the social planner is unable to make intergenerational transfers. In this case the problem reduces to one in which the social planner tries to write insurance contracts with the outside insurers separately for the young and old. Thus the $(R.C.)$ and $(0\ P.C.)$ decouple in two, one for each type of agent,

$$(R.C.Y.) \quad C_{1,t}(s) = Y_{1,t}(s) - P_{1,t}(s)$$

$$(R.C.O.) \quad C_{2,t}(s) = Y_{2,t}(s) - P_{2,t}(s)$$

$$(0\ P.C.Y.) \quad \sum_{s \in S} q_s P_{1,t}(s) = 0$$

$$(0\ P.C.O.) \quad \sum_{s \in S} q_s P_{2,t}(s) = 0$$

$$(I.C.Y.) \quad \ln C_{1,t}(s) + \beta \sum_{z \in S} q_z \ln C_{2,t+1}(z) \geq \ln Y_{1,t}(s) + \beta \sum_{z \in S} q_z \ln Y_{2,t+1}(z)$$

$$(I.C.O.) \quad C_{2,t}(s) \geq Y_{2,t}(s)$$

From the $(I.C.O.)$, and the second period zero profit condition for the old, it can be seen that the agent gets no insurance in the second period and consumes her endowment. Plugging this in the $(I.C.Y.)$ the second term in both sides cancels out. The remaining inequality is given by,

$$(I.C.Y.)' \ \ln C_{1,t}(s) \geq \ln Y_{1,t}(s)$$

Similar reasoning now tells us that the agent can get no insurance in the first period. Thus, in the absence of intergenerational transfers, a social planner that has no taxation power is unable to get insurance from the international capital markets

Proposition 2. *If the social planner has no taxation power, and cannot make intergenerational transfers, the economy can get no insurance. Agents must consume their endowments.*

2.4 Social planner with no taxation power, but able to make intergenerational transfers

After having considered the previous two benchmark cases we will study now an intermediate situation in which the social planner has to take into consideration the incentive compatibility constraints of young and old, but can make intergenerational transfers. Let's rewrite the FOC $(3)-(4)$ for this case,

$$\frac{1 + \frac{\lambda(s)}{q_s}}{C_1(s)} = \mu$$

$$\frac{1 + \sum_{z \in S} \lambda(z)}{C_2(s)} - \delta(s) = \mu$$

Let's call the sum of the multipliers $\sum_{z\in S}\lambda(z)$ as Σ, and define $C_1 \equiv 1/\mu$. From the $(I.C.O.)$ and the FOC we get that when $\delta(s)=0$, something that happens for low second period income realizations, consumption for the old is stabilized at level $C_1(1+\Sigma)$ and increases one to one with income for higher shocks when the $(I.C.O.)$ is binding. Something similar can be said about the consumption of the young, who get C_1 for low income realizations when $\lambda(s)=0$[8]. The optimal allocations can now be rewritten as:

$$C_1(s) = (1+\frac{\lambda(s)}{q_s})C_1 \tag{5}$$

$$C_2(s) = \max[(1+\Sigma)C_1, Y_2(s)] \tag{6}$$

Let's now go back to the $(I.C.Y.)$. Its RHS is increasing in $Y_1(s)$, therefore there is a threshold income, Y_1^* at which it starts to bind. For this and higher income levels then $(I.C.Y.)$ holds as an equality,

$$\ln C_1(s) + \beta\sum_{z\in S} q_z \ln C_2(z) = \ln Y_1(s) + \beta\sum_{z\in S} q_z \ln Y_2(z) \quad \forall s\in S\ /\ Y_1(s)\geq Y_1^*$$

$$\ln C_1 + \beta\sum_{z\in S} q_z \ln C_2(z) = \ln Y_1^* + \beta\sum_{z\in S} q_z \ln Y_2(z) \quad \forall s\in S\ /\ Y_1(s) = Y_1^* \tag{7}$$

Taking the difference of the $(I.C.Y.)$ for a state s such that $Y_1(s)\geq Y_1^*$ and the $(I.C.Y.)$ for a state s such that $Y_1(s) = Y_1^*$ we get the following expression for $C_1(s)$,

$$\ln C_1(s) - \ln C_1 = \ln Y_1(s) - \ln Y_1^* \quad \forall s\in S\ /\ Y_{1i}\geq Y_1^*$$

This allows us to rewrite the optimum allocations $(5)-(6)$ as,

$$C_1(s) \ = \ \max\ [C_1, \frac{C_1}{Y_1^*}Y_1(s)] \tag{8}$$

$$C_2(s) = \max[(1+\Sigma)C_1, Y_2(s)] \tag{9}$$

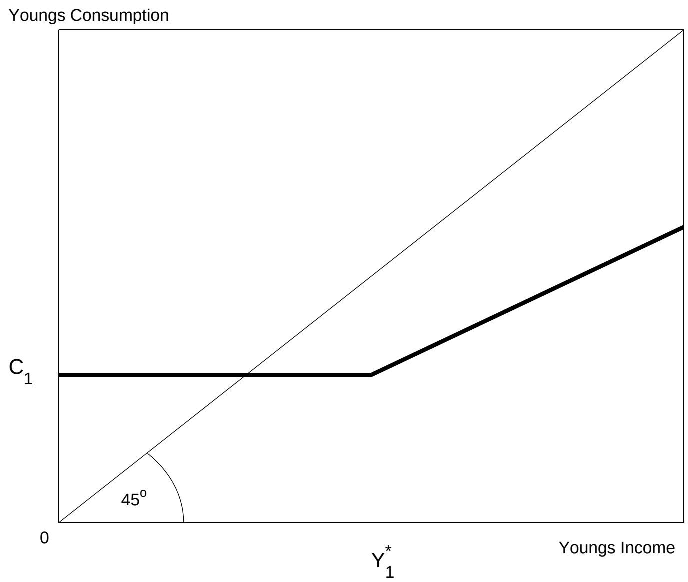

Figure 1: Optimal Allocations for the Young

The optimal allocations are sketched in figures 1 and 2. The young are taxed[9] a constant proportion of their income and in exchange they receive a put option on their after tax income when young and another on their income when old. It is easy to understand the intuition behind the optimal incentive compatible contract. Let's start with the old. Ex post, in every state, they cannot consume less than their income, because they can always resort to autarky. But if they were to consume only their income, there would be no incentive for the young to pay in the states of nature where they are called to do so. As can be seen in the $(I.C.Y.)$, it is a higher expected utility when old that drives incentives for the young to pay the taxes. Therefore there must be net intergenerational transfers from the young to the old in order to support foreign insurance. We will see that this result turns out to be robust to changes in the set-up.

[8]This explains why I defined $C_1 \equiv \frac{1}{\mu}$, C_1 is the level at which insurance stabilizes the consumption of the young for bad shocks.

[9]Actually in this economy the government has no taxation powers, all transfers are voluntary.

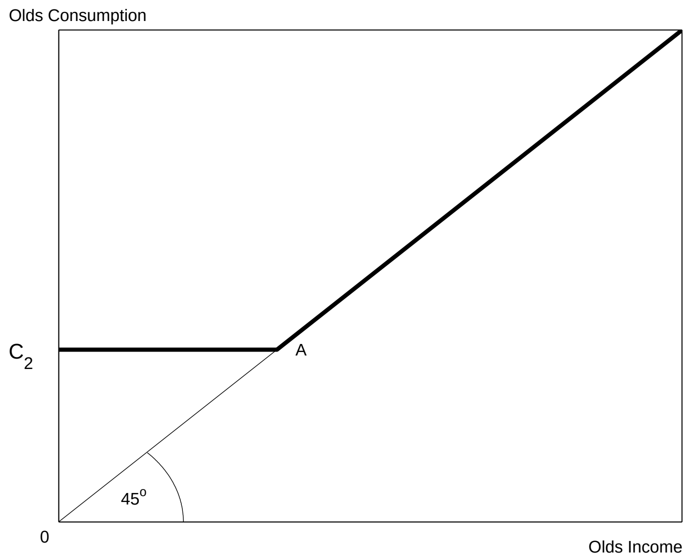

Figure 2: Optimal Allocations for the Old

Proposition 3. *If the social planner has no taxation power, but can make intergenerational transfers, then the economy can sustain a positive level of insurance with the outside world.*

Transfers to the old take place for low realizations of their income, when they are most valued, and stabilize their consumption at some level C_2. The level of this transfers, T, is given by the difference between the expected consumption of the old and their expected income, the area of triangle $0C_1A$ in figure 2. For the young, at low levels of income there is no enforcement problem and consumption can be smoothed across these states. For higher levels of income the temptation to default would be too big under full insurance so the optimal contract calls for increasing consumption after some threshold income level Y_1^*. As is the case in representative agents models, limitations on how much both types of agents are willing to pay in good times reduce the level of consumption guaranteed by insurers for the bad states of nature.

It can be seen from the $(I.C.Y.)$ that for a representative young the utility gain of the transfers that she will receive when old is equal to the utility loss of being taxed at rate $1 - \frac{C_1}{Y_1^*}$ in every state receiving no insurance.

Therefore, from her perspective, the utility difference of having the insurance and consuming C_1 instead of $\frac{C_1 Y_i}{Y_1^*}$ for incomes below Y_1^* is the lifetime utility gain of having access to the international capital markets. The social planner cares about the current young and old, therefore from her perspective the welfare gains from foreign insurance is composed of the utility difference as seen by the young plus $1-\beta$ times the utility value of the intergenerational transfers T.

Proposition 4. *Intergenerational transfers from the young to the old, by raising collateral that supports foreign insurance, increase welfare.*

The optimum allocations achievable through foreign insurance are completely characterized by three parameters: the minimum consumption of the young, C_1, the level of income at which the young need to be given incentives not to default, Y_1^*, and the ratio between the minimum consumption of the old and the young, $1+\Sigma$. That this is the case can be seen in figures 1 and 2. Therefore three equations in these three unknowns are needed to solve the problem. In the appendix I show how to get these equations for the special case when the income shocks are lognormally distributed.

Comparative statics[10] show that an increase in the volatility of first period income σ_1 does not affect the tax rate or the intergenerational transfers to the old. It also increases S because although the expected lifetime utility decreases, the reduction of the autarky utility is larger. The reason for these results is that an increase in σ_1 has the double effect of increasing ex-ante the value of insurance, but making it more likely that ex-post it will be desirable to default. Therefore these two effects lead to a reduction in the effective insurance level that the young receive (i.e. C_1 falls), accompanied by an increase in its value.

An increase in the volatility of second period consumption σ_2 increases the tax rate, transfers but reduces S. This works by increasing the cost of defaulting for the young since they will be facing a lower expected utility of second period income. This allows to increase the taxes that the social planner can exact for a given level of transfers. This mechanism is very similar to

[10]These results are derived in the appendix, keeping aggregate expected income $\bar{Y_1}+\bar{Y_2}$ constant.

the precautionary motive for savings[11]. If marginal utility is convex, which is the case for logarithmic utility, then an increase in second period endowment volatility increases the desire to transfer consumption to the future. In our model there are no savings, but intergenerational transfers shift consumption from the first to the second period.

Increasing the average income of the old relative to the average income of the young has negative effects on welfare because now a given transfer to the old is less valuable to them. This reduces the taxes and transfers in the economy. Finally, an increase of β increases the taxes and insurance level for the young while leaving the intergenerational transfers constant. This is so because more patience means that future transfers are valued more by the young when taking their default decision. Therefore they can be taxed more and in exchange receive more coverage (i.e. C_1 increases).

There is an important distinction between the optimal contract in the open economy and that of a closed economy, as studied in Coate and Ravallion (1993), or Kocherlakota (1996). In the closed economy case, the size of steady state transfers between parties is inversely related to the degree of covariance in their income streams. Instead, in our set-up the degree of risk sharing achieved by foreign insurance is unaffected by the correlation of shocks across agents. This is so because the outside option is assumed to be one of no further transfers between agents. If instead default is followed by some state contingent transfers from the young to the old, these transfers are more valuable the more negatively correlated their income shocks. Thus the reservation utilities of the agents would be higher, and the level of insurance supported lower the more negatively correlated are the shocks across generations.

3 Insurance and Political Economy

In modern democracies, public decisions are taken by popular vote. Since only the living vote it is natural to ask ourselves under what conditions, if any, an economy with the same structure as in the previous section, and

[11] See for example Leland (1968), Sandmo (1970), or more recently Kimball (1987) and Caballero (1990)

with democratic institutions, can achieve some risk sharing with the rest of the world. We will see that, if living generations behave cooperatively conditioning intergenerational transfers to the default decision of previous generations, a positive level of insurance can be supported in equilibrium.

The access to international capital markets has some elements of what Rangel (1997) calls an *intergenerational good* or IG. These are commodities that are supplied before the generations that benefits most from them are born. Agents pay later in life by producing IGs for the next generations. But, assuming that it is not possible to exclude future generations from consuming the IG, living agents have no incentive to produce them[12]. Rangel then studies how the political process allocates these IGs. He finds that, despite the problem with the timing of exchange, they are supplied in equilibrium if fiscal policies like capital taxation are linked to the provision of the IGs.

Now I can consider the similarities between these intergenerational goods and the access to international capital markets. First, access is supplied each period by the renewed compromise of those alive not to default on outstanding contracts. Also there is no excludability since once access is renewed it is not possible to exclude future generations from their benefits. Thus an externality arises because while agents alive pay the costs of renewed access, they do not internalize the benefits that access to these markets have on future generations. The timing problem can be seen more clearly if one changes the previous assumptions and gives the old a constant income. Therefore foreign insurance benefits only the young ex-ante, and is worthless for the old[13].

I assume that every period there is an election in which all agents alive vote, choosing an element of the policy space P_t, which might include decisions on default and on the level of intergenerational transfers. I also assume that every period the young are in power with probability θ, and the old are in power with probability $1 - \theta$[14]. Then under the assumptions of homogeneity among agents of the same generation, policy is taken acording to the

[12] An example of an IG would be expenditures in the education of the next generation.

[13] This would be an example of a pure intergenerational good, one that does not produce any benefit to the generation that pays for it.

[14] This would arise if, for example, there is stochastic population growth and θ is the probability that the rate of population growth be positive.

preferences of the "median voter"[15], the representative agent of the larger generation. Thus θ is the probability that the young are a political majority.

Let's model the electoral process as an infinite extensive form game of complete information. In every period t the largest generation chooses a policy $p_t \in P_t$ knowing the history of previous moves $h^t = (p_1, ..., p_{t-1})$. An outcome of the game is given by a vector $p = (p_1, p_2, ...)$, and the payoff of generation t is given by $E[\ln(C_1(p_t)] + \beta E[\ln(C_2(p_{t+1})]$. The set of political equilibria is given by the set of subgame perfect equilibria of this game.

If the default decision is included in the public policy space this means that the ruling party is the only one that decides whether to default or not. If the ruling party also decides on allocations[16] we would have a situation in which when the old are in power the economy has no insurance with the outside world and the old fully expropiate the young. A richer outcome is achieved if one assumes that the default decision is a private choice that agents can make even when they are not in power. A way to interpret this is to think that there is a constitutional clause that says that agents have the right to withdraw from society at any time. This makes the policy space to only include allocation decisions. By changing the allocations, the size and the distribution of the surplus of foreign insurance changes.

As before I am going to concentrate on steady state outcomes, i.e. equilibria where the state contingent transfers and insurance payments are constant through time. It is easy to show that there exist infinitely many stationary equilibria in which some level of insurance is warranted by outside insurers. These are all allocations that give both generations alive a higher ex-ante utility than autarky, and that are at the same time ex-post incentive compatible. The out of equilibrium strategies associated with these equilibria are punishments that take the economy to autarky forever in case of deviations from the stationary allocations.

Proposition 5. *A positive level of foreign insurance can be sustained as a political equilibrium if intergenerational transfers are conditioned on past default decisions.*

[15] Actually, the concept of a median voter is not well defined in models with multidimensional policy spaces.

[16] This would correspond to the case of full taxation power in the social planner problem.

I am interested in the best possible outcome, and this can be found as the equilibrium of the game in which both generations maximize their utilities when in power subject to the relevant constraints. When the old are in power this results in the young being taxed at the maximum level that leaves them indifferent between cooperating or going to autarky. By contrast when the young are in power they have an incentive to make transfers to the old, as long as they expect to receive themselves a transfer next period in case the future young are in power. Denoting with ˆ allocations when the young are in power, and with ˇ allocations when the old are in power, the problem is then for the young:

$$\max_{\hat{C}_1(s),\hat{C}_2(s),\hat{P}(s)} \sum_{s\in S} q_s \ln \hat{C}_1(s) + \beta[\theta \sum_{s\in S} q_s \ln \hat{C}_2(s) + (1-\theta) \sum_{s\in S} q_s \ln \check{C}_2(s)] \quad (10)$$

$$s.t. \quad (R.C.)\ \hat{C}_1(s) + \hat{C}_2(s) = Y_1(s) + Y_2(s) - \hat{P}(s)$$

$$(I.R.)\ \sum_{s\in S} q_s \hat{P}(s) = \hat{K}$$

$$(I.C.Y.)\ \ln \hat{C}_1(s) + \beta \sum_{z\in S} q_z[\theta \ln \hat{C}_2(z) + (1-\theta) \ln \check{C}_2(z)] \geq \ln Y_1(s) + \beta \sum_{z\in S} q_z \ln Y_2(z)$$

$$(I.C.O.)\ \hat{C}_2(s) \geq Y_2(s)$$

And the corresponding problem for the old:

$$\max_{\check{C}_1(s),\check{C}_2(s),\check{P}(s)} \sum_{s\in S} q_s \ln \check{C}_2(s) \quad (11)$$

$$s.t. \quad (R.C.)\ \check{C}_1(s) + \check{C}_2(s) = Y_1(s) + Y_2(s) - \check{P}(s)$$

$$(I.R.)\ \sum_{s\in S} q_s \check{P}(s) = \check{K}$$

$$(I.C.Y.)\ \ln \check{C}_1(s) + \beta \sum_{z\in S} q_z[\theta \ln \hat{C}_2(z) + (1-\theta) \ln \check{C}_2(z)] \geq \ln Y_1(s) + \beta \sum_{z\in S} q_z \ln Y_2(z)$$

$$(I.C.O.)\ \check{C}_2(s) \geq Y_2(s)$$

The difference in the set-ups comes from the fact that when the old are in power they don't care about the young, while the young care about the old because the following period they will be old themselves. Also note that in a general set-up the outside insurers may make net transfers $\hat{K}$ to the country when the young are in power, and $\check{K}$ when the old rule[17]. The solution to this problem is more involved than the one for the social planner because in each one of the maximisations the variables $\hat{C}_2(s)$ and $\check{C}_2(s)$ appear, therefore the optimal allocations have to be found as the equilibrium of the game in which both agents simultaneously choose their allocations. The optimal contracts can be characterized in spite of this technical difficulty. The first order conditions tell us that as before consumption is stabilized up to some level and that for the old it increases one to one with income for higher levels of income, while for the young it increases by less than one to one, reflecting taxes paid for the insurance when old. Some further results can be obtained. First, the tax rate on the young is the same whether they rule or not. This is so because as can be seen from the $(I.C.Y.)$ it is the difference between expected utilities when old that determines the slope of consumption with respect to income once the constraint binds. What is different is that if the young are in power they get partial insurance.

Proposition 6. *If every period, the probability that one group is in power is independent of what group was in power the previous period, then the tax rate on the young is the same whether they are in power or not.*

If the uncertainty about who holds power is revealed before contracting takes place, or if it is revealed before observing the income shocks and insurance contracts can be renegotiated, then the only outcome is to have $\hat{K} = \check{K} = 0$. In this case the level of insurance for the old is greater when they are in power, i.e. $\check{C}_2 > \hat{C}_2$. On the other hand, if the uncertainty about who will rule is revealed at the same time as the income shock, it is possible

[17] Fair insurance calls for $\theta\hat{K} + (1-\theta)\check{K} = 0$.

to have net transfers being made to or from the outside insurers depending on who is the ruling party.

Proposition 7. *If the uncertainty about who holds power is revealed before insurance contracts are written, then the minimum consumption level for the old is higher when they are in power. Independently of who rules, there are no net transfers between the country and the outside world.*

Let's now consider two particular cases that are of importance, $\theta = 0$ and $\theta = 1$. In the first case the old always rule and qualitatively the solution is that the young are taxed up to the point of indifference between defaulting or not[18]. The reason for this is that since the old do not care about the young, the $(I.C.Y.)$ binds in all states[19]. These resources are then transfered to the old that use them to insure themselves for bad shocks to their income. The same reasoning as in the previous section tells us that the utility loss of the young is equal to the utility gain of the old discounted by the factor β. But in this case the young receive no insurance. Therefore there is no lifetime utility gain from having access to international capital markets. All that foreign insurance gives is a redistribution of utility from the first to the second period of life.

In the case were the young always rule the problem's set up is very similar to the one of the social planner. I write the set-up to clarify this comparison.

$$\max_{\hat{C}_1(s),\hat{C}_2(s),\hat{P}(s)} \quad \sum_{s\in S} q_s \ln \hat{C}_1(s) + \beta \sum_{s\in S} q_s \ln \hat{C}_2(s) \tag{12}$$

$$s.t. \quad (R.C.)\ \hat{C}_1(s) + \hat{C}_2(s) \ = \ Y_1(s) + Y_2(s) - \hat{P}(s)$$

$$(I.R.)\ \sum_{s\in S} q_s \hat{P}(s) \ = \ 0$$

$$(I.C.Y.)\ \ln \hat{C}_1(s) + \beta \sum_{z\in S} q_z \ln \hat{C}_2(z) \geq \ln Y_1(s) + \beta \sum_{z\in S} q_z \ln Y_2(z)$$

[18] See appendix for a detailed derivation of these and the following results.

[19] If the $(I.C.Y.)$ does not bind for a state i then it is possible to reduce consumption of the young in that state giving the extra resources to the old.

$$(I.C.O.)\ \hat{C}_2(s) \geq Y_2(s)$$

One difference is in the relative weights of utilities in the objective function. While the social planner weighted equally the utility of the current young and old, the young when in power discount the utility of the old by β since for them the utility of second period consumption comes in the future. The other difference is that I am directly solving for the steady state, so it is the same second period allocation that enters the objective function, the $(R.C.)$ and the $(I.C.Y.)$. In the appendix I show that the solution of this problem can be compared to the one of the social planner by doing an artifice using comparative statics. I find that there is lower insurance for the old and higher insurance for the young, and it can be shown that the overall insurance level is lower than the case of the social planner.

Proposition 8. *The higher the probability that the young are in power, the higher the insurance that can be supported with the outside world. In the extreme case when the old are always in power, insurance provides no gain in lifetime utility.*

4 Conclusions

An open economy that has no commitment technology to guarantee repayment on its contracts with foreign insurers, can still support some international risk sharing by instituting intergenerational transfers and linking them to the default decision of domestic residents. These transfers, which can be associated to social insurance payments to the old, give the young an incentive not to default on contractual obligations, allowing the collection of taxes from them. The reallocation of resources across states of nature between young and old agents, and between domestic residents and foreign insurers, leads to welfare gains. It is this higher utility that provides the reputational collateral that supports international insurance.

This result was found both for the case of a social planner that maximizes the discounted sum of the expected utilities of all present and future generations, and for the case of a political process where decisions are taken each period by the majority vote of living agents. The need to provide incentives to prevent default results in the optimal allocation being one of partial insurance. Consumption is constant when income is low, and must grow with income for high income levels. This result is consistent with the observed low degree of international risk sharing, and thus provides an additional rationale for the home equity bias puzzle.

It was found that increases in volatility lead to higher levels of transfers. This result is related to the discussion in Rodrik (1995) and Alesina and Wacziarg (1998) about the relation between government size and the degree of openness in an economy. Rodrik argues that more open economies being more volatile have larger governments which provide insurance services to the population. Alesina and Wacziarg show that controlling for country size openess no longer explains government size, except for the case of government transfers. Given the fact that openness is correlated with the level of capital flows in and out of a country, the observed relation between openness and transfers can be reinterpreted as being consistent with the predictions of my model. Higher volatility means that insurance is more valued and therefore more taxes can be collected. The counterpart of this higher tax collection is a higher level of intergenerational transfers that help to support a higher level of insurance for the economy. Finally more insurance requires a larger volume of capital flows ("openness"). It should be noted that although the correlation is the same as in the above mentioned papers, the causality is reversed. It is uncertainty that leads to more "openness", not the other way around.

5 Appendix

Lognormal income shocks

To get the three equations in the three unknowns: C_1, Σ, and Y_1^*, I assume from now on that the income shocks are lognormally distributed.

$$\ln Y_1 \sim N(\mu_1, \sigma_1) \qquad \ln Y_2 \sim N(\mu_2, \sigma_2)$$

The first equation is simply 7, the $(I.C.Y.)$ holding as an equality for Y_1^*. I rewrite it here splitting the integral on the logarithm of second period consumption in two parts, the one over which consumption is constant, and the one over which consumption is given by income. To simplify notation I define $\Phi_2 \equiv Prob(Y_2 < (1+\Sigma)C_1)$,

$$\ln C_1 + \beta\Phi_2 \ln(1+\Sigma)C_1 + \beta \int_{(1+\Sigma)C_1}^{\infty} \ln Y_2(s) f(Y_2) ds = \ln Y_1^* + \beta \int \ln Y_2(s) f(Y_2) ds \tag{13}$$

The second one is obtained by averaging the expressions for the consumption of the young given by equations (5) and (8), and simply gives an expression for Σ. To simplify notation I define $\Phi_1 \equiv Prob(Y_1 < Y_1^*)$

$$(1+\Sigma) = Prob[Y_1 < Y_1^*] + \frac{1}{Y_1^*} \int_{Y_1^*}^{\infty} Y_1(s) f(Y_1) ds \tag{14}$$

The last one comes from the average resource constraint of the economy that says that the average consumption of the young plus the average consumption of the old should be equal to the average income.

$$C_1(1+\Sigma) + C_1(1+\Sigma)\Phi_2 + \int_{(1+\Sigma)C_1}^{\infty} Y_2(s) f(Y_2) ds \; = \; \bar{Y_1} + \bar{Y_2} \tag{15}$$

Comparative Statics

To derive comparative statics results I use Cramer determinant method. The first step is to get the determinant of the matrix A given by the derivatives of (13) – (15) with respect to the three variables C_1, Σ, and Y_1^*. This is given by,

$$det\ A \ = \ \left| \begin{array}{ccc} \frac{1+\beta\Phi_2}{C_1} & \frac{\beta\Phi_2}{1+\Sigma} & -\frac{1}{Y_1^*} \\ 0 & 1 & \frac{1+\Sigma-\Phi_1}{Y_1^*} \\ (1+\Sigma)(1+\Phi_2) & C_1(1+\Phi_2) & 0 \end{array} \right|$$

$$det\ A \ = \ \frac{\Phi_1(1+\Phi_2)}{Y_1^*} > 0$$

To get the effect of a change in σ_1 on the equilibrium I have to get the derivative of the three equations with respect to σ_1 and replace this in each of the columns of A. Then calculate the determinant of each of this modified matrices. Minus the ratio of this determinant over the determinant of A is the corresponding partial derivative of each variable with respect to σ_1. I get,

$$\frac{dC_1}{d\sigma_1} \ = \ -\frac{\phi_1 C_1}{\Phi_1} < 0$$

$$\frac{d(1+\Sigma)}{d\sigma_1} \ = \ \frac{\phi_1(1+\Sigma)}{\Phi_1} > 0$$

$$\frac{dY_1^*}{d\sigma_1} \ = \ -\frac{\phi_1 Y_1^*}{\Phi_1} < 0$$

Where ϕ_1 is an abreviation for the density function for first period income evaluated at Y_1^*. From this relations I can derive the desired results. For example it is direct that changes in first period volatility do not affect the minimum second period consumption $C_2 = C_1(1+\Sigma)$, nor the tax rate $1-\frac{C_1}{Y_1^*}$. Utility goes down, but the lifetime surplus goes up. This last result can be derived as follows. First remember that I had that lifetime utility was given by,

$$S \ = \ \int_0^{Y_1^*} [\ln C_1 - \ln Y_1] f(Y_1(s)) ds$$

then,

$$\frac{dS}{d\sigma_1} \ = \ \Phi_1\sigma_1 > 0$$

It is easy to see what are the effects of an increase in β. Transfers and taxes increase, as does the minimum consumption level in the first periods C_1. Thus unambiguously the suplus S increases. To get other comparative statics I do a simplification in order to reduce the problem to one of two equations in two unknowns. I do this by having old's income taking two levels, Y_2^H with probability q, and Y_2^L with probability $1-q$. This allows to write C_1 as,

$$C_1 = \frac{\bar{Y} - qY_2^H}{(2-q)(1+\sum_{s\in S}\lambda(s))}$$

Replacing this expression in the first two equation (10) and (11) gives a system of two equations in two unknowns: Σ and Y_1^*. Increasing the volatility of second period consumption increases the level of transfers and taxes. There is a decrease in C_1 and therefore in the surplus S. I can also get the influence of a swift in average income from the young to the old. These reduce the value of transfers, reducing taxes transfers, C_1, and the surplus S.

Political Economy

Let's solve now for the two special cases mentioned in section 4, i.e. when power is always in the hands of the same age group. I start by analysing the case of $\theta = 1$, i.e. when the young are in power every period. In this case the young maximize their lifetime expected utility subject to the relevant constraints. The problem is given by equation (8). The set-up is very similar to the social planner one, and I do not repeat the first order conditions here. Let's note that the expression for $\hat{C}_2$ is now given by

$$\hat{C}_2 \;=\; \beta(1+\Sigma)C_1$$

Therefore the only change from the social planner case is that it is multiplied by β. Let's rewrite the system of three equations in three unknowns for this case and see what are the consequences of this change

$$\ln \hat{C}_1 + \beta\Phi_2 \ln \beta(1+\Sigma)\hat{C}_1 + \beta \int_{\beta(1+\Sigma)\hat{C}_1}^{\infty} \ln Y_2(s) f(Y_2) ds = \ln Y_1^* + \beta \int \ln Y_2(s) f(Y_2) ds$$

$$(1+\Sigma) = Prob[Y_1 < Y_1^*] + \frac{1}{Y_1^*}\int_{Y_1^*}^{\infty} Y_1(s) f(Y_1) ds$$

$$\hat{C}_1(1+\Sigma) + \beta\hat{C}_1(1+\Sigma)\Phi_2 + \int_{\beta(1+\Sigma)\hat{C}_1}^{\infty} Y_2(s) f(Y_2) ds \; = \; \bar{Y_1} + \bar{Y_2}$$

So the only difference is that now there is a factor of β in one term in the LHS of the first and the third equations. By taking comparative statistics from the social planner's outcome when this $\beta < 1$ is introduced in these terms we can get the effect on the equilibrium allocations. What I find is that C_1 increases and C_2 decreases. There is a decreases in aggregate insurance, as measured by $C_1 + C_2$. Being two different optimizations, comparisons of welfare are meaningless.

Let's consider now the case when the old are always in power, i.e. when $\theta = 0$. The old maximize their utility subject to the constraint that in every state they consume at least their income and that the young do not want to default. Since they do not care about the utility of the young, the $(I.C.Y.)$ holds with an equality for every state i, giving the young an expected lifetime utility equal to the autarky one. This is the maximization problem,

$$\max_{\check{C}_1(s), \check{C}_2(s), \check{P}(s)} \quad \sum_{s \in S} q_s \ln \check{C}_2(s)$$

$$s.t. \;\; (R.C.)\; \check{C}_1(s) + \check{C}_2(s) \; = \; Y_1(s) + Y_2(s) - \check{P}(s)$$

$$(I.R.)\; \sum_{s \in S} q_s \check{P}(s) \; = \; 0$$

$$(I.C.Y.)\; \ln \check{C}_1(s) + \beta \sum_{z \in S} q_z \ln \check{C}_2(z) \geq \ln Y_1(s) + \beta \sum_{z \in S} q_z \ln Y_2(z)$$

$$(I.C.O.)\; \check{C}_2(s) \geq Y_2(s)$$

From the $(I.C.Y.)$ we see that for all states s the ratio $\check{C}_1(s)/Y_1(s)$ is constant and given by,

$$\frac{\check{C}_1(s)}{Y_1(s)} = e^{-\beta\{\sum_{z\in S} q_z[\ln \check{C}_2(z) - \ln Y_2(z)]\}}$$

The logic is similar to the social planner case and it is the transfers that she expects to receive when old that provide the incentive to the young to be taxed. The difference is that in this case the young do not receive any insurance, therefore the lifetime utility is the same as in autarky. Thus the more likely it is that the old are in power the lower the utility gains from foreign insurance, and in the limiting case that they are always in power there are no gains.

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