The politics of sovereign default under financial integration

Marina Azzimonti
Stony Brook University

Vincenzo Quadrini
University of Southern California

PRELIMINARY AND INCOMPLETE

Abstract

In this paper, we study the optimal default of sovereign debt in a two-country model with large economies which are financially integrated. Relative to a closed economy, the integration of financial markets increases the incentives to default by a given country not only because part of the defaulted debt is owned by foreigners (the standard channel), but also because the endogenous macroeconomic cost of default is smaller when the defaulting country is financially integrated. In our model, government debt is held by producers for insurance purposes. When financial markets are integrated, the portfolio of producers also includes foreign government debt, which allows them to hedge against domestic defaults. The domestic country internalizes that producers are only partially affected by a default, and that this has smaller consequences for aggregate production, all of which reduces the costs of default. Furthermore, we show that increases in external liquidity (e.g. in the stock of safe debt issued by the foreign country) make defaults less costly and hence more likely. This implies that the sovereign default of a country could be externally induced by the excessive borrowing of foreign countries. Interestingly, the resulting crowding out of riskier debt results in larger spreads not only because the interest rate on risky debt increases, but also because the risk-free rate declines. In other words, increases in the supply of risk-free rate may result in declines in its interest rate as a result of changes in the portfolio composition of producers.

1 Introduction

Following the recent debt crisis in Europe, there has been a revival of the literature on sovereign default. The primary interest of this literature is to understand the conditions under which countries decide or are forced to default and the main forces that bring countries to these conditions.

The majority of studies focus on the dynamics that take place within a defaulting country. For example, a sequence of negative productivity or fiscal shocks induces the country to borrow more and, if the economic situation continues to deteriorate, it becomes optimal or necessary for the country to default. Sometimes, however, the mechanism that leads a country to default, may not originate domestically. One of the goals of this paper is to explore some of the possible external mechanisms.

A trend that we have seen during the last 30 years is an increase in government debt in the majority of industrialized countries. This trend does not characterize only the 'troubled' countries, that is, countries that experienced difficulties in refinancing their sovereign debt (see Figure 1) but also the 'safe' countries, that is, countries that did not experience these difficulties (see Figure 2).

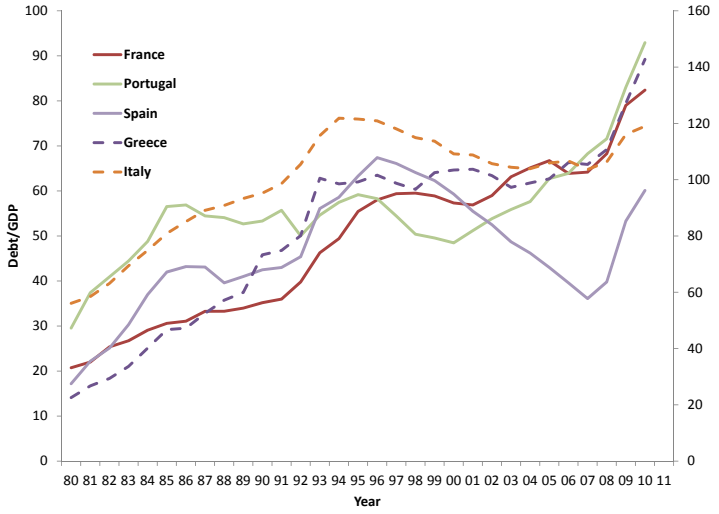


Figure 1: Debt to GDP in Portugal, Ireland, Greece, Spain and France

The increase in government debt took place in the period in which financial markets became more globalized, that is, a period in which cross-country

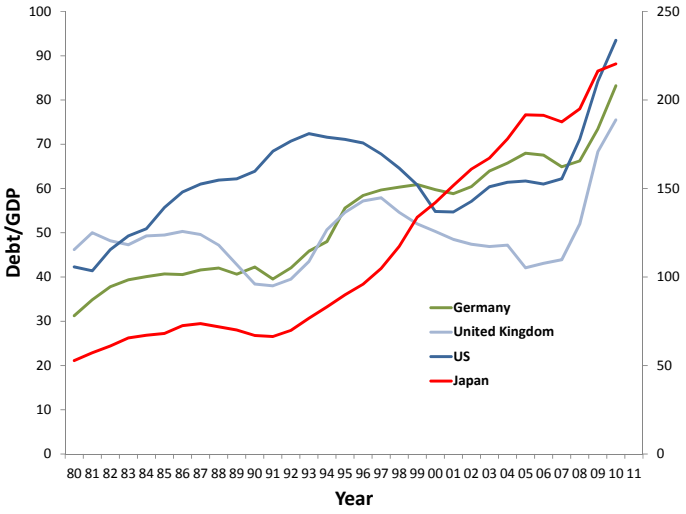


Figure 2: Debt to GDP in UK, US, Germany, and Japan

ownership of financial assets, including sovereign debt (see Figure 1), increased substantially. Of course, if a larger share of sovereign debt is held by foreigners, the incentive of the government to default may increase since default redistributes wealth from foreign residents to domestic residents. This mechanism is well recognized in the literature (although there are studies challenging this view like Broner and Ventura).

In this paper, however, we explore a second mechanism through which financial globalization increases the incentive of a country to default. We show that the negative macroeconomic consequences of default are smaller when financial markets are globalized.

Why are the negative macroeconomic consequences of default smaller when the country is financially integrated? The central mechanism is the disruption that default generates in financial markets. When a government defaults on its debt, the holders of government debt incur capital losses. To the extent that financial wealth is important for economic decisions, this has a negative effect on aggregate economic activity. However, when financial markets are integrated, domestic residents hold a smaller share of their wealth in domestic financial assets (part of which are sovereign debt) and, therefore, a larger share in foreign assets. This implies that, when the domestic government defaults, the wealth losses of domestic residents will be smaller and this

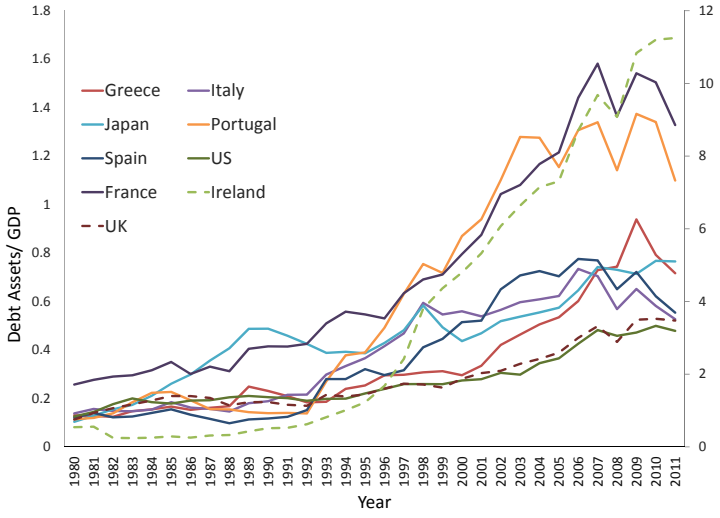


Figure 3: External debt assets as a percentage of GDP (Greece, Portugal, Japan, UK, US, France, Ireland, Italy, Spain)

generates a smaller macroeconomic contraction. Being the macroeconomic cost smaller, the government has a higher incentive to default.

When looking at the problem from this prospective, it is possible to see the origin of the European debt problems not only on the rising debt of the defaulting countries (which obviously also played a role) but also on the rising debt of the supposedly 'safe' countries like Germany, United States and Japan. As the stock of safe debt raised worldwide, so did the holdings of this debt in risky countries. Because the share of financial wealth that was immune to domestic default decreased, the cost of sovereign default declined. This increased the incentives of the risky countries to default.

To study this mechanism, we consider a two-period/two-country model where country 1 is a 'risky' country and country 2 is a 'safe' country. The issuance of debt and its repayment are chosen optimally by the governments of both countries. Using this model we consider an exogenous change in the debt of country 2 and study how this affects the incentive of country 1 to default. An increase in debt in country 2 does not affect only the incentive of country 1 to default. It also affects the incentive of country 1 to change the issuance of its own debt, which also changes the ex-post incentive to default.

To isolate the impact of higher debt issued by country 2 on country 1

default from the impact of the change in country 1 debt, we conduct a counterfactual exercise. We impose that the government of country 1 cannot change the stock of its own debt in response to the change in the debt of country 2. Through this exercise we are able to show that the incentive of country 1 to default increases even if its own debt does not change and the share of its debt owned by foreigners stays the same.

This result has a simple intuition. As the debt of country 2 increases, residents in country 1 acquire (hold) more foreign debt. This implies that the holding of safe, nondefaultable debt increases in country 1. Then, if the domestic government defaults, domestic agents face a proportionally smaller loss in their financial wealth, which in turn implies that the negative macroeconomic consequences of default are smaller. This reduces the macroeconomic cost of default and increases the incentive of the government to default.

A related implication is that this mechanism creates the conditions for greater instability also in country 2, even if the debt of this country is safe. This is because the higher incentive to default in country 1 implies higher potential wealth losses for the residents of country 2 since they hold part of the debt of country 1. Thus, country 2 will also experience a potential macroeconomic cost. This helps us understand why safe countries have a vested interest in avoiding default of 'risky' countries. It also illustrates a potential inefficiency in government policies: when a government chooses to default, it does not take into account the macroeconomic cost that other countries incur.

2 Literature review

This paper builds on a large literature on public debt determination under incomplete markets. An influential theoretical literature studies the optimal choice of public debt over the business cycle with contributions by Barro (1979); Lucas and Stokey (1983); Aiyagari et al. (2002); and Marcet and Scott (2009).[1] We depart from the tax-smoothing mechanism by abstracting from distortionary taxation. Instead, we focus on the role of heterogeneity within a country, which is assumed away in these papers. The main role of government debt in our paper is to partially complete the assets market when

[1]See Pouzo and Presno (2014), who extended Aiyagari et al. (2002)'s framework to incorporate default and renegotiation.

agents are subject to uninsurable idiosyncratic risk. The mechanism is similar to that in Aiyagari and McGrattan (1998), Azzimonti, de Francisco, and Quadrini (2014, AFQ henceforth), Golosov and Sargent (2012), and Floden (2001), who study heterogeneous agents models without default. Closest to our paper is the work by Azzimonti, de Francisco, and Quadrini (2014), in which debt also acts a self-insurance mechanism affecting consumption dispersion. There are, however, three main departures from that paper. First, our economy is subject to both idiosyncratic and aggregate uncertainty, whereas AFQ only considers the first type of uncertainty. Second, the stock of public debt affects labor markets and hence the level of production. Finally, and more importantly, debt can be partially defaulted on in this model. Because of this, our paper is also related to a growing literature on external sovereign default based on the influential work of Eaton and Gersovitz (1981) (e.g. Aguiar and Amador (2013), Aguiar and Gopinath (2006), Arellano (2008), Cuadra, Sanchez, and Sapriza (2010), Yue (2010), among others).[2]

Because defaults cause redistribution, and affects agents asymmetrically, our work is related to the literature on political economy and sovereign default. Alesina and Tabellini (1990), Aghion and Bolton (1990), D'Erasmo and Mendoza (2013, 2016), Dovis, Golosov, and Shourideh (2014) focused on the consequences of default in closed economies, whereas Amador (2003), Aguiar, Amador, Farhi, and Gopinath (2013), Guembel and Sussman (2009), Hatchondo, Martinez, and Sapriza (2009), Mendoza and Yue (2012), and Tabellini (1991) concentrated on external defaults instead.

The paper is also related to a sub-strand of this literature that focuses on the consequences of default on domestic agents and the role of secondary markets in cases where debt provides liquidity (see Guembel and Sussman (2009), Broner, Martin, and Ventura (2010), Broner and Ventura (2011), Gennaioli, Martin, and Rossi (2014), Basu (2009), Brutti (2011), and Di Casola and Sichlimiris (2014)). As in these studies, the government cannot discriminate across any of its creditors (local vs foreign) when it defaults. Extending the work of Gennaioli, Martin, and Rossi (2014), a recent set of papers studies the interaction between sovereign debt and domestic financial institutions (e.g. Sosa-Padilla (2012), Bocola (2014), and Perez (2015)). Like in our paper, the cost of default is endogenous in their work, as it disrupts the financing of productive firms and creates a recession. Because they focus on

[2]See Aguiar and Amador (2014) or Tomz and Wright (2012) for recent reviews of this literature.

domestic debt, the effects of increases in the supply of debt by safe countries is ignored, which is at the core of our paper.

As in Arellano and Bai (2008), a default in the domestic country affects other countries through changes in the interest rate.[3] In their paper, this results from borrowers being risk-averse, whereas in our case it arises from strategic interaction between the governments of these countries. The difference arises because they restrict attention to small open economies, whereas we consider large open economies which are not price-takers.

3 Environment

Consider a two-period model with two countries: home and foreign. We start analyzing the economy when the two countries are not financially integrated. Therefore, for the moment, we can focus on a single county and characterize the equilibrium in isolation from the foreign sector. After doing so we will consider the case with integrated financial markets where the equilibrium is determined jointly in the two countries. This presentation sequence will make clear the role played by financial markets integration.

In each country there are two types of agents: a measure 1 of workers and a measure 1 of entrepreneurs. The assumption that the number of workers is the same as the number of entrepreneurs is without loss of generality because the equilibrium is unaffected by the relative size of the two groups. Production takes place only in period 2. In period 1 the available resources are exogenously given. Workers start the period with wealth e and entrepreneurs with wealth a. We can think of e and a as the wealth of workers and entrepreneurs accumulated up to the end of period 1. Out of this wealth agents decide how much to consume and invest and they move to period 2. In the terminal period 2, workers supply labor while entrepreneurs produce with the input of labor hired from workers. Therefore, production takes place only in the second period.

The production function run by entrepreneurs in period 2 takes the form

$$y_2 = A(z_2, \varepsilon_2) l_2,$$

[3]See also Borri and Verdelhan (2009), Park (2013), and Lizarazo (2013) for similar environments and Pouzo and Presno (2011) for a setup with lenders with uncertainty aversion

where l_2 is the input of labor, z_2 is an aggregate shock (aggregate productivity) known before choosing the input of labor and ε_2 is an idiosyncratic shock observed after choosing the input of labor. The assumption that the idiosyncratic shock is observed after choosing l_2 implies that production is risky and this feature plays an important role in the model.

The cost of labor is the wage rate w_2 which is determined in equilibrium to clear the labor market. There is no market for contingent claims. Therefore, the idiosyncratic risk cannot be perfectly insured. Also, the wage cannot be contingent on the realization of ε_2. The only way for entrepreneurs to insure the risk is through the purchase of government bonds as discussed below.

The utility of workers is

$$U(c_1) + \beta U\Big(\bar{c}(c_2, h_2)\Big) = \ln(c_1) + \beta \ln\left(c_2 - \alpha \frac{h_2^{1+\frac{1}{\nu}}}{1+\frac{1}{\nu}}\right),$$

where c_1 and c_2 denote consumption in period 1 and 2, respectively, and h_2 is the labor supplied in period 2. The function $\bar{c}(.,.)$ denotes, in a compact form, consumption net of the dis-utility of working.

The utility of entrepreneurs is

$$u(d_1) + \beta u(d_2) = \ln(d_1) + \beta \ln(d_2),$$

where d_1 and d_2 denote their consumption in period 1 and 2, respectively.

Since there is no production in period 1, the only choices that workers and entrepreneurs make in the first period is to save out of their endowment. However, because workers cannot borrow, the only way in which entrepreneurs can save in equilibrium is by purchasing government bonds.

Denote by B_1 the bonds issued by the government and by $1/R_1$ the equilibrium price for these bonds. The government revenues in period 1 are distributed to workers with lump-sum transfers. Thus, the per-worker transfers, denoted by T_1, are equal to

$$T_1 = \frac{B_1}{R_1}. \tag{1}$$

Effectively, the government borrows on behalf of workers. Notice that, since B_1 is not restricted to be positive, the government could choose to save. In practice, we will focus on parameter values for which B_1 is positive but, theoretically, it could be possible for the government to save instead of borrowing.

In period 2 the government has to repay the debt and to do so it has to tax workers (or make transfers to them if $B_1 < 0$). However, the government could also choose to default and repay only a fraction $\delta_2 \leq 1$ of the debt. Denoting by $\tilde{B}_2 = \delta_2 B_1$ the chosen repayment, the lump-sum taxes paid by workers (negative transfers) are

$$T_2 = -\tilde{B}_2. \tag{2}$$

The government's welfare function is the weighted sum of the utility of workers and entrepreneurs,

$$(1-\Psi)\Big[U(c_1) + \beta \mathbb{E}_z U\Big(\bar{c}(c_2, h_2)\Big)\Big] + \Psi\Big[u(d_1) + \beta \mathbb{E}_{z,\varepsilon} u(d_2)\Big],$$

where Ψ denotes the relative weight assigned to entrepreneurs in period 1. The expectation in the second term of the welfare function is with respect to both the aggregate and idiosyncratic shocks because the consumption of entrepreneurs in the second period depends also on the idiosyncratic shock.

We will see later that under certain conditions, workers choose not to save. Then, the workers' budget constraints in the first and second periods are, respectively,

$$\begin{aligned} c_1 &= e + T_1, \\ c_2 &= w_2 h_2 + T_2. \end{aligned}$$

The budget constraints for entrepreneurs in the first and second periods are,

$$\begin{aligned} d_1 &= a - \frac{b_1}{R_1}, \\ d_2 &= \Big[A(z_2, \varepsilon_2) - w_2\Big] l_2 + \delta_2 b_1, \end{aligned}$$

where b_1 represents the government bonds purchased in period 1 by the entrepreneur.

Shocks, uncertainty and timing. There are two sources of uncertainty: (i) The aggregate productivity shock z_2; and (ii) The idiosyncratic productivity shock ε_2. Aggregate and idiosyncratic shocks are both realized in period 2. However, while the aggregate shocks z_2 are revealed before agents and government make any decisions in period 2, the idiosyncratic shock is revealed at the end of the period after the repayment decision of the government and after the hiring decisions of entrepreneurs. Following is the detailed description of the timing sequence of information and decisions.

Period 1:

1. The government chooses the debt B_1.
2. Entrepreneurs choose their savings b_1.
3. The interest rate R_1 clears the market for government bonds.

Period 2:

1. Aggregate productivity z_2 becomes known.
2. Given the debt B_1, the government chooses the repayment $\tilde{B}_2 = \delta_2 B_1$.
3. Entrepreneurs choose the input of labor l_2 before knowing the idiosyncratic productivity ε_2 and workers choose the supply of labor h_2. The wage w_2 will clear the labor market.
4. The idiosyncratic productivity ε_2 is realized, production and consumption take place.

4 Equilibrium given policy

We start characterizing the equilibrium for given government policies. To simplify notation, from now on we abstract from the time subscript unless it is necessary to avoid ambiguities. For example, B without subscript denotes the debt issued by the government in period 1 and $\tilde{B}$ denotes the repayment of the debt in period 2. If the government repays the debt in full then $\tilde{B} = B$. The variable h denotes the labor supply by a worker in period 2. Also in this case we can abstract from time subscripts because workers supply labor only in period 2. Along the same line, we omit the time subscript in the shocks since they are only realized in period 2.

Government policies are denoted by $\pi = (B, \tilde{B}(z))$. While borrowing is chosen in period 1, the repayment is chosen in period 2 after the observation of the aggregate shock. Therefore, the repayment depends on the realization of z. Individual decisions and the equilibrium wage in period 2 are also functions of z.

The workers' problem can be written as

$$U\Big(c_1(\pi)\Big) + \beta \mathbb{E}_z U\left(\bar{c}\Big(c_2(\pi, z), h(\pi, z)\Big)\right) \tag{3}$$

subject to

$$c_1(\pi) = e + \frac{B}{R(\pi)} \tag{4}$$

$$c_2(\pi, z) = w(\pi, z)h(\pi, z) - \tilde{B}(z). \tag{5}$$

The entrepreneurs' problem can be written as

$$u\Big(d_1(\pi)\Big) + \beta \mathbb{E}_{z,\varepsilon} u\Big(d_2(\pi, z, \varepsilon)\Big) \tag{6}$$

subject to

$$d_1(\pi) = a - \frac{b(\pi)}{R(\pi)} \tag{7}$$

$$d_2(\pi, z, \varepsilon) = \Big[A(z, \varepsilon) - w(\pi, z)\Big] l(\pi, z) + \delta(z) b(\pi) \tag{8}$$

Definition 1 *A competitive equilibrium for given policies $\pi = \{B, \tilde{B}(z)\}$ is defined by price functions $R(\pi)$ and $w(\pi, z)$, decision functions for workers, $c_1(\pi)$, $h(\pi, z)$, $c_2(\pi, z)$, and entrepreneurs, $b(\pi)$, $d_1(\pi)$, $l(\pi, z)$, $d_2(\pi, z, \varepsilon)$, such that workers solve problem (3), entrepreneurs solve problem (6), asset and labor markets clear, that is, $b(\pi) = B$ and $l(\pi, z) = h(\pi, z)$.*

While the decisions of workers reduce to the choice of labor in period 2, the decisions of entrepreneurs are more complex. Because of the concavity of the utility function, the saving and hiring decisions of entrepreneurs take into account the risk associated with production. The following lemma characterizes the optimal entrepreneurs' decisions.

Lemma 2 *Let $\phi(\pi, z)$ satisfy the condition $\mathbb{E}_\varepsilon \frac{A(z,\varepsilon)-w(\pi,z)}{1+[A(z,\varepsilon)-w(\pi,z)]\phi(\pi,z)} = 0$. The entrepreneurs's decisions take the form*

$$\begin{aligned} b(\pi) &= \frac{a\beta}{1+\beta} R(\pi) \\ d_1(\pi) &= \frac{a}{1+\beta} \\ l(\pi, z) &= \phi(\pi, z)\delta(z)b(\pi) \\ d_2(\pi, z, \varepsilon) &= \Big[1 + \Big(A(z, \varepsilon) - w(\pi, z)\Big)\phi(\pi, z)\Big]\delta(z)b(\pi) \end{aligned}$$

Proof. See Appendix **??** ■

The competitive equilibrium for given government policies $\pi = (B, \tilde{B}(z))$ can be computed recursively as shown in Appendix **??**. The following lemma characterizes how the equilibrium responds to changes in $\tilde{B}(z)$.

Lemma 3 *Suppose that $\phi(\pi, z) > 0$ for all $\tilde{B}(z) \geq 0$. Then,*

1. *The factor $\phi(\pi, z)$ is strictly decreasing in $\tilde{B}(z)$;*
2. *Wages and employment are (weakly) increasing in $\tilde{B}(z)$.*

Proof. See Appendix **??**. ■

We have established that $w(\pi, z)$ and $l(\pi, z)$ are increasing functions of the debt repayment $\tilde{B}(z)$. This implies that if the second period government decides to partially default on the debt, both employment and wages will decline. Therefore, government default will generate a macroeconomic contraction. The central mechanism through which default generates a contraction is by destroying the financial wealth of entrepreneurs. This has two effects. On the one hand, it redistributes wealth from entrepreneurs (who hold the government debt) to workers (who have to pay taxes to repay the debt). Notice that the assumption that only workers pay taxes is not essential. The mechanism would still operate if taxes were equally paid by workers and entrepreneurs. What matters is that taxes are not proportional to the holding of public debt. Thus, default implies that agents who hold the debt (the entrepreneurs) experience a net loss while agents who do not hold the debt (the workers) experience a net gain.

Although default redistributes wealth from entrepreneurs to workers, it also induces a recession which would have negative consequences for workers (through the lower demand of labor and, consequently, lower wages). Therefore, from the perspective of workers, government default implies a trade-off: the benefit is the lower payment of taxes and the cost is the reduction in labor income. From the perspective of entrepreneurs, instead, government default implies only a cost. These considerations will be key to understand the optimal choice of government policies.

5 Determination of government policies

To characterize the government's problem we proceed backward. We first consider the problem solved in period 2 and then, given the optimal policy in the second period, we solve the government's problem in period 1.

Government problem in period 2. In the second period, given B and the realization of aggregate productivity z, the government solves

$$\max_{\tilde{B}\leq B} \quad \left\{(1-\Psi)U\Big(\bar{c}\Big(c_2(\pi,z),h(\pi,z)\Big)\Big)+\Psi\mathbb{E}_\varepsilon u\Big(d_2(\pi,z,\varepsilon)\Big)\right\}. \quad (9)$$

Consider first the relaxed problem where the choice of the repayment is not subject to the constraint $\tilde{B}\leq B$ (or $\delta\leq 1$). Assuming that the objective function (9) is strictly concave in $\tilde{B}$, there will be a unique solution to the government problem characterized by the first order condition. We show in the appendix that the first order condition is

$$(1-\Psi)U'\Big(\bar{c}\Big(c_2(\pi,z),h(\pi,z)\Big)\Big)=\Psi\mathbb{E}_\varepsilon u'\Big(d_2(\pi,z,\varepsilon)\Big), \quad (10)$$

where the prime denotes the derivative of the utility function. The government equalizes the marginal utility of consumption for workers (net of the dis-utility from working) to the expected marginal utility of consumption for entrepreneurs, which is intuitive. Using this condition we derive the following result.

Proposition 4 *The optimal repayment $\tilde{B}(z)$ is strictly increasing in the aggregate shock z.*

Proof. See Appendix ? ■

This result shows that the incentive to default, that is, the incentive to repay a lower value of the debt, is higher when the country is in recession. To understand why we have to consider the two effects induced by default. The first effect is the redistribution of wealth from entrepreneurs to workers. The second effect is the amplification of the recession: as $\tilde{B}$ declines, entrepreneurs' financial wealth declines and this reduces the demand of labor. The amplification effect of a recession is damaging for workers. However, since their consumption is low when productivity is low, the marginal utility of workers is high. From the prospective of the government, this increases the benefit of redistributing wealth toward workers which increase the incentive to default (the first effect).

Denote by $\hat{B}(z)$ the unconstrained optimal repayment. This is the solution to the government problem (9) without the constraint $\tilde{B} \leq B$, which satisfies the first order condition (10). Figure 4 plots the government indirect utility for two levels of aggregate productivity. We can see that when productivity is high the government prefers a higher repayment, that is, $\hat{B}(z_H) > \hat{B}(z_L)$.

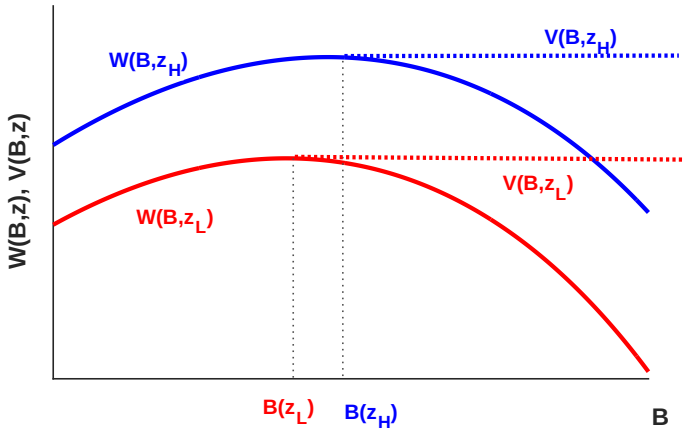


Figure 4: Second period welfare. Constrained indirect utility is denoted by $V(B, z)$ and unconstrained utility is denoted by $W(B, z)$.

After characterizing the unconstrained optimal repayment, we can now characterize the constrained optimal policy which is subject to the constraint

$\tilde{B}(z) \leq B$. This is given by

$$\mathcal{B}(B,z) = \begin{cases} B, & \text{if } B \leq \hat{B}(z) \\ \\ \hat{B}(z), & \text{if } B > \hat{B}(z). \end{cases}$$

In the second period the government can choose to repay the full value of the debt or negotiate a lower repayment. If the preferred repayment $\hat{B}(z)$ is larger than B, the government will repay the debt in full, that is, $\tilde{B}(z) = B$. However, if $\hat{B}(z) < B$, the government will default and repay $\hat{B}(z)$. The fraction repayed is simply equal to $\delta(B,z) = \hat{B}(z)/B$.

Government problem in period 1. Because of the particular specification of preferences (log-utility), government policies do not affect consumption in period 1. In fact, Lemma 2 shows that the consumption of entrepreneurs in period 1 is equal to $d_1 = a/(1+\beta)$ and, therefore, is independent of B. The consumption of workers is $c_1 = e - B/R(\pi)$. But Lemma 2 shows that $B/R(\pi) = a\beta/(1+\beta)$. Therefore, c_1 is also independent of B. We can then characterize the government problem in period 1 ignoring the flow of utility in period 1 (since this is independent of government policies) and write it as

$$\max_B \quad \mathbb{E}_z \left\{ (1-\Psi) U\left(\bar{c}\Big(c_2(\hat{\pi}, z), h(\hat{\pi}, z) \Big) \right) + \Psi \mathbb{E}_\varepsilon u\left(d_2(\pi, z, \varepsilon) \right) \right\},$$

where the policy vector $\hat{\pi} = (B, \mathcal{B}(B,z))$ now contains the optimal repayment policy chosen by the government in period 2 as characterized above. Therefore, by choosing the debt today the government affects the optimal repayment in period 2.

Notice that the maximization problem above can be rewritten more compactly as

$$\max_B \mathbb{E}_z V(B,z).$$

The objective is a weighted sum of the dotted lines in Figure 4, where the weights are given by the probabilities of different realizations of aggregate TFP z. Because $V(B, z_L)$ is constant for $B > \hat{B}(z_L)$ whereas $V(B, z_H)$ is increasing, it must be that the objective function, namely $\mathbb{E}_z V(B,z)$, is increasing up to $\hat{B}(z_H)$. This implies that the optimal value of debt chosen

by the first period government, B^*, is

$$B^* = \hat{B}(z_H).$$

The government in the first period is constrained by default decisions of the second period government. By choosing the largest possible value of sustainable debt $\hat{B}(z_H)$, it will have the option of reducing it in bad times. Notice that during booms debt is repaid in full $\delta(B^*, z_H) = 1$, whereas partial defaults are observed in recessions, $\delta(B^*, z_L) = \hat{B}(z_L)/\hat{B}(z_H)$. The size of default depends on the relative weight of workers and entrepreneurs, as well as on the degree of aggregate uncertainty (that is, the distance between z_H and z_L). This choice of first period debt, together with the ability of partially defaulting in the second period, attempts to replicate allocations available with state-contingent debt (an instrument which the government does not have in this environment).

By solving the government's problem backward, we have effectively characterized the time consistent problem. This raises the question of whether government commitment matters for the equilibrium. With commitment the government would choose both B and $\tilde{B}(z)$ in period 1. Notice that the repayment choice is contingent on the realization of the aggregate productivity in period 2. It turns out that in autarky the commitment problem is time-consistent. In other words, the government has no incentive to change $\tilde{B}(z)$ chosen in period 1 after the observation of z even if it is allowed to do so. As we will see, however, this result does not carry to the environment with financially integrated markets.

6 Financial Integration

In this section we consider the case in which the two countries are financially integrated and, therefore, they can trade sovereign bonds. Labor, however, is immobile. We refer to the first country as 'home' country and to the second as 'foreign' country. We will denote by B^h the debt issued by the home country and by B^{hh} and B^{hf} the home debt held, respectively, by entrepreneurs in the home and foreign countries. In equilibrium, $B^h = B^{hh} + B^{hf}$. Similarly, the debt issued by the foreign country is denoted by B^f, in part held by entrepreneurs in the home country, B^{fh}, and in part by entrepreneurs in the foreign country, B^{ff}. Therefore, the first superscript denotes the country that issued the debt and the second subscript the country that holds it.

The two countries are homogeneous except in the commitment to repay the debt. While the home country does not commit to repay the debt, and therefore, it could default in period 2, the foreign country commits to repay the debt. This implies that, while for the home country $\tilde{B}^h$ may differ from B^h, for the foreign country $\tilde{B}^f = B^f$. The prices for home and foreign bonds are, respectively, $1/R^h$ and $1/R^f$. Even though financial markets are perfectly integrated, the prices for home and foreign bonds could differ because of the different probability to default.

The set of states in period 2, denoted by s, now includes variables of both countries $s = (z^h, z^f, B^{hh}, B^{hf}, B^{fh}, B^{ff})$. The policy variables are $\pi = (B^h, B^f, \tilde{B}^h(s))$.

Definition 5 *With financially integrated markets, a competitive equilibrium for given policy π is defined by prices $\{R^i, w^i(\pi, s)\}_{i\in\{h,f\}}$, decision functions for workers $\{c_1^i(\pi), h^i(\pi, s), c_2^i(\pi, s)\}_{i\in\{h,f\}}$, decision functions for entrepreneurs $\{b^{hi}(\pi), b^{fi}(\pi), d_1^i(\pi), l^i(\pi, s), d_2^i(\pi, s, \varepsilon)\}_{i\in\{h,f\}}$, such that*

1. *Workers in country i maximize*

$$U\Big(c_1^i(\pi)\Big) + \beta\mathbb{E}_s U\bigg(\bar{c}\Big(c_2^i(\pi, s), h^i(\pi, s)\Big)\bigg)$$

subject to

$$c_1^i(\pi) = e + \frac{B^i}{R^i(\pi)}$$

$$c_2^i(\pi, s) = w^i(\pi, s)h^i(\pi, s) - \tilde{B}^i(s);$$

2. *Entrepreneurs in country i maximize*

$$u\Big(d_1^i(\pi)\Big) + \beta\mathbb{E}_{s,\varepsilon}\Big(d_2^i(\pi, s, \varepsilon)\Big)$$

subject to

$$d_1^i = a - \frac{b^{hi}(\pi)}{R^h(\pi)} - \frac{b^{fi}(\pi)}{R^f(\pi)}$$

$$d_2^i(\pi, s, \varepsilon) = \Big[A(z^i, \varepsilon^i) - w^i(\pi, s)\Big]l^i(\pi, s) + \delta^h(\pi, s)b^{hi}(\pi) + b^{fi}(\pi).$$

3. Asset and labor markets clear, that is, for $i \in \{h, f\}$

$$\begin{aligned} B^i &= b^{ih}(\pi) + b^{if}(\pi), \\ l^i(\pi, s) &= h^i(\pi, s). \end{aligned}$$

An important difference between the autarky equilibrium and the equilibrium with integrated financial markets is that in the latter entrepreneurs hold a portfolio of assets issued by both home and foreign governments. This has two implications. First, the default of the government of one country (let's say the government of the home country) affects employment and output in both countries (home and foreign). This implies that default in one country is *exported* to the other country, creating a negative externality. Second, the presence of foreign assets in the portfolio of home entrepreneurs makes default less costly for the home country. This implies that when the foreign country issues more debt, entrepreneurs in the home country holds a larger volume of foreign assets. By reducing the default cost, the home country could have a higher incentive to default. In this sense sovereign default could be the consequence of the rising debt issued by foreign countries.

6.1 Characterization

Workers Since labor is immobile, the optimal choices of workers under financial integration are the same as in the closed economy. Thus, the labor supply is still given by

$$h^i(\pi, s) = \left(\frac{w^i(\pi, s)}{\alpha} \right)^{\nu}$$

The equilibrium wage rate, however, could differ in the two countries, which in turn implies differences in equilibrium employment.

Entrepreneurs: As in the closed economy, entrepreneurs' decisions can be characterized in closed form as summarized by the following lemma.

Lemma 6 *Let $\phi^i(\pi,s)$ satisfy the condition $\mathbb{E}_z \frac{A(z^i,\varepsilon^i)-w^i(\pi,s)}{1+[A(z^i,\varepsilon^i)-w^i(\pi,s)]\phi^i(\pi,s)} = 0$. The entrepreneur's policies take the form*

$$\begin{aligned}
d_1^i(\pi) &= a\Big[1-\theta^h(\pi)-\theta^f(\pi)\Big] \\
b^{hi}(\pi) &= \theta^h(\pi)R^h(\pi)a \\
b^{fi}(\pi) &= \theta^f(\pi)R^f(\pi)a \\
h^i(\pi,s) &= \phi^i(\pi,s)\Big[\delta^h(\pi,s)b^{hi}(\pi)+b^{fi}(\pi)\Big] \\
d_2^i(\pi,s,z) &= \Big[1+\Big(A(z^i,\varepsilon^i)-w^i(\pi,s)\Big)\phi^i(\pi,s)\Big]\left[\delta(\pi,s)b^{hi}(\pi)+b^{fi}(\pi)\right]
\end{aligned}$$

where $\theta^h(\pi)$ and $\theta^f(\pi)$ solve

$$\begin{aligned}
\frac{1+\beta}{\beta} &= \beta\mathbb{E}_s\left[\frac{1}{\frac{\beta}{1+\beta}-\theta^h(\pi)\delta(\pi,s)\frac{R^h(\pi)}{R^f(\pi)}+\theta^f(\pi)}\right] \\
\theta^h(\pi) &= \frac{\beta}{1+\beta}-\theta^f(\pi)
\end{aligned}$$

Proof. See Appendix **??** ■

As in the autarky equilibrium, entrepreneurs split their initial wealth a between current consumption d_1^i and financial assets. Moreover, since the fraction saved, $\theta^h(\pi)+\theta^f(\pi)$, does not depend on policies, consumption in the first period is exactly the same as in a closed economy. The main difference relative to the autarky equilibrium is that entrepreneurs also decide how to split their savings between domestic and foreign bonds. Because the foreign country commits to repay the debt whereas the home country does not, the returns on the government bonds issued by the two countries differ in equilibrium. Hence, the portfolio decision in this case is non-trivial. Given the particular functional forms, however, it is optimal for entrepreneurs to devote a fraction $\theta^h(\pi)$ to bonds issued by the home government and a fraction $\theta^f(\pi)$ to bonds issued by the foreign government. Interestingly, this proportion is independent of the residence of the entrepreneur, that is, home and foreign entrepreneurs choose the same fraction of wealth allocated to bonds issued by the two countries. This results from the assumption that the two countries are identical in preferences and technology (including the distribution of the idiosyncratic shock). The second period consumption, on the other hand, may differ due to different realizations of aggregate shocks z^h and z^f.

The following Proposition characterizes the competitive equilibrium in a financially integrated economy.

Proposition 7 *Let $s = \{z^h, z^f\}$ and $\pi = \{B^h, B^f, \tilde{B}^h(s), \tilde{B}^f(s)\}$. The competitive equilibrium in a financially integrated economy given policy is characterized by*

1. *Interest rates satisfy*

$$R^i = \frac{B^i}{2a\frac{\beta}{1+\beta}\varphi^i}$$

with $\varphi^f = E_s\left[1 + \frac{\tilde{B}^h(s)}{\tilde{B}^f(s)}\right]^{-1}$ and $\varphi^h = 1 - \varphi^f$.

2. *Aggregate labor supply and wage rates satisfy*

$$h^i(\pi, s) = \phi^i(\pi, s)\frac{\tilde{B}^h(s) + \tilde{B}^f(s)}{2} \quad \text{and} \quad w^i(\pi, s) = \alpha\left(h^i(\pi, s)\right)^{1/\nu}$$

where $\phi^i(\pi, s)$ solves $\mathbb{E}_z \frac{A(z^i,\varepsilon^i) - w^i(\pi,s)}{1+[A(z^i,\varepsilon^i)-w^i(\pi,s)]\phi^i(\pi,s)} = 0$.

3. *Entrepreneurs' consumption satisfies*

$$d_1^i = \frac{a}{1+\beta}$$

$$d_2^i(\pi, s, \varepsilon^i) = \Big(1 + [A(z^i, \varepsilon^i) - w^i(\pi, s)]\phi^i(\pi, s)\Big)\frac{\tilde{B}^h(s) + \tilde{B}^f(s)}{2}.$$

4. *Workers' (net-of-labor-disutility) consumption satisfies*

$$\bar{c}_1^i = e + \frac{2a\beta}{1+\beta}\varphi^i$$

$$\bar{c}_2^i(\pi, s) = \tilde{\nu} w^i(\pi, s)^{1+\nu} - \tilde{B}^i(s),$$

with $\tilde{\nu} = \frac{1/\nu}{1+1/\nu}\alpha^\nu$.

Proof. See Appendix **??** ■

In absence of aggregate TFP shocks, that is $z^h = z^f = \bar{z}$, the distribution of entrepreneurs' second period consumption would be identical across countries. This happens because entrepreneurs do not receive transfers from

their local governments and they have access to the same financial assets independently of their residence. Their first period consumption is identical and independent of borrowing decisions. This also implies that the worldwide consumption of workers in the first period is independent of policies. In fact, using Proposition 7, we have that

$$c_1^h + c_1^f = 2e + 2a\frac{\beta}{1+\beta}.$$

However, even if worldwide consumption is independent of policies, the consumption of workers in each country does depend on policies. More specifically, asymmetric issuances of B^h and B^f will affect the cross-country distribution of workers' consumption in the first period via the interest rates (which depend on the repayment of the debt in period 2, that is, $\tilde{B}^i$).

Proposition 7 makes evident how a default in country h impacts the competitive equilibrium in *both* countries. When a default occurs, financial wealth of entrepreneurs is destroyed in both countries. This reduces their demand for labor, which in turn reduces employment $h^i(\pi, s)$ and wages $w^i(\pi, s)$. The negative consequences of default in one country are no longer limited to agents living in the defaulting country but also to agents in the non-defaulting country.

6.2 Government choices under Financial Integration

Government problem in Period 2 Given the aggregate states $s = \{z^h, z^f, B^{hh}, B^{hf}, B^{fh}, B^{ff}\}$, the government of the home country chooses the repayment $\tilde{B}^h$ in order to maximize (9).

We can now take into account the structure of the problem to reduce the sufficient state variables needed to characterize the government problem. First, from the optimal portfolio choice of entrepreneurs we have that $B^{hh} = B^{hf} = B^h/2$ and $B^{fh} = B^{ff} = B^f/2$. Therefore, the financial wealth of both home and foreign entrepreneurs is $(B^h + B^f)/2$. This implies that B^h and B^f are sufficient state variables for the portfolio holdings of entrepreneurs. Second, the wage rate and, therefore, the factor that determines the demand of labor depend on home productivity z^h and wealth of home entrepreneurs after government default $(\tilde{B}^h + B^f)/2$. Therefore, we will denote the wage as $w^h(\tilde{B}^h, B^f, z^h)$ and the labor demand factor as $\phi^h(\tilde{B}^h, B^f), z^h)$. The optimization problem of the home government can then be written as

$$V^h(B^h, B^f, z^h, z^f) =$$
$$\max_{\tilde{B}^h \leq B^h} \left\{ (1-\Psi) \ln \left(\tilde{\nu} w^h \left(\tilde{B}^h, B^f, z^h \right)^{1+\nu} - \tilde{B}^h \right) + \Psi \ln \left(\frac{\tilde{B}^h + B^f}{2} \right) \right.$$
$$\left. + \Psi E_\varepsilon \ln \left(\left[A(z^h, \varepsilon^h) - w^h \left(\tilde{B}^h, B^f, z^h \right) \right] \phi^h \left(\tilde{B}^h, B^f, z^h \right) + 1 \right) \right\}. \quad (11)$$

The key difference between this government problem and that solved in autarky is that consumption allocations and prices depend also on the foreign debt B_f. Notice that, even though the problem of the home government does not depend on the aggregate productivity in the foreign country, we included z^f as an argument of the value function for notational convenience later.

Denote by $\hat{B}(B^f, z^h)$ the unconstrained optimum. Assuming that the objective is strictly concave, there will be a unique solution to problem (11), characterized by the first order condition

$$\Psi E_\varepsilon u' \Big(d_2^h(\tilde{B}^h, B^f, z^h, \varepsilon^i) \Big) = (1-\Psi) U' \Big(\bar{c}_2^h(\tilde{B}^h, B^f, z^h) \Big) \Omega(\tilde{B}^h, B^f, z^h),$$

where $\Omega(\pi, s) \geq 1$.

Relative to the autarkic solution, the government gives now relatively higher weight to workers.[4] This implies that the government will have higher incentives to default in a financially integrated world. There are two reinforcing effects at play. The first effect derives from redistributing wealth from foreigners to domestic agents. Because some of the domestic debt is sold to foreigners, default redistributes wealth not only from domestic entrepreneurs to domestic workers but also from foreigner entrepreneurs to domestic workers. Recall that the portfolio of entrepreneurs is now diversified, with holdings of $(\tilde{B}^h + \tilde{B}^f)/2$. This redistribution from foreigners to domestic agents has been widely emphasized in the literature, and is typically the main reason why governments have incentives to default in Eaton-Gercovitz style models. The second effect is to lower the disruption in financial markets because entrepreneurs are hedged: they own safe bonds B^f. Because the elasticity of the labor demand to reductions in B^h is lower, the effect on wages and aggregate employment are smaller than in a closed economy. Hence, the size of the recession generated by a default is smaller. This mechanism, which is novel in the literature, increases the government's incentive to default.

[4] In the appendix, and given $F = \frac{\tilde{B}^h(s) + \tilde{B}^f(s)}{2}$, we show that $\Omega(\pi, s) = \frac{1 - \frac{\partial w_2}{\partial F} h_2}{\frac{1}{2} - \frac{\partial w_2}{\partial F} h_2} \geq 1$.

The solution to the *constrained* problem, that is, problem (11) subject to the constraint $\tilde{B}^h \leq B^h$ is

$$\mathcal{B}(B^h, B^f, z^h) = \begin{cases} B^h, & \text{if } B^h \leq \hat{B}(B^f, z^h) \\ \hat{B}(z^h, B^f), & \text{if } B^h > \hat{B}(B^f, z^h). \end{cases} \tag{12}$$

For the foreign government the value in period 2 is given by

$$V^f(B^h, B^f, z^h, z^f) =$$
$$\left\{(1-\Psi)\ln\left(\tilde{\nu}w^f\left(\mathcal{B}(B, z^h), B^f, z^f\right)^{1+\nu} - B^f\right) + \Psi\ln\left(\tfrac{\mathcal{B}(B,z^h)+B^f}{2}\right)\right.$$
$$\left. +\ \Psi E_\varepsilon \ln\left(\left[A(z^h, \varepsilon^h) - w^f\left(\mathcal{B}(B, z^h), B^f, z^h\right)\right]\phi^f\left(\mathcal{B}(B, z^h), B^f, z^h\right) + 1\right)\right\}. \tag{13}$$

Government problem in Period 1 In the previous analysis of the autarky regime, we have seen that the consumption of workers and entrepreneurs in period 1 are independent of the debt chosen by the government in period 1. Because of this, in the autarky regime the optimal debt was determined by simply maximizing the second period value function. This is no longer the case when financial markets are integrated. In this case the choice of debt by the government in the home country, B^h, does affect the consumption of workers. Therefore, in solving the optimal policy in period 1 we also need to take into account this effect. The objective of the government in country i is

$$\max_{B^i}\left\{(1-\Psi)U(c_1^i(B^h, B^f)) + \beta\mathbb{E}_{z^h,z^f}\, V^i(B^h, B^h, z^i, z^f)\right\}.$$

with $c_1^i = e + \frac{2a\beta}{1+\beta}\varphi^i$. Note that φ^i is increasing the B^i, implying that the optimum value of debt chosen by the home country would be

$$g^h(B^f) = \hat{B}(z_H, B^f).$$

Let the optimal choice of the foreign government be denoted by $g^h(B^f)$. The government of country i takes as given the debt chosen by the other government and the solutions are denoted by $B^h = g^h(B^f)$ and $B^f = g^h(B^f)$. The Nash equilibrium for the policy game played by the two governments is defined by $\bar{B}^h$ and $\bar{B}^f$ satisfying the conditions

$$\begin{aligned} \bar{B}^h &= g^h(\bar{B}^f), \\ \bar{B}^f &= g^f(\bar{B}^h). \end{aligned}$$

Figure 5 plots the response functions of the two countries as a function of the other country debt. The response functions are downward sloping. This is because, as the other country increases the debt, part of which is purchased by domestic entrepreneurs, there is less need to liquidity. The equilibrium is characterized by the intersection of the two response functions.

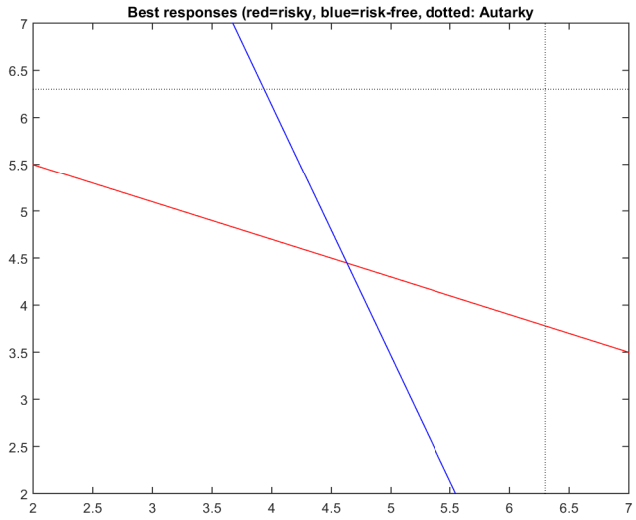


Figure 5: Response functions

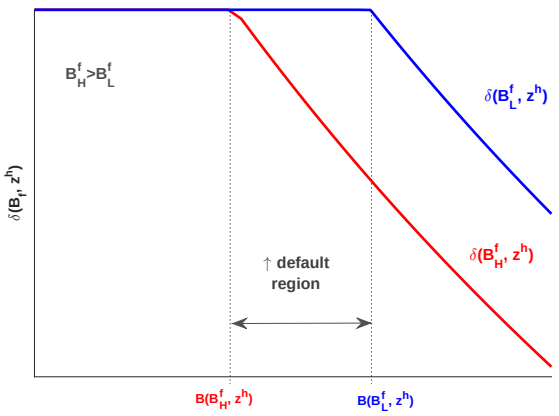
6.3 The impact of foreign borrowing

To show how foreign borrowing affects the incentive to default of the home country, we conduct a simple exercise. We compare the Nash equilibrium characterized above with an alternative allocation where the foreign country chooses a higher level of debt in period 1 while the home country continues to choose the debt chosen in the Nash equilibrium.

To be more precise, denote by $\bar{B}^h$ the debt chosen by the home country in the Nash equilibrium and $\bar{B}^f$ the debt chosen by the foreign country also in the Nash equilibrium. Now consider an laternative allocation where we artificially impose that the debt chosen by the foreign country in period 1 is $B^f > \bar{B}^f$ while the home country chooses $B^h = \bar{B}^h$. It is important to emphasize that these levels of debt artificially imposed. The default decision in period 2, however, it is still chosen optimally by the home country. The

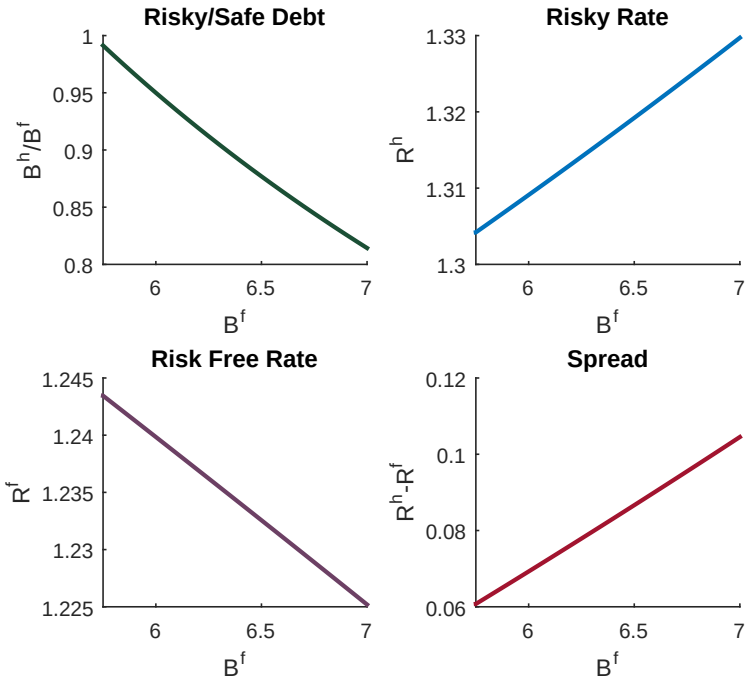
goal is to show how the higher debt of the foreign country would affect the default incentive of the home country.

In the second period, the home country behaves according to the rule $\mathcal{B}(B^h, B^f, z^h)$ defined by eq. (12). Because the level of debt at the outset of this period is given by $B^h = \bar{B}^h$, the home country chooses the unconstrained optimum, $\hat{B}(B^f, z^h)$, which depends on the external debt assets B_f of entrepreneurs. When the foreign country increases B^f, the additional external liquidity reduces the financial disruption caused by a domestic default. The reason being that safe debt represents a larger share of the assets in the portfolio of domestic entrepreneurs. The decline in the domestic demand for labor is smaller, as the reduction in the total wealth of entrepreneurs shrinks. This, in turn, results in a smaller recession caused by the decline in domestic output. Overall, the macroeconomic costs of default become smaller when B^f rises. The net redistributive benefits of a default, on the other hand, remain the same (this is because we have artificially assumed that the domestic government does not change its supply of debt, set at $\bar{B}^h$). Because the redistributive consequences of default are unchanged, but the macroeconomic costs are much smaller, an increase in external liquidity results in higher incentives for default by the home country. This is illustrated in Figure 6.3, which depicts the repayment function for two alternative values of foreign debt, $B^f_H > B^f_L$ (and a given realization of aggregate uncertainty z^H). As B^f increases, the repayment schedule moves to the left. In other words, $\hat{B}(B^f, z^h)$ goes down.



It is interesting to also analyze the effects of an increase in external liq-

uidity on prices. The analysis is performed for a numerical example, in which $\beta = 0.9825$, $\nu = \alpha = 1$, $a = e_1 = e_2 = 10$, ε is uniformly distributed over the interval $[0.9, 1.1]$, $z \in \{0.9, 1.1\}$ (with equal probability), and $\Psi = 0.7$. The upper left panel of Figure 6.3 depicts the ratio between risky and safe debt, $\bar{B}^h/B^f$ as a function external liquidity B^f. This is declining by construction, as $B^h = \bar{B}^h$. From the analysis above, we know that as B^f increases above and beyond $\bar{B}^f$, the home country has additional incentives to default. This reduces the expected benefits of holding domestic debt, resulting in a reduction of the demand for B^h by entrepreneurs in both countries (through a decline in θ^h). Clearly, risky debt becomes less attractive when agents understand that default risks have gone up. Given that the supply of B^h remains unchanged, the only way in which the same stock of (now riskier) debt is absorbed by the market is through an increase in its rate of return R^h. The upper right panel of Figure 6.3 shows that R^h is indeed increasing in B^f.



Interestingly, we also see that R^f is *decreasing* in its own debt (as seen in the lower left panel of the figure). The intuition is simple: agents in both countries have incentives to substitute assets away from risky debt into safe

debt when the probability of default on B^h raises. This implies that θ^f raises. Recall that the interest rate on foreign debt, $R^f = \frac{B^f}{2a\theta^f}$, depends on the ratio between the stock of debt and the share θ^f. It turns out that the increase in the denominator when B^f goes up exceeds that in the numerator, and we see a negative relationship between the risk free rate and the stock of risk free debt. So even though the foreign country is increasing the supply of debt, the indirect effect of this on the incentive to default by other countries makes B^f more valuable for investors, who are willing to pay a higher price to keep it in their portfolios. Note that this result depends critically on the fact that risk-averse entrepreneurs have a non-trivial portfolio composition problem, with two assets that are not perfect substitutes.

7 Conclusion

In this paper we have shown that the default of a country on its sovereign debt could be induced by excessive borrowing from other countries if financial markets are integrated. The integration of financial markets increases the incentive to default not only because part of the defaulted debt is owned by foreigners (as widely emphasized in the literature) but also because the 'endogenous' macroeconomic cost of default is smaller when the defaulting country is financially integrated. In our model government debt is held by producers for insurance purposes. When financial markets are integrated, producers also hold foreign government debt. Therefore, when the domestic government defaults, producers are only partially affected by default with smaller consequences for aggregate production in the domestic country. Furthermore, higher is the debt issued by the foreign country and higher is the incentive of the home country to default since domestic producers are more insured by holding the foreign debt. This implies that the sovereign default of a country could be externally induced by the excessive borrowing of foreign countries. From this perspective, the recent debt problems experienced by some European countries can be the result (at least in part) of the increased debt in 'safe' industrialized countries since the early 1980s.

8 Appendix

TO BE COMPLETED

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