Chapter VI

Assessing Intertemporal Solvency and Creditworthiness

VI.1 Introduction and Overview

In a world in which individuals, firms, and governments borrow on international financial markets in order to compensate temporary income fluctuations or to realize profitable investment opportunities, an increase of foreign liabilities is neither unusual nor alarming. Quite on the contrary: the resulting fluctuations of the current account can be interpreted as a sign that the gains from intertemporal trade are realized. However, such a view is based on the assumption that agents always comply with their intertemporal budget constraint: given a country's initial net international investment position (NIIP), individuals, firms and public institutions adjust their spending plans in order to avoid running into payment problems. This assumption, in turn, hinges on the notion that consumption and investment can be varied at will, and that international financial contracts are enforced in such a way that reneging on them is prohibitively expensive.

History, however, abounds with episodes during which countries failed to honor their external liabilities, ***defaulting*** on their debt or ***expropriating*** foreign firms. Acknowledging this fact forces us to question the notions underlying our analysis so far. But if we stop imposing the integrity of the intertemporal budget constraint by assumption, how can we assess whether a given NIIP is ***sustainable***, i.e. compatible with intertemporal solvency? And what are the incentives that induce a country to honor its intertemporal budget constraint at all? These are the questions we will deal with in this chapter. We will start by determining the level of foreign liabilities that is compatible with intertemporal solvency in an infinite-horizon RC model, in which consumption follows a plausible – but exogenous – time path. Our analysis will demonstrate that a mechanical consideration of the intertemporal budget constraint that merely focuses on the expected future time path of net exports delivers implausibly low values for the sustainable level of the NIIP. In a next step, we will address the question of under which circumstances agents have an incentive to renege on their international liabilities, i.e. we will shift our focus from a country's anticipated ***ability***

to pay to its ***willingness to pay***. We will show that the decision to default on international debt or to expropriate foreign investors crucially depends on the aggregate costs associated with such a decision, but also on the distribution of these costs within the population. Finally, we will demonstrate that the interdependence of interest rates and the incentive to default may give rise to multiple equilibria, such that a country's creditworthiness is determined both by the size of its external liabilities and by market expectations.

VI.2 Characterizing Intertemporal Solvency

The intertemporal budget constraint introduced in Chapter III is often called the ***intertemporal solvency condition***. An economy is ***solvent*** if its inhabitants are able to serve their external liabilities in the long run. In a similar vein, a current account deficit is considered ***sustainable*** if it can be maintained for a longer time span without jeopardizing the country's intertemporal solvency.[1]

To show how it can be assessed whether this condition is satisfied for a particular country, we start with the intertemporal budget constraint in a perfect-foresight, infinite-horizon model, assuming that the return on external assets and external liabilities is the same, and that this return does not vary over time:

(6.1)

$$\left(1+r\right)B_t + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(Y_s + BPI_s^L + BSI_s - I_s\right) = \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(C_s + G_s\right)$$

Note that we have augmented the expression in (4.25) by accounting for foreign labor income and net secondary income, and that, as in Chapter IV, C_t and I_t represent *private* consumption and *private* investment, respectively. Intertemporal solvency is given if, for an initial level of the net international investment position B_t, the above equation is satisfied. For a given time path of income, consumption, investment and government spending, we can thus define a critical value $B_t^{\min}$ which the net international investment position must not fall short of. This critical value is given by

$$B_t^{\min} = -\left(\frac{1}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(Y_s + BPI_s^L + BSI_s - I_s - C_s - G_s\right) \tag{6.2}$$

Using the fact that $Y_s - I_s - G_s - C_s = NX_s$, we can transform this equation into

[1] This definition is used, among others by, Sachverständigenrat (2006) and Mann (2002).

$$B_t^{\min} = -\left(\frac{1}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left(NX_s + BPI_s^L + BSI_s\right) \tag{6.3}$$

The expression $NX_s + BPI_s^L + BSI_s$ represents the ***primary current account balance***, i.e. the current account balance minus the returns on the – positive or negative – net international investment position. Equation (6.3) can thus be interpreted as follows: the sustainable NIIP is determined by the present value of future primary account balances. If this present value is positive, a negative net international investment position – i.e. an excess of liabilities over assets in period t – is compatible with intertemporal solvency. The reason is that the country will be able to make the required payments through positive net exports of goods and services, or by receiving foreign labor income and secondary income flows. If, by contrast, the above present value is negative, intertemporal solvency requires a positive net international investment position. In order to determine the critical value $B_t^{\min}$ one has to forecast the evolution of a country's future primary current accounts. This evolution, in turn, depends on the development of income, consumption, and investment, as well as on government spending and primary and secondary income flows.

Note that we are turning the logic underlying the analysis of Chapters III – V on its head: in these chapters, we assumed that agents *always* complied with their intertemporal budget constraint, and we computed the optimal consumption path for given preferences and given values of B_t and $(1+r)$. By construction, the NIIP never fell below the minimal level $B_t^{\min}$ along this path. Now we are taking a different approach: we assume that RC is confronted with an exogenous net international investment position in period t, and we want to find out whether this initial NIIP is compatible with the intertemporal budget constraint, provided that domestic spending follows a plausible – but exogenous! – time path.

To implement this approach by means of a simple example, we abstract from investment, foreign labor income and secondary income. Moreover, we assume that the government spends a constant fraction ϕ of GDP in every period. In this case, the expression in (6.2) turns into

$$B_t^{\min} = -\left(\frac{1}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t}\left[(1-\phi)Y_s - C_s\right] \tag{6.4}$$

Moreover, we assume that gross domestic product Y_s grows at an exogenous rate g, with $0 < g < r$, i.e. the growth rate of real GDP is lower than the real interest rate.[2] Finally, we assume that private consumption must not fall below a minimum ("subsistence") level, which may be expressed as a fraction of period-*t* income, i.e. $C_s \geq \varphi^{\min} Y_t$. Fixing consumption at this level allows us to identify the *lowest* net international investment position that is compatible with intertemporal solvency. Given the above assumptions and the result that $\sum_{s=t}^{\infty} a^{s-t} = 1/(1-a)$ for $|a|<1$, we can rewrite the expression in (6.4) as

$$(6.5) \qquad B_t^{\min} = \frac{\varphi^{\min} Y_t}{r} - \frac{(1-\phi)Y_t}{1+r} \sum_{s=t}^{\infty} \left(\frac{1+g}{1+r} \right)^{s-t}$$

Due to the assumption that $0 < g < r$, the summation term on the right-hand side is a converging geometric series, and by dividing both sides of the equation by Y_t, we arrive at

$$(6.6) \qquad b_t^{\min} = \frac{\varphi^{\min}}{r} - \frac{(1-\phi)}{(r-g)},$$

where $b_t^{\min} \equiv B_t^{\min} / Y_t$ is defined as the minimum NIIP *relative to GDP*. Let's perform a simple back-of-the-envelope calculation of $b_t^{\min}$, replacing the parameters in (6.6) by plausible values. We assume that $r = 0.06$, $\phi = 0.2$ and $g = 0.02$. Moreover, we set $\varphi^{\min} = (1-\phi)$, i.e. minimum consumption is such that net exports are zero in period *t*. By substituting these values into (6.6), we arrive at $b_t^{\min} = -6.67$. Hence, for the above constellation of parameter values, the net international investment position is compatible with intertemporal solvency as long as it is above *minus 667 percent* (!) of GDP – a value that is surprisingly low for an economy with non-positive exports in the current period. The mechanism that explains this result is the positive growth rate of income, i.e. our assumptions that $g > 0$ and that consumption is constant over time. Future income growth allows RC to incur large external liabilities today since capital market participants anticipate that output will exceed government spending and private consumption in the future, generating positive primary current account balances.

The scope for incurring external liabilities becomes even bigger if we take into account that we defined minimum consumption as a fraction of GDP in period t. As we move to subsequent periods, the share of consumption in GDP declines as output expands at a rate *g*, and we can write

[2] If this assumption were not satisfied, the present value of income would be infinite, and RC's optimization problem would not have a well-defined solution.

(6.7) $$b_{t+j}^{\min} = \frac{\varphi^{\min}}{(1+g)^j r} - \frac{(1-\phi)}{(r-g)} \qquad \text{with } j = 0, 1, 2, \ldots$$

As j becomes infinitely large, this expression converges to the steady state value $b^{\min,ss} = -(1-\phi)/(r-g)$, regardless of the size of $\varphi^{\min}$. Using the numerical values from above, $b^{\min,ss}$ would be -2000 percent! The ***sustainable current account deficit*** (relative to GDP) that is associated with this steady state can be computed by using the relationship $ca_{t+j}^{\min} = (1+g)\,b_{t+j+1}^{\min} - b_{t+j}^{\min}$. For the steady state, this implies

(6.8) $$ca^{\min,ss} = gb^{\min,ss}$$

Substituting the numerical values from above into this expression yields $ca^{\min,ss} = -0.4$. Hence, in the long run a current account deficit of 40 percent of GDP would be sustainable for the above parameter values. Note, however, that this would require a *primary* current account surplus of $b^{\min,ss}\,(g-r)$ – in our case 80 percent of GDP.[3] These are very high values, and history hardly offers any example where the capital market would have tolerated such an extreme discrepancy between external assets and liabilities. Figure 6.1 shows the distribution of net international investment positions for a large number of industrialized and developing countries in the year 2010. It is obvious that, for the majority of countries, the net international investment position in that year was way above minus 100 percent of GDP.[4]

There are several ways to explain this blatant discrepancy between theoretically feasible and actually observed net international investment positions: first, *uncertainty* about future income growth and capital returns is likely to make financial markets reluctant to tolerate a level of external liabilities that could be justified under perfect foresight. Moreover, we have to take into account that a country's net international investment position consists of assets and liabilities with very different risk profiles and payment structures. Hence, a combination of short-run liabilities and long-run assets may result in a situation in which a

[3] To arrive at this expression, we use the fact that the primary current account balance is given by $CA_t^{pr} = CA_t - rB_t$

[4] Most of the countries with a net international investment position below minus 100 percent are developing countries, whose external liabilities are dominated by official debt to public creditors or international organizations. More recently, however, some countries that were affected by the sequence of financial crises which started to unfold in 2007 joined this group.

country fails to make due payments on its liabilities although its intertemporal solvency, as defined by (6.3), is guaranteed.[5]

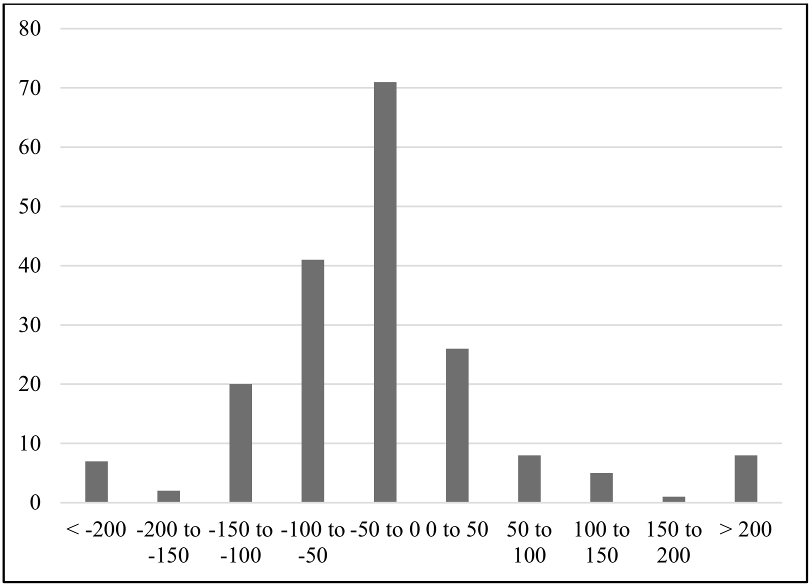

Figure 6.1: The net international investment position (in percent of GDP) of a cross section of countries in 2010. Source: Updated and extended version of the dataset constructed by Lane and Milesi-Ferretti (2007).

However, the most important critique of the numbers presented above is based on the argument that there is always an incentive to renege on a liability – especially in case of debt-type contracts, which are associated with clearly defined repayment obligations. Of course, such an incentive also exists for purely *intra*-national loans. But, as we will argue in the next section, it is particularly pronounced whenever lender-borrower relationships involve different countries. As a consequence, doubts about a country's creditworthiness may arise at a value of B_t that is much higher than the level that would be identified as "sustainable" by the above analysis. To support this point, Box 6.1 documents that some financial crises of the past occurred at very moderate levels of external indebtedness, and that the volume of foreign debt which is tolerated by the international capital market differs widely across countries.

[5] In Chapter X, we will devote more attention to the distinction between liquidity and solvency. Moreover, we will add the exposure to exchange rate fluctuations as another reason why a country's ability to honor its external liabilities may be at risk.

Box 6.1: "Debt Intolerance"

As we have shown above, the sustainable level of countries' net international investment position in a model with perfect financial markets and infinite time horizons is much lower than real-world NIIPs. In fact, focusing on countries' external *debt*, Carmen Reinhart, Kenneth Rogoff, und Miguel Savastano (2003) document that, in the past, some countries ran into financial crises without even coming close to the "sustainable" level of external liabilities derived above. This is documented by Table B6.1, which reproduces data from Reinhart et al. (2003).

Country	**Year of Debt Crisis**	**External debt as Share of GNI**
Egypt	1984	112.0
Argentina	2001	53.3
Bulgaria	1990	57.1
Ecuador	1999	89.2
Mexico	1982	46.7
Peru	1978	80.9
Russia	1998	58.5
Venezuela	1995	44.1

Table B6.1: External debt in the year of a debt crisis. Source: Reinhart et al. (2003).

Reinhart et al. (2003) show that there is a statistically significant relationship between countries' external debt and their creditworthiness. However, the strength of this relationship depends on various factors – in particular, on countries' ***debt intolerance***, which is defined as a vulnerability to financial crises at moderate levels of external debt. The authors identify the factors that determine the extent of debt intolerance and show that, ceteris paribus, the likelihood of a crisis is particularly high in those countries who ran into payment difficulties in the past. Reinhart et al. (2003) explain this path dependence of countries' creditworthiness by arguing that historical experience shapes structures and incentives in a country's financial markets – e.g. the prevalence of short-term debt instruments, the currency denomination of liabilities etc. – and that these structures and incentives generate constellations which determine the likelihood of a new crisis. This finding implies that, when assessing the sustainable level of external debt, one has to account for a country's specific debt intolerance. Moreover, the outcome of a one-time reduction of external debt crucially depends on whether policymakers succeed in solving the structural problems that are at the root of a country's vulnerability to debt crises.

VI.3 Default: Determinants and Consequences

VI.3.1 Motivation

In the preceding section we derived a country's net international investment position that should be considered "sustainable" by financial markets. In that context, we defined "sustainability" as a combination of external assets and liabilities which – for a realistic assessment of future primary current accounts – was compatible with a country's intertemporal budget constraint. While this concept sounds straightforward, it becomes questionable as soon as one realizes that agents may have an incentive *not* to comply with their intertemporal budget constraint. Of course, the temptation to renege on due repayments also exists in a closed-economy context. However, it becomes particularly severe once financial relationships involve different jurisdictions: while intra-national debt contracts usually specify some type of ***collateral*** – e.g. the value of a house in case of a real estate loan – such collateral rarely exists in international borrowing and lending. This problem is particularly pronounced for government debt, which is rarely collateralized, and which involves an institution that may decide to change the rules of the game to its own advantage. Moreover, public debt is usually held by a large number of small-scale creditors who have divergent interests and often fail to coordinate their activities. This, in turn, substantially broadens a public debtor's scope to shape the modalities of repayment.

In fact, the past offers numerous episodes during which governments defaulted on their debt. Figure 6.2 shows the total value of outstanding debt for which national governments denied or postponed repayment since 1975. The figure shows that there were several waves of defaults – in the 1980s, in the early 2000s, and, quite recently, in 2012. The sudden increases of the time series were often driven by the default of one big debtor – e.g. Argentina in 2001 or Greece in 2012.[6] Eventually, these spikes are followed by slow declines of the total debt in default, reflecting the fact that debtors and creditors reached some type of settlement.

Of course, ***sovereign defaults*** are rarely discriminatory, exclusively targeting only foreign creditors. However, *external* debt is particularly exposed to a

[6] For various reasons, policymakers were careful to define the write-off of substantial parts of Greek sovereign debt by foreign financial institutions as a voluntary concession. This helped to avoid the term "default", but did not really change the fact itself.

government's decision to deny repayment: foreign creditors usually have a much lower weight in the domestic political process, and the damage inflicted on them does not jeopardize policymakers' political survival by as much as default on domestically held debt. The argument is therefore that international debt contracts in general – and external *public* debt in particular – are especially vulnerable to a default. In fact, while Figure 6.2 does not differentiate between foreign and domestic loans, the data of Beers and Nadeau (2015) document that the brunt of a sovereign default was usually borne by foreign creditors.[7] The precarious state of cross-country financial claims explains why a lot of resources are devoted to assessing countries' creditworthiness. Box 6.2 presents various attempts to accomplish this task.

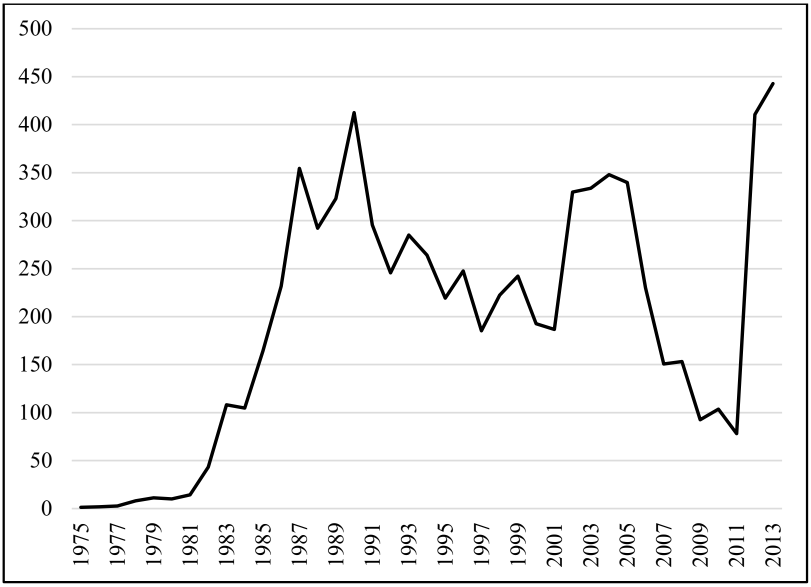

Figure 6.2: Total debt in default (billions of nominal US dollars). Source: Beers and Nadeau (2015).[8]

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[7] More specifically, the share of local currency loans in countries' total debt in default is usually in the single-digit range. However, it has to be taken into account that "…local currency debt defaults are only sporadically reported as such." (Beers and Nadeau, 2015:9) – which suggests that the burden imposed on domestic creditors may be higher than suggested by their data. Reinhart and Rogoff (2011) emphasize the importance of domestic public debt in explaining a governments' decision to default. However, they also document that domestic defaults are less common than external defaults.

[8] According to the definition of Beers and Nadeau (2015:2), "a default has occurred when debt service is not paid on the due date (or within a specific grace period), payments are not made within the time frame specified under a guarantee". Moreover, those authors specify

Box 6.2: Measuring Country Creditworthiness

There are several ways to measure market participants' assessment of the likelihood that a particular individual, firm or institution will comply with repayment obligations. First, it is possible to consider ***interest rate spreads***, i.e. the difference between interest rates charged on a particular debtor and the interest rate on an asset that is considered to be risk-free. The higher that spread, the higher obviously the default risk that creditors have to be compensated for. A second possibility is to look at ***credit default swaps (CDS)***, i.e. the price of securities that insure a creditor against default. Rising CDS prices usually signal that the market has become more pessimistic about a particular borrower's creditworthiness. A third possibility is to look at ***credit ratings.*** While the accuracy and forecasting properties of these ratings are not uncontested, there is some empirical evidence that they influence interest spreads and CDS.

Credit ratings are published by companies like *Standard & Poor's, Moody's* or *Fitch*, and usually refer to particular entities – firms, financial institutions, or governments. However, there are also measures that reflect the perceived creditworthiness of entire *countries*, such as the country creditworthiness indicator of the magazine *Institutional Investor*. This indicator has been published twice a year since 1980, is based on a questionnaire-based survey among employees of multinational banks and insurance companies, and is defined on a scale between 0 and 100, with 0 indicating minimal creditworthiness and 100 indicating maximal creditworthiness. Figure B6.2 shows the evolution of this measure for a set of industrialized and developing countries.

Of course, such an aggregate measure of *country creditworthiness* only makes sense if the likelihood of default is highly correlated among agents within an economy. One reason for such a correlation may be the fact that a government default usually triggers a financial crisis that results in widespread defaults among private financial institutions and firms as well. There is, indeed, some evidence that markets believe in such a relationship: debt issued by private entities is often considered at least as risky as public debt, and this gives rise to a "***sovereign ceiling***" in terms of creditworthiness (Cavallo and Valenzuela, 2010). The Institutional Investor's measure should thus be interpreted as a country-specific average that is strongly

"circumstances where creditors incur material economic losses on the sovereign debt they hold" – e.g. "agreements between governments and creditors that reduce interest rates and/or extend maturities on outstanding debt" – which qualify as a default even if there is no "outright payment default".

influenced by market participants' assessment of governments' creditworthiness.

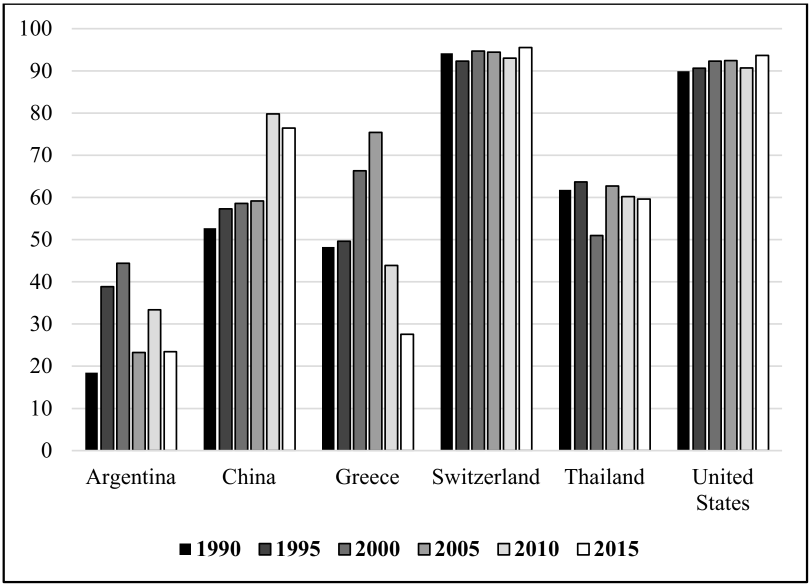

Figure B6.2: The indicator of country creditworthiness published by the *Institutional Investor* magazine. Source: Institutional Investor, various issues.

Once we acknowledge a debtor's incentive to deny repayment by declaring a default, we have to re-define the concept of "sustainability": a certain level of external debt is sustainable if it is compatible with the intertemporal budget constraint *and* if there is no incentive to deviate from this constraint. Hence, evaluating creditworthiness may not only be about assessing a debtor's ***ability to pay***, but also about his ***willingness to pay***. This does not deny that defaults are often caused by severe economic crises. Nevertheless, the decision whether to repay or not to repay always involves a debtor's assessment of the relative economic, political and social costs of a default.[9]

[9] Tomz and Wright (2007) support this point by documenting that, in the past, defaults during periods of economic prosperity were almost as frequent as defaults in times of crises. Moreover, if one emphasizes that the ability to repay is usually beyond a debtor's influence, one has to explain how an excessive level of external debt could be accumulated in the first place. At the same time, however, one has to acknowledge that public indebtedness often goes back to policymakers who are no longer in power at the time of the default. In particular, it can

To describe how these considerations affect international capital flows, we use the simple two-period model with an exogenous income that was introduced in Chapter III. We assume that all international liabilities are debt-type contracts, and we do not distinguish between private individuals and the government. Instead, we assume that the decision over default and repayment is taken by a single representative consumer. Given the above statements about the special role of *public* debt, this is a strong simplification. However, it may be justified by referring to a scenario in which all external liabilities are public, the government maximizes the welfare of its representative citizen, and repayment of public debt forces the government to raise taxes that lower private agents' consumption.[10]

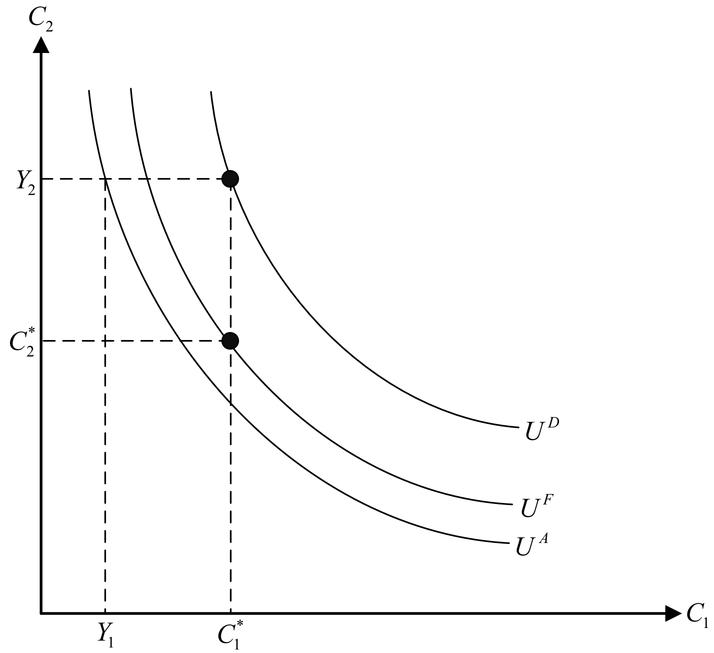

Figure 6.3: The incentive to default in a two-period model.

In Figure 6.3, the indifference curve U^A represents the utility attainable under financial autarky, while U^F refers to the case of perfect capital mobility. The third indifference curve U^D reflects the utility that is attainable if the amount

be argued that successor governments should not be held liable for the "***odious debt***" they inherit from recklessly spending autocrats (House, 2007).

[10] Restrictive as it may seem, this is the usual approach adopted by the literature (see, e.g., Aguiar and Amador, 2014).

borrowed in period 1 is not repaid in period 2. Obviously, such a default raises RC's consumption in that period, and there is a clear temptation to deny repayment. However, financial market participants who understand RC's incentives are reluctant to provide him with credit in period 1. This implies that, despite its de jure access to international financial markets, the country is de facto cast into financial autarky. Hence, the possibility to improve upon U^F by refusing repayment in period 2 reduces RC's welfare as of period 1.

This variant of the ***time inconsistency problem*** – i.e. of the discrepancy between ex-ante optimal plans and ex-post optimal actions – also exists for purely domestic lender-borrower relationships. However, as we have discussed above, it is considerably harder to enforce repayment claims across national borders, and there often does not exist any collateral that a creditor can get hold of.[11] Considering this fundamental problem, the question to ask is not why we occasionally observe a default. Instead, the puzzle to solve is why, despite the obvious incentive to default, we observe any international borrowing and lending *at all*. If the RC characterized by Figure 6.3 decides to repay his debt, this must be due to the fact that denying repayment is associated with costs that make honoring foreign liabilities preferable to default. In the following subsections, we will present two prominent theoretical approaches that have been used to model the default decision as the result of a cost-benefit comparison. As we will highlight, the two approaches fundamentally differ in the type of "default costs" they consider.

Before we embark on this analysis, a further comment is necessary: the astute reader will have noticed that we started by talking about institutions' and firms' incentive to renege on their *liabilities*, but that we ended up considering only a default on *debt*. Of course, difficulties with enforcing the conditions of international financial contracts also exist with respect to *equity*-type liabilities. This is why Section VI.3.6 will discuss the determinants and consequences of ***expropriation***.

VI.3.2 The Costs of a Default: Financial Embargo

While a default may be attractive in the short run, it may entail considerable long-run costs if it implies that RC is denied access to the international capital market. Starting with Eaton und Gersovitz (1981) a large strand of the literature argues that it is the fear of such a ***financial embargo*** that generates an incentive to repay foreign debt. To illustrate this concept, we use a simple example. We

[11] Federico Sturzenegger and Jeromin Zettelmeyer (2006) offer an excellent survey on the legal framework that is relevant for international credit relationships. In particular, they describe the ***sovereign immunity*** doctrine, which stipulates that states cannot be held legally liable for their debts abroad. They also document that, despite an attenuation of this principle in the late 1970s, it is still difficult to enforce financial claims against foreign governments.

assume that, as of period t, the representative consumer of a small open economy has an infinite time horizon and perfectly anticipates the following time path of income. His income arrives in the form of a non-storable good:

$$(6.9) \qquad Y_{t+j} = \begin{cases} \overline{Y} \equiv Y + \Delta, & \text{for } j = 0, 2, 4, 6, ... \\ \underline{Y} \equiv Y - \Delta, & \text{for } j = 1, 3, 5, 7, ... \end{cases}$$

Hence, the country's income regularly alternates between a high value ($\overline{Y}$) and a low value ($\underline{Y}$). As long as he makes the due payments, RC has access to an international capital market that allows to borrow and lend at a constant real interest rate r. Hence, all external liabilities are actually "foreign debt". We assume that RC's instantaneous utility function is logarithmic and that $\beta(1+r)=1$, which implies that the optimal consumption path is flat. RC implements this path by borrowing in low-income periods and repaying in high-income periods. By using the intertemporal budget constraint, we can derive RC's lifetime utility U_t^{ND} (*ND* for "no default") that he achieves for a given initial net international investment position B_t if he honors his repayment obligations in period t and all subsequent periods:[12]

$$(6.10) \qquad U_t^{ND}(B_t) = \left(\frac{1+r}{r}\right) \ln\left(r\,B_t + Y + \frac{r}{2+r}\Delta\right)$$

This expression obviously increases in B_t. If the net international investment position is negative, and if RC refuses to make the due payment $-(1+r)B_t$ at the end of period t, this increases his consumption possibilities in the short run.[13] However, he is banned from the international capital market in all subsequent periods, and this ties his consumption to his fluctuating income in all subsequent periods.[14] Hence, RC's lifetime utility U_t^D in case of default is given by

$$(6.11) \qquad U_t^D = \frac{(1+r)^2}{r(2+r)}\left[\ln(Y+\Delta) + \frac{\ln(Y-\Delta)}{1+r}\right]$$

[12] The appendix to this Chapter provides a detailed description of how to derive equations (6.10) and (6.11).

[13] Note that we are implicitly assuming that a default not only eliminates all foreign *liabilities*, but also all foreign *assets*. This assumption is not very plausible, but it is inconsequential for our argument.

[14] For simplicity, we assume that default is always *complete* and never *partial*. In reality, the reduction of repayment imposed on foreign lenders – the so-called "***haircut***" – rarely amounts to 100 percent and usually emerges as the result of lengthy and tedious negotiations.

Using Jensen's inequality, which we have introduced in Section IV.5.2, we can show that $U_t^{ND} > U_t^D$ if $B_t = 0$:

(6.12) $$\ln\left(Y + \frac{r}{2+r}\Delta\right) > \left(\frac{1+r}{2+r}\right)\ln\left(Y+\Delta\right) + \left(\frac{1}{2+r}\right)\ln\left(Y-\Delta\right)$$

This result reflects the fact that having access to international financial markets, which entails the possibility to smooth temporary income fluctuations, represents a welfare gain. Thus, the critical level of the net international investment position that keeps RC indifferent between repayment and default (B_t^{crit}) is negative and implicitly defined by $U_t^{ND} = U_t^D$. Figure 6.4 illustrates this relationship. As we demonstrate in the appendix to this chapter, this critical value *decreases* in Δ. This is intuitive: the more volatile the time path of income, the more important the access to the international capital market is for RC, and the higher the welfare costs of being cast into financial autarky. The fear of losing access to the international capital market guarantees that RC chooses repayment even if his initial net international investment position B_t is low, and $b_t^{crit} \equiv B_t^{crit} / Y_t$ establishes a lower bound for the country's NIIP (relative to its GDP) that market participants consider sustainable – regardless of the present value of the country's future net exports.

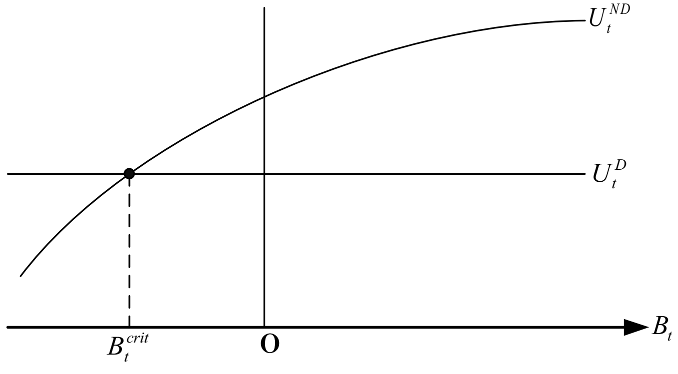

Figure 6.4: The incentive to default and the minimum net international investment position.

The argument that debtors repay loans in order to maintain their access to the international capital market seems convincing at first glance.[15] However, it is

[15] Some studies identify this motive with the goal to keep a good "***reputation***" among foreign investors. Bear in mind, however, that microeconomic models that analyze the role of

important to note that the exclusion from the international capital market has to affect a country both in its role as a debtor and as a creditor. If the embargo only applies to international *borrowing* while international *lending* remains unconstrained, the argument sketched above breaks down. As emphasized by Bulow and Rogoff (1989), a default on foreign debt would allow to achieve a higher welfare level in this case, regardless of the degree of macroeconomic volatility and the volume of outstanding debt. All that would be needed is the possibility to invest the amount owed at the international interest rate. Table 6.1 illustrates how such a strategy could be realized in the above example: as before, we assume that the country's income is high $\left(\bar{Y}+\Delta\right)$ in period t, and that the net international investment position is negative at the start of this period $\left(B_t<0\right)$. If RC decided to default, he could shift the outstanding principal $\left(-B_t>0\right)$ plus a positive amount B_{t+1} to a third country, and consume the outstanding interest payments $\left(-rB_t>0\right)$ instead of transferring them to foreign creditors. As a result, his consumption $\left(C_t^D\right)$ would be higher than in the case of repayment $\left(C_t^{ND}\right)$. In period $t+1$, a *non-defaulting* RC would collect principal and interest on his positive net international investment position B_{t+1} and borrow an amount $\left(-B_{t+2}\right)$, which – due to the symmetry of the income process – would equal $\left(-B_t\right)$. A *defaulting* RC, by contrast, would consume principal and interest on his net international investment position $B_{t+1}-B_t$ and thus, again, enjoy a higher consumption level than in the non-defaulting case. In period $t+2$ and all following periods, this sequence of events would repeat itself (with $B_{t+3}=B_{t+1}$ etc.).

Period	Y_t	C_t^{ND}	C_t^D
t	$\bar{Y}$	$\bar{Y}+(1+r)B_t-B_{t+1}$	$\bar{Y}-\left(B_{t+1}-B_t\right)$
$t+1$	$\underline{Y}$	$\underline{Y}+(1+r)B_{t+1}-B_t$	$\underline{Y}+(1+r)\left(B_{t+1}-B_t\right)$
$t+2$	$\bar{Y}$	$\bar{Y}+(1+r)B_t-B_{t+1}$	$\bar{Y}-\left(B_{t+1}-B_t\right)$

Table 6.1: Consumption levels in case of repayment $\left(C_t^{ND}\right)$ and default $\left(C_t^D\right)$. In case of default, the outstanding principal $\left(-B_t>0\right)$ plus a positive amount $\left(B_{t+1}>0\right)$ are transferred to a third country, which offers a return r. In period $t+1$, this amount and the resulting interest payments are consumed. The same strategy is adopted in subsequent periods.

reputation usually involve some kind of informational asymmetry, which is completely absent in the perfect-information framework we consider in this chapter.

This example illustrates that the embargo threat only makes sense if reluctant debtors are *completely* excluded from the international capital market, i.e. they are stripped of the possibility to combine the default with a savings and withdrawal strategy that generates a higher consumption level for all future periods. This, however, is not very realistic. The denial of future *credit* already requires a high degree of coordination among lenders, and, after a short while, high interest rates may induce foreign individuals to buy bonds of a defaulting country. To prevent other countries from *borrowing* from a defaulting country and from thus supporting the strategy sketched in Table 6.1 is even harder, if not impossible.[16]

VI.3.3 The Costs of a Default: Direct Costs

If the threat of a financial embargo does not have a bite, there must be another type of cost that prevents countries from defaulting on their debt and that sustains international borrowing and lending. One example of such a “direct cost” is a serious deterioration of trade relationships between the defaulting country and its partners that results in a substantial income loss.[17]

To illustrate the role of direct costs, we consider the following infinite-horizon model of a small open economy. We assume that the RC’s instantaneous utility function is logarithmic and that $\beta(1+r)=1$. Hence, optimal consumption does not vary over time. Unlike in the previous subsection, a default does not have any consequences for the country’s access to the international capital market. However, it results in an income loss in all subsequent periods, i.e.

$$(6.13) \qquad Y_s = \begin{cases} Y & \text{without a default} \\ \gamma\, Y & \text{in case of a default in } t < s \end{cases} \qquad \text{with } 0<\gamma<1$$

[16] Amador (2012) emphasizes that committing to the consumption path sketched in this subsection requires a lot of discipline, which short-sighted governments are unlikely to exhibit. Knowing their inability to constrain consumption, they may anticipate that, sooner or later, they will require access to the international capital market. This, in turn, raises the burden associated with a financial embargo and partly reinstates the argument that it is for this reason that agents refrain from defaulting on their debt.

[17] Rose (2005) provides empirical evidence that the volume of trade of a defaulting country drops by up to eight percent for a longer time span. Whether this drop is due to creditors’ explicit sanctions or just happens to be associated with a default is of no importance. However, when interpreting this empirical finding, one has to take into account that the default may be a consequence rather than a cause of the shrinking trade volume. Martinez and Sandleris (2011) are skeptical about the relevance of trade sanctions as punishments for defaults while Fuentes and Saravia (2010) report that default triggers a drop in FDI inflows. For the costs that a sovereign default imposes on the domestic financial sector, see Gennaioli et al. (2014).

The country's net international investment position – once more assumed to entirely consist of debt-type assets and liabilities – at the start of period t is given by B_t. Deriving the optimal (constant) consumption level in case of repayment and substituting it into RC's lifetime utility yields[18]

$$(6.14) \qquad U_t^{ND} = \frac{1}{1-\beta} \ln\left(r\, B_t + Y \right)$$

If RC decides to default in period *t*, this essentially wipes out B_t. However, his income will drop in all subsequent periods. Accounting for this consequence in the intertemporal budget constraint, deriving the optimal (constant) consumption level and plugging it into RC's lifetime utility yields

$$(6.15) \qquad U_t^{D} = \frac{1}{1-\beta} \ln\left(\frac{r+\gamma}{r+1} Y \right)$$

It follows from a comparison of U_t^{ND} and U_t^{D} that a default is welfare-increasing if

$$(6.16) \qquad \frac{1}{1-\beta} \ln\left(\frac{r+\gamma}{1+r} Y \right) > \frac{1}{1-\beta} \ln\left(r\, B_t + Y \right)$$

Defining, as before, $b_t \equiv B_t / Y_t$ to be the net international investment position relative to GDP, the above condition can be transformed into

$$(6.17) \qquad b_t < \frac{\gamma - 1}{r\left(1+r\right)} \equiv b^{crit}$$

This expression illustrates how direct costs affect the incentive to default: the smaller γ, i.e. the greater the income reduction associated with a default, the lower the value of b_t for which RC still decides to repay his debt. Hence, the stronger a country is hit by direct costs in case of a default, the more credible its promise to repay outstanding loans is, and the less restrictive potential credit constraints are. By contrast, an increasing interest rate raises the critical net international investment position. This is because a higher interest rate increases the effective debt burden for any value of B_t, but also because future

[18] The appendix explains how to derive equations (6.14) and (6.15).

income losses are discounted more heavily. Again, the international capital market perceives b^{crit} as a lower boundary to the country's net international investment position (relative to its GDP).

VI.3.4 Uncertainty and Multiple Equilibria

So far, our analysis was based on two important assumptions: first, we assumed that all agents had perfect foresight, i.e. there was no uncertainty about future income levels, the costs of default, etc. Second, the interest rate was fixed, and the international capital market adjusted the volume of lending to make sure that a country's net international investment position did not fall below a critical level B_t^{crit}. These assumptions implied that the interest rate charged on external loans did not reflect the likelihood of default – quite simply, because default never happened in equilibrium. This is in stark contrast to historical experience: we *do* see large cross-country differences in the interest rates charged on public debt, and we *do* witness episodes of sovereign default.

To analyze the consequences of uncertainty and a variable interest rate for the likelihood of default, we consider the following two-period model: suppose, once more, that all securities traded on the international capital market are debt-type securities. At the start of period 1, the RC of the economy we are considering faces an exogenous net international investment position B_1, which entirely consists of debt-type liabilities, and receives an exogenous income Y_1. Moreover, his consumption is pushed down to some exogenous minimal ("subsistence") level $C_1^{\min}$. We exclude the possibility of default in period 1. These assumptions imply that the NIIP at the start of the second period is exogenous, and we assume $B_2 = Y_1 + (1+r)B_1 - C_1^{\min}$ to be negative.

At the end of period 2 – which is the last period of his life – RC has to decide whether to repay all liabilities or to default. Default is associated with some (exogenous) cost κ_2, which reflects the economic and political damage resulting from a debt crisis. Comparing costs and benefits in period 2, RC chooses to default if the following condition is satisfied:

$$(6.18) \qquad Y_2 + (1+r)B_2 < Y_2 - \kappa_2$$

Hence, if the burden of repayment exceeds the costs inflicted by a default, RC refuses to repay. As of period 1, the default-cost κ_2 is a random variable whose stochastic properties are described by a cumulative distribution function $F(x)$, with $F(x)$ denoting the probability that κ_2 does not exceed a given value x. Using (6.18), it is easy to show that the probability of default is given by $F(-(1+r)B_2)$, and that the probability of repayment is $[1 - F(-(1+r)B_2)]$.

The international capital market is populated by risk-neutral agents who have access to an alternative security that offers the risk-free "world interest rate" r^W. For participants on the international capital market to be willing to lend to the country under consideration, the expected return associated with a loan has to equal the risk-free return, i.e.

$$(1+r)\left[1-F\left(-(1+r)B_2\right)\right] = 1+r^W \tag{6.19}$$

This expression can easily be transformed into

$$(1+r) = \frac{1+r^W}{\left[1-F\left(-(1+r)B_2\right)\right]} \tag{6.20}$$

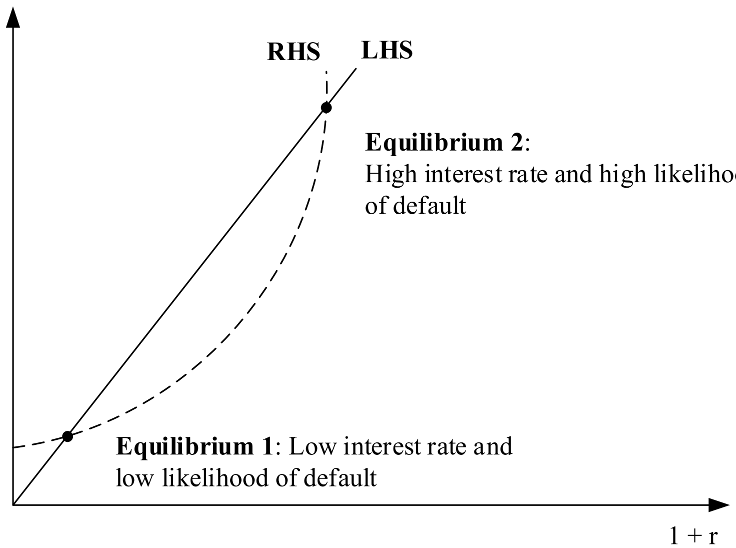

Figure 6.5: Multiple equilibria and default risk

Obviously, the interest rate charged on loans increases in the likelihood of default, i.e. in the probability that the realization of κ_2 is lower than the critical level defined by $-(1+r)B_2$. Note, however, that this critical level, in turn, depends on the burden of repayment and thus on the interest rate. The implication of this mutual dependence – the interest rate being determined by the likelihood of default, which is, in turn, determined by the interest rate – is illustrated by Figure 6.5. This figure shows the left-hand side (LHS) and the right-hand side (RHS) of (6.19) as functions of $(1+r)$. Of course, the exact shape and location of RHS depends on the specification of the cumulative distribution function

$F(x)$. In Figure 6.5, we have drawn RHS as a convex curve, which intersects LHS twice. This demonstrates that there are possibly ***multiple equilibria*** with very different consequences for the interest rate charged and the likelihood of default. The point denoted by "Equilibrium 1" describes a constellation where the international capital market has a rather favorable view on the country's creditworthiness. As a consequence, the interest rate it charges is low, which, in turn, implies a low likelihood of default, vindicating market participants' optimistic expectations. In the point labelled "Equilibrium 2", by contrast, the international capital market perceives the likelihood of default to be high. This results in a high interest rate and a high probability that the country actually refuses repayment, justifying ex post the originally pessimistic attitude.

This simple example demonstrates that, when it comes to default risk, equilibria are not necessarily unique, and expectations may matter as much as facts. The potential role of ***self-fulfilling prophecies*** – i.e. of expectations resulting in prices that generate equilibrium outcomes which, in turn, confirm the initial expectations – has important implications for economic policy. How this insight affected policymakers' reactions to the ***European Debt Crisis*** that started to unfold in 2009 is described in Box 6.3.

Box 6.3: The European Debt Crisis

As we reported in Chapter II (Box 2.3), the financial crisis originating in the breakdown of the US real estate market and implying the bankruptcy of major financial institutions shattered global financial markets in the years 2007 to 2009. In the fall of 2009, the worst seemed to be over, but financial institutions all over the world still stood on wobbly feet, and as a result of various expensive rescue operations and stimulus packages, governments had amassed substantial volumes of public debt. It was at that time that the newly-elected Greek government sprung a rude surprise: in the recent past, its actual budget deficits had been almost twice as high as the official figures, and the level of government debt exceeded the one announced by almost 20 percentage points. Given that, according to rough estimates, two thirds of Greek government debt was in foreign hands, this was likely to have international repercussions.

Indeed, the Greek revelations put an end to a long phase during which European governments had borrowed at almost identical interest rates. In the spring of 2010, tensions started to build, the yield on Greek government bonds increased rapidly, and in April the Greek government saw itself literally shut off from the international capital market. Both European governments and international financial institutions – in particular, the IMF – recognized the severity of the problem and took measures that were meant to avert the imminent default of the Greek government: while a first "rescue package" consisted of bilateral public credits, governments eventually established the ***European Financial Stability Facility*** (***EFSF***). This institution used the Eurozone countries' collective creditworthiness to borrow on the international capital market and to pass on the loans at favorable terms to governments in need.

For various reasons, however, this did not calm down market participants, which started charging ever higher interest rates on Greek government debt. To make matters worse, other European countries like Ireland, Portugal, Cyprus, Spain and Italy were drawn into the spotlight, and spreads on their governments' debt increased as well (see Figure B6.3). Some of these countries had inflated their government debt by pumping money into their recession-ridden economies or a large bureaucracy, others incurred large liabilities in an attempt to rescue domestic banks in the context of the "Global Financial Crisis".

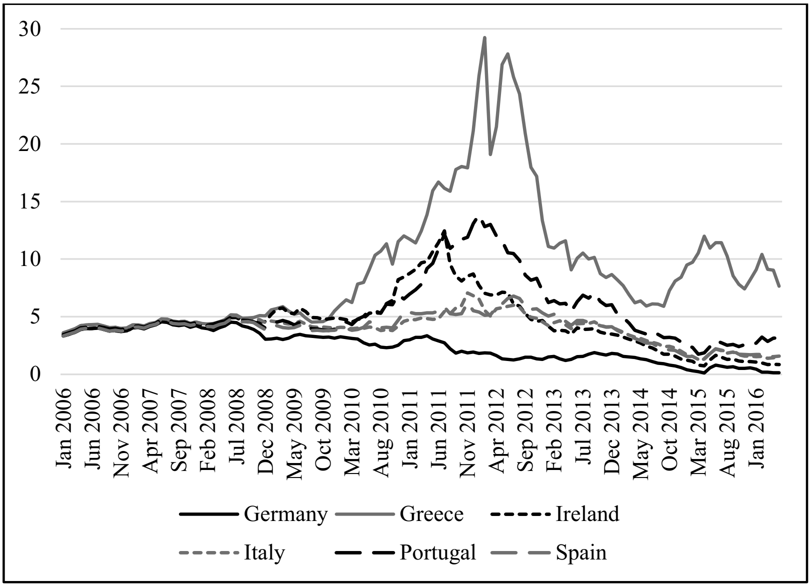

Figure B6.3: Interest rates on government bonds during the European Debt Crisis. Source: IMF (International Financial Statistics)

In early 2012, private creditors of the Greek government were persuaded that it would be better to write off some of their loans. Moreover, the ***European Stability Mechanism*** (***ESM***) replaced the *EFSF* as a permanent rescue funding program that stood ready to provide troubled Eurozone governments with financial resources, conditional on these governments' commitment to reduce their deficits and to reform their economies. Last, but not least, the ***European Central Bank*** (***ECB***) took measures that convinced markets that a sovereign default by countries like Spain or Italy was unlikely. By decisively shifting market participants' expectations, the combination of these measures managed to reduce interest rates, and in late 2014, the genie of imminent and widespread sovereign default had been pushed back into his bottle. An exception was Greece which, in early 2015, elected a new government whose tough negotiations with foreign creditors, once more, brought the country to the brink of financial collapse.

For better or worse, the European Debt Crisis was quickly labelled the "***Euro crisis***", and the rescue packages that were put together to support troubled governments were often motivated as attempts to "save the Euro". There is, indeed, an important relationship between the fiscal problems described in the preceding paragraphs and the responsibilities and constraints imposed on monetary policy in the Eurozone. Later chapters will shed more light on this relationship and delve deeper into an analysis of this crisis.

VI.3.5 Distributional Conflict and Default

So far, we have assumed that both the benefits and the costs of a default are equally spread over the entire population. Alternatively, we could have assumed that there is a transfer mechanism that allows to model the default decision as the decision of a representative consumer. However, this idea is not very plausible, and we have all reason to believe that a default meets neither the unanimous support nor the unanimous resistance of the domestic population. To arrive at a deeper understanding of the determinants and consequences of sovereign default we thus need a *political economy* model in which the government's default decision depends on the resulting costs and benefits for different groups of the population as well as on these groups' political influence.

To illustrate this, we use a simple example which abandons the idea that we can blur the distinction between private agents and the government: we assume that all external liabilities of the country considered are public debt and that, in the period we consider, the government has to repay the amount $D\left(1+r\right)$ to foreign creditors.[19] To make this payment, the government has to raise taxes that are equally distributed across the population. For a given population size n, the individual tax burden thus amounts to $T=\left(\left(1+r\right)D\right)/n$. We assume

[19] We choose this notation in order to simplify the exposition. If we had stuck to our previous convention, we could have written $D_t=-B_t^{pub}$.

that the population consists of "rich" individuals who receive an exogenous income Y^R, and "poor" individuals, whose income amounts to $Y^P < Y^R$. The economy's total income is thus given by $Y = n^P Y^P + n^R Y^R$, with n^P and $n^R = n - n^P$ reflecting the size of the two groups. We assume that the poor part of the population represents the majority $\left(n^P > n^R\right)$, and that the government follows the preferences of the majority when deciding between default and repayment. Given the relative size of the two groups, it thus implements the policy desired by the poor part of the population. As in the model presented in subsection VI.3.3, we assume that the income of *every* individual decreases by a share $\left(1-\gamma\right)$ if the government defaults on its debt. Adopting the perspective of a poor individual, a default is therefore advantageous if the gains from avoiding repayment exceed the costs, i.e. if the following condition is satisfied:

$$(6.21) \qquad Y^P - \frac{\left(1+r\right)D}{n} < \gamma Y^P$$

Using the inequality in (6.21), we can compute a critical level of government debt (relative to the country's total income) that must not be exceeded to avoid default. This critical level $\left(D/Y\right)^{\max}$ is given by

$$(6.22) \qquad \left(\frac{D}{Y}\right)^{\max} = \frac{1-\gamma}{1+r} \cdot \left(\frac{n^P}{n} + \frac{n-n^P}{n}\frac{Y^R}{Y^P}\right)^{-1}$$

Apparently, $\left(D/Y\right)^{\max}$ decreases in the interest rate r and in the parameter γ. Given the discussion in subsection VI.3.3, these effects are not surprising. What is new is that $\left(D/Y\right)^{\max}$ also decreases in the ratio $\left(Y^R/Y^P\right)$. The greater the income difference between rich and poor individuals, the lower the level of government debt (relative to aggregate income) that triggers default. This result is driven by the fact that the costs of default are proportional to agents' incomes, while the costs of repayment are equally distributed among the entire population. The more unequal the income distribution, the lower the damage of a default – compared to the costs of repayment – for the poor part of the population. If this group represents the majority and is decisive in the political process, the likelihood of a default is greater the more unequal the income distribution.

Of course, many of the assumptions on which this simple model was based can be contested: first, it is not very realistic that all individuals bear the same tax burden and thus have to contribute the same amount to a repayment of government debt. Moreover, the assumption that the default decision reflects the political preferences of the (poor) majority – i.e. that we can use the ***median voter model*** to describe the outcome of the political process – contradicts the political reality of many countries. Nevertheless, the result in (6.22) reflects an important insight: a country's creditworthiness does not just depend on aggregate variables like GDP, total external liabilities, or the "economic costs" of a default. What matters as well are the heterogeneous distributional interests of different parts of the population, and their importance in the political process.

VI.3.6 Expropriation

Our analysis has so far focused on constellations where all foreign liabilities consisted of *debt* and where RC – or a government – had to choose between *default* and repayment. In principle, the decision to ***expropriate*** foreign firms is determined by similar considerations as the decision to default. In both cases, an unfavorable transfer of property rights is imposed on foreigners, and in both cases, such a decision entails individual and aggregate costs.

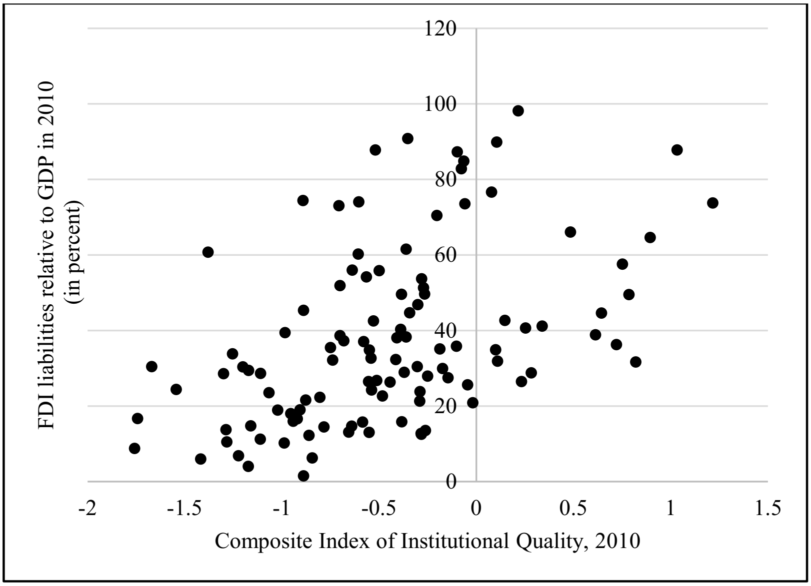

Figure 6.6: Institutional quality and foreign direct investment. Sources: World Bank (Worldwide Governance Indicators data base) and the updated and extended version of the dataset constructed by Lane and Milesi-Ferretti (2007).

However, there are also important differences between default and expropriation: for example, the costs of expropriating a multinational firm predominantly reflect the fact that operating this firm may require a technological and organizational expertise that is proprietory to the foreign owner. A second important difference is that a default usually reflects the decision between two clear-cut alternatives (default vs. repayment) whereas expropriation can come in many different guises. Governments may refrain from openly nationalizing foreign firms, but there are many forms of ***creeping expropriation*** that materialize, e.g. through a corrupt administration or an unpredictable legal system. It is thus not surprising that foreign firms are reluctant to invest in countries in which a bad institutional environment reduces their expected returns.

The scatterplot in Figure 6.6 relates the stock of FDI liabilities (relative to GDP) in a large number of developing countries and emerging markets in the year 2010 to a measure of institutional quality, which reflects people's rights to participate in the political process, political stability, the effectiveness of the bureaucracy, the absence of corruption, the rule of law, and the regulatory environment. This measure is the unweighted average of indicators provided by the World Bank's Worldwide Governance program, and it assumes a higher value for a more favorable institutional environment. The correlation between the two variables is clearly discernible, suggesting that a higher quality of institutions raises foreign firms' willingness to engage in a particular country.

VI.4 Summary and Outlook

In this chapter, we considered the concept of "sustainability" from two different angles. We started by defining the sustainable net international investment position as a combination of assets and liabilities, which – for a given time path of primary current accounts – allows a country to comply with its intertemporal budget constraint. Implicitly, we thus accounted for the possibility that a country is *unable* to honor its external liabilities. In the second part of the chapter, we shifted the focus from a country's *ability* to repay to its *willingness* to repay, and we highlighted the fundamental time inconsistency problem involved in international capital flows. Based on the insight that there is a strong incentive to deny the repayment of outstanding liabilities, we discussed the various costs that are associated with a default, and that ultimately sustain international capital flows. Moreover, we demonstrated that the likelihood of default may be driven as much by market participants' expectations as by observable facts. Finally, we underlined the importance of a careful political-economic analysis when it comes to assessing a country's creditworthiness.

Real-world debt crises are frequently associated with considerable fluctuations of the exchange rate, and a country's ability to honor its liabilities is often jeopardized by a massive depreciation of its currency. Conversely, this depreciation may result from international investors' decision to reduce their exposure to a country. So far, exchange rates have been completely absent from our analysis. This will change in the following chapters, in which we will consider the forces that determine the relative prices of national currencies. We will start by identifying the fundamental forces that drive movements of real and nominal exchange rates. Endowed with these insights, we will then return to the analysis of financial crises in Chapter X, giving justice to the role of exchange rate fluctuations and monetary policies in the context of such crises.

VI.5 Keywords

Ability to pay
Credit rating
Default
Distributional conflict
Embargo
European Debt Crisis
Expropriation
External debt
Haircut
Intertemporal solvency
Multiple equilibria
Primary current account
Sanction
Self-fulfilling prophecies
Sovereign ceiling
Sustainable current account
Willingness to pay

VI.6 Literature

Different versions of the general approach presented in Section VI.2 are adopted by the IMF in the context of its Debt Sustainability Analyses (for a description, see http://www.imf.org/external/pubs/ft/dsa/index.htm) and of the Joint World Bank IMF Debt Sustainability Framework for Low-Income Countries (see http://www.imf.org/external/pubs/ft/dsa/lic.htm). Wyplosz (2007) articulates a critical position on traditional methods to assess the sustainability of current account balances. Aguiar and Amador (2014) offer a recent survey on the determinants and consequences of sovereign default, while Tomz and Wright (2013) review the empirical evidence. Sturzenegger and Zettelmeyer (2006) and, more recently, Schumacher et al. (2015) put a special emphasis on the legal implications of sovereign default, while Reinhart and Rogoff (2009) embed the analysis of sovereign default into a comprehensive discussion of financial crises. Borensztein and Panizza (2009) discuss the empirical relevance of the different costs resulting from a default, while Cruces and Trebesch (2013) show that these costs depend on the size of the "haircut" inflicted on foreign lenders. Broner et al. (2010) offer a compelling argument that questions the view that foreign lenders are particularly exposed to sovereign default. Harms (2000, 2002a) as well as Harms and an de Meulen (2012) model the risk of expropriation as reflecting a distributional conflict between different generations. Harms (2002b), Busse and Hefeker (2007) as well as Alfaro et al. (2008) estimate the empirical effect of political risk and institutional quality on various types of capital inflows. Lane (2012), Shambaugh (2012), Sinn (2014) and Baldwin et al. (2015) provide accounts and interpretations of the European Debt Crisis.

VI.7 Exercises

6.1. Stable external debt. We consider a small open economy without a public sector whose (exogenous) real GDP grows at a constant rate g, which does not receive any foreign labor income or secondary income, and which is able to borrow and lend at a real interest rate $r > g$ on international financial markets.

a) Show that the evolution of the net international investment position (relative to the country's GDP) is characterized by the following difference equation:

$$b_{t+1} = \frac{1+r}{1+g} b_t + \frac{ca_t^{pr}}{1+g}$$

with $ca_t^{pr} \equiv (Y_t - C_t)/Y_t$ denoting the primary current account relative to GDP.

b) Assume that $ca_t^{pr} = ca^{pr}$ for all t. That is, the primary current account as a share of GDP is constant. Draw the above difference equation in a graph that shows b_t on the horizontal axis and b_{t+1} on the vertical axis.
c) The steady state b^{SS} is given by the intersection of this line with the 45-degree line. Mark the steady state in the diagram and compute it analytically.
d) How does b_t evolve over time if the initial net international investment position (relative to GDP) is greater (or smaller) than b^{SS}?
e) In Subsection VI.2, we have shown that, in steady state, the minimal net international investment position (relative to GDP) that is compatible with intertemporal solvency is $b^{\min} = 1/(g-r)$ if $\phi = 0$. Explain the difference between this finding and the result derived in c).

6.2. Empirical determinants of a default. Suppose you are conducting an empirical analysis to identify the factors that determine the likelihood of a government declaring default. Which effect would you expect the following variables to have? Use the reasoning presented in this chapter to justify your answers.
a) Trade openness (measured as the sum of exports and imports relative to GDP)

b) Government debt (in percent of GDP)
c) The volatility of the price of a country's main export commodity.
d) The quality of institutions (the rule of law, the quality of the bureaucracy, the absence of corruption)
e) Inequality (as reflected by the Gini coefficient)
f) GDP per capita

6.3. Adverse effects of debt relief? As mentioned in Box 6.3, policymakers managed to persuade private creditors of the Greek government to write off a substantial share of their claims. Some commentators warned that, despite the temporary relief this meant for Greek public finances, the write-off might be counterproductive in the long run. Do you agree?

VI.8 Appendix to Chapter VI

VI.8.1 The Default Decision with an Embargo Threat.

In order to derive equation (6.10) we start by computing the consumption level of RC for the case that he honors his liabilities in every period. Due to the assumption that $\beta(1+r)=1$, this consumption level is constant, and we can use equation (3.72):

$$(6.A1)\qquad C_t^{ND} = r\,B_t + \left(\frac{r}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} Y_s$$

Taking into account (6.9), the present value of future incomes is given by

$$(6.A2)\qquad \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} Y_s = \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} Y + \left[1-\left(\frac{1}{1+r}\right)+\left(\frac{1}{1+r}\right)^{2}-\left(\frac{1}{1+r}\right)^{3}+\ldots\right]\Delta$$

This can be re-written as

$$\text{(6.A3)} \qquad \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} Y_s = \frac{1+r}{r} Y + \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{2(s-t)} \Delta - \left(\frac{1}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{2(s-t)} \Delta$$

Reshuffling the term on the right-hand side and using the formula

$$\text{(6.A4)} \qquad \sum_{s=t}^{\infty} a^{2(s-t)} = \frac{1}{1-a^2}$$

which holds for $|a|<1$ yields

$$\text{(6.A5)} \qquad \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} Y_s = \frac{1+r}{r} Y + \frac{r(1+r)}{(1+r)^2-1}\Delta$$

By substituting this result into (6.A1) we arrive at

$$\text{(6.A6)} \qquad C_t^{ND} = r\,B_t + Y + \frac{r}{2+r}\Delta$$

This constant consumption level can be plugged into the utility function. Due to the assumption that $\beta(1+r)=1$ we get

$$\text{(6.A7)} \qquad U_t^{ND} = \frac{1+r}{r}\ln\left(r\,B_t + Y + \frac{r}{2+r}\Delta \right)$$

In case of default, the possibility of borrowing and lending vanishes for all future periods. Hence, consumption coincides with the exogenous (volatile) income in every period, and RC's lifetime utility is given by

$$\text{(6.A8)} \qquad U_t^{D} = \sum_{s=t}^{\infty} \beta^{s-t} \ln Y_s$$

Using the income process described by (6.9), we get

$$U_t^D = \sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{2(s-t)}\ln\left(Y+\Delta\right) + \left(\frac{1}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{2(s-t)}\ln\left(Y-\Delta\right) \tag{6.A9}$$

In order to arrive at the expression in (6.11), we once more use the formula in (6.A4).

VI.8.2 The Effect of Output Volatility on the Critical Net International Investment Position

Combining (6.10) and (6.11), we can show that the minimal net international investment position at which RC is indifferent between default and repayment is implicitly defined by

$$\ln\left(r\,B_t^{crit} + Y + \frac{r}{2+r}\Delta\right) - \frac{(1+r)}{(2+r)}\left[\ln\left(Y+\Delta\right) + \frac{\ln\left(Y-\Delta\right)}{1+r}\right] = 0 \tag{6.A10}$$

We want to show that B_t^{crit} is *decreasing* in Δ. Observing that the left-hand side of (6.A10) unambiguously increases in B_t^{crit} and using the implicit function rule, we have to show that this expression also increases in Δ. By taking the derivative with respect to Δ, we can show that this is the case if

$$\frac{r}{r\,B_t^{crit} + Y + \frac{r}{2+r}\Delta} - \frac{1+r}{Y+\Delta} + \frac{1}{Y-\Delta} > 0 \tag{6.A11}$$

If this condition is satisfied for $B_t^{crit} = 0$, it is satisfied for any $B_t^{crit} < 0$ as long as the first term on the left-hand side of (6.A11) is positive. We therefore continue by setting $B_t^{crit} = 0$. By adding the terms on the left-hand side and rearranging, we can show that the inequality in (6.A11) is equivalent to

$$\frac{Y+\Delta}{Y-\Delta} > \frac{(2+r)Y - r\,\Delta}{(2+r)Y + r\,\Delta} \tag{6.A12}$$

Given the assumption that $Y > \Delta$, this condition is satisfied.

VI.8.3 The Default Decision with Direct Costs

In order to derive equation (6.14) we use equation (3.72) combined with the assumption that $\beta\left(1+r\right)=1$. This yields

$$\text{(6.A13)} \qquad C_t = r\,B_t + \frac{r}{1+r}\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} Y_s$$

If the country honors its liabilities we have $Y_s = Y$ and hence

$$\text{(6.A14)} \qquad C_t^{ND} = r\,B_t + Y$$

By contrast, if RC declares default in period t he achieves a consumption level

$$\text{(6.A12)} \qquad C_t^{D} = \frac{r}{1+r}\left(Y + \left(\frac{1}{1+r}\right)\sum_{s=t}^{\infty}\left(\frac{1}{1+r}\right)^{s-t} \gamma Y \right)$$

This can easily be transformed into

$$\text{(6.A13)} \qquad C_t^{D} = \frac{r+\gamma}{r+1} Y$$

The (constant) consumption levels can be substituted into the utility function. In order to derive (6.14) and (6.15), we use the fact that

$$\text{(6.A14)} \qquad U_t^{j} = \sum_{s=t}^{\infty}\beta^{s-t}\ln\left(C_t^{j}\right) = \frac{1}{1-\beta}\ln\left(C_t^{j}\right) \quad \text{with } j\in\left\{D, ND\right\}.$$