COUNTRY PORTFOLIOS

Aart Kraay
The World Bank

Luis Servén
The World Bank

Norman Loayza
The World Bank

Jaume Ventura
CREI and Universitat Pompeu Fabra

Abstract
Capital flows to developing countries are small and mostly take the form of loans rather than direct foreign investment. We build a simple model of North–South capital flows that highlights the interplay between diminishing returns, production risk, and sovereign risk. This model generates a set of country portfolios and a world distribution of capital stocks that resemble those in the data. (JEL: F32, F34)

1. Introduction

Capital flows to developing countries are positive, small, and mostly take the form of lending instead of foreign investment. The bold line in Figure 1 shows the combined net foreign asset position of 47 non-OECD countries as a share of their combined wealth from 1970 to 1997. Throughout this period these countries have been net recipients of capital. Their net capital imports average about 10% of their wealth, fluctuating moderately between 8% and 12%. Figure 1 also shows that loans are the preferred asset to finance capital flows to poor countries. Over the period 1970–1997, on average about three-quarters of the net foreign liabilities of poor countries consisted of net lending, with the remainder consisting primarily of foreign investment. The share of net lending has declined over time, but is still well over 50% toward the end of our sample period. Foreign investment by

Acknowledgments: We thank Mark Aguiar, Daron Acemoglu, Giancarlo Corsetti, Raquel Fernandez, Robert E. Lucas, and Mark Wright for insightful comments on a previous draft, Gian Maria Milesi-Ferretti for his advice on the data, and Natalia Tamirisa for sharing data on capital controls. We are also grateful to César Calderón, Alex Karaivanov, Megumi Kubota, George Monokroussos, and Rashmi Shankar for excellent research assistance. The opinions expressed here are the authors' and do not necessarily reflect those of the World Bank, its executive directors, or the countries they represent. Financial support from the Regional Studies Program of the Latin America Region of the World Bank is gratefully acknowledged. Jaume Ventura also acknowledges financial help from the Fundación Ramón Areces.

E-mail addresses: Kraay: akraay@worldbank.org; Loayza: nloayza@worldbank.org; Servén: lserven@worldbank.org; Ventura: jaume.ventura@upf.edu

Journal of the European Economic Association June 2005 3(4):914–945

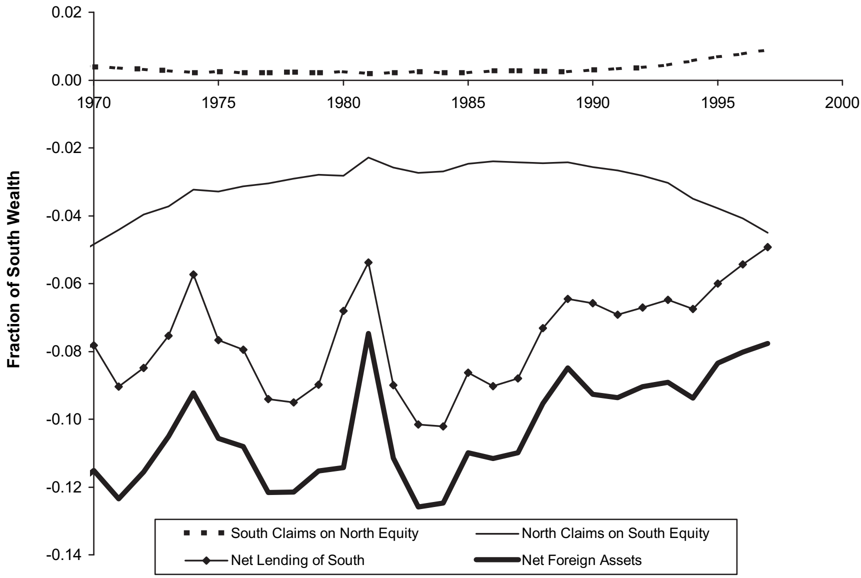


FIGURE 1. North–South capital flows.

poor countries in rich countries is negligible. Appendix A describes the data and provides a number of robustness checks regarding these basic facts.[1]

It seems safe to argue that a theory of North–South capital flows requires at least two ingredients to be able to explain these empirical observations. The first one would be one or more incentives for capital to flow from rich to poor countries. Natural candidates for this role are diminishing returns at the country level and/or country-specific production risk. If either of these two forces are present, the risk-adjusted rate of return to capital declines as more capital is invested in a country, creating an incentive to invest in countries that have little capital. In the absence of a countervailing force, this incentive would only be eliminated if capital stocks per person were equalized across countries. Since the set of developing countries considered in Figure 1 has about four-fifths of the world population and owns about one fifth of the world's wealth, equalization of capital stocks per person would require a net foreign asset position of 300% of their wealth! The theory clearly needs a second ingredient to explain why capital flows are so small.

A popular view is that the theory just needs to recognize that rich countries have better technologies and human capital, and this is why investors keep most

1. Throughout the paper we use the data of Kraay et al. (2000). See Sinn (1990), Rider (1994), and Lane and Milesi-Ferretti (2001a) for alternative sources of data.

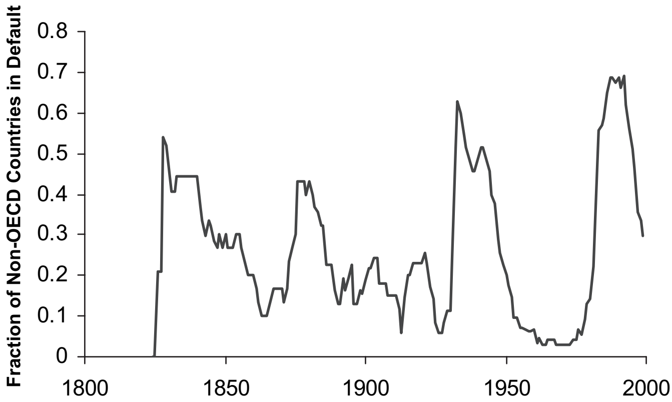


FIGURE 2. Incidence of sovereign default.

of their capital in rich countries even in the presence of diminishing returns and production risk. As stated, this explanation only begs the question, since it is not clear why technologies and human capital do not flow to poor countries together with physical capital. But even if one is willing to take this for granted, it cannot be the whole story. While better technology and human capital in rich countries can explain why net foreign asset positions are small, it cannot explain how they are financed. To the extent that countries have some desire to diversify production risk, the theory leads to the prediction that countries should hold large gross foreign investment positions that are roughly balanced, and they should have no incentive to lend. But Figure 1 has already shown that most capital flows take the form of loans, and that gross foreign investment positions are small.

In this paper we explore the alternative hypothesis that sovereign risk might be the second ingredient that the theory needs.[2] Figure 2 shows that over the past 200 years there have been four episodes of widespread systemic default by poor countries. These episodes lasted around 20 years, and were interspersed by 30–40-year periods during which defaults were relatively rare. The notion that foreign investments and loans are subject to sovereign risk is therefore hardly novel or controversial. The interesting question is whether the presence of this type of risk can account for the main empirical features of capital flows to developing countries. To determine this, we construct a simple North–South model of international capital flows. The production technology exhibits diminishing returns

2. Obstfeld and Rogoff (1996, p. 349) define sovereign risk as referring to "... any situation in which a government defaults on loan contracts with foreigners, seizes foreign assets located within its borders, or prevents domestic residents from fully meeting obligations to foreign creditors." This is a good description of what we have in mind. Rogoff, Reinhart, and Savastano (2003) document the history of default on sovereign debt in a large sample of countries over the past 200 years.

at the country level and country-specific risk. In this model, the world economy experiences periods with substantial North–South capital flows, which culminate in the South defaulting on its foreign obligations. This initiates a crisis period in which international financial markets shut down. Eventually, North–South capital flows resume and the cycle starts again. As a result of these recurrent crises, domestic capital offers a country not only the value of its production flow, but also a hedge against the risk of foreign default. This creates a home bias in the demand for capital that might explain why capital flows to developing countries are small.

Whether sovereign risk can also explain how capital flows to developing countries are financed depends crucially on how we model the consequences of a default. Assume first that if a country defaults on its foreign obligations, foreign countries respond by seizing the assets that this country owns abroad and then using these assets to (partially) compensate the loss. Assume also that the process by which assets are seized and transferred to creditors is not costly. Or, if this transfer is costly, assume this cost is always avoided through efficient renegotiation of claims after the default.[3] Under either of these assumptions, default is just a transfer of the net foreign asset position to the defaulting country. To minimize exposure to sovereign risk, countries then choose small net foreign asset positions, but they do not have to hold small gross foreign investment positions. Once again, to the extent that countries have a desire to diversify production risk they would again choose large gross foreign investment positions that are roughly balanced, and they would have no incentives to lend.

Assume instead that transferring ownership of foreign investments is costlier than transferring ownership of loans.[4] Moreover, assume also that renegotiation of claims is inefficient, and sometimes defaulting countries seize loans and foreign investments despite the costs. An implication of these assumptions is that the costs of default rise with the share of capital flows that take the form of foreign investments. If the desire to avoid diminishing returns creates an incentive to transfer capital from rich to poor countries, foreign loans will be a more attractive asset if sovereign risk is high relative to production risk. Thus, sovereign risk has also the potential to explain why loans are the preferred asset to finance capital flows, and why gross foreign investment positions are small.

This paper is related to at least three lines of literature. The growth literature has studied how differences in returns affect incentives for international capital flows. Most influentially, Lucas (1990) asked why capital does not flow from rich to poor countries, given likely large return differences. A second line of

3. If seizing assets is costly and renegotiation of claims is efficient, there will never be a seizure of assets. Instead, the country will extract a payment from foreign countries in exchange for “honoring” its financial obligations towards them.

4. After all, the former requires transferring the control of real assets, while the latter consists only of canceling financial claims.

literature has studied the incentives for international portfolio diversification and risk sharing. This literature has wondered why foreign investments are so small given substantial opportunities to share risk internationally. Lewis (1999) surveys the extensive theoretical and empirical literature in this area, which has for the most part focused on the foreign investment positions of industrial countries. A third, more recent, and much smaller strand of the literature has asked how countries' foreign investment positions are financed. Lane and Milesi-Ferretti (2001b) document that the composition of international capital flows has shifted toward direct and portfolio equity investment during the 1990s, and Albuquerque (2003) develops a model in which foreign direct investment is the preferred asset to finance international capital flows since it is more difficult to expropriate.

The paper is organized as follows: Section 2 presents a benchmark model of North–South capital flows and shows that differences in technology and human capital alone cannot explain the main features of the data. Even with plausible differences in technology, we find that too much capital flows from North to South, and that these flows take the form of foreign investments rather than loans. Section 3 introduces sovereign risk, assuming that renegotiation is efficient. We find that adding an empirically plausible amount of sovereign risk to the model brings its predictions for net foreign asset positions much closer to the data. However, the model still cannot explain how these positions are financed. Section 4 adds inefficient renegotiation, and shows that this inefficiency can account for why North–South capital flows are financed primarily by loans. Section 5 concludes. Appendix A describes the data and Appendix B provides solution details.

2. Complete Markets and the Technology Gap

We start by describing a benchmark world in which countries can commit to honouring all of their contractual obligations. Although this assumption shall be relaxed later, the assumptions on preferences and technology remain constant throughout the paper. We consider a world with two countries, North and South; one factor of production, capital, and a single good that can be used for consumption and investment. This good is the numeraire. North and South contain a continuum of identical consumers/investors that evaluate consumption sequences as follows:

$$E \int_0^{\infty} \ln c(t) e^{-\delta t} dt \qquad (\delta > 0) \tag{1}$$

where c is per capita consumption of the North. The time index will be omitted whenever this is not confusing. Throughout, we use an asterisk $(*)$ to denote South variables. We assume North has higher initial wealth than South, i.e., $a(0) > a^*(0)$.

Production requires capital. Let k and k^* be the capital stocks located in North and South. We assume that a fraction η of the world population lives in North, and normalize the world population to one. To produce one unit of capital, one unit of the consumption good is required. Since capital is reversible, the price of each unit is always one and its return is the flow of production net of depreciation (see Figure 1). Let ω and ω^* be two standard Wiener processes with independent increments with $E[d\omega] = E[d\omega^*] = 0$, $E[d\omega^2] = E[d\omega^{*2}] = dt$ and $E[d\omega d\omega^*] = 0$. The flow of production net of depreciation is given by $Rdt + Vd\omega$ in North and $R^*dt + V^*d\omega^*$ in South; where R and R^* are shorthand for $R = \pi(k/\eta)^{-\gamma}$ and $R^* = (k^*/(1-\eta))^{-\gamma}$, and V and V^* are shorthand for $V = \sigma/\sqrt{\eta}$ and $V^* = \sigma/\sqrt{1-\eta}$.[5] The parameter π ($\geq$1) measures the technological advantage of North, i.e., higher mean productivity. The parameter γ ($0 \leq \gamma \leq 1$), measures the strength of diminishing returns, which for simplicity are treated here as an externality or congestion effect.[6] The parameter σ ($\geq$0) measures the importance of country-specific production risk. This formulation allows countries to have different technologies and populations. It also captures the two forces that, in the absence of a technology gap, create incentives to equalize the capital stock per worker across countries.

We assume that North's (South's) residents own and operate all the capital stock that is located in the North (South). As usual, we could obtain the prices and allocations that apply with complete markets by assuming that North and South residents have access to a sophisticated financial market in which a full set of Arrow–Debreu securities are traded. In this environment however, the same prices and allocations are obtained by assuming that North and South residents have access to a financial market in which only risk-free bonds and claims on North and South production are traded.[7] Risk-free bonds have a price of one and promise an instantaneous interest rate rdt. Claims to North's (South's) production have a price v (v^*) and promise to pay the net flow of production generated by one unit of North's (South's) capital. We shall refer to the holdings of risk-free bonds and claims to overseas production as foreign loans and foreign investments, respectively.

5. One way to understand these assumptions is to imagine the North as a collection of identical individuals, each running a different uncorrelated project. If this project has size K, it promises an expected return of $\pi K^{-\gamma}$ with a standard deviation equal to σ. Then, a portfolio of all the projects of the North has mean and standard deviation equal to R and V, as defined in the text. A similar set of assumptions for the South justifies the choice of R^* and V^*.

6. At the cost of further notation, we could generate this dependence by assuming there is a production factor that is not priced, or an export good that faces a downward-sloping demand.

7. See Merton (1990, ch. 14 and 16) for a comprehensive analysis of the complete-markets model in continuous time. He also constructs a dynamic trading strategy that replicates the payoffs of any Arrow–Debreu security with a portfolio that, in the context of our model, contains only risk-free bonds and claims to North and South production.

Given this asset choice, North's budget constraint can be written as follows:

$$da = \left[\frac{R(k-e) + R^*e^* + rl}{\eta} - c\right] dt + V\frac{k-e}{\eta}\, d\omega + V^*\frac{e^*}{\eta}\, d\omega^* \tag{2}$$

where a is the per capita wealth of the North; e and e^* are foreign investments in North and South; and l are foreign loans held by North. Naturally, the following restriction applies:

$$\eta a = k - ve + v^*e^* + l; \tag{3}$$

The budget constraint in equations (2)–(3) shows how the expected return and volatility of wealth depend on portfolio decisions. Throughout, we rule out Ponzi schemes and impose short-sale constraints on foreign investments, i.e., $e \geq 0$ and $e^* \geq 0$.

To determine the optimal consumption and portfolio rules, the representative consumer in North maximizes (1) subject to (2), (3), and the dynamics of asset prices and their return characteristics, i.e., the laws of motion of r, v, v^*, R, and R^*. Since the representative consumer is infinitesimal, he/she understands that his/her actions have no influence on these prices and their evolution. Appendix B shows that the first-order conditions associated with this problem can be written as follows:

$$c = \delta a \tag{4}$$

$$R - \rho = V^2\,\frac{k-e}{\eta a} \tag{5}$$

$$r - \rho = 0 \tag{6}$$

$$\rho v - R = -V^2\,\frac{k-e}{\eta a} \tag{7}$$

$$R^* - \rho v^* \leq V^{*2}\,\frac{e^*}{\eta a}; \qquad \text{with strict inequality if } e^* > 0 \tag{8}$$

where ρ is the multiplier associated with constraint (3) divided by the marginal utility of wealth. This quantity can be interpreted as the risk-free rate that applies to loans between North's residents. A similar set of first-order conditions applies to South.

The first-order conditions in equations (4)–(8) are quite standard. Equation (4) is the first-order condition associated with c; and shows the familiar result that consumption equals the annualized value of wealth. With logarithmic preferences, the discount factor is equal to the rate of time preference. Equation (5) is the first-order condition associated with k, and says that the premium for holding domestic production risk, $R - \rho$, is the covariance between the return to one unit of domestic capital and one unit of the investor's portfolio, $V^2((k-e)/\eta a)$. Equation (6) is the first-order condition associated with l; it says that the domestic interest rate equals the interest rate on foreign loans. Equation (7) is the first-order condition associated with e; it can be interpreted as determining the price at which North is willing to sell claims on its own output. Equation (8) is the first-order condition associated with e^*; it defines the demand for foreign investment.

We are ready now to derive the implications of this model for North–South capital flows and their financing. Straightforward algebra shows that the quantity of loans and foreign investments are given by:[8]

$$e = \frac{(1-\eta)a^*}{\eta a + (1-\eta)a^*}k; \qquad e^* = \frac{\eta a}{\eta a + (1-\eta)a^*}k^*; \qquad \text{and} \qquad l = 0. \quad (9)$$

This result means that there is full sharing of production risk, as each country receives a share of world production that is proportional to its share of world wealth. What is the cost of foreign investments? Since the supply of capital is flat, North and South are willing to sell shares of production at a constant price:[9]

$$v = v^* = 1 \quad (10)$$

The implications for country portfolios of equations (9) and (10) are twofold: (i) foreign investment positions are large since each country holds the same share of its wealth as claims on North and South production, i.e.,

$$\frac{k - ve}{\eta a} = \frac{ve}{(1-\eta)a^*} = \frac{k}{\eta a + (1-\eta)a^*}$$

and

$$\frac{v^* e^*}{\eta a} = \frac{k^* - v^* e^*}{(1-\eta)a^*} = \frac{k^*}{\eta a + (1-\eta)a^*};$$

and (ii) there is no trade in loans in equilibrium.

A little bit of additional algebra shows that, in equilibrium, the world distribution of capital stocks is implicitly determined by:[10]

$$r = \pi\left(\frac{k}{\eta}\right)^{-\gamma} - \sigma^2 \frac{k/\eta}{\eta a + (1-\eta)a^*} \quad (11)$$

$$r = \left(\frac{k^*}{1-\eta}\right)^{-\gamma} - \sigma^2 \frac{k^*/(1-\eta)}{\eta a + (1-\eta)a^*} \quad (12)$$

$$\eta a + (1-\eta)a^* = k + k^* \quad (13)$$

8. This follows from equations (3), (6)–(8), and South's counterparts.

9. This follows from equations (5), (7), and South's counterparts.

10. To see this, substitute equation (9) into equations (3), (5)–(6), and South's counterparts.

Equations (11) and (12) describe the demand for North and South capital, and equation (13) is the market-clearing or world adding-up constraint. Note that the interest rate is lower than the marginal product of capital, as investors demand a premium for holding production risk. The demand for North capital is higher than the demand for South capital as a result of the technological gap, i.e., $\pi \geq 1$. In the absence of this gap, both countries would have the same capital per person in equilibrium.

Figure 3 plots South's net foreign asset position i.e., $\text{NFA}^* = ((1-\eta)a^* - k^*)/(1-\eta)a^*$, and the structure of its portfolio as a share of its wealth, as a function of π, σ, and γ. We set $V = \sigma/\sqrt{\eta}$ equal to the standard deviation of OECD aggregate per capita GDP growth during our sample period of 1970–1997, which is 0.02. Since the OECD's population share of our sample is $\eta = 0.2$, this implies a benchmark value of $\sigma = 0.01$, and we also consider values ranging from zero to 0.02. Since the expected value of per capita production is $\pi(k/\eta)^{1-\gamma}$, the case of $\gamma = 0$ corresponds to the linear growth model, while $\gamma = 0.5$ roughly corresponds to the neoclassical growth model. Within this range, we consider $\gamma = 0.25$ as a reasonable intermediate benchmark, as well as a range from 0 to 0.5. Finally, we allow North's productivity advantage to vary from $\pi = 1$ to $\pi = 2$, with a benchmark value of $\pi = 1.5$.[11]

Consistent with the evidence, the theory predicts North–South capital flows to be positive for our benchmark parameter values, i.e., the foreign asset position of South is negative. However, these flows are much larger than those observed in the data. For our benchmark parameters, the net foreign asset position of South is −126% of its wealth, while in the data it is only about −10%. As noted above, these net foreign asset positions consist entirely of foreign investments, and net lending is zero. North's investment in South represents 181% of South's wealth, while South investment in North is 55% of South's wealth. In contrast, in the data South investments in North are negligible, North investments in South are about 2.5% of South wealth, and South borrowing accounts for 7.5% of South wealth.

Not surprisingly, the predictions of the model for net foreign asset positions are quite sensitive to the key parameters describing the production technology. The smaller is the North's productivity advantage, π, the greater are North–South capital flows. In fact, as discussed in the introduction, if one assumes that $\pi = 1$, the model predicts that South's net foreign asset position is −300% of its wealth. In contrast, if North has a twofold productivity advantage, North–South flows begin to approach magnitudes observed in the data. The bottom two panels of Figure 3 show that the greater is production risk and the stronger are diminishing

11. To produce Figure 3 and all the figures that follow, we normalize world wealth $\eta a + (1-\eta)a^* = 1$. We also set $\eta a/(\eta a + (1-\eta)a^*) = 0.8$ to reflect our estimate that the wealth of the OECD constitutes about 80% of world wealth. Finally, we scale the expected return to capital in both countries so that the world average expected return to capital is equal to 2% for all parameter values.

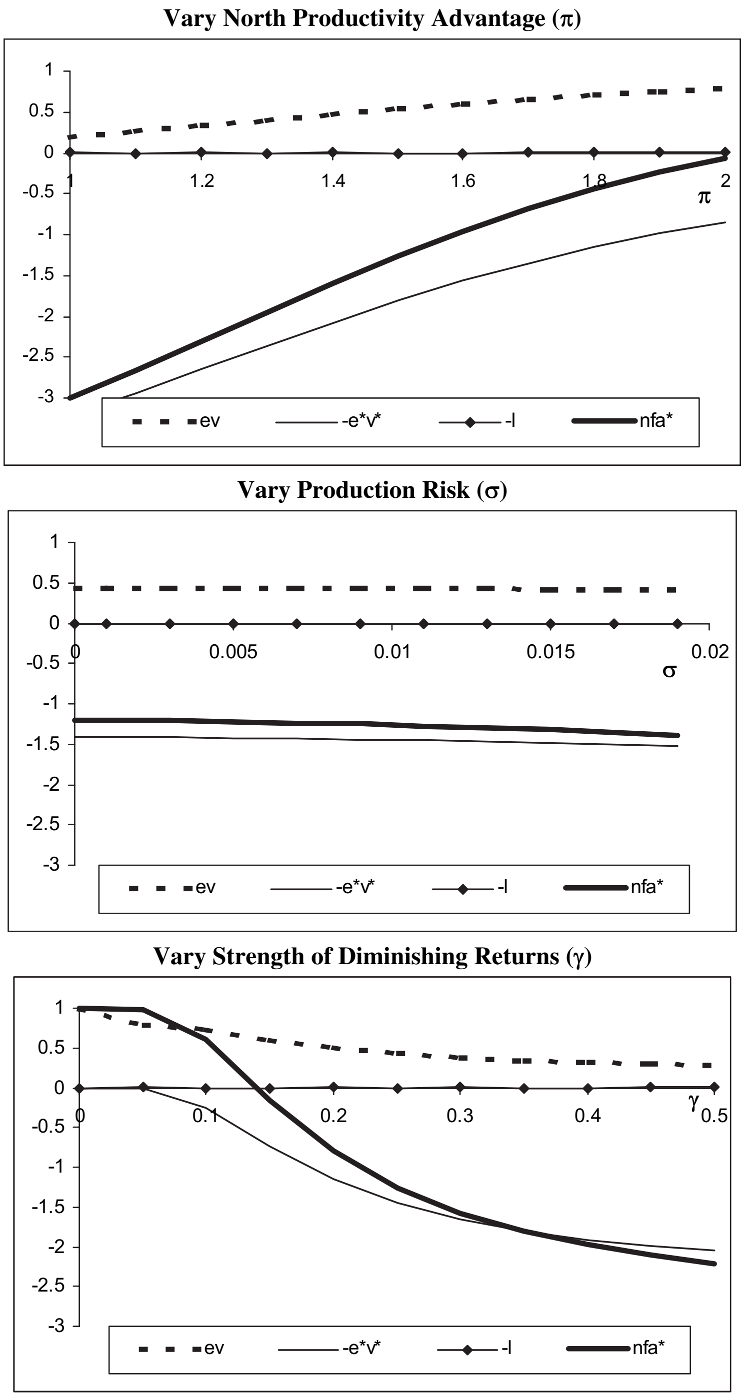


FIGURE 3. Foreign asset position of South in complete markets model (fraction of South wealth).

returns, the greater are North–South capital flows. For our baseline parameter values, capital can even flow from South to North if diminishing returns are weak enough.[12] In all cases, however, these foreign investment positions are financed entirely by equity, and international borrowing and lending is zero.

To summarize, the complete-markets model can generate positive North–South capital flows for reasonable parameter values. But the model also exhibits two features that do not sit well with the data: (i) the theory predicts North–South capital flows that are much larger than the data; and (ii) the theory predicts that these capital flows are financed by large foreign investment positions, while in the data they mostly take the form of loans. What is the source of this discrepancy between theory and data? Our hypothesis is that the model goes wrong when it assumes that countries can commit to fulfilling all of their contractual obligations. By adopting this assumption, the complete-markets model neglects the history of North–South capital flows, which is plagued by recurrent episodes of default and renegotiation of foreign obligations. Surely, these episodes must have an effect on the investment strategies of North and South residents. We shall explore this next.

3. Sovereign Risk

It is evident that foreign loans and foreign investments will be used in equilibrium if and only if the probability they are honored is high enough. It is also evident that enforcing contracts sometimes requires the threat of force. These observations raise a familiar time-inconsistency problem. Since governments cannot punish foreign citizens, international financial transactions crucially rely on governments' willingness to punish their own citizens if they default on their obligations towards foreigners. All governments would like to commit to punish default ex ante, since this would allow domestic investors to exploit beneficial trade opportunities. But this commitment might not always be credible, since governments might not have an incentive to punish default ex post. It is this lack of credibility that creates sovereign risk, and its key implication is that beneficial trade opportunities are left unexploited for fear of default.

We model the decision to punish default as a rational decision of the government. Let $s = \{0, 1\}$ be the state of the world. During "normal times" ($s = 0$) both countries can credibly commit to punish their citizens in the case of default with penalties that are large enough to discourage default in the first place. As a result, if $s = 0$ no country defaults. During "crisis periods" ($s = 1$) countries cannot credibly commit to imposing penalties in the case of default that go beyond retaliation in kind. As a result, if $s = 1$ the country with a negative net

12. When diminishing returns are sufficiently weak, we arrive at a corner solution where all of the capital stock is located in the North, given our choices for the other parameters.

foreign asset position defaults.[13] Let αdt and βdt be the probabilities that the world transitions from $s = 0$ to $s = 1$ and vice versa; and assume these transitions are independent of production shocks, i.e., $E[d\omega ds] = E[d\omega^* ds] = 0$. The value of ds is revealed after countries have chosen their portfolios. As a result, the probability of default is αdt if $s = 0$ and $1 - \beta dt$ if $s = 1$.[14] The world economy therefore exhibits periods of trade in assets that culminate in crises (s transitions from $s = 0$ to $s = 1$) in which the debtor country defaults. After this happens, a crisis period ensues in which there is no trade in assets. Eventually, international trade in assets resumes (s transitions from $s = 1$ to $s = 0$) and the cycle starts again. Naturally, the complete-markets model presented in the previous section applies as the special case in which the world economy starts in normal times and the probability of a crisis is negligible, i.e., $s = 0$ and $\alpha \to 0$.

In normal times there is trade in assets and we can write North's budget constraint as follows:

$$da = \left[\frac{R(k-e) + R^* e^* + rl}{\eta} - c\right] dt + V\frac{k-e}{\eta} d\omega + V^* \frac{e^*}{\eta} d\omega^* + \frac{ve - v^* e^* - l}{\eta} ds \tag{14}$$

and the restriction in equation (3) still applies. The only novelty with respect to equation (2) is the presence of a third term describing the wealth shock that the investor experiences at the onset of a crisis period. As a result of default, all foreign obligations are forfeited and the country loses/gains its net foreign asset position. During crisis periods there is no trade in assets and we must impose the additional restriction that $e = e^* = l = 0$.

To determine the optimal consumption and portfolio rules, the representative consumer in North maximizes (1) subject to (3), (14), and the restriction that $e = e^* = l = 0$ if $s = 1$, and the dynamics of asset prices and their return characteristics, i.e., the laws of motion of r, v, v^*, R, and R^*. Appendix B shows that the first-order condition associated with c and k are independent of the state of the world and are still described by equations (4) and (5). During crisis periods this is all that is required to characterize the dynamics of the world economy.

13. Since time is continuous, returns are of order dt, and stocks are of order 1. Therefore, returns have only a negligible impact on the default decision.

14. If the probability of default is large, investors do not purchase foreign loans and foreign investments. But then both countries are indifferent on whether to default or not. To ensure the existence of equilibrium, we assume they default (on their nonexistent foreign obligations) so that the beliefs of investors are consistent with the proposed default probabilities.

In normal times, we also have the following generalized versions of the first-order conditions for l, e, and e^*:

$$r - \rho = \alpha \frac{\eta a}{k} \tag{15}$$

$$\rho v - R = -V^2 \frac{k - e}{\eta a} - \alpha \frac{\eta a}{k} v \tag{16}$$

$$R^* - \rho v^* \leq v^{*2} \frac{e^*}{\eta a} + \alpha \frac{\eta a}{k} v^*; \qquad \text{with strict inequality if } e^* > 0. \tag{17}$$

Since now there is some probability that foreign obligations are not fulfilled, international transactions require a sovereign risk premium. Equation (15) says that the premium for holding sovereign risk, $r = \alpha - \rho$, is equal to the covariance between one unit of loans and one unit of the investor's portfolio, i.e., $\alpha((\eta a - k)/\eta a)$, times the ratio of the marginal value of wealth before and after a crisis occurs, i.e., $\eta a/k$.[15] Equation (16) can still be interpreted as determining the price at which North is willing to sell claims to its own output. Each claim sold by North reduces its income by the flow of production generated by one unit of capital, but now it also provides a gain of one unit of capital in the event of a crisis. Equation (17) defines the demand for foreign investment in the presence of both production and sovereign risk.

What are the implications of sovereign risk for North–South capital flows? It is straightforward to show that equation (9) still describes the equilibrium foreign investments and foreign loans as a function of the world distribution of capital stocks. In other words, the presence of sovereign risk does not preclude full sharing of production risk. This result might seem counterintuitive at first sight, but the intuition behind it is rather simple. Since countries' only exposure to sovereign risk is their net foreign asset position, countries hedge against this type of risk by holding small net foreign asset positions. This does not preclude countries from hedging against production risk by holding many foreign investments, provided that their value be roughly balanced.

Does this mean that we are back to the complete-markets model? Not quite. A first effect of sovereign risk is that, unlike the complete-markets model, full sharing of production risk might now be achieved with small foreign investment positions. The reason is that sovereign risk creates a discount on foreign investments that makes them "cheap" relative to domestic ones. To see this, note that we can now write the prices of foreign investments as a function of domestic and foreign interest rates:

$$v = \frac{\rho}{r} \qquad \text{and} \qquad v^* = \frac{\rho^*}{r}. \tag{18}$$

15. Default shocks are rare but large. Production shocks are instead frequent but small and, in the limit of continuous time, the ratio of the marginal value of wealth before and after a production shock is one. This is why the premium on holding production risk is simply the covariance.

Countries are willing to sell foreign investments at a discount reflecting the probability of default, since in this event they will reclaim these investments. An implication of equation (18) is that full sharing of production risk does not require countries to spend the same share of their wealth to purchase domestic and foreign production. If discounts are large enough, the model might be able to explain why gross foreign investment positions are small.

A second and more important effect of sovereign risk is that it makes North–South capital flows smaller than in the complete-markets model. To see this, note that the world distribution of capital stocks is now implicitly determined by equation (13) and these generalizations of equations (11)–(12):

$$r = \pi\left(\frac{k}{\eta}\right)^{-\gamma} - \sigma^2\frac{k/\eta}{\eta a + (1-\eta)a^*} + \alpha\left(\frac{k}{\eta a}\right)^{-1} \tag{19}$$

$$r = \left(\frac{k^*}{1-\eta}\right)^{-\gamma} - \sigma^2\frac{k^*/(1-\eta)}{\eta a + (1-\eta)a^*} + \alpha\left(\frac{k^*}{(1-\eta)a^*}\right)^{-1}. \tag{20}$$

Now the world interest rate need not be below the marginal product of capital. Although capital still commands a premium to compensate for production risk, foreign loans also command a premium to compensate for sovereign risk. This creates a home bias in the demand for capital that raises the demand for North capital more than for South capital. As $\alpha \to \infty$, we find that the world distribution of capital stocks approaches the world distribution of wealth, i.e., $k \to \eta a$ and $k^* \to (1-\eta)a^*$.

Figures 4 and 5 illustrate the quantitative implications of adding sovereign risk to the basic model. In order to interpret these figures, we need a benchmark value for α. To obtain this, note that normal times last on average for $1/\alpha$ years before a crisis occurs. Figure 2 showed that the two major default episodes of the 20th century were preceded by periods of 30–40 years where default was relatively rare (1890–1930, 1950–1980). This suggests that $\alpha = 0.03$ is a reasonable benchmark value. We also consider a range of values for α between 0 and 0.06 to explore the sensitivity of our results to the importance of sovereign risk.

The top panel of Figure 4 shows that modest amounts of sovereign risk lead to substantial reductions in the price of foreign investments. For our benchmark parameter values, we find that $v = 0.37$ and $v^* = 0.48$, and these discounts become larger as the probability of default increases.[16] The bottom panel of Figure 4 shows that South investments in North increase, and North investments in South decrease. To see why, note that sovereign risk creates a home bias in the demand for capital, but since North is richer than South, the North's capital

16. An additional question is whether we observe these substantial discounts in reality. The evidence is overwhelming that loans to developing countries usually command a higher interest rate than domestic loans in normal times. But we do not know of any evidence suggesting that foreign investments earn an excess return over domestic investments in normal times.

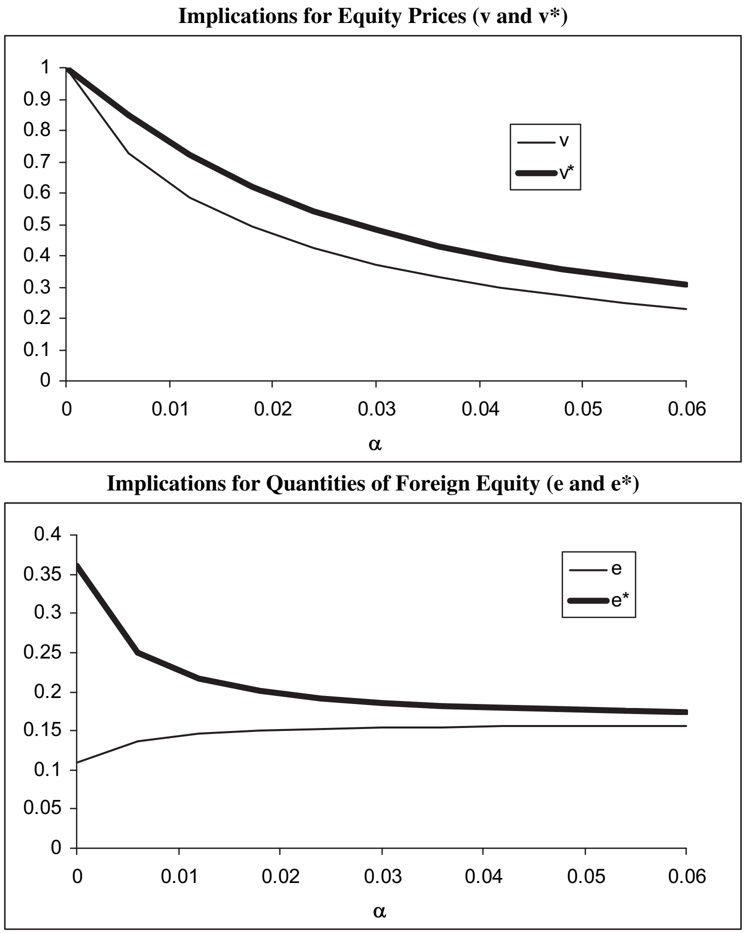


FIGURE 4. Sovereign risk and country portfolios.

stock increases while the South's decreases. Full risk sharing then implies that South's investments in North must increase, and North's investments in South must decrease.

The first panel of Figure 5 shows the net effect of these movements in quantities and prices on the net foreign asset position of South. The value of foreign investment in both countries falls, and South's net foreign asset position shrinks in absolute value as sovereign risk increases. For the benchmark value of $\alpha = 0.03$ South's net foreign assets are -16% of wealth. This is roughly a fifth as large as in the model with no sovereign risk, and is now quite close to the -10% of wealth that we observe in the data. While the predictions of the model for net foreign

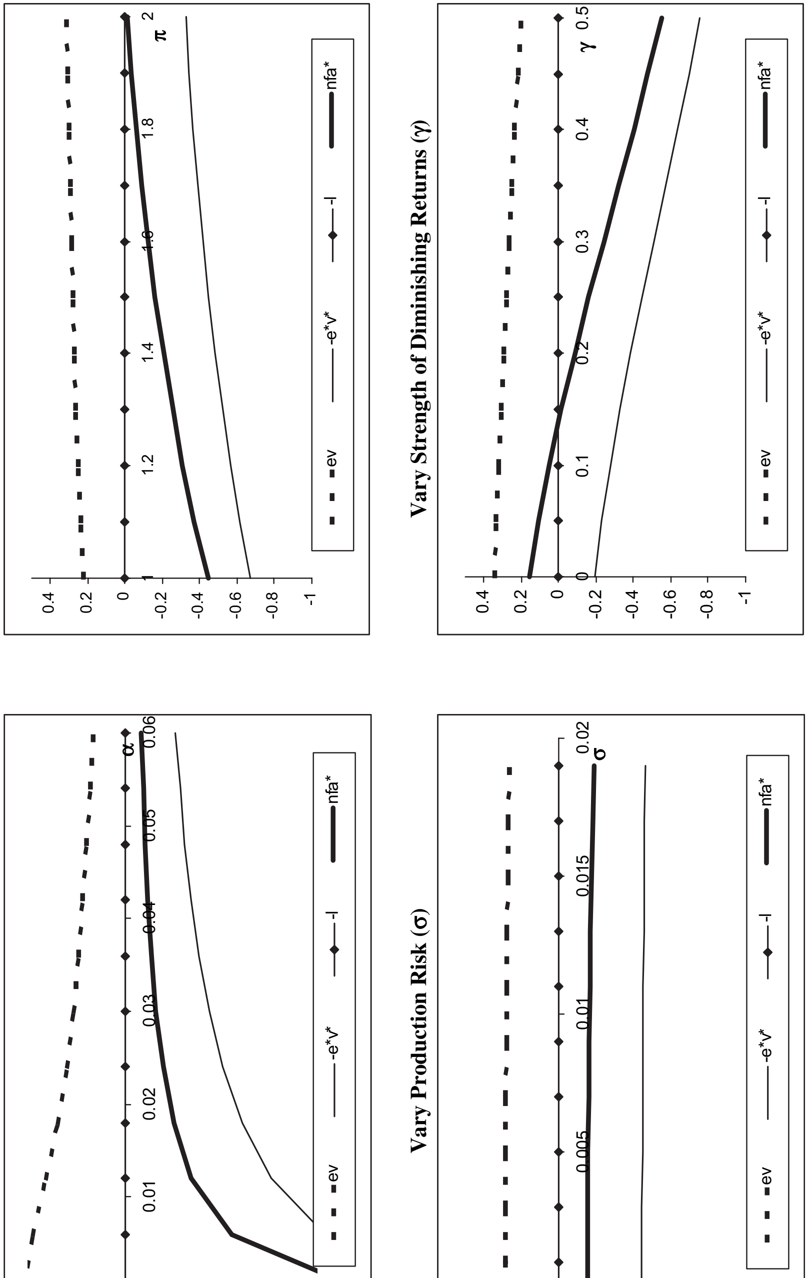


FIGURE 5. Sovereign risk and country portfolios (fraction of South wealth).

assets begin to resemble the data, foreign investment positions continue to be financed exclusively by equity, and international lending is zero. The associated gross foreign investment positions, although smaller than before, remain large relative to the data. For our benchmark parameter values, South's investment in North constitutes 28% of South's wealth, and North's investment in South is 45% of South's wealth. While these are much smaller than the corresponding values of 55% and 181% in the model with no sovereign risk, they remain much larger than in the data where South investments in North are negligible and North's investments in South are 2.5% of wealth.

The remaining panels of Figure 5 shows how the addition of sovereign risk affects the sensitivity of the model's predictions to changes in the parameters summarizing the production technology. As before, increases in North's technological advantage reduce the magnitude of North–South capital flows, while increases in production risk and diminishing returns result in greater North–South flows. However, comparing Figures 3 and 5 it is clear that the sensitivity of the model's predictions to technology parameters is substantially dampened by the introduction of sovereign risk. Consider for example the extreme case where North has no technology advantage over South. In the previous model this resulted in foreign assets equal to −300% of South's wealth. Adding a modest dose of sovereign risk to the model reduces this by a factor of six, to −44% of South wealth.

Removing the assumption that countries always fulfill their obligations has moved the model closer to the data by providing a reason why these flows are so small. But the success is not complete. Although the model predicts smaller net foreign investment positions than the complete-markets model, these positions are still too large relative to the data. Moreover, the model still predicts that there should be no trade in loans, while in reality foreign asset positions are financed primarily by loans. What is wrong with the model? How do we fix it? A key assumption of the model is that each country owns and operates its own capital. Foreign loans and foreign investments are merely financial obligations, and default consists of forfeiting these obligations without inducing any change in the ownership and control of real assets or capital. This might not be a very realistic assumption, especially as it applies to foreign investments. In the real world, foreign investments include more than the right to receive a share of production. Typically, they also include the right to control and operate the real assets that generate this production. In the event of default, foreign investors might be forced to relinquish this control and this might be costly. We next explore the implications of this.

4. Inefficient Renegotiation

Assume that a foreign investment or claim to production gives its owner the right to operate and control the unit of capital that generates this production. Perhaps there is a moral hazard problem underlying this specific packaging of rights. But here we shall leave this friction unspecified and simply take the contract as a given. Assume also that the country must incur a cost x to take control of one unit of capital away from the foreign investor, if the latter does not cooperate. We shall think of this as a physical cost, but it could also measure the loss of any valuable advantage that the foreign investor brings to production and is unwilling to leave behind after being expropriated (experience, managerial skills, know-how, access to better technology or relationships, and so on). If the investor cooperates, the country does not incur any cost when taking control of foreign investments.

An implication of this new assumption is that the country will be willing to pay the foreign investor up to x per unit of capital in order to secure its cooperation in the event of default.[17] This gives room to a renegotiation of claims. If this renegotiation is efficient, the foreign investor will ask the defaulting country to pay up to x per unit of capital in exchange for his/her cooperation. The country will accept and, as in the previous model, default does not generate a loss of capital. Unlike the previous model however, the default is only partial now since foreign investors can keep a fraction of their investments. With efficient renegotiation, the costs of transferring the control of capital act as a penalty to default and make sovereign risk less severe. As a result, the model solution lies somewhere in the middle of the previous two models.[18]

Yet, renegotiation of claims under the threat of default is hardly efficient in real world situations. One reason might be asymmetric information. Assume the defaulting country knows x, but the foreign investor does not. In particular, assume $x = H$ with probability p and $x = L$ otherwise, with $L < H \leq 1$. In any renegotiation, the best strategy for the defaulting country is to claim that $x = L$ and, as a result, a separating equilibrium is not possible. Assume that foreign investments consist of a continuum of projects and that x is uncorrelated across them. Then, if $pH > L$, the foreign investor's optimal strategy is to ask for a payment of up to H per unit of capital in exchange for his/her cooperation. With probability $1 - p$, this offer is not accepted and the foreign investor does not cooperate. With asymmetric information, renegotiation is therefore inefficient and episodes of default lead to a loss of capital of $\lambda = (1 - p)L$ units of capital.[19]

17. Another interpretation of the model is that the country is willing to accept a bribe of $1 - x$ in order to "honor" its financial obligation and leave the unit of capital under the control of the foreign investor. After this happens, the foreign investor rushes out of the country. Otherwise, he/she would be forced to pay the bribe again a period later with probability $1 - \beta dt$.

18. The solution of this model is "almost" the same as the solution to the model of Section 4, provided that we replace α for αx. It differs only in one inconsequential detail (x affects the marginal utility of wealth after default). In any case, the solution converges to the complete-markets model of Section 3 as $x \rightarrow 1$; and it converges to the sovereign risk model of Section 4 as $x \rightarrow 0$.

19. Following the interpretation of the earlier footnote, this assumption is equivalent to assuming the country expropriates only a fraction $1 - p$ of the foreign investments. Thus, the model is consistent with most foreign investments not being expropriated in a crisis.

What is the equilibrium probability of default with inefficient renegotiation? As before, if $s = 0$ no country defaults. However, if $s = 1$ a country defaults only if its net foreign asset position is negative enough. That is, South (North) defaults if and only if $ve - l - v^*e^* \leq -\lambda e^*$ ($v^*e^* + l - ve \leq -\lambda e$), i.e., if the gains from repudiating debt and expropriating foreign investments exceed the loss of investment abroad and the loss in capital due to expropriation. These conditions apply if and only if $(1-\eta)a^*/\eta a < 1 - \lambda$ and α is not too large. If $(1-\eta)a^*/\eta a > 1 - \lambda$, the net foreign asset positions are small because countries are similar and the incentives for capital flows are small.[20] If α is high, the net foreign asset positions are small because countries fear default.[21] We shall therefore assume from now on that $(1-\eta)a^*(0)/\eta a(0) < 1 - \lambda$ and α is positive but not too high. Under these assumptions, the probabilities of default are as in the previous section.

Assuming inefficient renegotiation affects the budget constraint of the North during normal times, since now taking control of foreign investments entails a cost in terms of capital. This is reflected in the following generalization of equation (13):

$$da = \left[\frac{R(k-e) + R^*e^* + rl}{\eta} - c\right]dt + V\frac{k-e}{\eta}\,d\omega + V^*\frac{e^*}{\eta}\,dw^* + \frac{(V-\lambda)e - v^*e^* - l}{\eta}\,ds. \tag{21}$$

Solving the problem of North's representative consumer, we still find that equations (4)–(5) apply, but we must replace equations (15)–(17) by the following generalizations:

$$r - \rho = \alpha\frac{\eta a}{k - \lambda e} \tag{22}$$

$$\rho v - R = -V^2\frac{k-e}{\eta a} - \alpha\frac{\eta a}{k-\lambda e}(v - \lambda) \tag{23}$$

$$R^* - \rho v^* \geq V^{*2}\frac{e^*}{\eta a} + \alpha\frac{\eta a}{k-\lambda e}v^*; \qquad \text{with strict inequality if } e^* > 0. \tag{24}$$

The only novelty in equations (22)–(24) is the presence of λ, which measures how inefficient debt renegotiations are. Equation (22) shows that inefficient

20. If investors believe that no country defaults when $s = 1$, the equilibrium of the model implies the complete-markets equilibrium. If $(1-\eta)a^*/\eta a > 1 - \lambda$, no country has an incentive to default in such an equilibrium and this validates investors' beliefs.

21. In this case, there is no Nash equilibrium in which the country follows a pure strategy. But we can construct a mixed-strategy Nash equilibrium as follows: Let q be the probability of default that leads investors to choose country portfolios such that $ve - l - v^*e^* = -\lambda e^*$. South is indifferent between defaulting or not. There is an equilibrium in which South defaults with probability q/α when s shifts from zero to one.

renegotiations increase the sovereign risk premium because North's wealth after default is lower. This effect also appears in equations (23) and (24). Inefficient renegotiations also imply that North gains less from defaulting on foreign investments. This effect is shown in equation (23).

The first implication of inefficient renegotiation is that full risk sharing is no longer possible. The foreign investments in North and South are now implicitly determined by the following generalization of equation (9):[22]

$$\begin{aligned} e &= \max\left\{0, \left(\frac{(1-\eta)a^*}{\eta a + (1-\eta)a^*}\right)k \right.\\ &\qquad \left. - \left(\frac{\alpha\lambda}{\sigma^2/\eta}\right)\left(\frac{\eta a(1-\eta)a^*}{\eta a + (1-\eta)a^*}\right)\left(\frac{\eta a}{k-\lambda e}\right)\right\} \\ e^* &= \max\left\{0, \left(\frac{na}{\eta a + (1-\eta)a^*}\right)k^* \right.\\ &\qquad \left. - \left(\frac{\alpha\lambda}{\sigma^2/(1-\eta)}\right)\left(\frac{\eta a(1-\eta)a^*}{\eta a + (1-\eta)a^*}\right)\left(\frac{(1-\eta)a^*}{k^*-\lambda e^*}\right)\right\} \end{aligned} \tag{25}$$

In contrast with equation (9), North and South no longer hold shares of each others' production that are proportional to their shares in wealth. Rather, the interaction of inefficient renegotiation combined with sovereign risk implies that foreign investments are smaller than would be required to achieve full risk sharing. The size of departures from full risk sharing is governed by the balance of sovereign risk relative to production risk, $\alpha\lambda/\sigma^2$. On the one hand, foreign investments are better than loans to finance capital flows because they allow countries to diversify production risk. The importance of this incentive to use foreign investments grows with the importance of this type of risk, i.e., with σ^2. On the other hand, foreign investments are less attractive to finance capital flows because in the event of default they generate social losses. The importance of this disincentive to use foreign investments grows with the importance of these losses and these depend on the frequency of default and the loss per default, i.e., with $\alpha\lambda$. In the previous models, we always assumed that $\lambda = 0$. Since there was no disincentive to use foreign investment to finance capital flows, full risk sharing was obtained.

We now have two reasons why gross foreign investment positions might be smaller than the benchmark of full risk sharing: fewer foreign investments are made, and they still trade at a discount. To see this, we can compute the discount on foreign investments with efficient renegotiation as follows:

$$v = \frac{\rho}{r}(1-\lambda) + \lambda; \qquad \text{and} \qquad v^* = \frac{\rho^*}{r}(1-\lambda) + \lambda \tag{26}$$

22. This follows from equations (22)–(24) and South's counterparts.

The higher λ is, the smaller is the residual value of foreign investments to the seller in the event of default, and hence the smaller is the discount countries offer on foreign investments. In the limiting case $\lambda \to 1$, foreign investments are fully destroyed during default, and $v = v^* = 1$.

The world distribution of capital stocks is now implicitly determined by equations (13), (25), and the following two equations:

$$r = \pi\left(\frac{k}{\eta}\right)^{-\gamma} - \left(\frac{\sigma^2}{\eta}\right)\left(\frac{k-e}{\eta a}\right) + \alpha\left(\frac{k-\lambda e}{\eta a}\right)^{-1} \tag{27}$$

$$r = \left(\frac{k^*}{1-\eta}\right)^{-\gamma} - \left(\frac{\sigma^2}{1-\eta}\right)\left(\frac{k^*-e^*}{(1-\eta)a^*}\right) + \alpha\left(\frac{k^*-\lambda e^*}{(1-\eta)a^*}\right)^{-1}. \tag{28}$$

These expressions generalize equations (19) and (20) for the case where $\lambda > 0$.

Figure 6 and 7 explore the quantitative implications of inefficient renegotiation for the size and composition of country portfolios. Figure 6 shows how foreign investments in North and South decline as λ increases. For our benchmark parameter values, North investments in South reach zero when $\lambda = 0.006$, and South investments in North reach zero when $\lambda = 0.016$. This is because North's exposure to sovereign risk is higher, resulting in a weaker North demand for foreign assets than South demand for foreign assets. Figure 6 also shows that the prices of foreign investments increase slightly with λ. Higher values of λ mean that the value of expropriated capital is smaller, and hence countries offer smaller discounts on foreign investments.

The first panel of Figure 7 shows that South's net foreign asset position does not vary significantly with λ, and remains around -16% of wealth. However, increases in λ do have strong effects on how this position is financed. As λ increases from zero to 0.006, North's investments in South are replaced by North's lending to South. When λ reaches 0.016, South's investments in North also fall to zero, and international capital flows are financed entirely through loans. This suggests that inefficient renegotiation can help to bring the theory much closer to the data, by providing a reason why countries prefer to use loans rather than equity to finance their foreign asset positions. Moreover, only a relatively small dose of inefficiency in the renegotiation is required for this to be true, as the composition of foreign assets switches entirely to loans at very small values of λ. Where the theory is less successful is in its predictions for the relative magnitudes of North and South foreign investments. The theory predicts weakly larger South's investments in North than North's investments in South for all values of λ, while in the data we see that South's investments in North are negligible and North's investments in South are 2.5% of South's wealth.[23]

23. As shown in Figure 1, during the 1990s foreign investment to developing countries grew at the expense of net borrowing. In the context of our model, this composition change can be explained

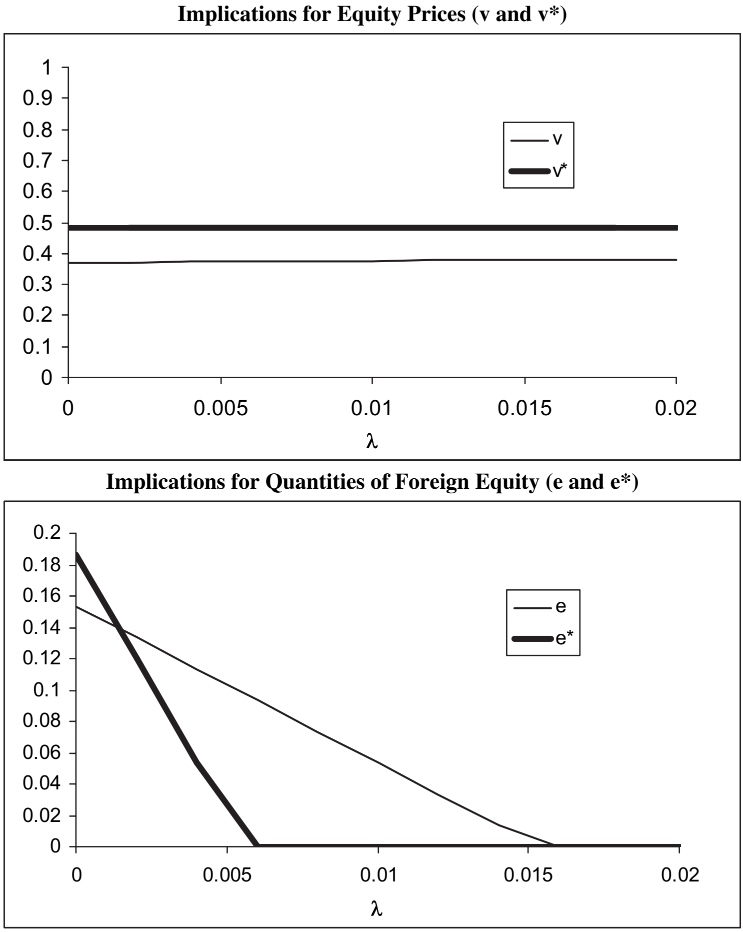


FIGURE 6. Inefficient renegotiation and country portfolios.

The remaining panels of Figure 7 show how the predictions of the model vary with the remaining parameters of interest. We do not have a good sense of what is a reasonable value of λ to use as a benchmark. We therefore take $\lambda = 0.02$ in what follows simply because it delivers foreign investment positions that are financed only by loans. As before, increases in α reduce South's net foreign assets as well as gross foreign investment positions. In addition, higher values of α lead a shift in the composition of North–South flows away from foreign investments and towards loans. As before a larger North productivity advantage

by improvements in the perceived ability to renegotiate successfully in the event of default. One hypothesis would be that this is the result of the policy and institutional reforms that took place in many developing countries in the 1990s.

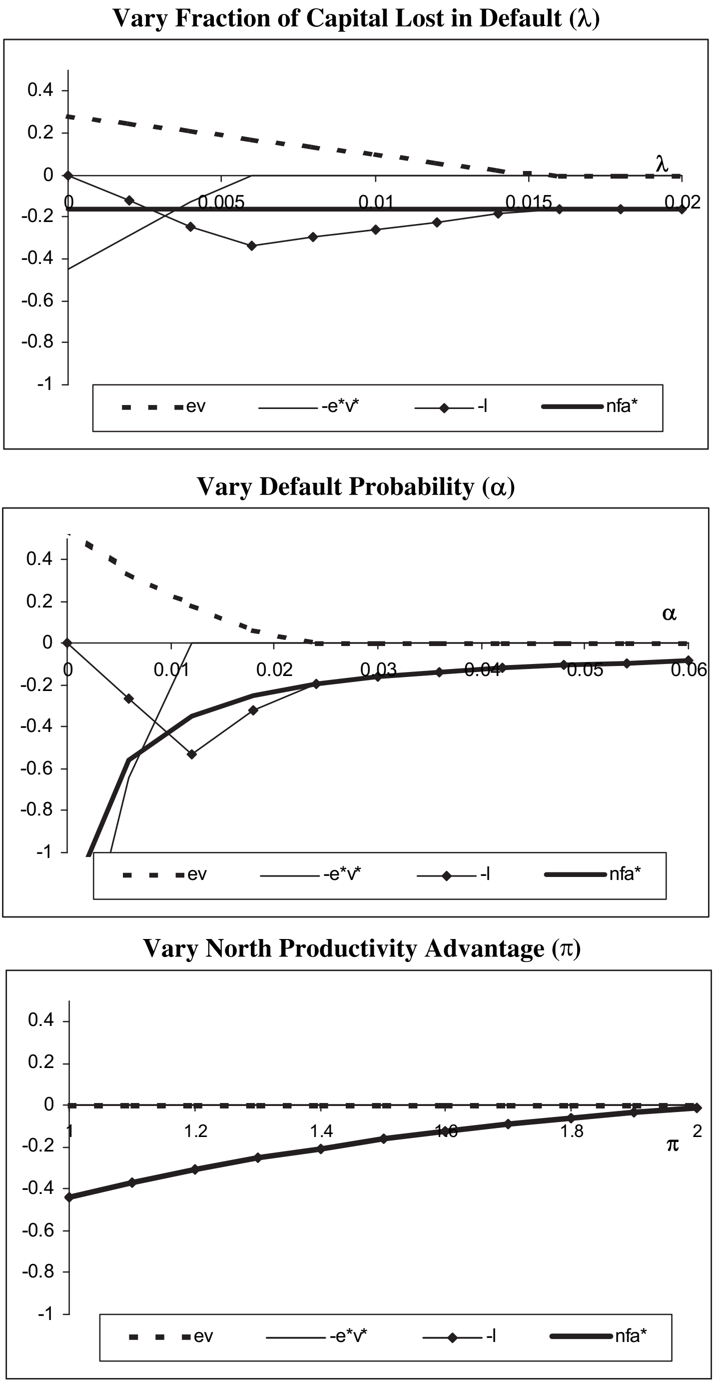
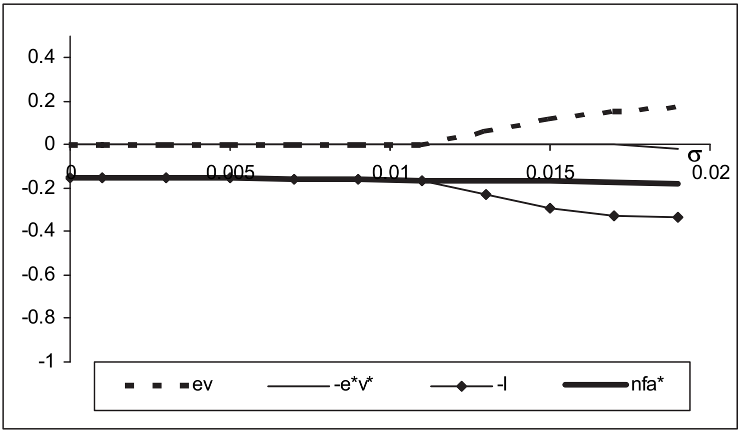


FIGURE 7. Inefficient renegotiation and country portfolios (fraction of South wealth).

Vary Production Risk (σ)



Vary Strength of Diminishing Returns (γ)

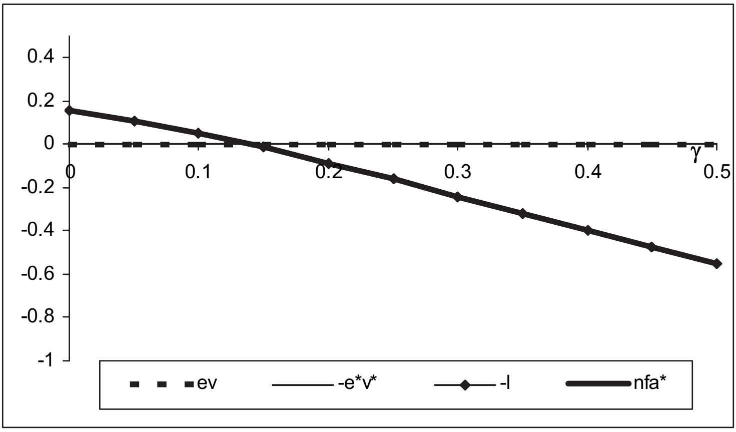


FIGURE 7. CONTINUED.

and/or weaker diminishing returns reduce North–South capital flows. However, for most of the range of the parameters we consider, these flows are now financed primarily through loans. Finally, increases in production risk again lead to slightly larger North–South flows, and when production risk is sufficiently large there are foreign investments in North and South despite the inefficiency of renegotiation in the case of default.

5. Concluding Remarks

The data shows that capital flows to developing countries are small and mostly take the form of loans rather than foreign investment. The standard complete-markets model of international finance, based on diminishing returns at the country level and country-specific production risk, predicts large capital flows to developing countries that mostly take the form of foreign investments instead of loans. This discrepancy between the model and the data remains even after we take into account that developed countries have more human capital and better technologies than developing ones.

Our contribution consists of showing that two reasonable modifications to the standard model go a long way towards reconciling the theory with the data. The first one is to recognize that the world economy experiences recurrent episodes of systemic default, and that this creates an impediment to capital flows. In fact, we find that an empirically reasonable dose of sovereign risk reduces predicted flows to levels that start to resemble those we see in the data. The second modification is to recognize that, during default episodes, renegotiations are likely to be more inefficient for foreign investments than for loans, and this introduces a bias against the former and towards the latter. Although it is admittedly difficult to calibrate this effect, we have found that a relatively modest amount of inefficiency is consistent with loans being the preferred vehicle to finance capital flows to developing countries.

Despite these positive results, there is still much to do on both the theoretical and empirical fronts. For the sake of parsimony, we have considered a world in which developed and developing countries differ only in their initial wealth and productivity levels. Surely there are other differences between countries that are likely to be relevant for the issues at hand, such as economic structure and institutions. Also, we have chosen to work with a very streamlined model of default and renegotiation in which repayment is based only on the commitment to apply penalties, and the inefficiencies in renegotiation are caused only by asymmetric information. It seems reasonable, however, to think that repayment is, in part, based on the desire to maintain a good reputation and that coordination failures among creditors and debtors also constitute an important source of inefficiency in renegotiations. Finally, we want to emphasize that our assessment of how well the model approximates the data is based on a simple calibration exercise and this can never be a substitute for serious econometric work. For these and other reasons, the results presented here should be seen as only a step towards a better understanding of capital flows to developing countries.

Appendix A: Data on North–South Capital Flows

Our data on North–South capital flows is taken from the working paper version of this paper, Kraay et al. (2000), and is described in detail there. In that paper, we have constructed estimates of the stocks of domestic and foreign assets for a sample of 68 countries from 1966 to 1997. In particular, we have constructed estimates of the domestic capital stock, stocks of foreign direct investment and portfolio

TABLE A.1. Foreign asset position of South: robustness of stylized facts.

	Net foreign assets	Foreign direct investment assets	Portfolio equity investment assets	Foreign direct investment liabilities	Portfolio equity investment liabilities	Net lending
Baseline: Data from Kraay et al. (2000), South = Non-OECD						
1970–79	−11.2%	0.3%	0.0%	3.4%	0.2%	−8.0%
1980–89	−10.6%	0.2%	0.0%	2.4%	0.1%	−8.3%
1990–97	−8.8%	0.4%	0.1%	3.0%	0.5%	−5.8%
1970–97	−10.3%	0.3%	0.1%	2.9%	0.2%	−7.5%
Variant 1: Data from Kraay et al. (2000), South = GDP/Capita < $5,000						
1970–79	−9.6%	0.2%	0.0%	2.8%	0.2%	−6.9%
1980–89	−10.7%	0.2%	0.0%	2.1%	0.1%	−8.7%
1990–97	−8.8%	0.4%	0.1%	2.8%	0.6%	−5.9%
1970–97	−9.8%	0.3%	0.0%	2.5%	0.3%	−7.3%
Variant 2: Data from Lane and Milesi-Ferretti (2001a), South = Non-OECD						
1970–79	−6.0%	0.0%	0.0%	2.2%	0.0%	−3.8%
1980–89	−5.6%	0.1%	0.0%	1.7%	0.0%	−4.1%
1990–97	−5.4%	0.4%	0.2%	2.7%	0.6%	−2.7%
1970–97	−5.7%	0.2%	0.1%	2.1%	0.2%	−3.6%

Note: This table reports the time series averages of the foreign assets and liabilities of the South as a fraction of South wealth. The South is an aggregate of the countries listed in Table A.2.

equity investments assets and liabilities, as well as international borrowing and lending.[24] Domestic capital stocks are constructed by cumulating domestic investment flows. Foreign assets and liabilities are primarily constructed by cumulating corresponding flow data from the IMF Balance of Payments Statistics Yearbook, accounting for changes in the value of the underlying assets, and drawing on a variety of sources and assumptions to generate initial stocks for these series. We define the wealth of a country as the sum of its domestic capital stock and its net foreign assets.[25]

The first panel of Table A.1 shows the net foreign assets and their components for an aggregate of non-OECD countries that we refer to in the text as the "South".[26] Table A.2 reports the country-year observations underlying this

24. We do not include accumulated net errors and omissions in our measures of foreign assets. We do so because (i) it is not clear whether errors and omissions reflect errors in the current account or the financial account of the balance of payments, and (ii) we do not know which gross balance of payments items are affected by the measurement error summarized in net errors and omissions.

25. As is well known, global balance of payments data do not balance, and the sum of the current accounts of all countries in the world has been significantly negative over the past 20 years (see for example IMF 1992). These global discrepancies in flow data are also reflected in our stock data on foreign assets. Unless we attribute the bulk of this discrepancy to net South–North flows, our stylized facts on North–South flows continue to hold.

26. Note that we do not have information on bilateral foreign asset positions. Throughout we maintain the fairly reasonable assumption that South–South investments are negligible. This allows us to estimate South's gross foreign assets and liabilities vis-à-vis the North by simply summing the gross foreign assets and liabilities of every country in the South. To the extent that South–South flows are important, our method may overstate the size of the South's gross positions.

TABLE A.2. Countries included in South.

Country	First year	Last year
Algeria	1966	1991
Argentina	1966	1997
Bangladesh	1972	1997
Bolivia	1966	1997
Brazil	1966	1997
Cameroon	1979	1995
Chile	1966	1985
China	1981	1997
Colombia	1967	1994
Congo, Rep.	1973	1997
Costa Rica	1966	1995
Cote d'Ivoire	1970	1995
Dominican Republic	1969	1994
Ecuador	1966	1996
Egypt, Arab Rep.	1966	1996
El Salvador	1966	1997
Guatemala	1966	1994
Honduras	1966	1997
India	1966	1997
Indonesia	1966	1994
Iran, Islamic Rep.	1966	1982
Israel	1969	1997
Jamaica	1968	1995
Jordan	1966	1991
Korea, Rep.	1969	1997
Lao PDR	1989	1991
Lesotho	1980	1994
Malaysia	1976	1994
Mauritius	1974	1997
Mexico	1966	1997
Morocco	1966	1997
Nicaragua	1966	1994
Oman	1973	1989
Pakistan	1966	1997
Peru	1975	1993
Philippines	1967	1997
Saudi Arabia	1966	1989
Senegal	1968	1996
Singapore	1966	1997
South Africa	1968	1997
Sri Lanka	1966	1997
Syrian Arab Republic	1967	1988
Thailand	1969	1997
Trinidad and Tobago	1974	1994
Tunisia	1966	1997
Uruguay	1967	1997
Venezuela, RB	1974	1997

aggregate. The data on net foreign assets and net lending are identical to those underlying Figure 1 in the text. We have however disaggregated the data on foreign investments shown in Figure 1 into foreign direct investment and portfolio equity investments. We do this to recognize the possibility that the problems of inefficient renegotiation discussed in the text may not apply to the minority ownership stakes captured in the portfolio equity investment data. This in turn raises the issue of whether we should measure the foreign investments in the theory as foreign direct investment alone, or as the sum of foreign direct investment and portfolio equity investments. In the data, however, portfolio equity investments are a very small part of total foreign investments, and so this distinction matters little empirically. The portfolio equity liabilities of the South average 0.2% of the South's wealth, as compared with direct investment liabilities averaging 2.9% of wealth. Although portfolio equity investments in the South have increased significantly in the 1990s, they remain small at 0.5% of South's wealth.

The second panel of Table A.1 presents the same information as before, but instead defining the South as countries with per capita GDP in 1985 less than US $5000 at market exchange rates. Although this alters somewhat which countries we identify as "North" and "South," it does not change our basic observation that capital flows are small and are financed primarily through loans. In this alternative sample, the net foreign assets and net lending of South average −9.8% and −7.3% of South wealth, as opposed to −10.3% and −7.5% in the baseline.

Lane and Milesi-Ferretti (2001a) also present estimates of stocks of foreign assets for a large sample of countries over the period 1970–1998. Their data is also based on the accumulation of flow balance of payments data, but the authors make a number of different assumptions, primarily regarding the valuation of these stocks. The bottom panel of Table A.1 verifies that our stylized facts also hold in this alternative data set. This alternative data set shows smaller gross and net positions than in our data, in part reflecting some differences in country coverage between the two data sets. South's net foreign assets average −5.7% of wealth, with net lending averaging −3.6% of wealth. On average, this data set shows that net lending is 63% of South's net foreign assets, while in our data set, net lending is 75% of net foreign assets. We conclude from this that our main stylized facts of small North–South capital flows financed primarily through loans holds in this data set as well.[27]

Both data sets also show that the share of net lending in the net foreign assets of the South has declined during the 1980s and 1990s. In our data set the share of net lending falls from 78% during the 1980s, to 67% during 1990–1997. In

27. The only other notable difference between the two data sets is that South's portfolio equity liabilities are relatively larger and increase faster in the Lane and Milesi–Ferretti data set. This is likely due to the fact that they use stock market valuations for portfolio equity that increased sharply in the 1990s, while in our data we use domestic investment deflators to measure changes in the value of domestic capital.

the Lane–Milesi–Ferretti data set, the corresponding figures are 73% and 51%, respectively. This decline in the relative importance of net lending appears to have continued in recent years. The World Bank's 2003 Global Development Finance publication reports that the ratio of external debt to stocks of inward FDI fell from around 300% to 200% between 1997 and 2001 (World Bank 2003). Understanding the factors driving this trend is an interesting issue that we postpone to future research.

As a further robustness check, we consider the possibility that the low share of equity in the South's portfolio is due to the legal restrictions on foreign direct investment that were prevalent in many South countries during our sample period. We do not have a long time series of restrictions on equity investments required to systematically investigate this hypothesis. We do however have some limited and suggestive evidence, relying on the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions which has begun to distinguish between restrictions on different types of capital inflows after 1996. Based on the unpublished data underlying this source, Tamirisa (1999) has constructed a series of detailed indices of capital controls for the period 1996–2001. We focus on the year 1996, which gives us the most observations in our database on country portfolios.

We measure restrictions on FDI as the simple average of her two indices of restrictions on FDI flows and restrictions on the liquidation of FDI positions.[28] The indices range from zero (no restrictions) to one (restrictions are present in all the underlying categories measured by the IMF). This index does show that restrictions on FDI are more prevalent in poor countries than rich countries: the mean value of the index in the North is 0.15, while in the South it is 0.46. Interestingly, however, this measure of controls does not seem to be significantly correlated with share of FDI in total liabilities: a regression of the share of FDI on this measure of controls yields a slope coefficient of -0.03 with a t-statistic of 0.63 using all countries in our sample in 1996.

For the South countries alone, the slope is -0.10 with a t-statistic of -1.45. Of course this evidence is only suggestive, and we cannot reject the possibility that the lack of a significant correlation between restrictions and the share of FDI is due to measurement error in the restrictions variable. Nevertheless, this finding seems consistent with the larger literature on the effects of capital controls, which typically has found mixed evidence on the impacts of capital controls on the volume and composition of capital flows (see for example Eichengreen 2001 for a survey). Taken together this suggests to us that the presence of overt restrictions

28. The index of restrictions on FDI flows aggregates restrictions on inflows and restrictions on outflows. However, this distinction may not be so important. For a smaller sample of countries in 1996, Tamirisa (1999) constructs separate subindices of controls on inflows and on outflows. Removing controls on outflows from our overall index of controls results in a measure that is correlated at 0.84 with the overall index.

on equity investment is not the only reason why capital flows to poor countries mostly take the form of loans.

Appendix B: Proofs

Here, we solve the representative consumer's problem and show that equations (4), (5), and (22)–(24) describe the optimal consumption and portfolio rules. The investment opportunity set that the consumer faces is fully described by the vector $X = (v, v^*, r, R, R^*, \sigma, \sigma^*)$. We shall denote the ith element of this vector as x_i. Let the dynamics of this element be given as follows:[29]

$$dx_i = \mu_i dt + \psi_i d\omega + \psi_i^* d\omega^* + \xi_i ds. \tag{B.1}$$

In equilibrium, μ_i, ψ_i, ψ_i^*, and ξ_i might be functions of aggregate variables, but the representative consumer is infinitesimal and does not take into consideration how individual choices affect these aggregates. Let F^0 and F^1 be the value functions of the representative consumer when $s = 0$ and $s = 1$, respectively. Then during crisis periods ($s = 1$), we have that:

$$\begin{aligned} \delta F^1 = \max_{<c>} \Bigg\{ & \ln c + \frac{\partial F^1}{\partial a}(Ra - c) + \sum_i \frac{\partial F^1}{\partial x_i}\mu_i + \frac{\partial^2 F^1}{\partial a^2}\frac{V^2 a^2}{2} \\ & + \sum_i \frac{\partial^2 F^1}{\partial x_i^2}\frac{\psi_i^2 + \psi_i^{*2}}{2} + \sum_i \frac{\partial^2 F^1}{\partial a \partial x_i} V a \psi_i \\ & + \sum_i \sum_j \frac{\partial^2 F^1}{\partial x_i \partial x_j}(\psi_i \psi_j + \psi_i^* \psi_j^*) + \beta\left[F^0(a) - F^1(a)\right] \Bigg\}. \end{aligned} \tag{B.2}$$

Note that the last term captures the effect of the change in state from crisis to normal times. Since the change in state does not affect wealth, both F^0 and F^1 are evaluated at the same level of wealth, a. The first-order condition associated with this Bellman equation is:

$$0 = c^{-1} - \frac{\partial F^1}{\partial a}. \tag{B.3}$$

29. During crises, v, v^*, and r are to be interpreted as the asset prices that would apply if the state changed.

During normal times ($s = 0$) we have that δF^0 is equal to

$$
\begin{aligned}
\delta F^0 = \max_{\{c,k,l,e,e^*\}} & \left\{ \ln c + \frac{\partial F^0}{\partial a}\left[\frac{R(k-e)+R^*e^*+rl}{\eta} - c\right] \right. \\
& + \sum_i \frac{\partial F^0}{\partial x_i}\mu_i + \frac{\partial^2 F^0}{\partial a^2}\frac{V^2(k-e)^2+V^{*2}e^{*2}}{2\eta^2} \\
& + \sum_i \frac{\partial^2 F^0}{\partial x_i^2}\frac{\psi_i^2+\psi_i^{*2}}{2} \\
& + \sum_i \frac{\partial^2 F^0}{\partial a \partial x_i}\frac{V(k-e)\psi_i + V^*e^*\psi_i^*}{\eta} \\
& + \sum_i \sum_j \frac{\partial^2 F^0}{\partial x_i \partial x_j}(\psi_i\psi_j + \psi_i^*\psi_j^*) \\
& \left. + \alpha\left[F^1\left(\frac{k-\lambda e}{\eta}\right) - F^0(a)\right]\right\} \\
& \text{subject to } \eta a = k - ve + v^*e^* + l; \qquad k \geq e \geq 0; \qquad e^* \geq 0.
\end{aligned}
\tag{B.4}
$$

Note that the effect of a transition from normal times to crisis periods is captured by the last term in the Bellman equation, and that this transition is accompanied by a jump in wealth. The first-order conditions associated with this Bellman equation are:

$$0 = C^{-1} - \frac{\partial F^0}{\partial a} \tag{B.5}$$

$$0 = \frac{\partial F^0}{\partial a}R + \frac{\partial^2 F^0}{\partial a^2}V^2\frac{k-e}{\eta} + \sum_i \frac{\partial^2 F^0}{\partial a \partial x_i}V\psi_i - \frac{\partial F^0}{\partial a}\rho + \kappa_1 \tag{B.6}$$

$$0 = \frac{\partial F^0}{\partial a}r - \frac{\partial F^1}{\partial a}\alpha - \frac{\partial F^0}{\partial a}\rho \tag{B.7}$$

$$
\begin{aligned}
0 = & \frac{\partial F^0}{\partial a}R - \frac{\partial^2 F^0}{\partial a^2}V^2\frac{k-e}{\eta} - \sum_i \frac{\partial^2 F^0}{\partial a \partial x_i}V\psi_i - \frac{\partial F^1}{\partial a}\alpha(\lambda - v) \\
& + \frac{\partial F^0}{\partial a}\rho v - \kappa_1 + \kappa_2
\end{aligned}
\tag{B.8}
$$

$$
\begin{aligned}
0 = & \frac{\partial F^0}{\partial a}R^* + \frac{\partial^2 F^0}{\partial a^2}V^{*2}\frac{e^*}{\eta} \\
& + \sum_i \frac{\partial^2 F^0}{\partial a \partial x_i}\sigma\psi_i^* - \frac{\partial F^1}{\partial a}\alpha v^* - \frac{\partial F^0}{\partial a}\rho v^* + \kappa_3,
\end{aligned}
\tag{B.9}
$$

where $(\partial F^0/\partial a)\rho$ is the multiplier of the constraint $\eta a = k - ve + v^*e^* + l$, and κ_1, κ_2, and κ_3 are the multipliers associated with the constraints that $k \geq e$, $e \geq 0$, and $e^* \geq 0$, respectively. The usual Kuhn-Tucker complementary-slack conditions apply: $\kappa_1(k - e) = 0$, $\kappa_2 e = 0$, and $\kappa_3 e^* = 0$. It is straightforward to verify that $F^0 = (1/\delta)\ln a + f^0(X)$ and $F^1 = (1/\delta)\ln a + f^1(X)$ solve the Bellman equations (B.2) and (B.4). Using these value functions and the first-order conditions, it follows that (B.5)–(B.9) correspond to equations (4), (5), and (22)–(24) in the text. Equations (6)–(8) follow immediately by setting $\alpha = \lambda = 0$ in equations (22)–(24), and equations (15)–(17) follow from setting $\lambda = 0$ in equations (22)–(24).

References

Albuquerque, Rui (2003). "The Composition of International Captial Flows: Risk Sharing Through Foreign Direct Investment." *Journal of International Economics*, 61, 353–383.

Eichengreen, Barry (2001). "Capital Account Liberalization: What Do Cross-Country Studies Tell Us?" *World Bank Economic Review*, 15(3), 341–365.

International Monetary Fund (1992). "Report on the Measurement of International Capital Flows." Washington, DC.

Kraay, Aart, Norman Loayza, Luis Serven, and Jaume Ventura (2000). "Country Portfolios." Working Paper 7795, NBER.

Lane, Philip and Gian Maria Milesi-Ferretti (2001a). "The External Wealth of Nations: Measures of Foreign Assets and Liabilities for Industrial and Developing Countries." *Journal of International Economics* 55, 263–294.

Lane, Philip and Gian Maria Milesi-Ferretti (2001b). In *The World's New Financial Landscape: Challenges for Economic Policy*, edited by Horst Siebert. Springer-Verlag, Berlin.

Lewis, Karen (1999). "Trying to Explain Home Bias in Equities and Consumption." *Journal of Economic Literature*, 37, 571–608.

Lucas, Robert E. (1990). "Why Doesn't Capital Flow From Rich to Poor Countries?" *American Economic Review*, 80, 92–96.

Merton, Robert (1990). *Continuous-Time Finance*. Basil Blackwell, Cambridge.

Obstfeld, Maurice and Kenneth Rogoff (1996). *Foundations of International Macroeconomics*, MIT Press.

Rider, Mark (1994). "External Debt and Liabilities of Industrial Countries." Research Discussion Paper 9405, Reserve Bank of Australia.

Rogoff, Kenneth, Carmen Reinhart, and Miguel Savastano (2003). "Debt Intolerance." *Brookings Papers on Economic Activity*.

Sinn, Stefan (1990). "Net External Asset Positions of 145 Countries: Estimation and Interpretation." Institut für Weltwirtschaft, University of Kiel.

Tamirisa, Natalia (1999). "Exchange and Capital Controls as Barriers to Trade." IMF Staff Papers, 46, 69–88.

World Bank (2003). *Global Development Finance 2003: Striving for Stability in Development Finance*. Washington, DC.