Country Portfolios

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Abstract: Capital flows to developing countries are small and are 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.

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 percent of their wealth, fluctuating moderately between 8 and 12 percent. 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 percent toward the end of our sample period. Foreign investment by poor countries in rich countries is negligible. Appendix 1 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 percent of their wealth! The theory clearly needs a second ingredient to explain why capital flows are so small.

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[1] Throughout the paper we use the data of Kraay, Loayza, Servén and Ventura [2000]. See Sinn [1990], Rider [1994] and Lane and Milesi-Ferretti [2001] for alternative sources of data.

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 of their capital in rich countries even in the presence of diminishing returns and production risk. As stated however, 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 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

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[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.

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 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

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[3] If seizing assets is costly and renegotiation of claims is efficient, there will never be a seizure of assets. Instead, the country will extracts a payment from foreign countries in exchange of "honoring" its financial obligations towards them.
[4] After all, the former requires transferring the control of real assets, while the latter consist only of canceling financial claims.

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 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 (2001) 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 1 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 2 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 3 adds inefficient renegotiation, and shows that this inefficiency can account for why North-South capital flows are

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financed primarily by loans. Section 4 concludes. Appendix 1 describes the data, and Appendix 2 provides solution details.

1. 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 consumer/investors that evaluate consumption sequences as follows:

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

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. Let ω and ω^* be two standard Wiener processes with independent increments with E[dω]= E[dω*]=0, E[dω^2]=E[dω^{*2}]=dt and E[dω·dω*]=0. The flow of production net of depreciation is given by R·dt+V·dω in North and R*·dt+V*·dω* in South; where R and R* are shorthand for $R = \pi\cdot\left(\dfrac{k}{\eta}\right)^{-\gamma}$ and $R^* =\left(\dfrac{k*}{1-\eta}\right)^{-\gamma}$, and V and V* are shorthand for

$V = \dfrac{\sigma}{\sqrt{\eta}}$ and $V^* = \dfrac{\sigma}{\sqrt{1-\eta}}$.[5] The parameter π (≥ 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 (≥ 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 (South) residents own and operate all the capital stock

that is located in 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 r·dt. Claims to North (South) production have a price v (v*) and promise to pay

the net flow of production generated by one unit of North (South) capital. We shall

refer to the holdings of risk-free bonds and claims to overseas production as foreign

loans and foreign investments, respectively.

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[5] One way to understand these assumptions is to imagine the North as a collection of identical individuals running each a different uncorrelated project. If this project has size K, it promises an expected return of $\pi \cdot K^{\gamma}$ 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. See also Obstfeld and Rogoff [1996, chapter 5] for a discussion of this issue in the model of Lucas [1982].

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

$$(2) \qquad da = \left[\frac{R \cdot (k - e) + R * \cdot e * + r \cdot l}{\eta} - c \right] \cdot dt + V \cdot \frac{k - e}{\eta} \cdot d\omega + V * \cdot \frac{e *}{\eta} \cdot d\omega *$$

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:

$$(3) \qquad \eta \cdot a = k - v \cdot e + v * \cdot e * + l \,;$$

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 2 shows that the first-order conditions associated with this problem can be written as follows:

$$(4) \qquad c = \delta \cdot a$$

$$(5) \qquad R - \rho = V^2 \cdot \frac{k - e}{\eta \cdot a}$$

$$(6) \qquad r - \rho = 0$$

$$(7) \qquad \rho \cdot v - R = -V^2 \cdot \frac{k - e}{\eta \cdot a}$$

$$(8) \qquad R * - \rho \cdot v* \leq V *^2 \cdot \frac{e *}{\eta \cdot a} \,; \text{ with strict ineq. if } e*>0$$

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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 on loans between North 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-ρ, is the covariance between the return to one unit of domestic capital and one unit of the investor's portfolio, $V^2 \cdot \dfrac{k-e}{\eta \cdot a}$. Equation (6) is the first-order condition associated with l; and says that the domestic interest rate equals the interest rate on foreign loans. Equation (7) is the first-order condition associated with e; and 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*; and 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]

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

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]

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[8] This follows form Equations (3), (6)-(8) and South's counterparts.

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

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. $\dfrac{k - v \cdot e}{\eta \cdot a} = \dfrac{v \cdot e}{(1-\eta) \cdot a^*} = \dfrac{k}{\eta \cdot a + (1-\eta) \cdot a^*}$

and $\dfrac{v^* \cdot e^*}{\eta \cdot a} = \dfrac{k^* - v^* \cdot e^*}{(1-\eta) \cdot a^*} = \dfrac{k^*}{\eta \cdot a + (1-\eta) \cdot a^*}$; 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]

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

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

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

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. $\text{NFA}^* = \dfrac{(1-\eta) \cdot a^* - k^*}{(1-\eta) \cdot a^*}$,

and the structure of its portfolio as a share of its wealth, as a function of π, σ, and γ.

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[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.

We set $V = \dfrac{\sigma}{\sqrt{\eta}}$ 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 η=0.2, this implies a benchmark value of σ=0.01,

and we also consider values ranging from zero to 0.02. Since the expected value of

per capita production is $\pi \cdot \left(\dfrac{k}{\eta}\right)^{1-\gamma}$, the case of γ=0 corresponds to the linear growth

model, while γ=0.5 roughly corresponds to the neoclassical growth model. Within this

range, we consider γ=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

π=1 to π=2, with a benchmark value of π=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

percent of its wealth, while in the data it is only about –10 percent. As noted above,

these net foreign asset positions consist entirely of foreign investments, and net

lending is zero. North investment in South represents 181 percent of South wealth,

while South investment in North is 55 percent of South wealth. In contrast, in the

data South investments in North are negligible, North investments in South are about

2.5 percent of South wealth, and South borrowing accounts for 7.5 percent 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

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[11] To produce Figure 3 and all the figures that follow, we normalize world wealth $\eta \cdot a+(1-\eta) \cdot a^*=1$. We also set $\eta \cdot a/(\eta \cdot a+(1-\eta) \cdot a^*)=0.8$ 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.

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 percent of its wealth. In contrast, if North has a two-fold 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 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 sum up, 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.

2. 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

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[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.

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 foreign asset position defaults.[13] Let $\alpha \cdot dt$ and $\beta \cdot dt$ 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. $E[d\omega \cdot ds]=E[d\omega^* \cdot ds]=0$. The value of ds is revealed after countries have chosen their portfolios. As a result, the probability of default is $\alpha \cdot dt$ if s=0 and $1-\beta \cdot dt$ 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

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[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 non-existent foreign obligations) so that the beliefs of investors are consistent with the proposed default probabilities.

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:

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

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

$$(15) \quad r - \rho = \alpha \cdot \frac{\eta \cdot a}{k}$$

$$(16) \quad \rho \cdot v - R = -V^2 \cdot \frac{k-e}{\eta \cdot a} - \alpha \cdot \frac{\eta \cdot a}{k} \cdot v$$

$$(17) \quad R^* - \rho \cdot v^* \leq V^{*2} \cdot \frac{e^*}{\eta \cdot a} + \alpha \cdot \frac{\eta \cdot a}{k} \cdot v^* \text{ ; with strict ineq. if e*>0.}$$

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. $\alpha \cdot \dfrac{\eta \cdot a - k}{\eta \cdot a}$, times the ratio of the marginal value of wealth before and after a crisis occurs, i.e. $\dfrac{\eta \cdot a}{k}$.[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

[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.

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:

$$(18) \qquad v = \frac{\rho}{r}; \quad \text{and} \quad v^* = \frac{\rho^*}{r}$$

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):

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

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

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. $k \to \eta \cdot a$ and $k^* \to (1-\eta) \cdot a^*$.

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 stock increases while the South's decreases. Full risk sharing then implies that South investments in North must increase, and North 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 percent 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 percent of wealth that we observe in the data. While the predictions of the model for net foreign assets begin to resemble the data, foreign investment positions continue to be

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[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.

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 investment in North constitutes 28 percent of South wealth, and North investment in South is 45 percent of South wealth. While these are much smaller than the corresponding values of 55 percent and 181 percent in the model with no sovereign risk, they remain much larger than in the data where South investments in North are negligible and North investments in South are 2.5 percent 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 percent of South's wealth. Adding a modest dose of sovereign risk to the model reduces this by a factor of six, to –44 percent 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.

3. 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 x (minus epsilon) 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

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[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 $1-\beta \cdot dt$.

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]

But 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 p·H>L, the foreign investor's optimal strategy is to ask for a payment of H (minus epsilon) 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 λ=(1-p)·L units of capital.[19]

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 v·e-l-v*·e*$\leq$-λ·e* (v*·e*+l-v·e$\leq$-λ·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 $\dfrac{(1-\eta)\cdot a^*}{\eta\cdot a}<1-\lambda$

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[18] The solution of this model is "almost" the same as the solution to the model of section 3, provided that we replace α for α·x. 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 2 as x$\rightarrow$1; and it converges to the sovereign risk model of section 3 as x$\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.

and α is not too large. If $\dfrac{(1-\eta)\cdot a^*}{\eta\cdot a} > 1-\lambda$, 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 $\dfrac{(1-\eta)\cdot a^*(0)}{\eta\cdot a(0)} < 1-\lambda$ 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):

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

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:

$$(22)\quad r-\rho = \alpha\cdot\frac{\eta\cdot a}{k-\lambda\cdot e}$$

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

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[20] If investors believe that no country defaults when s=1, the equilibrium of the model implies
the complete-markets equilibrium. If $\dfrac{(1-\eta)\cdot a^*}{\eta\cdot a} > 1-\lambda$, 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 v·e-l-v*·e*=-λ·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.

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(24) $R^* - \rho \cdot v^* \leq V^{*2} \cdot \dfrac{e^*}{\eta \cdot a} + \alpha \cdot \dfrac{\eta \cdot a}{k - \lambda \cdot e} \cdot v^*$; with strict ineq. if e*>0.

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

$$e = \max\left\{ 0, \left(\frac{(1-\eta)\cdot a^*}{\eta \cdot a + (1-\eta)\cdot a^*}\right)\cdot k - \left(\frac{\alpha \cdot \lambda}{\sigma^2/\eta}\right)\cdot\left(\frac{\eta \cdot a \cdot (1-\eta)\cdot a^*}{\eta \cdot a + (1-\eta)\cdot a^*}\right)\cdot\left(\frac{\eta \cdot a}{k - \lambda \cdot e}\right) \right\}$$

(25)

$$e^* = \max\left\{ 0, \left(\frac{\eta \cdot a}{\eta \cdot a + (1-\eta)\cdot a^*}\right)\cdot k^* - \left(\frac{\alpha \cdot \lambda}{\sigma^2/(1-\eta)}\right)\cdot\left(\frac{\eta \cdot a \cdot (1-\eta)\cdot a^*}{\eta \cdot a + (1-\eta)\cdot a^*}\right)\cdot\left(\frac{(1-\eta)\cdot a^*}{k^* - \lambda \cdot e^*}\right) \right\}$$

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 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, $\alpha \cdot \lambda / \sigma^2$. 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

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[22] This follows from Equations (22)-(24) and South's counterparts.

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 $\alpha \cdot \lambda$. 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 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 forign investments with efficient renegotiation as follows:

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

The higher is λ, 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:

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

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

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 percent 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 investments in South are replaced by North lending to South. When λ reaches 0.016, South 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 investments in North than North investments in South for all values of λ, while in the data we see that South investments in North are negligible and North investments in South are 2.5 percent of South wealth.[23]

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[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 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.

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 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.

4. 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 however reasonable 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 1 – Data on North-South Capital Flows

Our data on North-South capital flows is taken from the working paper version of this paper, Kraay, Loayza, Serven and Ventura (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 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 A1 shows the net foreign assets and their components for an aggregate of non-OECD countries which we refer to in the text as the "South".[26] Table A2 reports the country-year observations underlying this 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

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[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.

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 percent of South wealth, as compared with direct investment liabilities averaging 2.9 percent of wealth. Although portfolio equity investments in the South have increased significantly in the 1990s, they remain small at 0.5 percent of South wealth.

The second panel of Table A1 presents the same information as before, but instead defining the South as countries with per capita GDP in 1985 less than $5000 US 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 percent of South wealth, as opposed to -10.3 and -7.5 percent in the baseline.

Lane and Milesi-Ferretti (2001) 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 A1 verifies that our stylized facts also hold in this alternative dataset. This alternative dataset shows smaller gross and net positions than in our data, in part reflecting some differences in country coverage between the two datasets. South's net foreign assets average –5.7 percent of wealth, with net lending averaging –3.6 percent of wealth. On average, this dataset shows that net lending is 63 percent of South's net foreign assets, while in our dataset net lending is 75 percent 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 dataset as well.[27]

Both datasets 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 dataset the share of net lending falls from 78 percent during the 1980s, to 67 percent during 1990-97. In the Lane-Milesi-Ferretti dataset, the corresponding figures are 73 percent and 51 percent, 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 percent to 200 percent 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 their two indices of restrictions on FDI flows and restrictions on the liquidation of FDI positions.[28] The

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

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

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[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.

Appendix Table A1: 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, Loayza, Serven and Ventura (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, Loayza, Serven and Ventura (2000), South = GDP/Capita<$5000						
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 (2001), 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 A2.

Appendix Table A2: Countries Included in South

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

Appendix 2 -- Proofs

In this appendix, 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]

(A1) $\quad dx_i = \mu_i \cdot dt + \psi_i \cdot d\omega + \psi_i^* \cdot d\omega^* + \xi_i \cdot ds$

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:

(A2)
$$\delta \cdot F^1 = \max_{<c>} \left\{ \ln c + \frac{\partial F^1}{\partial a} \cdot (R \cdot a - c) + \sum_i \frac{\partial F^1}{\partial x_i} \cdot \mu_i + \frac{\partial^2 F^1}{\partial a^2} \cdot \frac{V^2 \cdot a^2}{2} + \right.$$
$$+ \sum_i \frac{\partial^2 F^1}{\partial x_i^2} \cdot \frac{\psi_i^2 + \psi_i^{*2}}{2} + \sum_i \frac{\partial^2 F^1}{\partial a \partial x_i} \cdot V \cdot a \cdot \psi_i +$$
$$\left. + \sum_i \sum_j \frac{\partial^2 F^1}{\partial x_i \partial x_j} \cdot (\psi_i \cdot \psi_j + \psi_i^* \cdot \psi_j^*) + \beta \cdot \left[F^0(a) - F^1(a) \right] \right\}$$

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:

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

(A3) $0 = c^{-1} - \dfrac{\partial F^1}{\partial a}$

During normal times (s=0) we have that:

$$\delta \cdot F^0 = \max_{<c,k,l,e,e^*>} \left\{ \ln c + \frac{\partial F^0}{\partial a} \cdot \left[\frac{R \cdot (k-e) + R^* \cdot e^* + r \cdot l}{\eta} - c \right] + \sum_i \frac{\partial F^0}{\partial x_i} \cdot \mu_i + \right.$$

$$+ \frac{\partial^2 F^0}{\partial a^2} \cdot \frac{V^2 \cdot (k-e)^2 + V^{*2} e^{*2}}{2 \cdot \eta^2} + \sum_i \frac{\partial^2 F^0}{\partial x_i^2} \cdot \frac{\psi_i^{\ 2} + \psi_i^{*2}}{2} +$$

(A4) $$+ \sum_i \frac{\partial^2 F^0}{\partial a \partial x_i} \cdot \frac{V \cdot (k-e) \cdot \psi_i + V^* \cdot e^* \cdot \psi_i^{\ *}}{\eta} + \sum_i \sum_j \frac{\partial^2 F^0}{\partial x_i \partial x_j} \cdot (\psi_i \cdot \psi_j + \psi_i^* \cdot \psi_j^*) +$$

$$\left. + \alpha \cdot \left[F^1 \left(\frac{k - \lambda \cdot e}{\eta} \right) - F^0(a) \right] \right\}$$

subject to $\eta \cdot a = k - v \cdot e + v^* \cdot e^* + l$; $k \geq e \geq 0$; $e^* \geq 0$.

Note that the effect of a the 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:

(A5) $0 = c^{-1} - \dfrac{\partial F^0}{\partial a}$

(A6) $0 = \dfrac{\partial F^0}{\partial a} \cdot R + \dfrac{\partial^2 F^0}{\partial a^2} \cdot V^2 \cdot \dfrac{k-e}{\eta} + \sum_i \dfrac{\partial^2 F^0}{\partial a \partial x_i} \cdot V \cdot \psi_i - \dfrac{\partial F^0}{\partial a} \cdot \rho + \kappa_1$

(A7) $0 = \dfrac{\partial F^0}{\partial a} \cdot r - \dfrac{\partial F^1}{\partial a} \cdot \alpha - \dfrac{\partial F^0}{\partial a} \cdot \rho$

(A8) $0 = -\dfrac{\partial F^0}{\partial a} \cdot R - \dfrac{\partial^2 F^0}{\partial a^2} \cdot V^2 \cdot \dfrac{k-e}{\eta} - \sum_i \dfrac{\partial^2 F^0}{\partial a \partial x_i} \cdot V \cdot \psi_i - \dfrac{\partial F^1}{\partial a} \cdot \alpha \cdot (\lambda - v) + \dfrac{\partial F^0}{\partial a} \cdot \rho \cdot v - \kappa_1 + \kappa_2$

(A9) $0 = \dfrac{\partial F^0}{\partial a} \cdot R^* + \dfrac{\partial^2 F^0}{\partial a^2} \cdot V^{*2} \cdot \dfrac{e^*}{\eta} + \sum_i \dfrac{\partial^2 F^0}{\partial a \partial x_i} \cdot \sigma \cdot \psi_i^* - \dfrac{\partial F^1}{\partial a} \cdot \alpha \cdot v^* - \dfrac{\partial F^0}{\partial a} \cdot \rho \cdot v^* + \kappa_3$

where $\dfrac{\partial F^0}{\partial a} \cdot \rho$ is the multiplier of the constraint $\eta \cdot a = k - v \cdot e + v^* \cdot e^* + I$; 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: $\kappa_1 \cdot (k-e) = 0$, $\kappa_2 \cdot e = 0$ and $\kappa_3 \cdot e^* = 0$. It is straightforward to verify that $F^0 = \dfrac{1}{\delta} \cdot \ln a + f^0(X)$ and

$F^1 = \dfrac{1}{\delta} \cdot \ln a + f^1(X)$ solve the Bellman equations (A2) and (A4). Using these value

functions and the first-order conditions, it follows that (A5)-(A9) 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).

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Figure 1: North-South Capital Flows
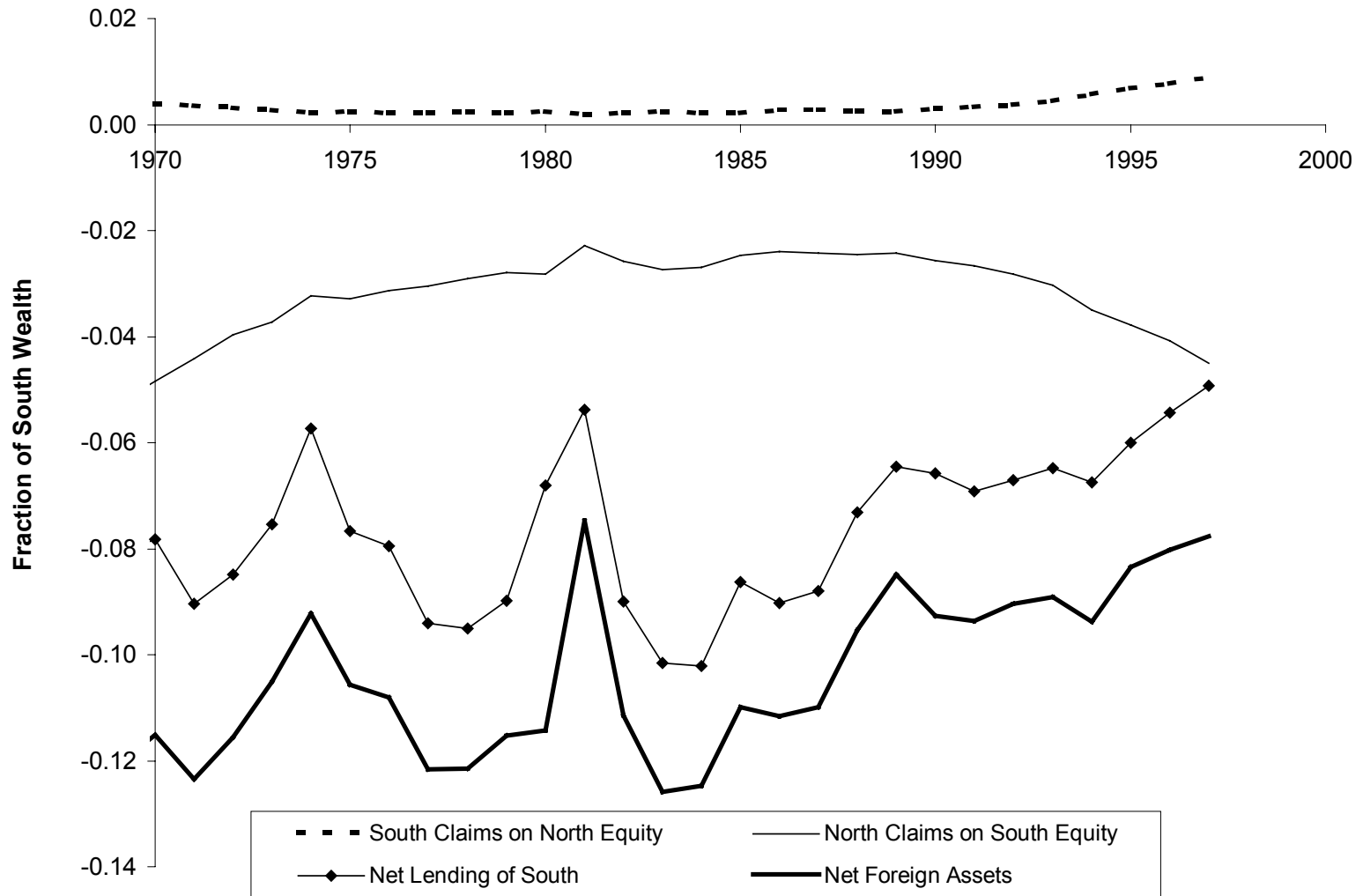
Figure 2: Incidence of Sovereign Default
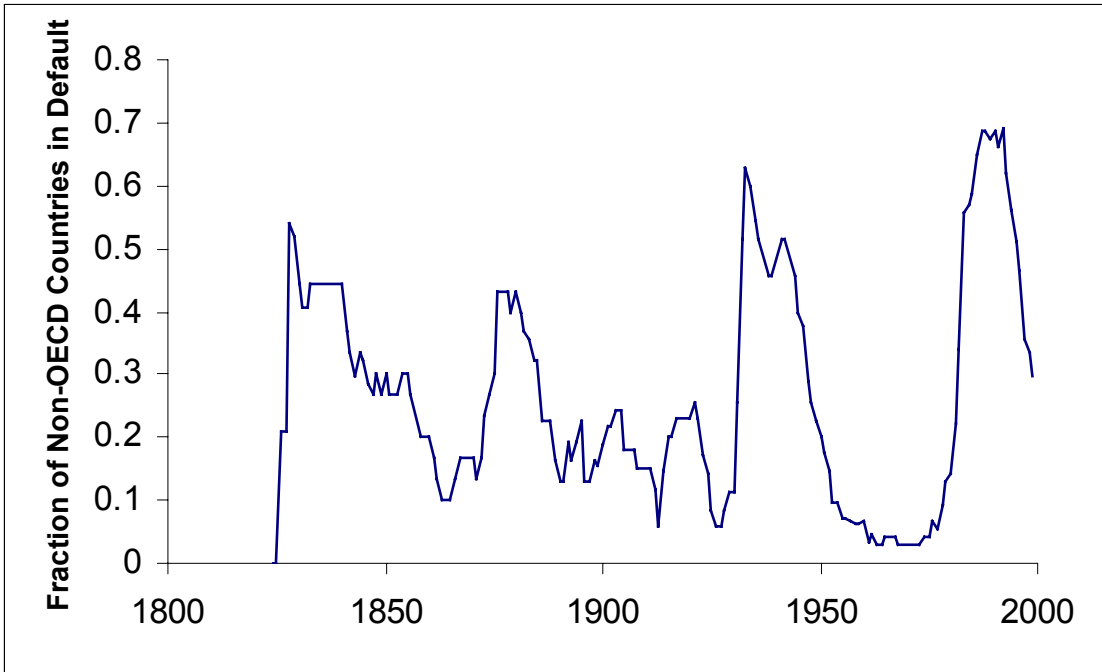
Figure 3: Foreign Asset Position of South in Complete Markets Model (Fraction of South Wealth)

Vary North Productivity Advantage (π)
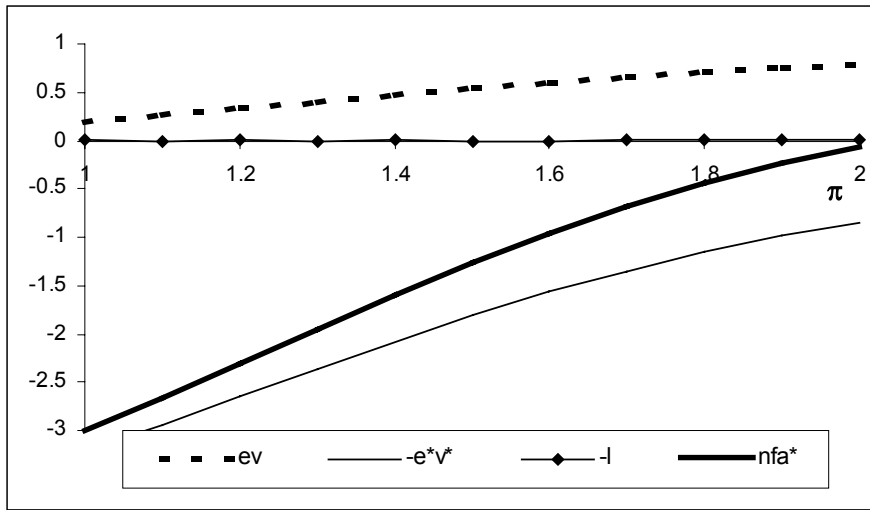
Vary Production Risk (σ)
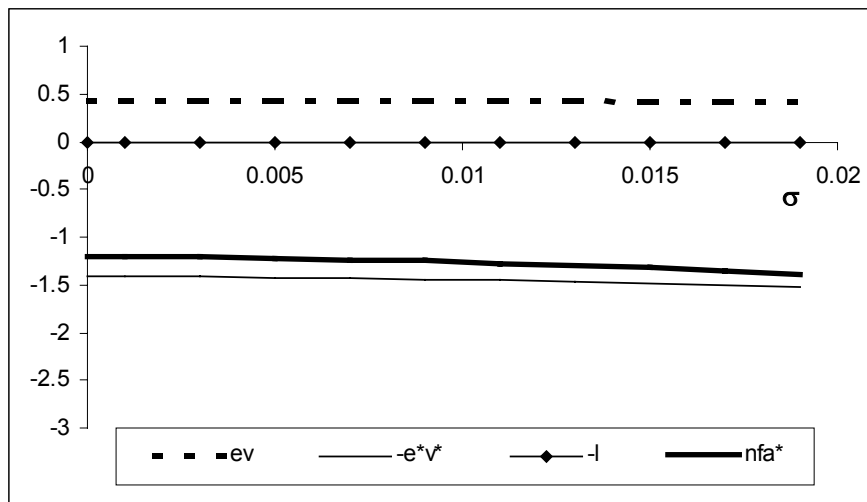
Vary Strength of Diminishing Returns (γ)
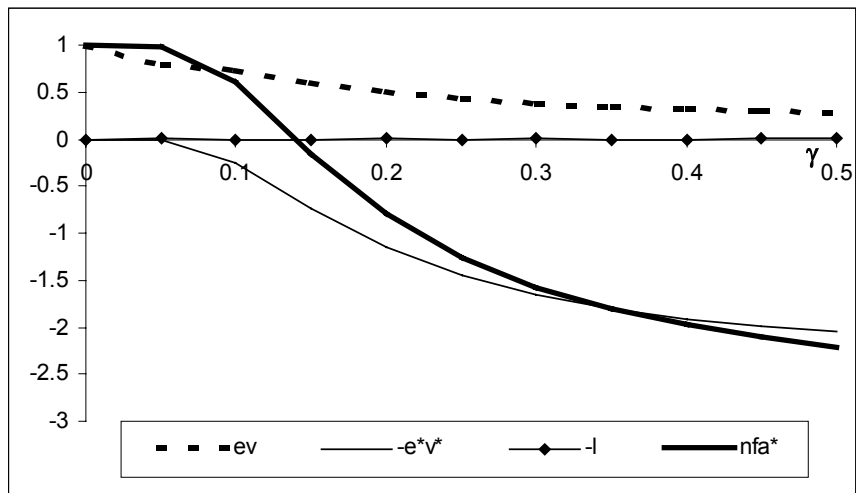
Figure 4: Sovereign Risk and Country Portfolios

Implications for Equity Prices (v and v*)
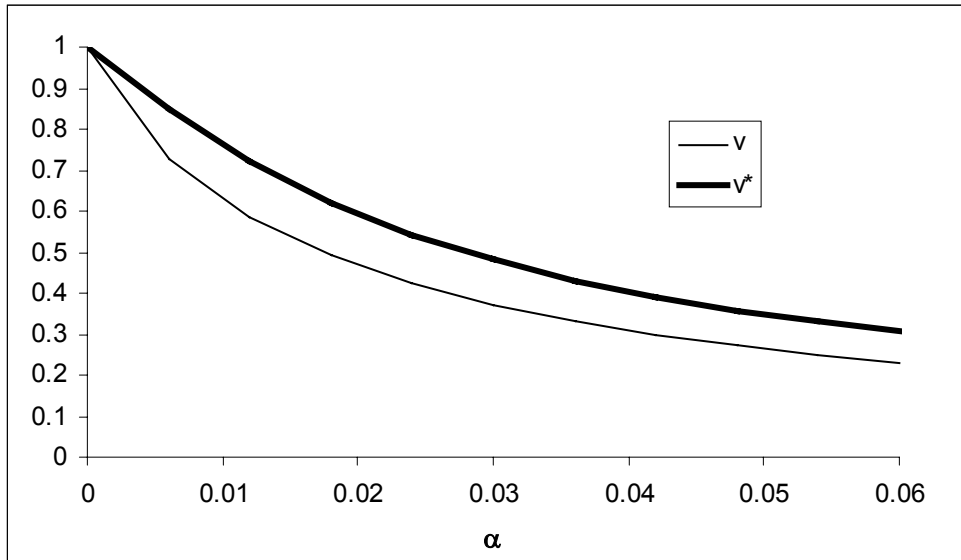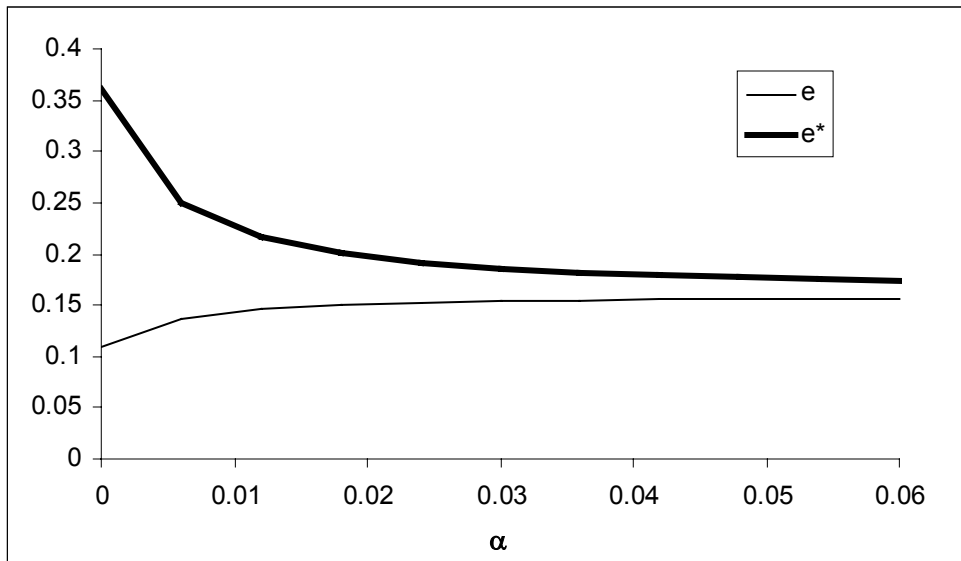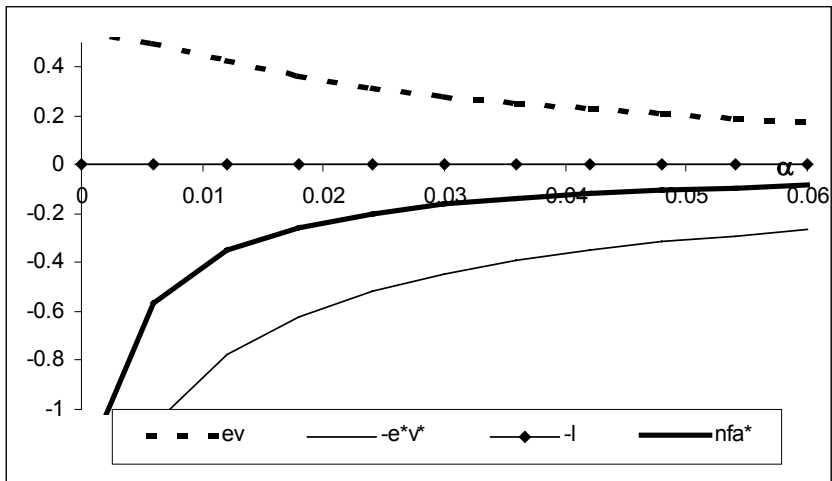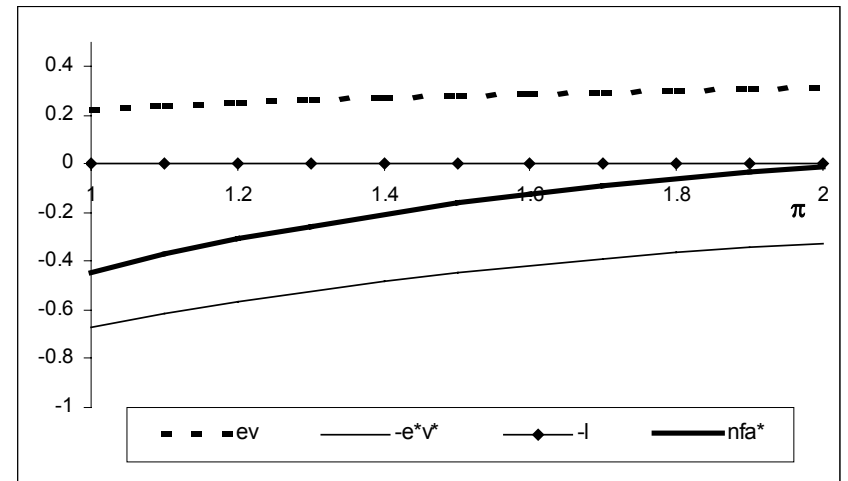
**Implications for Quantities of Foreign Equity (e and e*)**

Figure 5: Sovereign Risk and Country Portfolios
(Fraction of South Wealth)

Vary Default Probability (α)

Vary North Productivity Advantage (π)

Vary Production Risk (σ)
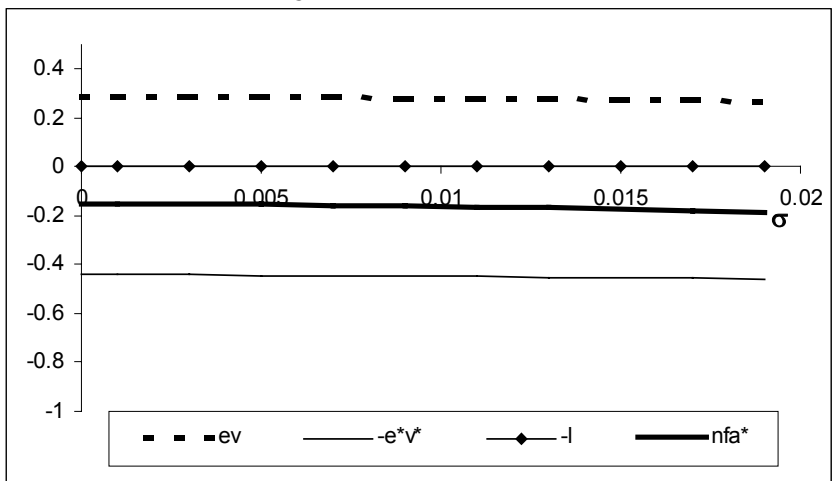
Vary Strength of Diminishing Returns (γ)
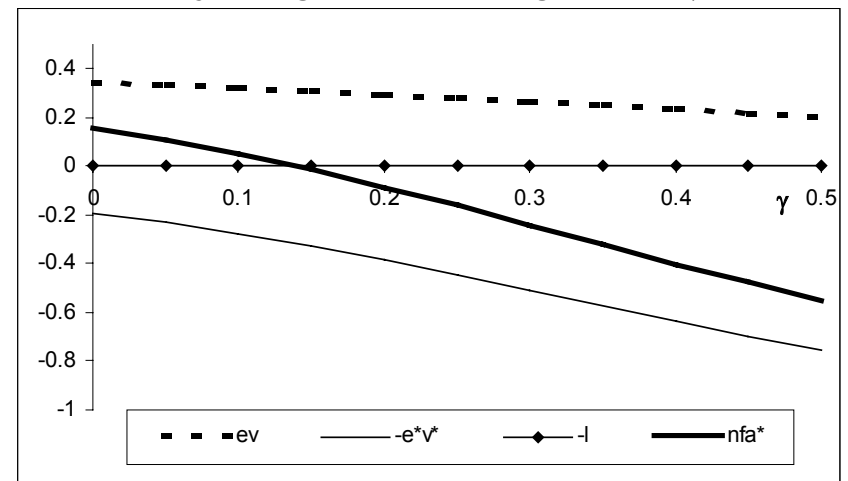
Figure 6: Inefficient Renegotiation and Country Portfolios

Implications for Equity Prices (v and v*)
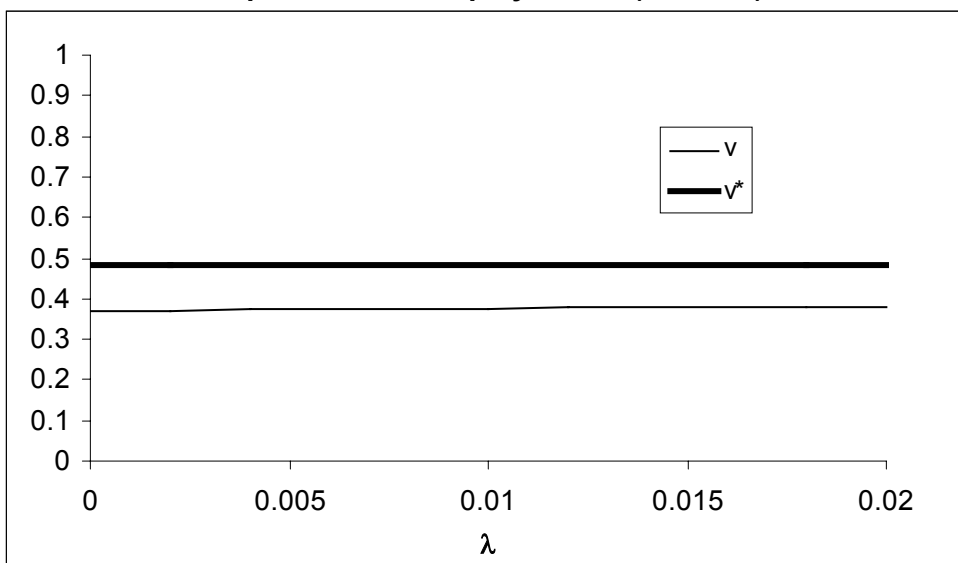
Implications for Quantities of Foreign Equity (e and e*)
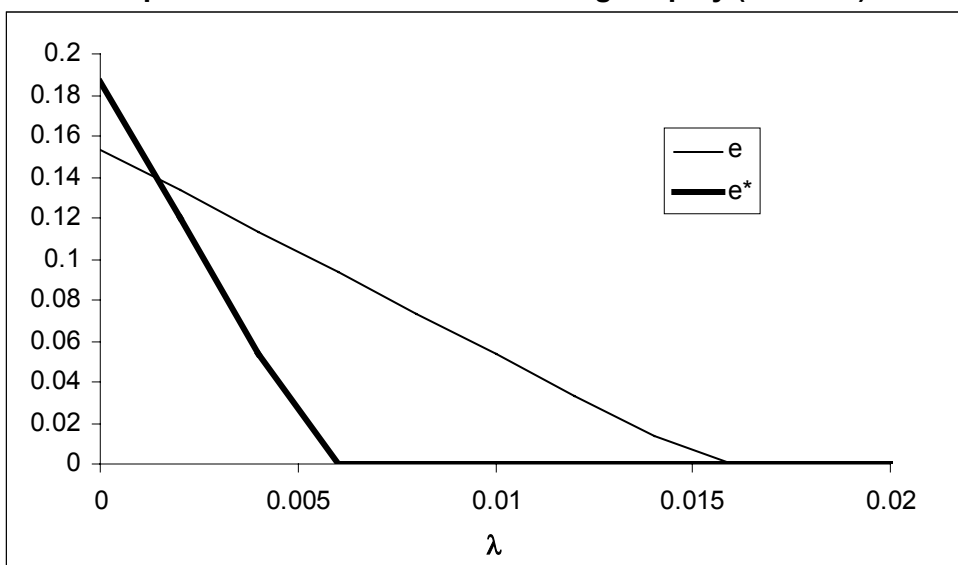
**Figure 7: Inefficient Renegotiation and Country Portfolios
(Fraction of South Wealth)**

Vary Fraction of Capital Lost in Default (λ)
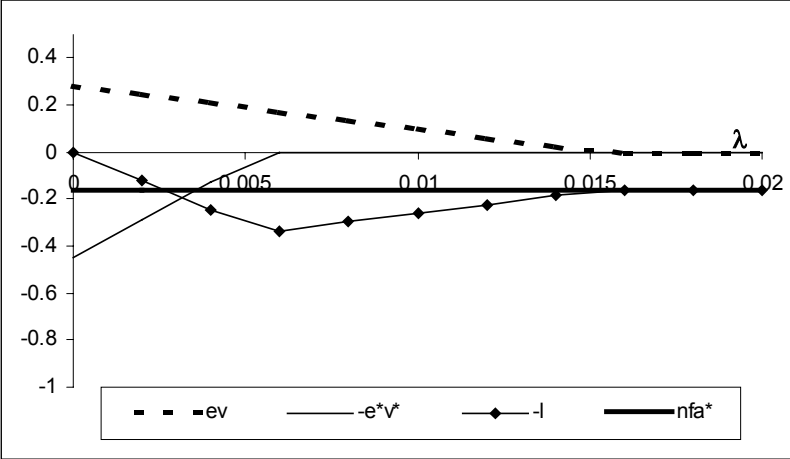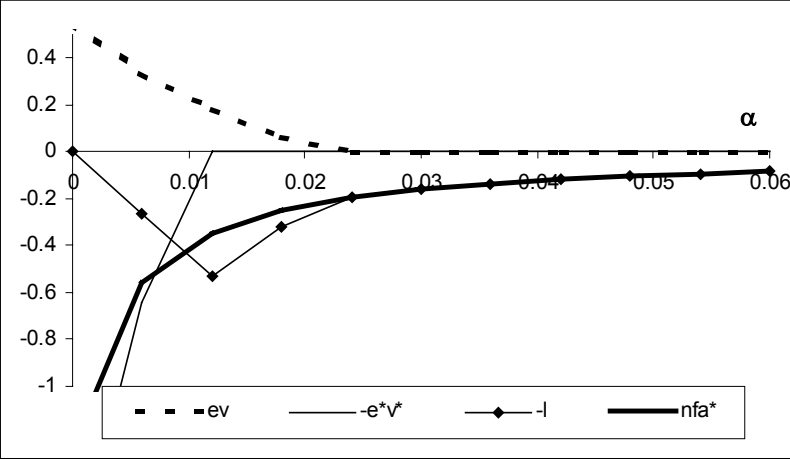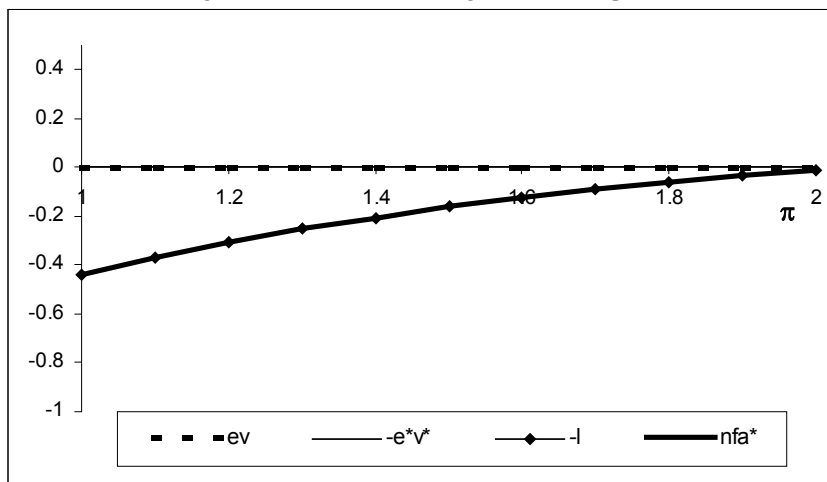
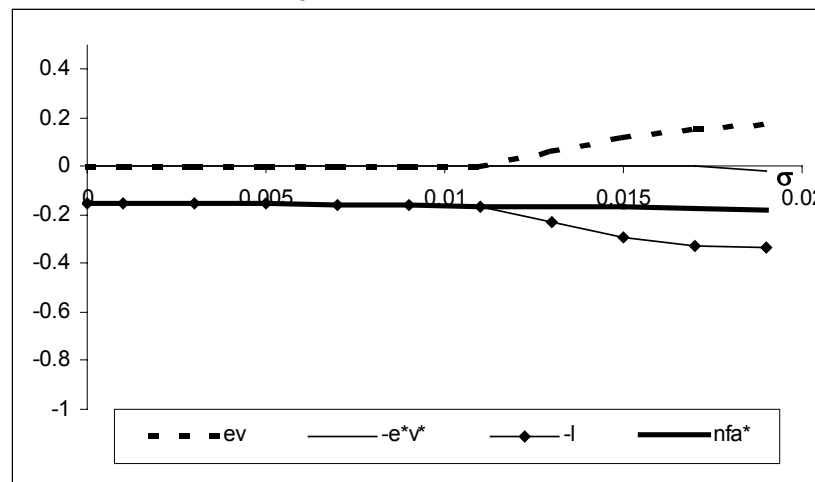**Vary Default Probability (α)**

Figure 7, cont'd: Inefficient Renegotiation and Country Portfolios
(Fraction of South Wealth)