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COUNTRY PORTFOLIOS

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Resumen

¿Cómo mantienen los países su riqueza financiera? Construimos una nueva base de datos por país relativa a derechos sobre capital doméstico o externo, y a préstamos y endeudamiento, cubriendo 68 países desde 1966 a 1997. Encontramos que tan sólo una pequeña cantidad de capital es la que fluye desde los países más ricos a los más pobres. Las posiciones de activos externas de los países son bastantes persistentes, y la mayoría adopta la forma de préstamos externos en vez de activos externos. Para interpretar estos hechos, construimos un modelo simple de flujo internacional de capital que ilumine las interacciones entre los retornos decrecientes, el riesgo de producción y el riesgo soberano. Mostramos que en presencia de razonables retornos decrecientes y riesgo de producción, la probabilidad que una crisis internacional ocurra dos veces en un siglo es suficiente para generar un conjunto de portfolios de los países que sea consistente con los datos.

Abstract

How do countries hold their financial wealth? We construct a new database of countries' claims on capital located at home and abroad, and international borrowing and lending, covering 68 countries from 1966 to 1997. We find that a small amount of capital flows from rich countries to poor countries. Countries' foreign asset positions are remarkably persistent, and mostly take the form of foreign loans rather than foreign equity. To interpret these facts, we build a simple model of international capital flows that highlights the interplay between diminishing returns, production risk and sovereign risk. We show that in the presence of reasonable diminishing returns and production risk, the probability that international crises occur twice a century is enough to generate a set of country portfolios that are roughly consistent with the data.

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Introduction

How do countries hold their financial wealth? Our objective is to provide a description of country portfolios and advance a parsimonious explanation of their main features. By country portfolio, we refer to the financial wealth of the country and how it is distributed across holdings of domestic capital and various foreign assets. By the net foreign assets of a country, we refer to the country's holdings of foreign equity and loans minus foreigners' holdings of domestic equity and loans. We first turn to the data and ask: How large are net foreign asset positions? What country characteristics seem to be associated with positive net foreign asset positions? How persistent are net foreign asset positions? What is the relative importance of foreign loans and equity? With the answers at hand, we go to the theory and ask: Why?

To determine the main features of country portfolios, we construct a new database on foreigners' holdings of domestic equity and loans, and domestic residents' holdings of foreign equity and loans. Our sample covers the period 1966-1997 and includes 68 countries that account for over 90 percent of world production and trade. Constructing this database forces us to choose among fragmentary and imperfect sources of information and then make (heroic?) assumptions on how to reconcile them and fill in the gaps.[1] Despite this, we feel confident the inferences we draw from this data are robust. In fact, there is nothing subtle about the empirical regularities we highlight here. The following are all very striking features of the data:

1. Net foreign asset positions as a share of wealth are small in absolute value and negative for most countries. Roughly 80 percent of the observations in our sample consist of countries whose net foreign assets as a share of wealth are less than 20 percent in absolute value. We also find that the net foreign asset position is negative for about 80 percent of the observations in our sample.

[1] See Sinn [1990], Rider [1994] and Lane and Milesi-Ferretti [1999] for alternative sources of data on foreign asset positions.

2. There is a strong positive relationship between financial wealth and the net foreign asset position in a cross-section of countries. In particular, we find that when financial wealth doubles, the share of net foreign assets in wealth increases by three to six percentage points. Cross-country variation in financial wealth seems to explain (in a statistical sense) most of the variation in net foreign asset positions, even after controlling for a set of variables that are designed to capture cross-country differences in aggregate production functions.

3. The share of net foreign assets in wealth is very persistent over time. A simple regression of this share on its lagged value delivers a slope coefficient of 0.98 and a R^2 of 93 percent. Since we find that between 40 percent and 70 percent of the variation in changes in net foreign assets can be attributed to changes in relative wealth, it seems reasonable to conclude that persistence in relative wealth is an important source of persistence in foreign assets.

4. Gross foreign asset positions are small and consist mostly of foreign loans rather than foreign equity. In developing countries, foreign equity assets and liabilities are roughly 0.3 and 2.8 percent of wealth, while foreign loan assets and liabilities account for 4.5 percent and 8.8 percent of wealth. In industrial countries, foreign equity assets and liabilities are roughly 3.3 and 3.9 percent of wealth, while foreign loan assets and liabilities account for 11 percent of wealth each.

To sum up, we observe that net foreign asset positions are small relative to wealth and tend to be negative, except for a few rich countries. These net foreign asset positions are remarkably persistent as a fraction of wealth, and mostly consist of foreign loans rather than foreign equity holdings. This picture that emerges from the data is so clear that we think it should constitute the main target of any successful theory of international capital flows.

It seems safe to argue that such a theory requires at least two ingredients. To explain the strong positive association between wealth and net foreign asset positions, the theory must contain at least one force that creates incentives for capital

to move from rich to poor countries. Natural candidates for this role are diminishing returns at the country level and 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 were equalized across countries.

Hence the theory needs a second ingredient to explain why net foreign asset positions are so small.[2] A popular view is that the theory just needs to recognize that rich countries have better aggregate production functions, and this is why investors keep most of their capital in rich countries even in the presence of diminishing returns and production risk. While this is likely to be true to some extent, we look elsewhere for the second ingredient of the theory, for three reasons. First, we find that standard variables we think are associated with better aggregate production functions (human capital, quality of institutions, and others) seem to be either unrelated to the net foreign asset position of a country or, alternatively, explain very little of its variation (See Table 3 and the discussion of it below). Second, while better aggregate production functions in rich countries can explain why net foreign asset positions are small, they cannot explain why gross foreign equity positions are also small. To the extent that investors have a desire to diversify production risk, the theory would predict that they choose large gross foreign equity positions that are roughly balanced. Finally, better aggregate production functions in rich countries cannot explain why most international trade consists of loans rather than equity. While both assets are useful to transfer capital across countries, equity has the additional benefit of allowing countries to share production risk and should therefore always be preferred over loans. Why are observed foreign equity positions so small? Why are foreign loans rather than foreign equity the asset that is most traded internationally? To answer these questions, we would still need to add additional elements to the theory anyway.

[2] See Lucas [1990] for a review of alternative possibilities.

In this paper we explore the alternative hypothesis that sovereign risk might be the second ingredient that the theory needs.[3] In the presence of this sort of risk, domestic capital offers domestic investors 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 net foreign asset positions are small. Should we also expect that sovereign risk leads to small gross foreign equity positions? Is it even possible that sovereign risk explains why most international trade in assets consists of loans rather than equity? The answers to these questions depend crucially on the consequences for investors of a foreign 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 creditors. Assume also that the process by which assets are seized and transferred to creditors does not give rise to any costs or loss of value. In this case, the loss suffered by creditors in the event of default is determined by their net foreign asset position vis-à-vis the defaulting country. To minimize exposure to sovereign risk, investors then choose small net foreign asset positions. But they do not have to hold small gross foreign equity positions. In fact, to the extent that investors have a desire to diversify production risk they would again choose large foreign equity positions that are roughly balanced. Under these assumptions, sovereign risk provides a rationale for why net foreign asset positions are small, but it cannot explain why gross foreign equity positions are small. Neither can it explain why most international trade consists of loans rather than equity.

If we want to hold sovereign risk responsible for the small gross foreign equity positions observed in the data, we need to remove at least one of the assumptions of the previous paragraph. Perhaps legal systems do not allow creditors to seize the foreign assets of defaulting countries. Or, even if they do, the transfer of ownership

[3] 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.

might involve large costs and a substantial loss of value. In this case, investors' exposure to sovereign risk is no longer their net foreign asset position vis-à-vis the defaulting country, but instead some fraction of their gross foreign asset position. Now the existence of sovereign risk can potentially explain why investors choose small gross foreign equity positions.

With the help of the additional (and we think realistic) assumption that transferring ownership of equity is costlier than transferring ownership of loans, sovereign risk can also explain why most international trade in assets consists of foreign loans rather than foreign equity. Investors issuing foreign loans and equity are willing to sell these assets at a discount that reflects the value for them of the gain they receive in the event of default.[4] What is this gain? A domestic investor who has borrowed abroad receives the full value of the loans. This gain is exactly equal to the loss experienced by the foreign investor. A domestic investor who has sold equity claims to foreigners receives the full value of the equity, but loses any valuable advantage that foreign investors brought to the firm (experience, managerial skills, know-how, access to better technology or relationships, firm-specific knowledge, and so on). This gain is less than the loss experienced by the foreign investor. Therefore in the event of default, foreign loans give rise only to pure transfers while foreign equity creates losses. While the latter allows investors to hedge against production risk, it is a worse hedge against sovereign risk than the former. If the desire to avoid diminishing returns induces investors 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.

The notion that foreign equity and loans are subject to sovereign risk is hardly novel or controversial among observers of international financial markets. The interesting issue is whether reasonable probabilities of default can quantitatively

[4] This discount in loan contracts shows up in the interest rate. The evidence is overwhelming that loans to developing countries usually command a higher interest rate than domestic loans. It is much less clear whether we could find any comparable discount on equity.

explain the main features of country portfolios. 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 international trade in assets, which end up in a crisis period in which South defaults on its foreign obligations. North investors seize South's foreign assets, but this transfer of assets is costly. The default initiates a crisis period in which international financial markets shut down. Eventually, international trade in assets resumes and the cycle starts again.

It seems clear that this model can, in principle, explain the facts discussed above. If sovereign risk is sufficiently high, net capital flows will be small (Fact 1). If either diminishing returns or country-specific production risk is important, we should observe a tendency for capital to flow from rich to poor countries (Fact 2). To the extent that transferring ownership of foreign equity is costlier than transferring ownership of loans, gross foreign asset positions should be small and consist primarily of loans rather than equity (Fact 4). If the model generates persistence in the world distribution of wealth, this can naturally explain the persistence of foreign asset positions (Fact 3). It is much less clear however whether this model is able to provide a reasonable quantitative description of the data. A perhaps surprising finding is that, even in the presence of reasonable diminishing returns and production risk, the probability that international crises occur twice a century is enough to generate a set of country portfolios that are roughly consistent with the data.

The paper is organized as follows: Section I provides a brief description of our database and extensively documents the four facts mentioned above. Section II presents the model and discusses its main qualitative and quantitative implications. Appendix A provides a detailed discussion of how we constructed our database, while Appendix B contains some proofs.

I. A Description of Country Portfolios

In this section, we describe the main characteristics of country portfolios using a new database covering 68 countries from 1966 to 1997. We first provide an overview of the sources and methodology used to construct the data. We then summarize its main features in the form of four facts. Appendix A provides details on the data and describes how we account for changes in the value of stocks of assets.

I.1 A New Database on Country Portfolios

Our database contains estimates of domestic capital stocks and foreign assets of countries.[5] In particular, we have measures for the following quantities:

k = Domestic capital stock
e = Domestic equity owned by foreign residents.
e* = Foreign equity owned by domestic residents.
l = Loans issued by domestic residents and owned by foreign residents.
l* = Loans issued by foreign residents and owned by domestic residents.

We measure these quantities per domestic resident in constant 1990 US dollars. We define a=k+e*-e+l*-l and f=e*-e+l*-l as the financial wealth or portfolio of the country and its net foreign assets, respectively. We refer to a country as a creditor (debtor) if its net foreign assets are positive (negative).

We construct estimates of each component of financial wealth in two steps. First, we use the limited available information on stocks of these assets to determine an initial value. Second, we use flow data and estimates of changes in the value of these assets to extend the initial stocks forward and backward over time. We rely on

[5] We abstract from other components of wealth such as land, natural resources, and human capital.

this method of cumulating flows even for those countries where more stock data is available in order to avoid a potential bias. Since long time series of stock data are available only for a few rich countries, using these as the primary source would essentially result in different methods being used to construct stocks for rich and poor countries. These differences would then contaminate our inferences regarding how portfolios vary with wealth.

We rely on data from a number of standard sources. We obtain initial stocks of domestic capital from the Penn World Tables, and use flow data on gross domestic investment to build up stocks of capital valued in US dollars at PPP. In order to determine foreign holdings of domestic equity and domestic holdings of foreign equity, we rely primarily on data on stocks and flows of direct and portfolio equity investment reported in the International Monetary Fund's Balance of Payments Statistics Yearbook. We again use the limited available information on stocks reported in this and a variety of other sources to determine the initial level of each asset for each country, and then use corresponding flow data from the balance of payments to construct stocks for remaining years. Finally, we combine stock data on the debts of developing countries reported in the World Bank's Global Development Finance with data on stocks and flows on debt from the Balance of Payments Statistics Yearbook to build up stocks of borrowing and lending for all countries in our sample.[6]

Our sample of countries is determined primarily by data availability. We begin with a sample of 98 countries with population greater than one million and per capita GDP greater than 1000 US dollars at PPP in 1990. Of these we discard 25 countries with missing, incomplete, or inconsistent balance of payments data. This leaves us with an unbalanced panel of 73 countries spanning on average 25 of the years between 1966 and 1997. In the empirical work that follows we restrict attention to a

[6] We assume throughout that stocks of debt reported in these sources constitute solely the assets and liabilities of domestic residents. To the extent that these reflect debt issued by or owed to foreign-owned firms operating in the country, we are overestimating the loan assets and liabilities of domestic residents. Given that foreign holdings of domestic equity are small relative to wealth this mismeasurement is unlikely to be empirically important.

set of 68 countries excluding five transition economies. Table 1 lists these countries classified by geographical region. As the table shows, our sample includes basically all industrial countries and a substantial number of developing countries from all regions of the world. The countries in our sample account for over 90 percent of world production and commodity trade. It is reasonable to think that these countries also account for a similar fraction of world trade in assets.[7] Despite this wide coverage, we do not find that net foreign assets sum to zero across countries in our sample. In the case of claims on equity, we find that the sum of all countries reported claims on foreign equity is on average about 3 percent less than reported foreign claims on domestic equity. In the case of lending the discrepancy is larger, with world reported borrowing exceeding lending by about 12 percent. While these discrepancies are not trivial, they are of a comparable order of magnitude to well-known discrepancies in flows on foreign assets.

I.2 Main Features of Country Portfolios

In this subsection we examine the main features of country portfolios using the database described above. We organize the discussion around four main facts or findings.

Fact 1: *Net foreign assets as a share of wealth are small and negative for most countries.*

Figure 1 shows the distribution of the share of foreign assets in wealth, $\frac{f}{a}$, pooling the available 1717 observations for all countries and years. Overwhelmingly, net foreign assets represent a small fraction of the wealth of domestic residents.

[7] Our procedure results in estimates of wealth that are very small (and occasionally negative) for a few country-year observations, corresponding to countries with very large external debt. We exclude these observations by limiting the sample to those where the ratio of wealth to GDP is greater than 0.5.

Roughly 80 percent of the country/year observations are less than 20 percent in absolute value. Also, about 80 percent of the country-year observations are negative. Perhaps Figure 1 is concealing important variation across regions and over time in the size and sign of the net foreign asset position. To rule out this possibility, Table 2 reports the share of net foreign assets in wealth, aggregating across countries in different regions and time periods. The top panel reports wealth-weighted averages, and the lower panel reports the share for the typical (median) country in each group and period. Clearly, the finding that most countries have a small but negative net foreign asset position holds across regions and over time.

Since net foreign asset positions are small relative to wealth, it follows that there is a strong relationship between countries' financial wealth and their capital stock. To see this, Figure 2 plots the capital stock, k, against financial wealth, a, averaging the available years over the period 1966-1997 for each country. A simple regression of the capital stock on domestic wealth delivers and R^2 of 98 percent and a slope coefficient of 0.93. Clearly, the world distribution of capital stocks is very close to the world distribution of wealth. This does not mean however that differences between these two distributions are random or uninteresting. Although the slope coefficient appears to be very close to one, the null hypothesis that this coefficient is one is rejected at conventional significance levels. We also reject the null hypothesis that the intercept is zero. That is, on average the capital stock exceeds wealth in poor countries and is less than wealth in rich countries. This leads us to the next fact:

Fact 2: *The share of net foreign assets in the country portfolio increases with wealth in a cross-section of countries.*

The strong positive association between the share of net foreign assets and wealth is apparent in Figure 3, which plots the average share of net foreign assets in wealth, $\frac{f}{a}$, against the logarithm of wealth, ln(a), for each country over 1966-1997. Virtually all (44 out of 47) developing countries are debtors, as are two-thirds of

industrial countries (14 out of 21). The ten creditor countries in our sample are mostly rich industrial countries (Belgium/Luxembourg, Switzerland, Germany, France, United Kingdom, Japan, and the Netherlands), and three developing countries (Saudi Arabia, Singapore, and Lesotho).[8]

The relationship between wealth and net foreign asset positions holds across subperiods. The first row of Table 3 confirms that the simple results in Figure 3 (shown in the first column) hold across the different subperiods (shown in the remaining columns). The estimated coefficients range from 0.04 to 0.08 and are significantly different from zero in each subperiod. The magnitudes of these coefficients indicate that when wealth doubles, the share of foreign assets in wealth increases by three to six percentage points. In the next row of Table 3 we introduce regional dummies. With the exception of the first subperiod, the coefficient on the logarithm of wealth increases slightly, and remains significantly positive. In the third row of Table 3 we check whether the changes in the wealth elasticity across periods is an artifact of the changing composition of the sample by restricting attention to a balanced panel of 8-year average observations. The results do not change substantially.

There are reasons to think that the relationship between wealth and the net foreign asset position is even stronger than what a simple regression would find. It is easy to think of factors that are positively correlated with wealth and are likely to be negatively correlated with the net foreign asset position of a country. First, wealth is strongly correlated with human capital, technology and institutional quality, all of which raise the returns to capital and make foreign assets less attractive for rich countries. Second, the variability of returns is also negatively correlated with wealth, making foreign assets less attractive for rich countries. Third, there may also be scale effects whereby returns are higher in some of the larger, richer economies in our sample. All of these arguments can be summarized by saying that it is likely that rich

[8] Lesotho is somewhat of an anomaly, as it runs large current account surpluses reflecting primarily workers' remittances from South Africa.

countries have better aggregate production functions and therefore find foreign assets less attractive. To the extent that this is the case, the simple regressions of the net foreign asset position on wealth contain omitted variables that bias downwards the slope coefficient. We therefore introduce a number of additional control variables into the regression. We proxy for human capital with the number of years of secondary education in the workforce, and control for scale effects using the logarithm of population. We include openness to international trade measured as trade volumes as a share of GDP, financial depth measured as the ratio of M2 to GDP, government consumption as a share of GDP, and an index of civil liberties, as proxies for the quality of the institutional environment. We measure the variability of returns using the standard deviation of real per capita GDP growth over the indicated period. Finally, we include a set of regional dummies to control for other unobserved region-specific heterogeneity.

The remainder of Table 3 summarizes the results of this augmented regression. Averaging over all years, the coefficient on wealth rises to 0.07 and remains very significant. Consistent with the view that high levels of human capital make domestic capital more attractive, we find that years of secondary education enters negatively although not quite significantly at the 10 percent level. Somewhat surprisingly, population size enters positively, suggesting that there may be diseconomies of scale or congestion effects that make domestic capital less attractive in large countries. Public consumption as a share of GDP enters negatively and approaches significance at the 10 percent level, which may reflect an increased demand for foreign loans to finance public consumption. Finally, financial depth enters positively and significantly. This may reflect the fact that countries with well-developed financial markets have less need for recourse to international financial markets. The remaining control variables, openness, civil liberties, and the volatility of growth do not enter significantly. Although the magnitude and significance of the coefficients on these variables differs somewhat across subperiods, the results are qualitatively similar to those obtained in the first column.

From Table 3 we can also obtain a sense of the magnitude and relative importance of wealth relative to other factors as a determinant of foreign assets positions. Consider the regression in the first column of Table 3 based on average data over the period 1966-1997. A one standard deviation increase in the logarithm of wealth (which corresponds to roughly a three-fold increase) leads to roughly two-thirds of a standard deviation increase in the net foreign asset position, or about 10 percentage points. In contrast, a one standard deviation increase in the remaining significant control variables leads to an increase (in absolute value) of only one-third of a standard deviation in the the net foreign asset position. Another way to see the importance of wealth in explaining the cross-country variation in foreign assets is to perform a variance decomposition of the fitted values from these regressions. The bottom row of Table 3 reports the share of the variance in predicted foreign assets that can be attributed to wealth. [9] Averaging over the entire sample period, we find that almost 60 percent of the cross-country variation in predicted foreign assets is due to cross-country variation in wealth. In all but the first subperiod we similarly find that the majority of the variation in predicted foreign assets is due to variation in wealth.

Fact 3: *The share of net foreign assets in the country portfolio is persistent over time.*

Figure 4 plots the share of net foreign assets in wealth in a given country and year on the vertical axis, against its value lagged one year (in the first panel), five years (in the second panel) and 10 years (in the third panel) on the horizontal axis, pooling all country-year observations over the period 1966-1997. From these three figures it is clear that the share of foreign assets in wealth is very persistent.[10] The

[9] We use a decomposition of the variance of the sum of two correlated random variables suggested by Klenow and Rodríguez-Clare [1997]. In particular, if Z=X+Y, they define the share of the variance of Z attributable to X as COV(X,Z)/VAR(Z). This number has the following natural interpretation: If we observe that Z is one percent above its mean but we did not observe X and Y separately, then we would infer that X is COV(X,Z)/VAR(Z) percent above its mean value. We apply this defining Z as fitted foreign assets, and X as the estimated coefficient on wealth multiplied by wealth.

[10] This fact was also noted by Kraay and Ventura [Forthcoming] in a smaller sample of 13 OECD economies, who argue that this observation can explain the long-standing puzzle raised by Feldstein and Horioka [1980].

simple correlation between the share of foreign assets in country portfolios in a given year and the same share lagged one year is 0.96. Even over a 10-year horizon the simple correlation is a respectable 0.55. This very strong persistence of the share of foreign assets in country portfolios is all the more surprising when one considers how small foreign assets are relative to wealth. In our sample the typical (median) country holds roughly –10 percent of its wealth in foreign assets, and its ratio of wealth to GDP is around 2. This implies that a current account surplus of 5 percent of GDP sustained for only four years would be sufficient to entirely erase a country's net foreign asset position. Yet in the data we see that net foreign assets as a share of wealth on average barely change over this horizon, as indicated by the estimated slope coefficients which are very close to one.

The pooled data in Figure 4 nevertheless mask some interesting variation over time in the persistence of foreign assets in country portfolios. In Figure 5 we disaggregate the annual persistence in the top panel of Figure 4 by year. For each year indicated on the horizontal axis, we regress the share of foreign assets in wealth on a constant and its one-year lag, and then plot the resulting slope coefficients on the vertical axis as a dashed line. The solid line shows a three-year centered moving average of these estimated slopes. When this slope is greater than (less than) one, the foreign assets of all countries on average expand (contract). From the mid-1970s to the mid-1980s, the slopes are all greater than one. This reflects primarily the rapid buildup of debt of developing countries financed by borrowing from rich countries and oil producers, followed by an even greater increase in their recorded debts as many of these countries suspended payment during the debt crisis of the 1980s. As the debt crisis was eventually resolved in the late 1980s, the portfolios of all countries contracted and the slopes fall below one. Somewhat surprisingly, the estimated slope is near one during the 1990s, providing little evidence of systematic increases in the share of net foreign assets in country portfolios during this period.

Why is the net foreign asset position as a share of wealth so persistent? One immediate possibility is that the persistence of net foreign assets reflects the persistence of wealth, which we have seen to be an important determinant of the

cross-country variation in net foreign assets. We investigate this hypothesis empirically by regressing the change in net foreign assets on the change in the logarithm of wealth and the changes in the other control variables considered in Table 3, using the three eight-year changes implied by the four 8-year averaged periods using in Table 3. We then perform the same variance decomposition as before to determine what share of the variation in changes in net foreign assets are due to changes in wealth. We find that between 40 percent and 70 percent of the variation in changes in net foreign assets can be attributed to changes in wealth. This suggests to us that persistence in wealth is an important source of persistence in foreign assets.

Fact 4: *Gross foreign asset positions are small and consist mostly of foreign loans rather than foreign equity.*

Net foreign assets consist of net claims on foreign equity (e*-e) and net lending abroad, (l-l*). We illustrate the relative importance of the latter in explaining the cross-country variation in country portfolios in two ways. Table 4 shows the composition of foreign assets as they vary across regions, income groups, and time. Averaging over all years, claims on foreign equity consist of only 0.3 percent of the wealth of developing countries, while foreign claims on domestic equity account for 2.8 percent of wealth. Among industrial countries claims on foreign equity and foreign claims on domestic equity are only somewhat larger and consist of only 3.3 percent and 3.9 percent of wealth.[11] In contrast gross borrowing and lending account for 8.8 percent and 4.5 percent of wealth of developing countries, and 11 percent of wealth each for industrial countries. Finally, it is interesting to note that the share of gross borrowing and lending in the wealth of industrial countries is much larger than that of developing countries, especially during the 1990s.

[11] A large literature has documented that the holdings of foreign equity of investors in a few rich countries are very small (French and Poterba [1991], Tesar and Werner [1992] and others). Lewis [1999] provides an excellent survey of alternative explanations for this empirical regularity. Our data confirms that it applies to a much broader set of countries and assets.

In contrast with Table 4 which focuses on gross positions, Figure 6 provides evidence on the importance of net lending in explaining the cross-country variation in net foreign assets. We plot net lending as a share of wealth on the vertical axis, and the share of foreign assets in wealth on the horizontal axis, averaging over the period 1966-97. The top panel shows the results for all countries, while the bottom panel shows the same information for industrial countries only. Since the slope of this relationship is nothing more than the covariance between net foreign assets and net lending divided by the variance of net foreign assets, this slope can be interpreted as the fraction of the variance in net foreign assets attributable to variation in net lending. In our full sample of countries this fraction is 82 percent. For the developing countries in our sample this is not surprising at all, since we have seen that gross equity positions are small. What is more surprising is that the same number applies to industrial countries where cross-border claims on equity are much more prevalent than in developing countries. From this evidence we conclude that most of the cross-country variation in net foreign assets can be attributed to differences in net lending rather than in foreign direct and portfolio equity investment.

To sum up, we have seen that the share of net foreign assets in country portfolios is small and typically negative (Fact 1), exhibits a strong positive association with wealth in a cross-section of countries (Fact 2), is remarkably persistent over time (Fact 3), and consists primarily of foreign loans rather than foreign equity (Fact 4).

II. Towards an Explanation of Country Portfolios

We next develop a model that emphasizes the interplay of diminishing returns, production risk and sovereign risk in a world populated by homogeneous mean-variance investors.[12] Diminishing returns and production risk imply that the risk-adjusted rate of return to capital declines as more capital is invested in a country. If these were the only forces at work, we would observe all countries choosing the same portfolios, and the world distribution of capital stocks would be determined by the equalization of risk-adjusted rates of return. Sovereign risk however generates a home bias in the demand for capital. If this were the only force at work, countries would hold only domestic capital and the world distribution of capital stocks would mimic the world distribution of wealth. The set of country portfolios and the world distribution of capital stocks is shaped by the interaction of these forces.

II.1 A Model of International Capital Flows

The world contains 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 used as the numeraire. Each country contains a continuum of identical consumer/investors that evaluate consumption sequences as follows:

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

where c is consumption. 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).

[12] The key property of these investors is that the share of each asset in their portfolio does not depend on their wealth, but only on the menu of available assets. By homogeneous, we mean that all investors have identical (homothetic) preferences, although possibly different wealth and menu of available assets.

The production technology is quite simple. Let k and k* be the capital stocks of North and South. 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. That is, $E[d\omega]= E[d\omega^*]=0$, $E[d\omega^2]=E[d\omega^{*2}]=dt$ and $E[d\omega \cdot d\omega^*]=0$. Then the flow of production net of depreciation is given by $\pi \cdot dt+\sigma \cdot d\omega$ in North and $\pi^* \cdot dt+\sigma \cdot d\omega^*$ in South; where π and π^* are short-hand for $\pi=\theta \cdot k^{-\gamma}$ and $\pi^*=\theta \cdot k^{*-\gamma}$ ($0 \leq \gamma \leq 1$; $\theta>0$) and σ is a positive constant. The parameter γ measures the strength of diminishing returns which, for simplicity, are treated here as an externality or congestion effect.[13] The parameter σ measures the importance of country-specific production risk. Therefore, this formulation assumes that both countries have the same technology and embodies the two forces that make the risk-adjusted rate of return to capital decreasing in the capital stock and create incentives for capital to move from rich to poor countries.

Domestic investors own the domestic stock of capital and can enter into loan and equity contracts with foreign investors. International loans promise to pay an instantaneous interest rate $r \cdot dt$. At the beginning of the period, the lender gives the principal to the borrower. At the end of the period there are two possible outcomes. The borrower might honor its promise, in which case the lender receives the principal plus interest. The borrower might also default on its promise, in which case the borrower keeps the principal and interest and the lender receives nothing. A share of North (South) equity has price v (v*) and promises to pay the net flow of production generated by one unit of North (South) capital. At the beginning of the period the buyer gives the value of the equity to the seller. The seller provides the buyer with a unit of capital and allows him/her to operate the production technology. Once again, at the end of the period there are two possible outcomes. The seller might honor its promise, in which case the buyer receives the value of the equity and keeps the net flow of production. The seller might also default on its promise, in which case the

[13] At the cost of further notation, we could generate this dependence by assuming there is a production factor that is not priced. Since this is well known, we dispense with the formalities.

seller keeps the value of the equity and then pays a cost λ ($0 \leq \lambda < 1$) to repossess the unit of capital and the net flow of production. The buyer receives nothing. Let l be the amount of lending from North to South and e (e*) be the number of North (South) shares owned by South (North).

It is evident that international loan and equity contracts will be used in equilibrium if and only if the probability that they are honored is high enough. This observation raises a familiar time-inconsistency problem. Since governments cannot punish foreign citizens, international trade in assets relies on governments' willingness to punish their own citizens if they default on their obligations towards foreigners. 'Ex-ante' both governments would like to commit to do this and allow investors to exploit beneficial trade opportunities. However, 'ex-post' governments do not have an incentive to punish default if the benefits exceed the costs. The benefits of default are clear. But, what are the costs of default? We shall assume they vary over time. Let s={0,1} be the state of the world. During 'normal times' (s=0) both countries can credibly commit to retaliate with penalties that are large enough to ensure that default never occurs. During 'crisis periods' (s=1) countries cannot credibly commit to penalties beyond retaliation in kind. As a result, if s=1 South (North) defaults if its net foreign asset position is negative enough, i.e. $v \cdot e - l - v^* \cdot e^* \leq -\lambda \cdot e^*$ ($v^* \cdot e^* + l - v \cdot e \leq -\lambda \cdot e$).[14] 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, $E[d\omega \cdot ds] = E[d\omega^* \cdot ds] = 0$. The value of ds is revealed after the beginning-of-period payments of loan and equity contracts have already been made.

What is the equilibrium probability of default? Assume investors believe the probability of default is zero. If $a^* > a \cdot (1-\lambda)$, the country portfolios chosen by investors are consistent with this belief.[15] In this case, the equilibrium probability of default is

[14] The seminal papers on sovereign risk and the ability of various types of penalties to sustain trade are Eaton and Gersovitz [1981] and Bulow and Rogoff [1989]. Eaton and Fernandez [1995] and Obstfeld and Rogoff [1996, chapter 6] are two excellent surveys of this topic.

[15] If investors believe that the probability of default is zero, the equilibrium of the model implies $v = v^* = 1$, $k = k^* = (a + a^*)/2$, $e = a^*/2$, $e^* = a/2$ and $l = 0$. Naturally, no country defaults if s=0. But even if s=1, North does not default and neither does South if $a^* > a \cdot (1-\lambda)$.

zero and sovereign risk is simply not an issue. We shall therefore assume from now on that $a^*(0) \leq a(0) \cdot (1-\lambda)$. In this case, the equilibrium probability of default is state-dependent. Assume the initial state is s=1 and investors believe that default occurs if the state does not change. Then, investors do not purchase foreign loans and equity since they expect default to occur with probability close to one, i.e. $1-\beta \cdot dt$. But then both countries are indifferent on whether to default or not. To ensure that an equilibrium exists we assume they default (on their non-existent foreign obligations) so that the beliefs of investors are consistent. This implies that there is no trade in assets during 'crisis periods'. Assume next that the initial state is s=0 and investors believe that default occurs if the state changes. In this case, investors will purchase foreign loans and equity since default occurs only with a very small probability, i.e. $\alpha \cdot dt$. If this probability is not too large, the chosen country portfolios are consistent with South defaulting in the unlikely event the state of the world changes. Otherwise, there is no Nash equilibrium in which the country follows a pure strategy.[16] We shall restrict the analysis to the case in which α is small. This implies that $\alpha \cdot dt$ is the equilibrium probability of default in 'normal times'.

To sum up, the world economy exhibits periods of trade in assets that culminate in crises (s transitions from s=0 to s=1) in which the debtor country defaults. The parameters α and λ measure the probability and the destructiveness of this crisis. After it occurs, a 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. Although in normal times there might be substantial trade in assets, the (small) probability that a crisis occurs has an important effect on the strategies followed by investors. We describe these strategies next.

[16] We can construct a mixed-strategy Nash equilibrium as follows: Let p be the probability of default that leads investors to choose country portfolios such that $v \cdot e\text{-}l\text{-}v^* \cdot e^* = -\lambda \cdot e^*$. South is indifferent between defaulting or not. There is an equilibrium in which South defaults with probability $(p/\alpha) \cdot dt$.

II.2 Investment Strategies

In crisis periods, the only decision that investors face is how much to consume and save. This limited choice is embedded in this budget constraint which applies only during crisis periods:

(2) $$da = (\pi \cdot a - c) \cdot dt + \sigma \cdot a \cdot d\omega$$

In normal times there is trade in assets, and we can write the budget constraint of the representative investor in North as follows:

(3) $$da = [\pi \cdot (k - e) + \pi^* \cdot e^* + r \cdot l - c] \cdot dt + \sigma \cdot [(k - e) \cdot d\omega + e^* \cdot d\omega^*] + [(v - \lambda) \cdot e - v^* \cdot e^* - l] \cdot ds$$

where, of course, the following restriction applies:

(4) $$a = k - v \cdot e + v^* \cdot e^* + l$$

The first two terms of the budget constraint (3) are standard and show how the expected return and volatility of wealth depends on asset choice, conditional on the state of the world not changing. The third term describes the wealth shock that the investor experiences at the onset of a crisis period. Throughout, we rule out Ponzi schemes and impose short-sale constraints on the holdings of foreign equity. This last restriction is a logical implication of sovereign risk.

To determine the optimal consumption and portfolio rules, the representative consumer in North maximizes (1) subject to (2)-(4) and the dynamics of asset prices and their return characteristics, i.e. the laws of motion of r, v , v*, π, π^*, σ and σ^*. Since the representative consumer is infinitesimal, he/she understands that his/her actions have no influence on these prices and their evolution. The representative consumer in the South solves a similar problem. Appendix B shows that the first-order conditions associated with the investor's problem can be written as follows:

(5) $c = \delta \cdot a$

(6) $\pi - \rho = \sigma^2 \cdot \frac{k - e}{a}$

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

(8) $\rho \cdot v - \pi = -\sigma^2 \cdot \frac{k - e}{a} + \alpha \cdot (\lambda - v) \cdot \frac{a}{k - \lambda \cdot e}$

(9) If $\pi^* - r \cdot v^* \leq 0$, $e^* = 0$. Otherwise, $\pi^* - \rho \cdot v^* = \sigma^2 \cdot \frac{e^*}{a} + \alpha \cdot v^* \cdot \frac{a}{k - \lambda \cdot e}$

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 apply to South.

Equation (5) is the first-order condition associated with c; and shows the familiar result that consumption equals the annualized value of wealth. Since the rate of time preference is used as the discount factor, the consumption rule is independent of the state of the world.

Equations (6) and (7) are the first order conditions associated with k and l; and describe how investors value production and sovereign risk, respectively. Equation (6) says that the premium for holding production risk, π-ρ, is the covariance between the return to one unit of capital and one unit of the investor's portfolio, $\sigma^2 \cdot (k-e)/a$. Equation (7) says that the premium for holding sovereign risk, r-α-ρ, is also proportional to the covariance between one unit of loans and one unit of the investor's portfolio, i.e. $\alpha \cdot \frac{a - k + \lambda \cdot e}{a}$. But since this time the effect of the shock is 'large' or non-local, the factor of proportionality is not one but the ratio of the marginal value of wealth before and after a crisis occurs, i.e. $\frac{a}{k - \lambda \cdot e}$.

Equations (8) and (9) are the first-order conditions associated with e and e*; and describe the supply of North equity and the demand for South equity, respectively. Equation (8) can be interpreted as determining the price at which North is willing to sell equity. Each share sold by the North reduces income by one unit of output, but also provides a gain of 1-λ in the event of a crisis. This is why equity will be sold at a discount, i.e. $v \leq 1$. Using Equations (6) and (7), we find that this discount is equal to the gain obtained in the event of a crisis times the price of one unit of income in this state of the world, i.e. $1-v=(1-\lambda)\cdot\frac{r-\rho}{r}$. Equation (9) defines the demand for South equity. This asset contains both production risk and sovereign risk and the required premium reflects just this.

This completes the description of the model. Equations (4)-(9) and their counterparts for South jointly determine asset prices (ρ,ρ*,r,v,v*), the world distribution of capital stocks (k,k*) and consumptions (c,c*); and the pattern of asset trade (e,e*,l) as a function of the distribution of wealth (a,a*) and technology (π,π*,σ,σ*). We use this set of equations to derive the cross-sectional implications of the theory. Then, the budget constraints (2)-(3) determine the law of motion of the world economy as a function of the initial distribution of wealth and technology and the realizations of the shocks. We use this additional set of equations to derive the time-series implications of the theory.

II.3 Three Examples

Before we embark in a quantitative analysis of the model, we discuss three examples or special cases that help build intuition on the role of the different forces that the theory emphasizes. In these examples, we assume the world economy starts in normal times and then ask: What is the initial pattern of trade in assets and how does it evolve over time?

EXAMPLE #1: Let $\alpha \to 0$ so that there is no sovereign risk. In this case, there is no discount on international assets, i.e. $\rho=\rho^*=r$ and $v=v^*=1$. Since countries have identical and homothetic preferences and, effectively, the same menu of assets, they choose the same portfolios. As a result, there is no borrowing or lending. Since technologies are identical, both countries invest 50 percent of their wealth in domestic capital and the rest in foreign equity. Thus, half of the world capital stock is located in each country and the world interest rate equals the marginal product of capital:

$$k = k^* = \frac{a + a^*}{2} \tag{10}$$

$$r = \theta \cdot \left(\frac{a + a^*}{2} \right)^{-\gamma} \tag{11}$$

If one interprets North and South as the set of industrial and developing countries in Table 1, we have that $\frac{a}{a + a^*} \approx 0.8$; and net foreign asset positions (as a percentage of wealth) of North and South are 37.5 and -150 percent, respectively. The distribution of wealth is constant over time, since both countries choose the same portfolios and therefore have the same growth rate:

$$\frac{da}{a} = \frac{da^*}{a^*} = (r - \rho) \cdot dt + \frac{\sigma}{2} \cdot (d\omega + d\omega^*) \tag{12}$$

An implication of this is that net foreign asset positions are time invariant.

The predictions of this example are both well-known and dead wrong. The model exhibits two features that are present in the data: net foreign asset positions are positively associated with wealth (Fact 2) and very persistent (Fact 3). But the model also predicts net foreign asset positions that are much larger than those in the data (Fact 1). It also predicts very large foreign equity positions and no borrowing and lending, while the data shows that countries hold little foreign equity and finance most of their net foreign asset positions with foreign loans (Fact 4).

EXAMPLE #2: Let $\sigma \to 0$ so that the only reason why capital flows from rich to poor countries is to exploit higher rates of return. Now foreign equity and loans deliver the same return in normal times. If $\lambda=0$, foreign equity and loans also deliver the same return in the event of default and, consequently, the composition of foreign assets is indeterminate. If λ is strictly positive, foreign equity becomes a dominated asset. In this case, countries do not hold foreign equity and finance their net foreign asset positions with foreign loans. The world distribution of capital stocks and the world interest rate are implicitly determined by:

$$r = \theta \cdot k^{-\gamma} + \alpha \cdot \left(\frac{k}{a}\right)^{-1} \tag{13}$$

$$r = \theta \cdot k^{*-\gamma} + \alpha \cdot \left(\frac{k^*}{a^*}\right)^{-1} \tag{14}$$

$$k + k^* = a + a^* \tag{15}$$

Equations (13) and (14) describe the demand for North and South capital, and Equation (15) is the market-clearing condition. These equations show that sovereign risk creates a home bias in the demand for capital. Also, note that the world interest rate exceeds the marginal product of capital in both countries. This difference is the risk premium required to compensate lenders for sovereign risk. The top panel of Table 5 computes the foreign asset position of North under alternative assumptions for γ and α (Remember the net foreign asset position of South is –4 times that of North). Net foreign asset positions for North and South range from zero (as $\alpha \to \infty$) to 37.5 and –150 percent (as $\alpha \to 0$). What are reasonable values for α and γ? For instance, $\alpha=0.02$ is consistent with the 20th century experience which features two episodes of large-scale defaults in the 1930s and the 1980s. Since the expected value of aggregate production is $\theta \cdot k^{1-\gamma}$, values of γ around 0.6 correspond to the neoclassical growth model, while values of γ near one are close to the linear growth model. Table 5 shows that if $\alpha=0.02$ and $\gamma=0.6$, the net foreign asset positions of North and South are 20.3 and –81.2 percent. These numbers are roughly half of those we found in the previous example. If $\gamma=0.1$, the net foreign asset positions are

5.4 and –21.6 percent. These numbers are now seven times smaller than in the previous example and start to resemble those we find in the data.

A nice feature of the first example was the prediction of constant net foreign asset positions. Since countries chose the same portfolios, they had the same growth rate and the world distribution of wealth was constant. Interestingly, this turns out to be the case also in this second example, albeit for different reasons:

(16) $$\frac{da}{a} = \frac{da^*}{a^*} = (r - \alpha - \rho) \cdot dt$$

Countries choose quite different portfolios. North invests part of its wealth in North capital and lends the rest to South. South invests more than its wealth in South capital and borrows the difference from North. Since there is less South capital, South obtains a higher return on its domestic capital than North does. But since the interest rate on foreign loans exceeds the marginal product of capital of South, North obtains an even higher return on its foreign loans during normal times. These effects balance and both countries share the same growth rate. An implication is that net foreign asset positions are constant over time.

This example shares with the first one the predictions that net foreign asset positions are positively associated with wealth and very persistent. But this is all that they have in common. Although the predicted net foreign asset positions are still a bit large relative to those in the data, the gap between theory and data has narrowed substantially. Moreover, if we are willing to assume that λ is positive (although arbitrarily small) the model also predicts that foreign equity holdings are zero and net foreign asset positions are financed through foreign loans. It seems therefore that this second example is a major improvement over the previous one, and a small dose of sovereign risk moves us a long way towards reconciling theory and data. But this example is a bit misleading since it suggests that λ plays a small role in the analysis. To counteract this impression, we explain what happens when we leave λ out of the theory.

EXAMPLE #3: Let $\lambda \to 0$ so that there are no costs of transferring ownership of equity. In this case, it follows from Equations (6)-(9) that countries share all the production risk:

(17) $$\frac{e}{a^*} = \frac{k-e}{a} = \frac{k}{a+a^*} \qquad \frac{e^*}{a} = \frac{k^*-e^*}{a^*} = \frac{k^*}{a+a^*}$$

This equations state that countries receive a fraction of each of the outputs that is equal to their share of world wealth. The intuition for this result is simple: Since the exposure to sovereign risk is the net foreign asset position, countries hedge against this type of risk by holding small net foreign asset positions. This does not preclude them from hedging against production risk by holding large gross foreign equity positions that are roughly balanced. In fact, it is possible to show that there is no borrowing and lending if $\lambda=0$. Does this mean that we are back to the predictions of the first example? Not quite. A major departure from the first example is that countries hold smaller net foreign asset positions. The distribution of capital stocks is implicitly determined by:

(18) $$r = \theta \cdot k^{-\gamma} + \alpha \cdot \left(\frac{k}{a}\right)^{-1} - \sigma^2 \cdot \frac{k}{a+a^*}$$

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

(20) $$k + k^* = a + a^*$$

Once again, Equations (18) and (19) describe the demand for North and South capital, and Equation (20) is the market-clearing condition. Now the world interest rate need not exceed the expected marginal product of capital. Although foreign loans still command a premium to compensate for sovereign risk, domestic capital also commands a premium to compensate for production risk. The middle panel of Table 5 show the predicted net foreign asset positions when σ is 0.05. We choose this number because it is the average standard deviation of the growth rate in

a sample of 88 countries from 1960 to 1994. Since production risk creates an additional incentive for capital to flow from North to South, the net foreign asset positions are larger here than in the second example, but only slightly so.

A second difference with the first example is that full sharing of production risk is now consistent with a measured home bias in country portfolios. Sovereign risk creates a discount on foreign equity, that is, $v<1$ and $v^*<1$. This means that full sharing of production risk does not require countries to invest a fraction of their wealth in foreign equity that is proportional to the share of foreign capital in the world capital stock. For instance, assume that 25 percent of the world capital is located in South. If discounts were zero, $v=v^*=1$, full sharing of production risk implies that both countries invest 25 percent of their wealth in South capital and the rest in North capital. If discounts are 50 percent, $v=v^*=0.50$, full sharing of production risk implies that South invests 52.5 percent of its wealth in South capital, while North invests only 12.5 percent. This is enough for North to buy the rights to 75 percent of South's output. If the discounts are large enough, the model might be consistent with the observation that foreign equity holdings are small. Table 6 shows these discounts when $\sigma=0.05$. The discount on South equity ranges from 20 to 30 percent. The discount on North equity (not shown in Table 6) is a little bit larger. Nevertheless, these discounts are not large enough to reconcile theory with data.

This example shares with the other two the result that both countries have the same growth rates:

$$(21) \qquad \frac{da}{a} = \frac{da^*}{a^*} = \left(\theta \cdot \frac{k^{1-\gamma} + k^{*1-\gamma}}{k + k^*} - \rho \right) \cdot dt + \sigma \cdot \left(\frac{k}{k + k^*} \cdot d\omega + \frac{k^*}{k + k^*} \cdot d\omega^* \right)$$

This result, which follows from the fact that there is complete sharing of production risk, implies that net foreign asset positions do not change over time.

As in the previous two examples we have the prediction that net foreign asset positions are positively associated with wealth and very persistent. As in the second example, predicted net foreign asset positions are small enough to resemble those we observe in the data. But this example departs dramatically from the previous one in its predictions regarding the composition of net foreign assets. As in the first example, we have now large foreign equity positions and no borrowing and lending. This difference between the second and third example illustrates how the composition of foreign assets is determined in the theory. During normal times, equity is a better asset to transfer capital from North to South since it allows countries to share production risk. But in the event of default, equity is a worse asset since it generates losses. If $\alpha \cdot \lambda$ is large relative to σ^2, investors hold little equity and instead use loans to finance net foreign asset positions. This is what happens in the second example where $\sigma \rightarrow 0$. If $\alpha \cdot \lambda$ is small relative to σ^2, investors hold large equity positions and do not use foreign loans. This is what happens in the third example where $\lambda \rightarrow 0$.

This is as far as we go with examples. We next turn to the full-fledged model.

II.4 Quantitative Implications

Can the model developed here replicate the main features of the data with a reasonable set of parameter values? The key issue is to agree on what constitutes a 'reasonable' set of parameters values. We propose the following benchmark values: $\gamma=0.2$, $\sigma=0.05$, $\alpha=0.02$ and $\lambda=0.20$. A choice of $\gamma=0.2$ means that we settle somewhere in between the neoclassical and the linear growth models. We set $\sigma=0.05$ because this is the average standard deviation of the growth rate in a sample of 88 countries from 1960 to 1994.[17] We also choose $\alpha=0.02$ because the 20th century has experienced two episodes of large-scale defaults by developing countries in the 1930s and the 1980s. Admittedly, we have little intuition as to what a reasonable

value for λ is. We therefore chose λ=0.20, which is a value that delivers relatively good results. Since there is substantial uncertainty regarding the values of all the parameters, we also show how the results vary with each of the them. Throughout, we assume that the share of world wealth in North is 0.8, which is consistent with the interpretation of North as the set of industrialized countries in Table 1.

Our base case predicts net foreign asset positions for the North and South of 10.5 percent and -42 percent, respectively. This means that 71.5 percent of the world capital is located in North and 28.5 percent in South. Therefore, only 8.5 percent of the world capital stock flows from North to South. The North portfolio contains 89.5 percent of North capital, and 6.25 and 4.25 percent of foreign loans and equity, respectively. North does not sell equity to South. The South portfolio contains 142 percent of South capital. This is financed by selling foreign loans and equity worth 25 and 17 percent of South's wealth, respectively. Overall, this base case predicts too much trade in assets relative to the data (See Figure 1 and Table 4). But these numbers show that substantial progress has been made by including a very modest dose of sovereign risk in the theory. This becomes apparent if we compare this base case to the standard model without sovereign risk (See Example 1). The latter predicts net foreign asset positions of 37.5 and 150 percent in North and South. This implies that half of the capital would be located in each country and 30 percent of the world capital stock would flow from North to South. Moreover, the country portfolios are predicted to be identical and contain 50 percent of domestic capital and 50 percent of foreign equity.

The next step, of course, is to determine how sensitive are these predictions to the particular choice of parameter values. Figure 7 shows how the predictions of the model vary with the two parameters that describe sovereign risk. In each panel of the Figure we change one of the parameters holding constant the rest at their benchmark values. Not surprisingly, increasing the probability of crises (α) and/or the

[17] In this same sample, the average growth rate was 0.02. We set the rate of time preference at δ=0.02 and choose a value for θ=0.04 so as to match this average growth rate given a choice of units such that a+a*=1.

destruction these generate (λ) leads to a reduction in net foreign asset positions. Halving the probability of crises from twice to once a century almost doubles the predicted net foreign asset positions (from 10.5 and –44 to 18.75 and –75 percent). Doubling the probability of crises from twice century to four times a century almost halves the predicted net foreign asset positions (from 10.5 and –44 to 5.75 and –23 percent). It seems therefore, that predicted net foreign asset positions are quite sensitive to changes in α. This is what we found also when we moved from the first example to the second and third ones. Figure 7 shows that this predicted net foreign asset positions are not very sensitive to changes in λ. We also found this to be the case when we moved from the second to the third example.

Figure 7 also shows how the base case predictions for the South portfolio vary with α and λ (the implications for the North portfolio follow immediately). Increases in both α and λ make equity less attractive relative to loans. In the base case, these variables are already high enough to close the North foreign equity market, but not large enough to close the South foreign equity market. Moderate increases in α and λ are sufficient to close the South foreign equity market. While moderate reductions in α and λ would open the North equity market, it would take large reductions in these parameters to raise foreign equity holdings substantially. It seems that the predictions for the composition of foreign assets in our base case are not very sensitive to small changes in α and λ. On the other hand, we have also a lot of uncertainty regarding the value of λ. If this value were close to zero, the predictions regarding the composition of foreign assets would change substantially, as shown in the second example above.

Figure 8 shows how the predictions of the model vary with the parameters that describe technology. Simple inspection of this Figure reveals that predicted net foreign asset positions are quite sensitive to our assumptions about diminishing returns (γ), but not very sensitive to our assumptions on production risk (σ). For example, if we raise γ from 0.2 to 0.6, the net foreign asset positions basically double (from 10.5 and –44 to 20.5 and –82 percent). As γ goes to zero, net foreign asset

positions collapse to zero as well. This reflects the fact that there are no longer any return differentials to provide incentives for capital flows and, for our choice of parameters, the risk of default is sufficiently high to outweigh any benefits of diversifying production risk. If $\alpha \cdot \lambda \geq \sigma^2$ (which is a restriction satisfied by the benchmark values), it is necessary to assume that $\gamma > 0$ to generate capital flows. The observation that changes in σ have small effects on net foreign asset positions was already made when we moved from the second to the third example. Not surprisingly, the relative importance of γ and σ for the composition of country portfolios is just the opposite. Increases in production risk raise the diversification benefits of holding foreign equity and induce investors to use more of it and less loans. We see that as σ increases first the North begins to purchase South equity and eventually the South also holds North equity. In the process, holdings of foreign loans decline.

An important feature of the data is the persistence of net foreign asset positions. This requires that relative wealth positions do not change much over time. Figure 9 confirms this is likely to be the case, since the expected values for the growth rate of wealth are quite similar across countries. In our base case, South's average growth rate is slightly higher than North's (2.7 vs. 2.5 percent per year);and the same is true for the standard deviation of this growth rate (6 vs. 4.7 percent per year). Over the 30-year horizon covered by our dataset this difference in average growth rates would lead to a cumulative increase in the relative wealth of the South of only 6%. This finding of an almost constant world distribution of wealth is not very sensitive to changes in the parameters. We had already encountered this result in each of the three examples discussed above.

To sum up, if diminishing returns at the country level are weak, a small doses of sovereign risk can move us a long way towards reconciling the theory's predicted capital flows with those we observe in the data. Both indicate that net foreign asset positions are small (Fact 1), positively associated with wealth (Fact 2), and very persistent (Fact 3). If diminishing returns at the country level are strong, the theory predicts net foreign asset positions that are too large relative to those in the data. A

natural way to reduce them would be to assume that North has a better technology. In any case, the key parameters regulating the size of capital flows are the probability of crises and the strength of diminishing returns. With respect to the composition of portfolios, we find that the theory can replicate the data only if equity is a bad asset to have in the event of crises and/or production risk is not very important. Only then does the theory predict that foreign equity holdings are small and most of the net foreign asset position is financed with loans (Fact 3).

Appendix A: Data Sources

In this appendix we describe the data and methodology used to construct estimates of country portfolios. To do this, we require data on the domestic capital stock, foreign claims on the domestic capital stock, the stock of domestic residents' holdings of capital located abroad, and domestic residents lending to and borrowing from abroad.

Data on stocks of some of these assets are available for some countries and for some years in a variety of sources. This existing stock data suffers from two deficiencies. First, the coverage is limited to rich countries and to recent years. Second, estimates of stocks of assets are constructed using methodologies which are often poorly documented and may vary considerably across countries, assets, and time. In contrast, data on flows of investment in these assets exist for a much larger set of countries, years, and assets. The flow of investment in the domestic capital stock is readily available from national accounts data, and a consistent treatment of flows on international assets is available in the balance of payments statistics reported in the International Monetary Fund's Balance of Payments Statistics Yearbook, Revisions 4 and 5 (BOPSY4 and BOPSY5). In order to expand country coverage and ensure a consistent methodology across assets and countries, we build up estimates of stocks of assets based primarily on this available flow data, some existing estimates of stocks, and the standard accounting identity that:

(A1) $$S_{ct} = V_{ct} \cdot S_{c,t-1} + F_{ct}$$

where S_{ct} is the value of the stock of a given asset in country c at the end of period t in constant 1990 US dollars, F_{ct} is the flow of new investment in that asset, also in constant 1990 US dollars, and V_{ct} is the gross change between periods t-1 and t in the value of the stock of that asset in period t-1.

In order to implement this approach for each asset, we require an estimate of its stock in some initial period, data on the corresponding flow of investment, and information on changes in the value of the asset. The remainder of this appendix describes how we do this for each asset of interest.

Domestic Capital

Flows: We use data on gross domestic investment in constant 1990 dollars at PPP from the Summers and Heston Penn World Table Version 5.6 (IxRGDPCHxPOP).[18] This covers non-residential and residential building, machinery and equipment, and changes in inventories. We depart from the usual practice of cumulating only gross domestic fixed investment (which excludes inventory accumulation) since inventories themselves form a (small) component of wealth.

Initial Stocks: Summers and Heston report estimates of capital stocks for 61 countries starting in 1965 (KAPWx(1+KRES/100)xRGDPCHxPOP/RGDPW). We start by estimating a cross-country regression of the capital/GDP ratio on the log-level of real GDP per capita. We then use the fitted values of this regression to estimate the initial capital stock for all of the countries in our sample, in the first year for which data on per capita GDP and investment are available. Since the correlation between capital output ratios and GDP per capita is very large, this procedure by construction delivers initial capital stocks that are very similar to the Summers-Heston estimates. Since many of the countries in our final sample have data on investment beginning in the 1950s, unavoidable measurement errors in initial stocks will have minimal impact on our estimated stocks after 1966 when our data on foreign assets begins.

[18] We work with an expanded version of the Penn World Tables which extends the coverage of real per capita GDP, investment, and population by using growth rates of local-currency constant price GDP and investment, as well as population, as reported in the World Bank World Tables.

Valuation. In principle we would like the capital stock, and all other assets, to be measured at market value. An obvious choice would be to proxy changes in the value of capital by changes in a share price index. This may be inappropriate for several reasons. Capital listed on the stock market, especially in developing countries, is not representative of the stock of capital as a whole. The link between changes in share prices and the underlying value of firms is tenuous, especially in developing countries where markets are thin. We instead consider replacement cost, and proxy changes in this by the change in the local currency investment deflator. Finally, we need to take into account physical depreciation. This of course varies across assets, and probably also across countries (consider the adverse effects of poor infrastructure). In the absence of better information we are forced to rely on the average value of 6 percent used by Summers and Heston.

In summary, we measure the gross change in value of the domestic capital stock during period t as:

(A2) $$V_{ct} = (1-\delta)\cdot\frac{P_{t-1}}{P_t}\cdot\frac{e_{ct}}{e_{c,t-1}}\cdot\frac{P^I_{c,t}}{P^I_{c,t-1}}$$

where δ=0.06 is the depreciation rate, P_t is the US price level, e_{ct} is the exchange rate in local currency units per US dollar, and P^I_{ct} is the investment deflator in country c at time t. A small concern is with the timing of these prices. Since we are measuring end-of-period stocks we would like to use corresponding end-of-period prices and exchange rates. Unfortunately gross domestic investment deflators are reported as mid-year averages for most countries, so that some mismatch in timing is unavoidable. Finally, for some countries with very high inflation, we find extremely large revaluations of the domestic capital stock that probably only reflect errors in the timing of exchange rate and price data. Rather than censor these from our dataset, we leave them in but discard them when appropriate in empirical work.

Cross-Border Claims on Equity

In order to isolate the portion of the domestic capital stock owned by domestic residents, we need to subtract foreign claims on this asset. Similarly, we need to measure domestic residents' claims on capital located abroad. These claims can take the form of direct investment or portfolio equity investment, although the dividing line between the two is vague. For example, many countries consider a 10 percent ownership stake to constitue direct investment, but this threshold varies for others. In this paper, we do not distinguish between majority and minority ownership as the distinction is irrelevant for our purposes. However, we construct data on the two stocks separately for use in other applications.

Flows: We rely on flows of inward and outward direct and portfolio equity investment as reported in the BOPSY5 (lines 4505, 4555, 4610 and 4660). Data on these items are also available under the Revision 4 presentation of the Balance of Payments Statistics Yearbook (BOPSY4). Although there are minor changes in definitions between the BOPSY4 and BOPSY5, in practice, the correspondence between the BOPSY5 and BOPSY4 is almost perfect for these items for most countries, We therefore extend the coverage of the BOPSY5 backwards using BOPSY4 data wherever possible.

Initial Stocks: The BOPSY5 reports data on the stocks corresponding to flows of direct and equity investment for most industrial economies (lines 8505, 8555, 8610 and 8660), and for some countries these stocks can be extended backwards using data from the BOPSY4. For most countries where these stocks are available, we use the first available stock reported in the BOPSY4 and BOPSY5, and then use Equation (A1) and the data on valuation changes discussed below to construct stocks for all years for which flow data are available before and after this date. Note that since stocks of direct investments are provided in the BOPS as reported by country sources, they are quite similar to those reported in other publications such as the OECD and UNCTAD, which rely on the same national sources.

For most developing countries, estimates of the stock of inward direct investment originating in OECD economies is available in OECD (1970) for 1967. We use this to measure initial stocks of direct investment in these countries. We are not aware of any comprehensive source of data on stocks of portfolio equity investment in or originating in developing countries, other than the BOPSY5 where coverage of this variable is very poor.

For countries for which no stock information is available in any of these sources, we infer initial stocks as the ratio of the flow of investment in that asset relative to gross domestic investment, multiplied by the domestic capital stock obtained above. In order to smooth out year-to-year deviations from the equality between marginal and average portfolios, we use the average investment ratio in the first three years for which flow data is available to implement this approach. In most cases for portfolio equity investment, the observed initial flows are zero, and so this results in an estimate of a zero initial stock, which is probably correct.

Valuation. We proceed from the assumption that changes in the value of capital located in a country do not vary systematically with the ownership of this capital. For inward direct and portfolio equity investment, we therefore use the same valuation method as for the domestic capital stock, as summarized in Equation (A2). Applying this same principle for valuing outward direct and portfolio equity investment is more difficult since for each country we need to know the destination by recipient country of their investment abroad. For direct investment by OECD economies, we have this type of information starting in the mid-1980s as reported by the OECD. We use the distribution of the stock of direct investment across recipient countries to construct a weighted average of the changes in value of capital located in each recipient country:

$$V_{ct} = (1-\delta)\cdot \sum_{c'\neq c} w_{c,c'} \cdot \frac{P_{t-1}}{P_t} \cdot \frac{e_{c't}}{e_{c',t-1}} \cdot \frac{P^I_{c',t}}{P^I_{c',t-1}} \tag{A3}$$

where $w_{c,c',t}$ is the share of foreign direct investment by country c located in country c'. We use this weighted average to measure changes in the value of outward direct investment for the 13 countries for which data on FDI by destination are available in 1990. For the remaining countries in our sample, we assume that the distribution of FDI across destination countries is similar to that of OECD economies. We therefore measure V_{ct} for these countries as a simple average of the V_{ct}s for the 13 countries for which we have the data required to implement Equation (A3).

For portfolio equity investment, we do not have comparable data on its distribution across recipient countries by source country. We therefore assume that its distribution across countries is sufficiently similar to that of direct investment that it is possible to use the same valuation adjustment as we do for direct investment.[19]

Cross-Border Borrowing and Lending

Flows: We rely on inward and outward non-equity flows as reported in the BOPSY5 (lines 4619+4703, and 4669+4753). This includes all debt securities, trade credits and other loans. Data on these items are also available in the BOPSY4. As with equity, there are some changes in definition between the BOPSYY5 and BOPSYY4, which in practice turn out to be minor for most of the countries in our sample, and so we extend the coverage of the BOPSY5 backwards using BOPSY4 data wherever possible.

Initial Stocks: Stock data corresponding to these flows are available from a variety of sources. For developing countries, the most comprehensive available data

[19] It is worth noting a small caveat here. Data on flows of direct investment include reinvested earnings of foreign-owned firms, while data on flows of portfolio equity investment do not. In principle changes in the stock market valuation of equities will reflect these reinvested earnings, while changes in the replacement cost of capital do not. To the extent these reinvested earnings are important, our procedure will understate the stock of portfolio equity claims. However, the alternative of using stock market data to value equity is even less attractive, given the weaknesses of stock market data noted above.

on stocks of debt is the World Bank's Global Development Finance (GDF) report, which provides data since 1970 (line DT.DOD.DECT.CD). For most industrial countries, data on stocks of borrowing and lending are reported in the BOPSY5 and BOPSY4. The only source of data that we are aware of for lending by developing countries is the BOPSY5 and BOPSY4, where coverage is very weak. Finally, for those countries where we have no information at all on stocks of borrowing and lending, we infer stocks from flows as described above for equity.

Valuation: Changes in the dollar value of outstanding debt net of amortization can occur for three reasons. The value of the currencies in which the debt is denominated may change relative to the US dollar. Depending on the structure of debt and the term structure of interest rates, the value of debt will change over time. Finally, the value of debt may change with changes in the perceived probability of repayment. In principle each of these will be reflected in changes in the secondary market price of debt. Unfortunately, secondary markets are thin and recent, especially for developing country debt, which makes comprehensive valuation adjustments difficult. We therefore adopt a more limited strategy. For developing country debts, we rely on the full time series of stocks reported by the GDF, as these include adjustments for changes in the value of denominating currencies. For developing country lending, and for the borrowing and lending of industrial countries, we do not have data even on the currency composition of these assets, let alone their maturity structure. We therefore can do no more than assume that the nominal value of debt is constant, so that the change in the real value of debt outstanding is simply:

$$V_{ct} = \frac{P_{t-1}}{P_t} \tag{A4}$$

where P_t is the US consumer price index. It is interesting to note that for industrial countries with high-quality stock data on borrowing and lending, this simple method yields very similar estimates.

Other Items

The stocks of cross-border assets described above cover the majority of items in countries' international investment positions. For completeness, we also measure the reserves of the monetary authority, distinguishing between gold and non-gold reserves. Stocks of gold are a component of wealth that does not constitute a claim on foreigners. For the purposes of this paper, we therefore include it with the domestic capital stock. We measure the stock of gold in millions of fine troy ounces as reported in the International Monetary Fund's International Financial Statistics (IFS) (line 1ad) multiplied by the dollar price of gold. For most countries, short-term dollar-denominated debt instruments are an important component of non-gold reserves. For the purposes of this paper we therefore count non-gold reserves as a part of lending abroad. We measure the stock of non-gold reserves directly as reported in the IFS (line 1ld).

Data and Results

We implement these ideas using data described above. We restrict attention to the sample of 98 countries with population greater than 1 million and per capita GDP in 1990 greater than 1000 1990 US dollars at PPP. We then discard countries with fewer than five years of data on balance of payments items, and those for which there are substantial anomalies in the reported balance of payments statistics that we were unable to resolve with reference to country sources. By far the most problematic source of data is the BOPSY5 and BOPSY4. The electronic versions of these sources often report zero stocks when there are positive flows of assets. In the BOPSY4 the data occasionally contain outright errors which needed to be eliminated by inspecting the data for each variable, country and year. Since data coverage is weak and the prevalence of these types of difficulties increases sharply prior to 1966, we begin our sample in this year. This leaves us with an unbalanced panel of 73 countries covering an average of 25 years per country over the period 1966-1997.

Finally, occasionally our procedures described above result in estimates of stocks of assets that are negative in some years, most commonly as a result of extrapolating flows backwards from a stock estimate in later years. In the vast majority of cases these negative stocks are very small, less than 0.5 percent of GDP in absolute value. If the minimum observation in a given stock series is negative but no smaller than -0.5 percent of GDP, we shift up the series to eliminate these. The handful of remaining negative stocks are discarded.

The data are available at www.worldbank.org/research/growth.

Appendix B: Solution Details

In this appendix, we solve the representative consumer's problem and show that Equations (5)-(9) describe his/her optimal consumption and portfolio rules. The investment opportunity set that the consumer faces is fully described by the vector $X=(v,v^*,r,\pi,\pi^*,\sigma,\sigma^*)$. We shall denote the i^{th} element of this vector as x_i. Let the dynamics of this element be given as follows:[20]

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

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 his/her choices affect these aggregates. Let V^0 and V^1 be the value functions of the representative consumer when s=0 and s=1, respectively. Then, we have that:

(A2) $$\begin{aligned}\delta \cdot V^1 = \max_{<c>}\Bigg\{ & \ln c + \frac{\partial V^1}{\partial a}\cdot(\pi \cdot a - c) + \sum_i \frac{\partial V^1}{\partial x_i}\cdot\mu_i + \frac{\partial^2 V^1}{\partial a^2}\cdot\frac{\sigma^2\cdot a^2}{2} + \\ & + \sum_i \frac{\partial^2 V^1}{\partial x_i^2}\cdot\frac{\psi_i{}^2 + \psi_i^{*2}}{2} + \sum_i \frac{\partial^2 V^1}{\partial a \partial x_i}\cdot\sigma\cdot a\cdot\psi_i + \\ & + \sum_i\sum_j \frac{\partial^2 V^1}{\partial x_i \partial x_j}\cdot(\psi_i\cdot\psi_j + \psi_i^*\cdot\psi_j^*) + \beta\cdot\left[V^0 - V^1\right]\Bigg\}\end{aligned}$$

and the first-order condition associated with this Bellman equation is:

(A3) $$0 = c^{-1} - \frac{\partial V^1}{\partial a}$$

Also, we have that:

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

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

$$+ \frac{\partial^2 V^0}{\partial a^2} \cdot \frac{\sigma^2 \cdot (k-e)^2 + \sigma^{*2}\, e^{*2}}{2} + \sum_i \frac{\partial^2 V^0}{\partial x_i^2} \cdot \frac{\psi_i^{\ 2} + \psi_i^{*2}}{2} + \quad \text{(A4)}$$

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

$$\left. \alpha \cdot \left[V^1 - V^0 \right] \right\} \quad \text{subject to} \quad a = k - v \cdot e + v^* \cdot e^* - l \,;\, k \geq e \geq 0 \,;\, e^* \geq 0.$$

and the first-order conditions associated with this Bellman equation are:

$$0 = c^{-1} - \frac{\partial V^0}{\partial a} \quad \text{(A5)}$$

$$0 = \frac{\partial V^0}{\partial a} \cdot \pi + \frac{\partial^2 V^0}{\partial a^2} \cdot \sigma^2 \cdot (k-e) + \sum_i \frac{\partial^2 V^0}{\partial a \partial x_i} \cdot \sigma \cdot \psi_i - \frac{\partial V^0}{\partial a} \cdot \rho + \eta_1 \quad \text{(A6)}$$

$$0 = \frac{\partial V^0}{\partial a} \cdot r - \frac{\partial V^1}{\partial a} \cdot \alpha \cdot \phi - \frac{\partial V^0}{\partial a} \cdot \rho \quad \text{(A7)}$$

$$0 = -\frac{\partial V^0}{\partial a} \cdot \pi - \frac{\partial^2 V^0}{\partial a^2} \cdot \sigma^2 \cdot (k-e) - \sum_i \frac{\partial^2 V^0}{\partial a \partial x_i} \cdot \sigma \cdot \psi_i - \frac{\partial V^1}{\partial a} \cdot \alpha \cdot \phi \cdot (\lambda - v) + \frac{\partial V^0}{\partial a} \cdot \rho \cdot v - \eta_1 + \eta_2 \quad \text{(A8)}$$

$$0 = \frac{\partial V^0}{\partial a} \cdot \pi^* + \frac{\partial^2 V^0}{\partial a^2} \cdot \sigma^{*2} \cdot e^* + \sum_i \frac{\partial^2 V^0}{\partial a \partial x_i} \cdot \sigma \cdot \psi_i^* - \frac{\partial V^1}{\partial a} \cdot \alpha \cdot \phi \cdot v^* - \frac{\partial V^0}{\partial a} \cdot \rho \cdot v^* + \eta_3 \quad \text{(A9)}$$

where $\frac{\partial V^0}{\partial a} \cdot \rho$ is the multiplier of the constraint $a=k-v \cdot e+v^* \cdot e^*+l$; and η_1 η_2 and η_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: $\eta_1 \cdot (k-e)=0$, $\eta_2 \cdot e=0$ and $\eta_3 \cdot e^*=0$. It is straightforward to verify that $V^0 = \frac{1}{\delta} \cdot \ln a + f^0(x_i)$ and $V^1 = \frac{1}{\delta} \cdot \ln a + f^1(x_i)$ solve the Bellman equations (A2) and (A4). Using these value functions and the first-order conditions, it follows that (A5)-(A9) correspond to Equations (5)-(9) in the text.

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Table 1: Sample of Countries

I. Industrialized Countries

Australia	AUS
Austria	AUT
Belgium-Luxembourg	BLX
Canada	CAN
Switzerland	CHE
Germany	DEU
Denmark	DNK
Spain	ESP
Finland	FIN
France	FRA
United Kingdom	GBR
Greece	GRC
Ireland	IRL
Italy	ITA
Japan	JPN
Netherlands	NLD
Norway	NOR
New Zealand	NZL
Portugal	PRT
Sweden	SWE
United States	USA

II. Developing Countries

a. East Asia and the Pacific

China	CHN
Indonesia	IDN
Korea, Rep.	KOR
Malaysia	MYS
Philippines	PHL
Singapore	SGP
Thailand	THA

b. Latin American and the Caribbean

Argentina	ARG
Bolivia	BOL
Brazil	BRA
Chile	CHL
Colombia	COL
Costa Rica	CRI
Dominican Republic	DOM
Ecuador	ECU
Guatemala	GTM
Honduras	HND
Jamaica	JAM
Mexico	MEX
Nicaragua	NIC
Peru	PER
El Salvador	SLV
Trinidad and Tobago	TTO
Uruguay	URY
Venezuela	VEN

c. Middle East and North Africa

Algeria	DZA
Egypt, Arab Rep.	EGY
Iran, Islamic Rep.	IRN
Israel	ISR
Jordan	JOR
Morocco	MAR
Oman	OMN
Saudi Arabia	SAU
Syrian Arab Republic	SYR
Tunisia	TUN
Turkey	TUR

d. South Asia

Bangladesh	BGD
India	IND
Sri Lanka	LKA
Pakistan	PAK

e. Sub-Saharan Africa

Côte d'Ivoire	CIV
Cameroon	CMR
Congo	COG
Lesotho	LSO
Mauritius	MUS
Senegal	SEN
South Africa	ZAF

Table 2: Net Foreign Assets Are Small

(Share of net foreign assets in country portfolios, f/a)

	66-73	74-81	82-89	90-97	66-97
Weighted Average					
Industrial Countries	0.013	0.007	0.000	-0.006	0.004
Developing Countries	-0.099	-0.037	-0.081	-0.065	-0.068
EAP	-0.090	-0.036	-0.051	-0.036	-0.037
LAC	-0.095	-0.102	-0.150	-0.101	-0.112
MENA	-0.169	0.133	-0.034	-0.121	-0.068
SA	-0.054	-0.043	-0.054	-0.063	-0.054
SSA	-0.195	-0.138	-0.118	-0.069	-0.137
Median					
Industrial Countries	-0.011	-0.028	-0.025	-0.037	-0.016
Developing Countries	-0.120	-0.116	-0.167	-0.139	-0.137
EAP	-0.098	-0.113	-0.117	-0.080	-0.093
LAC	-0.116	-0.122	-0.215	-0.150	-0.153
MENA	-0.108	-0.072	-0.164	-0.165	-0.171
SA	-0.086	-0.102	-0.115	-0.095	-0.085
SSA	-0.202	-0.185	-0.112	-0.035	-0.206

Notes: Weighted averages are computed over an unbalanced panel 8-year averages for 68 countries. As a result, changes across periods to a small extent reflect changes in the composition of the sample. Results using a smaller balanced panel are similar.

Table 3: Net Foreign Assets Increase with Wealth

	66-97		66-73		74-81		82-89		90-97	
	Coef	Std. Err.	Coef	Std. Err.	Coef	Std. Err.	Coef	Std. Err.	Coef	Std. Err.
No Controls, Coefficient on ln(Wealth Per Capita)										
Constant Only	0.058	0.013	0.037	0.010	0.061	0.018	0.080	0.021	0.062	0.015
Regional Dummies	0.058	0.021	0.013	0.019	0.075	0.035	0.105	0.036	0.074	0.026
Regional Dummies, Balanced Panel	0.038	0.017	0.015	0.020	0.032	0.017	0.070	0.033	0.066	0.020
# Observations	66		56		65		65		56	
# Observations, Balanced	46		46		46		46		46	
With Controls and Regional Dummies										
Intercept	-1.165	0.251	-0.357	0.516	-1.343	0.406	-1.700	0.310	-1.419	0.306
ln(Wealth Per Capita)	0.069	0.017	0.016	0.027	0.060	0.027	0.126	0.034	0.116	0.022
Years Secondary Schooling	-0.048	0.030	0.060	0.044	0.001	0.023	-0.066	0.031	-0.045	0.022
(Exports + Imports)/GDP	0.027	0.037	0.028	0.168	0.098	0.090	-0.018	0.049	0.038	0.036
M2/GDP	0.336	0.155	0.025	0.166	0.175	0.100	0.280	0.152	0.155	0.100
Gov't Consumption/GDP	-0.331	0.203	0.080	0.355	-0.046	0.285	-0.584	0.324	-0.873	0.268
Civil Liberties	-0.009	0.014	-0.029	0.021	-0.011	0.011	-0.013	0.016	-0.015	0.016
ln(Population)	0.026	0.010	0.016	0.020	0.038	0.013	0.031	0.014	0.026	0.014
Std.Dev. Growth	0.690	0.731	0.541	1.430	0.294	0.948	0.668	0.830	-1.164	1.034
# Observations	63		53		62		62		51	
R-Squared	0.586		0.357		0.43		0.551		0.718	
Share of Variance in Fitted Values Explained by ln(Wealth Per Capita)	0.589		0.136		0.612		0.761		0.888	

Table 4: Foreign Assets Consist Primarily of Borrowing and Lending

	66-73	74-81	82-89	90-97	66-97
Weighted Average					
Industrial Countries					
Net Foreign Assets	0.013	0.007	0.000	-0.006	0.004
Equity Owned by Foreigners	0.025	0.024	0.029	0.042	0.033
Equity Held Abroad	0.028	0.029	0.032	0.053	0.039
Gross Lending	0.041	0.061	0.124	0.158	0.112
Gross Borrowing	0.031	0.059	0.127	0.175	0.114
Developing Countries					
Net Foreign Assets	-0.099	-0.037	-0.081	-0.065	-0.068
Equity Owned by Foreigners	0.039	0.022	0.023	0.029	0.028
Equity Held Abroad	0.004	0.002	0.002	0.005	0.003
Gross Lending	0.024	0.060	0.048	0.041	0.045
Gross Borrowing	0.088	0.077	0.108	0.082	0.088
Median					
Industrial Countries					
Net Foreign Assets	-0.011	-0.028	-0.025	-0.037	-0.016
Equity Owned by Foreigners	0.021	0.021	0.030	0.061	0.035
Equity Held Abroad	0.007	0.007	0.023	0.053	0.028
Gross Lending	0.046	0.050	0.119	0.140	0.105
Gross Borrowing	0.044	0.083	0.161	0.199	0.145
Developing Countries					
Net Foreign Assets	-0.120	-0.116	-0.167	-0.139	-0.137
Equity Owned by Foreigners	0.039	0.027	0.031	0.033	0.035
Equity Held Abroad	0.000	0.000	0.000	0.001	0.001
Gross Lending	0.028	0.043	0.045	0.056	0.051
Gross Borrowing	0.105	0.128	0.174	0.155	0.160

Notes: Weighted averages are computed over an unbalanced panel of 8-year averages for 68 countries. As a result, changes across periods to a small extent reflect changes in the composition of the sample. Results using a smaller balanced panel are similar.

Table 5: Examples 2 and 3

Foreign Assets / Wealth in the North

Sigma=0.00

	Alpha					
Gamma	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**
0.00	0.375	0.000	0.000	0.000	0.000	0.000
0.10	0.375	0.098	0.054	0.037	0.028	0.023
0.20	0.375	0.161	0.099	0.071	0.055	0.045
0.40	0.375	0.229	0.163	0.126	0.102	0.086
0.60	0.375	0.264	0.203	0.165	0.138	0.119

Sigma=0.05

	Alpha					
Gamma	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**
0.00	0.375	0.030	0.015	0.010	0.008	0.006
0.10	0.375	0.119	0.067	0.046	0.035	0.028
0.20	0.375	0.175	0.110	0.079	0.062	0.050
0.40	0.375	0.236	0.170	0.132	0.107	0.090
0.60	0.375	0.268	0.208	0.169	0.142	0.122

In this calculation, we set the average return to capital constant at 4 percent, that is, we set $\theta=0.04\cdot(k^{1-\gamma}+k^{*1-\gamma})^{-1}$. We also set world wealth equal to one, that is, $a+a^*=1$.

Table 6: Example 3

Discount on South Equity (v*)

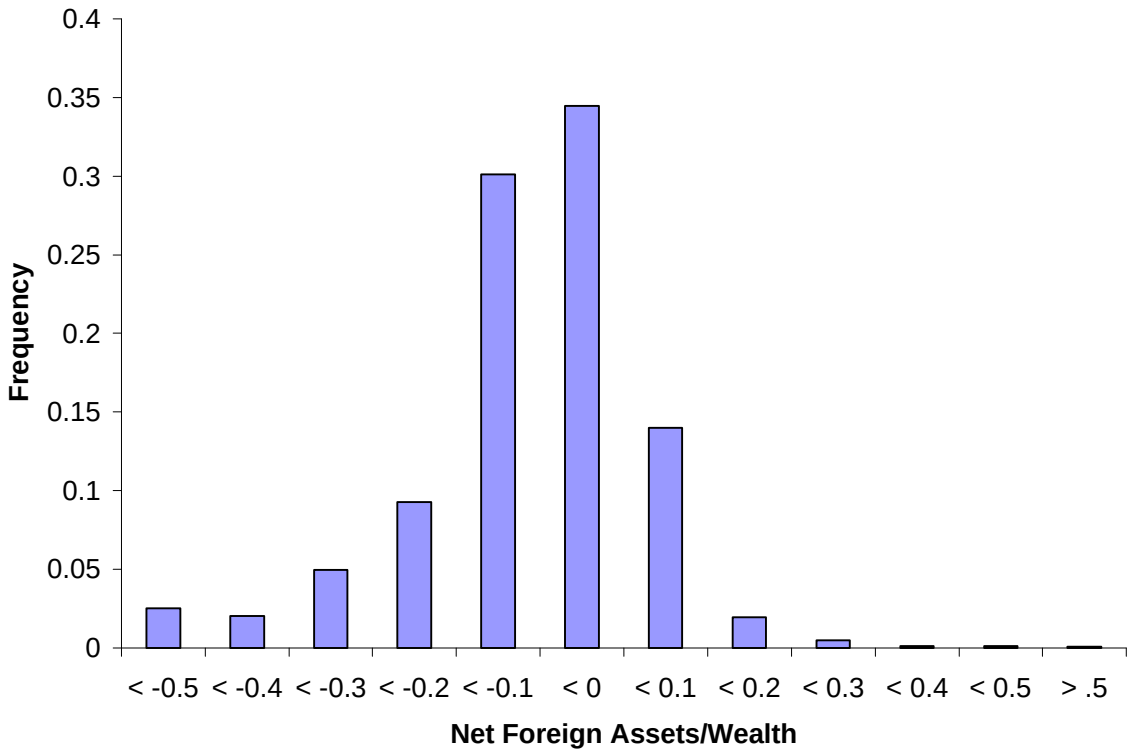
Gamma \ Alpha	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**
0.00	1.000	0.815	0.677	0.578	0.504	0.447
0.10	1.000	0.860	0.730	0.630	0.553	0.492
0.20	1.000	0.879	0.763	0.667	0.591	0.529
0.40	1.000	0.894	0.797	0.713	0.643	0.585
0.60	1.000	0.901	0.814	0.739	0.675	0.621

Foreign Investment in South (e*v*/a*)

Gamma \ Alpha	**0.00**	**0.01**	**0.02**	**0.03**	**0.04**	**0.05**
0.00	1.500	0.728	0.570	0.476	0.409	0.359
0.10	1.500	1.014	0.737	0.592	0.498	0.431
0.20	1.500	1.193	0.875	0.698	0.583	0.502
0.40	1.500	1.389	1.067	0.867	0.729	0.629
0.60	1.500	1.492	1.189	0.987	0.842	0.734

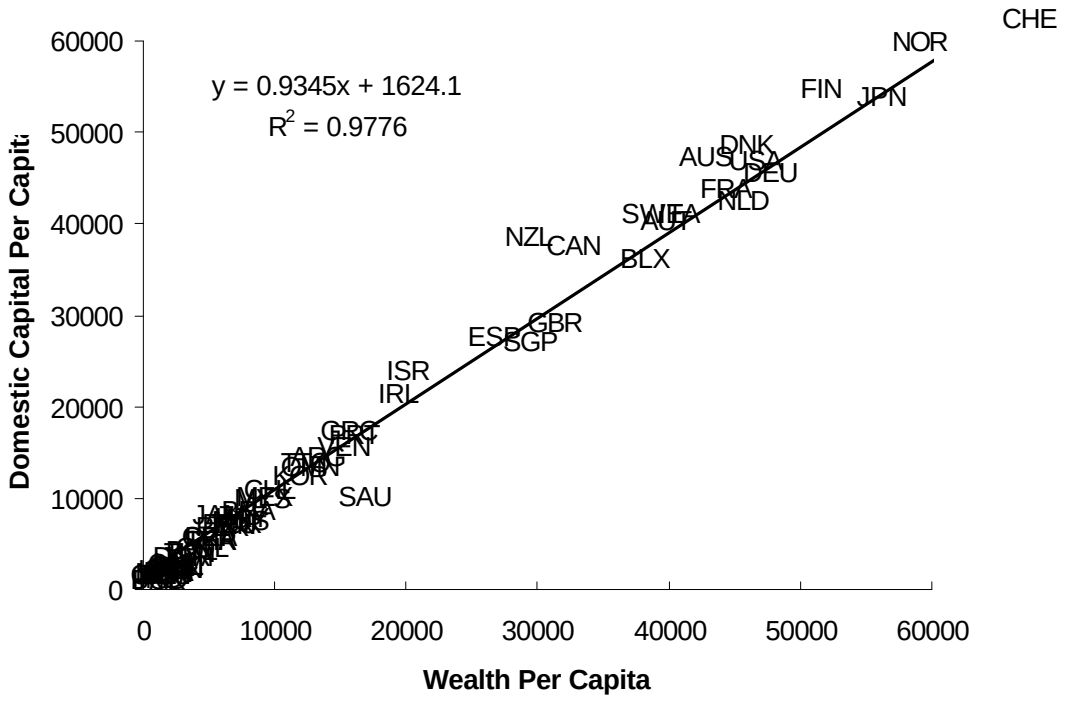
In this calculation, we set the average return to capital constant at 4 percent, that is, we set $\theta=0.04\cdot(k^{1-\gamma}+k^{*1-\gamma})^{-1}$. We also set world wealth equal to one, that is, $a+a^*=1$.

Figure 1: Net Foreign Assets Are Small



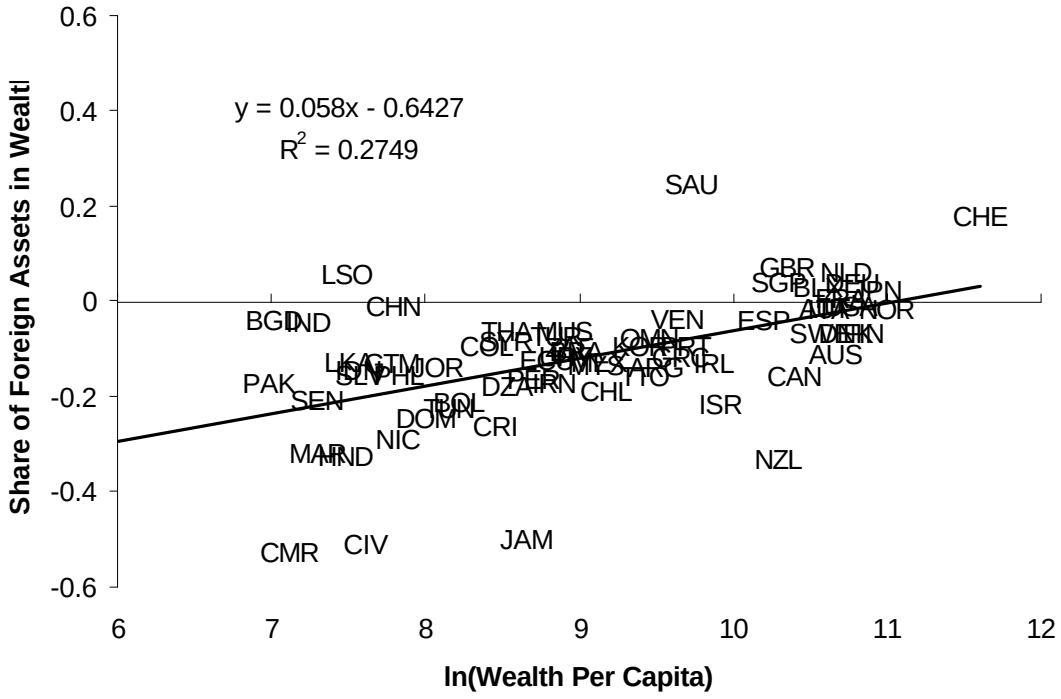
Notes: This figure plots the frequency distribution of the share of net foreign assets in wealth, pooling all country-year observations in an unbalanced panel spanning 68 countries over the period 1966-1997.

Figure 2: Domestic Capital Stocks and Wealth Are Highly Correlated



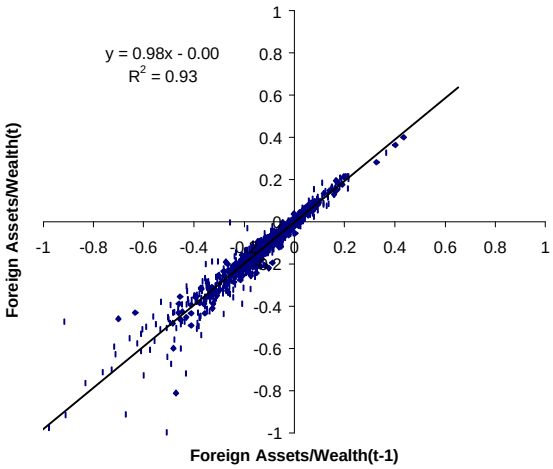
Notes: Switzerland (a=$110000, k = $90000) is not shown to scale.

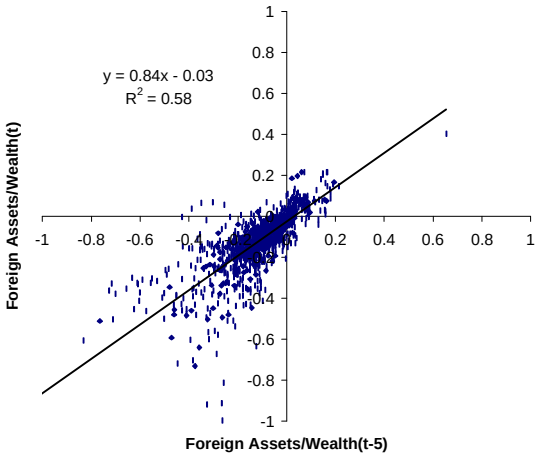
Figure 3: The Share of Net Foreign Assets In Country Portfolios Increases with Wealth

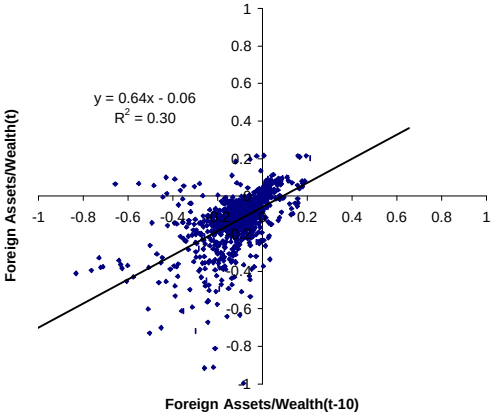


Notes: Congo (ln(a)=7.22,f/a -1.55) and Egypt (ln(a)=7.2, f/a-0.98) are influential and are excluded. Including these two observations gives a slope of 0.09 with a standard error of 0.01.

Figure 4: The Share of Net Foreign Assets In Country Portfolios Is Persistent

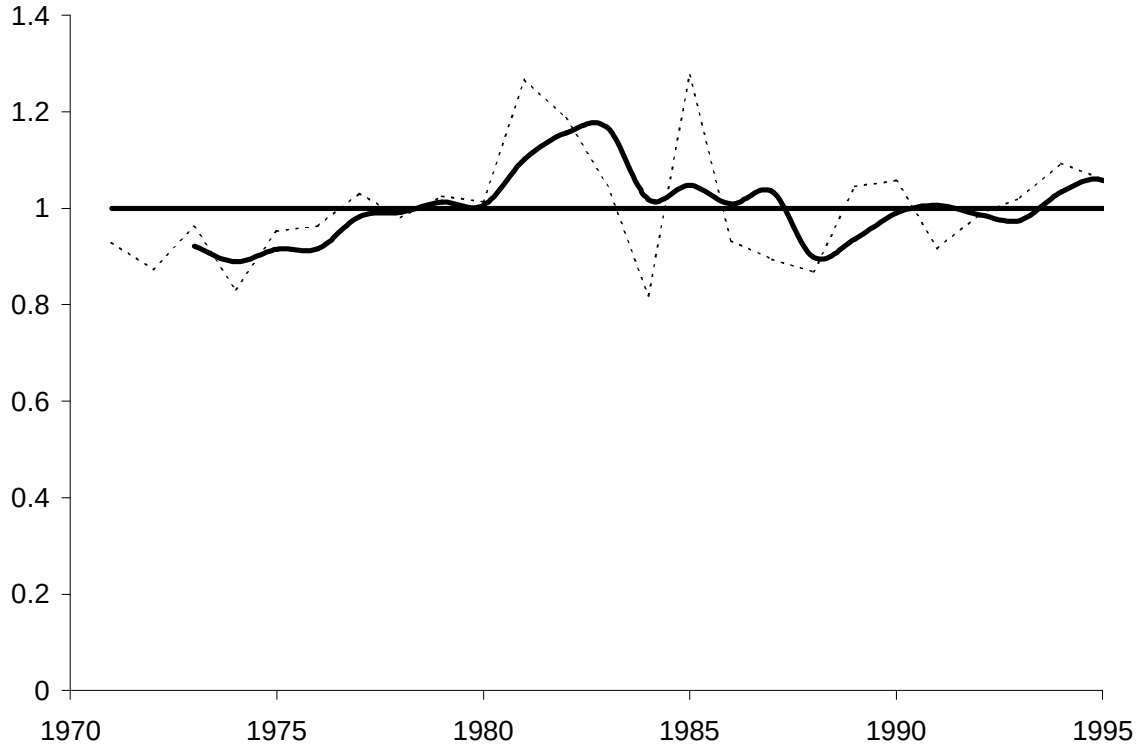






Notes: This graph plots the share of foreign assets in wealth against its one-year (five-year) (10-year) lag in the first (second) (third) panels, pooling all country-year observations in an unbalanced panel spanning 68 countries over 1966-97.

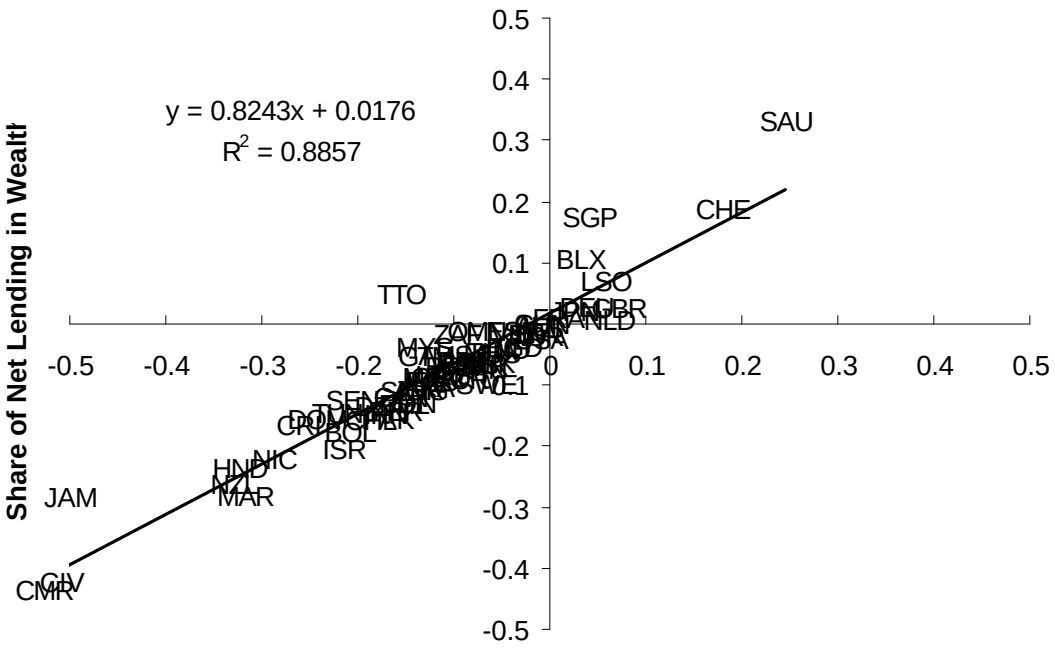
Figure 5: The Persistence of the Net Foreign Asset Share Changes Over Time



Notes: This graph plots the slope coefficient of a cross-sectional regression of the share of foreign assets in wealth on itself lagged one year, for the year indicated on the horizontal axis. The heavy line is a three-year centered moving average of these slope coefficients.

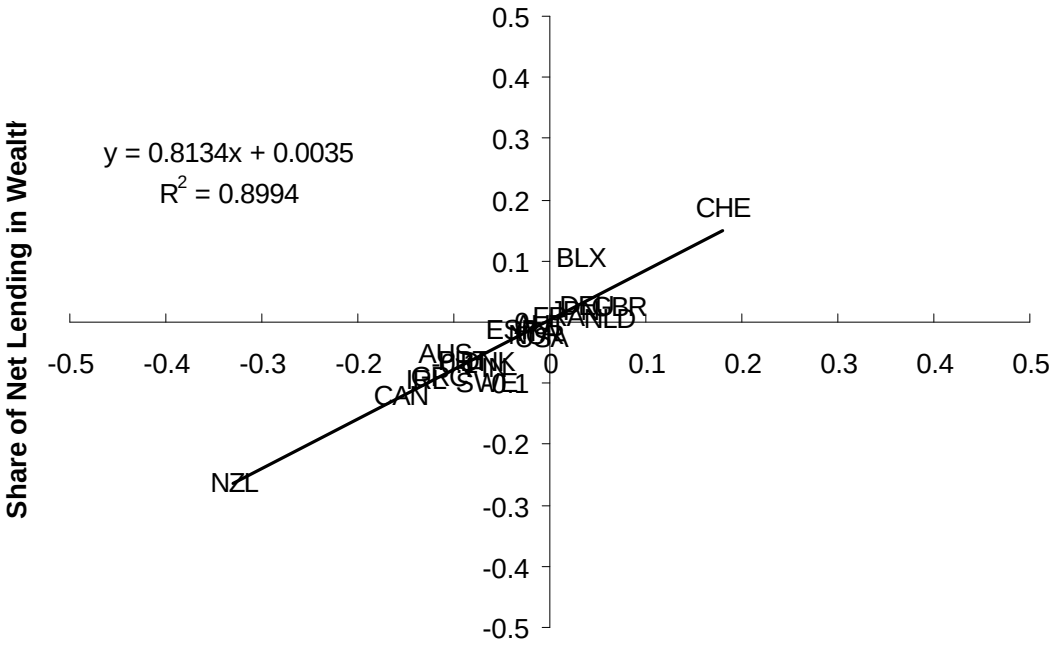
Figure 6: Foreign Assets Consist Primarily of Borrowing and Lending

(All Countries)



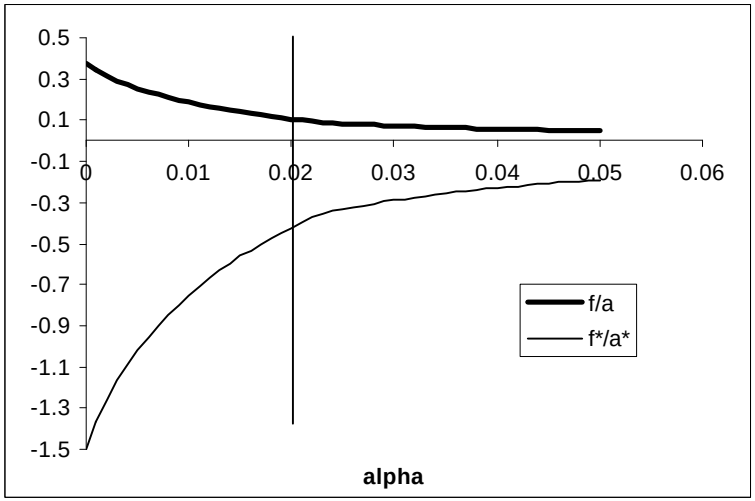
Share of Foreign Assets in Wealth

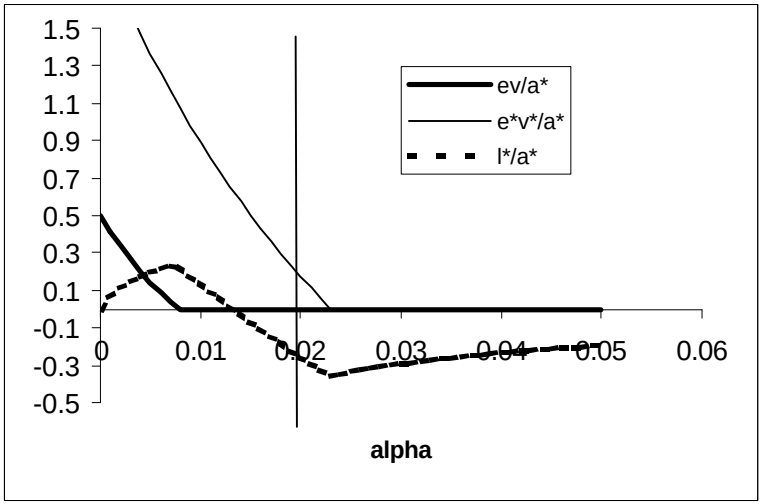
(Industrial Countries)

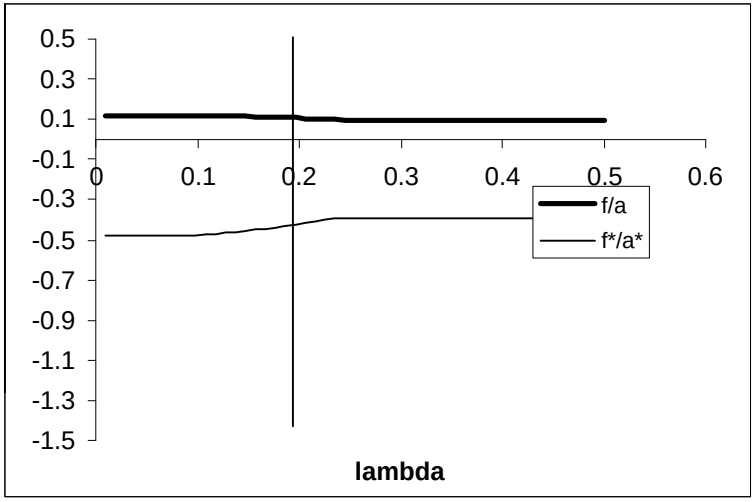


Share of Foreign Assets in Wealth

Figure 7: Sensitivity of Model Predictions to Assumptions About Sovereign Risk







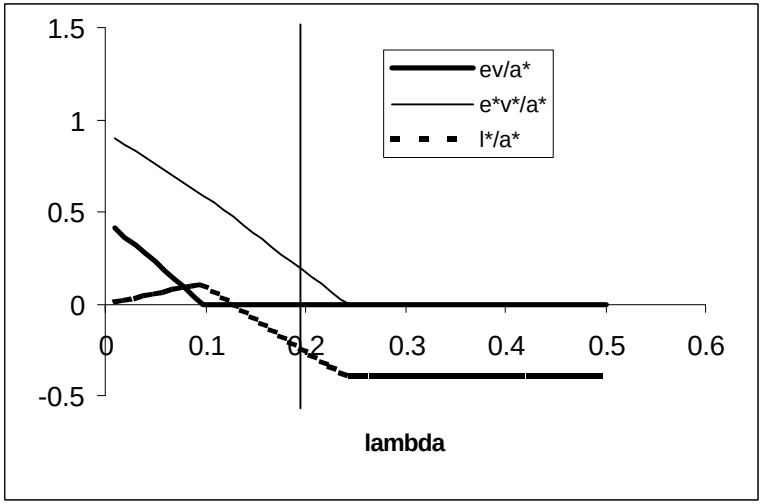
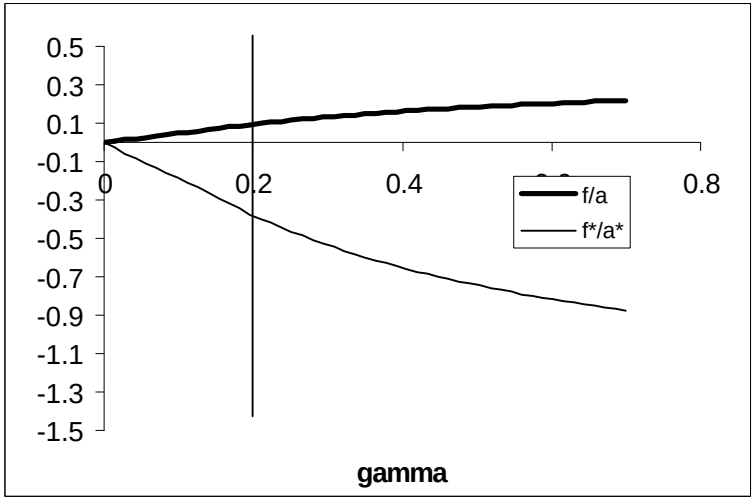
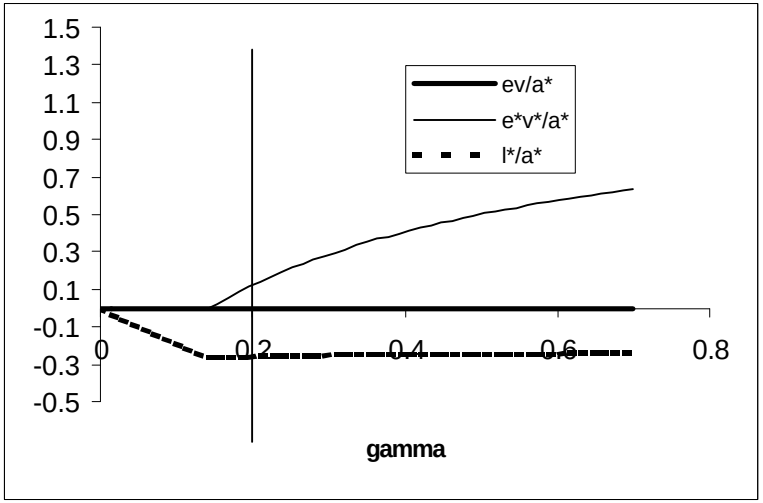
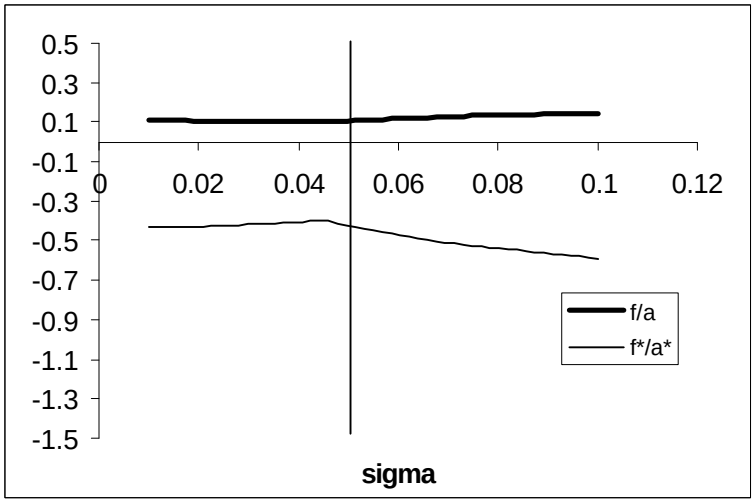


Figure 8: Sensitivity of Model Predictions to Assumptions About Production Technologies







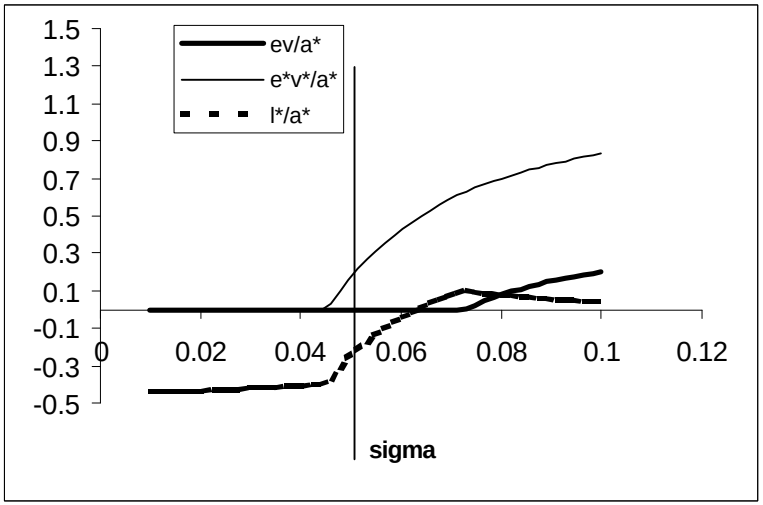
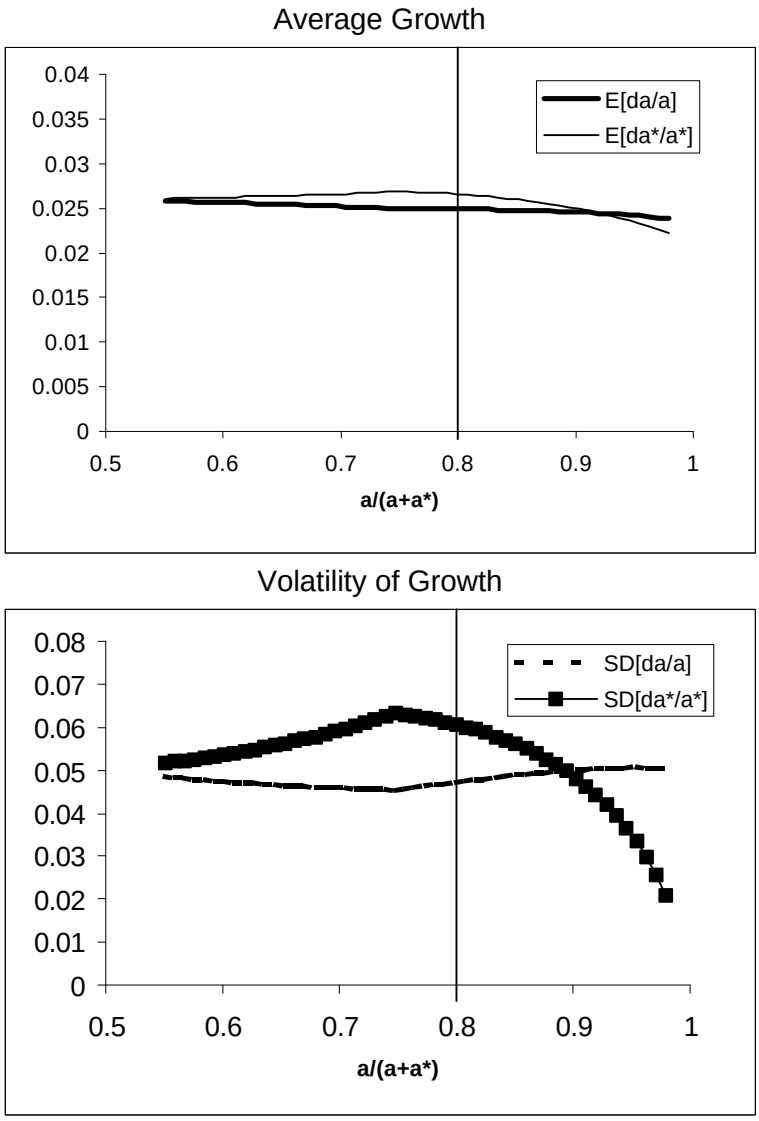


Figure 9: Implications of Theory for Persistence of Foreign Asset Positions



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