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Country Portfolios with Imperfect Corporate Governance*

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This Draft: August 31, 2010 ‡

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Equity home bias is one of the most enduring puzzles in international finance. In this paper, I start out by documenting a novel stylized fact about home bias: countries with *weaker* domestic institutions hold *fewer* foreign assets. I then explore a macroeconomic mechanism by which the presence of agency problems in firms may explain this pattern. To do so, I develop a two-country dynamic stochastic general equilibrium model of international portfolio choice with corporate governance frictions and two distinct agents – outside investors (outsiders) and large controlling shareholders (insiders). Insiders can extract private benefits of control from a firm at a cost which is lower when institutions are weaker. I show that the interaction between the insider's private benefits and investment decisions leads asset and labor income for outsiders to be more negatively correlated in countries with weaker institutions. Thus, outsiders in these countries bias their portfolios more towards home assets to hedge their labor income risk. Calibrating the model to match existing estimates of private benefits of control, I am also able to replicate the cross-country dispersion in insider ownership and investment volatility seen in the data.

Keywords: home bias, institutional quality, corporate governance
JEL Codes: F21, F41, G15

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1 Introduction

Equity home bias is one of the most enduring puzzles in international finance. This paper uncovers a novel stylized fact about home bias: countries with lower institutional quality ("the South") also hold fewer foreign assets.[1] This appears counter-intuitive. Why would countries with *worse* domestic institutions be *more* home-biased in their equity holdings, while having apparently better alternatives in countries with better institutions ("the North")? The central contribution of this paper is to show that this striking pattern might actually be an equilibrium outcome of agency problems in the South.

To better understand the crucial role of agency problems, I start with the observation that the shares of a firm are typically held by two different kinds of agents, outsiders and insiders. An outsider is an investor who owns stock in a firm but has no direct control over its operations. A large part of her income comes from supplying labor. In short, she fits the description of the classical atomistic agent in a business cycle model. By contrast, an insider is a large shareholder who has control over the investment, dividend, and employment policies of a firm by virtue of her sizeable equity stake. Weaker institutions lower the ability of outsiders to hold insiders accountable for their decisions through the usual mechanisms of corporate governance. I label this "imperfect corporate governance."

With this structure in mind, I develop a two-country dynamic stochastic general equilibrium model of international portfolio choice with two distinct agents in each country – an outsider and an insider. I incorporate the conflict of interest that arises between these two parties when the latter has full control of the firm, yet owns only a part of it. Weaker institutions, by opening up opportunities for self-interested behavior by insiders, affect the payoffs of claims to the firm's dividends. This influences the portfolio choice of both outsiders and insiders, yielding two main results. First, I find that for a given size of the float portfolio,[2] domestic *outsiders* will exhibit greater home bias in asset holdings in countries with weaker institutions. Second, in addition to this, worse institutions will make the domestic *float portfolio* itself smaller. The aggregate home bias in each country will then be the sum of these two elements.

The first result, that Southern outsiders are more home biased for a given float portfolio, follows from the impact of imperfect corporate governance on the ability of domestic assets to hedge labor income risk. The hedging properties of domestic assets have been examined as a possible explanation of home bias by Cole and Obstfeld (1991), Baxter and Jermann (1997), van Wincoop and Warnock (2006), Coeurdacier and Gourinchas (2008), Heathcote and Perri (2009), and Coeurdacier et al. (2009), among others. Building especially on the last two, I show that imperfect corporate governance makes domestic assets a

[1] Institutional quality, measured by the indices from Kaufmann et al. (2008), refers to aspects of the economic environment such as the standard of general governance, the strength of contract enforcement, or the efficiency of the judicial system.

[2] The float portfolio is a term used to describe the fraction of the Southern market portfolio actually traded in world equity markets, that is, the part not held by insiders.

better hedge against labor income risk in countries with worse institutions. The mechanism, working primarily through the dynamics of investment, plays itself out as follows.

Consider the case of the South while holding the level of insider ownership constant. Insiders here can extract rents from firms as private benefits of control. Since more rents can be extracted from larger firms, they become "empire-builders."[3] Empire-building affects the dynamics of investment in the following way. With a persistent productivity process, insiders anticipate a favorable shock to last for several periods. Hence, they find it privately optimal to reduce dividends below the first-best level to finance socially suboptimal capital investments in expectation of higher future private benefits. At the same time, a good productivity shock tends to increase labor income in the South, relative to the North, for two reasons. First, there is equilibrium over-employment in the Southern representative firm, resulting from higher investment. Second, the sharper increase in demand for domestic investment buffers the decline in South's terms of trade that follows a favorable supply shock. This contributes to an increase in the relative value of Southern labor income. Thus, imperfect corporate governance amplifies the negative correlation between dividends on the domestic asset and labor earnings in the South. Consequently, home bias for domestic *outside investors* is greater in the South, due to their increased demand for domestic shares for the purpose of hedging their labor income risk. In general equilibrium, this also leads to lower Northern ownership of the Southern float portfolio.

The second result, that the South also has greater *insider* ownership of firms, and hence, a smaller float portfolio, works through a channel that has been studied by Admati et al. (1994) and DeMarzo and Urošević (2006).[4] As noted earlier, weaker institutions in the South let domestic insiders extract private benefits of control. Lower insider equity, by reducing the insider's ownership of cash-flow rights of the firm, increases extraction. Thus, risk-averse Southern insiders, wishing to diversify country-specific risk by buying foreign assets, can only sell their stake at a discount; outside investors, anticipating greater extraction, are only willing to trade shares with the insider at lower prices.[5] This acts as an endogenous "transaction tax" on the insider's portfolio adjustments. The insider's trade-off, between the potential benefits of diversification and the penalty of the transaction tax, determines the size of the float portfolio of a country. Since the effect of the transaction tax dominates in the Southern equilibrium, it ends up with more insider ownership. This outcome can be thought of as home bias on the part of insiders.

While insider ownership and the agency problems associated with private

[3]This is a version of the free-cash flow problem first pointed out by Jensen (1986). Private benefits of control could vary from outright pilferage of firm assets, to more subtle forms like product discounts to subsidiaries and share sales at low prices to related parties. See Nenova (2003), Dyck and Zingales (2006), and Albuquerque and Schroth (2009) for empirical estimates of private benefits.

[4]These papers study the asset pricing problem of a large shareholder in a partial equilibrium environment.

[5]The price corresponds to the lower post-trade level of insider ownership.

benefits of control have long been central to the finance literature (see La-Porta et al. (1998b, 1999, 2000a,b, 2002), Shleifer and Wolfenzon (2002), Nenova (2003), and Dyck and Zingales (2006)), these have not yet been incorporated into international macroeconomics.[6] To the best of my knowledge, this paper presents the first international real business cycle model with labor income and endogenous asset returns that characterizes outsider holdings and insider ownership in the presence of agency issues.

I show how poor institutions may amplify the effects of a well-known candidate explanation of home bias, non-diversifiable labor income risk. For this, I draw on insights from two lines of research. The first is the literature concerning the implications of agency problems on asset-pricing (Dow et al. (2005), Albuquerque and Wang (2006, 2008)) and macroeconomic aggregates (Danthine and Donaldson (2005), Philippon (2006)). My results address international portfolio allocation in the backdrop of this literature. The second is the recent work of Heathcote and Perri (2009) and Coeurdacier et al. (2009) that has focussed on the interaction of trade openness and labor income risk to explain the home bias puzzle. In contrast, I emphasize a different channel, institutional quality, through which labor income risk determines home bias.[7] Thus, this paper brings together two areas in international macroeconomics and finance that have, surprisingly, remained separate until now.

In this context, one of the most important results of this paper is that imperfect corporate governance helps in resolving the asset home bias puzzle not only by limiting the size of the world float portfolio, but also by affecting its ownership pattern. Contrary to intuition, I find that domestic outside investors in countries with weaker institutions will hold more of their own country's float portfolio *because* it has weaker institutions. This paints a nuanced picture of the connection between insider ownership and home bias, a connection first described in Dahlquist et al. (2003) and Kho et al. (2006).

Building on the empirical research program of Faria et al. (2007) and Faria and Mauro (2009), this paper uncovers a new stylized fact about international asset holdings. It also contributes to the growing literature on the effects of institutions on economic outcomes such as financial development (LaPorta et al. (1997), LaPorta et al. (1998a)) by focusing on institutional heterogeneity in an international asset pricing framework. My work is also related to the extensive literature on financial integration and risk sharing in the presence of financial frictions, exemplified by the work of Kehoe and Perri (2002), Bekaert and Harvey (2003), Levchenko (2005), Kraay et al. (2005), Kalemli-Ozcan et al. (2008), Broner and Ventura (2008, 2009), Bai and Zhang (2008), Broner et al. (2008), and Kose et al. (2009), among others. The papers most closely related to my

[6] Albuquerque and Wang (2006) is a notable exception.

[7] Levy and Sarnat (1970), Tesar and Werner (1995), Lewis (1999), Warnock (2002), Lane and Milesi-Ferretti (2007), and Sørensen et al. (2007) have documented the asset home bias puzzle over the years. Some theoretical explanations of equity home bias in the finance and international macroeconomics literature are Cole and Obstfeld (1991), Uppal (1993), Stockman and Tesar (1995), Brennan and Cao (1997), Baxter and Jermann (1997), Baxter et al. (1998), Engel and Matsumoto (2006), Coeurdacier (2008), Heathcote and Perri (2009), and Nieuwerburgh and Veldkamp (2009).

work are Heathcote and Perri (2009), Albuquerque and Wang (2006, 2008), and Coeurdacier et al. (2009). I discuss the connections between my results and theirs in more detail in a later section.

The rest of the paper is organized as follows. Section 2 establishes a new empirical regularity about the cross section of country portfolios and reviews some that are well-known. Section 3 lays out a dynamic model of portfolio choice by outsider investors with exogenous insider ownership. Section 4 presents the main results of the paper and provides intuition for them. Section 5 discusses an extension with endogenous insider ownership. Section 6 concludes.

2 Stylized facts

This section makes two points. The first is that countries with weaker local institutions hold fewer foreign assets relative to their size. They also issue fewer foreign liabilities relative to their size, a fact that has been noted by Faria and Mauro (2009). The second is that, countries with weaker institutions have more insider ownership of their firms, first pointed out by LaPorta et al. (1999).

2.1 Data description

I look at the years 1996-2004 because that is the period of overlap of my two main sources of data: external wealth measures for the years 1970-2004 from Lane and Milesi-Ferretti (2007), and institutional quality indices for the years 1996-2007 from Kaufmann et al. (2008). The data sources are summarized in the appendix (7.1.1). Since the theoretical mechanism in the model is likely to be important only for those countries that make significant use of external financing for firms, I use the sample of LaPorta et al. (1999) with a few modifications.[8] The resultant group of 43 countries (21 developed markets, 22 emerging markets by the FTSE classification) retains significant heterogeneity in institutional quality.

I focus on portfolio and foreign direct investment as these financial claims have explicit equity attached to them, unlike debt. I construct two measures of diversification using the gross equity (portfolio and foreign direct investment) assets and liabilities held by a country's nationals, deflated by the size of a country's economy measured by its gross domestic product. I take the simple average of these measures over the year 1996-2004 to get the cross-section of holdings. My measure of the quality of institutions is the simple average of the six indices in Kaufmann et al. (2008) that quantify general governance, the degree of corruption, the rule of law, political stability, effectiveness of regulations, and the strength of media and public opinion. The index so constructed ranges

[8] Specifically, I include countries that had at least 5 domestic non-financial publicly traded firms with no government ownership in 1993. I exclude Luxembourg, Ireland and Switzerland from the analysis because their gross external positions are unusually large in relation to their GDP due to their status as financial centers. The countries are listed in the appendix.

from -1.21 to 1.78 in my sample, with higher scores assigned to countries with better institutional quality.[9]

2.2 Two stylized facts

Stylized fact 1 *Better institutional quality in a country is associated with greater foreign assets and liabilities for that country.*

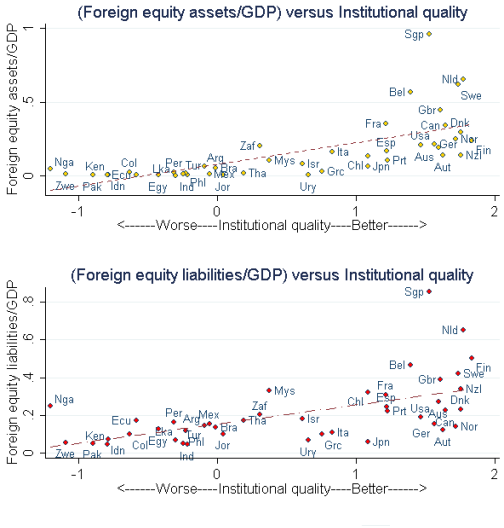

Figure 1: **Better institutions associated with more foreign equity assets and liabilities.** Each point represents the time average (1996-2004) for each country. Institutional quality measured by the Kaufmann et al. (2008) indices on the x-axis. The ratio of foreign equity assets (liabilities) to GDP in panel 1 (2) on the y-axis. Data source: Lane and Milesi-Ferretti (2007) and Kaufmann et al. (2008).

Figure 1 draws a scatter plot with institutional quality on the horizontal axis and two measures of international diversification on the vertical axis. The measures of international diversification are the ratios of foreign assets (and liabilities) to gross domestic product. The world distribution of assets and liabilities suggest that countries with better domestic institutions are also better

[9]These are meant to capture the quality of local economic institutions, rather then specific investor protection laws. Laws are effective only when enforced, and enforcement is dependent mainly institutional quality. For example, common law countries typically have better investor protection codified in their laws; yet the list of common law countries includes Zimbabwe, where such laws can hardly be expected to be useful. On the other hand, the list of civil law, where investor protection laws are generally weaker, includes Germany, where the existent laws would possibly be better implemented than in a lot of common law nations.

diversified using greater cross-holdings.[10]

Stylized fact 2 *Better institutional quality in a country is associated with lower insider ownership in that country.*

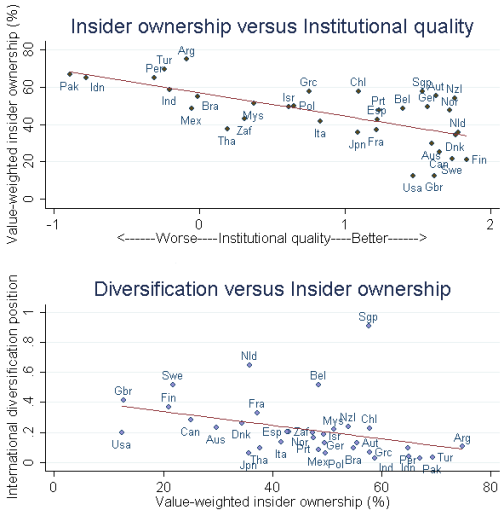

Figure 2: **Better institutions associated with lower insider ownership; lower insider ownership associated with greater diversification.** Each point represents the time average (1996-2004) for each country. Institutional quality measured by the Kaufmann et al. (2008) indices on the x-axis of panel 1. The value-weighted average percentage insider ownership in a country's firms on y-axis in panel 1 and x-axis of panel 2. The ratio of foreign equity assets and liabilities to GDP on y-axis in panel 2. Data source: Kho et al. (2006), Lane and Milesi-Ferretti (2007) and Kaufmann et al. (2008).

The first panel of figure 2 plots the percentage of market capitalization of a

[10]In OLS regressions reported in appendix A (7.1.4), institutions remain significant after controlling for factors that have been shown in the empirical literature to be important determinants of international diversification (Dahlquist et al. (2003), Kho et al. (2006), Faria et al. (2007), Coeurdacier (2008)), such as country size (GDP), the level of general development (per capita GDP), openness to trade (share of total trade in GDP), the level of financial development (domestic credit to GDP ratio), financial openness (Chinn and Ito (2008) index), and insider ownership (fraction of market capitalization closely held). The adjusted R-squares of the fitted lines are about 70%. The regressions for equity liabilities for my sample yield similar results to those reported by Faria et al. (2007) and Faria and Mauro (2009). Year-by-year regressions for the cross section (not reported here) show that the coefficient on the institutional index has grown larger over the sample period. I do not pursue a time-series analysis of how *changes* in diversification may have been affected by changes in institutional quality. This is because the time-variation in the institutional quality index for each country is much smaller than the variation across countries. The cross-sectional variance of institutional quality ranges from roughly 4 to 100 times the variance for individual countries.

country closely held, versus institutional quality, using a subset of 34 countries for which insider ownership data has been compiled by Kho et al. (2006). This shows countries having better institutional quality also exhibiting lower insider ownership. The second panel of figure 2 plots the ratio of foreign equity assets *plus* liabilities to GDP on the vertical axis versus insider ownership. It makes a point about insider ownership and international risk sharing – the greater the fraction of financial claims on a nation available to be held by outsiders, the more internationally diversified a nation is. That is, freeing up a greater fraction of the float portfolio for outside investors leads to greater foreign cross holdings. Not all the freed domestic liabilities are held by domestic residents. Nor is all the freed wealth re-invested locally, as some of it finds its way abroad as an accumulation of foreign assets.

These facts raise several questions about portfolio allocation when insiders and outsiders co-exist. For instance, given a certain amount of insider ownership, what is the composition of ownership of foreign versus domestic investors? What will happen when institutional quality improves in the South? Will the effects be felt mostly through an expansion of the world float portfolio, or also through portfolio adjustments by outsiders? I try to address these questions in a dynamic framework with insiders and outsiders.

3 A model of outsider portfolios with exogenous insider ownership

This section lays out a model of international portfolio choice by outsiders with endogenous labor supply and asset returns. It extends the basic two-country, two-good framework developed by Backus et al. (1995) by embedding in it the free-cash-flow problem of Jensen (1986). The agency problem is incorporated in reduced form for analytical tractability, as in Albuquerque and Wang (2008). In what follows, I describe the economic environment in (3.1), the optimization problems of the agents in (3.2), and the concept of equilibrium in (3.3).

3.1 Setup

3.1.1 Countries, firms and agents

There are two countries in the world – North and South. North and South may differ in the quality of their institutions, with the South having weaker institutions. Institutional quality is modeled in a very specific way that will be described in detail later. In each country, there is one firm which produces an internationally traded intermediate good. There are four agents in the world, two agents in each of the two countries. One of them, labeled the insider, derives utility from consumption, and does not supply labor inputs. Her only source of income are dividends from the shares she owns in her own country's firm, and private benefits of control, a concept that will be clarified later. The other

agent, the outsider, is a worker-investor. She earns wages from working in her own country's firm. She also has dividend income from the shares she holds in the domestic firm and the foreign firm.

3.1.2 The goods market

Each country produces an internationally traded intermediate good using capital (K) and labor (L). $a(s^t)$ is produced only in the North, and $b(s^t)$ only in the South.[11] Except for the total output of the intermediate goods in the North and the South, which are denoted by Y_a and Y_b respectively, all quantities associated with the South are superscripted with a "*". The production functions for the intermediate goods are

$$Y_a(s^t) = Z(s^t)K(s^{t-1})^\theta L(s^t)^{1-\theta} \tag{3.1}$$
$$Y_b(s^t) = Z^*(s^t)K^*(s^{t-1})^\theta L^*(s^t)^{1-\theta} \tag{3.2}$$

The only source of uncertainty is the technology in the intermediate goods sector of each country, described by the stochastic processes $Z(s^t)$ and $Z^*(s^t)$. These evolve according to first-order auto-regressive processes driven by homoscedastic shocks $\epsilon(s^t)$ and $\epsilon^*(s^t)$.

$$\log(Z(s^t)) = \rho_{11}\log(Z(s^{t-1})) + \rho_{12}\log(Z^*(s^{t-1})) + \epsilon(s^t) \tag{3.3}$$
$$\log(Z^*(s^t)) = \rho_{22}\log(Z^*(s^{t-1})) + \rho_{21}\log(Z(s^{t-1})) + \epsilon^*(s^t) \tag{3.4}$$

Both intermediate goods are used in the production of the final consumption-investment good in each country. The two intermediates are combined using a Cobb-Douglas technology that is not subject to uncertainty

$$Y(s^t) = a(s^t)^\omega b(s^t)^{1-\omega} \tag{3.5}$$
$$Y^*(s^t) = a^*(s^t)^{\omega^*} b^*(s^t)^{1-\omega^*} \tag{3.6}$$

This sets the elasticity of substitution between Northern and Southern intermediates to unity. A constant fraction of the value of final output is used in the purchases of each intermediate input. The Cobb-Douglas assumption is relaxed later. ω and ω^* are assumed to be greater than $\frac{1}{2}$ to reflect an exogenous preference for domestic intermediates.

Let the price of the Northern and Southern intermediate be p_a and p_b, and the price index of each country's final consumption good be $p(p_a, p_b)$ and $p^*(p_a, p_b)$ respectively. Define $q_a(s^t) = \frac{p_a}{p(p_a,p_b)}$, $q_a^*(s^t) = \frac{p_a}{p^*(p_a,p_b)}$, $q_b(s^t) = \frac{p_b}{p(p_a,p_b)}$, and $q_b^*(s^t) = \frac{p_b}{p(p_a,p_b)}$ as the intermediates prices in each country in

[11] A reminder of standard notation: at each time t, the economy is in state $s_t \in \mathbb{S}$, where $\mathbb{S}$ is the set of possible states of the world. The sequence of events from the start of time till date t is denoted by the history s^t.

units of the local final good. The real exchange rate between the two countries, which is defined as the price of the Southern final good relative to the Northern final good, can then be written in two ways,

$$e(s^t) = \frac{q_a(s^t)}{q_a^*(s^t)} \tag{3.7}$$

$$e(s^t) = \frac{q_b(s^t)}{q_b^*(s^t)} \tag{3.8}$$

by the law of one price for the traded intermediate goods. Defined this way, a depreciation of the real exchange rate for North is an increase in its algebraic value. The terms of trade for North, similarly, is defined as the price of its imports divided by the price its exports, both denominated in terms of its own consumption good

$$t(s^t) = \frac{q_b(s^t)}{q_a(s^t)} \tag{3.9}$$

so that an improvement in North's terms of trade is a decline in the algebraic value of $t(s^t)$.

3.1.3 Asset markets

There are two assets in fixed supply, equity in the Northern intermediate goods firm, and equity in the Southern intermediate goods firm. The supply of both assets is normalized to unity. Firms are entirely equity financed. Agents do not have access to a full range of Arrow-Debreu contingent claims, and can save and share risks by holding these two assets at most.

Definition 1 *A holder of an equity contract in the Northern (Southern) intermediate goods firm is entitled to dividend $D(s^t)$ $(D^*(s^t))$ at time t after the history of events s^t, paid in units of the final good of the country in which the firm is located.*

Let $\lambda_{ij(s^t)}$ (where $i, j = N, S$) denote the share of country j equity held by outsiders of country i. $\alpha(s^t)$ and $\alpha^*(s^t)$ denote ownership of own-country equity by the insider in the North and the South. Thus, asset market clearing requires

$$\lambda_{NN}(s^t) + \lambda_{SN}(s^t) + \alpha(s^t) = 1 \tag{3.10}$$

$$\lambda_{NS}(s^t) + \lambda_{SS}(s^t) + \alpha^*(s^t) = 1 \tag{3.11}$$

3.1.4 Description of agents: Insiders

This section lays out a bare bones description of the insider's optimization problem. A more complete discussion of how the insider affects the equilibrium comes in a later section (4.1). The insider has sole authority over the decisions of the representative domestic firm. I assume for the moment that the insider owns

a fraction α of the firm's equity, but cannot perform asset trades, so that she has her entire wealth invested in domestic equity. The insider has the following period-wise flow of income and consumption in the North.

$$M(s^t) = \alpha D(s^t) + q_a(s^t) f(s^t) Y_a(s^t) - \Phi(s^t) \tag{3.12}$$

where dividends, $D(s^t)$ are defined by

$$D(s^t) = q_a(s^t)[\{1 - f(s^t)\}\{Y_a(s^t)\} - W(s^t)L(s^t)] - \{K(s^t) - (1-\delta)K(s^{t-1})\} \tag{3.13}$$

$f(s^t)$ is the fraction of output extracted as private benefits of control, and $\Phi(s^t)$ is the deadweight cost to the insider for doing so.[12] The cost of stealing is assumed to take the following functional form

$$\Phi(s^t) = q_a(s^t) \frac{\eta f(s^t)^2 Y_a(s^t)}{2} \tag{3.14}$$

which is quadratic in the fraction stolen and linear in the scale of stealing.[13] It depends on a parameter η, which captures institutional quality. Higher values of η correspond to better institutional quality.[14]The value of η may differ between the North and the South to reflect differences in institutional quality. When η differs between the two countries, it will be lower in the South.

Let us consider the insider's problem in the North. She chooses $\{I(s^t), D(s^t), L(s^t), f(s^t)\}_0^\infty$,[15] which are investments, dividends, labor demand, and fraction of output extracted as private benefits. Her maximization problem, for a *given* level of ownership α, is

$$\max_{\{\mathrm{I(s^t),D(s^t),L(s^t),f(s^t)}\}} \sum_{t=0}^{\infty} \sum_{s^t} Q(s^t)(\alpha D(s^t) + q_a(s^t) f(s^t) Y(s^t) - \Phi(s^t)) \tag{3.15}$$

where $Q(s^t)$ is the stochastic discount factor that the insider uses to price her own flow of income after history s^t. $Q(s^t)$ is assumed to be

$$Q(s^t) \equiv \pi(s^t)\beta^t \frac{U'(M(s^t))}{U'(M(s^0))}$$

[12]Think of Φ as monetary bribes, the costs of running front companies, doctoring accounts or paying court-mandated fines in the event of litigation. I assume that this output is simply burnt and does not enter the consumption stream of any other agent.

[13]Fractional private benefits of control and a quadratic cost-of-stealing function are common modeling devices used in the corporate finance literature. See Shleifer and Wolfenzon (2002) and Kim and Durnev (2005) for empirical implementations, and Albuquerque and Wang (2008) for an example of a recent DSGE model which uses these functional forms to model the free cash flow problem.

[14]In other words, private benefits of control are easier to extract in certain countries due to institutional failures. This is consistent with the empirical evidence in Nenova (2003) and Dyck and Zingales (2006). Conversely, better institutions make it easier for outside investors to extract the free cash flow of a firm in the form of dividends, as in LaPorta et al. (2000b), and Dittmar et al. (2003).

[15]Note that in this section of the paper, the insider does not choose her own level of ownership. Endogenous insider ownership is explored in a later section.

where $U(M(s^t)) = \log(M(s^t))$ is the utility function of the insider, defined only over consumption. The Southern insider has a similar problem.

There are two forces of misalignment at work here: the assumption that the insider maximizes with respect only to her own flow of consumption, not the stream of dividends; and the discount factor used to value this consumption stream. Perfect alignment of interests amounts to the insider maximizing *dividends* with respect to the *correct* discount factor, which could be a ownership-weighted average of insider and outsider marginal utilities. I assume the polar opposite, that the stochastic discount factor in question does not heed the ownership of outsiders, and the insider maximizes her own consumption stream.[16]

3.1.5 Description of agents: Outsiders

There are two representative outsiders in the model, one a resident of the North and the other residing in the South. They have preferences over the final consumption good produced in their own country and leisure. The two outsiders take the wage earned at the domestic firm and the flow of dividends from the two representative intermediate goods firms as given and choose a sequence of consumption, labor supply and asset holdings. For example, the Northern outsider chooses $\{C(s^t), L(s^t), \lambda_{NN}(s^t), \lambda_{NS}(s^t)\}_0^\infty$. The maximization problem of the representative Northern agent is

$$\max_{\{\mathrm{C(s^t)},\mathrm{L(s^t)},\lambda_{\mathrm{NN}}(\mathrm{s^t}),\lambda_{\mathrm{NS}}(\mathrm{s^t})\}} \sum_{t=0}^{\infty} \sum_{s^t} \beta^t \pi(s^t) U(C(s^t), L(s^t)) \tag{3.16}$$

subject to the period-wise budget constraint

$$\begin{aligned} C(s^t) + P(s^t)(\lambda_{NN}(s^t) - \lambda_{NN}(s^{t-1})) + e(s^t)P^*(s^t)(\lambda_{NS}(s^t) - \lambda_{NS}(s^{t-1})) \\ = q_a(s^t)W(s^t)L(s^t) + \lambda_{NN}(s^{t-1})D(s^t) + \lambda_{NS}(s^{t-1})e(s^t)D^*(s^t) \end{aligned} \tag{3.17}$$

We can also write this budget constraint in terms of a state variable, the outsider's financial wealth, and asset returns. Define financial wealth of the Northern outsider, $\Lambda(s^t)$, as the value of total holdings of assets after history s^t,

$$\Lambda(s^t) \equiv P(s^t)\lambda_{NN}(s^t) + P^*(s^t)\lambda_{NS}(s^t) \equiv \Lambda_{NN}(s^t) + \Lambda_{NS}(s^t) \tag{3.18}$$

and asset returns in units of the local final good as

$$R(s^t) \equiv \frac{P(s^t) + D(s^t)}{P(s^{t-1})} \tag{3.19}$$

$$R^*(s^t) \equiv \frac{P^*(s^t) + D^*(s^t)}{P^*(s^{t-1})} \tag{3.20}$$

[16] See Danthine and Donaldson (2005) for a discussion on the alignment of discount factors between owners and managers. Quite intuitively, they find that an optimal remuneration package for the manager involves a component that is a function of aggregate labor income.

The budget constraint of the Northern outsider can then be written as

$$\Lambda(s^t) = q_a(s^t)W(s^t)L(s^t) + \Lambda_{NN}(s^{t-1})R(s^t) + e(s^t)\Lambda_{NS}(s^{t-1})R^*(s^t) - C(s^t) \tag{3.21}$$

or,

$$\Lambda(s^t) = q_a(s^t)W(s^t)L(s^t) + \Lambda(s^{t-1})\tilde{R(s^t)} - C(s^t) \tag{3.22}$$

where $\tilde{R(s^t)} \equiv \frac{\Lambda_{NN}(s^{t-1})}{\Lambda(s^{t-1})}R(s^t) + \frac{\Lambda_{NS}(s^{t-1})}{\Lambda(s^{t-1})}e(s^t)R^*(s^t)$ is the weighted average return on the entire portfolio.
The felicity function is $U(C(s^t)) = \log(C(s^t)) - V(L(s^t))$, an assumption that is relaxed later.

3.1.6 Optimal combination of intermediate goods

The optimal combination of the two intermediate goods can be found by thinking of a proxy final goods firm in each country that takes input prices $q_a(s^t)$ and $q_b(s^t)$ as given to maximize profits every period. Thus their problem is static profit maximization.

$$\Pi = \max_{\{a(s^t),b(s^t)\}} Y(a(s^t), b(s^t)) - q_a(s^t)a(s^t) - q_b(s^t)b(s^t) \tag{3.23}$$

$$\Pi^* = \max_{\{a^*(s^t),b^*(s^t)\}} Y^*(a^*(s^t), b^*(s^t)) - q_a^*(s^t)a^*(s^t) - q_b^*(s^t)b^*(s^t) \tag{3.24}$$

Having a final goods firm in each country is just a convenient way to bypass specifying a price index for final consumption for each country. The real exchange rate between the two countries, which is defined as the relative price of their consumption bundles, is the same whether we model the aggregation as taking place in a final goods sector or in the utility function of the individual. Therefore, the final goods sector plays absolutely no role in any of the qualitative or quantitative results that follow.

3.2 First order and market clearing conditions

First, I set out the optimality and market clearing conditions of the decentralized economy, and then define the concept of equilibrium in the next section.

3.2.1 First order conditions for the insider's problem

The Northern insider observes the history of states up to the period t, s^t, and forms expectations on the future state s_{t+1}. Then she decides on investment, employment and amount of private benefits based on the following conditions.

$$\sum_{s_{t+1}\in\mathbb{S}} \frac{Q(s^t, s_{t+1})}{Q(s^t)}[\theta(1 + \frac{(1-\alpha)^2}{2\alpha\eta})\frac{q_a(s^t, s_{t+1})Y_a(s^t, s_{t+1})}{K(s^t)} + (1-\delta)] = 1 \tag{3.25}$$

This is the inter-temporal optimality condition for investment. Since the cash-flow ownership of the insider is limited to α, she bears only a fraction of the costs of investment. But private benefits of control extracted are a fraction of the revenue of the firm. Thus she assigns a higher-than-optimal weight to returns on capital, over and above the normal marginal product of capital, $\theta\frac{q_a Y_a}{K}$. This is because her private pay-off from capital comes through dividends *and* private benefits.

$$W(s^t)L(s^t) = (1-\theta)\Big(1+\frac{(1-\alpha)^2}{2\alpha\eta}\Big)Y_a(s^t) \tag{3.26}$$

This is the period-wise labor demand function. Observe that the agency problem expands the share of labor income in output beyond $(1-\theta)$ by a fixed amount $\Big(1+\frac{(1-\alpha)^2}{2\alpha\eta}\Big)$, which goes to 1 as institutional quality gets better, that is, η gets very large.

$$f(s^t) = \frac{1-\alpha}{\eta} \tag{3.27}$$

The last equation states that the insider steals a constant fraction of output in each period and state, which follows directly from the quadratic cost of stealing that I assume. This simplifies the analysis substantially. There are a similar set of conditions for the South.

Remark 1 *The expression* $(1+\frac{(1-\alpha)^2}{2\alpha\eta})$ *that appears in the first two optimality conditions of the insider is the gross payoff (before deducting the insider's share of labor and investment costs) to the insider from dividends and private benefits of control (net costs of extracting that benefit) per unit of cash flow rights held. This payoff is lower, the better is the quality of domestic institutions (higher* η*).*

Two conditions need to be imposed on the parameter η for the solution to be economically meaningful. The first is trivial, that the fraction of output consumed as private benefits should not exceed 1. Also, the optimal solution to the investment problem should not require infusion of new funds from investors in the steady state, which would make steady state dividends and stock prices negative. Obviously, ensuring the second condition is sufficient for the first to hold. Note that the condition holding in the non-stochastic steady state does not ensure that dividends are positive for all states of nature.

Assumption 1 *For given insider ownership* α *and* α^**, the institutional quality parameters* η *and* η^* *are high enough so that dividends are non-negative in the steady state. These values are provided in the appendix.*

3.2.2 First order conditions for the outsider's problem

The outsider observes the history of states up to the period t, s^t, and forms expectations on the future state s_{t+1}. Since expectations are rational, she can implicitly calculate expected dividend policy and current labor demand of the

insider. She then solves for her own optimal consumption, labor supply and asset allocation, given the insider's behavior. The first order conditions for the outsiders are standard. The Northern outsider has the following optimality conditions for stock purchases

$$P(s^t) = \beta \sum_{s_{t+1} \in \mathbb{S}} \pi(s_{t+1}|s^t) \frac{U_C(s^t, s_{t+1})}{U_C(s^t)} \Big(D(s^t, s_{t+1}) + P(s^t, s_{t+1}) \Big) \tag{3.28}$$

$$e(s^t)P^*(s^t) = \beta \sum_{s_{t+1}} \pi(s_{t+1}|s^t) \frac{U_C(s^t, s_{t+1})}{U_C(s^t)} e(s^t, s_{t+1}) \Big(D^*(s^t, s_{t+1}) + P^*(s^t, s_{t+1}) \Big) \tag{3.29}$$

which is the standard asset-pricing Euler equation. The condition for hours worked is

$$\begin{aligned} U_C(s^t) q_a(s^t) W(s^t) + U_L(s^t) &\geq 0 \\ &= 0 \quad \text{if } L(s^t) > 0 \end{aligned} \tag{3.30}$$

There are a similar set of conditions for the South.

3.2.3 First order conditions for optimal combination of intermediates goods

The hypothetical final goods firms buy the two intermediate inputs in spot markets. Their optimality conditions for the use of inputs are

$$\omega Y(s^t) = q_a(s^t) a(s^t) \tag{3.31}$$

$$(1 - \omega) Y(s^t) = q_b(s^t) b(s^t) \tag{3.32}$$

such that the fraction of final output used to pay for intermediates is constant. There are a similar set of conditions for the South. I stress again at this point that the introduction of the final goods firm is just an expositional tool. These "firms" do not have any profits, do not employ capital or labor, and just serve as a proxy for the deterministic technology for assembling final goods from the two traded intermediates. In short, they play absolutely no substantive role in this model economy.

3.2.4 Market clearing conditions

Relative prices of intermediate goods, $q_a(s^t)$ and $q_b(s^t)$ adjust such that

$$a(s^t) + a^*(s^t) = Y_a(s^t) \tag{3.33}$$

$$b(s^t) + b^*(s^t) = Y_b(s^t) \tag{3.34}$$

The final consumption good market clearing requires

$$C(s^t) + K(s^t) - (1-\delta)K(s^{t-1}) + M(s^t) = Y(s^t) - \Phi(s^t) \tag{3.35}$$

$$C_{m^*}(s^t) + K^*(s^t) - (1-\delta)K^*(s^{t-1}) + M^*(s^t) = Y^*(s^t) - \Phi^*(s^t) \tag{3.36}$$

so that consumption demand by the representative outsider, investment demand and the consumption of the insider add up to the output of final goods.
Stock market clearing requires that

$$\lambda_{NN}(s^t) + \lambda_{SN}(s^t) = 1 - \alpha(s^t) \tag{3.37}$$

$$\lambda_{NS}(s^t) + \lambda_{SS}(s^t) = 1 - \alpha^*(s^t) \tag{3.38}$$

so that the total shares held by outsiders in a country's firms is constrained by the holdings of the insider. The fractions $(1-\alpha(s^t))$ and $(1 - \alpha^*(s^t))$ are the *float portfolios* in the North and the South.

3.3 Definition of equilibrium

An equilibrium in this model is a set of prices $P(s^t)$, $P^*(s^t)$, $R(s^t)$, $R^*(s^t)$, $W(s^t)$, $W^*(s^t)$, $q_a(s^t)$, $q_a^*(s^t)$, $q_b(s^t)$, $q_b^*(s^t)$, and $e(s^t)$ for all s^t and t satisfying the following conditions

1 *The insider's investment, employment and private benefits optimality conditions (3.25), (3.26) and (3.27) hold in the North. Analogous conditions hold in the South.*

2 *The outsider's stock purchase and labor supply optimality conditions (3.28), (3.29) and (3.30) hold in the North. Analogous conditions hold in the South.*

3 *Intermediate inputs are combined optimally according to conditions (3.31) and (3.32) in the North. Analogous conditions hold in the South.*

4 *Intermediate inputs resource constraints (3.33) and (3.34) hold worldwide.*

5 *Final goods resource constraints (3.35) and (3.36) hold in each country.*

6 *Asset markets clear according to constraints (3.37) and (3.38).*

In the equilibrium defined above, insiders make decisions regarding the investment, dividends, and labor demand of the intermediate goods firms. How their decisions influence the equilibrium is discussed in the following section (4.1). Outsiders take these decision rules as known and given, and formulate their consumption and labor supply plans. Additionally, they decide how much of their financial wealth to invest in each of the two available assets. Section (4.2) explores these portfolio shares.

4 Outsider portfolios

This section presents the key insights from the model regarding the general equilibrium effect of institutional quality and insider ownership on outsider portfolios. I first discuss in section 4.1 how the insider's decisions influence the second moments of variables that are crucial for the outsider's portfolio decision. I then provide analytical solutions to the portfolio allocation problem of outside investors in terms of these second moments in section (4.2), for an *exogenous* amount of insider ownership. This is done under some simplifying assumptions – countries are symmetric, agents have logarithmic utility in consumption, and the final good is a Cobb-Douglas aggregate of intermediate goods. These analytical solutions show the direct link between the insiders' investment decisions and outsider portfolios. I then implement a numerical technique to solve for asset prices and outsider portfolios for general functional forms in (4.4) and (4.5). Armed with these tools, I next define an equilibrium in which insider portfolios are endogenous, and solve for equilibrium holdings of both insiders and outsiders in section (5).

4.1 How does the insider influence the equilibrium?

The insider's consumption $M(s^t)$ has three components,

$$\underbrace{\alpha D(s^t)}_{\text{insider share of dividends}} \qquad \underbrace{+q_a(s^t)f(s^t)Y_a(s^t)}_{\text{private benefits}} \qquad \underbrace{-\Phi(s^t)}_{\text{cost of stealing}}$$

where dividends $D(s^t)$ are defined by

$$\underbrace{q_a(s^t)\big(1-f(s^t)\big)Y_a(s^t)}_{\text{revenue net of private benefit}} \qquad \underbrace{-q_a(s^t)W(s^t)L(s^t)}_{\text{labor costs}} \qquad \underbrace{-\{K(s^t)-(1-\delta)K(s^{t-1})\}}_{\text{investment}}$$

The agency problem in the model stems from the insider's limited ownership of the firm and her ability to extract private benefits of control. Because the insider owns only a fraction α of the firm, in effect $(1-\alpha)$ of her private benefits come from revenues that rightfully belongs to outsiders. The larger the share $(1-\alpha)$ owned by outsiders, the greater the incentive to steal. Thus, the optimal extraction of private benefits of control declines with greater insider ownership and increases with greater outsider ownership as in Shleifer and Wolfenzon (2002) and Albuquerque and Wang (2006, 2008), as shown by the insider's optimality condition (3.27).

$$f(s^t) = \frac{1-\alpha}{\eta}$$

Multiplying the expression for dividends by the insider's ownership share α and inspecting the last two terms, we see that the insider pays for only a fraction α of the labor and investment cost of the firm due to her limited ownership.

$$\underbrace{-\alpha\{q_a(s^t)W(s^t)L(s^t)\}}_{\text{insider share of labor costs}} \qquad \underbrace{-\alpha\{K(s^t)-(1-\delta)K(s^{t-1})\}}_{\text{insider share of investment}}$$

Since private benefits are proportional to firm size by assumption and the higher costs of a larger firm are partly subsidized by outside owners, the insider has an incentive to over-invest. Capital and labor being imperfect substitutes in production, a higher equilibrium capital stock also requires higher equilibrium employment. This distinguishes the agency aspect of the model in this paper from Albuquerque and Wang (2008), who focus only on over-investment.

As noted by these authors, there is also a separate reason that might make the insider *reluctant* to over-invest. Since the insider is risk averse and her consumption stream is derived entirely from the firm, over-investment reduces her utility by increasing the volatility of her consumption stream. Recall that the insider is not allowed to trade in other assets. This makes asset markets incomplete for the insider, because she has to insure against the two shocks in the world economy using a single asset, her fixed holdings in her own firm. This form of financial market incompleteness has real effects because the insider attempts to insure herself by affecting the pay-offs to the asset she holds. However, in their model as in this one, the incentive to over-investment dominates in equilibrium.

4.1.1 How does the insider affect the outsiders' portfolios?

Because of similar goods and asset market setups, the model shares an important feature of Heathcote and Perri (2009) and Coeurdacier et al. (2009): relative (to the other country) labor income and asset income are negatively correlated. This result comes from three interconnected channels. First, a positive productivity shock in any country leads to an increase in labor income in that country. Second, it also leads to a worsening of the terms of trade for that country because of an increase in supply of the their intermediate good. This is the "automatic insurance" role of the terms of trade emphasized by Cole and Obstfeld (1991). However, the dynamics of investment dampens the decline in the terms of trade. Recall that the final investment good is made from Northern and Southern intermediates. Since the technology for producing the final good is biased towards domestic inputs, an increase in domestic investment due to the positive shock to technology increases demand for the domestic intermediate good, cushioning the worsening of the terms of trade. This leads to an overall increase of the labor income in the country experiencing the positive technology shock, relative to the other country. Third, the increase in domestic investment due to the technology shock also leads to a contemporaneous decline in dividends, relative to the other country. These three effects in conjunction induce a negative correlation between domestic labor income and domestic dividend income.

The same forces are at work in the present model. However, the presence of the insider serves as an amplifying mechanism in the connection between investment and the income processes of outsiders. Following a good productivity shock that is known to be persistent, insiders find it optimal to reduce dividends below first-best to finance privately optimal projects in expectation of higher future private benefits of control. Figure 3 (4.1.1) shows the simulated labor income and dividend paths from the model for the North and the South when

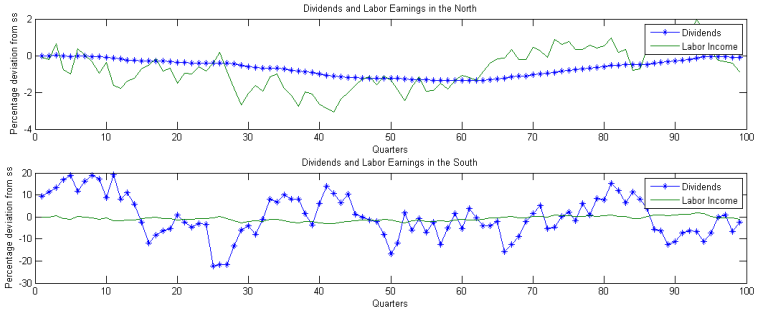

Figure 3: **Southern dividends are relatively more volatile and negatively correlated with labor income.** The top and bottom panel show simulated dividend and labor income paths in the North and South. The benchmark model has perfect institutions in the North. The dividend process for the South is for the model calibrated to the lowest decile of institutional quality.

the former has better institutions. In a country with good institutions, labor income and dividends are weakly positively correlated, whereas, this correlation is sharply negative in a country with poor governance. Note that dividends are also more volatile in the South, the vertical axis in each panel having different scales.[17]

4.2 Analytical solutions to the outsider's portfolio allocation problem

In this section I follow Heathcote and Perri (2004, 2009) in making a number of simplifying assumptions to solve for outsider's portfolios. I assume that the two countries are *symmetric* in all respects. I also assume that the technology that combines Northern and Southern intermediates is Cobb-Douglas. Under these conditions, a constant portfolio rule for outsiders is derived. The purpose of this proposition is purely to provide intuition for the results of the numerical simulations that follow and to highlight the main qualitative mechanisms at work. The more interesting case of two countries with different institutional quality is explored numerically.[18] The solution in Proposition 1 can be thought of as equity positions that decentralize a central planner's problem that maximizes the equally weighted sum of outsider utilities, *given* optimal behavior by the insiders in each country.

Proposition 1 *There exists an equilibrium for this economy with own-country portfolio share for outsiders,* $\lambda_{NN} = \lambda_{SS} = \lambda$*, such that the consumptions of*

[17] Note that this diagram plots only dividends and labor income, not these variables relative to the other country's labor income and dividends.

[18] This problem, due to the ex-ante asymmetry of the countries in question, cannot be solved by the simple algebra used in this section.

outside investors are equated across symmetric *countries in all states of nature. The value of* λ *is given by*

$$\lambda = \frac{1-\alpha}{2} + \frac{1}{2}\{\frac{\psi_0(2\omega-1)(1-\alpha)}{1-(1-\psi_0)(2\omega-1)}\} \tag{4.1}$$

where

$$\psi_0 = (1-\theta)\{1+\frac{(1-\alpha)^2}{2\alpha\eta}\}$$

is labor's share of total income.

Proof: See appendix. (7.2)

4.2.1 Intuition

The first piece in the solution is the minimum-variance portfolio used for pure diversification

$$\lambda_{\text{Div}} = \frac{1-\alpha}{2}$$

which just says that the outsiders should hold half of the world float portfolio for the purpose of diversification. This is the same dictum that a simple consumption-based asset pricing model would deliver, which is to hold the world float portfolio in proportion to the agent's share in world wealth. Since only a fraction $(1-\alpha)$ of the world market portfolio is actually available for purchase, and by symmetry, each representative outsider owns half of the freely investible wealth in the world, they each hold $\frac{1-\alpha}{2}$.

The second piece is the part of the portfolio which hedges against labor-income risk. As discussed in the previous section, the demand for this part of the portfolio comes from the endogenous negative correlation between labor and dividend income. The hedge portfolio is

$$\lambda_{\text{Hedge}} = \frac{1}{2}\{\frac{\psi_0(2\omega-1)(1-\alpha)}{1-(1-\psi_0)(2\omega-1)}\}$$

In this piece, ψ_0 in the numerator is the share of labor income in GDP. This can be seen most easily by inspecting the first order condition for labor employment (3.26) and the expression for ψ_0. Also observe that as we let the cost-of-stealing parameter, η, go to very large values, $\psi_0 \rightarrow (1-\theta)$, which is labor's share of income in the Cobb-Douglas production function. The higher labor income share ψ_0 resulting from beyond optimal firm sizes increases this term, augmenting the extent of home bias.[19] Thus, home bias in equity portfolios increases with declining institutional quality due to increased demand for domestic shares from domestic residents for the purpose of labor income risk

[19] Under perfect alignment of interests, perfect institutional quality, and insider ownership close to zero, the portfolio described above converges to the portfolio in Heathcote and Perri (2009), which is $\lambda = \frac{\omega+\theta-2\omega\theta}{1+\theta-2\omega\theta}$.

hedging. This demonstrates one of the channels by which the model generates cross sectional variation of asset holdings – the demand for the hedging component of outsider portfolios is more in countries with weaker institutions because there is more labor income to hedge. The other channel is an endogenous increase in the covariance between relative labor and dividend income. This channel is explored in the next section.

Note that there is no hedging demand when $\omega = \frac{1}{2}$. When this is the case, domestic investment is made up of equal proportions of the home and foreign intermediate. As described by Heathcote and Perri (2009), in this case increases in investment demand translate into equal increases in demand for the domestic and foreign intermediate goods, thereby having no terms of trade effects, ceteris paribus. In their model, the crucial feature that drives the home bias result is the *asymmetry* of the two countries' investment composition and its effect on the dynamics of the real exchange rate.[20] The investment and terms of trade channel is eliminated when there is no home bias in investment.

In contrast, the mechanism of the present model is primarily driven by the asymmetry in the countries' institutions. In the case where we are able to solve for portfolios analytically, this channel is eliminated completely because we assume that the two countries have equally bad or good institutions. Thus, varying the institutional quality parameter in the symmetric case changes home bias by very little. But significant quantitative effects are seen when the two countries are allowed to be asymmetric. However, since this case has to be solved numerically, the purpose of Proposition 1 (and Proposition 2 in the next section) is to highlight the qualitative mechanism at work – which is, the moments of certain endogenous variables.

4.2.2 Intuition using covariances of endogenous variables

Following Heathcote and Perri (2009), we can also write the portfolio as a covariance ratio of key endogenous variables.

Proposition 2 *The portfolio λ can also be expressed as*

$$\lambda = \frac{1-\alpha}{2} - \frac{1}{2}\Psi \frac{\text{cov}(\Delta\hat{\mathbb{L}}, \Delta\hat{D})}{\text{var}(\Delta\hat{D})}$$

where

$$\Psi = \frac{\theta {\psi_0}^2 \omega^{\omega} 1-\omega^{1-\omega}}{(1-\theta)(\psi_1-\psi_0)(\frac{1}{\beta}+\delta-1)-\delta}$$

and $\Psi = \frac{\bar{\mathbb{L}}}{\bar{D}}$, $\mathbb{L} = \bar{q_a}\bar{W}\bar{L}$ = Labor income, D = Dividends, $\Delta\hat{\mathbb{L}} = \hat{\mathbb{L}} - \hat{e} - \hat{\mathbb{L}}^*$, $\Delta\hat{D} = \hat{D} - \hat{e} - \hat{D}^*$. Hats over variables denote log deviations from symmetric steady state values and bars above variables denote symmetric steady state values.

[20] In a related paper Civelli (2008) shows that what is crucial for the result is home bias in investment, not all of domestic absorption.

Proof: See appendix. (7.2)

As shown in a previous section, the presence of the insider affects the moments of the model's variables. Specifically, (i) it increases the relative volatility of the domestic dividend process, making the domestic asset relatively riskier and therefore *less* attractive to outsiders; (ii) it increases the covariance between relative labor and dividend income, making the domestic asset a better hedge against labor income risk and therefore *more* attractive to outsiders; (iii) it makes the steady state labor income to dividend ratio $\frac{\mathbb{L}}{D}$ higher, increasing the need to hedge labor income risk, thereby making the domestic asset *more* attractive to outsiders. Since the effect of (ii) and (iii) dominate (i), the hedge portfolio increases with worse institutional quality.

Common sense tells us that domestic equity capital should flee from countries that have weaker institutions. This idea is captured by the volatility effect (i). However, how much wealth is allocated to an asset depends not only on the relative variance of its payoff but also on the covariance of this payoff with other sources of risk, effect (ii) above. The remainder of the paper shows by numerical simulations that the effect of these covariances overturns the riskiness of assets from the South, making them desirable for Southern worker-investors.

4.3 Related literature

The papers that are closest to mine are Albuquerque and Wang (2006, 2008), referred to as AW (2006) and AW (2008). AW (2006) study the investment and exchange rate effects of investor protection. They solve for equilibrium consumption allocations of outsiders under the assumption of asset market completeness and find portfolios that support these allocations. In their equilibrium, outsiders in each country hold claims on each other that are independent of the degree of investor protection. In the present paper, the focus is on portfolio allocation when the available assets are just equity in Northern and Southern firms. On the production side, the present model uses labor inputs, and this brings inefficient employment as an additional source of misalignment of incentives between insiders and outsiders. The inclusion of labor turns out to have implications for hedging labor income risk, and makes outsider portfolios dependent on institutional parameters.

AW (2008) is a closed economy variant of AW (2006) that examines the effects of poor corporate governance on investment and output. It has a risk averse insider who is allowed to trade in a risk-less asset and consumes dividend earnings plus private benefits, and an outsider whose consumption is financed solely by domestic dividends. The ratio of the marginal utilities of these two agents between different states and dates turn out to be the same because of the underlying structure of logarithmic utilities and linear private benefits, so that their marginal rates of substitutions coincide. Thus, in equilibrium, there is no incentives for asset trade between insiders and outsiders for *any* level of insider ownership, which is not true here because outsiders' consumptions are also affected by pay-outs of the foreign equity that they hold in equilibrium.

Also, insiders have incentives to reduce holdings in their own firm for the purpose of diversification due to the presence of a second risky security, foreign equity. Thus, the focus of both AW (2006) and AW (2008) is on the cross-section of macroeconomic aggregates like investment, stock market volatility, exchange rates and stock prices, while I attempt to quantify the connection between institutional quality and country portfolios.

The results on home bias presented in this paper are closely related to those in Heathcote and Perri (2009), referred to as HP (2009). Specifically, the solution in Proposition 1 approaches the portfolio in HP (2009) when three conditions are satisfied: (i) institutional quality in both countries is perfect; (ii) insider ownership in both countries is very close to zero; (iii) there is perfect alignment of interests between the insider and the outsider, in the sense that the insider uses a weighted average of discount factors of the firm's owners to value the stream of dividends.

4.4 Numerical solutions of the general model

This section solves the model numerically for two reasons. First, one needs solutions to the optimal time-paths for non-portfolio variables in order to verify the intuition provided in the previous section. Second, the time-invariant portfolio rule derived in the previous section works only under the assumption of log utility, Cobb-Douglas aggregation, and symmetric countries. The simple algebra used to solve for portfolios rests entirely on the linear structure that comes out of the logarithmic utility and Cobb-Douglas final goods aggregation. It is of interest whether the result of Proposition 1 is robust to more general specifications of utility and technology. Also, solving for portfolio positions when the countries are asymmetric is especially crucial, because the motivation of the paper is the observed heterogeneity of institutions in different countries. For the numerical solution, the insider and outsider both have power utility, which nests logarithmic utility as a special case when the elasticity of inter-temporal substitution, and co-efficient of risk aversion are both 1;[21] the final good is made using Armington technology; also, the countries are asymmetric, in that the level of insider holdings (α), and the quality of institutions (η) are allowed to be different.

Following perturbation techniques, I find second order Taylor-series approximations of the optimal decision rules for the control variables, and the transition equations of the endogenous state variables using the algorithms provided in Schmitt-Grohé and Uribe (2004). The details of this method are reviewed in section (7.4.2). I follow Devereux and Sutherland (2007) and Tille and Wincoop (2008) in choosing, for the non-portfolio variables, the non-stochastic steady-state of the model as the approximation point. As is well known, portfolio shares are indeterminate in the steady-state. Thus, after the first step of choosing the approximation point for non-portfolio variables, I approximate the dynamics

[21] Though these two parameters arguably have very different implications for portfolio allocation, I do not attempt to differentiate between them using Epstein-Zin utility.

of the model at different guesses for the portfolio shares. In the next step I use certain criterion to choose between the different approximation points for portfolio shares to come up with the steady-state portfolio value. As detailed in Judd and Guu (2001) and Devereux and Sutherland (2007), this amounts to finding a *bifurcation point* (see Judd (1998), Judd and Guu (2001)), which is the intersection of the set of stochastic and non-stochastic solutions of the model. The details of this procedure is described in section (4.4.1).

4.4.1 Choosing the portfolio approximation point

As discussed in recent papers like Devereux and Sutherland (2006, 2007) and Tille and Wincoop (2008), solving portfolio-choice DSGE using local approximation techniques is problematic because the portfolio choice problem is irrelevant in the non-stochastic steady-state, which is the approximation point used in such an approach. Without uncertainty it does not really matter which agent owns which stream of dividends, as long as their budget constraints hold. For example, if the countries are symmetric and thus are equally wealthy ex-ante, any mirror-image asset holdings can be used to support the steady-state levels of consumption in each country. As a result, portfolio shares are indeterminate at the determinate steady-state for other non-portfolio variables like capital stock and consumption. Thus, we need to pick out the true steady-state portfolios of a stochastic economy from the infinite possibilities that arise in the non-stochastic economy.

To do this, I simulate the economy around all points in a fine grid of steady state portfolio allocations. I store the data generated from these simulations and use certain criterion to pick the correct approximation point. First of all, recall that markets are effectively complete for the outsider. This means that there exists equilibrium portfolio shares such that the Backus and Smith (1993) full risk-sharing condition holds between outsiders of the two countries. For example, with power utility, it must be that at the neighborhood of the true equilibrium

$$\gamma\hat{c} = \hat{e} + \gamma\hat{c^*}$$

where γ, $\hat{c}$, $\hat{e}$, and $\hat{c^*}$ are the coefficient of relative risk aversion, and log-deviations from an approximation point, of Northern outsider consumption, the real exchange rate, and Southern outsider consumption respectively. I search for that point for which the squared approximation error (S.E.) for this condition, up to a second order approximation, is the least. In essence, this is the numerical counterpart of solving for an equilibrium using the first order conditions of a planner's problem. Let $\hat{\epsilon} = \gamma\hat{c} - \hat{e} - \gamma\hat{c^*}$. I choose the steady state λs to minimize

$$\text{S.E.}_{\hat{\epsilon}} = (\hat{\epsilon} - \bar{\hat{\epsilon}})'(\hat{\epsilon} - \bar{\hat{\epsilon}})$$

In the general model of this section, portfolio allocations are not time-invariant, as in the simplified version of the model in the previous section. Once we have

the correct approximation point, which by definition will be the average portfolio holding if the model is simulated around that point, I use the decision rules to simulate a distribution of asset holdings. To test the accuracy of this method, I follow Heathcote and Perri (2009) in comparing the numerically derived choice of steady-state portfolios for symmetric countries, to the analytical solution derived in Proposition 1 in section 4.2. This provides a robustness check for the method used.

4.5 Robustness checks: simulations of the general model

Simulations confirm that Proposition 1 carries through to the general case. In the following simulation, I fix the quality of institutions in one country (North) to very high levels (high η), and vary η for the other country (South). When I select the portfolio steady-state using the method described in the previous section, outsider portfolios are home-biased, and the degree of bias goes down with better institutional quality. The following table gives some simulated average values of portfolios for the two countries differing in the quality of institutions in the South, for a fixed level of insider ownership in each country ($\alpha = 0.01$, $\alpha^* = 0.5$), and perfect quality institutions in the North. The numbers for insider ownership are chosen in this simulation so that one can easily see that the portfolio positions add up to 0.99 in the North and 0.5 in the South.

Table 1: Average portfolios with different institutions in the South

Value of η^*	λ_{NN}	λ_{SN}	λ_{NS}	λ_{SS}
10	0.9738	0.0162	0.0628	0.4372
20	0.9074	0.0826	0.1313	0.3687
100	0.8531	0.1369	0.1479	0.3521
10^{10}	0.84	0.15	0.15	0.35

Going down column 1 of the table, as we increase the value of the institutional quality parameter, outsider portfolios become less home-biased. These numbers can be given a cross sectional interpretation. As we move down the column for λ_{SN}, we see that countries with better institutional quality will hold more international assets. Likewise, moving down the column for λ_{NS}, we see that such countries with should also be associated with higher levels of international liabilities. This pattern corresponds closely with the stylized facts noted before.

4.6 How well does the model explain the cross sectional dispersion of home bias?

The purpose of these exercises is to see if the model can come close to replicating the data. I use the group of 43 countries for which stylized patterns

were presented earlier. I try to see if the model can replicate the degree of home bias in equity assets. First, regressions confirm that trade openness and institutions are the two most important cross-sectional determinants of international diversification for this group, as predicted by the model. Qualitatively speaking, the model predicts (from Proposition 1) the correct sign of the regression coefficients – that countries more open to trade and with better domestic institutional quality will hold more foreign assets as a fraction of their wealth.

The numerical exercise proceeds as follows. I take one country (North) and set insider ownership there to be equal to the value for the US (12.35%) reported in Kho et al 2006. This is the lowest value of insider ownership in the sample. In terms of the model, α=0.1235. I set institutional quality in this country to be perfect, i.e., η is set to an arbitrarily large value. For the other country (South), I fix insider ownership to the median insider ownership in the sample (48.45%). In terms of the model, this means $\alpha^* = 0.4845$. Then I vary the quality of institutions (the parameter η^*) to match different deciles of private benefits of control as a fraction of firm value in the South using estimates from Dyck and Zingales (2006). For each value of η^*, I solve for the equilibrium fraction of wealth held in domestic and foreign assets for each of the two countries. This gives me 10 points. At one end are two symmetric countries with perfect institutions and the foreign asset holdings of any one of them (because they are symmetric). At the other end is one country with perfect institutions and another with private benefits in the 10th decile, and there are 8 more such points in between.

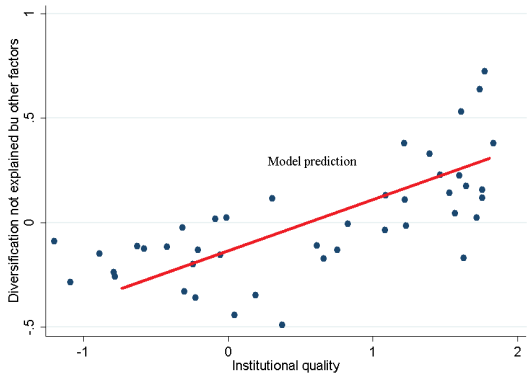

Figure 4: **Model versus data.** Each dot represents the residuals from a regression of average (1996-2004) diversification for each country on control variables other than institutional quality. Institutional quality on x-axis. Thus, the scatter plot shows the partial correlation in the data between portfolios and institutional quality. The line shown is that fitted by OLS to data generated from the model.

Figure 4 plots the results. I regress diversification on a set of controls other than institutional quality, and take the residuals of that regression as the data

points I am trying to explain. In that case, a model without the corporate governance friction, trivially, would not be able to explain *any* of this variation, while the present model explains the cross-sectional dispersion of home bias.

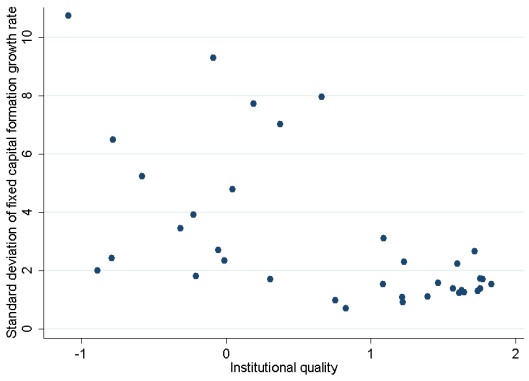

Figure 5: **Investment volatility goes down with stronger institutions.** Each dot represents the standard deviation (1996-2004) of fixed capital formation growth rate for a country. Institutional quality measured by the Kaufmann et al. (2008) indices on the x-axis.

4.6.1 The cross-sectional dispersion of investment volatility

The model also has clear predictions about the cross sectional variation of the second moments of some observable macroeconomic aggregates. For example it predicts that the amplitude of investment fluctuations from peak to trough should go down with better institutions. Figure 5 is a scatter plot of the standard deviation of the growth rate of fixed capital formation versus institutional quality. A regression with the usual controls used in this paper indicate institutions as the only significant variable. The years used are 1996-2004. A longer time sample yields the same cross-sectional dispersion.

5 Endogenous insider ownership

This section extends the model in the previous sections by letting insiders choose their portfolios. In order to maintain tractability, I make the simplifying assumption that the insider trades her shares only once during the horizon of the model. This is a reasonable simplification in the light of two empirical observations: Kho et al. (2006) note that the time series for average insider ownership around the world shows little variation, the reasons for which will be clear in the discussion at the end this section; also, there is ample evidence that insiders face large fixed costs of trading in their control blocks because of several factors such as asymmetric information between insiders and the market

(Goldstein and Razin (2006)), price impacts of large share sales because of negatively sloped demand curve for assets (Shleifer (1986), Chari and Henry (2004)), and the presence of private benefits of control (Nenova (2003), Dyck and Zingales (2006)). Thus, starting at some level of insider ownership, α_0 at $t = 0$, insiders trade in shares of country portfolios, and this fixes insider ownership α for the rest of time, as in the previous sections. When making this decision, insiders take the optimal reaction function of all other agents from time $t = 0$ onwards as given.

Models such as Shleifer and Wolfenzon (2002) show that better investor protection leads to more diffuse ownership of assets in a static, risk-neutral framework. When firms are equity financed, better investor protection and corporate governance increase the amount of pledgable income for outside investors, increasing the availability of external financing. The intuition as to why better institutional quality leads to lower insider ownership in a dynamic model is quite simple. There are two forces at work. The first is a risk-averse insider's desire to diversify internationally by lowering her ownership. However, poor institutional quality prevents insider from diversifying their positions in the domestic index, because lower ownership increases their incentives to extract private benefits of control. This reduces the value of the domestic index for outsiders. Outside investors take this into account, and hence any attempt to reduce ownership leads to downward revisions of stock prices, and hence, the value of the insider's holdings. This imposes a "transaction" tax on portfolio adjustments by insiders in markets with poor institutional quality.[22] The level of country insider ownership is determined when these two forces, the diversification benefit of the insider, and the penalty for reducing her stake, balance out.[23]

5.1 Algorithm for computing insider ownership

Recall from previous sections that I have in place a method for computing stock prices and the portfolio allocation of outsiders, given a certain level of insider holdings. Now, I start with a certain level of Southern insider holdings in the two risky securities, Northern and Southern equity. Let this be $(0, \alpha^{*'})$ initially, so that the Southern insider holds equity only in the South. I assume that the North has perfect institutions and fixed low insider ownership. Let there be an additional period $t = -1$ just prior to $t = 0$. In this period, only the Southern insider chooses her holdings of the two risky securities, Northern and Southern equity. She trades the securities at prices $(P(\alpha), P^*(\alpha^*))$, where α^* is the final holdings of Southern equity of the Southern insider. Note that because the insider is unable to commit to a certain level of the value-reducing action because of imperfect corporate control, the stock price depends on the *final* holdings of the insider, α^*, rather than the initial holdings $\alpha^{*'}$, as in

[22] This effect has been analyzed in the finance literature by Admati et al. (1994) and DeMarzo and Fishman (2007).

[23] Note that the insider takes into consideration the impact of her sale of shares on the price of these shares when deciding how much to sell. Thus the insider does not act as a price taker as in perfectly competitive markets.

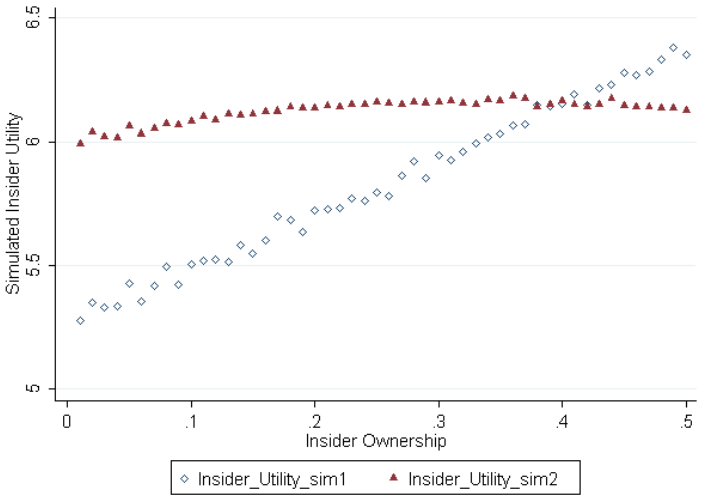

Figure 6: **Optimal insider ownership goes down with better institutions.** Each dot represents the average utility of the Southern insider when the model is simulated for 1000 periods at each level of insider ownership. The negatively sloped line is for weak institutional quality.

Admati et al. (1994) and DeMarzo and Urošević (2006).

The time-line is as follows. In period $t = -1$, the Southern insiders announces desired holdings α^* for time $t = 0$ to ∞. Enforceable contracts are written between the Southern insider, and outsiders in each country, that the insider will sell $(\alpha^{*'} - \alpha^*)$ units of Southern stock and will receive a share of the Northern stock index at prevailing prices. In period zero, as agreed in the previous period's contract, $\alpha_{SN} = \frac{(\alpha^{*'} - \alpha^*)P_0(\alpha^*)}{P_0(\alpha)}$ units of the Northern stock index are delivered to the Southern insider. Also, trade takes place between outsiders and portfolio holdings $\{\lambda_{NN}, \lambda_{SN}, \lambda_{NS}, \lambda_{SS}\}$ are established. The insider takes into account the effect her final holding has on the stock price, and consequently, her wealth, when she announces her desired holdings α^*. So she chooses α^* to maximize her discounted lifetime utility.

$$\alpha^*(\alpha^{*'}) = \text{argmax}_{\alpha^{*''}}\{V_e(\alpha^{*''})\} \tag{5.1}$$

I describe the numerical algorithm used to evaluate the best α^* in 7.4.4. In short, I evaluate the discounted lifetime utility of insiders for various insider ownership stakes.

Figure 6 plots the result. The downward sloping line (simulation 1) shows Southern insider utility for various levels of insider ownership when institutions are weak. Since the stock price falls when the post-trade equity held by the insider goes down, there is a fall in the insider's wealth. As a result, she gets very few Northern stocks in exchange for her stake. Thus, though she retains

private benefits of control, her lifetime utility falls because her total dividend income falls. The insider has no incentive to diversify because weak institutional quality acts as an endogenous "transaction tax" on her portfolio adjustments. The other line (simulation 2) shows average insider utility for various levels of insider holdings when institutional quality is perfect. Note that there is a slight gain from diversification and there exists an optimal amount of diversification for the insider when Southern institutions are strong. Thus, ownership tends to remain concentrated in the South as long as institutions are weak. Also, this yields the feature that we see in the data (see also LaPorta et al. (1999)), that countries with weaker institutions have more insider ownership.

6 Conclusion

I analyze the international portfolio diversification problem of small, security-only investors in the presence of insider ownership, corporate governance frictions, and non-diversifiable labor income risk. The main message of the paper is that imperfect corporate governance influences the dynamics of investment in ways that makes equity in domestic firms a better hedge against fluctuations in labor income for residents in a country with poor institutions. This creates a preference for home assets in countries with poor institutions, a cross-sectional prediction that is consistent with empirical evidence presented in the paper. I also solve the model numerically for the optimal amount of insider equity, and demonstrate the link between insider and outsider portfolios in general equilibrium.

Common sense tells us that domestic equity capital should flee from countries that have weaker institutions. This idea is captured by the model as an increase in the volatility of dividends in a country with weaker institutions. However, how much wealth is allocated to an asset depends not only on the relative variance of its payoff but also on the covariance of this payoff with other sources of risk – herein lies the key insight of the paper. Contrary to intuition, I find that domestic outside investors in countries with weaker institutions will hold more of their own country's float portfolio *because* it has weaker institutions.

Though most of the stock of international assets is held by a handful of countries with similar, well-developed capital markets, nations where investor rights are relatively weak are playing an increasingly important role in international capital movements. Understanding how agency problems affect macroeconomic aggregates and portfolio allocation thus constitutes an important set of open questions which this paper tries to address. An extension of the work in this paper would seek to provide a fully dynamic framework which yields sharper quantitative predictions about the degree of insider ownership, and the exact magnitudes of foreign diversification of countries under different institutional quality. Such an extension would be better able to address questions about the time-path of asset portfolios after financial liberalization and institutional reforms. These issues, and a more complete empirical test of the mechanism by which the model generates home bias is left for future work.

References

A. R. Admati, P. Pfleiderer, and J. Zechner. Large shareholder activism, risk sharing, and financial market equilibrium. *The Journal of Political Economy*, 102:1097–1130, 1994.

R. Albuquerque and E. J. Schroth. Quantifying private benefits of control from a structural model of block trades. *Journal of Financial Economics* (forthcoming), 2009.

R. Albuquerque and N. Wang. Corporate governance and asset prices in a two-country model. *Boston University and Columbia University working paper*, 2006.

R. Albuquerque and N. Wang. Agency conflicts, investment, and asset pricing. *The Journal of Finance*, 63:1–40, 2008.

D. K. Backus and G. W. Smith. Consumption and real exchange rates in dynamic economies with non-traded goods. *Journal of International Economics*, 35:297–316, 1993.

D. K. Backus, P. Kehoe, F. Kydland, and T. F. Cooley. *Frontiers of Business Cycle Research*. Princeton University Press Princeton, NJ, 1995.

Y. Bai and J. Zhang. Financial integration and international risk sharing. *University of Michigan and Arizona State University Working Paper*, 2008.

M. Baxter and U. J. Jermann. The international diversification puzzle is worse than you think. *The American Economic Review*, 87:170–180, 1997.

M. Baxter, U. J. Jermann, and R. G. King. Nontraded goods, nontraded factors, and international non-diversification. *Journal of International Economics*, 44: 211–229, 1998.

G. Bekaert and C. R. Harvey. Emerging markets finance. *Journal of Empirical Finance*, 10(1-2):3–56, 2003.

M. J. Brennan and H. H. Cao. International portfolio investment flows. *Journal of Finance*, pages 1851–1880, 1997.

F. Broner and J. Ventura. Rethinking the effects of financial liberalization. *CREI Working Paper*, 2008.

F. Broner and J. Ventura. Globalization and risk sharing. *CREI Working Paper*, 2009.

F. A. Broner, J. Ventura, and R. T. Fargas. Globalization and risk sharing. *CREI Working Paper*, 2008.

A. Chari and P. B. Henry. Risk sharing and asset prices: Evidence from a natural experiment. *The Journal of Finance*, 59:1295–1324, 2004.

M. D. Chinn and H. Ito. A new measure of financial openness. *Journal of Comparative Policy Analysis: Research and Practice*, 10(3):309–322, 2008.

A. Civelli. International real business cycles, portfolio diversification and valuation effects. *Princeton University Working Paper*, 2008.

N. Coeurdacier. Do trade costs in goods market lead to home bias in equities? *Journal of International Economics*, 2008.

N. Coeurdacier and P. O. Gourinchas. When bonds matter: Home bias in goods and assets. *Manuscript, London Business School*, 2008.

N. Coeurdacier, R. Kollmann, and P. Martin. International portfolios, capital accumulation and foreign assets dynamics. *Journal of International Economics (forthcoming)*, 2009.

H. L. Cole and M. Obstfeld. Commodity trade and international risk sharing. *Journal of Monetary Economics*, 28:3–24, 1991.

M. Dahlquist, L. Pinkowitz, R. Stulz, and R. Williamson. Corporate governance and the home bias. *Journal of Financial and Quantitative Analysis*, 38:87–110, 2003.

J. P. Danthine and J. B. Donaldson. Corporate governance meets macroeconomics: Optimal contracting in general equilibrium. 2005.

P. DeMarzo. Majority voting and corporate control: The rule of the dominant shareholder. *Review of Economic Studies*, 60:713–734, 1993.

P. M. DeMarzo and M. J. Fishman. Optimal long-term financial contracting. *Review of Financial Studies*, 20:2079, 2007.

P. M. DeMarzo and B. Urošević. Ownership dynamics and asset pricing with a large shareholder. *Journal of Political Economy*, 114:774–815, 2006.

M. B. Devereux and A. Sutherland. *Solving for Country Portfolios in Open Economy Macro Models*. Centre for Economic Policy Research, 2006.

M. B. Devereux and A. Sutherland. Country portfolio dynamics. *Discussion Paper Series - Centre for Economic Policy Research, London*, 6208, 2007.

A. Dittmar, J. Mahrt-Smith, and H. Servaes. International corporate governance and corporate cash holdings. *The Journal of Financial and Quantitative Analysis*, 38(1):111–133, 2003.

J. Dow, G. Gorton, and A. Krishnamurthy. Equilibrium investment and asset prices under imperfect corporate control. *American Economic Review*, 95: 659–681, 2005.

A. Dyck and L. Zingales. Private benefits of control: An international comparison. *A Reader in International Corporate Finance*, 59, 2006.

C. Engel and A. Matsumoto. *Portfolio Choice in a Monetary Open-economy DSGE Model*. National Bureau of Economic Research Cambridge, Mass., USA, 2006.

M. Evans and V. Hnatkovska. Solving general equilibrium models with incomplete markets and many financial assets. *Georgetown University and University of British Columbia Working Paper*, 2007.

A. Faria and P. Mauro. Institutions and the external capital structure of countries. *Journal of International Money and Finance*, 28(3):367–391, 2009.

A. Faria, P. Mauro, P. Lane, and G. Milesi-Ferretti. The shifting composition of external liabilities. *Journal of the European Economic Association*, 5(2-3): 480–490, 2007.

J. Geanakoplos, M. Magill, M. Quinzii, and J. Dreze. Generic inefficiency of stock market equilibrium when markets are incomplete. *Journal of Mathematical Economics*, 19:113–151, 1990.

I. Goldstein and A. Razin. An information-based trade off between foreign direct investment and foreign portfolio investment. *Journal of International Economics*, 70:271–295, 2006.

S. J. Grossman and J. E. Stiglitz. On value maximization and alternative objectives of the firm. *The Journal of Finance*, 32:389–402, 1977.

S. J. Grossman and J. E. Stiglitz. Stockholder unanimity in making production and financial decisions. *Quarterly Journal of Economics*, 94:543–66, 1980.

J. Heathcote and F. Perri. Financial globalization and real regionalization. *Journal of Economic Theory*, 119:207–243, 2004.

J. Heathcote and F. Perri. The international diversification puzzle is not as bad as you think. *University of Minnesota and Federal Reserve Bank of Minneapolis Working Paper*, 2009.

A. Heston, R. Summers, and B. Aten. *Penn World Table Version 6.2*. Center for International Comparisons of Production, Income and Prices at the University of Pennsylvania, September 2006.

M. C. Jensen. Agency costs of free cash flow. *American Economic Review*, 76: 323–329, 1986.

K. L. Judd. *Numerical Methods in Economics*. MIT Press, 1998.

K. L. Judd and S. M. Guu. Asymptotic methods for asset market equilibrium analysis. *Economic Theory*, 18:127–157, 2001.

S. Kalemli-Ozcan, L. Alfaro, and V. Volosovych. Why doesn't capital flow from poor to rich countries? an empirical investigation. *Review of Economics and Statistics*, 90, 2008.

D. Kaufmann, A. Kraay, and M. Mastruzzi. Governance matters VII: aggregate and individual indicators, 1996-2007. *World Bank Policy Research Paper*, 4654, 2008.

P. J. Kehoe and F. Perri. International business cycles with endogenous incomplete markets. *Econometrica*, 70(3):907–928, 2002.

D. Kelsey and F. Milne. The existence of equilibrium in incomplete markets and the objective function of the firm. *Journal of Mathematical Economics*, 25:229–245, 1996.

B. C. Kho, R. M. Stulz, F. E. Warnock, Monetary, E. Dept, and B. for International Settlements. *Financial Globalisation, Governance and the Evolution of the Home Bias*. Bank for International Settlements, 2006.

E. H. Kim and A. Durnev. To steal or not to steal: Firm attributes, legal environment, and valuation. *The Journal of Finance*, 60:1461–1493, 2005.

J. Kim and S. H. Kim. Spurious welfare reversals in international business cycle models. *Journal of International Economics*, 60:471–500, 2003.

M. A. Kose, E. S. Prasad, and M. E. Terrones. Does financial globalization promote risk sharing? *Journal of Development Economics*, 89(2):258–270, 2009.

A. Kraay, N. Loayza, L. Serven, and J. Ventura. Country portfolios. *Journal of the European Economic Association*, 3(4):914–945, 2005.

P. R. Lane and G. M. Milesi-Ferretti. The external wealth of nations mark ii: Revised and extended estimates of foreign assets and liabilities, 1970-2004. *Journal of International Economics*, 73:223–250, 2007.

R. LaPorta, F. Lopez-De-Silanes, A. Shleifer, and R. W. Vishny. Legal determinants of external finance. *The Journal of Finance*, 52:1131–1150, 1997.

R. LaPorta, F. L. de Silanes, A. Shleifer, and R. W. Vishny. Law and finance. *Journal of Political Economy*, 106:1113–1155, 1998a.

R. LaPorta, F. L. de Silanes, A. Shleifer, and R. W. Vishny. Law and finance. *Journal of Political Economy*, 106:1113–1155, 1998b.

R. LaPorta, F. L. de Silanes, and A. Shleifer. Corporate ownership around the world. *Journal of Finance*, 54:471–517, 1999.

R. LaPorta, F. L. de Silanes, A. Shleifer, and R. Vishny. Investor protection and corporate governance. *Journal of Financial Economics*, 58:3–27, 2000a.

R. LaPorta, F. L. de Silanes, A. Shleifer, and R. W. Vishny. Agency problems and dividend policies around the world. *The Journal of Finance*, 55:1–33, 2000b.

R. LaPorta, F. Lopez-De-Silanes, A. Shleifer, and R. Vishny. Investor protection and corporate valuation. *The Journal of Finance*, 57:1147–1170, 2002.

A. Levchenko. Financial liberalization and consumption volatility in developing countries. *IMF Staff Papers*, 52(2), 2005.

H. Levy and M. Sarnat. International diversification of investment portfolios. *The American Economic Review*, 60:668–675, 1970.

K. K. Lewis. Trying to explain home bias in equities and consumption. *Journal of Economic Literature*, 37:571–608, 1999.

T. Nenova. The value of corporate voting rights and control: A cross-country analysis. *Journal of Financial Economics*, 68:325–351, 2003.

S. V. Nieuwerburgh and L. Veldkamp. Information immobility and the home bias puzzle. *The Journal of Finance*, 64(3):1187–1215, 2009.

T. Philippon. Corporate governance over the business cycle. *Journal of Economic Dynamics and Control*, 30:2117–2141, 2006.

S. Schmitt-Grohe and M. Uribe. Closing small open economies. *Journal of International Economics*, 61:163–185, 2003.

S. Schmitt-Grohé and M. Uribe. Solving dynamic general equilibrium models using a second-order approximation to the policy function. *Journal of Economic Dynamics and Control*, 28:755–775, 2004.

A. Shleifer. Do demand curves for stocks slope down? *Journal of Finance*, 41: 579–590, 1986.

A. Shleifer and D. Wolfenzon. Investor protection and equity markets. *Journal of Financial Economics*, 66:3–27, 2002.

B. E. Sørensen, Y. T. Wu, O. Yosha, and Y. Zhu. Home bias and international risk sharing: Twin puzzles separated at birth. *Journal of International Money and Finance*, 26:587–605, 2007.

A. C. Stockman and L. L. Tesar. Tastes and technology in a two-country model of the business cycle: Explaining international comovements. *The American Economic Review*, 85:168–185, 1995.

L. L. Tesar and I. M. Werner. Home bias and high turnover. *Journal of International Money and Finance*, 14:467–492, 1995.

C. Tille and E. V. Wincoop. International capital flows. *University of Virginia Working Paper*, 2008.

R. Uppal. A general equilibrium model of international portfolio choice. *Journal of Finance*, pages 529–553, 1993.

E. van Wincoop and F. E. Warnock. Is home bias in assets related to home bias in goods? *NBER Working Paper 12728*, 2006.

L. Ventura. Investment decisions and normalization with incomplete markets: A pitfall in aggregating shareholders preferences. *International Journal of Business*, 3:21–28, 2004.

F. E. Warnock. Home bias and high turnover reconsidered. *Journal of International Money and Finance*, 21:795–805, 2002.

WorldBank. World development indicators. 2008.

7 Appendices

7.1 Appendix A

7.1.1 Data sources

Table 2: Data sources

Source paper	Data	Countries	Coverage
Lane and Milesi-Ferretti (2007)	External wealth	145	1970-2004
Heston et al. (2006)	Capital stock, Investment	188	1950-2004
Kho et al. (2006)	Insider ownership	46	1994, 2004
LaPorta et al. (1998b)	Governance	49	NA
Kaufmann et al. (2008)	Governance	212	1996-2007
WorldBank (2008)	Trade, GDP; Financial development	126; 104	Variable

7.1.2 Samples

Sample 1: Intersection of set of countries used in LaPorta et al. (1998b), and covered by WorldBank (2008), excluding financial centers Ireland and Switzerland (total FA + FL $>$ 150% of GDP). 43 countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Colombia, Denmark, Ecuador, Egypt, Finland, France, Germany, Greece, India, Indonesia, Israel, Italy, Japan, Jordan, Kenya, Malaysia, Mexico, Netherlands, New Zealand, Nigeria, Norway, Pakistan, Peru, Philippines, Portugal, Singapore, South Africa, Spain, Sri Lanka, Sweden, Thailand, Turkey, United Kingdom United States, Uruguay and Zimbabwe. The original LaPorta et al. (1998b) sample covers 49 countries from Europe, North and South America, Africa, Asia, and Australia. There are no socialist or transition economies in their sample. A country is selected for inclusion by them, if, on the basis of the WorldScope sample of 15,900 firms from 33 countries and the Moodys International sample of 15,100 non-U.S. firms from 92 countries, that country had at least 5 domestic nonfinancial publicly traded firms with no government ownership in 1993.

Sample 2: This sample is used to test if worse institutions affect portfolios primarily through increasing insider ownership and decreasing the float portfolio. Intersection of set of countries used in Kho et al. (2006), and covered by WorldBank (2008), excluding financial centers Ireland, Luxembourg and Switzerland (total FA + FL $>$ 150% of GDP). 34 countries are: Argentina, Australia, Austria, Belgium, Brazil, Canada, Chile, Denmark, Finland, France, Germany, Greece, India, Indonesia, Israel, Italy, Japan, Malaysia, Mexico, Netherlands, New Zealand, Norway, Pakistan, Peru, Poland, Portugal, Singapore, South Africa, Spain, Sweden, Thailand, Turkey, United Kingdom and United States.

7.1.3 Correlations between governance indices and dependent variables

The following table shows the correlations between my dependent variables, which are foreign assets and liabilities as a fraction of GDP (Lane and Milesi-Ferretti (2007)), and the six components of my institutional quality measure, taken from Kaufmann et al. (2008). All six measures show high correlation with the dependent variables, except for "voice". Thus the relationship between the institutional quality measure, which is the simple average of the six measures, and the dependent variables is not likely to be driven by a single measure.

Table 3: Pairwise correlations of dependent variables and individual components of the institutional quality index (for Sample 1)

	$\frac{FA+FL}{GDP}$	$\frac{FA}{GDP}$	$\frac{FL}{GDP}$
General governance	0.7018	0.7267	0.6222
Corruption	0.6809	0.7029	0.6064
Rule of law	0.6088	0.6367	0.5320
Political stability	0.6023	0.6141	0.5461
Regulations	0.6611	0.6633	0.6129
Voice	0.4686	0.5033	0.3927

The following table shows that the institutional quality measure is correlated with the measures constructed by LaPorta et al. (1998b). The measure seeks to capture those aspects of general institutional quality which facilitate contract enforcement between outside investors and insiders. It should be noted here that the anti-director index and the creditor-rights index constructed by LaPorta et al. (1998b), which are more direct measures of investor protection and creditor protection respectively, are weakly correlated with the above measures. This is because the *presence* of protective laws is related to the legal origin of the country. I place more importance on institutional quality as a good proxy for the *enforcement* of rules.

Table 4: Pairwise correlations of institutional quality index and select indices from LaPorta et al. (1998b) (for Sample 1)

	rulelaw	repud	riskexp	account	effjud
Institutional quality	0.94	0.90	0.90	0.52	0.69

Table 5: Pairwise correlations of dependent and independent variables. FA: Foreign FDI and Portfolio Assets, FL: Foreign FDI and Portfolio Liabilities

	$\frac{FA+FL}{GDP}$	$\frac{FA}{GDP}$	$\frac{FL}{GDP}$
Institutional quality	0.6458	0.7217	0.5224
GDP	0.6211	0.6944	0.5022
Per capita GDP	0.5840	0.6491	0.4755
$\frac{\text{Export+Imports}}{\text{GDP}}$	0.5862	0.6339	0.4932
$\frac{\text{Dom. credit to pvt. sec.}}{\text{GDP}}$	0.6241	0.6662	0.5330

Table 3, 4 and 5. FA: Foreign FDI and Portfolio Assets; FL: Foreign FDI and Portfolio Liabilities; rulelaw: Rule of law; repud: Risk of contract repudiation by government; riskexp: Risk of expropriation by government; account: Accounting standards; effjud: Efficiency of judicial system. Data source: LaPorta et al. (1998b), Lane and Milesi-Ferretti (2007), Kaufmann et al. (2008) and WorldBank (2008). Sample: intersection of set of countries used in LaPorta et al. (1998b), and covered by WorldBank (2008), excluding financial centers Ireland, Luxembourg and Switzerland (total FA + FL > 150% of GDP).

Table 6: Ownership Concentration in Low and High Institutional quality nations: two-sample t-test across two groups of countries with below and above median quality of institutions

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf.	Interval]
low (0)	19	.5462579	.0342863	.1494505	.4742251	.6182907
high (1)	18	.3990222	.0395198	.1676683	.3156427	.4824017
combined	37	.4746297	.0284791	.1732316	.4168714	.532388
diff		.1472357	.0521535		.0413584	.2531129
H_0: diff = 0						d.f.= 35
H_a: diff < 0			H_a: diff ≠ 0			H_a: diff >0
Pr(T < t)	= 0.9961		Pr($\|T\| > \|t\|$)	= 0.0078	Pr(T > t)	= 0.0039

7.1.4 Regressions

Table 7: Foreign assets: OLS regression coefficients with heteroscedasticity-robust standard errors

	(1)	(2)	(3)	(4)	(5)
Institutions	**.045*****(.008)	**.047*****(.009)	**.035****(.016)	**.025****(.012)	**.032*****(.011)
GDP		-.014(.01)	-.023(.015)	-.005(.01)	.007(.012)
GDP p.c.			.004(.005)	.004(.004)	.004(.003)
Trade/GDP				**.002*****(.0004)	**.002*****(.0003)
Fin. dev.					-.0009(.0007)
Constant	-.022(.015)	-.02(.014)	-.019(.015)	**-.124*****(.024)	**-.104*****(.023)
Observations	43	43	43	43	43
Adj. R-squared	0.4807	0.4792	0.4748	0.7168	0.7264

Table 5. Point estimates of regression coefficients with heteroscedasticity-robust standard errors in brackets, rounded to three or four significant digits. Specifications (1), (2), (3), (4) and (5), all with a constant term, consecutively add the regressors mentioned in the first column. Coefficients marked $***$, $**$, and $*$ are significant at 1%, 5%, and 10% respectively. Dependent variable: total foreign portfolio and FDI assets. Independent variables: Institutional quality index is the *square* of the Kaufmann et al. (2008) index normalized such that the country with the lowest score is 0; GDP in trillions of USD; per capita GDP in thousands of USD; trade as percentage of GDP; domestic credit to private sector as percentage of GDP. Data sources: Lane and Milesi-Ferretti (2007), Kaufmann et al. (2008) and WorldBank (2008). Sample: intersection of set of countries used in LaPorta et al. (1998b), and covered by WorldBank (2008), excluding financial centers Ireland, Luxembourg and Switzerland (total FA + FL > 150% of GDP).

Table 8: Foreign liabilities: OLS regression coefficients with heteroscedasticity-robust standard errors

	(1)	(2)	(3)	(4)	(5)
Institutions	**.031*****(.007)	**.034*****(.008)	**.049*****(.011)	**.04*****(.008)	**.045*****(.008)
GDP		**-.023****(.01)	-.011(.012)	.005(.008)	.014(.009)
GDP p.c.			-.005(.004)	**-.005****(.002)	**-.006****(.003)
Trade/GDP				**.002*****(.0002)	**.002*****(.0001)
Fin. dev.					-.0006(.0003)
Constant	**.086*****(.019)	**.09*****(.018)	**.089*****(.018)	-.006(.021)	.008(.023)
Observations	43	43	43	43	43
Adj. R-squared	0.3528	0.3830	0.3912	0.6987	0.7026

Table 6. Point estimates of regression coefficients with heteroscedasticity-robust standard errors in brackets, rounded to three or four significant digits. Specifications (1), (2), (3), (4) and (5), all with a constant term, consecutively add the regressors mentioned in the first column. Coefficients marked $***$, $**$, and $*$ are significant at 1%, 5%, and 10% respectively. Dependent variable: total foreign portfolio and FDI liabilities. Independent variables: Institutional quality index is the *square* of the Kaufmann et al. (2008) index normalized such that the country with the lowest score is 0; GDP in trillions of USD; per capita GDP in thousands of USD; trade as percentage of GDP; domestic credit to private sector as percentage of GDP. Data sources: Lane and Milesi-Ferretti (2007), Kaufmann et al. (2008) and WorldBank (2008). Sample: intersection of set of countries used in LaPorta et al. (1998b), and covered by WorldBank (2008), excluding financial centers Ireland, Luxembourg and Switzerland (total FA + FL $>$ 150% of GDP).

7.2 Appendix B

7.2.1 Planner's problem

The social planner allocates consumption between outsiders of the two countries taking the sum of income (labor and dividend income) in each period as given (denoted by subscript "eq"). Since the planner has a static allocation problem after the realization of the state s_t, I drop the state notation. Since asset trade takes place between outsiders only, any capital gains do not affect the sum of their incomes.

$$\max_{\{C,C^*\}} U(C, L_{\text{eq}}) + U(C^*, L^*{}_{\text{eq}})$$

subject to,

$$C(s^t) + e_{\text{eq}} C^* = \psi_0 q_{a\,\text{eq}} Y_{a\,\text{eq}} + \psi^*{}_0 q_{b\text{eq}} Y_{b\text{eq}} + (1-\alpha) D_{\text{eq}} + (1-\alpha) e_{\text{eq}} D^*{}_{\text{eq}}$$

The solution to this problems requires

$$\frac{U_C}{U_{C^*}} = \frac{1}{e}$$

Portfolios which yield this allocation of consumption between outsiders will effectively replicate the constrained Pareto efficient allocation in this economy.

7.2.2 Proof of Proposition 1

Consider the budget constraints of the outsiders in the two countries.

$$\begin{aligned} C(s^t) + P(s^t)(\lambda_{NN}(s^t) - \lambda_{NN}(s^{t-1})) + e(s^t)P^*(s^t)(\lambda_{NS}(s^t) - \lambda_{NS}(s^{t-1})) \\ = q_a(s^t)W(s^t)L(s^t) + \lambda_{NN}(s^t)D(s^t) + \lambda_{NS}(s^t)e(s^t)D^*(s^t) \\ C^*(s^t) + \frac{P(s^t)(\lambda_{SN}(s^t) - \lambda_{SN}(s^{t-1}))}{e(s^t)} + P^*(s^t)(\lambda_{SS}(s^t) - \lambda_{SS}(s^{t-1})) \\ = q_a(s^t)W(s^t)L(s^t) + \frac{\lambda_{SN}(s^t)D(s^t)}{e(s^t)} + \lambda_{SS}(s^t)D^*(s^t) \end{aligned}$$

With time invariant optimal portfolio shares the budget constraints reduce to

$$\begin{aligned} C(s^t) &= q_a(s^t)W(s^t)L(s^t) + \lambda_{NN}D(s^t) + \lambda_{NS}e(s^t)D^*(s^t) \\ C^*(s^t) &= q_b(s^t)W^*(s^t)L^*(s^t) + \frac{\lambda_{SN}D(s^t)}{e(s^t)} + \lambda_{SS}D^*(s^t) \end{aligned}$$

Using the first order conditions for employment and stealing from the insiders' problem,

$$\begin{aligned} W(s^t)L(s^t) &= \frac{1-\theta}{\alpha}\Big(\alpha + \frac{(1-\alpha)^2}{2\eta}\Big)Y_a(s^t) \\ W^*(s^t)L^*(s^t) &= \frac{1-\theta}{\alpha}\Big(\alpha + \frac{(1-\alpha)^2}{2\eta}\Big)Y_b(s^t) \\ f(s^t) &= \frac{1-\alpha}{\eta} \\ f^*(s^t) &= \frac{1-\alpha}{\eta} \end{aligned}$$

the dividend flows

$$\begin{aligned} D(s^t) &= q_a(s^t)[\{1-f(s^t)\}\{Y_a(s^t)\} - W(s^t)L(s^t)] - \{K(s^t) - (1-\delta)K(s^{t-1})\} \\ D^*(s^t) &= q_b(s^t)[\{1-f^*(s^t)\}\{Y_b(s^t)\} - W^*(s^t)L^*(s^t)] - \{K^*(s^t) - (1-\delta)K^*(s^{t-1})\} \end{aligned}$$

can be written as

$$D(s^t) = q_a(s^t)Y_a(s^t)[\psi_1 - \psi_0] - I(s^t)$$
$$D^*(s^t) = q_b(s^t)Y_b(s^t)[[\psi_1 - \psi_0]] - I^*(s^t)$$

where

$$\psi_0 = (1-\theta)\{1 + \frac{(1-\alpha)^2}{2\alpha\eta}\}$$
$$\psi_1 = \frac{\eta + \alpha - 1}{\eta}$$

Thus the budget constraints reduce to

$$C(s^t) = \psi_0 y(s^t) + \lambda_{NN}[(\psi_1 - \psi_0)y(s^t) - I(s^t)] + \lambda_{NS}e(s^t)[(\psi_1 - \psi_0)y^*(s^t) - I^*(s^t)]$$
$$C^*(s^t) = \psi_0 y^*(s^t) + \frac{\lambda_{SN}}{e(s^t)}[(\psi_1 - \psi_0)y(s^t) - I(s^t)] + \lambda_{SS}[(\psi_1 - \psi_0)y^*(s^t) - I^*(s^t)]$$

where, for notational simplicity, I have

$$I(s^t) = K(s^t) - (1-\delta)K(s^{t-1})$$
$$I^*(s^t) = K^*(s^t) - (1-\delta)K^*(s^{t-1})$$
$$y(s^t) = q_a(s^t)Y_a(s^t)$$
$$y^*(s^t) = q_b(s^t)Y_b(s^t)$$

With logarithmic utility, the planner's constrained Pareto efficient consumption allocations are

$$C(s^t) = e(s^t)C^*(s^t)$$

If there exists a portfolio share λ such that this condition holds for all states, then λ must satisfy

$$C(s^t) - e(s^t)C^*(s^t) = [\psi_0 + (\psi_1 - \psi_0)(2\lambda + \alpha - 1)]\{y(s^t) - e(s^t)y^*(s^t)\} - (2\lambda + \alpha - 1)\{I(s^t) - e(s^t)I^*(s^t)\} = 0$$

where I have expressed all portfolio shares in terms of λ by using symmetry and market clearing in asset markets, which imply

$$\lambda_{NN} = \lambda$$
$$\lambda_{SN} = 1 - \alpha - \lambda$$
$$\lambda_{NS} = 1 - \alpha - \lambda$$
$$\lambda_{SS} = \lambda$$

Now,

$$\begin{aligned} y(s^t) &= q_a(s^t)Y_a(s^t) \\ &= q_a(s^t)\{a(s^t) + a^*(s^t)\} \\ &= \omega Y(s^t) + (1-\omega)e(s^t)Y^*(s^t) \end{aligned}$$

and

$$\begin{aligned} y^*(s^t) &= q_b(s^t)Y_b(s^t) \\ &= q_b(s^t)\{b(s^t) + b^*(s^t)\} \\ &= (1-\omega)\frac{Y(s^t)}{e(s^t)} + \omega Y^*(s^t)\} \end{aligned}$$

Henceforth for all variables x, $\Delta x(s^t)$ denotes the value of $x(s^t) - e(s^t)x^*(s^t)$. Therefore

$$\begin{aligned}\Delta y(s^t) &= y(s^t) - e(s^t)y^*(s^t) \\ &= (2\omega - 1)\{Y(s^t) - e(s^t)Y^*(s^t)\} \\ &= (2\omega - 1)\Delta Y(s^t)\end{aligned}$$

Using the final-goods market-clearing conditions and the expression for the insiders' consumption demand

$$\begin{aligned}Y(s^t) &= C(s^t) + K(s^t) - (1-\delta)K(s^{t-1}) + M(s^t) + \Phi(s^t) \\ Y^*(s^t) &= C_{m^*}(s^t) + K^*(s^t) - (1-\delta)K^*(s^{t-1}) + M^*(s^t) + \Phi^*(s^t) \\ M(s^t) &= \alpha D(s^t) + q_a(s^t)f(s^t)Y_a(s^t) - \Phi(s^t) \\ M^*(s^t) &= \alpha D^*(s^t) + q_b(s^t)f^*(s^t)Y_b(s^t) - \Phi^*(s^t)\end{aligned}$$

together with the expressions for the optimal stealing fraction and dividends, we have

$$\begin{aligned}\Delta y(s^t) &= (2\omega - 1)\Delta Y(s^t) \\ &= (2\omega - 1)[\Delta C(s^t) + \Delta I(s^t) + \{\alpha\theta + \frac{(1+\theta)(1-\alpha)^2}{2\eta}\}\Delta y(s^t) - \alpha\Delta I(s^t)\end{aligned}$$

This gives after some algebra

$$\Delta y(s^t) = \frac{(2\omega - 1)}{\psi_2}\{\Delta C(s^t) + (1-\alpha)\Delta I(s^t)\}$$

where

$$\psi_2 = 1 - (2\omega - 1)\{\alpha\theta + \frac{(1+\theta)(1-\alpha)^2}{2\eta}\}$$

Now, plugging in the value of $\Delta y(s^t)$ in the expression for $\Delta C(s^t)$, we get, for some constant μ

$$\mu\Delta C(s^t) = [{\psi_2}^{-1}(1-\alpha)(2\omega - 1)\{\psi_0 + (\psi_1 - \psi_0)(2\lambda + \alpha - 1)\} - (2\lambda + \alpha - 1)]\Delta I(s^t)$$

This expression gives us the value of the portfolio share, λ, that will ensure that the complete markets condition, $\Delta C(s^t) = 0$, holds for all states. The value of λ is calculated by simply assuming this the condition holds, and then solving for λ.
This completes the proof of Proposition 1 in section (4.2).

7.2.3 Proof of Proposition 2

Since portfolio shares are constant, consumption of Northern and Southern outsiders can be written as,

$$\begin{aligned}C(s^t) &= q_a(s^t)W(s^t)L(s^t) + \lambda_{NN}D(s^t) + \lambda_{NS}e(s^t)D^*(s^t) \\ C^*(s^t) &= q_b(s^t)W^*(s^t)L^*(s^t) + \frac{\lambda_{SN}D(s^t)}{e(s^t)} + \lambda_{SS}D^*(s^t)\end{aligned}$$

Denote $q_a(s^t)W(s^t)L(s^t)$ by $\mathbb{L}$ and $q_b(s^t)W^*(s^t)L^*(s^t)$ by $\mathbb{L}^*$. λ ensures that

$$C(s^t) = e(s^t)C^*(s^t)$$

Plugging in the values for consumption and log-linearizing the above relationship around the symmetric steady-state we get,

$\bar{\mathbb{L}}\hat{\mathbb{L}}+\bar{D}\hat{D}\lambda+\bar{e}\bar{D^*}\hat{D^*}(1-\alpha-\lambda)+\bar{e}\bar{D^*}\hat{e}(1-\alpha-\lambda) = \bar{e}\bar{\mathbb{L}^*}\hat{\mathbb{L}^*}+\bar{e}\bar{\mathbb{L}^*}\hat{e}+\bar{D}\hat{D}(1-\alpha-\lambda)+\bar{e}\bar{D^*}\hat{D^*}\lambda+\bar{e}\bar{D^*}\hat{e}\lambda$

Gathering terms and noting that $\bar{D^*} = \bar{D}$, $\bar{L^*} = \bar{L}$, $\bar{e} = 1$ in a symmetric equilibrium we get

$$(2\lambda+\alpha-1)\bar{D}(\hat{D}-\hat{e}-\hat{D^*}) = \bar{\mathbb{L}}(\hat{\mathbb{L}}-\hat{e}-\hat{\mathbb{L}^*})$$

Denoting $(\hat{D}-\hat{e}-\hat{D^*})$ as $\Delta\hat{D}$ and $(\hat{\mathbb{L}}-\hat{e}-\hat{\mathbb{L}^*})$ as $\Delta\hat{\mathbb{L}}$ we get

$$(2\lambda+\alpha-1)\bar{D}\Delta\hat{D} = \bar{\mathbb{L}}\Delta\hat{\mathbb{L}}$$

which gives,

$$(2\lambda+\alpha-1) = -\frac{\bar{\mathbb{L}}}{\bar{D}}\frac{\text{cov}(\Delta\hat{\mathbb{L}},\Delta\hat{D})}{\text{var}(\Delta\hat{D})}$$

Solving for λ gives the result.

7.3 Appendix C

7.3.1 The steady-state with symmetric countries (and Cobb-Douglas)

If the countries are ex-ante symmetric, then $\{q_a^{ss}, q_a^{*ss}, q_b^{ss}, q_b^{*ss}\}$ simply reduce to

$$q_a^{ss} = \omega^\omega(1-\omega)^{1-\omega} \tag{7.1}$$
$$q_a^{*ss} = \omega^\omega(1-\omega)^{1-\omega} \tag{7.2}$$
$$q_b^{ss} = \omega^\omega(1-\omega)^{1-\omega} \tag{7.3}$$
$$q_b^{*ss} = \omega^\omega(1-\omega)^{1-\omega} \tag{7.4}$$

and $L^{ss} = L^{*ss}$, $\psi_0 = \psi_0^*$, $\psi_1 = \psi^*{}_1$. Thus the non-stochastic steady-state values of all other variables can be expressed in terms of just L^{ss} when the countries are symmetric. The quantity variables are

$$K^{ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0 q_a^{ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}}L^{ss} \tag{7.5}$$

$$K^{*ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0^* q_b^{*ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}}L^{*ss} \tag{7.6}$$

$$Y_a^{ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^\omega(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}}L^{ss} \tag{7.7}$$

$$Y_b^{ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^\omega(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}}L^{ss} \tag{7.8}$$

$$a^{ss} = \omega Y_a^{ss} = \omega\Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^\omega(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}}L^{ss} \tag{7.9}$$

$$a^{*ss} = (1-\omega)Y_a^{ss} = (1-\omega)\Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^\omega(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}}L^{ss} \tag{7.10}$$

$$b^{ss} = (1-\omega)Y_a^{ss} = (1-\omega)\Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^\omega(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}}L^{ss} \tag{7.11}$$

$$b^{*ss} = \omega Y_a^{ss} = \omega\Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^\omega(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}}L^{ss} \tag{7.12}$$

$$Y^{ss} = q_a^{ss} Y_a^{ss} \;=\; \omega^{\omega}(1-\omega)^{1-\omega}\Big[\frac{\theta}{1-\theta}\frac{\psi_0 \omega^{\omega}(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}} L^{ss} \tag{7.13}$$

$$Y^{*ss} = q_b^{*ss} Y_b^{ss} \;=\; \omega^{\omega}(1-\omega)^{1-\omega}\Big[\frac{\theta}{1-\theta}\frac{\psi_0 \omega^{\omega}(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}} L^{ss} \tag{7.14}$$

$$D^{ss} = \Big[\frac{(1-\theta)}{\theta}\frac{(\psi_1-\psi_0)}{\psi_0}(\frac{1}{\beta}+\delta-1)-\delta\Big]K^{ss} \tag{7.15}$$

$$D^{*ss} = \Big[\frac{(1-\theta)}{\theta}\frac{(\psi_1-\psi_0)}{\psi_0}(\frac{1}{\beta}+\delta-1)-\delta\Big]K^{ss} \tag{7.16}$$

$$C^{ss} = (1-\alpha)D^{ss} + q_a^{ss} W^{ss} L^{ss} \tag{7.17}$$

$$C^{*ss} = (1-\alpha)D^{*ss} + q_b^{*ss} W^{*ss} L^{*ss} \tag{7.18}$$

$$M^{ss} = \alpha(\frac{1}{\beta}-1)K^{ss} \tag{7.19}$$

$$M^{*ss} = \alpha^{*}(\frac{1}{\beta}-1)K^{*ss} \tag{7.20}$$

$$I^{ss} = \delta K^{ss} \;=\; \delta\Big[\frac{\theta}{1-\theta}\frac{\psi_0 q_a^{ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{ss} \tag{7.21}$$

$$I^{*ss} = \delta K^{*ss} \;=\; \delta\Big[\frac{\theta}{1-\theta}\frac{\psi_0^{*} q_b^{*ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{*ss} \tag{7.22}$$

The parameters η and η^* are selected such that steady state dividends are positive. In particular

$$\eta > \frac{(1-\alpha)\{\theta(1-\alpha)(1-\frac{1}{\beta})-(2-\alpha)(\frac{1}{\beta}+\delta-1)\}}{(1-2\alpha)(\frac{1}{\beta}+\delta-1)+2\alpha\theta(\frac{1}{\beta}-1)}$$

$$f^{ss} = \frac{1-\alpha}{\eta} \tag{7.23}$$

$$f^{*ss} = \frac{1-\alpha^{*}}{\eta^{*}} \tag{7.24}$$

and the other prices are

$$P^{ss} = \frac{\beta}{1-\beta} D^{ss} \tag{7.25}$$

$$P^{*ss} = \frac{\beta}{1-\beta} D^{*ss} \tag{7.26}$$

$$R^{ss} = \frac{1}{\beta} - 1 \tag{7.27}$$

$$R^{*ss} = \frac{1}{\beta} - 1 \tag{7.28}$$

$$W^{ss} = \psi_0 \frac{K^{ss\,\theta}}{L^{ss}} \tag{7.29}$$

$$W^{*ss} = \psi_0^{*} \frac{K^{*ss\,\theta}}{L^{*ss}} \tag{7.30}$$

$$e^{ss} = 1 \tag{7.31}$$

As in other models with portfolio selection like Devereux and Sutherland (2007) and Heathcote and Perri (2009), the value of portfolios in the non-stochastic steady-state is indeterminate. With ex-ante symmetric countries, any symmetric value of $\{\lambda_{NN}, \lambda_{SS}\}$ is an equilibrium, so that

$$\lambda_{NN} = \lambda_{SS} \in [0,1] \tag{7.32}$$
$$\lambda_{SN} = 1 - \alpha - \lambda_{NN} \tag{7.33}$$
$$\lambda_{NS} = 1 - \alpha^* - \lambda_{SS} \tag{7.34}$$

As a reminder

$$\psi_0 = (1-\theta)\{1 + \frac{(1-\alpha)^2}{2\alpha\eta}\}$$
$$\psi_1 = \frac{\eta + \alpha - 1}{\eta}$$

7.3.2 The steady-state with asymmetric countries

The steady-state value of $\{K^{ss}, K^{*ss}\}$ can be expressed in terms of $\{q_a^{ss}, q_a^{*ss}, q_b^{ss}, q_b^{*ss}\}$, and $\{L^{ss}, L^{*ss}\}$, the latter pair being calibrated to the data.

$$K^{ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0 q_a^{ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{ss} \tag{7.35}$$
$$K^{*ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0^* q_b^{*ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{*ss} \tag{7.36}$$

Substituting in the production function for intermediate goods we get

$$Y_a^{ss} = K^{ss\theta} L^{ss\,1-\theta} \;=\; \Big[\frac{\theta}{1-\theta}\frac{\psi_0 q_a^{ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}} L^{ss} \tag{7.37}$$
$$Y_b^{ss} = K^{*ss\theta} L^{*ss\,1-\theta} \;=\; \Big[\frac{\theta}{1-\theta}\frac{\psi_0^* q_b^{*ss}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{\theta}{1-\theta}} L^{*ss} \tag{7.38}$$
$$\tag{7.39}$$

and from the definition of dividends, the budget constraints of the four agents, and the final goods resource constraint we have

$$D^{ss} = \Big[\frac{(1-\theta)}{\theta}\frac{(\psi_1 - \psi_0)}{\psi_0}(\frac{1}{\beta}+\delta-1) - \delta\Big]K^{ss} \tag{7.40}$$
$$D^{*ss} = \Big[\frac{(1-\theta)}{\theta}\frac{(\psi^*{}_1 - \psi_0^*)}{\psi_0^*}(\frac{1}{\beta}+\delta-1) - \delta\Big]K^{*ss} \tag{7.41}$$
$$C^{ss} = Y^{ss} - M^{ss} - I^{ss} - \Phi^{ss} \tag{7.42}$$
$$C^{*ss} = Y^{*ss} - M^{*ss} - I^{*ss} - \Phi^{*ss} \tag{7.43}$$
$$M^{ss} = \alpha(\frac{1}{\beta} - 1)K^{ss} \tag{7.44}$$
$$M^{*ss} = \alpha^*(\frac{1}{\beta} - 1)K^{*ss} \tag{7.45}$$
$$\tag{7.46}$$

and the other prices are

$$P^{ss} = \frac{\beta}{1-\beta} D^{ss} \tag{7.47}$$

$$P^{*ss} = \frac{\beta}{1-\beta} D^{*ss} \tag{7.48}$$

$$R^{ss} = \frac{1}{\beta} - 1 \tag{7.49}$$

$$R^{*ss} = \frac{1}{\beta} - 1 \tag{7.50}$$

$$W^{ss} = \psi_0 \frac{K^{ss\,\theta}}{L^{ss}} \tag{7.51}$$

$$W^{*ss} = \psi_0^* \frac{K^{*ss\,\theta}}{L^{*ss}} \tag{7.52}$$

$$\tag{7.53}$$

The trade balance is zero in the steady-state. Using this fact, and the first order conditions for combining intermediate goods, we get

$$a^{ss} = \frac{\omega^\rho}{\omega^\rho + (1-\omega)^\rho} Y_a^{ss} \tag{7.54}$$

$$a^{*ss} = \frac{(1-\omega)^\rho}{\omega^\rho + (1-\omega)^\rho} Y_a^{ss} \tag{7.55}$$

$$b^{ss} = \frac{(1-\omega)^\rho}{\omega^\rho + (1-\omega)^\rho} Y_b^{ss} \tag{7.56}$$

$$b^{*ss} = \frac{\omega^\rho}{\omega^\rho + (1-\omega)^\rho} Y_b^{ss} \tag{7.57}$$

With $\rho = 1$ (Cobb-Douglas) we have

$$q_a^{ss} = \omega^\omega (1-\omega)^{1-\omega} \Big(\frac{K^*}{K}\Big)^{\theta(1-\omega)} \tag{7.58}$$

$$q_a^{*ss} = \omega^\omega (1-\omega)^{1-\omega} \Big(\frac{K^*}{K}\Big)^{\theta\omega} \tag{7.59}$$

$$q_b^{ss} = \omega^\omega (1-\omega)^{1-\omega} \Big(\frac{K}{K^*}\Big)^{\theta\omega} \tag{7.60}$$

$$q_b^{*ss} = \omega^\omega (1-\omega)^{1-\omega} \Big(\frac{K}{K^*}\Big)^{\theta(1-\omega)} \tag{7.61}$$

$$e^{ss} = \Big(\frac{K^*}{K}\Big)^{\theta(1-2\omega)} \tag{7.62}$$

$$t^{ss} = \Big(\frac{K^*}{K}\Big)^{\theta} \tag{7.63}$$

where t is the terms of trade of the North, all in terms of K and K^*. Using the expression connecting K and K^* to q_a and q_b^*, and the first order conditions for intermediate goods usage we get the expression for the steady-state capital stock as

$$K^{ss} = \zeta^{\frac{\zeta_1}{\zeta_1^2-\zeta_2^2}} \zeta^{*\,\frac{\zeta_2}{\zeta_1^2-\zeta_2^2}} \tag{7.64}$$

$$K^{*ss} = \zeta^{\frac{\zeta_2}{\zeta_1^2-\zeta_2^2}} \zeta^{*\,\frac{\zeta_1}{\zeta_1^2-\zeta_2^2}} \tag{7.65}$$

where

$$\zeta = \Big[\frac{\theta}{1-\theta}\frac{\psi_0\omega^{\omega}(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{ss} \tag{7.66}$$

$$\zeta^* = \Big[\frac{\theta}{1-\theta}\frac{\psi_0^*\omega^{\omega}(1-\omega)^{1-\omega}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{*ss} \tag{7.67}$$

$$\zeta_1 = \frac{1-\theta\omega}{1-\theta} \tag{7.68}$$

$$\zeta_2 = \frac{\theta(1-\omega)}{1-\theta} \tag{7.69}$$

Note that we can get symmetric countries as a special case of the above, when $\zeta = \zeta^*$. For the general aggregating function, we have, following the same procedure

$$q_a^{ss} = \Big[\omega^{\rho} + (1-\omega)^{\rho}\Big(\frac{K^*}{K}\Big)^{\frac{\theta(\rho-1)}{\rho}}\Big]^{\frac{1}{\rho-1}} \tag{7.70}$$

$$q_a^{*ss} = \Big[(1-\omega)^{\rho} + \omega^{\rho}\Big(\frac{K^*}{K}\Big)^{\frac{\theta(\rho-1)}{\rho}}\Big]^{\frac{1}{\rho-1}} \tag{7.71}$$

$$q_b^{ss} = \Big[\omega^{\rho}\Big(\frac{K}{K^*}\Big)^{\frac{\theta(\rho-1)}{\rho}} + (1-\omega)^{\rho}\Big]^{\frac{1}{\rho-1}} \tag{7.72}$$

$$q_b^{*ss} = \Big[(1-\omega)^{\rho}\Big(\frac{K}{K^*}\Big)^{\frac{\theta(\rho-1)}{\rho}} + \omega^{\rho}\Big]^{\frac{1}{\rho-1}} \tag{7.73}$$

$$e^{ss} = \Big[\frac{\omega^{\rho}K^{\frac{\theta(\rho-1)}{\rho}} + (1-\omega)^{\rho}K^{*\frac{\theta(\rho-1)}{\rho}}}{(1-\omega)^{\rho}K^{\frac{\theta(\rho-1)}{\rho}} + \omega^{\rho}K^{*\frac{\theta(\rho-1)}{\rho}}}\Big]^{\frac{1}{\rho-1}} \tag{7.74}$$

$$t^{ss} = \Big(\frac{\omega}{1-\omega}\Big)^{1-\rho}\Big(\frac{K^*}{K}\Big)^{\theta} \tag{7.75}$$

and capital stocks are solved from the simultaneous equations

$$K^{ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0\Big[\omega^{\rho} + (1-\omega)^{\rho}\Big(\frac{K^*}{K}\Big)^{\frac{\theta(\rho-1)}{\rho}}\Big]^{\frac{1}{\rho-1}}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{ss} \tag{7.76}$$

$$K^{*ss} = \Big[\frac{\theta}{1-\theta}\frac{\psi_0^*\Big[(1-\omega)^{\rho}\Big(\frac{K}{K^*}\Big)^{\frac{\theta(\rho-1)}{\rho}} + \omega^{\rho}\Big]^{\frac{1}{\rho-1}}}{\frac{1}{\beta}+\delta-1}\Big]^{\frac{1}{1-\theta}} L^{*ss} \tag{7.77}$$

7.4 Appendix D

This section contains descriptions of the numerical algorithms used in the paper.

7.4.1 Algorithm for computing approximate equilibrium for outsiders

1. The first step is to find a point around which to approximate the decision rules. This point is the unique stationary solution to the set of equilibrium conditions of the model, for the case when there is no uncertainty, that is, the scale parameter of the variance of the driving shocks is equal to zero. This is called the non-stochastic steady-state. To ensure stationarity of all variables, and a zero-current account, I follow Schmitt-Grohe and Uribe (2003) in positing a convex portfolio adjustment cost, which pins down a unique non-stochastic steady-state for portfolio variables, and hence for financial wealth. The approximation point for portfolio shares, $(\lambda_{NN}, \lambda_{NS}), (\lambda_{SN}, \lambda_{SS})$ is arbitrary at this juncture, because in the non-stochastic

steady-state, *any* portfolio share which keeps the wealth distribution unchanged with respect to the initial endowment of shares, is an equilibrium. We assume a small convex adjustment cost of changing portfolios from $(\lambda_{NN}, \lambda_{NS}), (\lambda_{SN}, \lambda_{SS})$. This is done to keep the foreign wealth position of each country stationary. As noted by Schmitt-Grohe and Uribe (2003), this modification does not significantly affect the dynamics of other macroeconomic variables at the level of approximation that these models are analyzed. This technique is also used by Heathcote and Perri (2009), and like them I find that the cost of adjustment τ, can be set to an arbitrarily small positive number. Of course, the higher τ is set, the less portfolio shares will diverge from the chosen value of $(\lambda_{NN}, \lambda_{NS}), (\lambda_{SN}, \lambda_{SS})$. In this model, I set τ to be 0.00001% of the un-weighted average steady-state stock price. Thus the budget constraint of the outsider in the North is as follows.

$$C(s^t) + P(s^t)(\lambda_{NN}(s^t) - \lambda_{NN}) + e(s^t)P^*(s^t)(\lambda_{NS}(s^t) - \lambda_{NS}) + \frac{\tau}{2}(\lambda_{NN}(s^t) - \lambda_{NN})^2$$
$$+\frac{\tau}{2}(\lambda_{NS}(s^t) - \lambda_{NS})^2 = q_a(s^t)W(s^t)L(s^t) + \lambda_{NN}(s^{t-1})D(s^t) + \lambda_{NS}(s^{t-1})e(s^t)D^*(s^t) \tag{7.78}$$

The steady-state values of all variables are provided in the previous section.
2. Around the chosen stationary steady-state, I find second-order Taylor series approximation of the optimal dynamics of the control and state variables using the algorithm developed by Schmitt-Grohé and Uribe (2004).

7.4.2 Second-order optimal dynamics

This section provides a brief review of the approximation technique described in Schmitt-Grohé and Uribe (2004), henceforth referred to as SGU, which is used to solve the model.[24] The n equations characterizing the stochastic equilibrium of this economy can be written in the form

$$\mathrm{E_t} f(y_{t+1}, y_t, x_{t+1}, x_t) = 0, \quad \mathrm{f} : \Re^{\mathrm{n_y} \times \mathrm{n_y} \times \mathrm{n_x} \times \mathrm{n_x}} \to \Re^{\mathrm{n}}$$

y is a $n_y \times 1$ vector of control variables and $x = (x_1, x_2)^{'}$ is a $n_x \times 1$ vector of state variables, where x_1 and x_2 are respectively $(n_x - n_\epsilon) \times 1$ and $n_\epsilon \times 1$ vectors of endogenous and exogenous state variables. The non-stochastic steady-state values of the arguments of $f(.)$ are denoted by the set $\{y^{ss}, x^{ss}\}$, and these values can be solved from

$$f(y^{ss}, y^{ss}, x^{ss}, x^{ss}) = 0$$

Lemma 1 *For the dynamic system described in the previous sections, there exists a unique, interior stationary solution for all non-portfolio variables, denoted by* $\{y^{ss}, x^{ss}\}_{(-\lambda)}$.

Proof: See previous section for steady state values. (7.3)

Following the notation of SGU, the solution to the model can be written in the form of two functions, $g(x, \sigma)$ which is the optimal policy function, and $h(x, \sigma)$ which describes the transition of both the endogenous and exogenous states. Thus

$$y = g(x, \sigma)$$
$$x^{'} = h(x, \sigma) + \eta\sigma\epsilon^{'}$$

where η is a $n_x \times n_\epsilon$ matrix, partly zeros, describing the variance-covariance structure of the errors in the exogenous driving variables, which in this case are technology in the Northern and

[24] In general, though the certainty-equivalent non-stochastic steady-state, and first-order approximate solution of the model are the same, they do not coincide with the true stochastic solution. This is because second or higher order terms of the true solution are significant in the presence of uncertainty. See Kim and Kim (2003) and Schmitt-Grohé and Uribe (2004) for further discussions of this point.

Southern intermediate goods sector. The two functions $g(x,\sigma)$ and $h(x,\sigma)$ are approximated up to the second order by writing them as functions of the first and second derivative of the function f in the neighborhood of the approximation point $\{y^{ss}, x^{ss}\}$. By solving a system of linear equations whose co-efficient matrix comprises of these numerical derivatives of the known function f, the SGU algorithm arrives at the functions $g(x,\sigma)$ and $h(x,\sigma)$. The row of the approximated policy function $g(x,\sigma)$ that is of paramount interest to us is the one which specifies stochastic-equilibrium portfolio allocations, $\lambda(x,\sigma)$, as a function of the state variables, and uncertainty. Further details of this method can be found in Schmitt-Grohé and Uribe (2004).[25]

7.4.3 Algorithm for choosing portfolio approximation point

We search in the neighborhood of a set of points $(\lambda_{NN}, \lambda_{SS}) \subset [0,1] \times [0,1]$ for the "correct" (in a sense that will be defined below) portfolio approximation point. We search among those points that keep (non-stochastic) steady-state wealth distribution constant, and the current account balanced.

Lemma 2 *The following locus of portfolios keeps (non-stochastic) steady-state wealth distribution constant, and the current account balanced.*

$$\lambda_{NN} P^{ss} - \lambda_{SS} P^{*ss} e^{ss} = (1-\alpha) P^{ss} - (1-\alpha^*) P^{*ss} e^{ss}$$

Proof: Recall that the non-stochastic steady-state values of all variables except portfolio shares are determinate. Also they are independent of the value of the portfolio shares, for example, labor incomes in any steady-state are independent of λ_{NN} and λ_{NS}. Thus in any two non-stochastic steady-states $(\lambda_{NN}, \lambda_{NS}) \in [0,1] \times [0,1]$, denoted by 1 and 2, we must have

$$\lambda_{hh1} D^{ss} + \lambda_{hf1} D^{*ss} e^{ss} = \lambda_{hh2} D^{ss} + \lambda_{hf2} D^{*ss} e^{ss}$$

In particular

$$\lambda_{NN} D^{ss} + \lambda_{NS} D^{*ss} e^{ss} = (1-\alpha) D^{ss}$$

Using the stock market clearing condition in the North, and the expression for steady-state stock prices, this reduces to the condition in the statement of the lemma. Also note that using the stock market clearing conditions in each country, and the expression for stock steady-state stock prices

$$\lambda_{NN} P^{ss} - \lambda_{SS} P^{*ss} e^{ss} = (1-\alpha) P^{ss} - (1-\alpha^*) P^{*ss} e^{ss} \tag{7.79}$$

$$\Rightarrow \lambda_{SN} P^{ss} = \lambda_{NS} P^{*ss} e^{ss} \tag{7.80}$$

which implies that net steady-state transfers are zero. This means the current account is balanced.

7.4.4 Algorithm for insider's choice of ownership

We are seeking a maximum of the function that maps insider ownership to expected lifetime utility of the insider.

1. Start with an initial distribution of ownership, $\alpha^{*'}$.

2. Use the "golden search" algorithm. Choose an interval for α, say $[\alpha_{\min}, \alpha_{\max}]$.

[25] A possible issue with this approximation technique is that it ignores the possible heteroscedasticity in the endogenous variables (see Evans and Hnatkovska (2007) for a discussion). In the context of this model, this is less of a problem because the feedback mechanism from asset returns, which depend on higher order moments of state variables, to the decisions of the firms is weak because of the insider-outsider dichotomy.

3. Approximate optimal decision rules of economy around steady-state with ownership $\alpha_{\min}$ and $\alpha_{\max}$. Home stock ownership of the Southern insider given by the budget constraint $\alpha_{SN} = \frac{(\alpha^{*'} - \alpha^*)P_0(\alpha^*)}{P_0(\alpha)}$ for each scenario.

4. Simulate economy with above decision rules around $\alpha_{\min}$ and $\alpha_{\max}$. Calculate average utility of insider in simulations. Update interval according to "golden search" algorithm.

5. Repeat till convergence occurs.

7.5 Appendix E

7.5.1 Calibration and variables

Table 9:

Notation	Explanation
Goods	
a	North intermediate good used in North
b	South intermediate good used in North
a^*	North intermediate good used in South
b^*	South intermediate good used in South
Y_a	Total North intermediate good produced
Y_b	Total South intermediate good produced
Price of goods and services	
q_a	North intermediate good price in North
q_b	South intermediate good price in North
q_a^*	North intermediate good price in South
q_b^*	South intermediate good price in South
W, W^*	North, South wages
e	Real exchange rate
t	Terms of trade
Asset market quantities and prices	
P, P^*	North, South stock prices
α, α^*	Insider ownership in the North, South
λ_{NN}	North outsider's ownership of Northern asset
λ_{SN}	South outsider's ownership of Northern asset
λ_{NS}	North outsider's ownership of Southern asset
λ_{SS}	South outsider's ownership of Southern asset
Parameters	
$\beta = 0.99$	Discount factor
$\theta = 0.34$	Capital share
$\delta = 0.025$	Depreciation
$\omega = 0.15$	Import share
$Z(t) = 0.91Z(t-1) + \epsilon(t)$	Domestic shocks
$Z^*(t) = 0.91Z^*(t-1) + \epsilon^*(t)$	Foreign shocks
$\sigma_\epsilon^2 = 0.006^2$	Variance of technology shocks