Entry Costs, Intermediation, and Capital Flows*

Ayşe İmrohoroğlu **Krishna B. Kumar**

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Abstract

In this paper, we reexamine the question "Why doesn't capital flow from rich to poor countries?" posed, most recently, by Lucas (1990). We build a simple contracting framework where costly intermediation together with an adverse selection problem have quantitatively important effects on capital flows. When intermediation costs are ignored, the model behaves much like the neoclassical model in terms of capital returns. However, when intermediation costs are considered, the return for a given amount of capital can be non-monotonic in costs. Therefore, the combination of capital and cost differences across countries gives rise to a rich variation of returns, one that suggests a tendency for capital to flow to middle income countries, as seen in data. Indeed, when we embed the static return function in a two-country dynamic model, there is capital outflow from a poor country that removes capital controls and becomes open. We find that even though the closed economy dominates in terms of capital employed in production, it is the open economy that dominates in terms of income, consumption and welfare.

*Finance and Business Economics, Marshall School of Business, HOH 701, USC, Los Angeles, CA 90089-1427. e-mail: ayse@marshall.usc.edu, kbkumar@usc.edu. We are grateful to Matthias Doepke, Charles Engel, Doug Joines, Robert Lucas, Aris Protopapadakis, Jan Zabojnik and participants at various seminars for helpful comments. Fanghui Song provided excellent research assistance. An earlier version of this paper circulated under the title, "Capital Flows."

1 Introduction

Capital flows that are observed in the world economy do not seem consistent with the predictions of a basic neoclassical model. Many less developed countries with low levels of capital receive very little foreign capital from the rest of the world. The first panel of Figure 1 displays the net private capital flows (which include private debt flows and private nondebt flows such as foreign direct investment and portfolio equity investment), for poor and middle income countries as obtained from The 2000 *World Development Indicators*. Except for 1987, net private capital flows are higher for middle income countries through out the 80s and the 90s. Private net flows as a percent of GDP that are presented in the second panel also show that poor countries received much less capital than the middle income countries during this period. This pattern holds for the 70s, for individual components of private capital flows, and for gross private capital flows as a per cent of GDP.

Overall, it seems safe to conclude that there is little tendency for capital to flow from the rich countries to the poorest countries. Similar observations are outlined in Lucas (1990) who asked why capital does not flow from the rich to poor countries as predicted by the neoclassical model. Indeed, the data seems to suggest that the flow, if anything, is to middle income countries. Moreover, there are, and have been in the past, many countries who have restricted capital flows in and out of their countries. These observations are at odds with the neoclassical model in which returns to capital are predicted to be higher in poor countries with low capital stocks.

In this paper we develop a simple disaggregation of the neoclassical production function based on a model of intermediation of funds between safe and risky projects, when there is *ex ante* heterogeneity of project potential. We assume that entrepreneurs can undertake a project with a tried and tested safe technology or a risky new technology. However, they are born without any endowment except for human capital and have to fund the entry costs as well as capital requirements of the risky projects by borrowing them from the intermediary. We take the view that all countries have access to the same projects, but institutional differences may lead to allocation of capital to inferior projects and affect the return to capital. Thus, the return is determined not only by the level of capital employed but also by the way it is allocated to different uses.

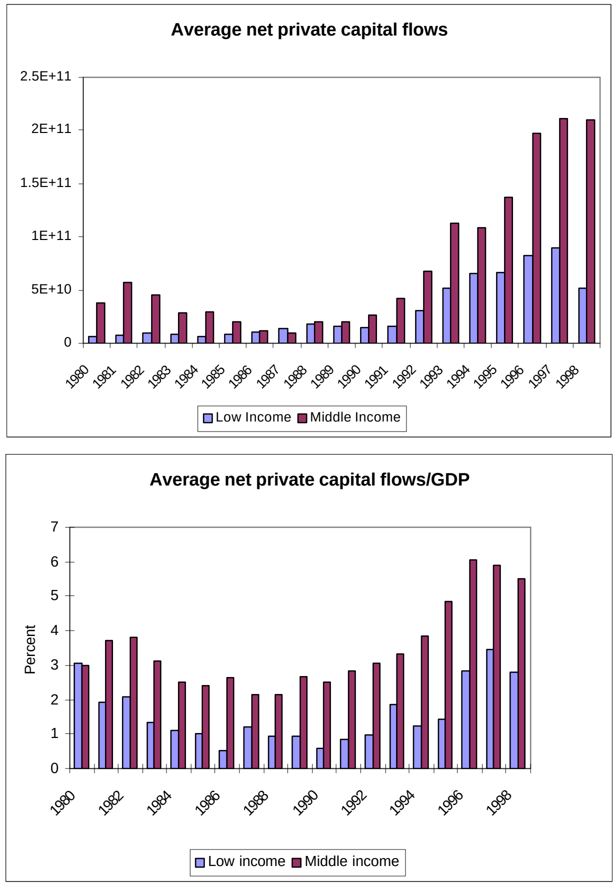

Figure 1: Capital Flows

While there might be a number of institutional details one can model, we focus on the role of financial institutions and government regulations across countries in affecting the allocation of resources. In Figure 2 we present the relationship between "entry regulations" provided by Djankov, La Porta, Silanes, and Shleifer (2001), and PPP-adjusted per capita GDP in 1997 for 84 countries. The data on entry regulations ranks countries with respect to bureaucratic and legal procedures to incorporate and register a new firm. It is based on required procedures that an average small-medium sized company needs to go through before starting operation legally. Countries seem to differ significantly with respect to the regulations concerning the entry of new businesses.[1] There is a strong negative correlation between the level of per-capital income and the "entry costs" presented in Figure 2.

[1] There are four indicators that make up the overall rank: number of procedures, average time spent during each procedure, official cost of each procedure, and minimum capital required which all show significant variance. For example, number of days required to obtain all necessary permits and licences varies between 2 and 168 days; monetary cost of these regulations varies between 0 and 3% of per-capita gross national income and minimum capital requirement varies between 0 and 43% of per-capita gross national income.

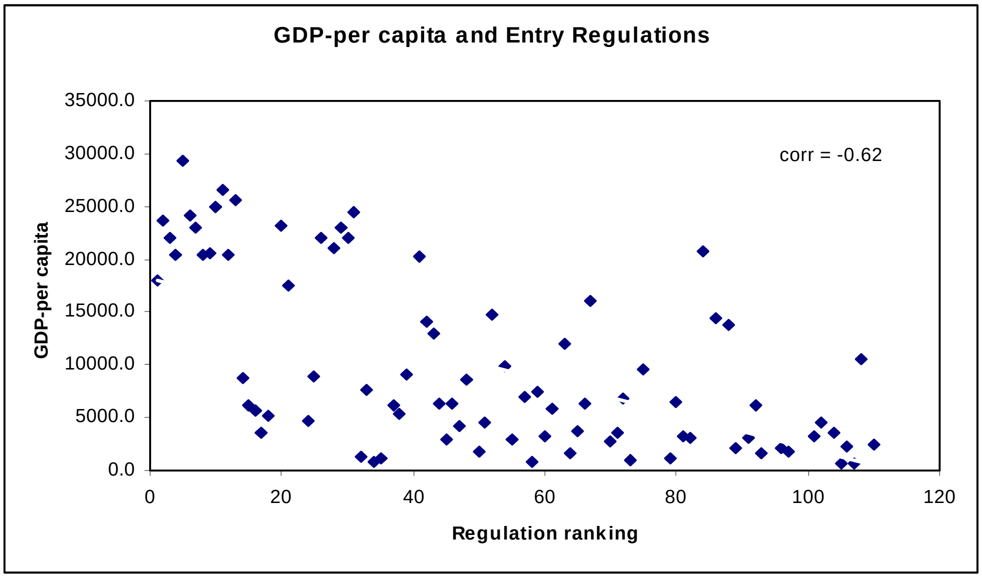

Figure 2: Entry Costs

In Figure 3 we present the relationship between intermediation costs measured as overhead costs as a percent of total loans, and PPP-adjusted per capita GDP in 1997 for 109 countries.[2] A negative relationship between income and cost is discernible. From this evidence we take away the stylized fact that resource costs of intermediation are higher in poorer countries.[3] We use this evidence together with the evidence on "entry regulations" presented in Figure 2 to argue that in poorer countries firms that undertake the risky projects face higher entry costs as well as costs of intermediating funds. In our model, we focus on a single cost parameter, the cost of intermediation, to capture the effect of the two institutional costs, captured in Figures 2 and 3, on the allocation of capital to projects.

[2] The data for intermediation costs are obtained from Beck, Demirgüç-Kunt and Levine (1999). Wages form a big part of overhead costs. For most countries there is data from 1990 to 1997. We plot the average intermedaition cost for the period available on the horizantal axis. These results are similar to the evidence presented in Erosa (2001) who examines data from the United Nations for 1985.

[3] The countries for which both intermediation costs and per capita GDP are both low do not fit this negative pattern. Some of the countries in this range are Egypt, Pakistan, Tunisia, Jordan, and Yemen. It is important to note that the costs as presented here (in the absence of direct evidence on costs), the only type of cross-country data available, should be viewed as resources actually spent on intermediation in equilibrium. If high direct costs of intermediation cause very few projects to be undertaken, one could find costs or resources spent to be very low. As we will see, our model is capable of producing such an outcome. In other words, even though the cost parameters we use in the model stand in for unobserved costs of intermediation, they give rise to equilibrium expenditures which can then be compared with data summarized in Figure 3 for assessing the empirical plausibility of the model.

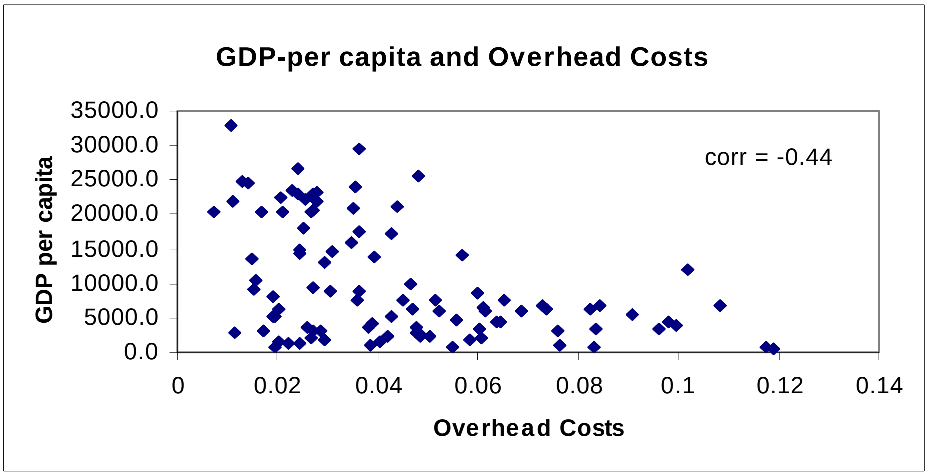

Figure 3: Overhead Costs

The reduced-form production function of our model looks very similar to the standard aggregate neoclassical production function, but its rates of return are endogenously determined based on the mix of safe and risky projects undertaken in response to varying intermediation costs.[4] When intermediation costs are ignored, and variations in the dimension of physical capital alone are considered, the model behaves exactly like the neoclassical model in terms of capital returns where poor countries dominate all other countries in rates of return to capital. However, when intermediation costs are considered two effects emerge. For a given level of capital, when costs increase, there is a substitution of funds from risky to safe projects, which given the neoclassical technology results in a decrease in the marginal return. At the same time there is a decrease in the net funds available for intermediation, which tends to increase the marginal return to capital (an "income effect"). These opposing effects make the return for a given amount of capital non-monotonic in costs and their relative strengths depend on the amount of capital. Therefore, the combination of capital and cost differences across countries gives rise to a rich variation of returns.[5]

The bulk of the paper involves presenting and discussing returns for various, empirically relevant, physical and human capital, and intermediation cost combinations for the above economies taking the capital stock in the 1980s as a starting point. We show that the model is able to quantitatively generate returns that are consistent with the stylized fact on capital flows, where middle income countries dominate in returns over a large range of intermediation costs we think are empirically plausible. The model also produces aggregate measures for intermediation costs to quantity intermediated, bankruptcy costs, and net interest margin

[4]In İmrohoroğlu and Kumar (2003) we show that this environment endogeneously generates TFP differences across countries.

[5]Later we show that a simple modification of the neoclassical model that ignores the effect on the mix of projects requires empirically implausible costs.

that are plausible.

Later, we embed the static return functions we obtain in a two-country dynamic model to get implications on the dynamics of capital flows. Even though the returns at the steady state are the same between this model and the neoclassical model, the transition paths that are implied by the two are significantly different. When we embed the static returns in a two-country dynamic model, we show that unlike the standard model, capital will flow from the richest country to the middle income country rather than to the poorest country - consistent with the data - until an integrated steady state is reached. Indeed the tendency for the poor country is also to invest in the richer country unless they impose controls to prevent capital outflow. The interesting experiment is the one in which the poor country removes capital controls and becomes "open", resulting in a capital *outflow* to the richer country. We compare this transition to that of a closed economy and show that even though the closed economy dominates in terms of capital employed in production, it is the open economy that dominates in terms of income and consumption.

It is important to point out that, there may be various arguments including corruption, sovereign risk, lack of legal institutions etc., that could play a role in explaining why capital doesn't flow to poor countries. However, what we are able to show is that, a small extension of the neoclassical model which incorporates costly intermediation of entry costs may be capable of accounting for the low returns in poor countries. All the other factors can of course enhance these return differences. There are several papers that are related to our work. For example, Zebregs (1999) provides a production function based rationale for capital immobility. In that framework, domestic and foreign capital are imperfect substitutes in production, and have an elasticity of substitution that varies with a country's technology gap with respect to developed countries. Therefore, "both capital-scarce, technologically less-advanced countries, and capital-rich, technologically advanced countries can have lower rates of return to foreign investment."[6] Kraay, Loayza, Serven and Ventura (2000) construct a two-country model which features diminishing returns and production risk, both of which provide incentives for investors in rich countries to invest in poor countries. However, this is countered by sovereign country risk which tempers the flow, especially during times of "crises". They report that twice a century occurrence of international crises is enough to generate empirically plausible flows between the "North", which owns 80% of the total capital stock, and the "South". Gertler and Rogoff (1990) and Boyd and Smith (1997) show that informational frictions may result in funds flowing from poor to rich countries. Informational frictions, while enhancing our results, are not required for them. Our focus is

[6] See Robertson (1999) for another technology based model. In his dual economy model, capital is used only in manufacturing. Low allocation of labor to manufacturing in capital-poor countries can keep the return low.

also more quantitative.[7]

2 Neoclassical Production Function

In this section we present the predictions of the standard neoclassical model, and some of its extensions, with respect to capital returns across countries. These results provide us with a benchmark for future comparisons.

In order to present quantitative results on capital returns that are implied by the neoclassical model, we use per worker capital levels in 1985 from Klenow and Rodriguez-Clare (1997) who report data for 88 countries.[8] We group the countries into quartiles from lowest to highest levels of physical capital per worker which allows us to smooth out highly idiosyncratic country elements. Huge differences in capital per worker, (k), can be seen across countries in the first column of Table 1 where we present the relative level of physical capital per worker averaged across countries within the group. The per worker physical capital in the richest group is about 40 times than that of the poorest group.

Table 1 : Capital and income by quartile

Capital quartile	k	$\mathbf{h}^{1-\alpha}$	k/y
lowest	0.025	0.087	0.472
second	0.090	0.180	0.621
third	0.283	0.338	0.839
highest	1.030	0.619	1.370

Initially, we can compute the static returns to capital for the group of countries displayed in Table 1 by using a neoclassical production function, and assuming that the technology parameter and the capital intensity parameter were same across countries. This can be viewed as an extension of the exercise carried out by Lucas (1990).

Consider the simple neoclassical aggregate production function in its intensive (per unit labor) form for a given country i: $y_i = A_i k_i^{\alpha}$. The return to capital is simply given by the marginal product of capital as $\alpha A_i k_i^{\alpha-1}$. In Table 2 we present the ratios of capital returns of the poorer country groups to that of the richest country group where we take α to be 0.35, a fairly standard value.

[7] There is also a related literature that connects financial intermediation and economic growth and development in general; see, for instance, Greenwood and Jovanovic (1990) for a theoretical exposition, and Levine, Loayza, and Beck (2000) for empirical support. Our focus is on the return to capital and its flow across countries.

[8] Out of the full sample we drop 10 countries who seem to have anomalously high TFP levels relative to the U.S. For example, Syria, Iraq, Trinidad and Tobaga have TFP levels ranging from 20% to 50% higher than that of the U.S.

Table 2 : Capital Returns

Capital quartile	k differences	k & h differences	k/y differences
Lowest (k = 0.025)	11.00	1.54	2.90
Second (k = 0.1)	4.47	1.30	2.21
Third (k = 0.275)	2.31	1.26	1.63
Highest (k = 1)	1	1	1

The relative per worker capital levels roughly correspond to the capital differences in Table 1. According to the results described in the second column of Table 2, if the only difference between countries was in their capital-labor ratios, the return to capital in the lowest income countries would be 11 times higher than the return in the highest income countries. According to these results, all capital would have to flow solely to low income countries. The lack of flows commensurate with such differentials is what motivated Lucas (1990) to ask why capital does not flow from rich to poor countries.

Suppose we now write the above production function as $y_i = Ak_i^{\alpha}h_i^{1-\alpha}$, where h_i is the per worker (or average) human capital in country i, and A is a common technology factor across all countries. The third column of Table 1 presents data on human capital $\left(h^{1-\alpha}\right)$ per-worker across these countries while the third column of Table 2 shows returns to capital for this case. Including differences in human capital reduces the difference in the returns between the richest and poorest countries to a factor of 1.54. The ordering of relative returns is preserved, and all capital should still flow to the poorest countries.

Even if output is written as $y = k^{\alpha}(\cdots)$, where we are agnostic about the other production inputs, one gets the expression for marginal return of capital as $r = \frac{\alpha}{k/y}$. Using the relative capital-to-output ratios for the four quartiles, as calculated from Klenow and Rodriguez (1997) and given in the last column of Table 1, we get the return in the poorest countries to be 2.9 times higher than the return in the highest income countries (last column of Table 2).[9]

2.1 Evaluating Alternate Explanations

Can the pattern of capital flows documented above be explained by differences in depreciation rates, capital intensities, or tax rates across countries– explanations that seem natural alternatives at first glance?

[9] One could proceed further, by assuming A is different across countries as well, but given our objective of using quantities that are directly measurable or estimable, we do not do so. Since A is typically calculated as a residual, using the levels of income, physical capital, and human capital as inputs, it is not clear that much can be gained by calculating capital return using such a measure of A.

What are the differences in depreciation rates between the poorest and richest countries that would be needed to equate returns across them, and thereby eliminate the incentive for capital to flow? We set $\alpha = 0.35$, a capital-output ratio of 3 for the richest quartile country, and use the relative k/y given in Table 1 to compute gross returns according to $r = \frac{\alpha}{k/y}$. For the net return of the lowest quartile countries to be equal to that of the highest quartile countries, their depreciation rate has to be higher by 22 percentage points; the depreciation rate of the second quartile countries has to be higher by 14 percentage points. Assuming a 10% depreciation rate for the richest countries, an average rate of 32% for the group of poorest countries appears too high to justify.

What if capital intensities were different? Similar to the depreciation analysis, we find that α for the highest quartile countries has to exceed the one for the second quartile countries by a factor of 2.2 before their returns are equated. Gollin (2002) presents estimates of capital share for several countries in our sample, though not for those in the lowest quartile. However, the above-mentioned factor in his data never exceeds 1 for his entire sample, and barely exceeds 1, when, as he does, Botswana is dropped.[10]

Restuccia and Urrutia (2001) argue that the high price of investment relative to consumption in poor countries is driven by high investment prices that prevail there. They interpret these high prices as barriers to investment in the economy; in their model, households face a tax rate on each unit of investment. They report investment price ratios for the poorest to rich countries of about 6.5; in other words, pre-tax return to investment has to be more than six times in the poorest country before there is an incentive for capital to flow there. However, in a recent paper, Hsieh and Klenow (2002) include non-traded goods to argue that the high relative price of investment to consumption is driven by lower prices of consumption in poor countries. They conclude, "Investment prices are no higher in poor countries than in rich countries." Here, as in the earlier two explanations, it will be difficult to reconcile returns with capital flows to middle income countries – there is no reason to expect non-monotonicity in depreciation rates, capital intensities, or investment prices across countries. Nevertheless, the connection between barriers and capital flows might be worth pursuing. The costs that we analyze could indeed be interpreted as one barrier to effective capital allocation.

3 The Model Economy

3.1 Individuals

Each economy has an infinitely-lived representative consumer. The consumer has a standard utility function $\sum_{t=0}^{\infty} \beta^t u(c_t)$, where β is the subjective discount factor. The consumer earns

[10] This is consistent with his main point that capital income shares, once properly accounted for, are not very different across countries.

interest income from intermediated capital and has to decide between consumption and saving. When we consider two integrated economies, we assume identical preferences for the consumers in both of them. We assume CRRA preferences, with risk aversion parameter σ.

In each economy, there is a continuum of one-period lived, risk neutral, entrepreneurs whose measure is normalized to one. The entrepreneurs are born without any endowment except for human capital and have to fund the entry costs as well as capital requirements of their projects by borrowing them from the intermediary. They can undertake either a safe project (an "old" technology) or a risky project (a "new" technology); the technology is described in greater detail below. Each entrepreneur is indexed by the potential to succeed in the risky project, which is denoted by a. This "ability" is meant to proxy differences in managerial talent, as well as luck or project potential. We will use the terms "entrepreneurial ability" and "project quality" interchangeably. We normalize $a \epsilon [0,1]$.[11] The distribution of this ability in the population of entrepreneurs is denoted by F, the density of which is given by f, and is assumed to be continuous and strictly positive in $[0,1]$. Entrepreneurs decide on their projects at the beginning of the period, borrow and invest the proceeds, and consume their output net of repayment at the end of the period. Notice that in this economy, physical capital is supplied by consumers and human capital is supplied by entrepreneurs.

3.2 Technology

The entrepreneurs can undertake a project with a tried and tested safe technology ("farm"), or a risky new technology ("factory"). The safe technology operates according to the production function $Y\left(\widetilde{i}\right)$, where $\widetilde{i}$ is the amount of capital employed in the safe technology. The risky technology produces $Y_H(i^*)$, when successful, and $Y_L(i^*)$ when it fails. Here, i^* is the amount of capital employed in the risky technology. We assume $Y_L(i^*) < Y(i^*) < Y_H(i^*)$, $\forall\ i^*$; when the new technology is implemented successfully it yields a higher output than the existing technology, but it can also fail on account of misadoption, problems inherent to untried technologies, and plain bad luck. We will present the model for a general Y_L, but often specialize to the case of $Y_L = 0$. We also assume that the above relationship among the three types of projects also holds for marginal yields: $Y_L'(i^*) < Y'(i^*) < Y_H'(i^*)$, $\forall\ i^*$, and that the three production functions are strictly concave.[12]

[11] We further assume that for any given ability there is a measure one of entrepreneurs. This is a purely technical assumption that allows the law of large numbers to be used in writing the intermediary's objective function.

[12] Obstfeld (1995) cites the work by Lucas (1990) and King and Rebelo (1993) to point out the problem inherent in using the simple neoclassical aggregate production function to calculate returns – it ignores multiple production activities with different capital requirements, a situation that could result in different aggregate capital-output ratios but similar factor returns. Our work stays very close in spirit to the standard neoclassical production function, but by considering a simple disaggregation of production shows one way of avoiding this pitfall.

An entrepreneur of ability a has a probability $\pi(a)$ of succeeding, that is, getting the high output, when the risky project is undertaken. We assume that $0 < \pi(a) < 1$, $\pi'(a) > 0$, and $\pi(0) = 0$. Entrepreneurial ability is irrelevant for the successful execution of a safe project.

3.3 Financial Intermediation

Since there is idiosyncratic risk in this environment, there is a role for intermediation – by pooling risks, an intermediary can guarantee a certain return to a consumer who wants to invest in the entrepreneurs' projects. Consumers, who want to intertemporally smooth their consumption, "deposit" their assets (capital) k_t with the intermediary, who guarantees them a certain rate of return r, at the beginning of time t.

Entry cost, as graphed in Figure 2, and intermediation cost for the risky (new) projects are denoted by a single parameter e. We assume that this cost is borne completely by the entrepreneurs. Given that entrepreneurs are born with no endowment and depend on borrowed funds to start the project, this seems a reasonable assumption to make. Therefore, any entrepreneur who undertakes the risky project will actually borrow $(e + i^*)$ from the intermediary. The safe projects cost nothing to intermediate.[13]

While the type of project undertaken ("farm" versus "factory") is costlessly observable to the financial intermediary, we assume that the ability of the entrepreneur who borrows to invest in a factory is not observable at any cost. The intermediary, therefore, cannot make a loan for a risky project that depends on ability. Instead, the financial contract offered by the intermediary to anyone who undertakes the risky project is given by the pair (i^*, r_r), where i^* is the amount lent, and r_r is the interest rate charged. For the safe project, the intermediary offers loans at any amount at the rate r_s.

Why cannot the intermediary design an ability-varying contract, where agents truthfully announce a, and get a corresponding (i^*, r_r), with both of them varying (presumably increasing) in a? It is easiest to examine this issue when $Y_L = 0$, though in section A.4, we argue that for small enough positive perturbations of Y_L, one could also rule out such contracts. In the zero output case, failure of a risky project will always result in default.

[13] The cost e is best interpreted as the *excess* cost of intermediating a loan for a risky (new) project as opposed to a safe (old) one. The zero cost assumption for safe projects is mainly made for simplicity. While we do not model entry explicitly, we interpret the risky technology as "new" technology that will face higher costs of implementation in poorer economies.

An alternative interpretation is to view the "safe" sector as agriculture. As is well known, in most developed and developing countries, the agricultural sector is often protected. Subsidized credit is one of the tools used for such protection. For example, Gardner (1990, p. 37-38) reports that an emergency loan program established in the mid-1970s in the US, provided more than \$6 billion in subsidized credit to farmers in counties declared as disaster areas. He notes, "In 1997, a year of record large crops, two-thirds of U.S. counties qualified as disaster areas."

The entrepreneur's *ex ante* problem is:

$$\max_{a_C} \ \pi\left(a_T\right)\left\{Y_H\left(i^*\left(a_C\right)\right) - r_r\left(a_C\right) i^*\left(a_C\right)\right\},$$

where a_T is the entrepreneur's true ability, and a_C is the ability that the entrepreneur claims ("announces"). It is obvious that all entrepreneur's will claim the a_C that maximizes profits if successful, irrespective of what their true ability a_T really is. As elaborated in the appendix, the inability to penalize low ability entrepreneurs in the failed state implies that a scheme in which allocations varied systematically with a would unravel.[14]

The sequence of events within a period is as follows. Entrepreneurs sign contracts (borrow) that are appropriate for the projects undertaken. The loan market clears – funds available for investment, k_t, equals the total amount of funds demanded by the safe and risky entrepreneurs (including entry and intermediation costs borne by those who undertake the risky projects). Risky projects succeed or fail. Claims of failure are inspected by the intermediary at a cost μ, which is assumed to be the same for all countries, and any output and all capital are appropriated by the intermediary. Claims of success are accompanied by debt repayment according to the interest stipulated by the contract. Entrepreneurs who undertook the safe projects also repay their debt with interest. Entrepreneurs who undertook the safe project or succeeded in implementing the risky one consume output net of debt repayment; failed entrepreneurs consume nothing. All entrepreneurs die at the end of the period.[15]

Since intermediation occurs within the period, it can be studied in a static setting; that is, we can study how any available amount of capital is intermediated without regard to the determination of the amount itself. The supposition is that the intermediary is a proxy not just for local consumers but anybody who chooses to invest in the country mutual fund including the foreign consumers.

[14]This argument implicitly assumes that entrepreneurs cannot be "bribed"; this, together with limited liability, implies that payoffs to entrepreneurs lie between zero and the output actually produced.

[15]Such a static intermediation structure is also considered by Carlstrom and Fuerst (1998) and Bernanke, Gertler, and Gilchrist (1998), who use the costly verification approach pioneered by Townsend (1979) to study the effect of agency costs in amplifying shocks to net worth. While the model here shares certain features with those models, there are important differences as well. They have only one type of project, a risky one, the productivity of which is unobservable and realized after the investment is made. Claims of default arising from inability to pay are verified at a cost. Such a costly verification reveals the output and hence the type of project ("ability"). In our model, there are two types of projects and the mix of the projects undertaken depends on initial costs and project potential, and all failed projects look alike. Therefore, μ, which is better interpreted as a bankruptcy cost rather than a true verification cost, plays a less important role in our setup.

3.4 A Two-Country Version

Consider an integrated, two country version of this setup – local and foreign (denoted by the superscripts L and F). The two countries differ in their initial physical capital, k_0, human capital, h, and the cost parameter e. Denote the return guaranteed to the depositor by the intermediary of a country by $r_I(k;h,e)$; we will characterize this function in the next section. The implicit assumption is that intermediation is a "non-tradeable" – all evaluation, screening, and monitoring of projects has to be done locally. How valid is this assumption given the prevalence of Foreign Direct Investment (FDI) flows? Fernandez-Arias and Hausmann (2000) note that financing through FDI does not completely preclude local intermediation since foreign companies may "hedge their earnings and protect the value of their assets, or outright speculate, by borrowing in domestic currency and pledging physical capital as collateral."[16] Therefore, in studying the effect of intermediation costs on capital flows, it appears we are not missing a first order or a systematic effect by assuming that all intermediation is done locally.

The total amount of capital *employed* in the local country at any time, denoted by $\widetilde{k_t^L}$, is given by:

$$\widetilde{k_t^L} = k_t^L - D_t^L + D_t^F,$$

where D_t^L is the amount deposited by the local consumers in the foreign mutual fund, and D_t^F is the amount deposited by the foreigners in the local mutual fund. Here k_t^L is the capital *owned* by the local consumers. The condition for the foreign intermediary will be identical with F replacing L and vice-versa.[17]

It is clear that during any period, the following equilibrium condition will hold:

$$r_I\left(\widetilde{k_t^L}; h^L, e^L\right) = r_I\left(\widetilde{k_t^F}; h^F, e^F\right),$$

and at the integrated steady state will be equal to $\rho + \delta$, given consumers' preferences. If we envision an ε transaction cost of investing in a foreign country, it will be the case that only one of the Ds will be positive. (Equivalently, we can interpret the Ds as net flows.) Without loss of generality, assume that $D_t^L = 0$ and $D_t^F > 0$; that is, the local country is the country with higher return initially.

[16] On a related note, Feldstein (1994) reports that by the end of 1989, net external finance from U.S. parent companies for their affiliates abroad was \$227 Billion, while those from non-US sources, mostly in the form of debt, was \$659 Billion.

[17] As will be seen below, the local intermediary's budget constraint is:

$$F\left(a^{*L}\right)\widetilde{i^L} + \left(1 - F\left(a^{*L}\right)\right)\left(e^L + i^{*L}\right) = \widetilde{k_t^L}.$$

4 Analytical Characterization

In this section, we outline the dynamic structure of the two-country model, taking as given the return as a function of capital employed and cost e. It is useful to think of the two country case in the standard neoclassical set up first – in our context, this could be interpreted as having no risky projects available. We then turn to our model with entry and intermediation costs.

The analysis of the (static) return function within an economy is presented subsequently.

4.1 Neoclassical Model

The return in this case can be characterized by $r_I(k_t; h)$, is decreasing in k/h, and is the same function for all countries. At time zero, we assume $k_0^F > k_0^L$ – either both countries are off their closed steady states or only the foreign country is in its closed steady state; implicit in this assumption is that both countries cannot be on their steady states, for there will be no capital flow as $r_I = \rho + \delta$ for both where ρ is the rate of time preference and δ represents the depreciation rate. Given the same $r_I(\cdot)$ for both, it follows that for returns to be equalized, we need:

$$\frac{\widetilde{k_t^L}}{h^L} = \frac{\widetilde{k_t^F}}{h^F} = \frac{k_t^F + k_t^L}{h^L + h^F} \equiv \frac{k_t^W}{h^W}.$$

The share of world capital employed in an economy is dictated by its human capital level. The capital flow is $D_t^F = \frac{h^L k_t^F - h^F k_t^L}{h^W}$. We can write the return as

$$r_t^W\left(k_t^W; h^W\right) = \alpha A\left(k_t^W\right)^{\alpha-1}\left(h^W\right)^{1-\alpha}.$$

Consumer optimization in country i implies the usual condition, $\beta\left(1 + r_{t+1}^W - \delta\right) = \left(\frac{c_{t+1}^i}{c_t^i}\right)^\sigma$. Given the common return, and commonality of the other parameters, it follows that the ratio of consumption in the two countries is the same in all periods. That is, $\frac{c_t^F}{c_t^L} = \frac{c_{t+1}^F}{c_{t+1}^L}$, $\forall\, t$. It is reasonable to conjecture that the share parameters for the two countries are, $s_t^i = \frac{k_t^i}{k_t^W}$; that is given the world quantities for consumption, investment, and capital, individual allocations are given by $c_t^i = s_t^i \cdot c_t^W$, $i_t^i = s_t^i \cdot i_t^W$ and $k_t^i = s_t^i \cdot k_t^W$. Since this implies $\frac{c_t^F}{c_t^L} = \frac{k_t^F}{k_t^L}$, and the consumption ratios are constant at all times, the asset ownership ratios are also constant at all times, and in particular equal to $\frac{k_0^F}{k_0^L}$. Therefore the share parameters are actually time-invariant, $s^i = \frac{k_0^i}{k_0^W}$. It is easy to verify that the individual budget constraints and the constancy of the consumption ratios will be satisfied with these share parameters. In other words, given the homotheticity of preferences and linearity of budget constraints, we can solve the dynamic system for an integrated world equilibrium:

$$\begin{aligned}\beta\left(1+r_{t+1}^{W}\left(k_{t+1}^{W};h^{W}\right)-\delta\right) &= \left(\frac{c_{t+1}^{W}}{c_{t}^{W}}\right)^{\sigma} \\ k_{t+1}^{W} &= (1-\delta)\,k_{t}^{W}+r_{t}^{W}\left(k_{t}^{W};h^{W}\right)k_{t}^{W}-c_{t}^{W},\end{aligned}$$

with the initial world capital $k_0^W = \frac{k_0^F + k_0^L}{2}$ given and r_t^W as given above. This dynamic system can be solved for the time (transition) paths c_t^W, i_t^W, k_t^W, and r_t^W, as well as the corresponding steady state quantities. Once the integrated world equilibrium is solved for, we can compute all quantities for the individual countries. Substitute for the assets owned in terms of the share parameters we can the get capital flow as $D_t^F = \left(h^L s^F - h^F s^L\right) \frac{k_t^W}{h^W}$.

4.2 Model with Entry, Intermediation Costs

Here, the $r_I(\cdot)$ functions are different for both countries. However, it should be possible to compute an integrated equilibrium as in the neoclassical case, with the rate of return for any given world capital, k_t^W, now computed by solving the equation:

$$r_I\left(\widetilde{k_t^L}; h^L, e^L\right) = r_I\left(k_t^W - \widetilde{k_t^L}; h^F, e^F\right).$$

For any given e, the return monotonically decreases in k/h, so the there is a unique allocation of world capital between the two countries that satisfies the above condition.

4.3 Optimal Allocation and Static Returns

We now turn to characterizing $r_I(k_t; e)$ within a country with the cost parameter e. The magnitude of differences in such returns across countries will give us an idea of the incentive for capital to flow across borders when these economies become integrated and serve as a basis for the dynamic analysis discussed above.

It is possible to get a sharper characterization by specializing the production functions to:

$$\begin{aligned}Y\left(\tilde{i}\right) &= A\tilde{i}^{\alpha}h^{1-\alpha} \\ Y_H\left(i^*\right) &= A_H\left(i^*\right)^{\alpha}h^{1-\alpha} \\ Y_L\left(i^*\right) &= A_L\left(i^*\right)^{\alpha}h^{1-\alpha},\end{aligned}$$

with $A_L < A < A_H$, where h is the level of human capital.[18] The capital intensity in the production function, $0 < \alpha < 1$, is assumed to be constant across production functions.

[18] In our experiments there will be no intersectoral differences in human capital within a country. This specification for human capital has the advantages of simplicity, direct comparability with previous studies such as Lucas (1990), and allows one to use estimates of average human capital based on schooling measures, say from Klenow and Rodriguez (1997) or Barro and Lee (1996). However, it does not fully exploit the possibilities of the model. Silva (2002) extends our model by allowing human capital to influence entrepreneurial ability and finds that our results are strengthened.

We also assume that project quality is uniformly distributed in $[0,1]$, and the probability of success as a function of quality is $\pi(a) = a$. We have $f(a) = 1$, and $F(a) = a$.

An entrepreneur with ability a in managing risky projects, who is faced with the financial contract $\left(\widetilde{i}, r_s\right)$ for the safe project and (i^*, r_r) for the risky project, decides to choose one by solving the problem:

$$\max_{safe,\ risky} \left\{ \max_{\widetilde{i}} \left(Y\left(\widetilde{i}\right) - r_s \widetilde{i} \right),\ \pi(a) \left\{ Y_H(i^*) - r_r (e + i^*) \right\} \right\}.$$

The problem has been written in the tradition of the costly state verification approach, where agents claim failure truthfully, the claim is verified by the intermediary, and all output (which will be less than the stipulated repayment amount) is collected by the intermediary.[19]

Since the profit from the safe project is independent of a, and the profit from the risky project is increasing in a for any given (i^*, r_r), it is clear that the decision rule follows a threshold policy. There exists an $a^* \epsilon (0,1]$, such that all agents with $a < a^*$ undertake the safe project, and those with $a \geqslant a^*$, undertake the risky project. For the person at the threshold ability, it follows that, the expected profit from the two activities should equalize

$$\pi(a^*) \left\{ Y_H(i^*) - r_r (e + i^*) \right\} = Y\left(\widetilde{i}\right) - r_s \widetilde{i}. \tag{1}$$

If there is free entry into the intermediation sector, one would expect the offered contracts to exhaust all gains from trade subject to informational constraints. We therefore solve for the contracts offered by maximizing the total surplus to the intermediary and the entrepreneurs. In other words, we envision a country mutual fund that intermediates available capital among projects and guarantees a safe return to investors. The problem is stated directly in terms of the threshold ability, a^*, and the capital rented for each type of project, $\widetilde{i}$ and i^*. Once we solve for these optimal quantities, the prices that support these quantities in a decentralized setup can be backed out from $r_s = \alpha A \widetilde{i}^{\alpha-1} h^{1-\alpha}$, and r_r from equation (1). We denote by $\Phi(a^*)$ the measure of successful risky projects, and by $\Theta(a^*)$ the measure of failed risky projects. That is,

$$\begin{aligned} \Phi(a^*) &\equiv \int_{a^*}^{1} \pi(a)\, dF(a) = \frac{1 - (a^*)^2}{2} \\ \Theta(a^*) &\equiv \int_{a^*}^{1} (1 - \pi(a))\, dF(a) = \frac{(1 - a^*)^2}{2}. \end{aligned}$$

It follows that $\Phi'(a^*) = -a^* < 0$, and $\Theta'(a^*) = -(1 - a^*) f(a^*) < 0$. However, more relevant to our results are the following facts. The *fraction* of successful projects is increasing

[19]The problem has also been written assuming the low state will result in default. This is automatic when A_L is zero. When it is not, the default will occur when A_H/A_L is high enough that the optimal contract would prefer default in the low state to throttling investment to high ability project. That is, the maximized value when the constraint $A_L (i^*)^\alpha h^{1-\alpha} \geqslant r_r (e + i^*)$ is in place is lower than when this constraint is not in place.

in a^*. That is, $\frac{\Phi(a^*)}{1-F(a^*)} = \frac{1+a^*}{2}$, is *increasing* in a^*. Any factor that causes fewer risky projects to be undertaken in equilibrium (an increase in a^*), for instance an increase in initial costs, will increase the quality of projects and the rate of successful completion. For the uninformed intermediary, this quantity can be viewed as the probability that a given project (whose potential cannot be observed) is successful, conditional on it being risky. It therefore follows that the fraction of failed projects, $\frac{\Theta(a^*)}{1-F(a^*)} = \frac{1-a^*}{2}$, is decreasing in a^*.[20]

Given these definitions, the optimal contracting problem can be written as:

$$\max_{a^*,\widetilde{i},i^*} F(a^*)\, Y\left(\widetilde{i}\right) + \Phi(a^*)\, Y_H(i^*) + \Theta(a^*)\left\{Y_L(i^*) - \mu\right\},$$

subject to the resource constraint:

$$F(a^*)\,\widetilde{i} + (1 - F(a^*))\,(e + i^*) = k_t. \tag{2}$$

The objective function takes into account the cost of verifying the claims of failure of the risky projects. The resource constraint takes into account the iceberg costs involved in intermediating the risky projects.

The first order conditions for this problem are:

$$\begin{aligned}
\left[\widetilde{i}\right] &: \; Y'\left(\widetilde{i}\right) = \lambda \\
[i^*] &: \; \frac{\Phi(a^*)}{1-F(a^*)} Y_H'(i^*) + \frac{\Theta(a^*)}{1-F(a^*)} Y_L'(i^*) = \lambda & (3) \\
[a^*] &: \; \left[Y\left(\widetilde{i}\right) - \lambda\widetilde{i}\right] \geqslant & (4) \\
&\qquad \pi(a^*)\, Y_H(i^*) + (1 - \pi(a^*))\left\{Y_L(i^*) - \mu\right\} - \lambda(e + i^*),
\end{aligned}$$

with (4) holding with equality if $a^* < 1$.

Condition (3) asserts that the marginal product of risky project, weighted by the probabilities of success and failure *averaged* over the risky pool, is equal to the marginal product of the safe project. Condition (4), asserts that the marginal risky project is as profitable as the safe project. An increase in the cost parameter e, exerts an upward pressure on the quality of the marginal project a^*; for high enough costs, it is not profitable to fund risky projects even for the most able entrepreneur, and (4) is an inequality.

Return to capital in this framework is calculated using revenues obtained by the intermediary. Since the intermediary is acting on behalf of the investors, this is also the share of funds going to all the individual investors. Given that $r_s = Y'\left(\widetilde{i}\right)$, the intermediary's share from the safe entrepreneurs is $F(a^*)\, Y'\left(\widetilde{i}\right)\widetilde{i}$. This share is increasing in a^*, and $\widetilde{i}$. The intermediary's share from the entrepreneurs who undertake the risky project is:

$$\Phi(a^*)\, r_r\,(e + i^*) + \Theta(a^*)\left\{Y_L(i^*) - \mu\right\},$$

[20] The properties of Φ and Θ are not specific to the functional forms chosen.

where the first term is the contracted repayment from the successful entrepreneurs, and the second term is the output "confiscated" from the failed entrepreneurs net of bankruptcy costs. Using (1), we get that the intermediary's total share from the safe and risky projects as:

$$imshare = y - \left\{ F\left(a^*\right) + \frac{\Phi\left(a^*\right)}{\pi\left(a^*\right)} \right\} \left[Y\left(\tilde{i}\right) - Y'\left(\tilde{i}\right)\tilde{i} \right], \tag{5}$$

where y is the maximized output. The return to funds can then be obtained by dividing this share by k_t, the total amount of funds available.

4.3.1 Characterizing Returns

In this section, we substantiate the following arguments (algebraic details are relegated to the appendix):

1. The optimal allocation can be characterized by a system of two equations in the quality threshold, a^*, and the risky project investment, i^*.

2. The aggregate production function has a form similar to the neoclassical production function. Without entry and intermediation costs, e, *or* with very large costs, the model behaves like the neoclassical model; an increase in the total capital stock causes the return to decrease.

3. The following effects govern the return to capital in the general case:

   (a) For a given amount of total capital, as the cost of funding risky projects, e, increases, the quality threshold, a^*, increases. The substitution of capital into safe projects causes a decrease in the marginal return to capital.

   (b) While the measure of risky projects, $(1 - a^*)$, decreases with e, the *total* cost of risky projects could increase. The resulting scarcity of net funds – an "income" effect – exerts a downward pressure on safe project funding causing the marginal return to increase.

   (c) The presence of these two opposing effects could make the return non-monotonic with respect to e. For low-cost, capital-rich countries, the substitution effect is weaker and the income effect stronger, making it likely that their returns are higher than those of poor countries.

   (d) The presence of private information induces an inefficiency in the funding of projects. The increase in the quality threshold decreases this inefficiency; the returns in rich countries increase disproportionately.

1) System of equations: With the specialization adopted, the marginal condition (3) becomes:

$$\frac{i^*}{\widetilde{i}} = \left[\left(\frac{1+a^*}{2}\right)\frac{A_H}{A} + \left(\frac{1-a^*}{2}\right)\frac{A_L}{A}\right]^{\frac{1}{1-\alpha}}. \tag{6}$$

We can see see here that the risky project investment relative to that of the safe project, $\frac{i^*}{\widetilde{i}}$, increases with the threshold quality, a^*.

We next derive the relevant equations that determine a^* and $\widetilde{i}$. Using (6) in (4) and after a few algebraic steps we get:

$$\Lambda(a^*) - \frac{\alpha}{1-\alpha}\frac{e}{\widetilde{i}} - \frac{(1-a^*)\,\mu}{(1-\alpha)\,A\widetilde{i}^{\alpha}} = 1, \tag{7}$$

where:

$$\Lambda(a^*) \equiv \frac{1}{1-\alpha}\left[\left(\frac{1+a^*}{2}\right)\frac{A_H}{A} + \left(\frac{1-a^*}{2}\right)\frac{A_L}{A}\right]^{\frac{\alpha}{1-\alpha}}\left\{(2-\alpha)\left[\left(\frac{1+a^*}{2}\right)\frac{A_H}{A} + \left(\frac{1-a^*}{2}\right)\frac{A_L}{A}\right] - \frac{A_H}{A}\right\},$$

is a factor that captures the quality of the risky pool and is increasing in a^*. The left hand side of (7) is the ratio of profit from the threshold risky project to that of the safe project, which has to equal one if any risky project is undertaken at all; if it is less than one even for the most able entrepreneur $(a^* = 1)$, say when costs are high, no risky projects are undertaken.

We now turn to the determination of $\widetilde{i}$ itself for a given amount of available capital, k_t. Using (6) in (2) we can get:

$$\Gamma(a^*)\,\widetilde{i} = k_t - (1-a^*)\,e, \tag{8}$$

where,

$$\Gamma(a^*) \equiv \left\{a^* + (1-a^*)\left[\left(\frac{1+a^*}{2}\right)\frac{A_H}{A} + \left(\frac{1-a^*}{2}\right)\frac{A_L}{A}\right]^{\frac{1}{1-\alpha}}\right\}. \tag{9}$$

$\Gamma(a^*)$, a factor that is decreasing in a^*, captures the extensive margin of funding. When multiplied by $\widetilde{i}$, it gives the total investment net of fixed costs in both types of projects. The first term within curly braces is the measure of safe projects and the second term, which drives the overall decrease, is the measure of risky projects adjusted for the increased investment in these projects relative to the safe project. Equations (7) and (8) can be solved for a^* and $\widetilde{i}$, and the latter can be used in (6) to get i^*. We can retrieve r_s from $r_s = Y'\left(\widetilde{i}\right)$, and r_r from (1).

2) Comparisons with the neoclassical function: We next derive expressions for the total output. Use (6) in the objective function, to write:

$$y = \Gamma(a^*)\,A\widetilde{i}^{\alpha}h^{1-\alpha} - \frac{\mu\,(1-a^*)^2}{2}. \tag{10}$$

When $\mu \to 0$, $y = \Gamma(a^*)\,A\widetilde{i}^{\alpha}h^{1-\alpha}$. Note the similarity with the neoclassical production function except for the endogenously determined factor, $\Gamma(a^*)$.

When costs are zero, (7) reduces to $\Lambda(a^*) = 1$, and the threshold, a^*, is determined by the technological parameters that are common to all countries. Therefore, $\Gamma(a^*)$ is also determined by these common technological parameters alone; denote this by Γ_0. Condition (8) reduces to $\Gamma_0 \widetilde{i} = k_t$. Use this $\widetilde{i}$ in (10), with μ set to zero, to get $y = (\Gamma_0)^{1-\alpha} A k_t^{\alpha} h^{1-\alpha}$. This is essentially the neoclassical production function, with its attendant implications for returns.

When costs are prohibitively large, the left hand side of (7) becomes less than 1, and $a^* = 1$. From (8) and (9), we can see that $\Gamma(1) = 1$, and $\widetilde{i} = k_t$. Total output in (10) reduces to $A k_t^{\alpha} h^{1-\alpha}$, which is the neoclassical production function.

Therefore, if the aim is to go beyond the neoclassical return implications, we need to consider differences in intermediation costs across countries that affect the *composition* of projects undertaken in them. It is in this sense, the more general case of $a^* < 1$ gives rise to a "disaggregated" production function with interesting implications for returns.

3) Analysis of the return: Using (10) in (5) yields:

$$imshare = \left\{ \Gamma(a^*) - (1-\alpha) \frac{\left(1 + (a^*)^2\right)}{2a^*} \right\} A \widetilde{i}^{\alpha} h^{1-\alpha} - \frac{\mu (1-a^*)^2}{2}. \tag{11}$$

The return is calculated as $imret = imshare/k_t$. As will be discussed in item *d*, the second term within the curly braces captures the effect of private information, and the last term captures verification / bankruptcy costs. To study the effect of safe project investment, $\widetilde{i}$, on returns – the focus of items *a* through *c* below – we ignore these two terms and write the remaining portion of the return as: $\Gamma(a^*) A \widetilde{i}^{\alpha} h^{1-\alpha}/k_t$. Using (8), we can write this as $\left[1 - (1-a^*) \frac{e}{k_t}\right] A \widetilde{i}^{\alpha-1} h^{1-\alpha}$. In other words, an increase in $\widetilde{i}$ has a tendency to decrease the return.

a) The substitution effect of an increase in e: Condition (7) indicates that an increase in the cost of funding each risky project would increase the threshold quality at which the risky project becomes profitable relative to the safe one. Indeed, as formally shown in section A.1, $\frac{\partial a^*}{\partial e} > 0$. We can write (8) as:

$$\widetilde{i} = \frac{k_t - (1-a^*) e}{\Gamma(a^*)}. \tag{12}$$

The increase in a^* causes the extensive factor $\Gamma(a^*)$ to decrease, thereby increasing $\widetilde{i}$. As the safe project is funded more intensively, the return tends to drop.

b) The "income" effect of an increase in e: From (12), we can see that when a^* increases, if $(1 - a^*(e)) e$ decreases, the substitution effect is reinforced. However, if the elasticity of a^* with respect to e is small, $(1 - a^*(e)) e$ could increase, causing $\widetilde{i}$ to drop; the return then increases. The increased *intensity* of funding risky projects relative to safe projects when a^* increases is evident from (6).

c) Non-monotonicities in return: These opposing effects can make returns to capital non-monotonic in costs even for a given level of capital. As shown in section A.1, the variation of $\widetilde{i}$ with costs is governed by:

$$\Gamma\left(a^{*}\right)\frac{\partial\widetilde{i}}{\partial e}=\frac{e}{1-\alpha}\frac{\partial a^{*}}{\partial e}-\left(1-a^{*}\right). \tag{13}$$

In the range where e is low, a^* is low; the negative term dominates, and $\widetilde{i}$ tends to decrease with e. When e is high, a^* is high; the positive term dominates, and $\widetilde{i}$ tends to increase with e. The safe project investment $\widetilde{i}$ is in general U-shaped in e, and the marginal return to capital is inverse U-shaped.

More importantly, the *profiles* of returns with respect to e themselves vary with the amount of capital available, in a way that could cause the return of a low-cost, capital-rich country to dominate that of a high-cost, capital-poor country. For instance, in section A.2, we show $\partial\left(\frac{\partial\widetilde{i}}{\partial e}\right)/\partial k<0$. The substitution effect that decreases return is weaker for capital-rich countries; this is to be expected, given the lower fraction of costs in total funding. Moreover, it can be shown that a capital rich country will have a greater fraction of risky projects; i.e. $\partial a^*/\partial k<0$. As seen in the discussion of (13), the low a^* would accentuate the increasing portion of the return curve. Alternately, in terms of the discussion in (3b), it is for such countries that the elasticity of a^* with respect to e is likely to be the lower, and the income effect more dominant. A prominent increasing portion in the return curve for rich countries, and decreasing portion for poor countries result.

d) The private-information effect: In section A.3, we show that the constraint on observability of project quality causes a given marginal project to be overfunded, and the highest quality project to be under-funded. The factor $\frac{\left(1+\left(a^{*}\right)^{2}\right)}{2a^{*}}$ in the second term within curly braces in (11), captures this inefficiency in funding. When a^* increases, say due to increased costs, this inefficiency decreases, increasing the intermediary's share and thus the return; that is, the wedge between the risky and safe interest rates decreases with decreasing heterogeneity in project quality. The presence of the constraint disproportionately increases the returns of rich countries, which have lower a^*s to begin with.[21]

Now that we have qualitatively demonstrated that differences in intermediation costs can give rise to non-monotonic returns, we turn to parametrizing this environment and investigating its properties quantitatively.

5 Quantitative Results

As a starting point for our quantitative results we consider countries that differ with respect to their physical and human capital levels. In order to reduce the number of parameters to

[21] There is also a direct effect of an increase in a^* on returns – lower observation costs with fewer failed projects.

seek, we assume $A_L = 0$. For the share of capital we use $\alpha = 0.35$. We set $\mu = 0.05$ and verify later whether the results are sensitive to our choice and if the resulting bankruptcy costs look reasonable. The calibration of the remaining technology parameters, A, A_H, are such that the k/y ratio and the net return for the richest ($k = 1$) group of countries when intermediation is costless ($e = 0$) are around 3 and 7% respectively. Depreciation rate is taken to be 9%. The values used are, $A = 0.2462$, $A_H = 0.5459$, with A_H/A being 2.2. This ratio, A_H/A, is very important for determining the differences in returns to capital in our setup and is further discussed in Section 6.1. It is worth emphasizing that these technology parameters are held constant across countries in the quantitative exercises that follow; only the cost parameter and the level of capital per effective labor, which are empirically observable quantities, are varied.[22]

Our strategy is to experiment with a large number of possible values for e, maintaining the assumption that poorer countries are faced with a higher e. In order to examine whether the size of these costs that are generated by our model are reasonable, we later compare them with the overhead costs that were displayed in Figure 3.

5.1 Static Returns

The returns for this case are obtained by solving (7) and (8), and calculating $imshare/k$ using (11) for various levels of costs and by using the distribution of physical and human capital, as estimated by Klenow and Rodriguez (1997), in the 1980s as a starting point.

Table 3 displays the returns where the return in the highest income country with zero intermediation costs is normalized to be 1. For the case where intermediation costs are set to zero for all the countries, the return ratio for the lowest income country is 1.24 relative to the highest income country. However, once we allow for positive costs the results change significantly. We may examine this table in several different ways. For example, if we consider the same intermediation cost for all the economies, we observe that physical and human capital differences are such that the middle income countries dominate in returns over the lowest income country, for any positive intermediation cost considered. In addition, if we assume differences in e across countries, we obtain cases where the rate of return in all the countries, even in the richest, dominate the rate of return in the lowest income country. This result is very different than the one in the pure neoclassical model described in the third column of Table 2, where the lowest income country dominates in rates of return.

[22] Equation (7) pins down a^* as a function of $\frac{A_H}{A}$ in the costless case. Equations (8), (10) and (11) can then be used to solve for A_H and A separately to get the above-mentioned capital-output ratio and gross return.

Table 3: Relative Returns

Cost	K=0.025	K=0.1	K=0.275	K=1
0.000	1.24	1.24	1.26	1.00
0.016	1.18	1.22	1.26	**1.00**
0.032	1.11	1.20	**1.25**	1.00
0.048	1.04	**1.17**	1.25	1.00
0.064	**0.97**	1.15	1.24	1.00
0.080	0.91	1.12	1.24	1.00
0.096	0.86	1.10	1.23	1.00
0.112	0.82	1.07	1.22	1.00
0.128	0.82	1.05	1.21	1.00
0.144	0.82	1.02	1.20	1.00
0.160	0.82	0.99	1.19	1.00
0.176	0.82	0.97	1.18	0.99

The results in this table, which are depicted Figure 4, seem consistent with the stylized facts about capital flows mentioned in the introduction. Once these closed economies open up, there will be a greater tendency for capital to flow from the richest to middle income countries rather than to the poorest. This dominance is stronger when we factor in the higher intermediation costs poorer countries are likely to face. As discussed in Section 4.3.1, the substitution effect of an increase in e, which decreases the return to capital, is stronger for the capital-poor countries; one can see a more prominent decreasing portion for them. One can also see that for all $e > 0.11$, the poorest country's return flattens out, as only safe projects are undertaken; that is, $a^* = 1$.

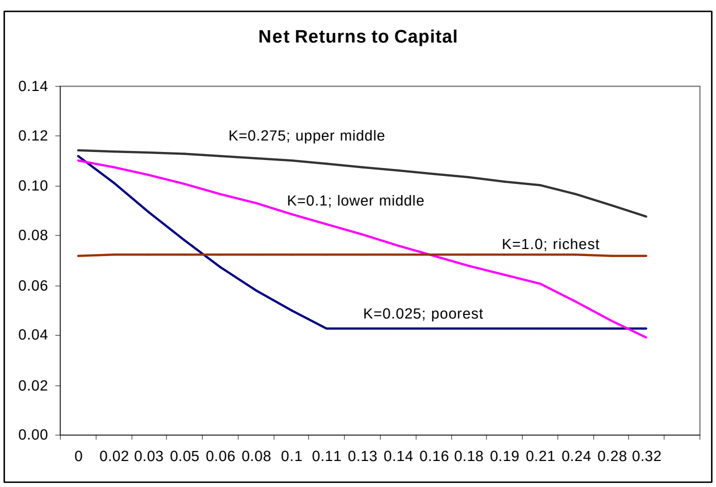

Figure 4: Returns to Capital

Another way to represent the implications of our model versus the neoclassical model on returns is given in Figure 5 which plots r_I versus k for the country groupings we consider assuming the cost parameters highlighted in Table 3. The relative capital stocks for 1985, shown in Table 2, are marked. Notice that while the neoclassical model would have yielded only one return function for the economy, in our model there is one return function *per* entry-intermediation cost combination. According to this picture, "middle income" countries – those in the third quartile – would receive all capital when the economies are integrated.[23] We conduct such an integration experiment in the next section.

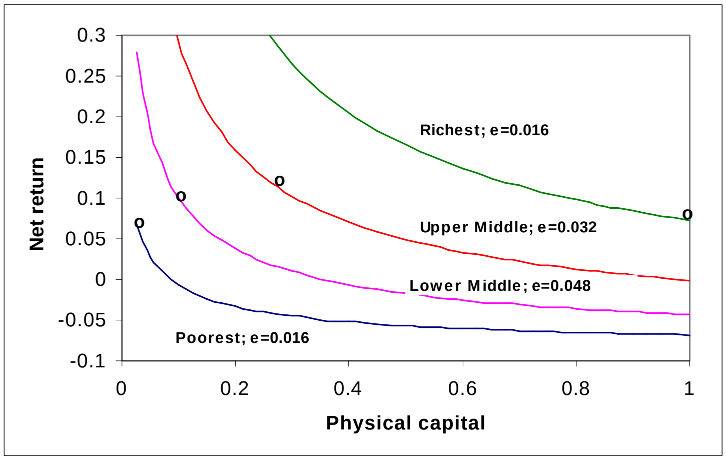

Figure 5: Capital Return vs Capital Employed

These results also allow us to highlight the implications of some of the modeling assumptions we have made. For example, we can isolate the importance of asymmetric information by examining the returns when costs are zero. As mentioned in Section 4.3.1, the presence of private information preferentially increases the return of rich countries by reducing the heterogeneity of risky project quality. As seen in Table 3, there is no clear dominance of returns by the poorest economy that one sees in the neoclassical model. Indeed, we have solved a version of this model in which ability is fully observed and capital can be allocated based on ability. In that case, with $e = 0$, the quantitative results are identical to those of the neoclassical model provided in Table 2, with the relative return in the poorest country equal to 1.54.

We get an extra quantitative kick by modeling the entry-intermediation costs. Notice that middle income countries dominate in returns for a very large range of intermediation costs once e is allowed to be different than zero, or different across countries. While the two aspects of the model can each generate qualitatively similar observations on returns, the quantitative results are much stronger when they are both present.

[23] Throughout the paper, we have considered capital flows for efficiency reasons rather than consumption insurance. (See Obstfeld, 1995, for an exposition on international capital flows.) This seemed more relevant, given our concern with flow of capital from rich to poorer countries rather than among rich countries. The implication that the middle income countries will receive all capital is likely to become less stark when this additional motive for capital flow is modeled.

Can the mere existence of these costs, without any effect on the mix of projects be sufficient to eliminate return differences across countries? One way of accommodating such costs in the standard neoclassical model is as follows: Let e_1 and e_2 represent a fixed cost and a variable cost associated with intermediation. If x denotes productive capital and k the total capital, one can write: $e_1 + (1 + e_2)x = k$ and the production function as $Y = Ax^{\alpha}h^{1-\alpha}$. We can then find the magnitude of e_1 and e_2 that are necessary to equate the returns between the poorest and the richest countries.[24] Considering variable costs, e_2 alone, the poorest country's cost has to be 240% of quantity intermediated for the returns to be equated. If we consider fixed costs alone, the cost to quantity for the *richest* country has to be 50%. None of the costs we have displayed in Figures 2 and 3 are of such magnitude.[25] This exercise confirms that small costs could have a big effect on returns to capital by altering the *composition* of projects undertaken.

In Table 4, we present additional properties of the economies considered above. In particular we are interested in comparing the intermediation costs obtained in these economies with the data. We present two measures of intermediation costs and bankruptcy costs as a per cent of output.

The first panel of Table 4 displays intermediation costs divided by the total quantity intermediated in this economy. The counterpart of this information in the data is what we have displayed in Figure 3.[26] Our results indicate that intermediation costs per unit intermediated in poor countries can be significantly higher than that of rich countries. For example, a uniform intermediation cost of 0.016 yields an overhead cost of 8.65% of total loans for the poorest country and 0.75% for the richest, resulting in about a factor of 11. The cost differences in the data that were displayed in Figure 3 ranged between almost zero to 12% of total loans intermediated. If we examine the case where poorer countries have higher intermediation costs, we can obtain larger differences. For example, if the poorest country has a cost level of 0.032 then the overhead costs as a percent of total loans jumps up to 12.94 yielding the costs in the poorest country group to be 17 times that of the richest country group. In addition, notice that these costs display non-monotonicity for a given level of capital stock. We observe that very high levels of intermediation costs for poor countries can generate a low equilibrium level of overhead costs per quantity. For example, overhead

[24] These results can be obtained from: $\alpha A \left[\frac{h_r}{k_r - e_1}\right]^{1-\alpha} = \alpha \frac{A}{(1+e_2)^{\alpha}} \left[\frac{h_p}{k_p}\right]^{1-\alpha}$ with values used in Table 2.

[25] One can convert the individual components of entry costs into dollars and find their annuitized values. Doing so reveals magnitudes much smaller.

[26] In the model economy we had assumed that intermediation cost are only incurred if risky projects are undertaken. To the extent that there are some intermediation costs associated with safe projects as well in the data, our results would be underestimating the total intermediation costs in lower income countries. That assumption also gives rise to zero intermediation costs at high levels of intermediation costs, since the only projects that are undertaken are the safe ones.

costs as a percent of total loans goes down from 12.17 to 8.99 as intermediation costs increase from 0.064 to 0.08 for the poorest country. This non-monotonicity is due to the fact that very few risky projects will be undertaken in economies with very high intermediation costs, perhaps accounting for the experiences of some of the low income countries we had presented in Figure 3.

Table 4: Additional Properties

	Overhead Costs as a % of Total Loans			
Cost	**K=0.025**	**K=0.1**	**K=0.275**	**K=1**
0.000	0.00	0.00	0.00	0.00
0.016	8.65	4.70	2.34	0.75
0.032	12.94	8.75	4.56	1.50
0.048	13.76	12.14	6.66	2.23
0.064	12.17	14.89	8.63	2.95
0.080	8.99	17.03	10.47	3.66
0.096	4.78	18.62	12.19	4.36
	Interest Rate Spread			
Cost	**K=0.025**	**K=0.1**	**K=0.275**	**K=1**
0.000	0.18	0.14	0.13	0.09
0.016	0.11	0.13	0.12	0.09
0.032	0.07	0.11	0.12	0.09
0.048	0.04	0.10	0.11	0.09
0.064	0.02	0.08	0.11	0.09
0.080	0.01	0.07	0.10	0.09
0.096	0.01	0.06	0.09	0.08
	Bankruptcy Costs/Output			
Cost	**K=0.025**	**K=0.1**	**K=0.275**	**K=1**
0.000	6.85	6.25	3.84	1.71
0.016	4.43	5.58	3.69	1.70
0.032	2.56	4.93	3.53	1.68
0.048	1.31	4.29	3.38	1.66
0.064	0.59	3.69	3.22	1.64
0.080	0.21	3.13	3.06	1.62
0.096	0.04	2.64	2.90	1.60

In the second panel of Table 4 we present the spread between the risky rate and the deposit rate that the intermediary provides for the depositors. Again for a given level of costs such as 0.016, we can see that poorest countries have higher spreads. As costs increase, the fraction of risky projects decrease faster for the capital-poor countries. This makes the risky project pool more homogeneous, resulting in a decrease in the risky rate. Eventually when all the projects undertaken are the safe ones, there is no difference between the two rates causing in the spread to go down to zero.

The last panel of this table documents bankruptcy costs as a percent of total output. It is interesting to note that bankruptcy costs may indeed be much lower in poorer countries since fewer risky projects are undertaken in those countries compared to rich countries. In fact, we find that both the fraction of total projects that fail and the fraction of risky projects that fail are higher in richer countries.[27] This implication of the model, seems consistent with the evidence presented by Bergoeing, Kehoe, Kehoe, and Soto (2002) on the higher incidence of bankruptcies in Chile in the 1980s and the 1990s relative to the slower-growing Mexico which had a less efficient financial system.

5.2 Dynamic Results

While a full analysis of integration should include all four types of countries, we can make the main point about the functioning of our model by examining what happens when a previously closed poor country opens up and becomes integrated with a richer country that has a higher return.[28] We consider countries in the second ($e = .048$) and third ($e = .032$) quartiles for this integration experiment .[29] Our results, shown in Figure 5, indicate that the countries that had a higher capital stocks in 1985 had higher returns to capital than those with lower stocks. In this case, contrary to the neoclassical model, the poorer country will experience capital outflow. For this experiment, it is interesting to compare the transition of the integrated poor country to that of the poor closed country. We do not show the capital outflow from the poor to rich country, but the panels in Figure 6 compare the income and consumption paths for the poor country during the two transitions.[30]

The first panel shows that the capital *employed* in the poor country when it is open is lower than the capital employed, and owned, by it when it is closed, except in the long run; this is the result of capital outflow that occurs in the integrated economy. However, capital *owned* by the poor country is higher even in the steady state for the open economy. The closed economy is forced to invest all its saving locally, while the open economy gets to invest it in the foreign country and earn higher returns. Therefore, in spite of the lower share of the world capital and income that the open country has to be satisfied with, it can accumulate more capital over time. This is also evident in the second and third panels, where consumption and income are higher in the open economy during the transition as well as at the steady state (by 5%). The last panel shows the return to the poor country being higher throughout the open transition and approaching the closed economy's return only asymptotically. The consumption supplement that would be required to make an individual in the closed economy as well off as the individual in the open economy turns out to be

[27] For example, the fraction of projects that fail are 0.91, 4.31, 8.08, and 11.06, form the poorest to the richest countries, for the intermediation cost level of 0.016, and 0.51, 3.73, 7.67, 10.90 for the intermediation cost level of 0.032.

[28] Notice that the integrated equilibrium in this framework involves capital flows from richest to middle income countries as opposed to the poorest as in the neoclassical model.

[29] We use $\rho = 0.07$, $\delta = 0.09$,and $\sigma = 2$ for this experiment.

[30] We have also conducted this experiment by assuming the same intermediation costs ($e = .032$) for both countries and found very similar results.

significant: 4.23% of consumption in each period. In addition, poor and rich economies in this framework do not converge to the same steady state, mainly due to the persistence of the initial differences in human capital. These results are not unexpected. However, in the standard neoclassical model one cannot even begin to address the issue of poor countries choosing to remain closed for fear of capital outflow, even in the face of overwhelming evidence that such a stance hurts growth.[31]

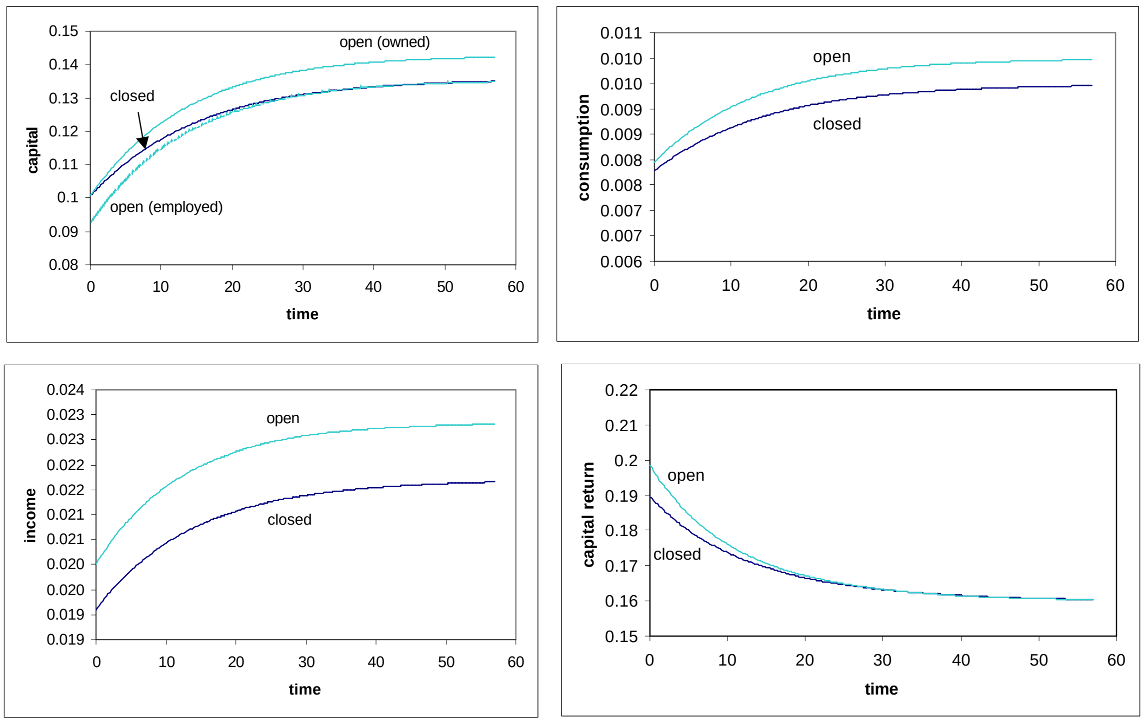

Figure 6: Comparison of Open and Closed Transitions

6 Discussion and Sensitivity Analysis

6.1 Plausibility of our Technology Parameters

In this section we investigate the sensitivity of our results to certain assumptions we have made and certain parameter choices we have implemented. For example, it is clear from the expressions in Section 4.3.1 that the ratio $\frac{A_H}{A}$ (and the ratio $\frac{A_L}{A}$ when A_L is non-zero) plays an important role in the allocation of funds and hence the return. One way of characterizing the efficacy of the model in reducing return differentials and thus explaining the pattern of capital flows, is to ask what $\frac{A_H}{A}$ needs to be in order to equalize the rate of return for the richest country group with that of the poorer country group, and ask whether this value is reasonable. The returns can be obtained from the expressions in the earlier subsection

[31] See, for example, Kumar (forthcoming), and the references therein.

suitably adapted for zero costs. For the $k = 0.025$ country to have the same return as the $k = 1$ country, $\frac{A_H}{A}$ needs to be 1.91 and for the $k = 0.1$ country to have the same return as the $k = 1$ country, $\frac{A_H}{A}$ needs to be 1.65.

A conservative way to assess the empirical plausibility of this technological ratio is to compare it to the ratio of TFPs for a given industry in a given country as summarized by Baily and Solow (2001). They report TFP measures for the manufacturing as well as service industries for several industrialized countries. These ratios fall in the range of 2 to 4. Even though these ratios represent TFP differences within a given industry in a given country, we take these as a conservative measure of possible TFP differences across the two types of projects available in our setup. To be consistent with these ratios for the richest country group when intermediation costs are negligible, $\frac{A_H}{A}$ can be between 2.11 and 2.76 for the model economy. These figures confirm the plausibility of the technology ratios needed to cause the capital return in richest country group to dominate that of the poorest country group.[32]

6.2 Non-zero A_L

In our numerical results for the economies we examined A_L was assumed to be zero. Below we show the results on returns to capital where the values used are $A = 0.196$, $A_H = 0.524$, and $A_L = 0.119$ and are consistent with a k/y ratio of 3. The qualitative properties of the findings remain unchanged when compared with the earlier results, where A_L was assumed to be zero.

The non-monotonicity of returns in intermediation costs still play an important role causing countries with lower capital-labor ratios to have lower returns than countries with higher capital-labor ratios. What changes is the threshold level of intermediation costs after which capital flows to middle income countries. In the above case the two middle income countries, with $K = 0.275$ and $K = 0.10$, dominate the returns in the poorest and the richest countries starting from zero intermediation costs.

6.3 The Role of Bankruptcy Costs

We have computed the rates of return for the model economy, with and without bankruptcy costs to display the impact of bankruptcy costs in this environment. Our results indicate that poorest countries get dominated in rates of return much more frequently when bankruptcy costs are assumed to be non-zero as opposed to zero. Similar to the results above, the threshold level of intermediation costs after which the middle income countries dominate increases in this case as well. Nevertheless, we find that for intermediation costs above

[32] Comparing the return in the richest and poorest countries is a conservative exercise. Lower $\frac{A_H}{A}$ ratios are needed to cause the return in a middle income country to dominate that of a poor country.

0.048, our model is able to generate returns that are consistent with the stylized fact that capital flows more to the middle income countries than to the poor countries even with zero bankruptcy costs.

6.4 Other Human Capital Measures

The available measures on human capital while all highly correlated differ widely in levels. In the results reported so far, we have used the Klenow and Rodriguez (1997) measure which is the most inclusive one. In this subsection we discuss the implications of using other measures, in particular the ones in Hall and Jones (1999) and the "raw" educational attainment measures in Barro and Lee (1996). This data is reported in Table 5.

Table 5 : Comparison of relative $h^{1-\alpha}$

Capital quartile	Klenow-Rodriguez	Barro-Lee	Hall-Jones
lowest	0.14	0.33	0.66
second	0.29	0.56	0.74
third	0.55	0.78	0.84
highest	1.00	1.00	1.00

The Hall and Jones measure seems to be most generous in assessing the human capital level of poor countries. While Klenow and Rodriguez would assess the poorest countries to have 14% of the human capital of the richest, Hall and Jones would assess the poorest to have more than a half of the human capital of the richest. The raw Barro and Lee measure falls in between.[33]

By choosing the technology parameters A, A_H, and A_L appropriately one could construct return patterns in which the richer countries dominate, at least for some values of the cost. The main effect of using the different measures of human capital is to alter the distance between the return curves shown in Figure 4. The *shapes* of these curves are preserved. Instead of pursuing this option in great detail, we conduct an analysis very similar to the one in the earlier subsection by asking what the ratio $\frac{A_H}{A}$ needs to be in order to equalize the rate of return for the richest country group with that of a poorer country group. Table 6 shows what this ratio needs to be to have the return of the second quartile group (with high enough costs) same as that of the highest quartile group (with zero cost), taking into account human capital differences as estimated by the above-mentioned sources.

[33] The physical capital levels are much closer across the datasets. The Hall and Jones (1999) measure assumes very strong diminishing returns to education beyond 8th grade which might account for a difference between the richest and poorest countries that is much smaller than is found in other data sources. In addition, Klenow-Rodriguez measure includes education as well as on-the-job learning in their measure of human capital.

Table 6 : $\frac{A_H}{A}$ needed to equate $k = 1$ and $k = 0.1$ differences

	Klenow-Rodriguez	Barro-Lee	Hall-Jones
Model Economy	1.65	2.76	3.37

These ratios appear reasonable when compared to the "admissible" ratios given in the earlier subsection.

7 Conclusions

We find that a very simple model, which is close to the neoclassical production model in spirit but uses variation in entry and intermediation costs to study the mix of projects undertaken, is capable of accounting for the pattern of capital flows among countries. The fact that only two new technological parameters (A_H, A_L) need to be introduced and calibrated to get a rich variation in returns is a testimonial to this simplicity. We can also get reduced-form expressions for production in our model which closely resemble the aggregate neoclassical production function.

Our study can be improved upon, by collecting more direct data on costs of intermediation and taxes on the intermediation sector and matching model outcomes with them. On the theoretical side, a future step is to use ideas from the dynamic contract literature in this quantification exercise. Allen and Gale (2000) note that except for Japan, retentions are the most important source of finance (but loans are also important). For this reason, the dynamics of firm behavior is likely to be important for aggregate returns. It would also be interesting to conduct the dynamic analysis with three country groups, rich, middle income, and poor. One could see the effect of capital flows from both the rich and the poor countries to the middle income countries, at least until the neoclassical effect dominates and the poor country also becomes competitive in returns.

We saw that it was beneficial for a poor country to become economically more open even if it experienced a capital outflow. An interesting question to ask in this regard is whether this result holds even if there are productivity improvements arising from local production due to learning by doing. One way of asking this question is, "How strong should learning by doing be before welfare in the closed and open economies are the same?" Finally, it would be very useful to model the development of the intermediation sector; to hold intermediation costs fixed over long periods of time is not satisfactory. This would also allow us to substantively address the issue of reforms in the financial intermediation sector. These are subjects of ongoing research.

A Appendix

A.1 Threshold quality increases with costs: $\frac{\partial a^*}{\partial e} > 0$

Differentiate (9) with respect to a^*, simplify, and use (7) to get, $\Gamma'(a^*) = -\frac{\alpha}{1-\alpha}\frac{e}{\widetilde{i}} < 0$, where we have set $\mu = 0$ for algebraic simplicity. Differentiate (8) with respect to e, and get the following condition:

$$\Gamma(a^*)\frac{\partial\widetilde{i}}{\partial e} = \frac{e}{1-\alpha}\frac{\partial a^*}{\partial e} - (1-a^*).$$

Next, differentiate (7) with respect to e, simplify, and use (8), and the above expression to get:

$$\left\{\left(\frac{1-\alpha}{\alpha}\right)\frac{\Lambda'(a^*)}{(1+e_B)^{\frac{\alpha}{1-\alpha}}} + \frac{(e)^2}{\Gamma(a^*)(1-\alpha)\widetilde{i}^2}\right\}\frac{\partial a^*}{\partial e} = \frac{1}{\widetilde{i}^2}\frac{k_t}{\Gamma(a^*)} > 0.$$

A simple examination of the definition of $\Lambda(a^*)$ under the equation (7) reveals $\Lambda'(a^*) > 0$, given $A_H > A_L$. Therefore it follows $\frac{\partial a^*}{\partial e} > 0$. □

A.2 Capital-rich countries have weaker substitution effect: $\frac{\partial\left(\frac{\partial\widetilde{i}}{\partial e}\right)}{\partial k} < 0$

Differentiate (7) and (8) with respect to k, and simplify to get:

$$\frac{\partial\widetilde{i}}{\partial k} = \frac{1}{\Gamma(a^*) + \frac{(\Lambda(a^*)-1)^2}{\alpha\Lambda'(a^*)}},$$

where use is made of (7), to substitute out for $\left(\frac{e}{\widetilde{i}}\right)$. It is clear that we have to show that the denominator (denoted Dr) is increasing in e to prove the result. Therefore, differentiate the denominator w.r.t. e, use the fact $\Gamma'(a^*) = -\frac{\alpha}{1-\alpha}\frac{e}{\widetilde{i}}$, and as before, use (7) to substitute out for $\left(\frac{e}{\widetilde{i}}\right)$, to get:

$$\frac{\partial Dr}{\partial e} = \frac{\partial a^*}{\partial e}\frac{\frac{\alpha^2}{1-\alpha}\left(\frac{e}{\widetilde{i}}\right)\left\{(2-\alpha)(\Lambda'(a^*))^2 - \Lambda''(a^*)(\Lambda(a^*)-1)\right\}}{\alpha^2(\Lambda(a^*))^2}.$$

We have seen $\frac{\partial a^*}{\partial e} > 0$. Therefore the sign of the derivative depends on the terms within curly braces. Given the definition of $\Lambda(a^*)$ in the text, it follows that:

$$\begin{aligned}
\Lambda'(a^*) &= \left(\frac{1}{1-\alpha}\right)\left(\frac{G'}{G}\right)\Lambda\left\{\frac{(2-\alpha)G - \alpha\frac{A_H}{A}}{(2-\alpha)G - \frac{A_H}{A}}\right\} > 0 \\
\Lambda''(a^*) &= \frac{\alpha}{(1-\alpha)^2}\left(\frac{G'}{G}\right)^2\Lambda\left\{\frac{(2-\alpha)G - (2\alpha-1)\frac{A_H}{A}}{(2-\alpha)G - \frac{A_H}{A}}\right\} > 0.
\end{aligned}$$

Using these, straightforward algebra shows that the terms within curly braces in $\frac{\partial Dr}{\partial e}$ is positive if $\alpha < \frac{1}{2}$; in particular, it is true for the $\alpha = 0.35$ value we use for our numerical exercise. Therefore, it follows that $\frac{\partial Dr}{\partial e} > 0$ and $\frac{\partial^2\widetilde{i}}{\partial e\partial k} < 0$. □

A.3 Inefficiency of funding caused by private information

The effect of private information can be seen by comparing the constrained outcome with the full-information outcome, where the intermediary is allowed to write contracts as a function of ability. Proceeding as we did in the main text, one can show that the equations that characterize $\widetilde{i}$ and a^* are the same as (7) and (8), but with:

$$\begin{aligned} \Lambda(a^*) &\equiv \left[a^* \frac{A_H}{A} + (1-a^*)\frac{A_L}{A}\right]^{\frac{1}{1-\alpha}} \\ \Gamma(a^*) &\equiv \left\{a^* + \frac{(1-\alpha)}{(2-\alpha)\left(\frac{A_H}{A} - \frac{A_L}{A}\right)}\left[\left(\frac{A_H}{A}\right)^{\frac{2-\alpha}{1-\alpha}} - \left(a^* \frac{A_H}{A} + (1-a^*)\frac{A_L}{A}\right)^{\frac{2-\alpha}{1-\alpha}}\right]\right\}. \end{aligned}$$

The analogue of (6), when risky project investment can be conditioned on quality, is:

$$\frac{i^*(a)}{\widetilde{i}} = \left[a\frac{A_H}{A} + (1-a)\frac{A_L}{A}\right]^{\frac{1}{1-\alpha}}, \ \forall a \epsilon [a^*, 1]. \tag{14}$$

When (14) is evaluated at a given a^* and compared with (6) it is easy to see the full-information ratio is lower, since $a^* \frac{A_H}{A} + (1-a^*)\frac{A_L}{A} < \left(\frac{1+a^*}{2}\right)\frac{A_H}{A} + \left(\frac{1-a^*}{2}\right)\frac{A_L}{A}$. Likewise, when (14) is evaluated at $a = 1$, the ratio in the full-information case is higher, since $\frac{A_H}{A} > \left(\frac{1+a^*}{2}\right)\frac{A_H}{A} + \left(\frac{1-a^*}{2}\right)\frac{A_L}{A}$ for any information constrained economy with a^* between zero and one. In other words, a given marginal project is relatively overfunded in the information constrained case, and the highest ability project is under-funded. This inefficiency is likely to decrease whenever a^* increases, say due to an increase in intermediation costs; that is, whenever there is not too much heterogeneity in the quality of risky projects undertaken. The ratio of funding of the highest ability risky project to the lowest ability risky project in the full-information case is $\left[\frac{\frac{A_H}{A}}{a^* \frac{A_H}{A} + (1-a^*)\frac{A_L}{A}}\right]^{\frac{1}{1-\alpha}}$, which decreases with a^* and approaches one when $a^* \to 1$. This ratio is always one in the information constrained case. Therefore the deviation from the full information allocation decreases as the information constrained a^* decreases and vanishes as $a^* \to 1$. $\square$

A.4 A sufficient condition for ability-invariant contracts when $A_L \neq 0$

In the interest of brevity, and given that nothing crucial hinges on A_L being > 0, we present only a sketch of the argument here. Write the maximization problem for allocation of funds among risky projects, conditional on the threshold ability being $a^* > 0$, as:

$$\max_{i(a),\ r_H(a),\ r_L(a)} \int_{a^*}^{1} aA_H i(a)^\alpha \, da + \int_{a^*}^{1} (1-a) A_L i(a)^\alpha \, da$$

subject to the following constraints:

$$
\begin{aligned}
(BC) &: \int_{a^*}^{1} i(a)\, da = \widehat{I} \\
(IR) &: a\left[A_H i(a)^{\alpha} - r_H(a)\, i(a)\right] + (1-a)\left[A_L i(a)^{\alpha} - r_L(a)\, i(a)\right] \geqslant \\
&\quad \pi_s\left(= (1-\alpha)\, A\widetilde{i}^{\alpha} > 0\right),\ \forall\ a\ \epsilon\ [a^*, 1] \\
(IC) &: a\left[A_H i(a)^{\alpha} - r_H(a)\, i(a)\right] + (1-a)\left[A_L i(a)^{\alpha} - r_L(a)\, i(a)\right] \geqslant \\
&\quad a\left[A_H i\left(a^C\right)^{\alpha} - r_H\left(a^C\right) i\left(a^C\right)\right] + (1-a)\left[A_L i\left(a^C\right)^{\alpha} - r_L\left(a^C\right) i\left(a^C\right)\right], \\
&\qquad\qquad\qquad\qquad\qquad \forall\ a,\ a^C \neq a\ \epsilon\ [a^*, 1],
\end{aligned}
$$

where we have imposed $\pi(a) = a$, $F(a) = a$, and neoclassical production functions with A_H and A_L corresponding to "success" and "failure" states. The financial contract $(i(a),\ r_H(a),\ r_L(a))$ stipulates an investment and a repayment rate for the two possible outcomes. (BC) is the budget constraint, where funds available for the risky projects net of fixed costs is denoted by $\widehat{I}$. (IR) is the individual rationality constraint, which states each risky entrepreneur gets at least the safe project profit, π_s, in an expected sense; if $\widetilde{i}$ is the investment level, and since safe project funding is devoid of informational problems, this profit is $(1-\alpha)\, A\widetilde{i}^{\alpha}$. The Inada condition guarantees positive safe project profits, and thus a positive reservation profit level. (IC) is the incentive compatibility constraint, which states that every entrepreneur whose true ability is a weakly prefers his "true" contract $(i(a),\ r_H(a),\ r_L(a))$ over a "false" contract $\left(i\left(a^C\right),\ r_H\left(a^C\right),\ r_L\left(a^C\right)\right)$ got by claiming ability a^C. Implicit are the constraints, $r_H(a),\ r_L(a) \geqslant 0$, which rule out "bribing" the entrepreneurs.

One could analyze this problem and completely characterize the type of contract, but for arguing that there are parameter configurations for which allocations are ability-invariant, this is unnecessary. Instead we examine the (IR) and (IC) constraints to seek a sufficient condition under which ability-varying contracts will not arise. Denote the net earnings of an ability-a entrepreneur in the two states as $w_H(a) \equiv A_H i(a)^{\alpha} - r_H(a)\, i(a)$ and $w_L(a) \equiv A_L i(a)^{\alpha} - r_L(a)\, i(a)$,and write the (IC) constraint as:

$$\left\{w_L(a) - w_L\left(a^C\right)\right\} \geqslant \left(\frac{a}{1-a}\right)\left\{w_H\left(a^C\right) - w_H(a)\right\}. \tag{15}$$

The left hand side is the loss to an entrepreneur at the bad state of overstating his ability and the term within curly braces on the right hand side is his gain in the good state. The probability weighted loss from lying has to outweigh the probability weighted gain from lying to satisfy incentive compatibility. Less able entrepreneurs are likely to be most responsive to a penalty in their highly probable low state.

An ability-varying incentive compatible contract cannot have $w_H(a) =$ constant, $\forall\ a\ \epsilon\ [a^*, 1]$. If this were so, everyone would claim to have ability $a^C \epsilon \arg\max\left(w_L(a)\right)$. The only surviving contract then stipulates $w_L(a) =$ constant, $\forall\ a\ \epsilon\ [a^*, 1]$, and thus the contract cannot be ability-varying to begin with. Indeed, if w_H is the same for any two ability levels, their w_Ls will also have to be same.

For $a_2 > a_1$ we can show we cannot have $w_H(a_2) < w_H(a_1)$. Suppose not. The (IC) for the a_1 entrepreneur relative to a_2 is: $a_1[w_H(a_1) - w_H(a_2)] \geqslant (1-a_1)[w_L(a_2) - w_L(a_1)]$. Given the supposition, the left hand side is positive. Since $a_2 > a_1$, the above inequality then implies $a_2 w_H(a_1) + (1-a_2) w_L(a_1) > a_2 w_H(a_2) + (1-a_2) w_L(a_2)$. In other words, the (IC) for the a_2 entrepreneur relative to a_1 is violated. These arguments show that $w_H(a)$ needs to be increasing in an ability varying contract. Moreover, $w_H(1) > w_H(a^*)$ in such a contract; if $w_H(1) = w_H(a^*)$, all the intermediate ability levels need to have the same w_H as well, and we are back in the realm of ability-invariant contracts. The candidate ability-varying contracts feature strictly increasing w_H or a step function (with the w_Ls being equated across ability levels within each step).

Consider the lowest ability entrepreneur in the pool, a^*. A sufficient condition for this entrepreneur to claim an ability of 1 under an ability-varying contract can be found by letting the left hand side of (15) take its maximum possible value. The maximum the left hand side can be (without bribes) is $A_L i(a^*)^\alpha$, that is give the low ability entrepreneur his entire output. Given $w_H(1) > w_H(a^*)$, as argued above, we can write the $\{w_H(1) - w_H(a^*)\}$ on the right hand side, without loss of generality, as $\varepsilon A\widetilde{i}^\alpha$, for some $\varepsilon > 0$. Therefore, a sufficient condition is $\frac{A_L i(a^*)^\alpha}{\varepsilon A\widetilde{i}^\alpha} < \frac{a^*}{1-a^*}$. Note that this condition is automatically satisfied when $A_L = 0$. In that case, there is no way to penalize the low ability person because he has nothing to lose when he gets the low state. Therefore, as argued in the main text, no ability-varying scheme is possible. To get a bound on A_L in the case where it is not zero, use the upper bound on $\frac{i(a)}{\widetilde{i}}$ from the full information case for $a = 1$ from equation (14) as $\left(\frac{A_H}{A}\right)^{\frac{1}{1-\alpha}}$, and the minimum possible a^* (also from full information case) as $\frac{A-A_L}{A_H-A_L}$, and write the sufficient condition for the a^* entrepreneur to claim to be of type 1 as:

$$A_L < \frac{A}{1+\varepsilon\left(\frac{A_H}{A}\right)^{\frac{1}{1-\alpha}}\left(\frac{A_H}{A}-1\right)}.$$

If a non-discriminatory contract is not possible between a^* and 1, as argued above it is not possible for intermediate ability levels as well. The above condition is very stringent; but for our purposes of arguing that for small enough positive perturbations of A_L we can still have ability-invariant contracts offered by the intermediary, this argument suffices. $\square$

References

[1] Allen, Franklin, and Gale, Douglas. *Comparing Financial Systems.* Cambridge, MA: The MIT Press, 2000.

[2] Martin, Baily, and Solow, Robert. "International Productivity Comparisons Built from the Firm Level." *The Journal of Economic Perspectives,* 2001, vol 15 no 3, 151-172.

[3] Barro, Robert J., and Lee, Jong-Wha. "International Measures of Schooling Years and Schooling Quality." *AEA Papers and Proceedings,* May 1996, vol 86 no 2, 218-223.

[4] Beck, Thorsten, Demirgüç-Kunt, Asli and Levine, Ross. "A New Database on Financial Development and Structure", World Bank Working paper 2146, June 1999.

[5] Bergoeing, Raphael, Keho, Patrick J., Kehoe, Timothy J., and Soto, Raimundo. "Decades Lost and Found: Mexico and Chile Since 1980," *Review of Economic Dynamics*, 5, 166-205, january 2002.

[6] Bernanke, Ben, Gertler, Mark, and Gilchrist, Simon. "The Financial Accelerator in a Quantitative Business Cycle Framework," NBER Working Paper 6455, March 1998.

[7] Boyd, H. John, and Smith, Bruce. "Capital Market Imperfections, International Credit Markets, and Nonconvergence," *Journal of Economic Theory*, 1997, vol 73, 335-364.

[8] Carlstrom, Charles T., and Fuerst, Timothy S. "Agency Costs, Net Worth, and Business Fluctuations: A Computable General Equilibrium Analysis," *The American Economic Review*, December 1997, vol 87 no 5, 893-910.

[9] Djankov, Simeon, La Porta, Rafael, de Silanes, Florencio Lopez, and Shleifer, Andrei. "The Regulation of Entry", *Quarterly Journal of Economics*, 117, 1-37, Feb. 2002

[10] Erosa, Andres. "Financial Intermediation and Occupational Choice in Development," *Review of Economic Dynamics*, 4, 303-334, April 2001.

[11] Feldstein, Martin. "The Effects of Outbound Foreign Direct Investment on the Domestic Capital Stock." *NBER,* Working Paper #4668, March 1994.

[12] Fernandez-Arias, Eduardo, and Hausmann, Ricardo. "Is FDI a Safer Form of Financing?" *Inter-American Development Bank,* Working Paper #416, March 2000.

[13] Gardner, Bruce L. "The United States," in Fred H. Sanderson (ed.), *Agricultural Protectionism in the Industrialized World*, Baltimore, MD.: The Johns Hopkins University Press, 1990.

[14] Gertler, Mark., and Rogoff, Kenneth. "North-South Lending and Endogenous Domestic Capital Market Inefficiencies," *Journal of Monetary Economics,* 1990, vol 26, 245-266.

[15] Gollin, Douglas. "Getting Income Shares Right," *Journal of Political Economy*, April 2002, vol 110 no 2, 458-474.

[16] Greenwood, Jeremy, and Jovanovic, Boyan. "Financial Development, Growth, and the Distribution of Income," *Journal of Political Economy*, 1990, vol 98, 1076-1107.

[17] Hall, Robert E., and Jones, Charles I. "Why Do Some Countries Produce So Much More Output Per Worker Than Others?" *The Quarterly Journal of Economics*, 1999, vol 114, 83-116.

[18] Hiseh, Chang-Tai, and Klenow, Peter J. "Relative Prices and Relative Prosperity," Working Paper, November 2002.

[19] İmrohoroğlu, Ayse, and Kumar, Krishna B. "Entry Costs, Intermediation, and Endogenous TFP Differences". Working paper, USC, 2003.

[20] King, Robert G., and Rebelo, Sergio T. "Transitional Dynamics and Economic Growth in the Neoclassical Model," *The American Economic Review*, September 1993, vol 83 no 4, 908-931.

[21] Klenow, Peter J., and Rodriguez, Andres. "The Neoclassical Revival in Growth Economics: Has it Gone Too Far?" *NBER Macroeconomics Annual 1997,* 73-103.

[22] Kraay, Aart, Loayza, Norman, Serven, Luis, and Ventura, Jaume. "Country Portfolios" *NBER Working Paper 7795*, 2000.

[23] Kumar, Krishna B. "Education and Technology Adoption in a Small Open Economy: Theory and Evidence," forthcoming, *Macroeconomic Dynamics.*

[24] Levine, Ross, Loayza, Norman, and Beck, Thorsten. "Financial intermediation and growth: Causality and causes," *Journal of Monetary Economics,* 2000, vol 46, 31-77.

[25] Lucas, Robert E., Jr. "Why Doesn't Capital Flow from Rich to Poor Countries?" *AEA Papers and Proceedings*, May 1990, vol 80 no 2, 92-96.

[26] Obstfeld, Maurice. "International Capital Mobility in the 1990s," in *Understanding Interdependence: The Macroeconomics of the Open Economy* (Peter B. Kenen, Editor), Princeton, NJ: Princeton University Press, 1995.

[27] Restuccia, Diego, and Urrutia, Carlos. "Relative Prices and Investment Rates," *Journal of Monetary Economics,* 2001, vol 47 no 1, 93-121.

[28] Robertson, Peter. "Economic Growth and Return to Capital in Developing Countries." *Oxford Economic Papers,* 1999, vol 51, 577-594.

[29] Silva, Andre de C. "Capital Flows," by Ayse İmrohoroğlu and Krishna Kumar: comments and an extension," mimeo, University of Chicago, May 2002.

[30] Townsend, Robert M. "Optimal Contracts and Competitive Markets with Costly State Verification." *Journal of Economic Theory*, October 1979, vol 21 no 2, 265-293.

[31] The World Bank. *2000 World Development Indicators.* Washington, DC: The World Bank, 2000.

[32] Zebregs, Harm. "Economic Growth with Endogenous Complementarity between Domestic and Foreign Capital Goods," IMF Working paper, May 1999.