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By Michael A. Clemens

Abstract

Global private capital flows have barely touched the poorest nations; the rich invest mostly with the rich. Confronted with this wealth bias in cross-border investment flows, one of the starkest facts of the global economy, theorists and empiricists have spent roughly the last decade looking for an explanation. It is possible that failures in the global capital market prevent capital from exploiting high returns in poor countries; it is also possible that fundamental returns to investment are lower in poor countries. Could a rich-country social planner, capable only of forcing capital flows across borders but not directly into the hands of individual poor-country entrepreneurs, improve the efficiency of the global capital allocation? She could—but only to the extent that market failures cause wealth bias, and moreover, only to the extent that those market failures drive wedges expressly across international boundaries. A novel empirical framework uses standard data to conclude that 85% of wealth bias, whether caused by market failure or not, is domestic in origin. That is, poor country lenders are deterred from investing in poor countries to nearly the same degree that rich-country lenders are. Schematically speaking, investors at the National Stock Exchange in Mumbai face much the same incentives to invest in India as do their counterparts on Wall Street.

Do Rich Countries Invest Less in Poor Countries Than the Poor Countries Themselves?[1]

by

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I. Wealth Bias

Global capital flows have barely touched the poorest nations. In the past, other equally stark empirical facts have excelled at prodding economists in new directions—both theorists and policymakers. The Great Depression, stagflation, and divergence have each done their part to fill the journals and even the halls of the Royal Swedish Academy of Sciences with rich discussions. But there remains no explanation, satisfactory to theorists nor to policymakers, for why the world's rich invest mostly with the world's rich. Until there is, one of the starkest facts of the global economy will not have had its day in the sun.

Figure 1 displays aggregate changes in the stock of liabilities to foreigners, in two types of private capital assets, across all nations. Shown are annual flows, not stocks, so the upward slope is not merely a trend in but a vast acceleration of cross-border investment up to 1999. This is a portrait of the second great global capital market boom; the first such expansion occurred in the decades preceding 1914. Although this once-sanguine boom may or may not have recently entered the domain of economic historians,[3] a large and thorough literature rightly has explored and continues to explore the causes of this slice of globalization. What country characteristics or events cause nations to invest at home or abroad ("push vs. pull")? How freely does capital cross borders (savings-investment correlations),[4] and why does so little seem to flow abroad (the "home bias" puzzle)? [5] All are compelling questions, and progress has been made. Common threads running through most extant analyses include 1) a focus on developed countries and high-performing emerging markets, and 2) a focus on crises and short-term determinants of capital flows.

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[3] The 2001 edition of the *World Investment Report*, disseminated by the United Nations Conference on Trade and Development, reports that global FDI flows are likely to plummet 40% this year—the first such decline since World War Two. Whether 1999/2000 will eventually represent a local or more global maximum cannot be known.

[4] See e.g. Obstfeld (1995).

Relatively recently, theoreticians opened a new and important line of inquiry related to *where all the capital has gone*. Crises come and crises go, but over the long run why do poor countries get so little foreign investment? If we believe in production functions that look remotely neoclassical, there should be large returns to investment in the capital-poor developing world. The incentives to send capital to the most destitute nations should dwarf those available elsewhere, and massive private investment in the poorest nations should be observed. Figure 2 makes dramatically clear just how far off the mark such a prediction would be. The big story of the second great global capital market boom is rich nations exporting capital to other rich nations—a phenomenon we term the *wealth bias* of foreign investment.

Robert Lucas (1990) posited this puzzle—"Why Doesn't Capital Flow from Rich to Poor Countries?"—in a parsimonious fashion that found resonance in several subsequent treatments of the issue. But his inquiries were just one part of a contemporaneous flurry of initial theoretical attention in the Growth and International literatures, which included the work of Barro (1989, 1991), Gertler and Rogoff (1990), King and Rebelo (1989, 1993), and others.

An inexplicit but key contribution of Lucas' slim paper was to divide possible answers to the question into two definitive categories. Put roughly but succinctly, either the returns to capital—for any investor, anywhere on earth—are lower in poor countries than a simplistic production function would predict, or the returns are in fact high but a market failure blocks the commensurate flow of capital. Over the past decade, a large theoretical literature—to be discussed below—has explored both mechanisms. This work has been closely paralleled the growth/convergence literature, which has explored the homologous question of whether international differences in factor endowments or international productivity differences cause cross-country variations in growth. While extensive empirical work has been done on the growth implications of this dichotomy,[6] very little empirical investigation of its implications for capital flows has been done. A

[5] The "home bias" puzzle goes back at least to Levy and Sarnat (1970) and is summarized in Lewis (1996).
[6] For example, Young (1995) and Easterly and Levine (2001).

possible explanation for this gap is that factor endowments are easy to measure, but market failures are not. This paper seeks to begin filling the gap.

An obvious reason underlying the interest in whether wealth bias is caused by differences in fundamental capital productivity or by market failures has been the desire to design policies which move more capital to poor countries. Indeed, lamentation of wealth bias is a pillar of the extant multilateral public finance architecture. The official goal of the powerful joint World Bank/IMF Development Committee is the "transfer of real resources to developing countries." Clearly, an omnipotent social planner desirous of greater capital flows to poor countries would behave differently depending on whether or not wealth bias were caused by market failures. In the presence of market failure, such a social planner could provide a more efficient global capital allocation by taxing rich countries and forcing capital transfers to borrowers in poor countries.

It is not obvious, however, that a *rich country* social planner with access to poor country lenders—but unable to deal directly with poor country borrowers—would optimally force cross-border capital flows. It would be folly, in an efficiency sense, if the same market failures driving a wedge between poor country borrowers and rich country lenders also separated poor country borrowers from *poor* country lenders. In this case, the marginal realized return on capital would be no greater after the rich country social planner had forced it into the hands of poor country investors. There would be no efficiency gain. The actions of a social planner located in a rich country wishing to remedy any market failures producing wealth bias are, therefore, contingent on whether or not the failure is an expressly international one. That is, optimal policy depends on whether the market failures specifically affect *international* capital flows to poor country borrowers or affect *all* capital flows to poor country borrowers, regardless of whether their source is foreign or domestic. Of course, if wealth bias is not caused by market failures at all but rather by international differences in the fundamental productivity of capital within a well-functioning capital market, no social planner could achieve efficiency gains by forcing capital flows.

Whether or not wealth bias is caused by market failure, it therefore matters whether it is caused by international asymmetries (market failures specifically affecting cross-border transactions) or domestic asymmetries (differences in fundamental capital productivity, or market failures affecting both national and international transactions with poor borrowers). Put simply, the question is this: does a poor Indian borrower have greater access to capital at the National Stock Exchange of India than on Wall Street? The contribution of this work is the empirical result that, to the extent that the wealth bias of international capital flows is caused by market failures at all, it is predominantly caused by domestic market failures within poor countries. A key implication is that whether wealth bias is caused by market failures or not, affecting it may be out of reach of a rich-country social planner that acts solely through forced capital flows. Section II briefly reviews the literature on wealth bias. Section III explores various extant theoretical explanations for wealth bias, and their implications for whether wealth bias springs from categorically international market failures or from domestically-rooted asymmetries that happen to extend to international lenders. Section IV describes how a novel empirical strategy can differentiate between international and domestic causes of wealth bias. Section V presents the empirical result that, to the extent that wealth bias is caused by market failure, it is an overwhelmingly domestic market failure rather than a specifically international one. Section VI discusses some implications.

II. PREVIOUS RESEARCH

Wealth Bias due to Market Failures

The foundation of this literature is the work of Gertler and Rogoff (1990), which appears to be the first careful theoretical model attributing wealth bias to an asymmetry of information between lenders and borrowers. Lenders cannot monitor borrowers' investment in a risky project, giving the latter an incentive to clandestinely divert assets to a riskless project and falsely claim a negative outcome in the contracted investment. The result is credit rationing by moral hazard, which is more severe in poor countries where low initial wealth requires more borrowing and therefore provides larger incentives to "cheat." As the title of their work implies, the authors are concerned with

domestic capital market failure; the informational asymmetry exists between all borrowers and all lenders regardless of nationality. Their model is easily extended, however, to a case of superior monitoring by domestic lenders.

Subsequent theoretical work has posited this and other forms of informational asymmetry (adverse selection) as the prime determinant of international capital flow patterns—focusing largely on the causes of home bias. These works include Low (1992), Gehrig (1993), Gordon and Bovenberg (1996), Kang and Stulz (1997), Brennan and Cao (1997), Zhou (1998), Hanson (1999) and Chinn and Kletzer (2000). Empirical investigations in this vein are numerous and include Carlos and Lewis (1995), Chuhan (1992), Giovanetti et al. (1993), Kang and Stulz (1997), Brennan and Cao (1997), Liljeblom and Löflund (2000), Ahearne, Griever and Warnock (2001), Bartram and Dufey (2001), and Janeba (2001). Very few of these[7] explicitly seek to explain wealth bias with informational asymmetry; rather they establish informational problems as a driving force behind capital flows and have therefore often been interpreted to explain why poor countries do not receive voluminous flows.

Agency problems are, of course, not the only market failures put forward as a primary determinant of capital flow patterns to poor countries. In Boyd and Smith's (1992) intermediation model, capital flows to developing countries can be rationed because developed-country investors will not write contracts with developing-country borrowers when the cost of verifying borrower compliance exceeds the benefit of the contract. Pecchenino and Pollard's (2000) model of costly state verification assumes that domestic lenders can distinguish between positive net present value projects but foreign investors cannot. Kraay, Loayza, Serven and Ventura (2000) seek to explain wealth bias by assuming that domestic investors have access to enforceable contracts but foreigners do not. Tornell and Velasco's (1992) model of capital flight is based on the premise that property rights in developing countries are insecure for all investors, domestic and foreign. In fact, Lucas (1990) suggested his own variety of international market failure with a simple model in which rich countries hold a monopoly on capital.

Wealth Bias without Market Failure

But Lucas (1990) has been the theoretical reference point for those believing that some third factor unrelated to market failure and specific to different countries (therefore inherently asymmetrical across international boundaries) is the cause of wealth bias. Lucas briefly explores the issues of how human capital endowments and associated externalities could produce wealth bias even in a world of perfect information and efficient capital movements. O'Rourke (1992) suggests such an explanation for low capital productivity in poor 19th-century Ireland.

Ciccone and Matsuyama (1995), Galí (1995), Rodríguez-Clare (1996), and Bardhan (1996) propose that the third factor could be specialized, non-tradable inputs. Implicitly interpreting the work of Jones (1971), Bardhan also advances the idea that the third factor could be sector specific and therefore bring more subtle effects on capital productivity and flows. Zeira (1998) and Robertson (1999) likewise rely on a two-sector model with sector-specific capital. But there is no recourse to market failure. As Galor (1996) points out, immobility of the third factor is crucial to these arguments. Faini (1996) does not even resort to a third factor but posits that international movements of the second factor, labor, out of countries with low capital stocks could keep the marginal productivity of capital low there.

Although the empirics of long-term capital movements are in their infancy[8] (see Lane and Milesi-Ferretti 2001), empirical works have also investigated the role of other third factors such as human capital, demographic structure, geographic location, and indicators of economic structure such as openness to trade and other macroeconomic policy variables. These include Schneider and Frey (1985), Hein (1992), Higgins (1993; summarized in Taylor 1998), Nerlove et al. (1993), Taylor and Williamson (1994), Barro

[7] The exceptions are Gordon and Bovenberg (1996), Giovanetti et al. (1993), and Hanson (1999).

[8] A clear indication of this immaturity in the empirical literature is the careful work of Warnock and Mason (2001), which questions whether or not the best available country estimates of capital outflows are even close to their correct values. Their estimates of the disparity, however, show no correlation with wealth. They find US portfolio capital outflows to financial centers such as Hong Kong to have been

et al. (1995), Singh and Jun (1995), Debelle and Faruqee (1996), Chunlai (1997), Higgins and Williamson (1997), Klenow and Rodríguez-Clare (1997), Milesi-Ferretti and Razin (1998), Lensink and White (1998), Clemens and Williamson (2000), Mody and Srinivasan (1998), Wilhelms (1998), Cheng and Kwan (2000), and Olson et al. (2000). The results of many of these studies are difficult for a social planner to interpret. If poor countries with more human capital attract more investment, is this because human capital raises the fundamental productivity of investment in those countries (i.e., there is no market failure), or because it serves as a signal of creditworthiness (i.e., there is market failure)? If it is market failure, is it international or domestic?

Additional work, while not explicitly addressing the issue of international capital flows, is relevant. Hall and Jones (1999) and Islam (1999) document vastly larger productivity per worker in rich countries, a difference that could hardly be lost on the international investor. Devarajan, Easterly and Pack (2001) analyze both country-level micro data with cross-country data from the World Bank and find no evidence that private or public capital is productive in Africa. Working in Ghana, Bigsten et al. (1997, 1998) use firm-level data to verify relatively high marginal products of capital—exceeding 20%—but find little effect of profits on firm-level investment, suggesting a lack of credit constraints.

Mankiw (1995) and Obstfeld (1995) seek to explain wealth bias not with a third factor but simply with certain plausible assumptions about the form of the production function including an increased substitutability between labor and capital. Again, no recourse to international market failure is needed. Unrealistic empirical implications of this approach, however, are severely criticized by Romer (1995; in Mankiw [1995], p. 318).

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overestimated, those to continental Europe underestimated, and those to Latin America roughly correct.

III. THREE EXPLANATIONS FOR WEALTH BIAS: A SYNCRETIC MODEL

The three main strains of the theoretical literature we will discuss here seek to explain wealth bias through asymmetries of 1) information, 2) enforcement, and 3) fundamental capital productivity.

Information Asymmetry

Adverse Selection: Asymmetries of information between lenders and poor borrowers could take the form of costly pre-contracting determination of borrower type (adverse selection), costly post-contracting determination of borrower action (moral hazard), or costly determination of states of the world (hidden investment outcomes). We will discuss each in turn.

Suppose that the international asymmetry of information between borrowers and lenders is related not to the post-contracting behavior of the borrower but instead to the pre-contracting type of the borrower. All entrepreneurs in the home country have identical savings but each has access to only one of two types of investment projects. Type *L* investors may invest only in a "low risk" project and type *H* only in a "high risk" project. For a moment we make the soon-to-be-relaxed assumption that a foreign lender has perfect information about all borrowers' types.

There are two periods and borrowers' utility is a linear function of the expected return on their investment. After investment I in period 1, the risky payoff in period 2 is

$$Y_2 = \begin{cases} X + \sigma & \text{with probability } \pi \\ X - \sigma & \text{with probability } 1 - \pi. \end{cases} \quad (1)$$

where $\sigma = \sigma_L$ for "low risk" borrowers and $\sigma = \sigma_H$ for "high risk" borrowers, such that $\sigma_L < \sigma_H$, and X and π are fixed and equal across types. Note that $E[Y_2] = X$ for both types. The lender loans $B = I - Y_1$ and demands collateral C. Contract enforcement is perfect, so the borrower defaults only if $Y_2 + C \leq B(1 + r)$. The borrower's payoff function μ and lender's payoff function ν are

$$\begin{aligned} \mu &\equiv MAX[Y_2 - (1+r)B;\ -C] \\ \nu &\equiv MIN[Y_2 + C;\ (1+r)B] \end{aligned} . \quad (2)$$

Assume that parameters are such that the borrower defaults if she receives a "bad" outcome in (1) and does not default if she receives a "good" outcome.[9] Under this assumption, the convexity of μ implies that $E[\mu]$ is strictly increasing in σ. That is, the "bankruptcy" clause built into the model means that investors with riskier, higher-return projects can expect fatter profits. The above assumption further implies that

$$\exists \hat{\sigma} > 0 \mid E[\mu] = \pi\big(X + \sigma - (1+r)B\big) + (1-\pi)(-C) = 0 . \quad (3)$$

That is, there exists a critical value of project risk such that investors with σ below the critical value expect negative profits and will not take loans. Note, then, that the higher the interest rate charged by lenders, the riskier must be the investor's project in order for her to take the loan, since

$$\hat{\sigma} = \frac{1}{\pi}\big(C - \pi(X - (1+r)B + C)\big) \quad \Rightarrow \quad \frac{\partial \hat{\sigma}}{\partial r} > 0 . \quad (4)$$

[9] Otherwise this highly simplified model does not capture the essential characteristics of a richer model in which there is a continuum of investor types with σ drawn from a continuous distribution. If both risky outcomes lead to default, then no lending takes place; conversely, if neither outcome leads to default, then the problem is trivial.

The interest rate has a double-edged effect on lenders' profits, as

$$E[\nu] = \pi\big((1+r)B\big) + (1-\pi)\big(X - \sigma + C\big) \quad \Rightarrow \quad \frac{\partial E[\nu]}{\partial r} > 0\,, \quad \frac{\partial E[\nu]}{\partial \sigma} < 0\,. \qquad (5)$$

In other words, the lender earns more *ceteris paribus* from each loan when interest rates are high, but less when its borrowers' projects entail greater risk. If the lender knows the borrower's type, the lender can charge different interest rates contingent on type that maximize E[ν]. There is no credit rationing, and I does not depend on Y_1, so poor countries receive more investment than rich countries:

$$\frac{\partial(I - Y_1)}{\partial Y_1} < 0\,. \quad (6)$$

Suppose now that borrowers know their own types but lenders do not. All lenders know is that, from (4), higher interest rates will eventually make their best (low-risk) customers drop out of the market. Equations (4) and (5) together imply the result of Stiglitz and Weiss (1981), that if the market-clearing interest rate is high enough to drive out low-risk investors, lenders may optimally depress r below its Walrasian equilibrium value and ration the credit supply.[10]

How does a borrower's initial wealth affect credit rationing? Recalling that $B = I - Y_1$, note that the critical value of project risk (4) increases with lending but decreases with initial wealth:

$$\frac{\partial \hat{\sigma}}{\partial I} > 0 \quad \text{and} \quad \frac{\partial \hat{\sigma}}{\partial Y_1} < 0\,. \qquad (7)$$

The implicit function theorem immediately gives us $\partial I / \partial Y_1 > 0$, opening the possibility that

$$\frac{\partial(I - Y_1)}{\partial Y_1} > 0\,. \quad (8)$$

Credit rationing induced by adverse selection provides, then a potential explanation of

[10] An assumption necessary for this to be strictly true is that lenders' profits at the artificially low interest rate, but with both borrower types still in the market, exceed profits at the higher interest rate when all borrowers are high-risk. This condition reduces to $\pi\big((1+\hat{r})\hat{B} - (1+r)B\big) > (1-\pi)\big(E[\sigma] - \sigma_H\big)$, where $\hat{r} = r \,\big|\, \sigma = \sigma_L$, E[$\sigma$] is the average σ in the investor population, and $\hat{B}$ is credit supplied at $r = \hat{r}$.

wealth bias. In loose terms, this is because the more initial capital the investor has, the less she must borrow to fund *I*. Thus the less she must pay back to the lender in the "good" project outcome and the less risky her project can be and still break even. The interest rate can then rise higher without pushing the critical value of project risk high enough to drive her out of the market, and the closer the interest rate can be to its Walrasian equilibrium value. Greater initial wealth means less credit rationing via adverse selection.

Moral Hazard: Gertler and Rogoff's (1990) model of wealth bias based on moral hazard is presented in Appendix 1. Briefly, borrowers are all of the same type but can undertake hidden action after the loan contract is signed that can influence the probability of a good outcome. Borrowers have access to a riskless investment unrelated to the contracted project (say, a Swiss Bank Account) and therefore have an incentive to incur less than the maximum effort, claim the project failed because of bad luck, and default on the loan while investing part or all of *I* in the hidden, riskless asset. Lenders, realizing that this "cheating" goes on, ration credit. Poorer borrowers must pay a larger fraction of the risky project return to the lender, and thus have a greater incentive to "cheat." Credit rationing is thus greater for poor countries, which therefore have higher real interest rates than rich countries.

Hidden outcomes: It is simple to extend the adverse selection model to explain wealth bias with costly state verification. Suppose now that σ is identical for all borrowers in equation (1), but only borrowers know whether or not the project achieved a "good" or "bad" outcome. As long as $X - \sigma + C \leq B(1 + r)$, then borrowers will always claim a bad outcome and default, pocketing the profits. No lending will occur, unless collateral is large enough and enforcement is perfect. Therefore richer countries—with higher *C*—receive more investment.

To what degree do information-based models of wealth bias imply that the associated market failure is domestic or international in nature? Although the models posit an asymmetry between poor-country borrowers and *all* lenders, it is not difficult to

imagine that informational asymmetries could be much greater for international lenders than for domestic lenders. Compared to an American lender, would not an Indian lender have superior ability to assess the type, monitor the behavior, or discover the project outcome of an Indian borrower?[11]

A classic model of financial intermediation by Diamond (1984) suggests why strictly international asymmetries of information might not explain wealth bias. Suppose, for example, that moral hazard causes wealth bias and it is the inability of international lenders to monitor poor domestic borrowers' efforts that rations international capital flows. Domestic agents, however, can perfectly monitor domestic borrowers. Any such agent could lend to her fellow domestic residents with an effort-contingent contract that would give borrowers the incentive to utilize maximum effort. Assuming that realizations of the project outcome for different borrowers are independent, the domestic lender could lend to a sufficiently large number of borrowers to achieve a diverse and nearly riskless portfolio. This intermediary could then finance those loans by borrowing from abroad with an non-contingent contract.

The fact that international lenders cannot monitor poor domestic borrowers would not, therefore, affect international capital flows as long as domestic lenders had superior monitoring ability. A similar argument applies to the other manifestations of asymmetric information. A purely international asymmetry of information would cause intermediaries to arise capable of eliminating wealth bias. If informational asymmetry causes wealth bias, then, it must be that domestic lenders do not have superior information. That is, any information asymmetry causing wealth bias must lie between poor borrowers and *all* lenders, domestic and foreign.

[11] Researchers such as Razin, Sadka and Yuen (2001) have suggested that foreign portfolio investors suffer from even greater information asymmetries than their counterparts among foreign direct investors. The implication that direct investors could have access to better information suggests the assumption of a purely cross-border component to the informational asymmetry between borrowers and lenders.

Unenforceable Contracts

All of the preceding models have assumed perfect contract enforcement. A different explanation of wealth bias, also based on market failures, involves the assumption that contract enforcement is not as strong in poor countries as in rich countries. Poor judicial systems or "sovereign risk" in poor countries prevent investors from realizing their contracted return despite complete information, so international investors ration credit to poor countries. Such is the basis of models like those of Tornell and Velasco (1992) and Kraay et al. (2000).

The insecure property rights in poor countries that drive such models are taken as exogenous, so could just as easily be assumed more severe for foreign investors than for domestic investors. In this case, the degree to which wealth bias is caused internationally rather than domestically depends upon foreign investors' access to non-financial "collateral" such as pressuring their home governments to impose trade sanctions on poor sovereigns that abrogate rich-country investors' property rights (as, for example, in the work of Bulow and Rogoff (1989)). Non-financial collateral would not be an issue if poor countries had sufficient financial collateral for rich-country investors to hold in escrow, but we assume that if poor countries had sufficient capital to financially collateralize international lending, they would prefer to self-finance.

Unlike in the case of informational asymmetry, domestic financial intermediaries could not arise to resolve wealth bias if inferior contract enforcement specifically for foreign investors is the root cause. Such an intermediary would require sufficient financial collateral to cover all foreign lending—lest the domestic intermediary face the same rationed capital flows as the poor domestic borrower—but if she had such capital, she could finance the borrowers herself. If wealth bias is caused by unenforceable contracts, then, it remains an empirical question whether the market failure is expressly international in nature ("sovereign risk") or domestic (applies to all investors, domestic or foreign).

Fundamental Capital Productivity

Suppose now that capital markets are perfect. Poor countries receive less capital not expressly because they are poor, but rather because other characteristics associated with poverty make the fundamental marginal productivity of capital lower in those countries. We return for a moment to the perfect information investment model above and relax their assumption that X is identical in all countries. The marginal product of investment equals the world interest rate when[12]

$$I = \pi'^{-1}\left(\frac{1+r^*}{X}\right), \qquad (9)$$

and therefore $\partial I / \partial X > 0$. The sign of

$$\frac{\partial I}{\partial Y_1} = \frac{\partial I}{\partial X}\frac{\partial X}{\partial Y_1}, \qquad (10)$$

and thus the sign of $\partial(I - Y_1) / \partial Y_1$, depends on the sign of

$$\frac{\partial X}{\partial Y_1} = \frac{\partial X}{\partial Z}\frac{\partial Z}{\partial Y_1} \qquad (11)$$

where Z measures some attribute of nations besides their endowment of labor and physical capital that affects the productivity of physical capital investments and is correlated with their wealth—a "third factor." Even under perfect information, then, we can expect to observe the same wealth bias predicted by (8) if either

$$\frac{\partial X}{\partial Z} > 0 \quad \text{and} \quad \frac{\partial Z}{\partial Y_1} > 0 \qquad (12)$$

or

$$\frac{\partial X}{\partial Z} < 0 \quad \text{and} \quad \frac{\partial Z}{\partial Y_1} < 0. \qquad (13)$$

Roughly speaking, wealth bias would be expected under perfect information if there is a third factor which augments the productivity of physical capital investment and rich countries happen to be better-endowed with it. It would also be expected if the third factor impairs productivity and rich countries were endowed with less of it. Such wealth bias would be domestic, rather than international, in origin. That is, it would discourage lending to poor country borrowers by *all* lenders, domestic and international.

[12] For details see Appendix 1.

Appendix 2 derives simple mechanisms that can lie behind equations (12) and (13). In a simple one sector model, it is easy to see that greater endowments of a productive third factor in rich countries could give them a higher productivity of physical capital, *ceteris paribus*. In two sector production, greater endowments of a productive third factor specific to a sector outside the physical capital-specific sector can actually *decrease* the productivity of physical capital. It does this by making the former sector more productive and starving the physical capital-specific sector of all mobile factors. An example of a productive factor with which rich countries are better endowed, and which could improve the productivity of physical capital, is human capital. An example of a productive factor which could be modeled as being specific to sectors outside those sectors employing most physical capital is the endowment of natural resources.

Summary: Theory predicts, then, that if wealth bias is caused by informational asymmetries or by differences in the fundamental productivity of capital, the consequent disincentive to invest in poor countries should apply equally to all lenders. There should be no difference between the incentives of poor-country lenders and those of rich-country lenders to invest in poor-country borrowers. If wealth bias is caused by less secure property rights in poor countries, this degree of insecurity could be different for domestic and international lenders. In that case, the degree to which wealth bias is an international or domestic phenomenon is an empirical question.

IV. Empirical strategy

As discussed above, empirically testing whether wealth bias is caused by market failures or by fundamentals is difficult. Charles Jones (1997, in Klenow and Rodríguez-Clare [1997]) points out that any empirical investigation seeking to distinguish between the two views of wealth bias faces an identification problem. How can one tell the difference in the data between shifts in a production function brought about by third factors, and movement along a single production function? Testing whether it is an international or a domestic phenomenon, however, is not difficult.

In a one-sector world where all countries faced the same neoclassical production function, poor countries would require massive capital inflows before they would exhibit marginal products of capital that were less than astronomical. If there were a group of investors somewhere on earth that could somehow escape the forces causing wealth bias, they would theoretically face an enormous incentive to invest in poor countries. In asking whether wealth bias is a domestic or international phenomenon, then, we are really asking whether domestic investors can somehow escape the causes of wealth bias. If unenforceable contracts are the problem, do domestic lenders have access to enforceable contracts? If informational asymmetries are the problem, do domestic lenders have better information? Naturally, if differences in the fundamental productivity of capital are at issue, one would not expect any investor on earth to be able to escape the incentives producing wealth bias.

Many previous studies on the determinants of international investment flows have attempted to explain the current account, net FDI flows, or other quantities that do not contain information about the ownership of the capital involved. Statistics on international investment flows broken down by liabilities (foreign owned) and assets (domestically owned) are, however, readily available from the International Monetary Fund.[13] Also widely available are statistics on domestic investment which—less its foreign-owned component—leaves Domestic Investment Financed Domestically (DIFD). With these numbers in hand, it is relatively simple to investigate whether domestic financiers of poor countries behave differently from their foreign counterparts.

First, the empirical analysis will attempt to measure the wealth bias of domestically financed investment flows and compare it to the wealth bias of international investment. Second, it will investigate the reactions of domestic and foreign investors to different domestic characteristics. The analysis seeks to demonstrate that the investors within poor countries do not respond to incentives that are much different from those faced by international investors. That is, it seeks to show that wealth bias is a predominantly domestic phenomenon.

V. Empirical Analysis

Table 1 measures the wealth bias present in two types of capital flows. The first type is the cumulative change in the stock of private foreign liabilities[14] per Economically Active Person (EAP)—that is, a person between the ages of 15 and 64. This is the cumulative flow of domestic investment financed from abroad. In the table, this is referred to as "liabilities." The second type is Domestic Investment Financed Domestically (DIFD), which is calculated as cumulative Gross Domestic Fixed Investment less cumulative private foreign liabilities flows and foreign aid flows, per EAP. This residual measures investment in the country in question by domestic investors.

Three different periods—1975-99, 1985-99, and 1995-99—are examined because the sample of countries for which complete data are available grows as we approach the present day. The tradeoff, of course, is that the shorter the time period examined, the more potentially subject the results are to short-run events such as the East Asian financial crisis of 1997-98. Both capital flows on the left hand side of the regressions, and income on the right, are in log terms so the resulting coefficients can be interpreted as unitless elasticities. Figure 1 makes it clear that the first of our three time periods covers most of the late 20th-century foreign investment boom.

The first two columns for each time period demonstrate the wealth bias of both foreign investment and DIFD. A 1% increase in GDP/EAP results in a >1% increase in both foreign investment and DIFD. The magnitude of wealth bias in foreign investment flows appears greater than that for DIFD flows, regardless of the time period examined. The third column for each time period shows that this difference in the degree of wealth bias is statistically significant. The matrices from the previous two regressions are stacked, and a dummy variable added that is 1 for foreign investment ("liabilities") flows

[13] For sources of these and other data, see Appendix 3.
[14] Measured as the sum of portfolio liabilities and FDI liabilities. These two types of capital are defined in

and 0 for DIFD flows. The positive, significant coefficient on the interaction term between this dummy variable and GDP/EAP reveals that wealth bias in foreign investment is stronger than that seen in DIFD. At the bottom of the table is a Chow test that both the coefficients measured for each of the two types of capital flows are equal. That is, it is an F-test of the hypothesis that the coefficients on the interaction term and the "liabilities" dummy are jointly equal to zero. The hypothesis is rejected.

Table 2 repeats the analysis, holding constant the country sample. Note that in Table 1, limitations of data coverage in the original source force the foreign investment sample to contain fewer observations than the DIFD sample, which could bias the analysis. Table 2, therefore, uses a multivariate specification to assess the relationship between GDP/EAP and both types of capital flows on the same sample. The resulting coefficients on GDP/EAP for the two types of capital flows are nearly identical to those seen in Table 1. At the bottom of the table, F-tests once again reject the hypothesis that the coefficients on GDP/EAP are equal for the two types of flows. Statistically speaking, there is significantly more wealth bias in foreign investment than in DIFD.

Is the difference economically significant? Figure 3 addresses this issue. At the top left, we see a plot of the DIFD flows analyzed in column 5 of Table 1 (that is, the 1985-99 period, chosen arbitrarily). At the top right, a plot of foreign-owned investment flows during the same period (analyzed in column 4 of Table 1). The bottom of the figure superimposes the two plots with their associated regression lines, graphically revealing the greater wealth bias of foreign investment flows.

Recall for a moment the puzzle pointed out by Robert Lucas. He pointed out that, given a one-sector production function with standard parameter values, the capital stock of poor countries would need to increase dramatically in order to equalize the marginal product of capital between rich and poor countries. Taking his production function ($y = Ak^{\alpha}$) and assuming a standard capital share α of 0.3, the log of this capital requirement in poor countries would increase as $(0.3)^{-1}$ for every one unit decrease in $\ln y$. The ensuing flow of capital to fill this requirement would, over the long run, look like the dotted line

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Appendix 3.

in the lower part of Figure 3. Lucas pointed out that foreign investors do not behave like this—starkly obvious in the figure—but neither do domestic investors.

One who believed that wealth bias is caused by strictly international asymmetries would expect the slope of the DIFD line to be closer to the slope predicted by Lucas. In fact, it is, but not by much. Using the coefficients from Table 1, the similarity of the divergence of the two lines from the predicted slope can be measured as $(1.46-(-(0.30)^{-1}))/(2.31-(-(0.30)^{-1})) = 0.849$. That is, whatever is causing the wealth bias posited by Lucas, 84.9% of it applies equally well to domestic investors.

We can use a Bonferroni confidence interval to establish bounds on this value. The Bonferroni method uses the $(1-(0.95)^{1/2}) \approx 2.5\%$ level of significance to perform conservative simultaneous inference on two coefficient estimates at the 5% level. For the 1985-99 period, at the 2.5% level the confidence interval for the slope coefficient in the foreign liabilities regression is (1.97, 2.64), and for the DIFD regression it is (1.32, 1.60). At the 5% level, therefore, the degree to which the two lines deviate from the Lucas-predicted lies between 0.779 and 0.930. This figure is not highly sensitive to the assumed capital share. Assuming $\alpha = 0.4$, the interval becomes (0.743, 0.917).
In other words, conservatively speaking, roughly 85% of wealth bias is caused by forces that affect in equal measure the incentives for domestic and foreign investors to invest in poor countries.

We could strengthen this conclusion by investigating whether domestic and foreign investors react differently to particular factors predicted by theory to influence the incentive to invest. The endowments of human and natural capital, for example, could affect investment either by altering the fundamental productivity of capital or by signaling creditworthiness to credit-rationing investors. Such processes could produce wealth bias if endowments differed between rich and poor countries.

Figure 4 reveals that rich countries indeed have significantly different endowments of these two factors than poor countries. The percentage of exports

comprising primary products[15] has been a widely used indicator of natural resources endowment, as predicted by the Heckscher-Ohlin framework, since the work of Sachs and Warner (2000). According to this measure, poor countries are relatively better endowed with natural resources following World War Two. The relationship can be seen in the top half of the figure. A simple regression of primary products as a fraction of exports in 1985 on GDP per economically active person (EAP) in 1985 gives a standardized coefficient of –0.547 with a a *t*-statistic of –8.85.[16]

In the lower half of the figure, we see the strong positive correlation between wealth and a widely used measure of human capital stock. Regressing the 1985 percentage of the adult population that has completed secondary school on 1985 GDP per EAP gives a standardized coefficient of 0.793 with a *t*-statistic of 13.3.[18] Clearly, for human capital, $\partial Z / \partial Y_I > 0$ as in equation (12). For the endowment of natural resources, $\partial Z / \partial Y_I < 0$ as in (13).

Table 3 tests whether or not these "third factors" affect the incentives of domestic investors differently than they affect those of foreign investors. The time period chosen for all regressions is 1985-99.

Observe first the deterrent effect of natural resources endowment on capital inflows. Standardized coefficients indicate that a one standard deviation increase in 1985 natural resources endowment was associated with more than a one-third standard deviation decline in capital inflows per economically active person. Table 3 uses, however, the same "pooled" specifications of Table 1 to test whether or not liabilities flows reacted differently to natural resources endowments than did DIFD flows. If the measure of natural resources endowment were capturing some effect with a special influence upon foreign investors, we would expect a positive coefficient on the

[15] Defined as SITC (revision 1) codes 0, 1, 2, 3, 4 and 68—see Data Appendix for details and sources.
[16] The standardized coefficient is measured by transforming regressor and regressand to have mean zero and standard deviation 1. The unitless coefficient thus measures how many standard deviations of the regressand are explained by a one standard deviation change in the regressor. This regression uses White's standard errors.

interaction term between the dummy for liabilities flows and the natural resources endowment. In fact, these coefficients are not significantly different from zero.

Turning to human capital, we note that all types of education attracted capital investment. Once again, the interaction term with the liabilities dummy is insignificantly different from zero. That is, for example, a one standard-deviation increase in the fraction of the population with a primary education was associated with a 0.37 standard-deviation increase in DIFD, a figure which was not significantly different for foreign-owned capital inflows.

Chow tests at the bottom of the table analyze both education and natural resources simultaneously. That is, they test the hypothesis that both interaction terms and the coefficient on the liabilities dummy are all jointly zero. The test fails to reject this hypothesis at the 5% level. That is, it fails to reject that the association between the two factors—jointly—and investor behavior was identical for both domestic and foreign investors.

Table 4 seeks to explore possible mechanisms for the negative coefficient on the endowment of natural resources. Abundant theoretical frameworks exist to explain the apparently negative postwar correlation between natural resources endowment and growth.[17] They fall roughly into two categories. The first posits that economies endowed with natural resources have fundamentally different structures and therefore capital productivities.[18] The second favors the view that economies focused on natural resources are more subject to the risk of price fluctuations, corrupt rent-seeking, and other forces unrelated to the fundamental productivity of the resource.[19] Is our measure of natural resources endowment merely acting as a proxy for some underlying structural difference? Does it proxy for investment risk engendered by natural resources

[17] For a recent review, see Gylfason (2001).
[18] These include Jones (1971), Matsuyama (1992), Sachs and Warner (1995) and Gylfason and Zeoga (2002), and are represented here by the exposition of Appendix 2. An alternative hypothesis is presented in Rodríguez and Sachs (2001).
[19] These include Leite and Weidmann (1999), Manzano and Rigobon (2001) and Stijns (2001).

dependence? Is it merely serving to flag low population density countries which, being located in the South, are geographically isolated from trade centers or even landlocked?

The first column establishes the univariate association between natural resources endowment and capital flows, a standardized coefficient of –0.588. Again, this coefficient is not significantly different for domestically-owned and foreign-owned investment.

The second column asks whether or not the effect can be explained solely by the physical distance between countries with large resource endowments and foreign investors.[20] The deterrent effect of distance predictably appears stronger (though not quite significantly so) for foreign investors. But it certainly does not explain the deterrent effect of natural resources endowment, which actually grows upon inclusion of the distance regressor.

The third column asks whether or not the natural resources variable is acting as a proxy for investment risk in the form of interest rate spreads or exchange rate fluctuations common to countries dependent on a limited range of commodity exports. Exchange rate variation has a negative but not quite significant effect on investment.[21] There is a slight associated decline in the measured natural resources effect, suggesting that the measure of natural resources used here is not serving as a proxy for these two measures of investment risk.

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[20] This is calculated by taking the average great-circle distance in miles from the capital of the country in question to the capitals of all other countries in the world, weighted by the value of exports going from the country in question to each other country. Ideally this measure would be weighted by capital flows as the true measure of integration, but the fact that certain countries' net flows with major partners are close to zero or even negative makes it clear why only gross flows should be used for such a purpose. The IMF does not report gross capital flows. We therefore implicitly assume a Kemp-Jones trade model with perfect capital mobility, in which goods trade and capital movements are compliments, rather than an immobile capital Heckscher-Ohlin model in which they are substitutes.

[21] Pecchenino and Pollard (2000) find that exchange rate fluctuations in the 1990s depressed capital flows to East Asian emerging markets in a model free of agency problems. Rather, they posit (harkening back to Froot and Stein 1991) international asymmetry of information regarding the net present value of investment projects. While our negative (albeit insignificant) coefficient on exchange rate variation is consistent with their results, the insignificant interaction term is not consistent with their explanation of the result. Odedokum (1992), Singh and Jun (1995), Debelle and Faruqee (1996), and Wang and Swain

The final two columns ask whether or not the natural resources effects can be accounted for by measures of overall economic structure such as the percentage of the economy dedicated to the production of services or the degree of urbanization. The inclusion results in a near-halving of the natural resources effect. This evidence—suggestive rather than conclusive—points to fundamental changes in economic structure engendered by differing endowments of natural resources as determinants of investment incentives, rather than investment risks associated with resource-dependent economies.

VI. Discussion

The empirical results presented here say nothing about the degree to which wealth bias is caused by market failures or by international differences in the fundamental product of investment. Rather, we can only conclude that the wealth bias present in incentives facing poor-country investors is of a magnitude 85% as large as that facing foreign investors. It is possible that the wealth bias facing domestic and foreign investors alike is caused by market failures placing a wedge between all poor borrowers and all lenders. It is also possible that it is caused by a low fundamental productivity of capital in poor countries, which by its nature affects all lenders. The results imply nothing, then, about the ability of an omnipotent social planner to increase efficiency in the global allocation of capital by placing it directly into the hands of poor country borrowers. But we based the motivation for this investigation on the premise that a *rich-country* social planner desirous of allocating more international capital to poor countries would be powerless to affect efficiency if any market failures causing wealth bias were not specifically international in nature.[22] That is, if a social planner located in a rich country can place capital in the hands of a poor-country lender—such as a government—this would only improve efficiency in the global allocation of capital to the extent that market failures were specifically placing a wedge between rich-country lenders and poor-country lenders.

(1995) likewise find the exchange rate fluctuations hurt flows.

[22] This says nothing, of course, about a social planner seeking distributional goals.

If no such wedge existed, but rather the wedge lay between poor-country borrowers and *all* lenders, then a rich-country social planner forcing capital into the hands of poor-country lenders would necessarily *decrease* the efficiency of the global capital allocation. If the rich-country social planner were to charge market interest rates on this capital, the result would be unpayable debt burdens and eventual default by the poor-country lender that received the capital. After all, if a profit could be made by lending to the poor-country borrowers, then rich-country lenders from whom the rich-country social planner taxed its capital would already have invested it in poor countries. Since they did not, there must likewise be no profitable opportunities for the poor-country lender at market interest rates—because we are here assuming that the market failures the social planner is attempting to overcome depress the realized returns of *all* lenders to poor borrowers in equal measure.

Our empirical results suggest that this may in fact be the case. In schematic terms, that is, whatever keeps foreign investment out of India in the famous example of Lucas, it is not a barrier between Wall Street and the National Stock Exchange of India. Roughly 85% of that barrier separates the poor borrowers of India from all lenders, everywhere.

After ten years of theoretical development regarding wealth bias, the corresponding empirical literature is in its infancy. But there is time; wealth bias, and its implications for the evolution of the global political and economic system, are not going anywhere. Here we have suggested pathways of inquiry that may be more fruitful than others. But those paths must be followed, and the best of this literature is yet to come.

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Figure 1: The late 20th-century global boom in international investment

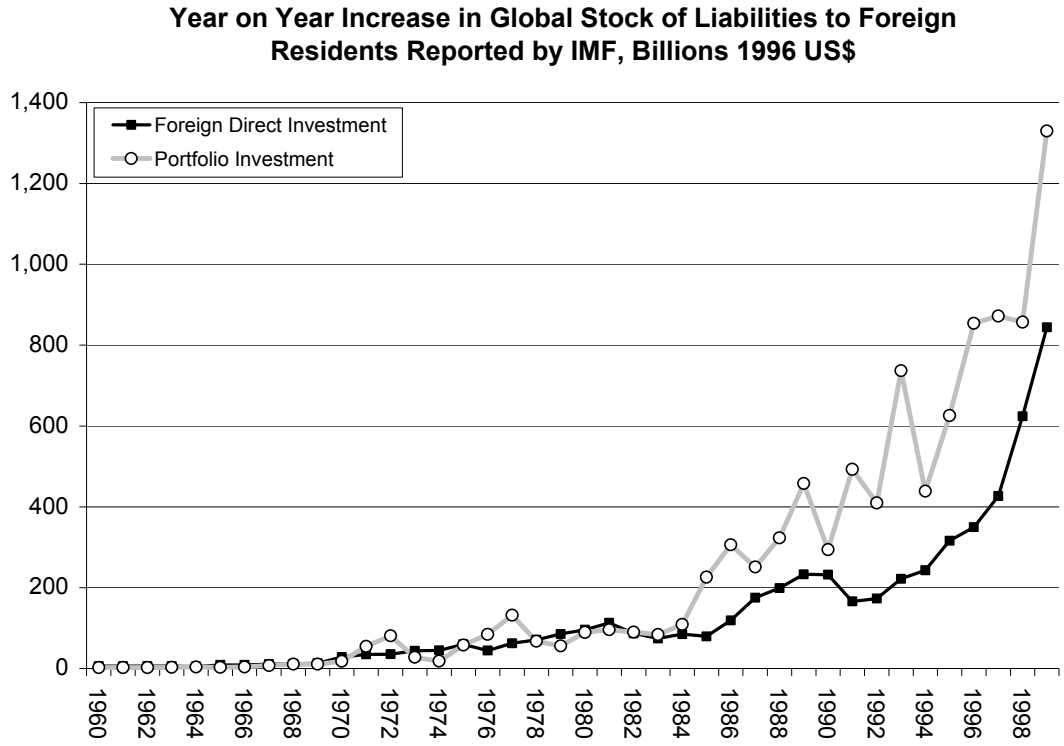


Figure 2: Initial income vs. subsequent capital flows on log-log scale, 1985-1999, in 1996 US$. *Left*: Cumulative increase in the stock of **foreign liabilities** per economically active person (*top*: FDI, *bottom*: Portfolio Investment). *Right*: Cumulative increase in the stock of **foreign assets** per economically active person (*top*: FDI, *bottom*: Portfolio Investment).

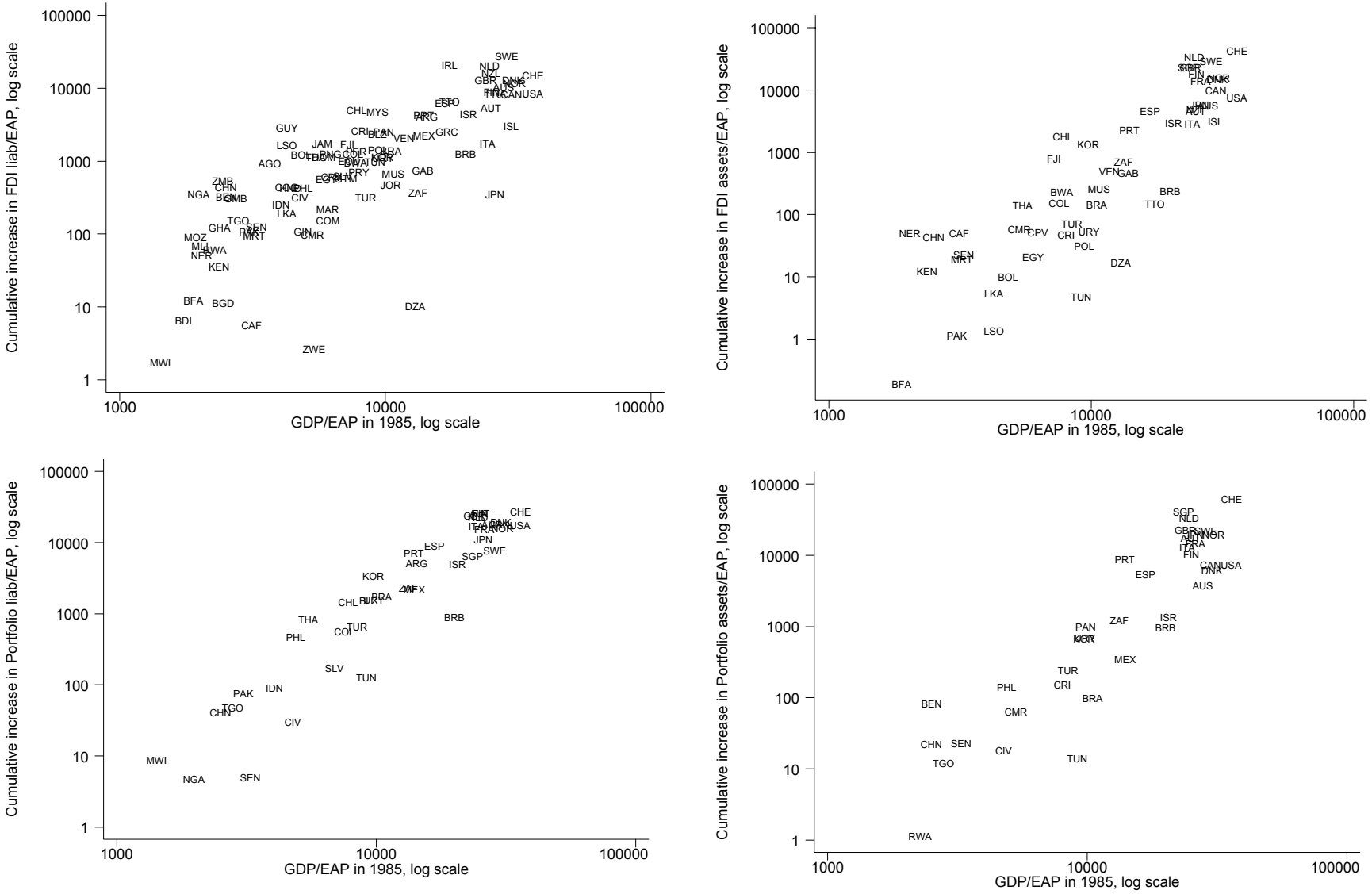


Table 1: Dependent variable: Log of cumulative capital flows per economically active person during the period in question1

Time period	1975-1999			1985-1999			1995-1999		
Type of capital flow in dependent variable2	Increase in liabilities stock	Increase in DIFD stock	Pooled liabilities and DIFD	Increase in liabilities stock	Increase in DIFD stock	Pooled liabilities and DIFD	Increase in liabilities stock	Increase in DIFD stock	Pooled liabilities and DIFD
Log of initial real GDP per economically active person3	2.24 (13.2)	1.40 (15.7)	1.40 (14.5)	2.31 (15.8)	1.46 (23.9)	1.46 (19.7)	1.99 (13.7)	1.28 (17.4)	1.28 (14.0)
Liabilities dummy			-9.52 (-5.89)			-9.54 (-7.68)			-7.99 (-5.67)
Interaction term (ln GDP_0/EAP) x (dummy)			0.842 (4.75)			0.843 (6.24)			0.709 (4.62)
Constant	-12.2 (-7.81)	-2.72 (-3.45)	-2.72 (-3.19)	-13.4 (-9.9)	-3.89 (-7.14)	-3.89 (-5.89)	-11.4 (-8.46)	-3.45 (-5.24)	-3.45 (-4.23)
N	48	98	146	49	100	149	94	103	197
R2	0.792	0.719	0.780	0.842	0.854	0.861	0.670	0.749	0.724
Adjusted R2	0.787	0.717	0.775	0.839	0.852	0.858	0.667	0.747	0.719
Chow test statistic4			88.5			34.8			72.7
p-value			0.000			0.000			0.000

Regression coefficients are unstandardized. *t*-statistics are in parenthses.

1 An economically active person (EAP) is defined as being aged between 15 and 64.

2 "Increase in liabilities stock" means that the regressand is the log of the cumulative increase in the stock of FDI and portfolio liabilities (i.e. net flow of private capital held by foreign residents into the country in question) per EAP during the period in question in each country, in 1996 dollars. "Increase in DIFD stock" means that the regressand is the log of cumulative Domestic Investment Financed Domestically (DIFD, defined as Gross Domestic Fixed Investment minus the increase in the stock of net foreign private liabilities and foreign official flows) in the country in question during the given time period, per EAP, in 1996 dollars. "Pooled liabilities and DIFD" means that data from the previous two regressions are pooled, with a dummy variable equal to 1 for liability flows and equal to 0 for DIFD flows.

3 "Initial" real GDP per EAP is the Summers and Heston real GDP (chain method, 1996 prices) per person between the ages of 15 and 64 in the first year of the time period in question.

4 This is an F-test of the null hypothesis that the coefficient on the dummy variable and that on the interaction term are jointly zero. It can be interpreted as a test of the hypothesis that the *all* coefficients (including constant term) in the previous two "liabilities" and "DIFD" regressions are equal.

Table 2: Simultaneous equations specification, holding fixed the country sample

Time period	1975-99	1985-99	1995-99
Eqn 1. *Dependent variable: log of cumulative increase in **foreign liabilities** stock during period*			
Log of initial real GDP per	2.15	2.37	2.00
economically active person	**(14.8)**	**(17.8)**	**(12.5)**
Constant	-11.3	-14.1	-11.5
	(-8.39)	(-11.4)	(-7.72)
N	45	45	68
R2	0.836	0.881	0.702
Eqn 2. *Dependent variable: log of cumulative increase in **DIFD** stock during period*			
Log of initial real GDP per	1.36	1.37	1.14
economically active person	(8.61)	(12.1)	(9.91)
Constant	-2.38	-3.03	-2.13
	(-1.63)	(-2.86)	(-2.00)
N	45	45	68
R2	0.633	0.772	0.598
Test of the null hypothesis that coefficients on ln(GDP_0/EAP) in the above equations are equal2			
F-Statistic	13.7	42.1	20.0
p-value	0.001	0.000	0.000

Regression coefficients are unstandardized. *t*-statistics are in parenthses.

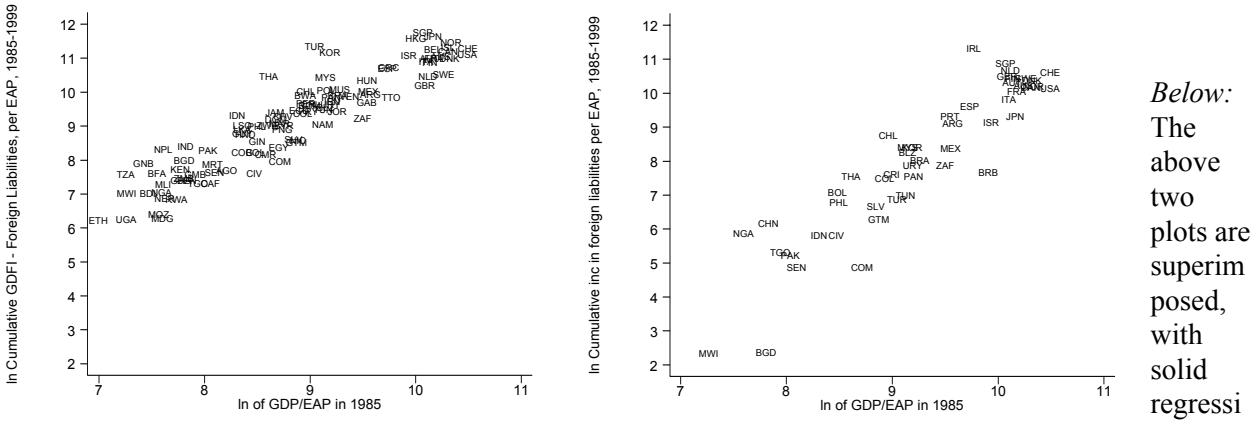
1 The multivariate model in each column is $\left\{ \begin{array}{c} \left(\ln(L/EAP)\right) = \alpha_1 + \beta_1 (\ln(GDP_0/EAP) + \varepsilon_1 \\ \left(\ln(DIFD/EAP)\right) = \alpha_2 + \beta_2 (\ln(GDP_0/EAP) + \varepsilon_2 \end{array} \right\}$

where L is the cumulative increase in the stock of foreign FDI and portfolio liabilities during the indicated period in 1996 dollars, DIFD is the cumulative increase in the stock of Domestic Investment Financed Domestically on the same period per EAP in 1996 dollars, GDP_0 is real GDP (chain method, 1996 prices), and EAP is the economically active population (defined as being between the ages of 15 and 64).

2 That is, this is a test of H_0: $\beta_1 = \beta_2$.

Figure 3: Comparing wealth bias in foreign capital and DIFD with the Solow model, 1985-99

At left: Wealth bias in Domestic Investment Financed Domestically (DIFD, calculated as cumulative GDFI less cumulative private foreign liabilities flows and aid flows). *At right*: Wealth bias in private foreign liabilities flows.



Below: The above two plots are superimposed, with solid regression lines added. A dotted line represents the relationship predicted by a one-sector, two-factor Solow model with capital share 0.3 (the dotted line is intended to show the slope of this relationship, not its intercept).

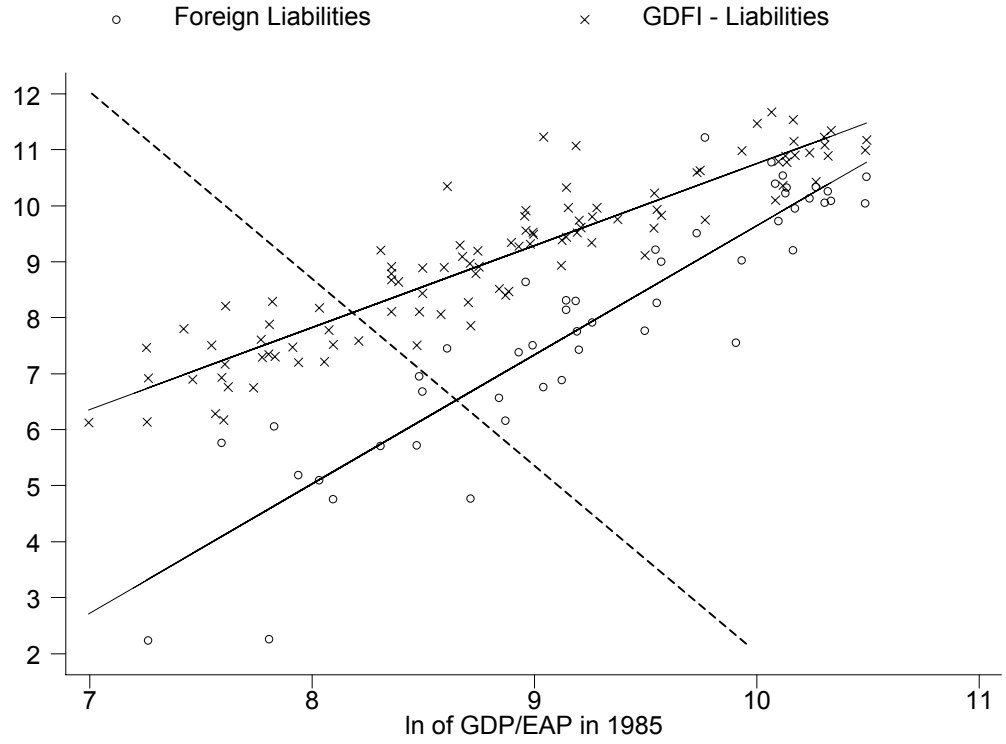


Figure 4: Wealth versus endowments of natural resources and human capital (log-log scales)

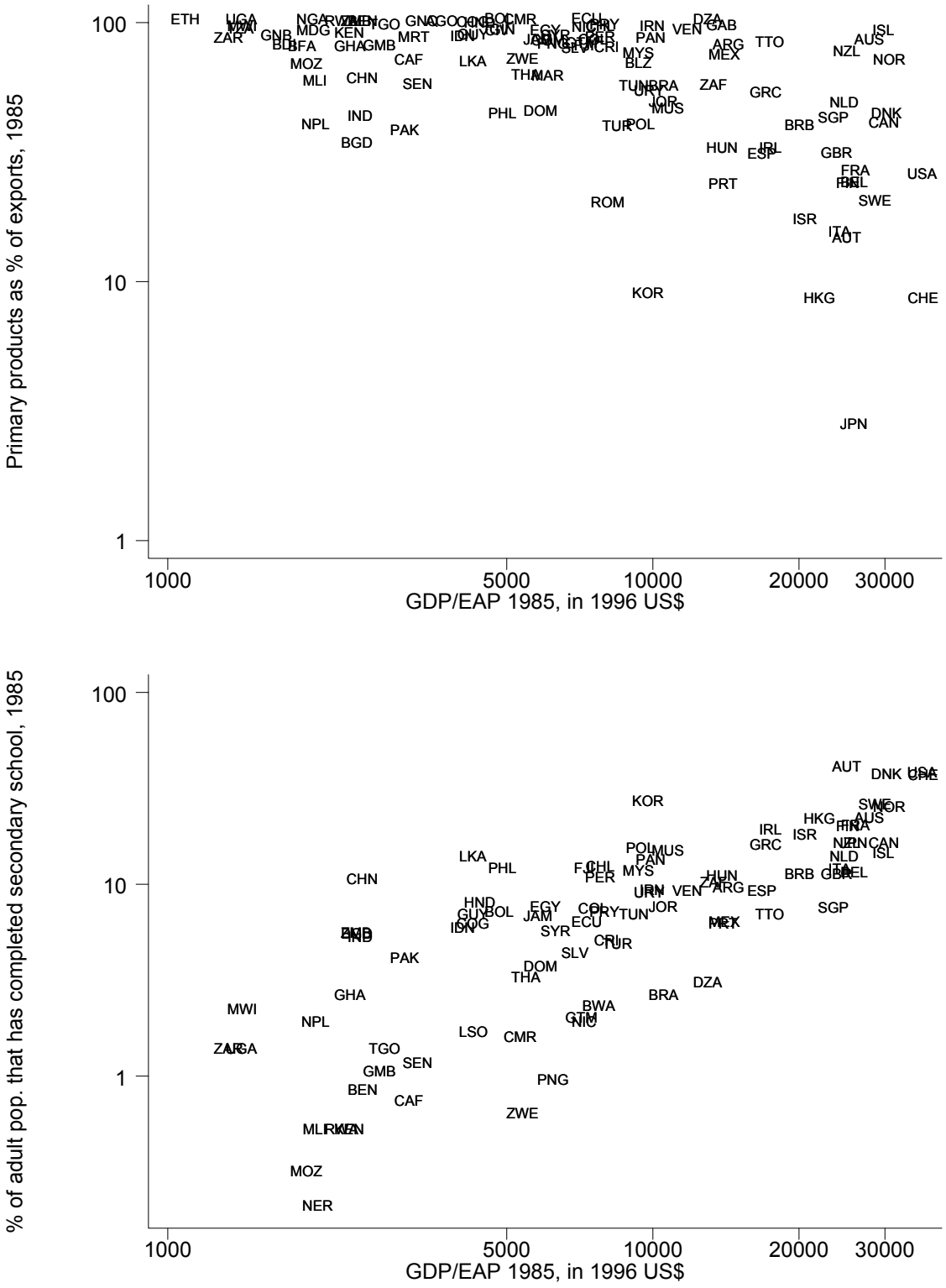


Table 3: Exploring the determinants of capital inflows with standardized regression coefficients, 1985-99
Dependent variable: Cumulative capital flows per economically active person during 1985-991
Type of capital flow in dependent variable: Pooled foreign liabilities and DIFD2
All variables standardized to mean 0 and standard deviation 1 for comparability.

	1985-99		
Primary products as % of exports, 19853	-0.483 (-4.83)	-0.311 (-2.91)	-0.447 (-4.29)
Interaction of above with liabilities dummy	0.0853 (0.49)	0.102 (0.55)	0.0475 (0.27)
Percentage of adults that has completed in 1985…4			
… primary school	0.372 (3.80)		
… secondary school		0.512 (4.96)	
… higher education			0.373 (3.67)
Interaction of above with liabilities dummy	-0.0484 (-0.25)	-0.121 (-0.76)	-0.158 (-0.98)
Liabilities dummy	-0.270 (-1.54)	-0.287 (-1.74)	-0.262 (-1.48)
Constant	0.0516 (0.53)	0.0865 (0.95)	0.0514 (0.53)
N	127	127	127
R2	0.363	0.432	0.355
Adjusted R2	0.337	0.409	0.328
Chow test statistic5	1.39	2.43	1.76
p-value	0.250	0.0682	0.159

All regression coefficients are standardized due to both regressand and regressors being transformed such that each has mean 0 and standard deviation 1. *t*-statistics are in parentheses.
1 In constant 1996 US$.
2 The specification is similar to that in Table 1. Rather than run separate regressions on liabilities and DIFD flows, the two matrices are stacked with a dummy variable equal to 1 for rows containing foreign liability flows, and equal to 0 for rows containing DIFD flows.
3 "Primary products" are defined as exports in categories 0, 1, 2, 3, 4, and 68 of SITC revision 1, as in Sachs and Warner (2000).
4 An "adult" is a person aged 25 or over.
5 This is an *F*-test of the hypothesis that the coefficients on both interaction terms and the liabilities dummy are all jointly equal to zero. It can be interpreted as a test of the hypothesis that the coefficients on Primary Products as a % of Exports, Education Levels, and the constant term are equal for foreign liabilities flows and DIFD flows.

Table 4: Possible mechanisms for the natural resources effect, 1985-99.

Dependent variable: Cumulative capital flows per economically active person during 1985-991
Type of capital flow in dependent variable: Pooled foreign liabilities and DIFD2
All variables standardized to mean 0 and standard deviation 1 for comparability.

Primary products as % of exports, 1985 3	-0.588 (-6.67)	-0.626 (-4.83)	-0.516 (-4.16)	-0.468 (-5.35)	-0.356 (-4.62)
Interaction of above with liabilities dummy	0.0992 (0.64)	0.297 (1.36)	0.134 (0.65)	0.180 (1.14)	0.172 (1.24)
Weighted average distance to all trading partners, 1985		0.0184 (0.13)			
Interaction of above with liabilities dummy		-0.375 (-1.68)			
Spread between bank lending rate and LIBOR, 1985			0.0486 (0.54)		
Interaction of above with liabilities dummy			-0.120 (-0.93)		
Coeff. of variation of exchange rate, 1985-98			-0.348 (-1.88)		
Interaction of above with liabilities dummy			-0.104 (-0.27)		
Percentage of value added from services sector, 1985				0.466 (4.76)	0.121 (1.19)
Interaction of above with liabilities dummy				0.00445 (0.02)	0.0482 (0.26)
Fraction of population living in cities, 1985					0.507 (5.97)
Interaction of above with liabilities dummy					-0.0395 (-0.26)
Liabilities dummy	-0.204 (-1.29)	-0.144 (-0.62)	-0.249 (-1.09)	-0.350 (-2.38)	-0.401 (-3.19)
Constant	0.0120 (0.14)	0.143 (1.07)	-0.0118 (-0.11)	-0.0201 (-0.26)	0.0184 (0.28)
N	148	103	111	135	135
R2	0.292	0.273	0.333	0.438	0.597
Adjusted R2	0.277	0.236	0.288	0.416	0.575
Chow test statistic5	1.36	2.39	0.930	3.13	3.89
p-value	0.259	0.0731	0.448	0.0280	0.00520

All regression coefficients are standardized due to both regressand and regressors being transformed such that each has mean 0 and standard deviation 1. *t*-statistics are in parentheses.
For explanatory footnotes see Table 3.

APPENDIX 1: *The Gertler-Rogoff model of wealth bias based on moral hazard*

Gertler and Rogoff (1990) pioneered the theory of market failure based endogenous wealth bias through the introduction of moral hazard between lender and borrower. The population of the home country consists exclusively of identical entrepreneurs who live for two periods. An entrepreneur receives exogenous endowment Y_1 at time 1, which she may invest risklessly on the international capital market for return $1 + r^*$ or invest domestically for a risky return. Domestic investment I yields random output Y_2 at time 2 according to

$$Y_2 = \begin{cases} X & \text{with probability } \pi(I) \\ 0 & \text{with probability } 1 - \pi(I). \end{cases}$$

It is assumed that $\pi'(I) > 0$, $\pi''(I) < 0$, $\pi(0) = 0$, and $\pi'(0)X > 1 + r^*$. The entrepreneur seeks to maximize consumption and consumes exclusively from Y_2. A self-financing entrepreneur would invest up to I_s, when the expected marginal product of capital would equal the world interest rate:

$$\pi'(I_s)X = 1 + r^* \tag{1}$$

Suppose that $I_s > Y_1$, such that $B = I_s - Y_1$ must be borrowed from risk-neutral, competitive lenders abroad who can perfectly monitor the entrepreneur's investment decision. Note that in the case where $Y_2 = 0$ the entrepreneur would not be able to repay the debt, thus any contract between borrower and lender must be state-contingent. Let $P(Y_2)$ be the payment from borrower to lender, where $P(0) = 0$. The lender's no-profit condition requires that the expected repayment equal the cost of funds

$$\pi(I_s)P(X) = (1 + r^*)(I_s - Y_1)\,. \tag{2}$$

Note that richer countries receive smaller capital inflows, since

$$\frac{\partial(I - Y_1)}{\partial Y_1} < 0\,. \tag{3}$$

Now suppose that information is no longer symmetric and the lender cannot directly observe I. An entrepreneur who was received b would allocate it between riskless foreign investment and risky domestic investment so as to maximize her expected return, yielding the incentive-compatibility condition

$$\underset{I}{MAX}\left\{\pi(I)[X - P(X)] + (1 + r^*)[Y_1 + B - I]\right\} \Rightarrow \; FOC:\; \pi'(I)(X - P(X)) = 1 + r^*. \tag{4}$$

Combining (2) and (4) gives

$$1 + r^* = \frac{\pi'(I)X}{1 + \frac{\pi'(I)}{\pi(I)}(I - Y_1)} \equiv \rho \,. \tag{5}$$

Since necessarily $\partial\rho / \partial Y_1 > 0$ and $\partial\rho / \partial I < 0$, the implicit function theorem gives $\partial I / \partial Y_1 > 0$. Thus not only do richer countries have more savings Y_1, but they also invest more. Intuitively, this is because being richer and more capable of self-finance decreases the fraction of Y_2 that must be paid out to the lender, and thus decreases the incentive to "cheat" by diverting I away from the domestic project. The possibility is now open that, rather than (3), we might observe

$$\frac{\partial(I - Y_1)}{\partial Y_1} > 0 \,. \tag{6}$$

* * *

APPENDIX 2: *How endowment of a productive third factor can encourage or deter capital inflows*

To better understand equations (12) and (13) from the main text, we require a more complete treatment of the production process. We move now to a richer analytical framework whose one-sector form is due to Manzocchi and Martin (1997). We assume costless, return-maximizing international capital mobility; two factors; and one sector[23]—in other words, the framework in which Lucas (1990) posed his original puzzle. The latter two assumptions will subsequently be relaxed.

Production takes place according to

$$Y = AK^{\alpha}L^{\beta} \quad \Rightarrow \quad y = Ak^{\alpha}, \tag{7}$$

where Y is total national output, K represents the stock of physical capital, L the total labor force, and A is a constant. We require $\alpha, \beta > 0$ and $\alpha + \beta = 1$. Lower case represents per capita.

[23] The initial setup is a modified version of the flexible framework in Manzocchi and Martin (1997). Note that this framework relaxes the assumption of instantaneous capital mobility made by the model found in the 1865-1913 paper on wealth bias by Clemens and Williamson (2000).

Autarky: At time 0 the country is not open to international capital flows, and

$$k_0 = \left(\frac{y_0}{A}\right)^{\frac{1}{\alpha}}. \qquad \textbf{(8)}$$

Open Economy: After opening, the capital stock adjusts so that

$$r^* = \frac{\partial y}{\partial k} - \delta = \alpha A k^{\alpha-1} - \delta \quad \Rightarrow \quad k^* = \left(\frac{\alpha A}{r^* + \delta}\right)^{\frac{1}{1-\alpha}}, \qquad \textbf{(9)}$$

where r^* is the world interest rate and δ is the rate of depreciation. This is, of course, analogous to (1). In the adjustment process, the home country becomes indebted to the world to a degree mitigated by the amount of capital accumulated by domestic saving. Total flow of foreign capital into the economy during the approach to the steady state is

$$b^* - b_0 = k^* - k_0 - \int_0^\infty s_t(y_t - r^* b_t)dt. \qquad \textbf{(10)}$$

where b is the per capita stock of foreign liabilities and s is the saving rate.[24, 25] That is,

$$b^* - b_0 = \left(\frac{\alpha A}{r^* + \delta}\right)^{\frac{1}{1-\alpha}} - \left(\frac{y_0}{A}\right)^{\frac{1}{\alpha}} - \int_0^\infty s_t(y_t - r^* b_t)dt. \qquad \textbf{(11)}$$

Note the prediction, in exact parallel to (3), that per-capita flows decline with increasing domestic wealth.

We now relax the assumption of a two-factor economy. Whereas the stock of K is still determined in the open economy by r^*, the stock of a third factor Z will be determined one of two ways. First (following Manzocchi 1999, p. 46) we consider the case in which Z may be accumulated by saving, and its stock is thus determined by an appropriate equation of motion. Second we consider an exogenous stock of Z. For concreteness, one might think of Z that can be accumulated as representing human capital, and exogenous Z as representing the endowment of natural resources. We have

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[24] As Manzocchi (1999, p. 48) notes, the saving rate shown here should be strictly speaking that part of savings which is invested domestically. In the long run, however, there is no reason for the home country to simultaneously borrow from and lend to the world. If it contributes s to the global pool of freely mobile savings, then we can consider its required withdrawal from that pool to be ultimately diminished by its cumulative savings. As Manzocchi additionally points out, the assumption of a constant saving rate makes this model fall short of a fully "intertemporal approach" to the Current Account (Obstfeld and Rogoff 1995). Endogenizing savings would be, however, a complication unnecessary to the model's conclusions.

[25] Note that (25) is in perfect analogy to $B = I - Y_I$ from our earlier framework, under (1).

$$Y = AK^{\alpha}L^{\beta}Z^{\gamma} \quad \Rightarrow \quad y = Ak^{\alpha}z^{\gamma}, \tag{12}$$

where $\alpha, \beta, \gamma > 0$ and $\alpha + \beta + \gamma = 1$. If Z can be saved and accumulated,

$$\dot{Z} = s_Z Y - \delta Z \quad \Rightarrow \quad \dot{z} = s_Z y - (n+\delta)z \quad \Rightarrow \quad z^* = \left(\frac{s_Z A}{n+\delta} (k^*)^{\alpha} \right)^{\frac{1}{1-\beta}}, \tag{13}$$

where a superimposed dot indicates the derivative with respect to time, n is the period-to-period rate of population growth, and δ is assumed identical to the depreciation rate for K. Combined with equations identical to (8) and (9) *mutatis mutandis*, equation (10) in this case becomes

$$b^* - b_0 = \left(\frac{\alpha A}{r^* + \delta} \left(\frac{s_Z A}{n+\delta} \right)^{\frac{\beta}{1-\beta}} \right)^{\frac{1-\beta}{1-\alpha-\beta}} - \left(\frac{y_0}{A z_0^{\beta}} \right)^{\frac{1}{\alpha}} - \int_0^{\infty} s_t (y_t - r^* b_t) dt . \tag{14}$$

Alternatively, if the third factor Z can be considered an exogenous endowment that does not accumulate, expression (13) is replaced simply by $z = z_0$ and (14) becomes

$$b^* - b_0 = \left(\frac{\alpha A}{r^* + \delta} z_0^{\beta} \right)^{\frac{1}{1-\alpha}} - \left(\frac{y_0}{A z_0^{\beta}} \right)^{\frac{1}{\alpha}} - \int_0^{\infty} s_t (y_t - r^* b_t) dt . \tag{15}$$

We expect greater inflows of foreign capital to be associated, then, with greater exogenous initial endowment of Z—or greater endogenous accumulation of Z (i.e. s_Z) if it can be accumulated—as well as lower income per capita.

This analysis assumes, of course, that z_0 and y_0 are independent in the data. What if, however, there is for any reason a positive correlation between z_0 and y_0 in a given sample of countries? If a researcher omitted Z and analyzed capital flows using equation (11) that were in fact described by equation (14) or (15), he could observe a positive correlation between capital flows and income per capita in the absence of credit constraints. To see this, note that a positive $\partial(k^* - k_0) / \partial Z_0$ (from (14) and (15)) and a positive $\partial z_0 / \partial y_0$ imply

$$\frac{\partial (k^* - k_0)}{\partial Y_0} = \frac{\partial (k^* - k_0)}{\partial Z_0} \frac{\partial Z_0}{\partial Y_0} > 0 . \tag{16}$$

These are the mechanics behind equation (12) from the main text. The omitted variable Z has provided one explanation of wealth bias.

Two sectors: Retaining the assumption of three factors, we now relax the assumption of one sector in order to explore a mechanism behind equation (13) from the main text **capable of**

producing observed wealth bias.[26] There are now two sectors, *a* and *m*. Physical capital *K* is specific to sector *m* while the exogenous endowment of factor *Z* is specific to sector *a*, and labor is mobile. Production takes place according to

$$\begin{cases} Y_m = A_m K^{\alpha} L_m^{\beta} \\ Y_a = A_a Z^{\gamma} L_a^{\varepsilon} \end{cases} \Rightarrow \begin{cases} y_m = A_m k^{\alpha} \\ y_a = A_a z^{\gamma} \end{cases}, \qquad \textbf{(17)}$$

where $\alpha + \beta = 1$, $\gamma + \varepsilon = 1$, and $\alpha, \beta, \gamma, \varepsilon > 0$. We have $L_m + L_a = L \equiv 1$, so that $Y = Y_a + Y_m = y = y_a + y_m$. Labor instantly and continuously reallocates between sectors so as to maximize y. The first-order condition for this adjustment (equivalent to intersectoral equalization of the marginal product of labor) is

$$A_m K^{\alpha} \beta L_m^{\beta-1} - A_a Z^{\gamma} (1 - L_m)^{\varepsilon} = \mathbf{0}. \qquad \textbf{(18)}$$

Initial capital stock is then given by

$$k_0 = K_0 = \left(\frac{A_a \varepsilon Z^{\gamma} L_{a,0}^{\varepsilon-1}}{A_m \beta L_{m,0}^{\beta-1}} \right)^{\frac{1}{\alpha}}, \qquad \textbf{(19)}$$

and an identical relationship at the steady state defines k^* in terms of $L_{a,*}{}^{\varepsilon-1}$ and $L_{m,*}{}^{\beta-1}$. Thus,

$$k^* - k_0 = \left(\frac{A_a \varepsilon}{A_m \beta} Z^{\gamma} \right)^{\frac{1}{\alpha}} \left(\frac{L_{a,0}^{\varepsilon-1}}{L_{m,0}^{\beta-1}} - \frac{L_{a,*}^{\varepsilon-1}}{L_{m,*}^{\beta-1}} \right)^{\frac{1}{\alpha}}. \qquad \textbf{(20)}$$

We can now consider the consequences for capital flows of differing endowments of *Z*. Note first of all the effect on L_m. Although it is intuitive that an increase in *Z* should decrease L_m—since the marginal product of labor has increased in sector *a*—this is easy to check. The partial derivative of the left-hand side of (18) with respect to *Z* is necessarily negative, as is the partial derivative with respect to L_m, so the implicit function theorem gives $\partial L_m / \partial Z < 0$ immediately.

In response to an increase in the endowment of *Z*, the term in the first parenthesis of (20) increases. The sign of $\partial(k^* - k_0) / \partial Z$ thus depends upon whether the labor reallocation response decreases the first term in the second parenthesis by more or by less than it decreases the second term. By inspection,

$$\frac{\partial L_{m,*}}{\partial Z} > \frac{\partial L_{m,0}}{\partial Z} \quad \Leftrightarrow \quad \frac{\partial (k^* - k_0)}{\partial Z} < 0. \qquad \textbf{(21)}$$

[26] The initial framework of equation (32) is due to Jones (1965, 1971). The concept of applying such a framework to the problem of wealth bias is due to Bardhan (1996).

To see that the left-hand expression of (21) must hold as long as the country receives any foreign capital, note first that if $K^* = \infty$ then the marginal product of labor in the *m* sector is large and no increase in *Z* can induce labor into the *a* sector: $\partial L_m^* / \partial Z = 0$. At the instant of opening (time 0), the left-hand expression of (21) holds with equality. Thus, the more capital flows into the country on the way to the steady state, the less negative $\partial L_m^* / \partial Z$ becomes, and (21) always holds.[27] Combining (21) with (10), we establish that in a two-sector economy, countries with greater exogenous endowment of *Z* receive *ceteris paribus* less foreign capital.

This stands in sharp contrast to (15), in which a greater exogenous endowment of *Z* increases capital inflows. The difference is due to the labor reallocation mechanism of the two-sector economy. Whereas additional endowment of *Z* increases the marginal productivity of capital in the one-sector case, encouraging foreign investors, additional *Z* in the two-sector economy removes labor from the capital-using *m* sector and decreases capital productivity. The other predictions of (15) remain unchanged in the two-sector case, notably the prediction that poor countries receive more foreign capital after controlling for *Z*.

What if, however, there is for any reason a *negative* correlation between z_0 and y_0 in a given sample of countries? In this case, if a researcher analyzed capital flows using equation (15) when in fact production occurs with many factors in many sectors, she could observe a positive correlation between capital flows and income per capita in the absence of credit constraints. To see this, note that if $\partial Z/\partial Y_0 < 0$ then in light of (21) the chain rule gives

$$\frac{\partial\left(k^* - k_0\right)}{\partial Y_0} = \frac{\partial\left(k^* - k_0\right)}{\partial Z}\frac{\partial Z}{\partial Y_0} > 0. \qquad \textbf{(22)}$$

This is the process behind equation (13) from the main text. The omitted variable *Z* is once again an explanation of wealth bias. The mechanism, however, is different from that of the one-sector economy. Speaking loosely but succinctly: in the one-sector case, if rich countries happen to be well-endowed with *Z*, wealth bias can be explained if this attracts foreign capital more than their wealth repells it. In the two-sector case, if *Z* is specific to a different sector than *K* and *poor* countries happen to have more *Z*, wealth bias can be explained if their large endowments of *Z* repel foreign capital more than their poverty attracts it.

* * *

[27] This cursory explanation can be checked by using the implicit function theorem as above to derive the exact functional form of $\partial L_m / \partial Z$ and noting that $\partial 2L_m / \partial Z\, \partial K > 0$ always.

APPENDIX 3: *Sources for and description of the data*

Capital Flows

All data on capital flows come from the *International Financial Statistics* CD-ROM version 1.1.54, disseminated in 2000 by the International Monetary Fund. Original figures are converted into 1996 dollars via a deflator from the Summers and Heston dataset (see below) and converted into "per economically active person" values in the same fashion and using the same sources for population and demographic structure as the conversion of the real GDP numbers (also below). On the *IFS* CD-ROM, annual increases in the stock of FDI liabilities in the country in question are labeled "Direct Investment in Reporting Economy, NIE [Not Including Exceptional financing]." Increases in the stock of FDI assets held by the country in question are labeled "Direct Investment Abroad." Increases in the stock of portfolio capital liabilities in the country in question are labeled "PI [Portfolio Investment] Debt Securities Liabilities NIE" and "PI Equity Securities Liabilities NIE", which are summed to arrive at the figures for total portfolio capital flows used here. Increases in stock of portfolio capital assets held by the country in question are similarly labeled. Annual increases are simply summed over the relevant period to arrive at the cumulative changes in stock used here. "Increase in assets" as used herein is simply the cumulative increase in the stock of domestically-held foreign assets of the relevant type.

The IMF divides all capital flows into the mutually exclusive, collectively exhaustive categories of direct investment, portfolio investment, and reserve assets. The definitions of direct investment and portfolio investment follow.

"Direct investment is the category of international investment that reflects the ojbective of obtaining a lasting interest by a resident entity in one economy in an enterprise resident in another economy. (The resident entity is the direct investor and the enterprise is the direct investment enterprise.) The lasting interest implies the existence of a long-term relationship between the direct investor and the enterprise and a significant degree of influence by the investor on the management of the enterprise. … [A] direct investment enterprise is defined …

as an incorporated or unincorporated enterprise in which a direct investor, who is resident in another economy, owns 10 percent or more of the ordinary shares or voting power (for an incorporated enterprise) or the equivalent (for an unincorporated enterprise). Direct investment enterprises comprise those entities that are subsidiaries (a nonresident investor owns more than 50 percent), associates (an investor owns 50 percent or less) and branches (wholly or jointly owned unincorporated enterprises) either directly or indirectly owned by the investor." (IMF 1993, p. 86)

> "Portfolio investment includes, in addition to equity securities and debt securities in the form of bonds and notes, money market instruments and financial derivatives such as options. Excluded are … instruments in the categories of direct investments and reserve assets. … Equity securities cover all instruments and records acknowledging, after the claims of all creditors have been met, claims to the residual values of incorporated enterprises. Shares, stocks, participation, or similar documents—such as American Depository [sic] Receipts (ADRs)—usually denote ownership of equity. Preferred stock or shares, which also provide for participation in the distribution of the residual value on dissolution of the incorporated enterprise, are included. … Mutual funds and investment trusts are also included. Debt securities cover (i) bonds, debentures, notes, etc.; (ii) money market or negotiable debt instruments; and (iii) financial derivatives or secondary instruments, such as options, that usually do not extend to actual delivery and are utilized for hedging of risks, investment, and trading purposes." (IMF 1993, p. 91)
>
> International Monetary Fund (1993). *Balance of Payments Manual*. (Washington, DC: IMF).

Income per economically active person, Gross Domestic Fixed Investment, and Foreign Aid as a % of Fixed Capital Formation

Real GDP per capita (chain method, 1996 prices) and Gross Domestic Fixed Investment come from release 6.0 of the Penn World Tables, better known as the Summers and Heston dataset, published by the Center for International Comparisons at the University of Pennsylvania. GDP per capita figures were converted to a per-economically-active-person basis by dividing by the fraction of the total population between the ages of 15 and 64 (inclusive), a figure taken from the *World Development Indicators 2001* CD-ROM, published by the World Bank. This same CD was the source for Aid as a % of Fixed Capital Formation, used in calculating Domestic

Investment Financed Domestically (DIFD).

Primary products as a percentage of exports

Primary products are defined, as in Sachs and Warner (2000), as exports in categories 0, 1, 2, 3, 4, or 68 of the Standard International Trade Classification (Revision 1). Figures were taken from Statistics Canada (1998) *World Trade Analyzer* CD-ROM, (Ottawa: Statistics Canada).

Schooling

All data on educational attainment come from the Barro and Lee database, publicly available at *http://www.nber.org/data*. Their collection methods are discussed in Robert J. Barro and Jong-Wha Lee (1993), "International Comparisons of Educational Attainment," National Bureau of Economic Research Working Paper 4349 (Cambridge, Mass.: NBER).

Weighted average distance to trading partners

Distances are calculated as great-circle distance between the capital cities of each pair of countries, in miles. For each country a weighted average of the distance from its capital to all other world capitals is calculated, weighted by the exports from the country in question to each trading partner. These exports come from International Monetary Fund (1999), *Direction of Trade Statistics*, published as computer file ICPSR 7628 by the Inter-University Consortium for Political and Social Research, University of Michigan (Ann Arbor: *http://www.icpsr.umich.edu*)

Interest rate spread, urbanization, and Gross Domestic Savings

Figures are taken from the *World Development Indicators* CD-ROM, aforementioned.

Variation of exchange rate

The coefficient of variation is defined as the ratio of the sample standard deviation to the sample mean. The figures for the exchange rate of national currency against the US dollar come from the *Penn World Tables*, aforementioned.

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